IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT



TAILINGS AND WATER MANAGEMENT FEASIBILITY STUDY DESIGN

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Knight Piésold CONSULTING
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EXECUTIVE SUMMARY

The Red Mountain Underground Gold Project is being developed by IDM Mining Ltd. (IDM). The Project, located 18 km east-northeast of Stewart, BC, involves mining approximately 2 million tonnes of ore using underground mining methods and processing the ore at a milling rate of 1,000 tonnes per day over a 6-year period.

Knight Piésold Ltd. (KP) completed the feasibility level design of the tailings and water management facilities for the Project. The feasibility design incorporates the May 2017 mine plan as the design basis. The mine plan was provided by JDS Energy & Mining Inc. (JDS).

The Tailings Management Facility (TMF) location and tailings distribution method (technology) are based on alternatives assessments completed in 2016 and 2017. Thickened tailings with a slurry solids content of 50% (by weight) will be pumped from the mill and discharged from the TMF embankments. The TMF is designed to store 1.5 Mm^3 of tailings, and to have sufficient capacity for an operational process water pond with provision for short-term storage of 160,000 m^3 of storm water (Environmental Design Flood). Larger storm events will be conveyed from the facility via an Emergency Discharge Spillway. A permanent spillway will be established at closure through the Bromley Humps that will convey all runoff from the surface of the reclaimed TMF.

The tailings are anticipated to be Potentially Acid Generating (PAG) and are anticipated to become Metal Leaching (ML) after approximately 20 years of exposure to oxidation. Tailings are still acceptable for sub-aerial disposal and maintaining a degree of saturation will be important to mitigate the acid generation risk. Saturation can be achieved through management of the TMF supernatant pond or application of new layers of tailings to prevent prolonged oxidation of the exposed beach. The TMF embankment classification is VERY HIGH based on CDA guidelines and the Health, Safety and Reclamation Code for Mines in BC. As per CDA guidelines, the Inflow Design Flood (IDF) for a VERY HIGH dam classification is 2/3 between the 1:1,000 year return period event and the Probable Maximum Flood (PMF) during construction and operations, and the PMF for post-closure (Passive Care Phase). As a conservative measure, the IDF that was used to design the Emergency Discharge Spillway is that of the post-closure IDF (i.e. the PMF).

For a VERY HIGH dam classification the design earthquake event is 1/2 between the 1:2,475 year and 1:10,000 year events during construction and operations and the 1:10,000 year event for post-closure (Passive Care Phase), as per the CDA guidelines. The Earthquake Design Ground Motion (EDGM) for the Construction and Operations Phases is the Operating Basis Earthquake (OBE). The EDGM for the Passive Care Phase is the Maximum Design Earthquake (MDE).

The TMF has two embankments (North and South) that close off natural topographic containment provided by the hillside to the east and the Bromley Humps to the west. The TMF will be constructed in four stages, with the first stage (Stage 1) designed to provide storage for one year of operations. Expansions will be completed using the downstream construction method every 1 to 2 years. Construction materials for the Stage 1 embankments will be generated from basin shaping activities and Plant Site pad preparation. Local borrow and quarry sources will provide fill materials for subsequent embankment expansions.

The TMF incorporates a full basin liner system consisting of an 80-mil HDPE geomembrane sandwiched between layers of non-woven geotextile. An internal Basin Underdrain, installed on the basin floor above the geomembrane, will promote tailings consolidation while maintaining a low head on the geomembrane. The Basin Underdrain will be connected to an internal wet well sump and recycle pump system and requires a minimum 2 m thick layer of tailings to be established prior to commissioning. Collected water will be recycled to the TMF supernatant pond.

Foundation Drains will be constructed beneath the TMF liner to collect groundwater flows, potential seepage and infiltration through the TMF embankments from direct precipitation on the downstream embankment slopes. This water will be collected in the seepage collection ponds located downstream of the TMF embankments and recycled to the TMF.

Runoff from the eastern side of the TMF will be diverted around the TMF via a Non-Contact Water Diversion Channel. The channel has been designed to convey flows up to the peak flow resulting from the 1 in 5 year precipitation event. Flows exceeding this will overflow the channel and report to the TMF.

Contact water on site will be managed through a combination of collection ditches, collection ponds, and sediment ponds. ROM Stockpile and Plant Site runoff will be collected in a system of collection ditches and routed to the TMF.

Two water balance models were developed for the Project using two mean annual precipitation (MAP) estimates – the “base case,” which assumes that climatic conditions at the TSF are the same as at Stewart, and the “adjusted case,” which assumes that orographic conditions result in greater precipitation at the TSF than at Stewart. Based on detailed water balance modelling for both cases (including statistical sensitivity analyses for wet and dry scenarios), a water surplus is expected to develop in the TMF under all conditions.

This surplus necessitated the design of a surplus water management and water treatment system for the TMF. Surplus water is anticipated to exceed Metal Mines Effluent Regulations (MMER) criteria for discharge and therefore will be pumped from the TMF to the Plant Site for treatment prior to being discharged to Bitter Creek. The TMF surplus will be managed by discharging between 10,200 m^3 and 44,400 m^3 per month under the base case average conditions and between 30,000 m^3 and 65,000 m^3 per month under the adjusted case average conditions.

The primary objectives of reclamation and closure activities will be to provide physical and chemical stability of the TMF and other water management facilities, and acceptable downstream water quality. Closure and reclamation will focus on the removal of surface infrastructure, covering exposed tailings, and establishing a permanent spillway. Additional closure work will involve progressive reclamation and revegetation of the TMF embankments and other disturbed surfaces.

Construction quantity estimates were provided for the tailings and water management facilities, and were incorporated into the overall feasibility study and cost estimate for the Project. The quantities were measured on the basis of the designs and dimensions shown on the relevant drawings in this report and are provided as neat-line quantities with no waste or overlap.

Recommendations for the next stage of engineering (detailed design and Mines Act Permit application) are summarized below:

- Continue collection of site specific meteorological and hydrological data. These data will be used to refine seasonal runoff and design storm values.
- Optimize the water balance to incorporate updated runoff and process flow estimates.

- Additional site investigations required to support the next phase of design and to comply with updated regulatory requirements.
- Tailings materials and properties should be reviewed during the next phase of design to be sure they are representative, especially if any changes to the process occur. Representative tailings samples should be provided and tested if they become available.
- Develop an Operations, Monitoring and Surveillance (OMS) Manual and Emergency Preparedness and Response Plan (EPRP) for the tailings and water management systems based on final designs and operating criteria.
- Develop a full closure plan for the tailings and water management facilities based on the final design configuration.
- Advancement of all design concepts to detailed design level in line with the expectations and requirements of the Joint Application Information Requirements for Mines Act Permit and Environmental Management Act Permit Applications.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

the Project	Red Mountain Underground Gold Project
ARD	acid rock drainage
BMP	best management practice
CDA	Canadian Dam Association
ECCC	Environment and Climate Change Canada
EDF	environmental design flood
EDGM	earthquake design ground motion
EMA	Environmental Management Act
EPRP	Emergency Preparedness and Response Plan
FOS	Factor of Safety
HDPE	High Density Polyethylene
IDF	inflow design flood
IDM	IDM Mining Ltd.
JDS	JDS Energy & Mining Inc.
KP	Knight Piésold Ltd.
MAP	mean annual precipitation
MAPA	Mines Act Permit Application
masl	metres above sea level
mbgs	metres below ground surface
MCE	maximum credible earthquake
MDE	maximum design earthquake
MEM	Ministry of Energy and Mines
ML	metal leaching
MMER	Metal Mine Effluent Regulation
MOE	Ministry of Environment
Mtonnes	million tonnes
NRCAN	Natural Resources Canada
OBE	operating basis earthquake
OMS	Operating, Maintenance and Surveillance
PAG	potentially acid generating
PEA	Preliminary Economic Assessment
PGA	peak ground acceleration
PMF	probable maximum flood
PMP	probable maximum precipitation
ROM	run of mine
SRK	SRK Consulting Inc.
tpd	tonnes per day
TMF	tailings management facility
TSS	total suspended solids
VWP	vibrating wire piezometer

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Red Mountain Underground Gold Project (the Project), situated in northwestern British Columbia, is approximately 18 km east-northeast of Stewart as shown on Figure 1.1. The Mine Site Area is located at 55° 57’ N latitude and 129° 42’ W longitude between the Cambria Ice Field and the Bromley Glacier, at elevations ranging from 1,500 m to 2,000 m.

The Tailings Management Facility (TMF) and Process Plant Site are located in Bitter Creek Valley, approximately 7 km northwest of the mine adit and underground portal. This area is known as Bromley Humps. The TMF is located on a plateau above Bitter Creek and north of Otter Creek, at elevations ranging from 350 m to 500 m. The area is characterized by steep, rugged terrain with sparse overburden cover, prevalent bedrock outcrops, and vegetation and weather conditions typical of the north coastal BC mountains.

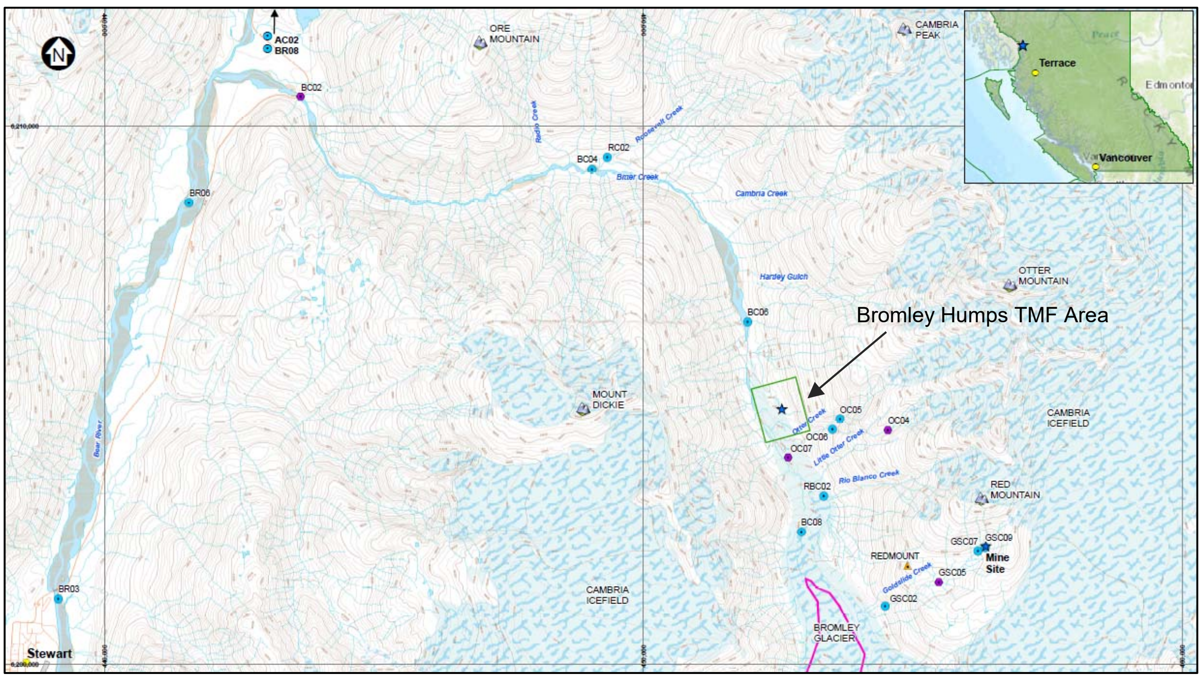


Figure 1.1 Project Location

1.2 BACKGROUND

Knight Piésold Ltd. (KP) was retained by IDM Mining Ltd. (IDM) in 2016 to conduct a Preliminary Economic Assessment (PEA) level design of tailings and water management for the Project. This was completed in June 2016 (KP, 2016a). IDM subsequently retained KP to develop the feasibility level design for tailings and water management.

A geotechnical site investigation program was conducted in August and September of 2016 to support the feasibility level design. The program investigated foundation conditions at the TMF and

Process Plant areas. A summary report and geotechnical assessment was prepared and issued to IDM in June 2017 (KP, 2016b).

1.3 SCOPE OF WORK

The scope of work to support the feasibility level design for tailings and water management includes the following main items:

- Develop the design basis and operating criteria for the TMF and water management structures.
- Complete the TMF design, including embankment design, staging, and water management.
- Complete stability and seepage analysis of the TMF.
- Design of the water management systems at Bromley Humps (TMF and Process Plant Site).
- Develop material quantities for these components, including initial capital, sustaining capital, and closure and reclamation, for use in the cost estimate prepared by JDS Energy & Mining Inc. (JDS).

2 – SITE CHARACTERISTICS

2.1 PHYSICAL SETTING

The Project is located in the Cambria Mountain Range, which is part of the Boundary Range (Alaska Boundary Range), and runs along the boundary of the state of Alaska and the province of British Columbia. The Project is located west of the Cambria Ice Field, and north of the Bromley Glacier. Two prominent peaks in the area are Otter Mountain (2700 masl) and Bromley Peak (2,300 masl).

Access to the property is currently by helicopter. Partially developed road access up Bitter Creek valley from Highway 37A for 13 km (to the Hartley Gulch-Otter Creek area) was constructed by Lac Minerals in 1994. Currently this road is passable for only a few kilometers from the highway. A separate feasibility level design is being prepared for access from the Highway 37A junction to the mine adit in the Red Mountain Mine Site area.

2.2 TOPOGRAPHY AND VEGETATION

Red Mountain is located in the Boundary Ranges of the Coast Mountain Physiographic Subdivision (SNC, 2017). This area comprises rugged, northwest trending, granitic mountains along the Alaska panhandle and British Columbia boundary. The range has a granitic core, flanked in the east by sedimentary and volcanic bedrock. The Boundary Ranges extend from sea level to 3,060 metres above sea level (masl) at Mount Ratz, to the northwest of Red Mountain. The Local Study Area (LSA) ranges in elevation from approximately 100 masl at Highway 37 to 2,692 masl at the peak of Otter Mountain.

Locally, the elevation at Bromley Humps varies from about El. 350 m at Bitter Creek to El. 500 m just above the upper extent of the proposed TMF, along the eastern slope of Bitter Creek Valley. This area of Bitter Creek Valley is primarily within the Mountain Hemlock Biogeoclimatic zone, characterized by high snowfall and a short growing season (SNC, 2017). The proposed TMF is located below the treeline in a densely forested area (mountain hemlock, amabilis fir, and varying amounts of yellow cedar, although several other species are also common and prolific in the area).

2.3 CLIMATE AND PRECIPITATION

2.3.1 Climate

2.3.1.1 Regional Climate

Three factors seasonally influence the climate and hydrology of the project area: distance from the coast, site elevation, and glacier cover. Large-scale atmospheric circulation, occurring over the Pacific Ocean and the Gulf of Alaska, is the driver of seasonal variations in weather patterns in the region. The onshore movement of moist maritime air and the steep topography of the Coastal Mountain Range result in consistently high precipitation conditions, with approximately two-thirds of the annual precipitation occurring during the October to March winter period, when much of the precipitation falls as snow. The Cambria Icefield dominates the area and many drainages are substantially covered by glacial ice.

The region has cold winters and warm summers, with no dry seasons, and has a Köppen-Geiger climate classification of Cfb or Dfb, meaning between a marine west coast climate and a moist continental or hemiboreal climate.

2.3.1.2 Local Climate

Elevation and proximity to the Pacific Ocean influence the climate at the Project site, which is characterized by cool short summers, cold winters, and no notable dry seasons. Monthly mean temperatures at elevation 1500 m range from a low of -6.4°C in December and January to a high of 6.9°C in August (SRK, 2017a), and annual precipitation frequently exceeds 2,000 mm.

Estimates of precipitation and evapotranspiration for the site are based on long-term records of precipitation and temperature from Stewart Airport (SRK, 2017b). All precipitation estimates generated by SRK (SRK, 2017a) for the site are predicated on the assumption that the precipitation conditions at Environment Canada's (EC) Stewart Airport climate station, located at sea level approximately 15 km northwest of the Project site, are directly representative of conditions in the Project Mine Site Area, at an elevation of 1,500 m. The SRK assessment did not explicitly account for an orographic effect at the Project site.

Due to limited site and applicable regional climate and streamflow datasets available to SRK for the hydrometeorological assessment, there is considerable uncertainty associated with the precipitation values developed as part of the *Baseline Climate and Hydrology Report* (SRK, 2017a), as discussed in the KP Water Balance Report (KP, 2017d), which is included as Appendix G. To address this uncertainty, KP developed an alternate mean annual precipitation (MAP) estimate that involves the application of an orographic factor to the Stewart Airport precipitation values. This estimate is referred to as the "adjusted case" and the SRK estimate is referred to as the "base case."

The orographic factor was determined on the basis of varying precipitation values with elevation that were derived from a widely used and generally accepted PRISM (Parameter-elevation Regressions on Independent Slopes Model) model for BC, which uses point data, a digital elevation model (DEM), and other spatial datasets to generate gridded estimates of annual, monthly, and event-based climatic parameters.

The mean annual precipitation (MAP) estimates for Bromley Humps at elevation 500 m are 1,457 mm and 2,084 mm, for the base case and the adjusted case, respectively. The mean monthly rainfall, snowfall and evapotranspiration amounts for Bromley Humps are shown in Table 2.1 for the base case and in Table 2.2 for the adjusted case. The wettest month is typically October, with an estimated average precipitation of 230 mm (base case) or 329 mm (adjusted case), most of which falls as rain. The driest month is typically June, with an estimated average precipitation of 52 mm (base case) or 75 mm (adjusted case). The highest evapotranspiration occurs in July, with estimated values of 96 mm (base case) and 71 mm (adjusted case).

Return period 24 hour extreme precipitation events are provided in Table 2.3. The base case values are equivalent to those published by Environment Canada for Stewart, while the adjusted case values include the application of an orographic factor developed for the average elevation of the TSF drainage basin, which is 820 m. The adjusted values were used for the design of water management structures such as diversion and collection ditches.

Development of the site water balance scenarios used both base and adjusted cases to develop six water balance scenarios:

- Base Case:
  - Abnormally Dry Conditions
  - Mean Conditions
  - Abnormally Wet Conditions
- Adjusted Case:
  - Abnormally Dry Conditions
  - Mean Conditions
  - Abnormally Wet Conditions

For a conservative design approach, the adjusted case mean conditions were adopted for sizing of collection ponds, ditches, pumps and pipelines.

Table 2.1 Bromley Humps Monthly Hydrometeorological Parameters (Base Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	173	138	36	0
February	108	84	21	4
March	96	79	20	26
April	71	71	2	59
May	57	55	0	88
June	52	51	0	88
July	61	62	0	96
August	96	99	0	81
September	167	171	0	41
October	230	225	1	19
November	179	153	22	7
December	169	131	35	0
Annual	**1,457**	**1,319**	**138**	**509**

Table 2.2 Bromley Humps Monthly Hydrometeorological Parameters (Adjusted Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	247	197	52	0
February	155	120	29	4
March	137	113	28	26
April	102	101	3	59
May	81	79	0	88
June	75	73	0	88
July	87	88	0	96
August	137	142	0	81
September	238	245	0	41
October	329	322	2	19
November	256	219	32	7
December	242	187	50	0
Annual	**2,084**	**1,886**	**198**	**509**

Table 2.3 24-Hr Intensity-Duration-Frequency (IDF) Events for Base and Adjusted Cases

Return Period (years)	Rainfall Depth (mm)	
	Base Case	Adjusted Case
1	50	71
2	58	83
5	76	109
10	87	124
25	101	144
50	112	159
100	122	174
200	130	185
1,000	157	223

2.3.2 Probable Maximum Flood

The Probable Maximum Flood (PMF) must be determined for developing the Inflow Design Flood (IDF), as per Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2014). The PMF is based on the inflow from the 24 hour Probable Maximum Precipitation (PMP) event of 530 mm and the coincident snowmelt from a 100-year snow pack. The total 24-hour PMF volume contributing to the TMF is 889,000 m^3.

2.4 GEOLOGY

2.4.1 Regional Geology

Greig et al (1994), Aldrick (1993) and Rhys et al (1995) have described the regional geology of the Project area as follows:

Red Mountain is located near the western margin of the Stikine terrain in the Intermontane Belt. There are three primary stratigraphic elements in Stikinia and all are present in the area:

- *Middle and Upper Triassic clastic rocks of the Stuhini Group*
- *Lower and Middle Jurassic volcanic and clastic rocks of the Hazelton Group, and*
- *Upper Jurassic sedimentary rocks of the Bowser Lake Group.*

Many primary textures are preserved in rocks from all these groups, and mineralogy suggests that the regional metamorphic grade is probably lower greenschist facies.

Intrusive rocks in the Red Mountain region range in age from Late Triassic to Eocene, and form several suites. The Stikinie plutonic suite is comprised of Late Triassic calc-alkaline intrusions that are coeval with the Stuhini Group rocks. Early to Middle Jurassic plutons are roughly coeval with the Hazelton Group rocks and have important economic implications for gold mineralization in the area, including the Red Mountain gold deposits. Intrusive rocks of this age are of variable composition (Rhys et al, 1995). Eocene intrusions of the Coast Plutonic Complex occur to the west and south of Red Mountain and are associate with high-grade silver-lead-zinc occurrences.

Structurally, Red Mountain lies along the western edge of a complex, northwest-southeast trending, and doubly plunging structural culmination, formed during the Cretaceous. At this time, rocks of the Stuhini, Hazelton and Bowser Lake groups folded and/or faulted, with up to 40% shortening in a northeast-southwest direction (Greig, 2001). The Red Mountain deposits lie at the core of the Bitter Creek antiform, a northwest-southeast trending structure created during this deformation event (Greig, 2000).

2.4.2 Surficial Geology

Several episodes of glaciation at the Project are evident in the regional geology, largely in the deposition of glacial material as well as in the erosion or debuttressing of valley slopes. The most recent major glacial episode at the Project was the Fraser Glaciation, about 10,000 to 30,000 years ago. Through the Holocene, four periods of Bromley Glacier advance were documented between 2,470 ± 30 to 830 ± 30 years before present, the most recent of these corresponding to early Little Ice Age expansion. The Bromley Glacier did not reach the same ice thickness in these expansions as it did during the earlier Fraser glaciations. As a result, recent advances have stripped away the lower elevations of prior lateral moraine deposits, and oversteepened these slopes. Presently, local glaciers continue to modify the environment through ongoing glacial retreat. Glacial ice originating in the Cambria Icefield primarily enters the valley via the Bromley Glacier, which has been retreating at an average rate of 86 m/year over the hundred-year period from 1910 to 2010.

Surficial geology mapping by IDM and drilling from the 2016 site investigation (KP, 2016b) provides information on the local geology setting at Bromley Humps. Overburden cover is sparse and was generally thin where encountered during drilling. The thickness ranged from 0 to 6.8 m with an average of 1.8 m (KP, 2016). The thickest overburden was intersected in lower lying areas above near the centre of the proposed embankments. The surficial geology primarily comprises bedrock outcrops, colluvium and glacial till. The colluvium is generally described as a dense gravel to sandy gravel unit with a low fines content based on six samples (KP, 2016b). The glacial till is described as a sandy silt to well graded sand gravel with moderate fines content based on two samples (KP, 2016b).

2.4.3 Local Bedrock Geology

Information about the local bedrock geology at Bromley Humps is based on the mapping of bedrock outcrops by IDM, a terrain assessment by SNC (2017), and drill core from site investigations in 1996 (Golder, 1996) and 2016 (KP, 2016b). Bedrock outcrops in the area of the TMF and Process Plant include siltstone, gabbro and quartz monzonite.

The North and South TMF Embankments are separated by a high relief gabbro intrusion (the Bromley Humps). This indicates that it is less susceptible to erosion than the surrounding siltstone and/or faulted stratigraphy.

Drilling at the North TMF Embankment mainly encountered gabbro, diorite, tuff and Goldslide porphyry suite rocks. Bedrock at the South TMF Embankment generally encountered gabbro and mafic and felsic dykes. Siltstone, mudstone greywacke and conglomerate rocks were encountered at the left (south) abutment and downslope of the embankment.

IDM also identified potential faults in the area of the TMF embankments as follows:

- Subparallel to Bitter Creek intersecting the alignment of the North TMF Embankment. The mapping includes one inferred fault at the left (west) abutment, although there may be additional sub vertical features. A Digital Elevation Model (DEM) of the TMF area suggests this inferred fault potentially extends through the TMF area. Another lineament intersecting the TMF North Embankment at the right (east) abutment was identified from the DEM.
- Perpendicular to Bitter Creek with two inferred faults acting as boundaries to the gabbro intrusion between the North and South TMF Embankments. One of these two faults intersects the South TMF Embankment at the right (north) abutment. A third fault intersects the South TMF Embankment, near its centreline.

2.5 HYDROGEOLOGICAL CONDITIONS

Hydrogeological observations from water level data collected during drilling and from monitoring sites is generally summarized as follows:

- Relatively deep water levels, greater than 30 m below ground surface (mbgs).
- Downward gradients.
- Rapid responses to rainfall events.

These observations are indicative of near saturated conditions with depth, and represent a vertical flow regime to the top of the regional water level, below which a sub-horizontal flow regime is present. Groundwater recharge will occur upslope of the TMF as well as locally in the TMF area. Glaciation of this area likely resulted in associated disturbance to the near-surface bedrock, creating enhanced permeability and effective porosity. This disturbance is likely to allow for elevated recharge rates during rain and snowmelt events, particularly on the terrace like feature where the TMF is located.

Deep groundwater, originating from upslope of the TMF, flows under the facility and towards Bitter Creek. Local recharge entering the shallow groundwater regime migrates downwards and then laterally, also ultimately toward Bitter Creek. A groundwater mound, expected below the high relief gabbro intrusion that lies between the North and South TMF Embankments, will result in shallow flow toward the TMF impoundment area. Some of this shallow groundwater flowing toward the impoundment area is anticipated to migrate to the northwest, primarily along structures, and the remainder will flow south to Bitter Creek. The flow to the northwest may discharge at surface within an area of low relief, downgradient of the North TMF Embankment. This discharged water may then potentially recharge the groundwater system, and flow to Bitter Creek. Alternatively, flow to the northwest may discharge directly to Bitter Creek.

Hydraulic conductivity test results from the 1996 (Golder, 1996) and 2016 (KP, 2016b) SI programs yield a wide range of variation in hydraulic conductivity (10^{-9} to 10^{-5} m/s). This four order of magnitude variation in hydraulic conductivity across a data set is typical of packer test results conducted in a fractured rock setting. The 1996 and 2016 datasets, representing 113 tests, are indicative of a moderately permeable bedrock with some enhanced permeability associated with structures.

3 – TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT

3.1 GENERAL

KP conducted assessments to determine the preferred location for the TMF and the best available technology (BAT) for tailings disposal and management. These assessments are described below.

3.2 TAILINGS LOCATION ASSESSMENT

The TMF location assessment (KP, 2016c) considered the use of slurry tailings due to site specific limitations including extreme topography, high precipitation and high snowfall values, etc.

A total of nine TMF alternatives in eight locations were identified. Three alternatives failed the pre-screening assessment and were excluded from further assessment.

The TMF location assessment indicated that Bromley Humps (Option 5A) was the preferred location for storage of tailings. This location was carried forward during the PEA (KP, 2016a) and optimized during this feasibility study. The Bromley Humps location has the following advantages:

- More favourable climatic conditions (snow accumulation, wind, etc.) and safer and more reliable winter operations at a lower elevation than the previously considered option (located at the Mine Site Area, near the mine adit).
- Location is outside the Otter Creek avalanche path.
- Potential for expansion into an additional nearby cell.
- Advantageous from a construction and project execution standpoint.
- Lower capital, sustaining and operating costs than other options.

The TMF location assessment is included in Appendix D.

3.3 TAILINGS BEST AVAILABLE TECHNOLOGY (BAT) ASSESSMENT

The tailings BAT assessment (KP, 2017c) considered different tailings technologies and management strategies for the Bromley Humps TMF location. Three candidate technologies were assessed:

- Candidate 1: Thickened Tailings.
- Candidate 2: Ultra-thickened Cemented Tailings.
- Candidate 3: Filtered Tailings.

A Qualitative Multiple Accounts Assessment (QMAA) was completed to evaluate the three candidates under four assessment categories: environmental, technical, social and economic. These categories were divided into sub-categories which were then further divided into specific criteria. Each criteria and sub-category was assigned a relative weight according to its importance in its specific category. Higher weights indicate greater relative importance and reflect the site conditions and issues relative to the proposed development. The tiered organization of separate weight systems at each level removes bias that may be caused by having different numbers of matrix sub-categories and evaluation indicators in the model.

Ratings were then developed to compare the criteria. Ratings of “Preferred”, “Acceptable” and “Least Preferred” were assigned to the site specific criteria of each candidate. Scores of 3, 2 and 1 were associated with the ratings, respectively.

The weighted results of the assessment are as follows:

- Candidate 1 (Thickened Tailings) had the highest rating of the three alternatives, achieving a weighted score of 1.39
- Candidate 2 (Cemented Tailings) had the second highest score of 1.30, and
- Candidate 3 (Filtered Tailings) had the lowest score of the three alternatives with a score of 1.26.

A sensitivity analysis was performed to determine whether the scoring of the economic criteria impacted the results of evaluation. The economic scores were removed from the assessment; however, the overall result remained unchanged.

The main factors for this conclusion are as follows:

- The tailings deposition and water management strategy is simple relative to the other candidates
- The process water is contained within the same facility and used for mill reclaim
- No additional mill processes are required
- There is a lower risk of operational problems (complications due to climactic conditions, etc.), and
- There is a greater ability to maintain a degree of saturation within the tailings mass to reduce exposure of the tailings to oxidation and to limit ARD/ML generation potential.

Opportunities for optimization of Candidate 1 include:

- Refinement of tailings deposition strategies including tailings solids content
- Incorporation of drainage measures to promote densification and consolidation of deposited tailings (i.e. Basin Underdrain)
- Confirmation of water management requirements and operating practices, and
- Confirmation of geochemical characteristics.

Based on the results of this BAT Assessment, thickened tailings management in a single lined TMF was advanced for this feasibility study.

The Tailings BAT Assessment is included in Appendix E.

4 – TMF OBJECTIVES AND DESIGN CRITERIA

4.1 GENERAL

The principal objectives for the TMF are to provide safe and secure storage of tailings, to protect regional groundwater and surface water during operations and in the long term (post-closure), and to achieve effective reclamation at mine closure. The design of the TMF has taken into account the following requirements:

- Permanent, secure and total confinement of all tailings waste materials within an engineered disposal facility.
- Diversion of non-contact water around the TMF to the maximum extent possible.
- Control, collection, and removal of free-draining liquids from the TMF during operations for recycling as process water to the maximum practical extent.
- The inclusion of monitoring features for all aspects of the facility to confirm performance goals are achieved and design criteria and assumptions are met.
- Staged development of the facility over the life of the Project.

The TMF was designed to permanently store tailings generated during the operation of the mine. The TMF comprises a lined basin with two zoned rockfill/earthfill dams (North TMF Embankment and South TMF Embankment). The embankments will be expanded during operations using the downstream method of construction.

The design basis and operating criteria for the TMF and water management facilities are based on the available information and operational requirements confirmed with IDM, the May 2017 mine plan provided by JDS Energy & Mining Inc. (JDS) and relevant design standards. The design basis is discussed in the following sections. A detailed design basis summary is included in Appendix A.

4.2 DESIGN STANDARDS

Design standards are based on the relevant federal and provincial guidelines for the construction and operation of mines and tailings facilities in British Columbia. The following regulations and guidelines were used to develop the design standards for the Project.

- *Canada Water Act* (Government of Canada, 1985)
- *Federal Fisheries Act* (Government of Canada, 1985)
- *BC Mines Act* (Government of BC, 1996)
- *BC Water Act* (Government of BC, 1996)
- *BC Water Protection Act* (Government of BC, 1996)
- *Canadian Environmental Protection Act* (Government of Canada, 1999)
- Federal Metal Mine Effluent Regulations under the *Fisheries Act* (Government of Canada, 2002, 2016)
- BC Approved Water Quality Guidelines (BC Ministry of Environment (MOE), 2006, 2006, 2008, 2009, 2012)
- Canadian Water Quality Guidelines (CCME, 2007, 2012)
- Dam Safety Guidelines (Canadian Dam Association (CDA), 2013)
- Technical Bulletin – Application of Dam Safety Guidelines to Mining Dams (CDA, 2014)
- *BC Environmental Management Act* – Technical Guidance Document 7 – Assessing the Design, Size, and Operation of Sediment Ponds Used in Mining (BC MOE, 2015)

- Health, Safety & Reclamation Code for Mines in British Columbia (BC Ministry of Energy and Mines (MEM), 2017)
    - Part 10 – Guidance Document (BC MEM, 2016)

4.3 DAM CLASSIFICATION

4.3.1 Methodology

A dam classification was carried out to determine the appropriate design earthquake and flood events for the TMF based on the classification criteria provided by the Canadian Dam Association Dam Safety Guidelines (CDA, 2013 and 2014). The TMF dam classification considers the potential incremental consequences of an embankment failure defined as the total adverse effect from an event with dam failure compared to the adverse effect that would have resulted from the same event had the dam not failed. Three areas of losses are considered; loss of life, environmental and cultural values, and infrastructure and economics, as shown on Table 4.1 (reproduced from the Dam Safety Guidelines (CDA, 2014)).

Table 4.1 Dam Classification (as per CDA, 2014)

Dam Class	Population at Risk[1]	Incremental Losses		
		Loss of Life[2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short-term loss. No long-term loss.	Low economic losses; area contains limited infrastructure or services.
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration in kind highly possible.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes.
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transportation, and commercial facilities.
Very High	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat. Restoration or compensation impossible.	Extreme losses affecting critical infrastructure or services (e.g. hospital, major industrial complex, major storage facilities for dangerous substances).

NOTES:

1. DEFINITIONS FOR POPULATION AT RISK:
   NONE – NO IDENTIFIABLE POPULATION AT RISK, NO POSSIBILITY OF LOSS OF LIFE OTHER THAN THROUGH UNFORESEEABLE MISADVENTURE.
   TEMPORARY – PEOPLE ARE ONLY TEMPORARILY IN THE DAM-BREACH INUNDATION ZONE (E.G. SEASONAL COTTAGE USE, TRANSPORTATION ROUTES, RECREATION).
   PERMANENT – POPULATION AT RISK IS ORDINARILY LOCATED IN THE DAM-BREACH INUNDATION ZONE (E.G. PERMANENT RESIDENTS).
2. IMPLICATIONS FOR LOSS OF LIFE:
   UNSPECIFIED – THE APPROPRIATE LEVEL OF SAFETY REQUIRED AT A DAM WHERE PEOPLE ARE TEMPORARILY AT RISK DEPENDS ON THE NUMBER OF PEOPLE, EXPOSURE TIME, NATURE OF ACTIVITY AND OTHER CONDITIONS. HIGHER CLASSES COULD BE APPROPRIATE DEPENDING ON REQUIREMENTS.

The Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) selection is governed by the dam classification. Target levels for these events are outlined in Table 4.2 (reproduced from the Guidance Document for Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia (BC MEM, 2016)).

Table 4.2 Target Levels for Flood and Earthquake Hazards (BC MEM, 2016)

Dam Class	Annual Exceedance Probability (AEP)			
	Water Retaining Dams		Tailings Dams	
	IDF[2,3]	EDGM	IDF[2,3]	EDGM
Low	1/100	1/100	1/3 between 1/975 and PMF[4]	1/2,475[6]
Significant	Between 1/100 and 1/1,000	Between 1/100 and 1/1,000	1/3 between 1/975 and PMF[4]	1/2,475[6]
High	1/3 between 1/1,000 and PMF[4]	1/2,475[6]	1/3 between 1/1,000 and PMF[4]	1/2,475[6]
Very High	2/3 between 1/1,000 and PMF[4]	1/2 Between 1/2,475[6] and 1/10,000 or MCE[7]	2/3 between 1/1,000 and PMF[4]	1/2 Between 1/2,475[6] and 1/10,000 or MCE[7]
Extreme	PMF[4]	1/10,000 or MCE	PMF[4]	1/10,000 or MCE[7]

NOTES:
1. ACRONYMS: PMF (PROBABLE MAXIMUM FLOOD), AEP (ANNUAL EXCEEDANCE PROBABILITY), MCE (MAXIMUM CREDIBLE EARTHQUAKE).
2. SIMPLE EXTRAPOLATION OF FLOOD STATISTICS BEYOND 1/1,000 AEP IS NOT ACCEPTABLE.
3. THE CODE REQUIRES THAT A FACILITY THAT STORES THE INFLOW DESIGN FLOOD USE A MINIMUM EVENT DURATION OF 72 HRS.
4. PMF HAS NO ASSOCIATED AEP.
5. MEAN VALUES OF THE ESTIMATED RANGE IN AEP LEVELS FOR EARTHQUAKES SHOULD BE USED. THE EARTHQUAKES WITH THE AEP AS DEFINED ABOVE ARE INPUT AS CONTRIBUTORY EARTHQUAKES TO DEVELOP EARTHQUAKE DESIGN GROUND MOTION (EDGM) PARAMETERS.
6. THE 1/2,475 AEP EARTHQUAKE HAS BEEN SELECTED FOR CONSISTENCY WITH SEISMIC DESIGN LEVELS GIVEN IN THE NATIONAL BUILDING CODE OF CANADA (NBCC, 2010).
7. MCE HAS NO ASSOCIATED AEP.

4.3.2 TMF Dam Classification

The TMF embankments have been assigned a dam classification of VERY HIGH. The potential incremental losses are as follows:

- Loss of life: Potential losses to permanent population - VERY HIGH (permanent population at risk downstream of TMF - anticipated losses of 100 or fewer).
- Environmental and cultural values: Expected loss to important fish habitat with restoration possible but impractical - VERY HIGH.
- Infrastructure and economics: Economic losses affecting infrastructure or services - VERY HIGH (potential risk to major highway entering Stewart, BC).

The dam classification is used to determine the IDF and EDGM for the TMF embankments. The following design flood and earthquake levels were adopted from the CDA guidelines (CDA, 2013 and 2014) and the BC Mining Code (BC MEM, 2016) for a VERY HIGH dam hazard classification for the construction and operations phases of the project:

- IDF: 2/3 between 1/1,000 year return period event and the Probable Maximum Flood (PMF), and

- EDGM: 1/2 between 1/2,475 year and 1/10,000 year (or MCE) return period seismic events.

For a VERY HIGH dam classification during the passive care phase (i.e. post-closure), CDA guidelines recommend that the TMF be designed to withstand the following seismic and precipitation events.

- IDF: Probable Maximum Flood.
- EDGM: 1/10,000 year (or MCE) return period seismic event.

The IDF was used to design the Emergency Discharge Spillway for the TMF while the EDGM was used to confirm the stability of the TMF embankments under seismic loading conditions.

4.4 TAILINGS CHARACTERISTICS

Tailings samples for testing were generated from metallurgical testwork on ore samples from two zones within the deposit: the Marc and AV zones. Geotechnical testing was conducted on tailings samples at the KP Soils Laboratory in Denver, Colorado.

4.4.1 Tailings Testing Design Criteria

Milling will be conducted at a production rate of 1,000 tpd (year round). JDS conducted a mill process optimization that identified a mill grind size of 25 μm (i.e. 80% passing the No.500 (25 micron) sieve) as the preferred grind.

The tailings testwork assumed the tailings are thickened at the mill to a slurry solids content of 50% by weight before being pumped to the TMF. The tailings will be conveyed in a single overland pressure pipeline and discharged from the TMF embankments via spigoted offtakes.

4.4.2 Testwork Summary

4.4.2.1 Geotechnical Testwork Summary

The geotechnical testing program was conducted to evaluate the physical characteristics of the tailings materials. Testing was completed on two tailings samples provided by JDS: AV Master Comp and Marc Master Comp. The test program included index testing to enable geotechnical classification of the materials, and slurry settling, air-drying and consolidation testing to determine the characteristics of the tailings following deposition for a range of possible field conditions.

The index test results were similar for both samples and the tailings can be generally described as an inorganic silt with low plasticity (PL = 25, LL = 30-31, PI = 5-6). The specific gravity of the tailings solids was determined to be 3.095 for the AV tailings, and 3.031 for the Marc tailings.

Slurry settling (or sedimentation) tests provide an estimate of the density the tailings slurry will settle in a sub-aqueous environment, under undrained and drained conditions. The tests provide an indication of the tailings dry density achieved in the TMF after settling and before any significant consolidation or air-drying occurs. Air-drying tests were carried out on tailings samples to estimate the effect of air-drying after initial slurry settling and removal of supernatant water. Slurry consolidometer tests provide information on the consolidation, compressibility and permeability characteristics over a wide range of confining stresses corresponding to expected field conditions. The tests were completed on the AV and Marc tailings at a design solids content of 50%.

4.4.2.2 Consolidation Modelling

Consolidation modelling used a one-dimensional finite difference computer model and the results from the geotechnical test program to predict the magnitude and rate of tailings consolidation, the amount of consolidation seepage (i.e. water losses from the tailings mass), and the corresponding average dry density of the tailings mass. Modelling considered one-dimensional consolidation for three columns within the tailings mass. Each of the three models assumed both a fully drained base and an impermeable base. Outputs from tailings consolidation modelling can be used to refine embankment height requirements, provide input to the tailings deposition strategy to correspond with operational and closure objectives, and facilitate water management planning, operational water balance modelling, watershed modelling, and associated water chemistry predictions.

Results of the consolidation modelling indicate the average dry density of the tailings mass increases over time, from approximately 1.21 tonnes/m^3 at Year 1, to 1.30 tonnes/m^3 at the end of operations, and 1.36 tonnes/m^3 at the beginning of the reclamation period (i.e. 2 years post-operations). Post closure consolidation modelling of the tailings estimates a reduction in average tailings thickness of less than 1 m.

4.5 SEISMICITY

4.5.1 General

The Canadian Dam Association Dam Safety Guidelines (CDA, 2014) and the Health Safety and Reclamation Code for Mines in British Columbia (BC MEM, 2017) both state that for tailings dams, the minimum design criteria for seismic loading corresponds to the following return period events:

- Construction and Operations Phases: 1/2 between 1/2,475 year and 1/10,000 year return period seismic events.
- Passive Care Phase (i.e. Post Closure): 1/10,000 year return period seismic event.

The EDGM for the Construction and Operations Phases is the Operating Basis Earthquake (OBE). The OBE is the earthquake that a structure must safely withstand no damage and has a reasonable probability of occurring during the life of the structure.

The EDGM for the Passive Care Phase is the Maximum Design Earthquake (MDE) for the life of the TMF. The MDE is the earthquake that would generate the most critical ground motions for evaluation of the seismic performance of a structure among those loadings to which the structure might be exposed.

Seismic stability analyses use the EDGM to confirm the physical stability of the TMF under seismic loading conditions as per CDA guidelines (CDA, 2013).

4.5.2 Methodology

Spectral accelerations (Sa) and Peak Ground Accelerations (PGA) were obtained for the Project site using the Natural Resources Canada Seismic Hazard Calculator (NRCAN, 2015). The calculator provides these parameters for events up to a 1/2,475 year seismic event. To obtain the 1/10,000 year seismic event parameters, the parameters for the 1/475 year and 1/2,475 year return period events were plotted on a log-log scale, and the values extrapolated to estimate the parameters for the 1/10,000 year seismic event, following procedures provided by NRCAN for estimating low-probability return period seismic events (NRCAN, 2016).

The Peak Ground Accelerations for the Project are as follows:

- 1/2,475 year return period seismic event = 0.064 g.
- 1/10,000 year return period seismic event = 0.12 g (MDE).

The OBE was evaluated as follows:

- 1/2 between 1/2,475 year and 1/10,000 year return period seismic events = 0.092 g (OBE).

A design earthquake magnitude of 7.5 has been estimated for the MDE based on historic earthquake data in the region (i.e. the earthquake magnitude corresponding to the return period for the MDE).

5 – TMF DESIGN SUMMARY

5.1 DESIGN CONCEPTS

The feasibility design uses the May 2017 production schedule and mine plan, with a mine life of 6 years and a total of 1.95 Mtonnes of tailings, all of which will be stored in the TMF. The TMF has a storage capacity of approximately 1.75 Mm^3, which includes 1.5 Mm^3 of tailings (1.95 Mtonnes at an average settled density of 1.3 t/m^3), 89,500 m^3 of process water (approximately 3 months of total process water), and 160,000 m^3 for the Environmental Design Flood (EDF) as per CDA guidelines (CDA, 2014). The EDF was determined as the total runoff from the 1 in 50 year wet month plus the total runoff from a 1 in 200 year 24-hr precipitation event that bypasses the Non-Contact Water Diversion Channel. Flood events exceeding the EDF event, up to and including the IDF, will be passed through an Emergency Discharge Spillway, located at the North TMF Embankment.

The tailings are anticipated to be Potentially Acid Generating (PAG) and are anticipated to become Metal Leaching (ML) after approximately 20 years of exposure to oxidation. Tailings are still acceptable for sub-aerial disposal and maintaining a degree of saturation will be important to mitigate the acid generation risk. Saturation can be achieved through management of the TMF supernatant pond or application of new layers of tailings to prevent prolonged oxidation of the exposed beach.

The TMF will be lined with an 80-mil HDPE Geomembrane Liner to prevent seepage from the tailings to the TMF foundation and to mitigate the PAG nature of the tailings.

The Non-Contact Water Diversion Channel located on the east side of the TMF will collect runoff from the upstream catchment and safely divert it around the TMF. The channel is designed for the peak runoff from a 1 in 5 year 24-hr precipitation event, discharging to the Bitter Creek drainage area.

The general arrangement for the ultimate (Stage 4) TMF is shown on Figure 5.1. Staged embankment layouts are shown on Drawings C201 to C205.

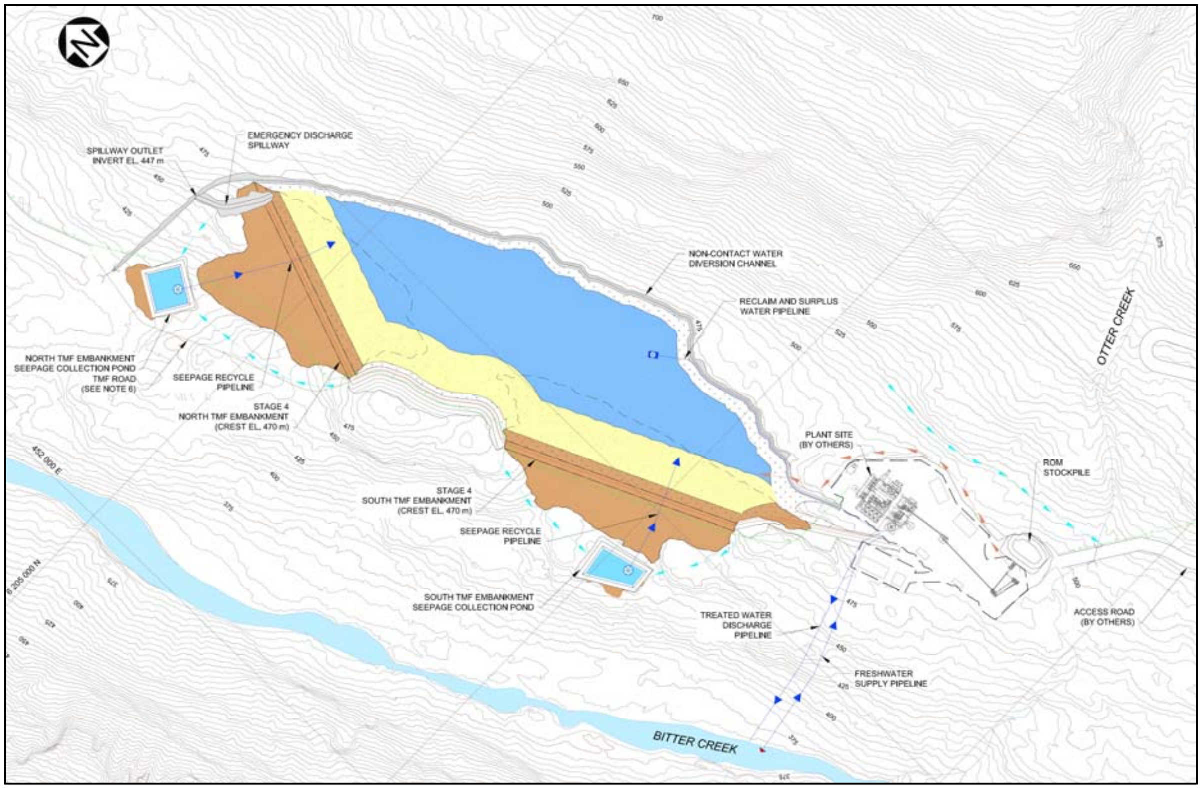


Figure 5.1 TMF General Arrangement (Stage 4 – Ultimate)

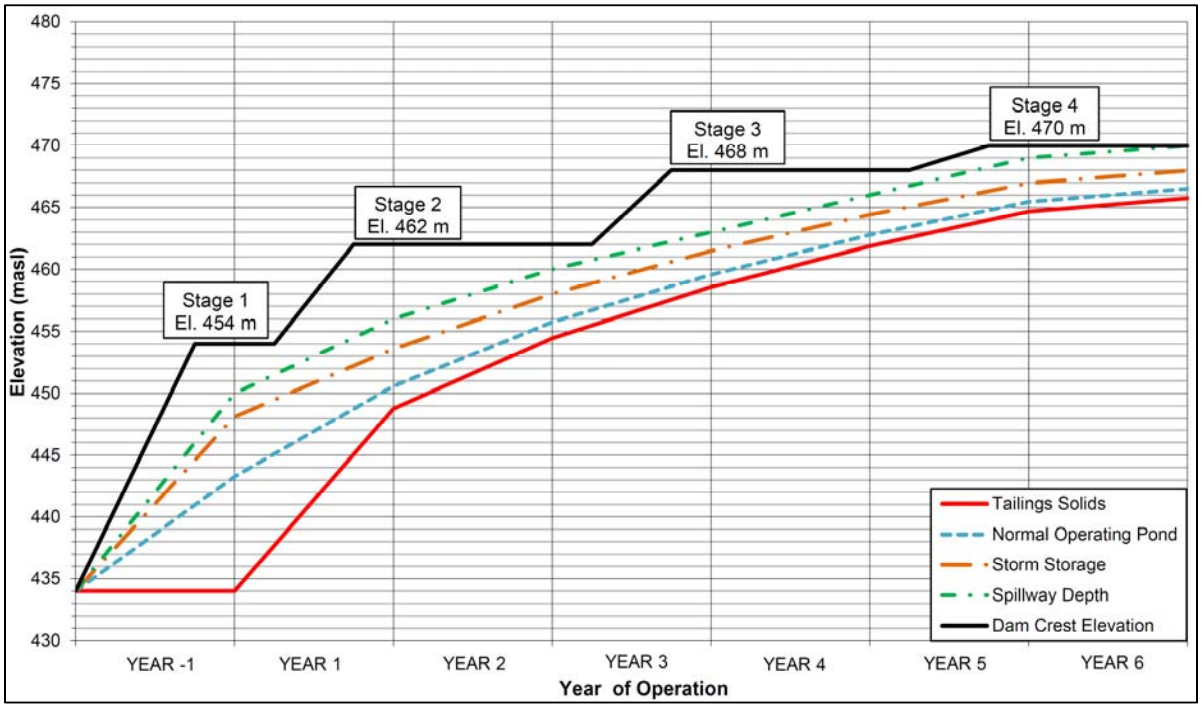
5.2 EMBANKMENT STAGING AND FILLING SCHEDULE

The TMF will be developed in four stages over the mine life. This staged approach offers the following advantages:

- The ability to refine design, construction, and operating methodologies as experience is gained with local conditions and constraints.
- The ability to adjust plans at a future date to remain current with evolving best practices (engineering and environmental).
- To allow the observational approach to be utilized in the ongoing design, construction and operation of the facility. The observational approach can deliver substantial cost savings and a higher level of safety. It also enhances knowledge and understanding of site-specific conditions.
- The potential to reduce initial capital costs and defer capital expenditure relating to TMF construction until the mine is operating.

The stages are shown on the TMF filling schedule on Figure 5.2. The filling schedule and timing for staged expansions must be reviewed on an on-going basis during operations. The actual rate of filling may vary, depending on a variety of operating factors, including:

- Mill throughput.
- Settled tailings density.
- Tailings surface slopes.



NOTES:

1. TAILINGS TONNAGES AND RAMP-UP SCHEDULE PROVIDED BY IDM MINING (MAY 2017).
2. ALLOWANCE FOR A MINIMUM OF 2 METRES FOR SPILLWAY DEPTH.
3. AVERAGE SETTLED TAILINGS DRY DENSITY ASSUMED TO BE 1.21 T/M3 IN YEARS 1 AND 2 CONSOLIDATING TO 1.30 T/M3 BY YEAR 6.

Figure 5.2 TMF Filling Schedule

5.3 SEEPAGE CONTROL MEASURES

Potential seepage from the TMF will be controlled by incorporating the following measures:

- Geomembrane Liner.
- Basin Underdrain.
- Foundation Drains.

These systems are described in the following sections.

5.3.1 Geomembrane Liner

The entire TMF basin, including the upstream embankment faces, will be lined with an 80-mil HDPE geomembrane. The liner system includes layers of 12 oz/yd^2 non-woven geotextile above and below the geomembrane, for protection from the adjacent materials. The liner system also incorporates a prepared subgrade comprising processed bedding material. The geomembrane is effectively impermeable, with seepage only possible through defects that may occur during fabrication and/or installation. Details of the geomembrane liner system are shown on Drawing C207.

5.3.2 Basin Underdrain

An internal underdrain will be installed above the geomembrane on the basin floor to promote tailings consolidation while maintaining a low head on the geomembrane. The Basin Underdrain will connect to an internal wet well sump and recycle pump system. Collected water will be recycled to the TMF supernatant pond.

The Basin Underdrain will be constructed using suitably graded material generated during construction of the haul road and TMF, or from local borrow sources. The underdrain includes perforated drain pipes within a free draining surround. A blanket layer of filter sand (Zone F), 300 mm thick, will be placed on the basin floor above the geomembrane liner and surrounding the drain pipes, to assist in providing drainage, to prevent the migration of fine tailings and to protect the geomembrane liner. The underdrain system will drain towards the wet well sump.

The Basin Underdrain requires a well-established tailings cover before commencing operations. A minimum cover of 2 m of tailings is required before this system is commissioned. The layout for the basin underdrain is shown on Figure 5.3 and in more detail on Drawing C208, while typical sections and details are provided in Figure 5.4 and in more detail on Drawing C210.

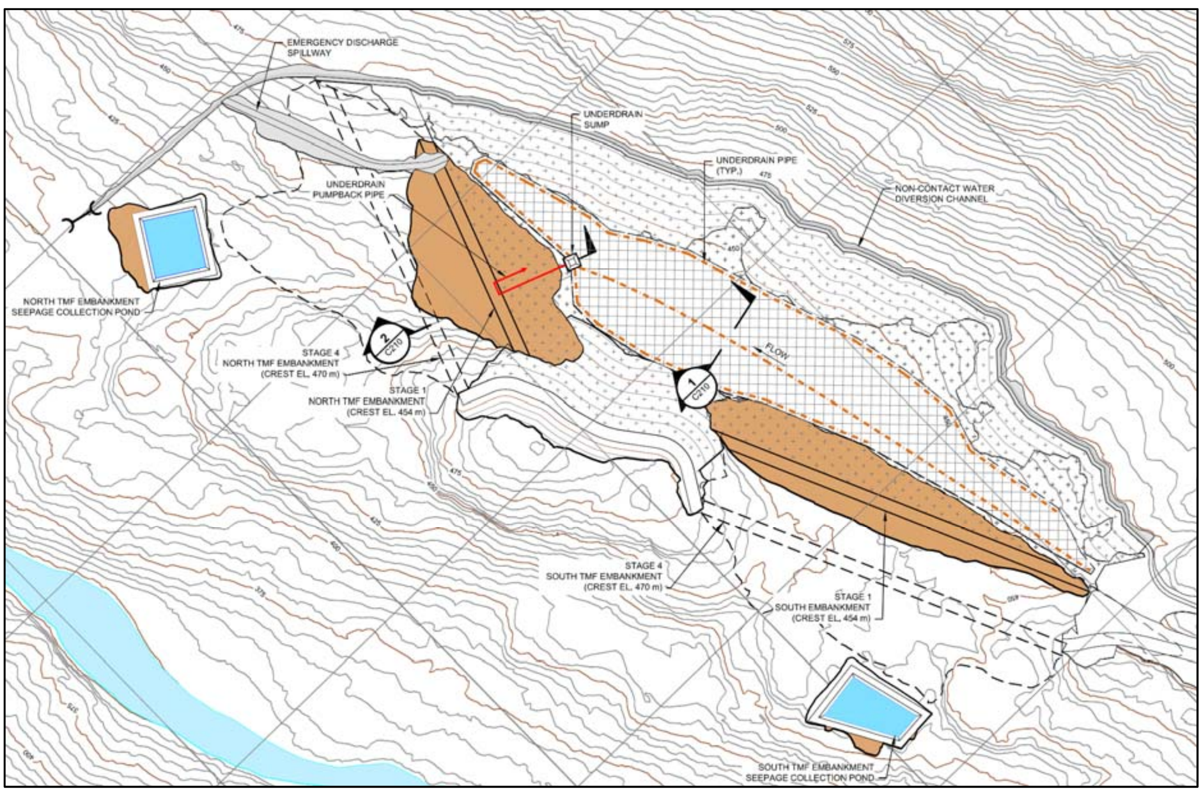


Figure 5.3 Basin Underdrain Plan

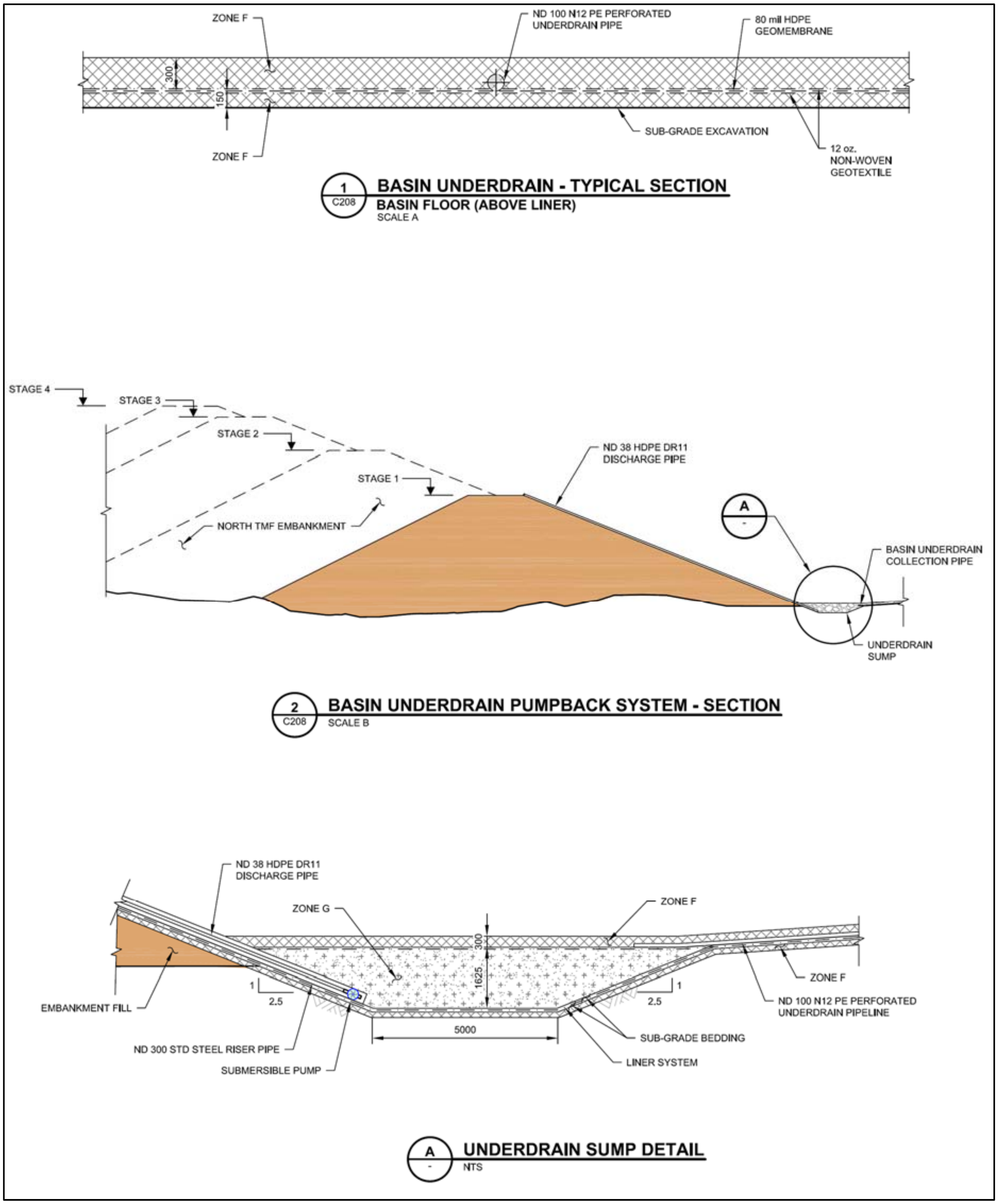


Figure 5.4 Basin Underdrain Sections and Details

5.3.3 Foundation Drain

Foundation Drains will be installed below the geomembrane liner to collect groundwater flows, potential seepage and infiltration through the TMF embankments. Collected water will drain to the seepage collection and recycle pond downstream of the North TMF embankment. The pond will be lined with 80 mil HDPE geomembrane. A submersible turbine pump and HDPE pipeline will be used to convey water from the pond to the TMF.

The foundation drain comprises interconnected pipes surrounded by drain gravel (Zone G) to manage groundwater flows. The foundation drain will be constructed using suitably graded material generated during construction of the haul road and TMF, or from local borrow sources. The foundation drain includes perforated drain pipes within a free draining surround. The foundation drain will be constructed beneath the TMF liner bedding layer and TMF embankments.

The layout for the foundation drain is shown on Figure 5.5 and in more detail on Drawing C209, while typical sections and details are provided in Figure 5.6 and in more detail on Drawing C210.

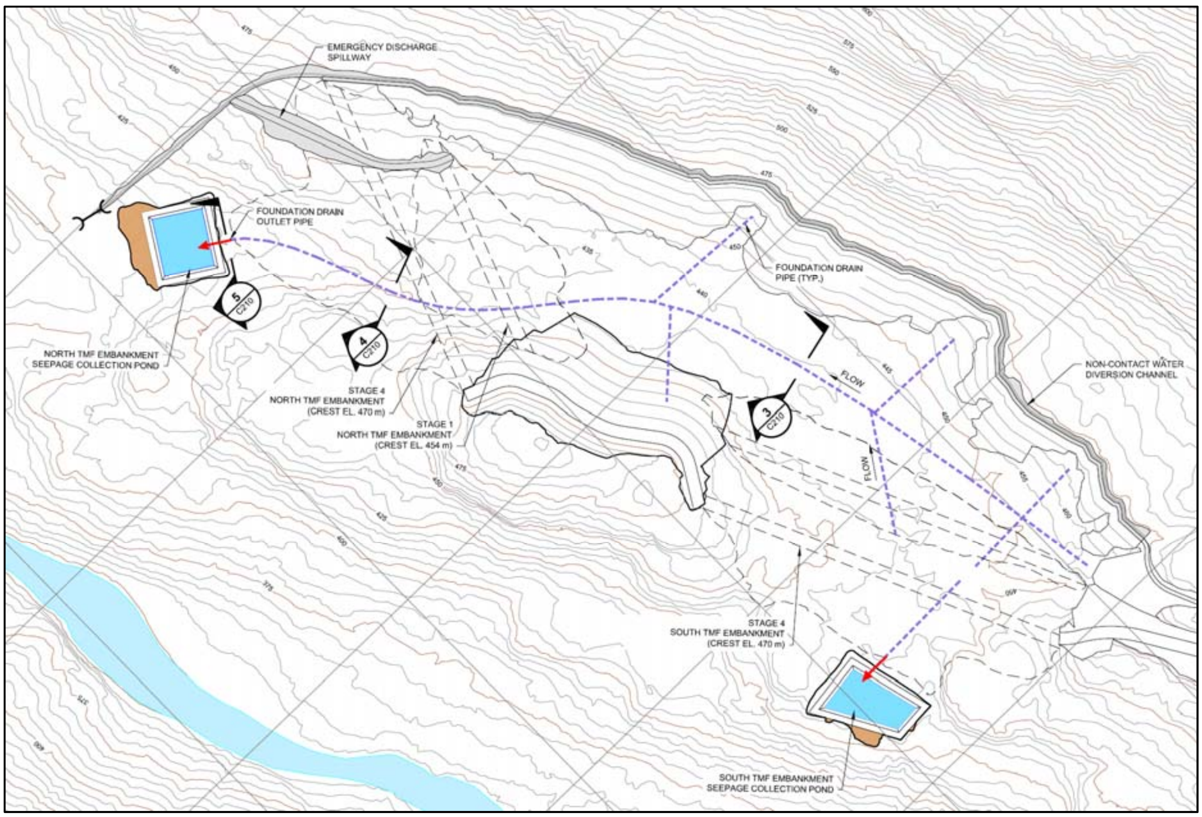


Figure 5.5 Foundation Drain Plan

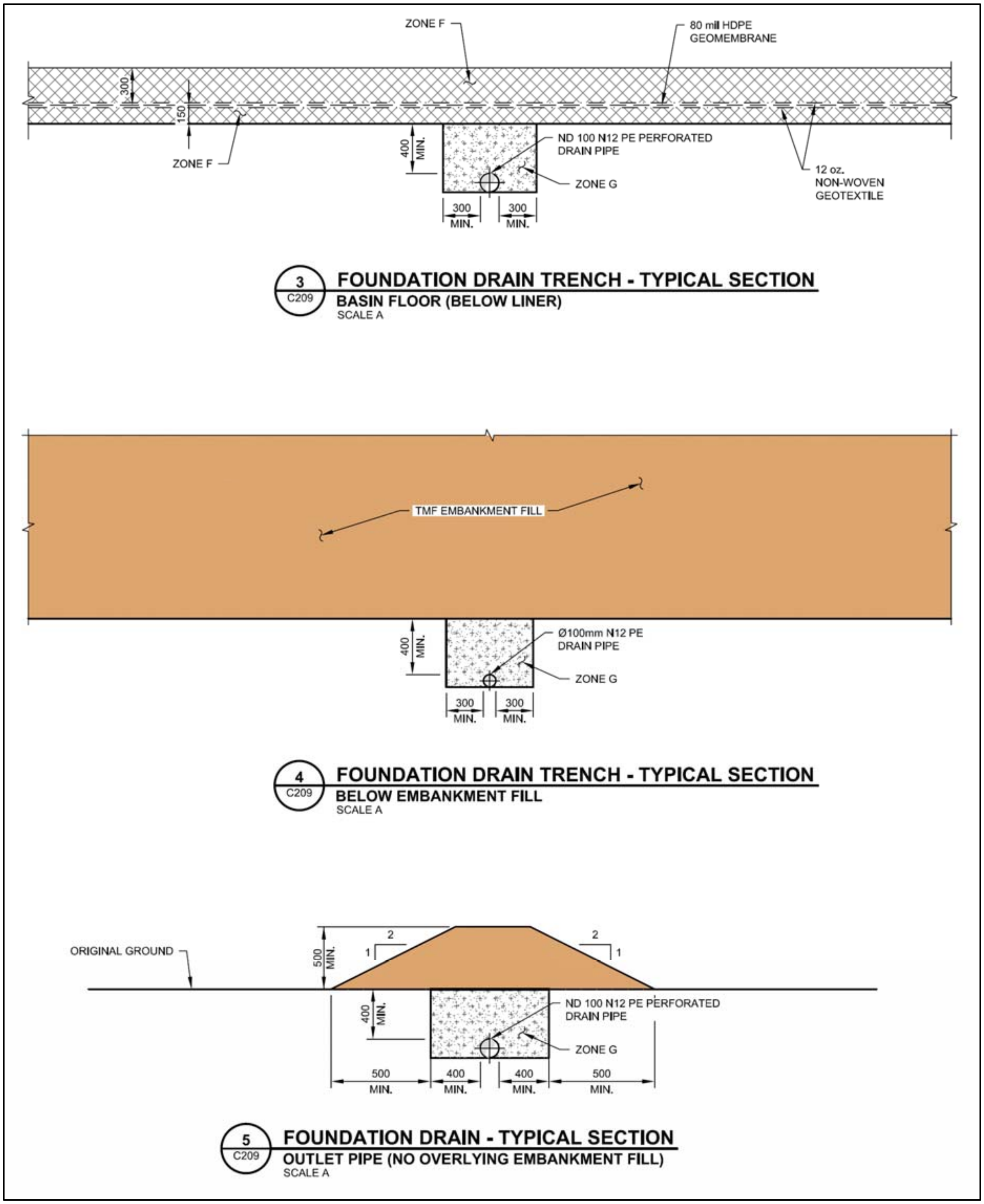


Figure 5.6 Foundation Drain Sections and& Details

5.4 EMBANKMENT CROSS-SECTION

The TMF has two embankments: the North TMF Embankment and South TMF Embankment. These embankments will be constructed using material from local borrow sources including material generated during construction of the process plant site, TMF and haul road, or from other local borrow sources.

The TMF embankments are rockfill/earthfill embankments. The upstream slopes are 2.5H:1V to facilitate geomembrane placement. The downstream slopes are 2H:1V. The minimum embankment crest width is 10 m to allow working space for tailings and reclaim water pipelines and traffic. The maximum embankment height is approximately 35 m, while the maximum elevation difference between the dam crest and the lowest ground elevation at the toe of the North TMF Embankment is 60 m.

The majority of fill for the Stage 1 embankment will be general rockfill sourced from excavation of the plant site pad. Subsequent embankment expansions will incorporate construction materials from local borrow pits and quarries along the haul road alignment.

The embankment fill zones (Zone C) will be general rockfill/earthfill. The upstream face of the embankments includes a layer of filter sand (Zone F) which will function as a geomembrane liner bedding. The geomembrane liner will be installed on the filter sand material.

The embankment cross section is shown on Figure 5.7.

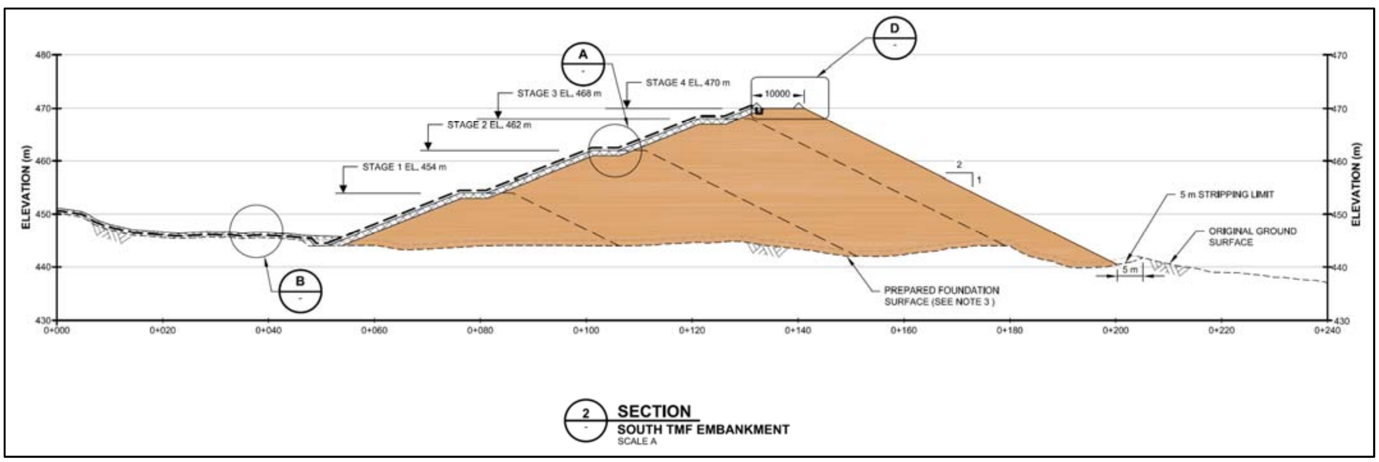


Figure 5.7 South TMF Embankment Cross-Section

5.5 EMERGENCY DISCHARGE SPILLWAY

A spillway will be constructed at the North TMF Embankment for each embankment stage. The spillway is designed to pass extreme storm events from the TMF (events exceeding the EDF).

The TMF is designed to contain the normal operating pond level (defined as 3 months of total tailings process water), with an additional allowance for the EDF volume of 160,000 m^3. The EDF is defined as the runoff from a 1/50 year historic wet month (i.e. flood duration of 30 days) plus the total runoff from a 1/200 year 24-hour precipitation event that bypasses the Non-Contact Water Diversion Channel. Flood events exceeding this volume, up to the peak runoff from a PMF event, will be conveyed from the TMF through the emergency discharge spillway at the North TMF Embankment and will report to Bitter Creek.

The emergency discharge spillway is 2 m deep, with a base width of 5 m and side slopes of 2H:1V and a minimum channel gradient of 1%. The spillway will be lined with a HDPE geomembrane to provide erosion protection. Additional erosion protection measures, such as concrete reinforcement, may be implemented as required. The Emergency Discharge Spillway alignments are shown on Drawings C201 to C205, while a cross-section is provided on Drawing C104.

5.6 SEEPAGE COLLECTION AND RECYCLE

Seepage collection and recycle ponds will be located downstream of the North TMF Embankment and South TMF Embankment and will collect seepage from the TMF basin, runoff from the downstream TMF embankment slopes and flow from the foundation drain.

Water collected in these ponds will be recycled to the TMF supernatant pond using submersible pumps and HDPE pipelines.

The seepage collection and recycle ponds will be lined with an 80-mil HDPE geomembrane installed on a sand bedding layer. The embankments for the ponds incorporate 2.5H:1V upstream and 2H:1V downstream side slopes. The ponds are designed to store the total runoff from a 1 in 200 year 24-hr rainfall event from their contributing catchments. Overflow from the seepage collection and recycle ponds will report to Bitter Creek in the event of an event exceeding the design storm for the ponds. The seepage collection ponds are shown on Drawings C105 and C106.

5.7 TAILINGS DISTRIBUTION SYSTEM

The tailings distribution system is designed to deliver the tailings to the TMF and to facilitate development of tailings beaches along the inside perimeter of the TMF embankments. The system consist of three primary components: a tailings pump station, tailings conveyance pipeline and discharge spigots. The tailings distribution system and the configuration of discharge spigots will evolve during operations as the TMF embankments develop and as operating procedures are refined.

Tailings discharge will be rotational, whereby a spigot (or multiple spigots) will be used for a while, then discharge is moved to the next spigot etc. This process will be repeated to ensure a suitable tailings beach is established and that the pond is not against the embankments. Tailings will be selectively discharged to ensure a degree of saturation is maintained within the tailings mass to reduce ARD/ML generation potential.

A Process and Instrumentation Diagram (P&ID) for the tailings distribution system is provided on Drawing M301. Tailings distribution pipeline alignments for Stage 1 and Stage 4 are shown on Drawings M310 and M311, respectively.

5.8 WATER RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEM

The water reclaim and surplus water management system serves two purposes:

- To allow for the reclaim of supernatant for use in the mill.
- To allow for the removal of surplus water for water treatment and environmental release.

The water reclaim and surplus water management system consists of a pump barge located on the TMF supernatant pond. One HDPE pipeline will extend from the barge to the reclaim water tank at the plant site. From this tank, water will be used in mill processing or transferred to the water treatment plant (designed by others) for treatment and discharge to Bitter Creek.

The water reclaim and surplus water management system consists of a barge with three 25 kW centrifugal end-suction pumps (with one additional standby) reclaiming water through a 450 m long, 150 mm diameter (6-inch) HDPE DR17 pipeline. The pipeline will follow the access road constructed alongside the Non-Contact Water Diversion Channel back to the process plant. Three pumps in parallel provide flow rates in 52 m^3/hr increments, up to a total of 157 m^3/hr. This variability is needed because reclaim and surplus water management requirements vary seasonally and throughout the mine life.

The surplus water system consists of one 10 kW centrifugal end-suction pump (with one additional standby pump) with a 100 m long, 150 mm diameter (6-inch) HDPE DR17 pipeline. This pipeline will convey surplus water from the reclaim water tank to the water treatment plant. It has been assumed that the water treatment plant will be located in close proximity and elevation to the water reclaim tank and that surplus water will be pumped the tank to the water treatment plant for treatment and discharge. Depending on the final configuration of the plant site, the reclaim water tank may provide sufficient gravity head to eliminate the requirement for pumping from the water reclaim tank to the water treatment plant. The water treatment plant and the water reclaim tank are being designed by others.

Discharge from the water treatment plant will flow by gravity through a 350 m long, 150 mm diameter (6-inch) HDPE DR11 pipeline into Bitter Creek. The water treatment and surplus water management system has been designed to operate on a year-round basis. As a contingency, the system has been sized to discharge only during the peak flow months of Bitter Creek (i.e. March to October) to account for potential low-flow winter months and minimizing the impact to Bitter Creek.

A Process and Instrumentation Diagram (P&ID) for the reclaim and surplus water management system is provided on Drawing M301. The water reclaim and surplus water management pipeline alignments for Stage 1 and Stage 4 are shown on Drawings M310 and M311, respectively.

5.9 NON-CONTACT WATER DIVERSION CHANNEL

The Non-Contact Water Diversion Channel will collect non-contact runoff from the catchment upstream of the TMF on the east side of the TMF and convey it around the TMF for discharge to the downstream environment. The diversion channel reduces the amount of runoff contributing to the TMF, in turn reducing the required capacity within the TMF to for managing storm events.

The diversion channel is designed to carry the predicted peak flow from a 1 in 5 year return period flood event. HydroCAD was used to model the contributing areas in order to estimate the peak instantaneous discharge associated with the storm event that would report to the channel.

The channel, and associated access berm, will be constructed in fill material along the eastern slope of the TMF basin. The access berm is also part of the basin shaping/preparation required for geomembrane installation in the TMF basin. The channel will be lined with HDPE geomembrane to prevent erosion of the channel bed during high flows. The base width of the channel is 0.5 m while the channel depth is approximately 0.8 m.

The channel elevation is above the TMF up to a point downstream of the North TMF Embankment, where the channel outlets. The downstream fill slope within the TMF basin will be lined with geomembrane liner (i.e. lined to an elevation above the final Stage 4 TMF embankment crests). The channel, constructed to a 0.5% grade, will outlet to the existing drainage path, which reports to Bitter Creek downstream of the North TMF Embankment.

A plan and profile for the Non-Contact Water Diversion Channel is provided on Drawing C103 while sections and details for the channel are provided on Drawing C104.

5.10 INSTRUMENTATION

Instrumentation will be installed in the TMF embankments and underlying foundations and monitored during construction and ongoing operations to assess performance and to identify any conditions that differ from those assumed during design and analysis. Amendments to the ongoing designs, operating strategies and/or remediation work can be implemented to respond to changing conditions, should the need arise. The following types of instrumentation that may be installed:

- Survey Monuments: To evaluate the performance of the embankments with respect to movement, settling, etc.
- Vibrating Wire Piezometers: To monitor pore pressures within the TMF embankments to evaluate performance of the geomembrane liner.
- Slope Inclinometers: To monitor subsidence in the TMF embankments.
- Flow meters: To monitor effectiveness and performance of pipeline systems.
- Pond level indicators: To monitor supernatant pond level to assess performance and volume of supernatant pond.

6 – STABILITY AND SEEPAGE ANALYSIS

6.1 GENERAL

Key components of the TMF design include the assessment of the facility for geotechnical stability under seismic and static loading conditions and an evaluation of potential seepage from the facility. The results of the stability and seepage analyses for the TMF are summarized below and discussed in detail in KP Ref. No. VA17-00261 (KP, 2017), included in Appendix C.

6.2 STABILITY ANALYSES

6.2.1 Modelling Approach

The following cases have been evaluated for stability analysis of the TMF:

- Static conditions at the end of construction (i.e. prior to basin filling) for all stages of embankment construction.
- Static conditions post deposition (i.e. long-term conditions) for all stages of embankment construction.
- Earthquake loading from the Maximum Design Earthquake (MDE) and Operating Basis Earthquake (OBE) for all stages of embankment construction.

The recommended Factors of Safety (FOS) applicable to the design of the TMF, as per Table 6-2 and Table 6-3 of the Canadian Dam Association Dam Safety Guidelines (CDA, 2013 and 2014) and Tables 3-1 and 3-2 of the BC Mines Code Guidance Document (BC MEM, 2016) are summarized on Table 6.1 below:

Table 6.1 Factors of Safety for Slope Stability

Loading Condition	Minimum FOS	Slope
End of construction, prior to filling	1.5	Upstream and Downstream
Long-term (steady-state seepage, normal reservoir level)	1.5	Downstream
Full or partial rapid drawdown	1.5	Upstream
Psuedo-static	1.0	Upstream and Downstream
Post-earthquake	1.2 – 1.3	Upstream and Downstream

Rapid drawdown conditions were not analyzed for the TMF as it is a fully lined facility and there would be no change in the pore water pressures within the embankment in the event of a drawdown.

Static conditions at the end of construction were modelled by performing static stability at the end of construction and prior to deposition (i.e. tailings level corresponding to deposition from prior stage).

Long-term static conditions (post deposition) were modelled by performing static stability analyses at the end of the operational life of each stage (i.e. post tailings deposition but prior to construction of the next TMF embankment stage).

Pseudo-static (seismic) loading was modelled by performing pseudo-static analyses for the MDE, as required by BC MEM regulations and CDA guidelines. Pseudo-static analyses apply a horizontal force (seismic coefficient) to the model to simulate earthquake loading. The horizontal seismic coefficients for the seismic stability analysis were estimated using the formula developed by Melo and Sharma (2004), K_H = 0.5 x PGA, as follows:

- OBE = 1/2 between 1/2,475 year and 1/10,000 year = 0.046 g (PGA = 0.092 g).
- MDE = 1/10,000 year = 0.06 (PGA = 0.12 g).

The minimum required FOS for the pseudo-static analysis and post-earthquake conditions are 1.0 and 1.2, respectively. Satisfying this requirement implies the design earthquake events would result in deformations that are acceptable and do not affect the integrity of the facilities (i.e. are not anticipated to affect required embankment freeboard and HDPE liner integrity).

The stability analysis was carried out using the limit equilibrium program SLOPE/W (Geostudio, 2012). This program uses a systematic search to obtain the minimum factor of safety associated with the critical slip surface. The FOS were calculated using the Morgenstern-Price method.

6.2.2 Piezometric Levels and Pore Pressure Response

The TMF is a fully lined facility, and the embankments will be constructed using free draining rockfill/earthfill materials, therefore it is expected that the TMF embankments will be unsaturated. For conservatism, the groundwater table was assumed to be at the top of the excavated ground surface, at the bedrock-overburden interface, and the piezometric line was fully specified in the model. The groundwater table was encountered at depths of between 10 m to 25 m beneath the North TMF Embankment during recent investigations.

Construction of the embankments could generate excess pore pressures in the overburden under saturated conditions, which could lead to instability of the embankments during operations prior to the dissipation of excess pore pressures. It is therefore assumed that the overburden materials will be excavated and the embankments will be constructed on bedrock.

6.2.3 Material Strength Parameters

The shear strength of the embankment fill zone (Zone C) material is based on a function that defines the variation of shear strength with normal stress. The shear strength of rock materials typically reduces at higher stresses due to the crushing of particle contact points within the material and a reduction in material dilatancy. Shear strength is also related to the density and durability of the material and the particle size distribution. The strength function representative of lower shear strength rockfill (Leps, 1970) was selected based on the assumption that fill may comprise of low density, poorly graded, weak particles (i.e. glacial till material from local borrow for the Stage 2 to Stage 4 TMF embankment raises).

Bulk unit weights and effective friction angles for the Zone F material was based on typical values for similar materials. The material parameters are presented in Table 6.2.

6.2.3.1 Thickened Tailings

Based on geotechnical laboratory testing of the tailings and subsequent consolidation modelling of the tailings mass within the TMF, the bulk unit weight of the thickened tailings is estimated to increase from 11.9 kN/m^3 in Year 1 to 12.7 kN/m^3 at the end of Year 6 (end of operations) and ultimately to 13.4 kN/m^3 post-closure.

Table 6.2 Material Strength Parameters

Material Type	Model	Unit Weight γ kN/m^3	Effective Friction ϕ' degrees	Effective Cohesion c' kPa	τ/σ Ratio
Zone C	Shear/Normal Function (Lower Bound Leps)	19	-	-	-
Zone F	Mohr-Coulomb	18.5	37	0	-
Tailings	S=f(overburden)	11.9 – 13.4	-	-	0.25

6.2.4 TMF Stability Analysis

The calculated FOS for the TMF embankments exceeds the minimum required FOS for the short-term (i.e. end of construction) and long-term (i.e. steady-state) cases for all embankment stages, during static and seismic conditions. The FOS values for each loading condition are presented in Table 6.3. The critical slip surface and FOS for loading conditions and configurations for the final (Stage 4) embankment are shown on Figures 6.1 to 6.4. All analyses were conducted on the critical cross-section (i.e. the cross-section where the TMF embankment is at its highest point). For this scenario, the critical section is at the North TMF Embankment.

Table 6.3 TMF Stability Analysis Results

Slope Stability Conditions	Slip Surface Direction	Required Minimum FOS	FOS for Stage of Construction			Figure
			Stage 1	Stage 2	Stage 4	
Pseudo-static (MDE = 0.120g)	Upstream	**1.0**	1.61	1.61	1.61	-
	Downstream	**1.0**	1.70	1.66	1.66	6.3
Post-Earthquake (OBE = 0.064g)	Upstream	**1.2**	1.67	1.67	1.67	-
	Downstream	**1.2**	1.78	1.71	1.71	-
End of Construction	Upstream	**1.5**	1.90	1.90	1.90	-
	Downstream	**1.5**	1.96	1.90	1.91	6.4
Long-term Steady State Conditions (Normal Operating Conditions)	Downstream Only	**1.5**	1.96	1.90	1.90	6.1
Long-term Steady State Conditions (Flood Event Conditions)	Downstream Only	**1.5**	1.95	1.91	1.90	6.2

NOTES:
1. END OF CONSTRUCTION CONDITIONS ANALYSE FULL STAGE CONSTRUCTION WITH TAILINGS AND POND LEVEL REPRESENTATIVE OF END OF PREVIOUS STAGE OF CONSTRUCTION.
2. FLOOD CONDITIONS ASSUME POND VOLUME IS FULL TO BASE OF EMERGENCY DISCHARGE SPILLWAY IN NORTH TMF EMBANKMENT.
3. ASSUMES OVERBURDEN EXCAVATED PRIOR TO CONSTRUCTION.

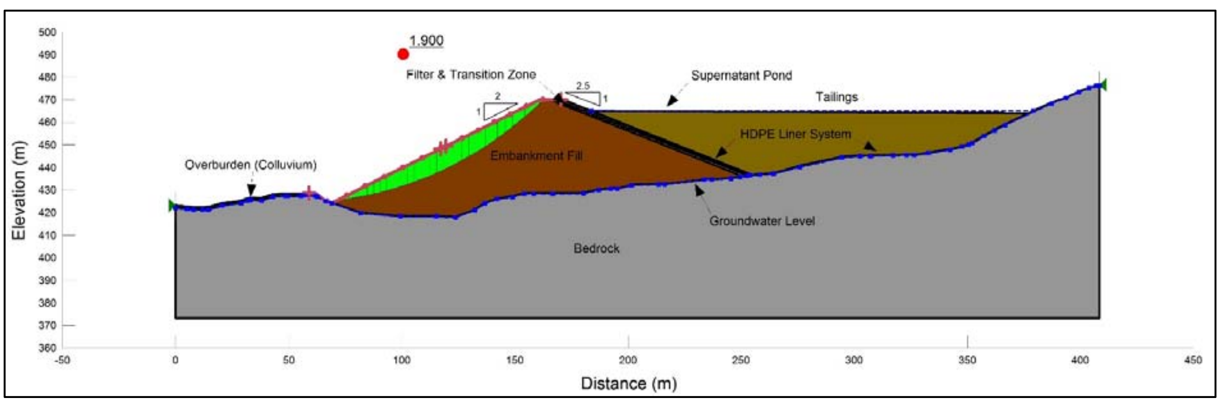


Figure 6.1 Final Long-Term Steady State Conditions (Normal Operating Conditions)

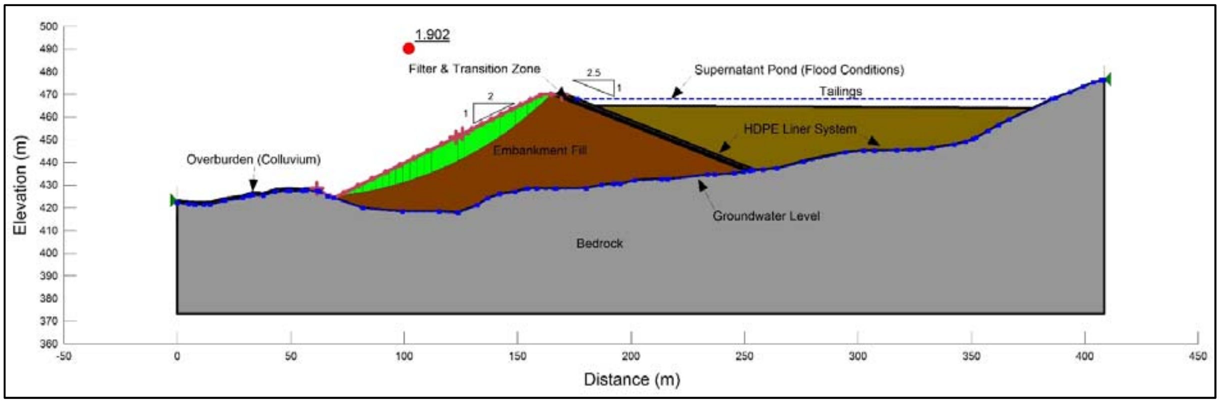


Figure 6.2 Final Long Term Steady-State Conditions (Post-Flood Conditions)

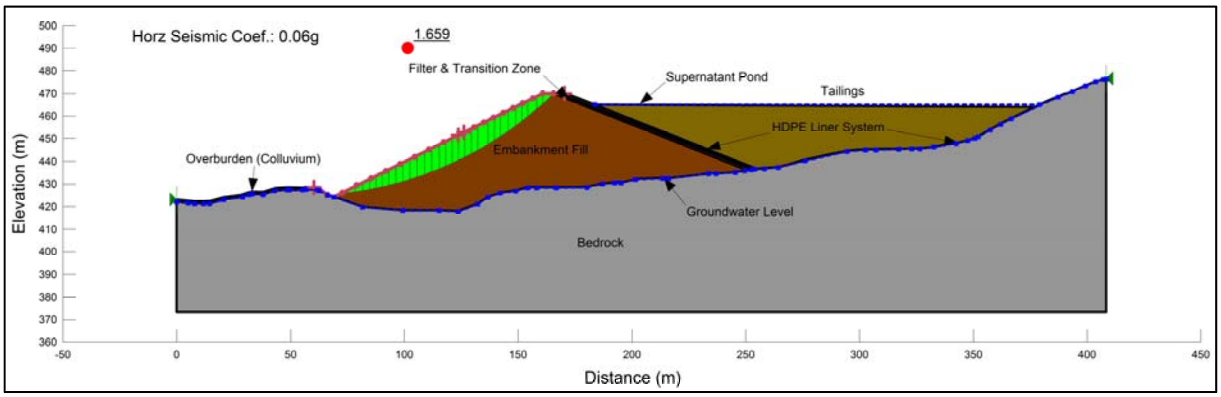


Figure 6.3 Final Pseudo-Static (MDE) Conditions (Downstream Analysis)

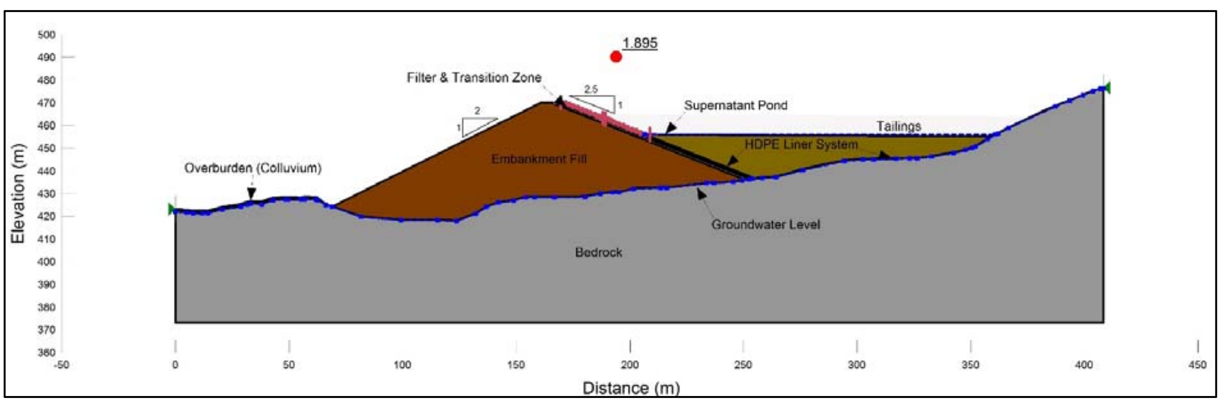


Figure 6.4 Final Short-Term Conditions (End of Stage Construction) (Upstream Analysis)

6.3 SEEPAGE ANALYSES

6.3.1 Modelling Approach

The seepage analyses assume that during the effective life of the liner system, seepage from the TMF will be limited to leakage from potential defects in the HDPE geomembrane. The upper bound estimate for leakage through the HDPE geomembrane due to defects was estimated using Bernoulli's equation for free flow through an orifice (Giroud and Bonaparte, 1989). This analysis considered one defect (2 mm diameter) per acre (~4,000 m^2) of geomembrane (Giroud and Bonaparte, 1989) having a reasonable potential to exist for various geomembrane installation methods.

The total seepage rate through the geomembrane was calculated by multiplying the results of the analysis by the surface area of the TMF, assuming that a single defect (2 mm diameter) is present for every acre of geomembrane liner (Giroud & Bonaparte, 1989).

The equation has the form:

$$Q = C_B a \sqrt{2gh_w}$$

Where:

- Q = leakage rate through geomembrane defect
- C_B = dimensionless coefficient related to shape of edges of the aperture (assumes C_B = 0.6 for sharp edges)
- a = area of hole in geomembrane (3.1 mm^2 for 2 mm diameter hole)
- g = acceleration due to gravity, and
- h_w = liquid depth on geomembrane

This equation provided an upper bound estimate for leakage through the HDPE geomembrane due to liner defects during construction, and was estimated for varying hydraulic heads of between 5 m and 30 m.

An estimate for leakage through the HDPE geomembrane due to liner defects during operations was estimated by using a more detailed SEEP/W model, devised to mimic the conditions of the Bernoulli equation, but to account for a more complex cross-section (i.e. presence of tailings mass, liner bedding material, bedrock subgrade, basin underdrain, etc.).

This model included a total hydraulic head of 5 m acting directly on the geomembrane liner, to mimic flood conditions within the TMF (i.e. the maximum allowable water level).

6.3.2 TMF Seepage Analysis

The total potential seepage through the TMF geomembrane during construction is estimated to be less than 1 L/s (1.5 US gpm) for a hydraulic head of 15 m or less acting directly on the liner (i.e. maximum allowable water level at startup). This is an upper bound estimate assuming unrestricted flow through an orifice as per Giroud & Bonaparte (1989) (i.e. does not consider the effect of liner bedding layer, tailings deposition, etc. on the analysis).

Total potential seepage through the TMF geomembrane during operations has been estimated using a more detailed SEEP/W model (i.e. a model which includes liner bedding layer, tailings deposition, geotextile presence and basin underdrain), and is estimated to be approximately 5×10^{-3} L/s. The reduction in total seepage is due to the presence of the low permeability tailings mass, and the addition of the liner bedding layer, geotextiles and basin underdrain to the model.

Foundation Drains will collect seepage through the geomembrane liner and convey this to the North TMF Embankment Seepage Collection Pond.

7 – WATER MANAGEMENT

7.1 WATER BALANCE

As discussed in Section 2.3.1, two MAP estimates were developed for the Project based on two different assessments of precipitation conditions in the Project area, which are identified as the "base case" and the "adjusted case." Water balance modelling was conducted for both precipitation cases, with precipitation values estimated for an elevation of 500 m.

- **Base case:** The MAP suggested in the *Baseline Climate and Hydrology Report* (SRK, 2017a) for elevation 1,500 masl (Mine Site Area), and then adjusted down to an elevation of 500 m based on an orographic adjustment 2.4% per 100 m elevation.
- **Adjusted case:** A MAP determined from the PRISM model for the Project area at elevation 500 m.

The details of the MAP estimates determined from the PRISM model are presented in KP Memorandum *Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs* (KP, 2017d). The same monthly distributions for precipitation, rainfall, and snowfall, as percentages of annual totals, were used for both cases.

Both precipitation cases were modelled stochastically and the water balance results were summarized in terms of mean, abnormally wet (95th percentile), and abnormally dry (5th percentile) conditions. A gamma distribution was assumed for the precipitation data in the stochastic models and a Monte Carlo simulation was executed using 10,000 iterations in GoldSim©. The estimated monthly volumes of water reporting to the proposed Project site, and the resulting effects on the water volumes in the facilities, have been presented in terms of probability of occurrence:

- **Scenario 1 – Mean**: The results correspond to TSF conditions (such as pond volumes) that have a 50% chance of being equalled or exceeded.
- **Scenario 2 – 95th Percentile (Abnormally Wet)**: The results correspond to abnormally wet TSF conditions that have a 5% chance of being equalled or exceeded (likely to be equalled or exceeded once every 20 years, on average).
- **Scenario 3 – 5th Percentile (Abnormally Dry)**: The results correspond to abnormally dry TSF conditions that have a 95% chance of being equalled or exceeded (likely to be equalled or exceeded 19 times out of 20). Alternately, they have only a 5% chance of not being equalled or exceeded.

This produced six sets of results from the water balance. The results of the mean conditions for the adjusted case were adopted as the design basis for all ponds and pump systems.

7.1.1 Results

The preliminary water balance results for both cases (base and adjusted) and all three climatic conditions considered, suggest that the site is in an annual water surplus. The water balance is sensitive to the hydrometric input assumptions, and therefore the uncertainty in the inputs should be considered when using the results for planning purposes. The input variables that have the greatest influence on the results at the Bromley Humps are the MAP and the mill process water requirements.

The monthly surplus volumes will be managed with an active water discharge scheme to prevent unscheduled surplus discharge and to maintain a manageable supernatant pond volume. The discharge is assumed to be pumped to the Water Treatment Plant (located at the Process Plant) for treatment, and then released to Bitter Creek.

The discharge rates are assumed constant each year during an eight month window from March through October, with zero discharge from November through February (i.e. discharge only during high flow conditions in Bitter Creek). For modelling purposes, the annual water discharge rates were selected to based on an estimate of the rate required to maintain a balance between inflows and outflows for average conditions.

The results of the models suggest that the TMF is expected to operate in a surplus condition and will be managed by discharging 10,200 m^3 to 44,400 m^3 per month under the base case average conditions and 30,000 m^3 to 65,000 m^3 per month under the adjusted case average conditions.

There are opportunities to further refine both the water management plan (by reviewing catchment areas contributing to the TMF and determine if additional diversions could be designed to reduce the overall areas reporting to the TMF) and the water balance during the detailed design phase of the project. A detailed water balance report is included in Appendix G.

7.1.1.1 Base Case Results

The maximum allowable volume of available water in the TMF assumes that a minimum storm storage capacity must be maintained at all times throughout the life of mine. The storm storage capacity for the TMF equates to the environmental design flood (EDF) volume (160,000 m^3).

The monthly TMF pond volume and discharge rates are shown on Figure 7.1. The pond volume, under average climatic conditions, fluctuates between a 22,000 and 280,000 m^3.

The discharge rates have been developed to ensure a balance between surplus and deficit conditions is achieved under average climatic conditions, however, further refinement is possible. It is anticipated that the pond will potentially be in a deficit condition under abnormally dry conditions in some years and in a surplus condition under abnormally wet conditions in other years.

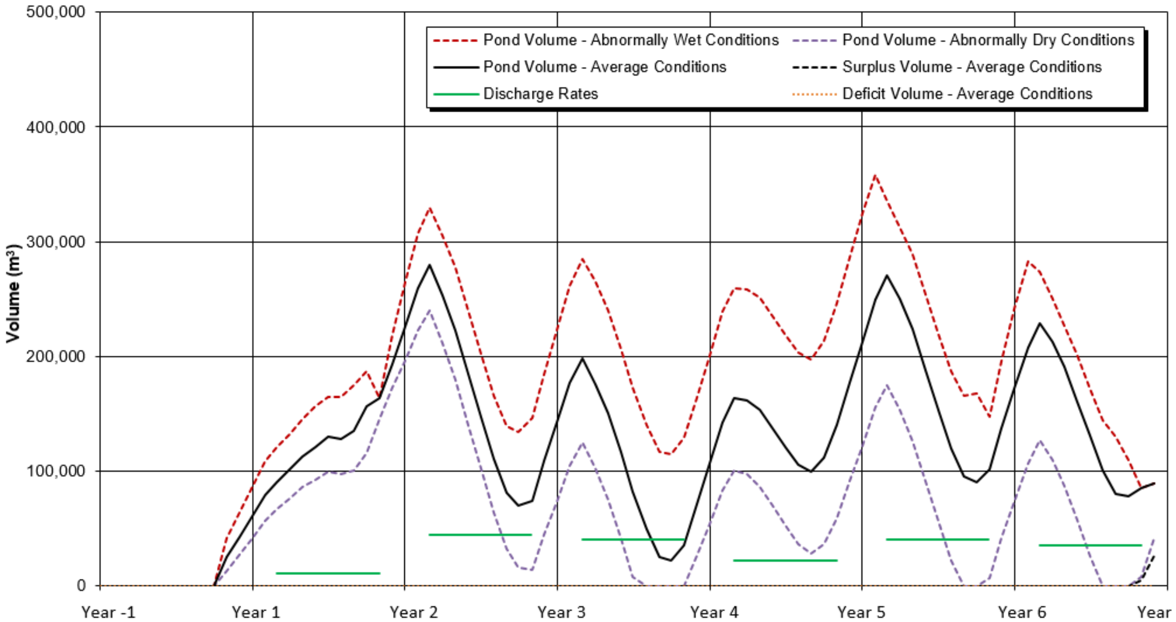


Figure 7.1 Water Balance Results - Base Case Results

7.1.1.2 Adjusted Case Results

The monthly TMF pond volume and discharge rates are shown on Figure 7.2. The pond volume, under average climatic conditions, fluctuates between 9,000 and 336,000 m^3.

The discharge rates have been developed to ensure a balance between surplus and deficit conditions is achieved under average climatic conditions, however, further refinement is possible. However, it is anticipated that the pond will potentially be in a deficit condition under abnormally dry conditions in some years. It is further anticipated that the pond will potentially be in a surplus condition under abnormally wet conditions in most years.

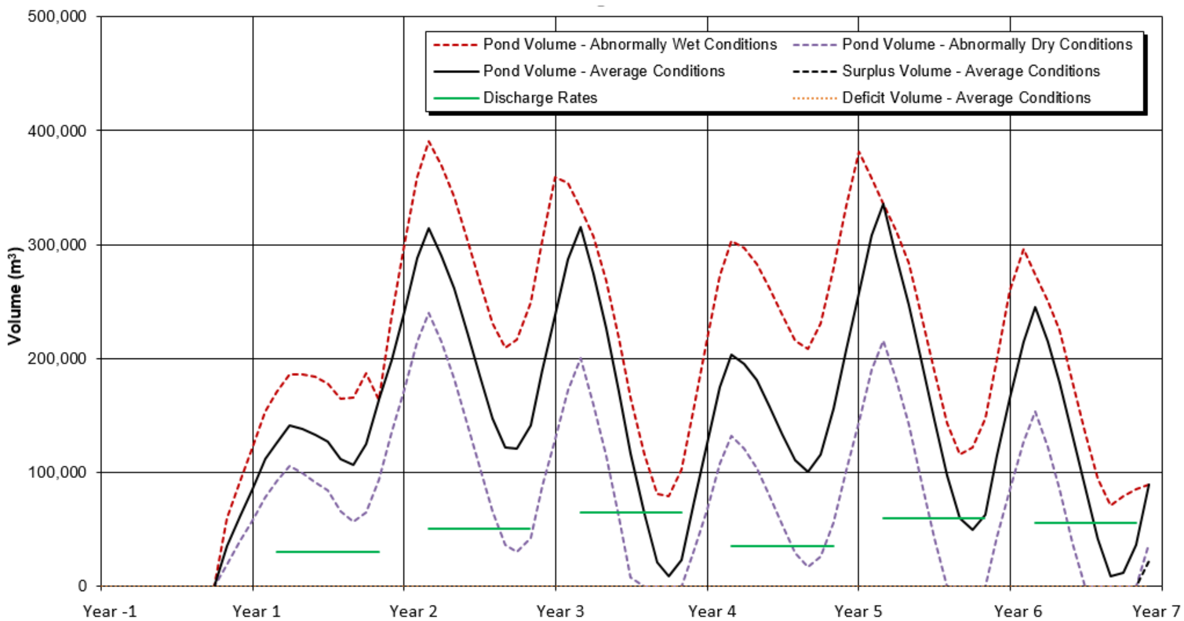


Figure 7.2 Water Balance Results - Adjusted Case Results

7.2 SITE WATER MANAGEMENT

7.2.1 General

Site water management involves the management of surface water at the Bromley Humps and Mine Site Area, during the construction, operations and closure and reclamation phases of the Project. Two types of surface water are identified for the site water management design:

- Contact water, which is impacted by mine workings or disturbed areas (groundwater inflows from the underground mine, waste rock, ore stockpile, quarry areas, tailings, laydown areas, etc.).
- Non-contact water, which is runoff from undisturbed areas.

Management of surface water will be undertaken by the construction of systems of ditches, ponds, berms, selective grading of surfaces, and pump and pipeline systems. The water management concepts and objectives are described in the sections below, and in more detail in Appendix F.

7.2.2 Design Storm Events

The design criteria for temporary and permanent general site drainage structures are:

- Temporary structure design flow event: Peak flow resulting from the 1 in 10 year, 24-hour rainfall event, or smaller with appropriate contingency measures, and
- Permanent structure design flow event: Peak flow resulting from the 1 in 200 year, 24-hour rainfall event, or smaller with appropriate contingency measures.

Design storm events and water management for the TMF are described in previous sections of this report.

7.2.3 Surface Water Collection and Diversion

Contact and non-contact water are managed separately. Contact water is contained in collection ponds and the TMF, and is transferred through collection ditches and pipelines. Non-contact water is diverted off-site through diversion ditches, berms, and culverts.

Contact runoff from site facilities is assumed to contain suspended solids due to the erosion of ground surfaces, as well as oils and grease from heavy equipment. Discharge water quality for concentrations of suspended sediment, nutrients, metals and pH levels will meet the Federal Metal Mining Effluent Regulations (MMER, 2016) and additional criteria that will be established using provincial and federal water quality guidelines.

General site drainage measures include collection and diversion structures that will be used throughout the Project site.

7.2.4 Environmental Protection Measures

Water will be controlled with the objective of minimizing erosion in areas disturbed by construction and operations and preventing the release of untreated contact water that could adversely affect the quality of receiving waters. Minimizing erosion is the primary objective, while sediment control is a mitigation that will be used as needed.

Erosion management and sediment control will be a process of stabilizing disturbed land surfaces to minimize erosion, establishing diversion and collection ditches to manage surface water runoff, constructing sediment ponds, establishing temporary vegetation covers, and re-establishing vegetation where final slopes or surfaces are created. Collected runoff and contact water will be managed in both sediment ponds and contact water collection ponds.

The Water Management Plan (WMP) addresses the potential hazards for effective management of surface water and contact runoff during construction and operations.

Installation of temporary erosion and sediment control features or BMPs will be the first step towards controlling erosion and sedimentation during construction and operations. All temporary sediment and erosion control features will require maintenance and inspection after each significant rainfall. These temporary features will be reclaimed after achieving soil and sediment stabilization. Typical sediment and erosion design elements and BMPs are described below.

7.2.5 Sediment and Erosion Control Best Management Practices

Erosion control BMPs will be implemented prior to and during construction to minimize erosion and sediment discharge into surrounding areas.

The planned BMPs are described in Appendix F and typical BMPs are shown on Drawings C006 – C008.

Erosion control BMPs will reduce erosion by stabilizing exposed soil or by reducing surface runoff flow velocities. There are generally two types of erosion control BMPs:

- Source control BMPs for protection of exposed surfaces, and
- Conveyance BMPs for control of runoff.

7.2.6 Construction Phase

Construction activities are expected to elevate total suspended solids (TSS) in runoff. Specific surface water control elements and measures will be implemented to minimize erosion and prevent sediment discharge into surrounding areas. Surface water sediment mobilization and erosion will be managed throughout the site through the implementation of a number of best management practices, described in more detail in Appendix F.

Subsurface water will be controlled by the use of sump pits, wells, or removable pumping stations to draw down the natural water table and provide dry stable construction areas. Excavations will be kept stable and workable by pumping water collected in the excavation sump pits to sediment control devices such as temporary holding ponds, sediment basins, or sediment filter bags where required. An adaptive management approach will be implemented that allows sediment and erosion control works to be field fit to suit conditions encountered during construction.

7.2.7 Mine Operations Phase

The objective of water management during operations is to protect the regional groundwater and surface water resources while meeting the project water demands for mine waste management, and providing water to the Process Plant to support processing.

The main sources of water contributing to water supply and site water management during the operations phase are as follows and are described in more detail in the Water Management Strategies Report, included in Appendix F:

- Tailings Management Facility (TMF)
- TMF Embankment Seepage Collection Ponds
- ROM Stockpile Runoff
- Process Plant Site Runoff
- Non-Contact Water Diversion Channel, and
- Borrow Pit and Quarry Sediment Ponds.

7.2.8 Closure and Reclamation Phase Water Management

The primary objectives of the closure and reclamation activities will be to return the Project area to a self-sustaining state, protecting the downstream environment and managing surface water. This will be accomplished through active and passive closure phases. Active closure is defined as the period during which water quality objectives are achieved by active management on site. Passive closure is when the site facilities have been reclaimed, water quality is suitable for release, and the final water regime reaches a steady-state.

8 – CONSTRUCTION

8.1 GENERAL

Earthworks construction activities will include foundation preparation, basin shaping and subgrade preparation, embankment fill (Zone C) placement, filter sand (Zone F) and drain gravel (Zone G) material processing and placement, installation of geosynthetics, and installation of instrumentation. Additional activities will include installation of pumps and pipelines.

The Stage 1 TMF embankments will be constructed with rockfill from the Process Plant Site, as part of plant site pad preparation activities. Materials will be provided from local borrow sources for subsequent stages of construction. The main haul road will be constructed prior to TMF embankment construction to provide access to the TMF and Process Plant site.

During construction it is anticipated that a contractor would be responsible for foundation preparation, basin shaping, liner bedding placement, embankment fill placement, geosynthetic installation, and installation of instrumentation, sumps, pumps and pipelines. It is assumed that filter sand (Zone F) and drain gravel material (Zone G) will be processed from local borrow areas and basin shaping activities or by selective crushing of excavated rock.

It is anticipated that construction of the tailings and water management facilities will take place 12 to 15 months prior to the commencement of milling (i.e. in Year -1). The Non-Contact Water Diversion Channel will be constructed first to aid in water management for the TMF construction, and as part of the TMF basin grading. Completion of the TMF embankment construction and lining will be prioritized so that the TMF can begin storing water required for mill start-up.

8.2 FOUNDATION PREPARATION

Site investigations were completed at the TMF to characterize the subsurface conditions and to estimate the foundation preparation requirements. The TMF footprint was characterized by a thin veneer of topsoil and overburden overlying bedrock to depths ranging from 0.5 m to 5 m.

The topsoil layer is typically 0.1 to 0.3 m thick, with overburden layers ranging from 0.5 m to 5 m in thickness. These units will be stripped and the topsoil stockpiled separately prior to construction, while stripped overburden will be used in embankment construction and basin shaping activities. The overburden layers are expected to be suitable for construction, while topsoil will be utilized for the TMF closure cover and reclamation of the downstream embankment faces.

8.3 BASIN SHAPING AND SUBGRADE PREPARATION

The TMF basin will be graded in preparation for the installation of the geomembrane. This includes:

- Removal of topsoil across the entire TMF footprint.
- Removal of overburden beneath the TMF embankments.
- Construction of the Non-Contact Water Diversion Channel.
- Ripping, drilling and blasting of bedrock (if required).
- Redistribution of overburden across the TMF basin floor to provide a smooth surface for geomembrane installation.
- Select placement of fill in certain areas within the basin to achieve the grades and surfaces required for the installation of the geomembrane liner.

Erosion control and dewatering measures will be implemented on an as needed basis to manage groundwater and surface water inflows into construction areas. The Foundation Drains will be installed during this phase of construction.

The TMF basin floor and slopes will be prepared for geomembrane deployment following basin shaping activities. A processed bedding layer will be placed as a cushion layer for geomembrane installation.

8.4 GEOMEMBRANE INSTALLATION

The 80-mil HDPE geomembrane will be placed over the entire basin footprint of the TMF, including the upstream embankment faces. The HDPE panels will be welded together by thermal methods. All areas to be welded will be cleaned and prepared according to approved procedures. Adequate temporary anchoring devices to prevent damage due to winds will be installed. Non-woven geotextile will be placed below and above the geomembrane as an additional cushion layer to protect the geomembrane.

The geomembrane will be placed on the fill slopes on the east and west side of the TMF basin during initial preparation of the Stage 1 TMF to an elevation above the crest of the final Stage 4 TMF embankment.

The geomembrane will be anchored into the crest of the basin shaping fill platform on the east and west side of the TMF basin, and the crest of the TMF embankments. HDPE geomembrane for subsequent embankment expansions will be welded to existing sections and anchored via anchor trenches installed in the TMF embankment crests.

A primary objective of the Quality Assurance and Quality Control (QA/QC) procedures for the geomembrane will be to minimize the potential for defects during construction. The operations and monitoring plan must also address the exposed geomembrane and identify actions required to repair any defects that occur during operations.

8.5 WATER MANAGEMENT MONITORING

During construction, the emphasis of monitoring will be on the implementation and success of mitigation at construction areas. Toward the end of construction, operation phase monitoring activities will be implemented and monitoring will shift to include the relevant aspects of operations. This will include the installation of operation phase water management facilities, milling, pre-stripping and mining of underground facilities, and the development of waste rock stockpiles.

9 – OPERATIONS AND MONITORING

9.1 GENERAL

Proper operation, monitoring and record keeping are a critical part of all tailings and water management facilities.

A TMF Operation, Monitoring and Surveillance (OMS) Manual will be prepared for the tailings and water management systems as part of the Mines Act Permit Application (MAPA). This document will be reviewed and updated on an ongoing basis. The OMS Manual will outline regular monitoring, inspection and reporting requirements. The OMS manual should be referenced for all operations and monitoring activities relating to the TMF and ancillary water control structures.

Emergency response measures in the event of upset operating conditions will be addressed in the Tailings Emergency Preparedness and Response Plan (EPRP).

General comments on operations and monitoring are provided below.

9.2 OPERATIONS

9.2.1 General

Activities to be carried out during operation of the TMF will include monitoring and commissioning of the foundation drain, basin underdrain (once a suitable tailings cover has been established), tailings discharge, seepage collection and recycle systems, and collection ponds, as well as construction/extension and management of tailings discharge pipeworks and water reclaim system.

In addition, concurrent reclamation of the downstream embankment slopes can be undertaken for all facilities following the completion of final embankment construction.

9.2.2 Tailings Distribution

Tailings slurry will be delivered at 50% solids content by weight via pump and pipeline from the mill to the TMF. Tailings will be deposited using spigot offtakes positioned on the TMF embankments. The tailings beach will be developed from selective spigot placement to push the supernatant pond to the southeast of the TMF, away from the embankments and closer to the process water tank located at the plant site.

9.2.3 Foundation Drains

The Foundation Drains will be constructed early and will become operational shortly after commencing construction of the TMF. Groundwater, meteoric water, and foundation seepage will be collected by the foundation drain and directed to the North TMF Embankment Seepage Collection Pond. Water will be recycled to the TMF from the pond.

Water quality and flowrates from the Foundation Drains will be monitored on a regular basis to monitor the effectiveness of the TMF liner.

9.2.4 Basin Underdrain

The Basin Underdrain will promote tailings consolidation while maintaining a low head on the geomembrane. Collected water will be recycled to the TMF supernatant pond via a wet well sump located in the TMF basin floor. Operation of the Basin Underdrain requires a minimum tailings cover of 2 m to be established before becoming operational. The pump will be fitted with a water level indicator to ensure a sufficient head is present within the sump prior to pumping and a flow gauge at the end of pipe will monitor flows being recycled to the TMF to confirm and assess performance of the system.

9.2.5 Water Reclaim System

Water required for processing will be reclaimed from the TMF supernatant pond throughout operations. Reclaim water will be pumped by a floating pump barge in the supernatant pond to a process water tank located at the Process Plant site, via a HDPE pipeline.

The volume of water in the supernatant pond will be managed to ensure sufficient water is available throughout periods of low flow and during winter months to maintain the reclaim rate to the mill and to monitor flows in and out of the system.

Supernatant water will be monitored for water quality to confirm it meets water treatment and environmental discharge requirements.

Flow gauges will be installed to monitor reclaim rates and to identify if any losses occur within the system.

9.3 TMF MONITORING

Extensive monitoring will be undertaken as part of the ongoing operation of the facilities. Monitoring of the TMF and ancillary works will provide important input for performance evaluation and refinement of operating practices. Complete details of the monitoring program will be included in the OMS Manual that will be prepared for the TMF. Monitoring will be conducted throughout the life of the facility including construction, operation, decommissioning and post-closure.

The proposed monitoring falls into three basic types as follows:

- General Monitoring includes items such as tailings deposition locations, checks on pipe joints and pipe integrity, performance of pumps and valves, embankment freeboard, embankment spillway performance, Non-Contact Water Diversion Channel performance and integrity, water levels in ponds, etc. Regular inspections will help identify any areas of concern that may require maintenance or more detailed evaluation. General monitoring will largely be undertaken through visual inspections carried out by designated personnel. Detailed inspection checklists, action sheets, and recording and reporting procedures will be developed for daily, weekly and monthly inspections.
- Performance Monitoring includes items such as:
  - Tailings performance monitoring.
    - Tailings solids content.
    - Tailings discharge rates.
    - Tailings slurry volumes.
    - Tailings degree of saturation.

        - Tailings beach slope.
        - Tailings level and density surveys.
    - Supernatant pond monitoring.
        - Supernatant pond volume.
        - Operational pond levels.
        - Water flow measurements.
    - TMF embankment performance monitoring.
        - Analyzing settlement gauge data.
        - Analyzing vibrating wire piezometer data.
        - Monitoring movement monuments.
        - Completing embankment surveys.
- Water quality and compliance monitoring includes items such as:
    - Ongoing baseline surface and groundwater flow and water quality sampling.
    - Supernatant water quality monitoring sampling.
    - Groundwater monitoring well sampling and testing.

A sampling and analysis plan for water quality and facility operational and closure compliance monitoring will be included in the MAPA.

The monitoring program will be used to verify the performance of the facility, to refine future embankment raise levels, and to ensure that the project is meeting all its commitments related to operating a safe and secure facility. Monitoring of the waste and water management facilities will also provide performance evaluation information that will help refine operating practices.

9.4 WATER MANAGEMENT MONITORING

The success of site water management activities is dependent on monitoring of implemented BMPs. The Contractor, Field Engineers, and Environmental Monitoring Technicians will inspect erosion control measures periodically and after each significant runoff-producing rainfall event.

Silt fences, sediment traps/basins, ditches, culverts, and sediment control ponds will be visually inspected for the following:

- Excess sediment build-up.
- Structural/physical integrity.
- Anticipated wear and tear.

Sediment removal and proper disposal will be performed as required.

Inspections to confirm that the mitigation measures identified in this document are implemented satisfactorily are as follows:

- Visual inspections to monitor the effectiveness of sediment and erosion control and runoff collection measures on a regular basis (daily or weekly as appropriate).
- Monitor treated effluent discharges on a weekly basis for key indicators (i.e., TSS and turbidity) and monthly sampling using in-situ monitoring devices (pH, temperature, specific conductivity) as well as laboratory analysis for parameters listed in the permits issued by the regulatory agencies.
- Periodically sample runoff at active construction and operations areas to monitor discharge concentrations with respect to discharge water quality permit limits.

- Recording daily and monthly water consumption.
- Monitoring of water quantity and quality will occur during dewatering activities.

Volume of water transferred will be measured on a continuous basis using appropriate flow meters. Field turbidity and TSS will be monitored daily. As data become available, a TSS and turbidity curve will be generated to manage dewatering activities. Water transferred during dewatering activities will meet a TSS or turbidity threshold similar to the MMER limit for TSS.

The following is proposed for monitoring during the operation phase:

- Recording daily and monthly water consumption.
- Regular visual monitoring of operations phase water management facilities.
- Visual inspections and monitoring of construction areas.
- Daily monitoring of the tailings discharge and the supernatant water level within the reclaim barge.
- Monitoring of effluents prior to discharge in relation to the criteria identified for various effluents.
- Underground mine inflows will be sampled to verify water quantity predictions and verify storage requirements.
- Monitoring of mine contact water discharges as prescribed by a study design developed under the MMER and/or provincial permits.

10 – RECLAMATION AND CLOSURE

10.1 GENERAL

Reclamation and closure will involve an active closure period and a post-closure period, in which all mine components will be prepared for permanent closure. Closure will be completed in a manner that will satisfy physical, chemical and biological stability, as well as follow the applicable regulatory framework.

TMF closure and rehabilitation activities will be carried out progressively during the Operations Phase (where possible) and at the end of economically viable mining. Closure and rehabilitation activities will be conducted in accordance with international closure standards. Specifically, measures will be taken to ensure that:

- Dust is not emitted from the facility as a result of moisture loss from the TMF surface.
- Runoff does not affect surface or groundwater.
- The TMF embankments remain stable.
- The stored tailings remain physically and chemically stable.

The primary objective of the closure and reclamation initiatives will be to return the TMF site to a self-sustaining condition with pre-mining usage and capability. The reclaimed TMF will be required to maintain long-term geochemical and physical stability, protect the downstream environment and shed surface water. Activities that will be carried out during Operation Phase and at closure to achieve these objectives are discussed below.

Surface facilities will be removed in stages and full reclamation of the TMF will be initiated upon mine closure. General aspects of closure will include:

- Selective discharge of tailings around the facility prior to closure to establish a final tailings beach that will facilitate surface water drainage and reclamation.
- Removal of surface water ponds and drainage of tailing waters.
- Dismantling and removal of the tailings and reclaim delivery systems and all pipelines, structures and equipment not required beyond mine closure.
- Geomembrane capping of the tailings beaches and placement of a combined rock and soil cover that will shed runoff to a permanent spillway.
- Establishment of a permanent TMF spillway through the Bromley Humps.
- Removal of the seepage collection pump-back systems at such time that suitable water quality for direct release is achieved.
- Removal and re-grading of all access roads, ponds, ditches and borrow areas not required beyond mine closure.
- Long-term stabilization and vegetation of all exposed erodible materials.

The final reclaimed TMF is shown on Figure 10.1.

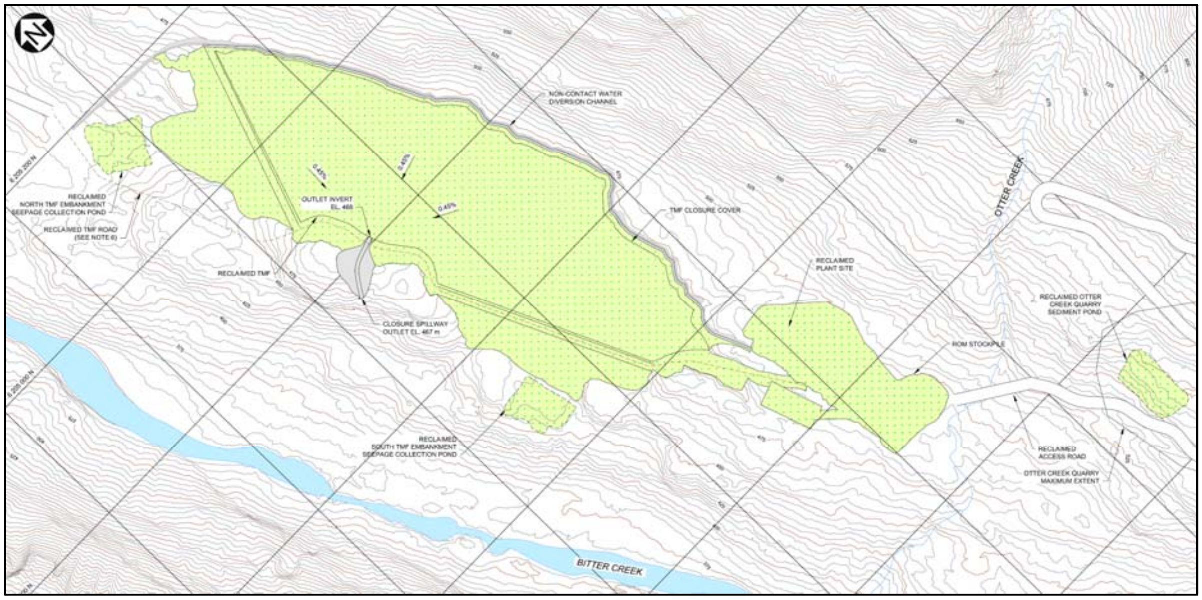


Figure 10.1 Reclaimed TMF General Arrangement

The groundwater monitoring wells and all other geotechnical instrumentation will be retained for use as long-term dam safety monitoring devices. Post-closure requirements will also include annual inspection of the former TMF and ongoing evaluation of water quality, flow rates and instrumentation records to confirm design assumptions and performance for closure.

Industry standard reclamation methods will be employed to close out the remainder of the Project sites. Hazardous materials will be collected for offsite disposal including hazardous components of vehicles and equipment (i.e., fuel tanks, gear boxes and glycol-based coolant). Buildings and equipment stripped of hazardous components will be demolished and disposed in an approved landfill, offsite. Culverts will be removed from roads and the natural drainage restored, but the roads will otherwise remain intact.

Once all buildings, facilities and equipment have been removed, the footprints (whether bedrock or pads) will be re-contoured to allow for restoration of natural drainage to the receiving environment.

10.2 POST-CLOSURE MONITORING

10.2.1 Water Management

Closure monitoring at receiving waters will be measured against water quality objectives. The following items are planned for monitoring during closure:

- Regular inspections to confirm that closure activities are being undertaken as identified in the final approved Mine Closure and Reclamation Plan
- Construction-type monitoring is undertaken during decommissioning activities, and
- TMF water quality monitoring until water quality guidelines are met.

Post-closure monitoring is expected to be required after completion of closure activities. Post-closure monitoring is expected to include:

- Water quality sampling at mine contact water discharge locations in accordance with water quality objectives.
- Final environmental effects monitoring studies in accordance with water quality objectives needed to obtain status as a recognized closed mine from Environment Canada and/or the BC Provincial Ministry of Energy and Mines.

11 – MATERIAL TAKE-OFFS

11.1 GENERAL

Material quantities for construction of the tailings and water management facilities were provided to JDS for the development of the Project cost estimate (capital costs). Operating cost estimates were calculated by JDS based on assumed manhour requirements for construction and maintenance of the tailings and water management faciltiies, including:

- Earthworks construction.
- Pump and pipeline installation.
- HDPE geomembrane liner and other geosynthetics installation.
- Pump and pipeline maintenance.
- Pump power requirements, etc.

Summaries of quantities submitted to support the development of capital, sustaining capital, operating, and closure and reclamation costs are provided in Appendix H.

11.2 CAPITAL COSTS QUANTITIES

Quantities for estimating the initial and sustaining capital costs were calculated for the following work areas:

- TMF area site preparation.
- TMF staged construction.
- Water management systems.
- Pump and pipeline systems.

Quantities were developed based on the TMF filling schedule and are provided as neat line quantities with no overlap or waste allowance included.

A detailed table of material quantities for the initial and sustaining capital costs is provided in Appendix H.

11.3 OPERATING COSTS

The quantities and power requirements were estimated to develop an annual operational cost for the TMF and water management facilities, and include the following work activities:

- Diversion channel maintenance.
- TMF and seepage collection and recycle pond operating costs (incl. pipeline maintenance, pump maintenance, and pump system operating costs).
- Water management operating costs (incl. pipeline maintenance, pump maintenance, and pump system operating costs).
- Environmental monitoring and management.
- Engineering support and reporting.
- System performance monitoring.
- Construction supervision and quality assurance.

11.4 CLOSURE AND RECLAMATION COSTS

Quantities for closure and reclamation have been estimated for the following work areas:

- Removal of pipelines and pump systems.
- Removal and drawdown of all ponds on site.
- Restoration of all water management facilities to pre-construction conditions.
- Construction of a permanent closure spillway through the Bromley Humps.
- Construction of a closure cover on the TMF to facilitate runoff from the TMF, prevent oxidation of encapsulated tailings, and facilitate passive care of the TMF (i.e. create a permanent landform that requires little to no active management).

12 – SUMMARY AND RECOMMENDATIONS

12.1 SUMMARY

The feasibility level design and quantities have been prepared for tailings and water management facilities at the Red Mountain Underground Gold Project. The feasibility design provides permanent and secure storage of thickened tailings, temporary storage during operations for process and contact water, and control of non-contact surface water.

The feasibility design is based on a projected 6 year mine life at a processing rate of 1,000 tonnes per day. The design was performed concurrently with the mine design and planning, and used the May 2017 mine plan as a design basis. A total of 1.95 million tonnes of ore will be processed over the life of mine and the tailings will be stored on surface in the Tailings Management Facility (TMF). The TMF has been designed to store 1.5 Mm^3 of tailings at a final average settled density of 1.3 t/m^3 with additional capacity for supernatant pond and an Environmental Design Flood (EDF) equivalent to the total runoff from a 1 in 50 year return event with a duration of one month plus the total runoff from a 1 in 200 year 24-hr precipitation event bypassing the Non-Contact Water Diversion Channel. Flood events exceeding the EDF will be safely passed from the facility via an Emergency Discharge Spillway located at the North TMF Embankment.

The main components of the tailings and water management systems are as follows:

- Thickened tailings slurry (50% solids content by weight) will be delivered by pipeline to the TMF.
- Tailings are anticipated to be PAG and to become ML after approx. 20 years of oxidation.
- Tailings will be discharged using spigot offtakes from the TMF embankments. The offtakes will be repositioned as necessary to develop a suitable beach, which will keep the supernatant pond away from the embankments.
- The TMF will be constructed with two rockfill/earthfill embankments to close off the natural topographic containment provided by Bromley Humps and the steep slope on the east side of the facility.
- The TMF embankments have been designed to remain physically stable under all static and seismic loading conditions as per CDA guidelines.
- The TMF has a geomembrane liner to minimize seepage and ML/ARD generation. The liner comprises 80 mil HDPE geomembrane sandwiched between protective layers of a 12 oz/yd^2 non-woven geotextile.
- Foundation Drains will be constructed beneath the TMF to collect groundwater flow and potential seepage through the geomembrane and deliver it to the North TMF Embankment Seepage collection and recycle pond.
- A Basin Underdrain system will be constructed above the geomembrane on the basin floor in the TMF to promote tailings consolidation while minimizing the head acting on the geomembrane.
- A reclaim water system consisting of a floating pump barge and a HDPE pipeline will be installed in the TMF supernatant pond and will deliver water to the Process Water Tank at the mill for use in processing.
- A water balance model developed for the TMF has indicated that the TMF will operate at a net water surplus during all years of operation. A pipeline and pump system installed on the reclaim barge will recycle surplus supernatant pond water to the Water Treatment Plant at the Process Plant Site for treatment and discharge to the environment.

- Surplus water will be treated and discharged to Bitter Creek from the Water Treatment Plant at a rate of between 10,200 m^3 and 44,400 m^3 per month under base case average conditions, and between 30,000 m^3 and 65,000 m^3 per month under adjusted case average conditions.
- Instrumentation will be installed for all embankments which includes survey monuments, vibrating wire piezometers, slope inclinometers, and vibrating wire settlement gauges. The instrumentation will be monitored as part of the detailed monitoring plans to be developed for the TMF.
- The primary objective of reclamation and closure activities will be to ensure physical and chemical stability of the TMF and ensure acceptable downstream water quality is maintained. Closure and reclamation will focus on removal of surface infrastructure and covering all exposed tailings surfaces. Additional closure work will involve progressive reclamation and revegetation of the embankments and any other disturbed surfaces.
- Construction quantities have been provided for the tailings and water management facilities. The quantities were measured on the basis of the designs and dimensions shown on the relevant drawings in this report and are provided as neat-line quantities with no waste or overlap.

12.2 RECOMMENDATIONS

Recommendations for the next phase of engineering for the project (Mines Act Permit Application) are summarized below:

- Continue collection of site specific meteorological and hydrology data. This data will be used to refine seasonal runoff values and design storms.
- Optimize the water balance to incorporate updated runoff and process flow estimates.
- Complete additional site investigations to support the next phase of design and to comply with updated regulatory requirements.
- Tailings materials and properties should be reviewed during the next phase of design to be sure they are representative, especially if any changes to the process occur. Representative tailings samples should be provided and tested if they become available.
- Develop an Operations, Monitoring and Surveillance (OMS) Manual and Emergency Preparedness and Response Plan (EPRP) for the tailings and water management systems based on final designs and operating criteria.
- Develop a full closure plan for the tailings and water management facilities based on the final design configuration.
- Advance all design concepts to detailed design level in line with the expectations and requirements of the Joint Application Information Requirements for Mines Act Permit and Environmental Management Act Permit Applications.

13 – REFERENCES

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14 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

<Original signed by>

Prepared: ____________________
Jim Fogarty, P.Eng.
Project Engineer

<Original signed by>

Reviewed: ____________________
Ken Embree, P.Eng.
Managing Principal

Approval that this document adheres to Knight Piésold Quality Systems:

APPENDIX A

DESIGN BASIS

(Pages A-1 to A-3)

Knight Piésold CONSULTING

TABLE A.1

IDM MINING INC.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS AND WATER MANAGEMENT FACILITIES
DESIGN BASIS AND OPERATING CRITERIA

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ITEM		DESIGN CRITERIA	SOURCE
1.0	GENERAL		
1.1	Project Location	Northwestern British Columbia, 18 km east of the town of Stewart. Project is located adjacent to the Cambria Ice Field and the Bromley Glacier on provincial crown land within the Regional District of Kitimat-Stikine.	Red Mountain Gold Project Description July 2015 (IDM Mining Ltd., 2015)
1.2	Site Coordinates	UTM Coordinates 452,450 E and 6,250,325 N (Zone 9 NAD 83) ; 55º59′04″ N, 129°45′37″ W	Preliminary Economic Assessment Report - Red Mountain Gold Project (JDS Energy & Mining Ltd., 2016)
1.3	Mine Site (Alpine) Elevation	Ranging 1,500 to 2,000 masl	
1.4	Tailings Management Facility Elevation (Bromley Humps)	Ranging 400 to 500 masl	2016 Geotechnical Site Investigation Program Factual Data Report (Knight Piésold Ltd., 2016)
1.5	Plant Site Elevation	Approximately 490 masl.	
1.6	Codes and Standards	Health Safety and Reclamation Code for Mines in British Columbia (2017), Mines Act (RSBC 1996), ASTM, CDA Dam Safety Guidelines (2013 & 2014) and related codes.	Knight Piésold Ltd.
1.7	Climate	Mean Annual Precipitation (Elevation 500 masl) = between 1457 mm/yr and 2084 mm/yr	Knight Piésold Ltd.
		Average Annual Snowfall (Elevation 500 masl) = between 138 mm/yr and 194 mm/yr snow water equivalent (SWE)	Knight Piésold Ltd.
		Runoff coefficients vary over mine site: - Undisturbed area = 0.7 - Disturbed areas = 0.9 - TMF beaches = 0.75 - Stockpiles = 0.7 - Embankments = 0.8	Knight Piésold Ltd.
1.8	24-hour Rainfall Events (Bromley Humps Area)	1 in 2 year 24-hour rainfall = 67 mm	Knight Piésold Ltd., SRK (2016)
		1 in 10 year 24-hour rainfall = 101 mm	
		1 in 50 year 24-hour rainfall = 130 mm	
		1 in 100 year 24-hour rainfall = 142 mm	
		1 in 200 year 24-hour rainfall = 151 mm	
		Probable Maximum Precipitation (PMP) = 530 mm	
		Probable Maximum Flood (PMF) = 50.5 m^3/s	Knight Piésold Ltd., CDA (2013), SRK (2016), BC MOEM (2016)
1.9	Snowpack and Snowmelt	Average monthly maximum snowmelt and mean monthly snowpack depth modelled by SRK.	Snowmelt Analysis Memo (SRK, 2016)
2.0	TAILINGS PRODUCTION		
2.1	Mine Production	Total Ore Milled = 1.95 Million tonnes	JDS Energy & Mining Inc.
		Mill throughput = 1,000 tpd	JDS Energy & Mining Inc.
		Mine Life = 6 years	JDS Energy & Mining Inc.
		Year -1 = 3,000 tonnes, Year 1 = 322,000 tonnes, Year 2 = 366,000 tonnes, Year 3 = 366,000 tonnes, Year 4 = 366,000 tonnes, Year 5 = 366,000 tonnes, Year 6 = 158,000 tonnes.	JDS Energy & Mining Inc.
		Tailings are Potentially Acid Generating (PAG)	SRK Consulting Inc.
		Subaqueous disposal of tailings to control the acid generating potential of the tailings.	Knight Piésold Ltd.
3.0	WATER MANAGEMENT		
3.1	Water Management Objectives	Utilise water within the project area to the maximum extent with zero untreated contact water discharged from site under normal operating conditions.	Knight Piésold Ltd.
		Divert undisturbed area runoff around the site as much as practical	Knight Piésold Ltd.
		Diversion ditches and collection ponds sized for the 1 in 200 year 24-hr precipitation event.	Knight Piésold Ltd.
		Minimize surface disturbances using staged construction and maximize concurrent reclamation	Knight Piésold Ltd.
		Collect seepage through and beneath the TMF embankments and runoff from the embankments	Knight Piésold Ltd.
		Collect and recycle runoff from disturbed areas or evaporate	Knight Piésold Ltd.
		Maximize recycle of water from TMF pond for process water	Knight Piésold Ltd.
3.2	TMF Supernatant Pond	Collects water from mill process, ROM collection pond, seepage collection ponds for recycle, undiverted runoff, and diversion ditch leakage.	Knight Piésold Ltd.
		TMF basin to be lined with a HDPE geomembrane.	Knight Piésold Ltd.
		Water pumped to mill for reclaim, with surplus to water treatment if required.	Knight Piésold Ltd.
		Sized to contain 100% of tailings, plus tailings bleed water (i.e. water in tailings) and precipitation up to the EDF.	Knight Piésold Ltd.
		Overflow discharge to emergency spillway in the event of large flood event exceeding the EDF for TMF.	Knight Piésold Ltd.
3.3	Seepage Collection and Recycle Pond (North)	Collects water from TMF North embankment, TMF Foundation Drain and undiverted runoff.	Knight Piésold Ltd.
		Sized to contain runoff and precipitation from the 1 in 200 year 24 hr precipitation event.	Knight Piésold Ltd.
		Impoundment will be unlined to allow seepage to infiltrate into pond.	Knight Piésold Ltd.
		Water pumped to TMF to be reclaimed in mill, with surplus directed through TMF to water treatment, if required.	Knight Piésold Ltd.
		Overflow discharge to diversion ditch in emergency.	Knight Piésold Ltd.
3.4	Seepage Collection and Recycle Pond (South)	Collects water from TMF South embankment and undiverted runoff.	Knight Piésold Ltd.
		Sized to contain runoff and precipitation from the 1 in 200 year 24 hr precipitation event.	Knight Piésold Ltd.
		Impoundment will be unlined to allow seepage to infiltrate into pond.	Knight Piésold Ltd.
		Water pumped to TMF to be reclaimed in mill, with surplus directed through TMF to water treatment, if required.	Knight Piésold Ltd.
		Overflow discharge to Bitter Creek in emergency.	Knight Piésold Ltd.
3.0	WATER MANAGEMENT		
3.5	ROM Collection Pond	Collects water from ROM stockpile and undiverted runoff.	Knight Piésold Ltd.
		Sized to contain runoff and precipitation from the 1 in 200 year 24 hr precipitation event.	Knight Piésold Ltd.
		Pond will be lined to prevent contaminating groundwater.	Knight Piésold Ltd.
		Water pumped to mill as reclaim or pumped to TMF supernatant pond.	Knight Piésold Ltd.
		Overflow discharge to TMF.	Knight Piésold Ltd.
3.6	Alpine Area Lower Portal and Runoff Collection Pond	Collects water from upper portal (if required) and lower portal.	Knight Piésold Ltd.
		Sized to contain runoff and precipitation from the 1 in 200 year 24 hr precipitation event.	Knight Piésold Ltd., BC MoE (2015)
		Retention ponds will be lined with HDPE geomembrane. Sediment ponds will be unlined.	Knight Piésold Ltd.
		Water discharged to environment, through water treatment, if required.	Knight Piésold Ltd.
		Overflow discharge to Goldslide Creek in emergency.	Knight Piésold Ltd.

Knight Piésold CONSULTING

TABLE A.1

IDM MINING INC.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS AND WATER MANAGEMENT FACILITIES
DESIGN BASIS AND OPERATING CRITERIA

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ITEM		DESIGN CRITERIA		SOURCE
3.0	WATER MANAGEMENT			
3.7	Borrow Pit and Quarry Sediment Ponds	Runoff from the talus quarry, stockpiles, and laydown areas will be collected in local sediment ponds or retention ponds, and then released to Goldslide Creek.		Knight Piésold Ltd.
		Sized to contain runoff and precipitation from the 1 in 200 year 24 hr precipitation event.		Knight Piésold Ltd., BC MoE (2015)
		Design discharge flow from sediment ponds for removal of suspended solids corresponds to hydrograph from the 1 in 10 year precipitation event.		Knight Piésold Ltd., BC MoE (2015)
		Minimum effective depth of 1.5 m above level of stored sediments.		Knight Piésold Ltd., BC MoE (2015)
		Minimum freeboard of 500 mm during flood events.		Knight Piésold Ltd., BC MoE (2015)
		Water discharged to environment, through water treatment, if required.		Knight Piésold Ltd.
3.8	Non-Contact Water Diversion Channel	Collects non-contact water from catchment on eastern side of TMF and diverts around TMF.		Knight Piésold Ltd.
		Designed for the 1 in 5 year precipitation peak flood flow.		Knight Piésold Ltd.
		Flows exceeding design flood flows will report to the TMF.		Knight Piésold Ltd.
		Lined with riprap or concrete, as required.		Knight Piésold Ltd.
4.0	TAILINGS MANAGEMENT FACILITY			
4.1	Function	Secure long term storage of approximately 2 Mt of tailings and associated water management.		Knight Piésold Ltd., JDS Energy & Mining Inc.
4.2	Concept	An earth/rockfill embankment constructed using the downstream method of construction using borrow materials from a local borrow. The impoundment and upstream faces of the embankments will be lined with a geomembrane liner to minimize seepage of tailings water into the surrounding area.		Knight Piésold Ltd.
		Filter zones included in embankment design to provide bedding for the geomembrane liner and prevent the migration of finer particles downstream. Suitable sub-base bedding layer beneath the geomembrane liner in the impoundment to provide drainage and prevent damage to the liner.		Knight Piésold Ltd.
4.3	Operational Criteria	Mill throughput (tailings production rate): 1,000 tpd		JDS Energy & Mining Inc.
		Runoff from storm events not exceeding the EDF contained within tailings impoundment. Return periods exceeding the EDF safely conveyed from TMF through emergency discharge spillway.		Knight Piésold Ltd.
		Available water from TMF recycled to mill to the maximum extent possible for use in the process of tailings.		Knight Piésold Ltd.
4.4	Closure Criteria	The downstream slope of the embankment will be reclaimed with topsoil and revegetated.		Knight Piésold Ltd.
		Tailings pond will be drawn down and tailings shaped with rockfill and covered by a geomembrane liner. A soil cover will be placed on top to provide a surface for revegetation of the reclaimed TMF. Seepage collection and treatment systems will be maintained after closure until such point that water quality is at acceptable levels.		Knight Piésold Ltd.
4.5	Dam Hazard Classification Consequence Category	The TMF has a VERY HIGH classification as defined by the Canadian Dam Association (CDA) "Dam Safety Guidelines" (2013) and "Application of Dam Safety Guidelines to Mining Dams" (CDA, 2014).		Knight Piésold Ltd.
4.6	Seismic Design Criteria	1 in 100 year return period event = 0.011g		NRCAN Seismic Hazard Rating (NRCAN, 2015)
		1 in 500 year return period event = 0.029g		NRCAN Seismic Hazard Rating (NRCAN, 2015)
		1 in 1,000 year return period event = 0.041g		NRCAN Seismic Hazard Rating (NRCAN, 2015)
		1 in 2,475 year return period event = 0.064g		NRCAN Seismic Hazard Rating (NRCAN, 2015)
		1 in 10,000 year return period event = 0.12g		NRCAN Seismic Hazard Rating (NRCAN, 2015)
		Operating Basis Earthquake (OBE) (1/2 between 1 in 2,475 year and 1 in 10,000 year return period events) = 0.092g		Knight Piésold Ltd.
		Maximum Design Earthquake (MDE) (1 in 10,000 year return period event or Maximum Credible Earthquake (MCE)) = 0.120g		Knight Piésold Ltd.
4.7	Storage Capacity	Tailings Solids plus Total Water: 1.50 Mm^3		Knight Piésold Ltd., JDS Energy & Mining Inc.
4.8	Tailings Properties	Tailings Initial Settled Dry Density = 1.21 t/m^3		Knight Piésold Ltd.
		Tailings Final Settled Dry Density = 1.30 t/m^3		Knight Piésold Ltd.
		Whole Ore Leach Tailings	100% of total tailings throughput	JDS Energy & Mining Inc.
			50% solids content by weight	JDS Energy & Mining Inc., Knight Piésold Ltd.
4.9	Environmental Design Flood (EDF)	EDF specified as the largest design flood event that can be stored safely within the facility, typically 1 in 50 to 1 in 200 year event.		Knight Piésold Ltd., CDA (2013), SRK (2016), BC MOEM (2016)
		EDF = 1 in 50 year wet month total direct precipitation on TMF in addition to 1 in 200 year 24 hr precipitation event across entire TMF catchment.		Knight Piésold Ltd.
		TMF Footprint Area = 13 ha		Knight Piésold Ltd.
		TMF Catchment Area = 125 ha		Knight Piésold Ltd.
		EDF Volume = (1 in 50 year wet month x TMF Footprint) + (1 in 200 year 24 hr precipitation event x TMF Catchment Area) = 160,000 m^3		Knight Piésold Ltd.
4.10	Inflow Design Flood (IDF)	Probable Maximum Flood (PMF) be modeled in HydroCAD using the 24 hour PMP and up to 1/100 year available snow accumulation.		Knight Piésold Ltd., CDA (2013), SRK (2016), BC MOEM (2016)
		TMF Flood Catchment Area = approximately 125 ha		Knight Piésold Ltd.
		IDF Volume = PMF x Catchment Area = 889,000 m^3		Knight Piésold Ltd.
4.11	Design Freeboard	Sufficient freeboard to accommodate a portion the IDF above maximum supernatant pond level at each stage plus 2 meter allowance for wave run-up protection, ice depth, seismic settlement and emergency discharge spillway depth.		Knight Piésold Ltd.
4.12	Dam Crest	Dam crest width: minimum 10 m between safety berms for one-way haul truck access		Knight Piésold Ltd.
4.13	Seepage and Runoff Control Measures	Seepage will be primarily controlled through the use of a HDPE geomembrane liner in TMF basin.		Knight Piésold Ltd.
		A system of collection ditches, ponds and pumpback systems downstream of embankments will collect runoff from the TMF.		Knight Piésold Ltd.
		Foundation drain and basin underdrain systems will be installed to promote consolidation of the tailings mass and reduce pore pressures acting on the geomembrane liner.		Knight Piésold Ltd.
		Water collected from seepage and runoff collection systems and from the foundation drain system will be recycled to the TMF supernatant pond.		Knight Piésold Ltd.
4.14	Embankment Slopes	Embankment slopes constructed to a maximum slope of 2.5H:1V on the upstream side to facilitate geomembrane installation and 2H:1V on the downstream side for reclamation purposes and to achieve the minimum required Factors of Safety (FOSmin) for static and seismic loading conditions.		Knight Piésold Ltd.
4.15	Embankment Stability	End of construction (started dam and dam raises)	FOS_{min} = 1.5	CDA (2007, 2013)
		Long term (at closure)	FOS_{min} = 1.5	CDA (2007)
		Seismic (Pseudo-static loading conditions)	FOS_{min} = 1.0	CDA (2007)
		Seismic (Post-earthquake; full liquefaction of tailings)	FOS_{min} = 1.2	CDA (2013)

Knight Piésold CONSULTING

TABLE A.1

IDM MINING INC.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS AND WATER MANAGEMENT FACILITIES
DESIGN BASIS AND OPERATING CRITERIA

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ITEM		DESIGN CRITERIA	SOURCE
4.0	TAILINGS MANAGEMENT FACILITY		
4.16	Starter (Stage 1) Dam	Stage 1 starter dam sized to provide approximately 12 months of tailings storage and sufficient water during construction to commence operations. Starter dam crest elevation 454 m.	Knight Piésold Ltd.
4.17	Staged Expansion Construction Method	Stage 2 embankment raise during first year of operations.	Knight Piésold Ltd.
		TMF embankments progressively raised during operations.	Knight Piésold Ltd.
		Downstream construction method.	Knight Piésold Ltd.
4.18	Dam Fill Materials	HDPE liner on upstream face of dam and TMF Basin.	Knight Piésold Ltd.
		Filter, transition and bedding zones (Zones F and T) - Processed material from borrow/quarry sources.	Knight Piésold Ltd.
		Shell zone material (Zone C) - Local quarried/borrow material.	Knight Piésold Ltd.
5.0	TAILINGS DISTRIBUTION AND RECLAIM SYSTEMS		
5.1	Tailings Stream	Tailing design production rate (tph) = 42 (1,000 tpd)	JDS Energy & Mining Inc.
		Tailings specific gravity of solids = 3.0 (Marc Zone Tailings) - 3.1 (AV Zone Tailings)	Knight Piésold Ltd.
		Tailings percent solids (%) = 50% (wt/wt)	JDS Energy & Mining Inc., Knight Piésold Ltd.
		Plant Availailability = 90%	JDS Energy & Mining Inc.
5.2	Tailings	Single stream discharge of whole ore leach tailings material from Process Plant 'tailings pump box'.	Knight Piésold Ltd.
		One overland, pressure tailings delivery pipeline along embankment crests. Pipeline capacity = 100% tailings production rate.	Knight Piésold Ltd.
		Tailings discharge spigots at typical spacing along TMF embankments.	Knight Piésold Ltd.
		Tailings pipeline pressure surge capacity = 20%	Knight Piésold Ltd.
		Tailings pipeline specification - HDPE, PE4710, maximum pressure rating DR21, minimum pressure rating DR9. Steel to be used only if required when pressure exceeds 250psi. Steel schedule to be selected based on pressure performance requirement.	Knight Piésold Ltd.
		Gravity discharge of tailings possible in early years and tailings pump system required in later years.	Knight Piésold Ltd.
5.3	Reclaim	Single overland reclaim delivery pipeline from TMF to Process Plant.	Knight Piésold Ltd.
		Reclaim pump - floating barge with two pump trains (one pump train for process water reclaim, one pump train for surplus water removal) and standby pump train in case of system shutdown.	Knight Piésold Ltd.
		Reclaim pump design flowrate = 100% of tailings water requirements.	Knight Piésold Ltd.
		Reclaim pump flowrate variability: no variable frequency drive in system.	Knight Piésold Ltd.
		Reclaim pipeline discharge flange connection elevation: 500 m (Process Plant pad elevation + assumed 10 m for water tank).	Knight Piésold Ltd.
		Reclaim pipeline specification - HDPE, PE4710, maximum pressure rating DR21, minimum pressure rating DR9. Steel to be used only if required when pressure exceeds 250psi. Steel schedule to be selected based on pressure performance requirement.	Knight Piésold Ltd.
		Reclaim pipeline alignment adjacent to access/maintenance roads where available.	Knight Piésold Ltd.
		Reclaim pipeline pressure surge capacity = 20%	Knight Piésold Ltd.
6.0	INSTRUMENTATION AND MONITORING		
6.1	Geotechnical Instrumentation and Monitoring	Vibrating wire piezometers to measure pore water pressure in main dam and tailings	Knight Piésold Ltd.
		Pond level indicator in TMF supernatant pond	Knight Piésold Ltd.
		Inclinometers as required	Knight Piésold Ltd.
		Water management pond inflow weirs	Knight Piésold Ltd.
		Survey and surface movement monitoring monuments	Knight Piésold Ltd.
		Wick drains installed in tailings mass, if required, to increase drainage and further promote consolidation.	Knight Piésold Ltd.
		Flow monitoring for embankment and foundation drains	Knight Piésold Ltd.
7.0	CLOSURE OBJECTIVES OF TAILINGS AND WATER MANAGEMENT FACILITIES		
7.1	Physical Stability	Ensure long-term physical stability to protect public safety and reduce erosion and downstream sedimentation. - Remaining structures, such as TMF, will be physically stable in the long-term, in accordance with Section 10.7.6 of the BC Mining and Reclamation Code. - All spillways will be designed by a professional engineer in accordance with the CDA Dam Safety Guidelines, and installed prior to final abandonment of the TMF (Section 10.6.10). - Monitoring will be undertaken to demonstrate that reclamation and environmental protection objectives, including stability of structures, are being achieved (Section 10.7.21).	Knight Piésold Ltd.
7.2	Chemical Stability	Ensure long-term chemical stability of the tailings by achieving applicable water quality standards in the receiving environment (Section 10.7.20). - Prediction will be completed on potential metal leaching (ML) and/or acid rock drainage (ARD) materials (Section 10.1.16) to compile a material inventory of ML/ARD to be submitted to the chief inspector (10.5.7). - ML/ARD material will be stored, segregated, and/or removed from the TMF to ensure chemical stability. - Monitoring will be undertaken to demonstrate that reclamation and environmental protection objectives, including water quality, are being achieved (Section 10.7.21).	Knight Piésold Ltd.
7.0	CLOSURE OBJECTIVES OF TAILINGS AND WATER MANAGEMENT FACILITIES		
7.3	Future Use & Aesthetics	Create a final landform capatible with the surrounding landscape and consistent with the agreed upon post-closure land use. - The endpoint for land capability at closure is either not less than the average that exisited prior to mining (Section 10.7.5), or will be reclaimed to an end land use approved by the chief inspector (Section 10.7.4). The TMF will be reclaimed in a manner consistent with adjacent landforms (Section 10.7.9) and to the approved land use (Section 10.7.4). - Lands (including the TMF) will be revegetated to a self-sustaining state using appropriate plant species (Section 10.7.7), and growth mediums used will statisfy land use, capability and water quality objectives (Section 10.7.8). - All machinery, equipment and building superstructures will be removed, concrete foundations covered and revegetated, and scrap material disposed of in a manner acceptable to an inspector (Section 10.7.10). - Monitoring will be undertaken to demonstrate that reclamation and environmental protection objectives, including land use, and productivity, are being achieved (Section 10.7.21).	Knight Piésold Ltd.

\\KPL\VA-Prj$\1\01\00594\04\A\Report\4 - Feasibility Design Report\Rev 0\Appendices\Appendix A - Design Basis Table\[Table A1 - Design Basis_r0.xlsx]Design Basis

0	30JUN'17	ISSUED FOR INFORMATION	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	CHK'D

APPENDIX B

DESIGN DRAWINGS

(Pages B-1 to B-30)

RED MOUNTAIN PROJECT - BROMLEY HUMPS TMF		
NO. OF DRAWINGS	DRAWING NOS	TITLE
	000	**GENERAL CIVIL**
7	G001	COVER SHEET
	G002	INDEX SHEET
	G003	OVERALL SITE PLAN
	G004	CONSTRUCTION MATERIAL SPECIFICATIONS
	G006	SEDIMENT AND EROSION CONTROL - TYPICAL SECTIONS AND DETAILS - SHEET 1 OF 3
	G007	SEDIMENT AND EROSION CONTROL - TYPICAL SECTIONS AND DETAILS - SHEET 2 OF 3
	G008	SEDIMENT AND EROSION CONTROL - TYPICAL SECTIONS AND DETAILS - SHEET 3 OF 3
	100	**SITE WATER COLLECTION AND PUMPING SYSTEMS**
7	C101	WATER MANAGEMENT STRUCTURES - PLAN
	C103	NON-CONTACT WATER DIVERSION CHANNEL - PLAN AND PROFILE
	C104	NON-CONTACT WATER DIVERSION CHANNEL - SECTION AND DETAILS
	C105	NORTH TMF EMBANKMENT SEEPAGE COLLECTION POND - PLAN AND SECTIONS
	C106	SOUTH TMF EMBANKMENT SEEPAGE COLLECTION POND - PLAN AND SECTIONS
	C107	MINE SITE WATER MANAGEMENT STRUCTURES - PLAN
	C108	BORROW AND QUARRY WATER MANAGEMENT STRUCTURES - PLAN
	200	**TAILINGS MANAGEMENT FACILITY**
11	C201	GENERAL ARRANGEMENT - STARTUP CONSTRUCTION END OF YEAR - 1
	C202	GENERAL ARRANGEMENT - STAGE 1 END OF YEAR 1
	C203	GENERAL ARRANGEMENT - STAGE 2 END OF YEAR 3
	C204	GENERAL ARRANGEMENT - STAGE 3 END OF YEAR 5
	C205	GENERAL ARRANGEMENT - STAGE 4 END OF YEAR 6
	C206	GENERAL ARRANGEMENT - CLOSURE PLAN
	C207	TMF EMBANKMENTS - SECTIONS AND DETAILS
	C208	TMF BASIN UNDERDRAIN - PLAN
	C209	TMF FOUNDATION DRAIN - PLAN
	C210	TMF BASIN UNDERDRAIN AND FOUNDATION DRAIN - SECTIONS AND DETAILS
	C213	TMF EMBANKMENT - PROFILES
	C214	SITE GRADING - PLAN
	C215	SITE GRADING - SECTIONS AND DETAILS
	300	**MECHANICAL**
3	M301	TAILINGS RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEMS - PIPING AND INSTRUMENTATION DIAGRAM
	M310	TAILINGS RECLAIM AND SURPLUS WATER MANAGEMENT - STAGE 1 PLAN AND PROFILE
	M311	TAILINGS RECLAIM AND SURPLUS WATER MANAGEMENT - STAGE 4 PLAN AND PROFILE

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COVER SHEET

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SECTIONAL VIEW AND DETAIL IDENTIFICATION

SECTION OR DETAIL APPEARS ON THE SAME DRAWING:

SECTION AND DETAIL IDENTIFICATION

1 - **SECTION** SUB-TITLE SCALE A

A - **DETAIL** SUB-TITLE SCALE A

SECTION OR DETAIL APPEARS ON A DIFFERENT DRAWING:

SECTION AND DETAIL IDENTIFICATION

1 XXXXX **SECTION** SUB-TITLE SCALE A

A XXXXX **DETAIL** SUB-TITLE SCALE A

SECTION LOCATION ARROWS

SECTION OR DETAIL IS LOCATED ON THE SAME DRAWING

OR, SECTION OR DETAIL APPEARS ON A DIFFERENT DRAWING

SEE BELOW FOR DEFINITION

CHANGE IN CUTTING PLANE

OR,
WHEN SECTION IS OBVIOUS AND/OR SPACE IS LIMITED

XXX =	"C2110"	NUMBER REFERS TO THE DRAWING FROM WHICH THE SECTION OR DETAIL IS CALLED UP IN DIFFERENT FACILITY.

DETAIL REFERENCE

LOCATED AND IDENTIFIED THUS, THE DETAIL ENLARGEMENT WILL BE IN THE SAME ATTITUDE AND POSITION RELATIVE TO THE DRAWING AS THE PART CIRCLED.

THIS IS A REFERENCE ONLY, TO A DETAIL WHICH, IN ITS ENLARGED FORM, MAY OR MAY NOT BE IN THIS PARTICULAR ATTITUDE. IT WILL, HOWEVER, CONTRIBUTE SOME ADDITIONAL PERTINENT INFORMATION TO THIS VIEW.

LEGEND

- OVERBURDEN
- MINIMUM EXCAVATION LINE
- APPROX. (OR ASSUMED) ROCK SURFACE
- HDPE GEOMEMBRANE (SECTION)
- GEOTEXTILE
- HDPE GEOMEMBRANE (PLAN)
- ZONE F - FILTER SAND
- ZONE G - DRAIN GRAVEL
- EMBANKMENT FILL
- WATER
- FILL SLOPE SYMBOL
- CUT SLOPE SYMBOL
- FLOW DIRECTION
- W.L. EL. XXX — WATER LEVEL
- INFERRED GROUNDWATER LEVEL
- #H:1V — SLOPE (ARROW POINTS DOWN SLOPE)
- PIPE END
- TUBULAR SECTION ON END
- CREST EL. 273.5 OR CREST EL. 273.5 — INDICATE AN AREA ON PLAN VIEW
- MATCH LINE — MATCH LINE
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE

ABBREVIATIONS

APPROX.	APPROXIMATE
CTR	CENTRE
DIA. OR Ø	DIAMETER
EA.	EACH
EL.	ELEVATION IN METERS
EMB	EMBANKMENT
GWL	GROUNDWATER
m	METER
mm	MILLIMETER
NA	NOT APPLICABLE
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
REQ'D	REQUIRED
SOL	SETTING OUT LINE
TMF	TAILINGS MANAGEMENT FACILITY
TYP.	TYPICAL
UNO	UNLESS NOTED OTHERWISE
W/	WITH

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INDEX SHEET

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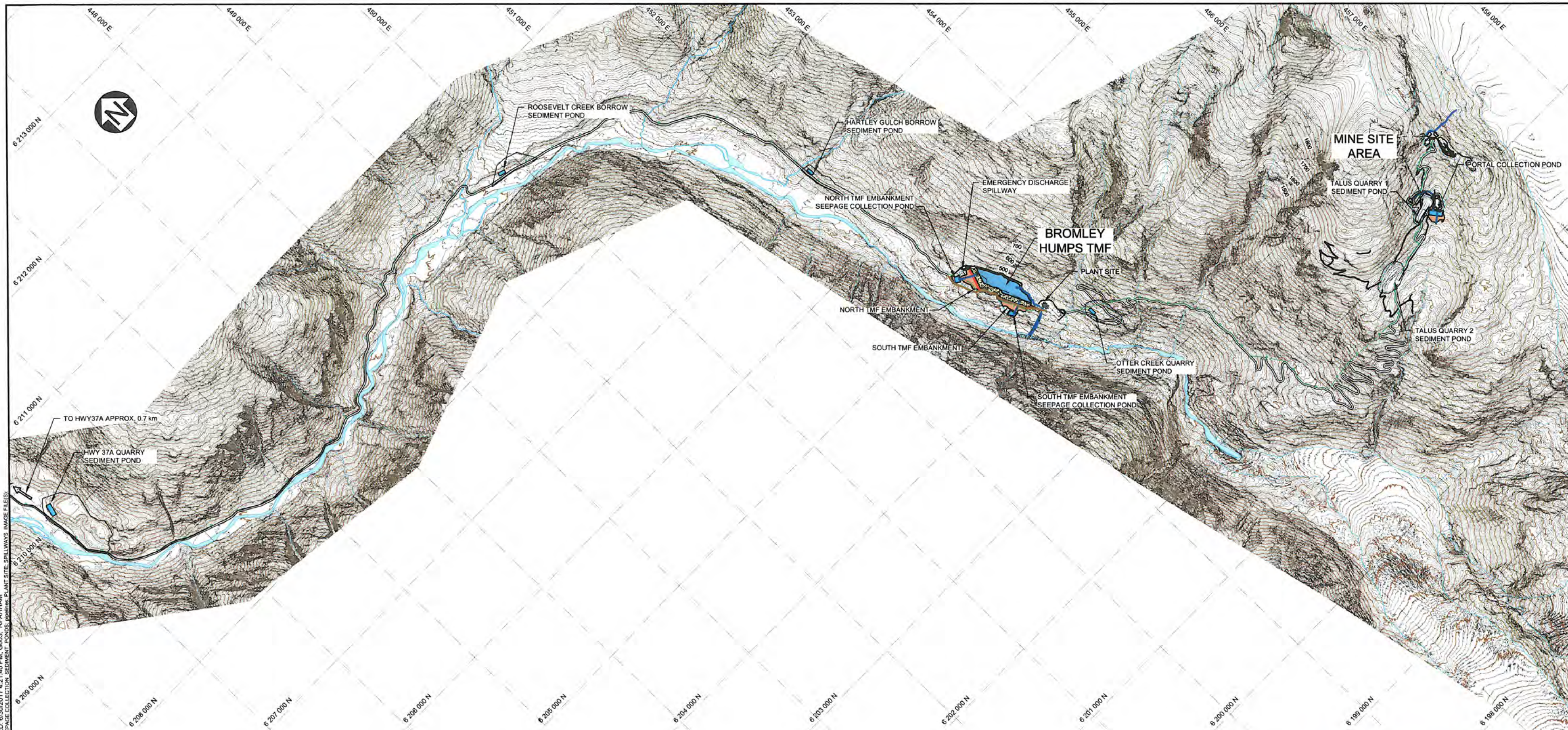

PLAN
SCALE A

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LEGEND:

- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- EXISTING ROAD
- POWER LINE

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL (STAGE 4) TMF LAYOUT SHOWN.

SCALE A 400 200 0 400 800 1200 1600 2000 m

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OVERALL SITE PLAN

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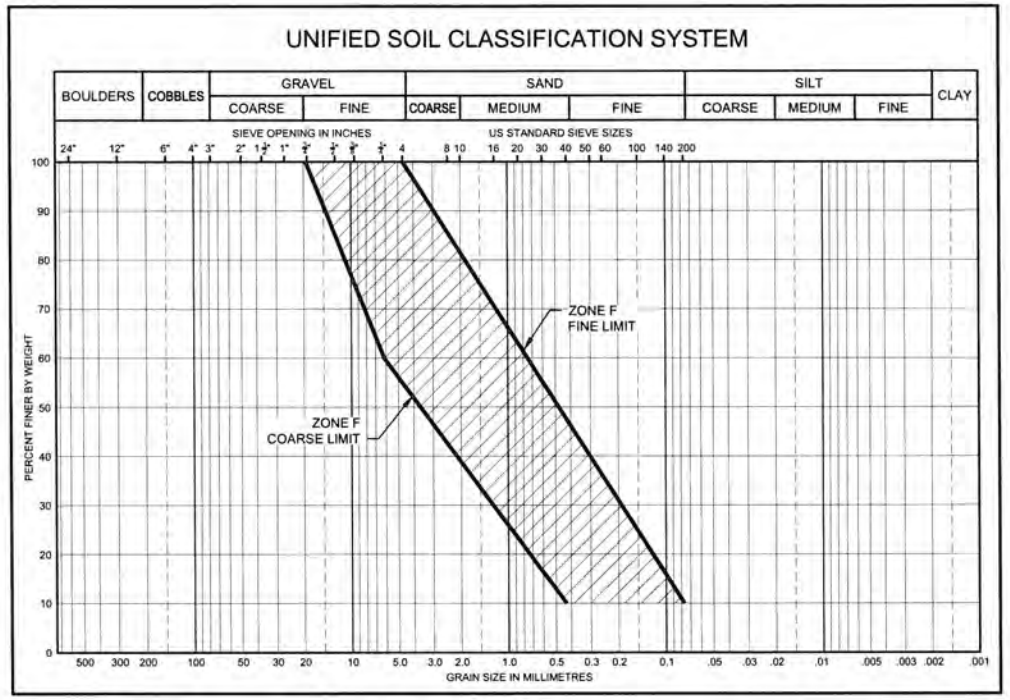
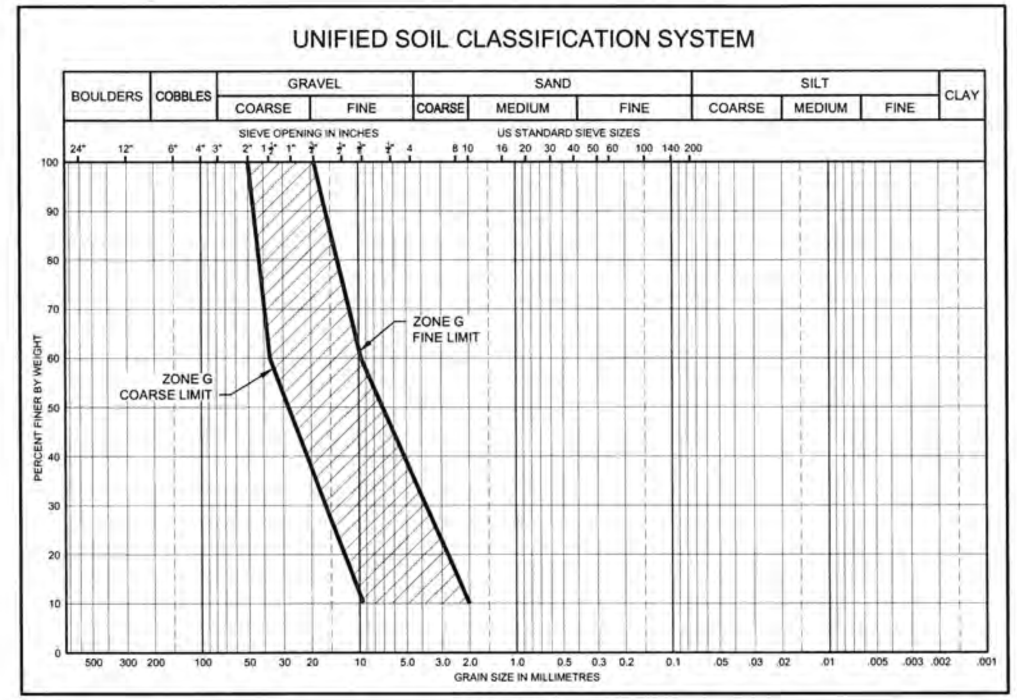
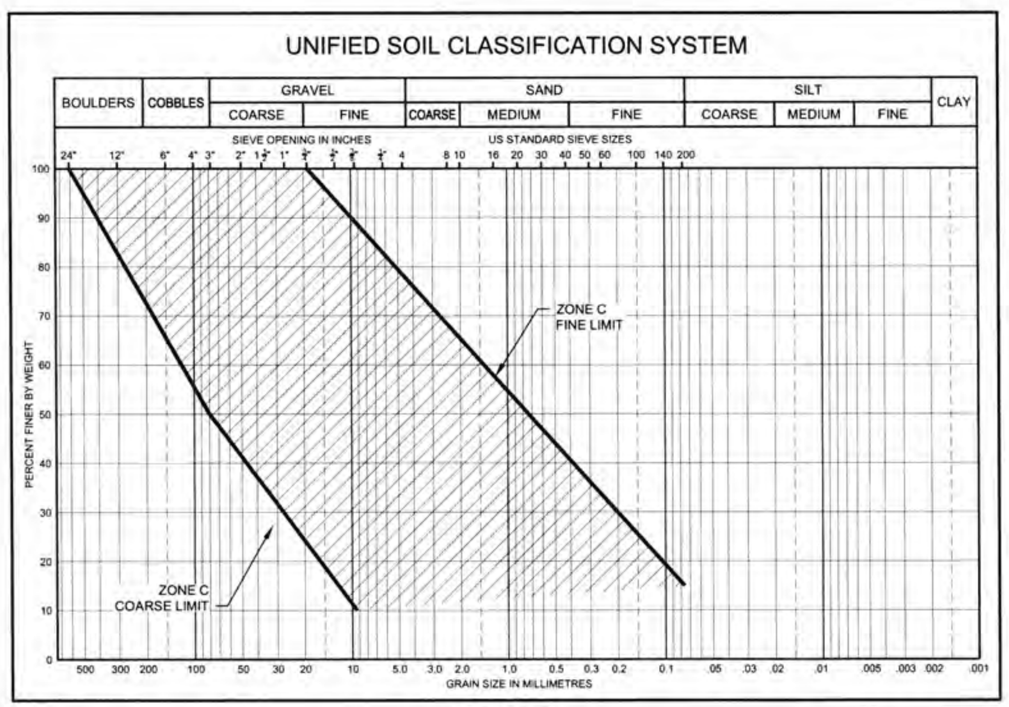


ZONE F



ZONE G



ZONE C

MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE	MATERIAL TYPE	LOCATIONS	PLACING AND COMPACTION REQUIREMENTS
F	FILTER SAND	GEOMEMBRANE BEDDING LAYER/ UNDERDRAIN	PLACED AND SPREAD IN MAXIMUM 500 mm THICK LAYERS AND COMPACTED WITH MINIMUM 2 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER.
G	DRAIN GRAVEL	UNDERDRAIN SUMP/ FOUNDATION DRAIN	PLACED AND SPREAD IN MAXIMUM 500 mm THICK LAYERS AND COMPACTED WITH NOMINAL COMPACTION.
C	GENERAL FILL	EMBANKMENT FILL ZONE	PLACED AND SPREAD IN MAXIMUM 1,000 mm THICK LAYERS AND COMPACTED TO 95% MODIFIED PROCTOR WITH MINIMUM 4 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER.

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

CONSTRUCTION MATERIAL SPECIFICATIONS

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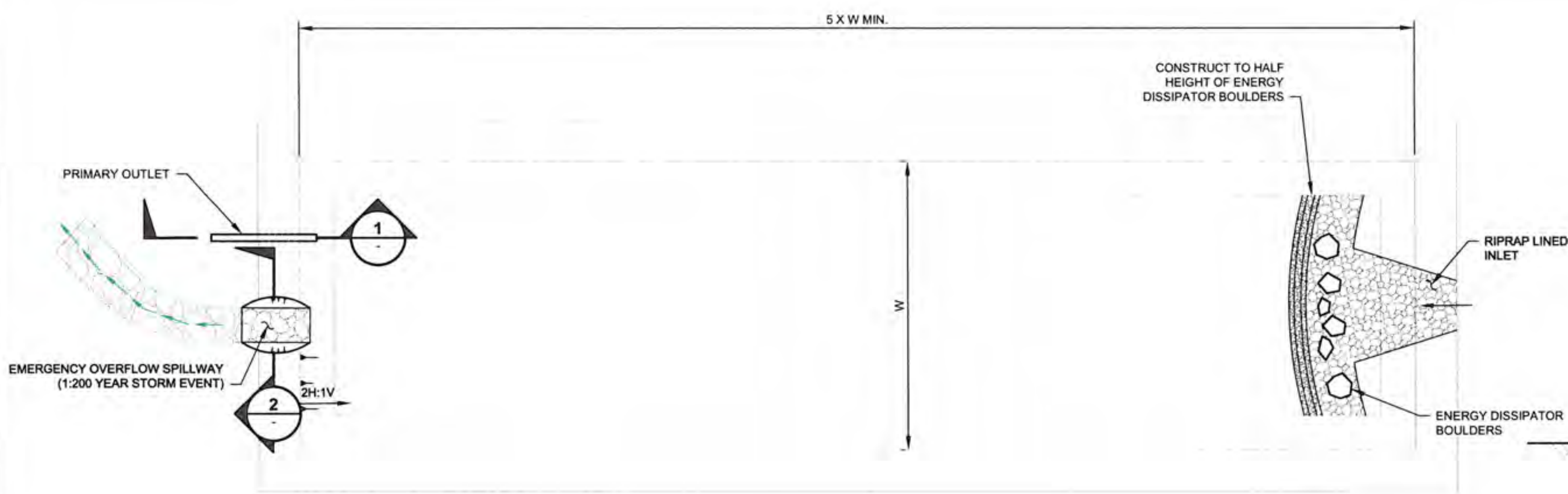

PLAN VIEW
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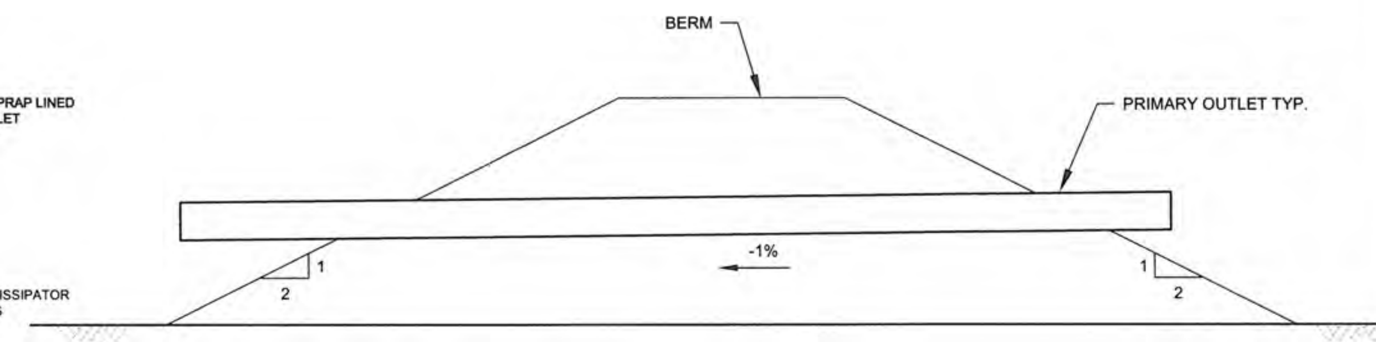
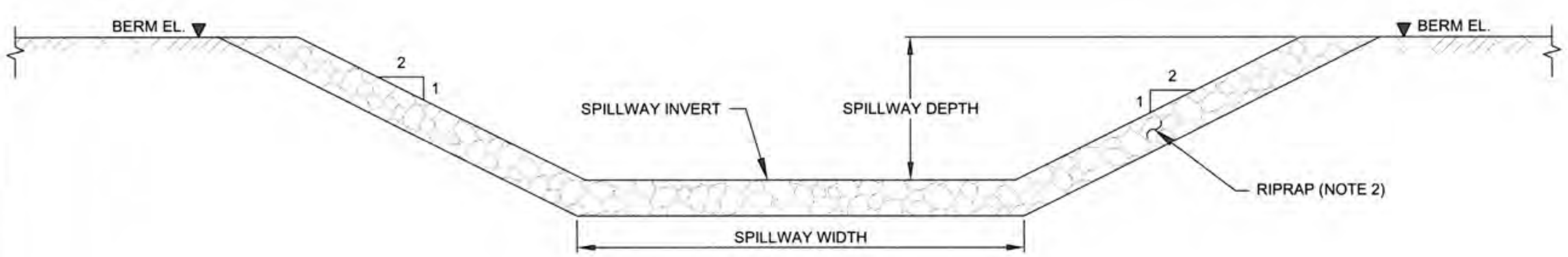


1 PRIMARY OUTLET SECTION
NTS



2 SPILLWAY SECTION
NTS

NOTES:

1. SEDIMENT POND LINING REQUIREMENTS SUBJECT TO ENGINEER'S REVIEW OF FOUNDATION MATERIAL.
2. RIPRAP TO BE SPECIFIED FOR EACH INDIVIDUAL SEDIMENT POND DURING DETAILED DESIGN PHASE.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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SCALE A 10 5 0 10 20 30 40 50 m

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

SEDIMENT AND EROSION CONTROL TYPICAL SECTIONS AND DETAILS SH 1 OF 3

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VA101-594/4	G006	0

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REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

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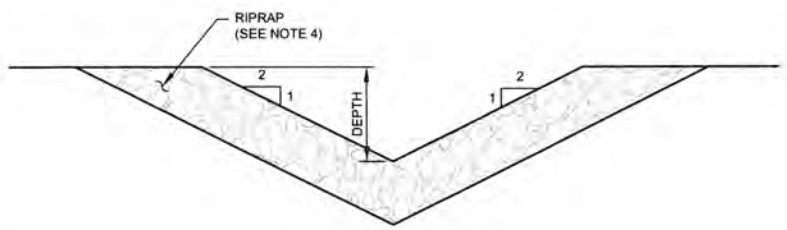
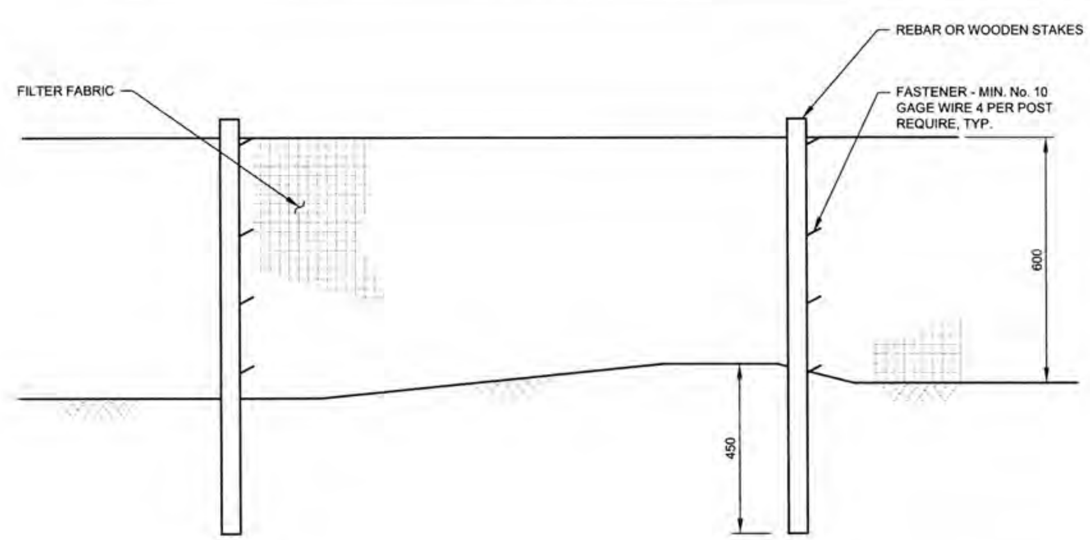


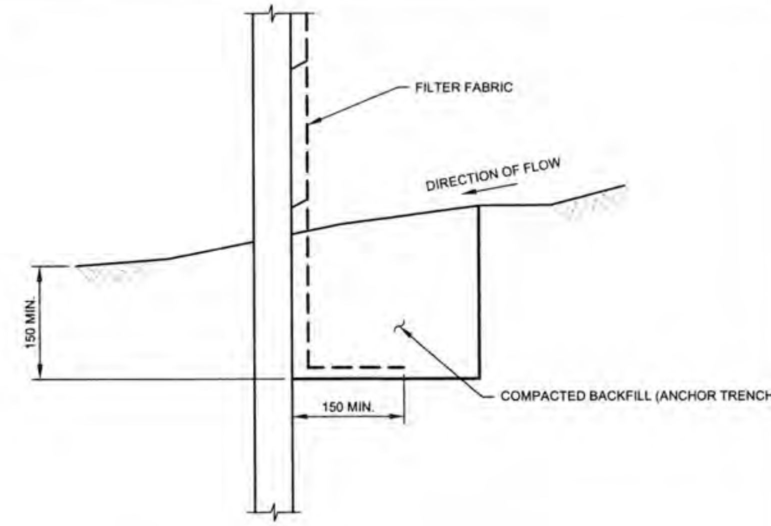
CD DD **COLLECTION AND DIVERSION DITCH**

SCALE A



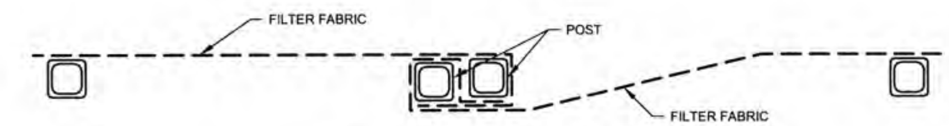
SF **SILT FENCING PROFILE**

SCALE A



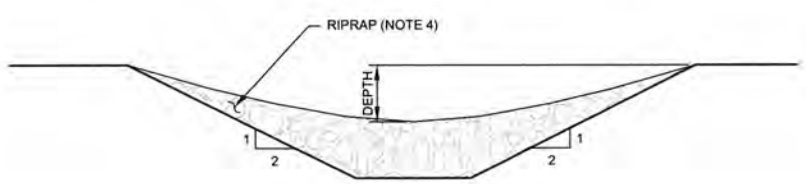
SF **SILT FENCING CROSSING SECTION**

SCALE B



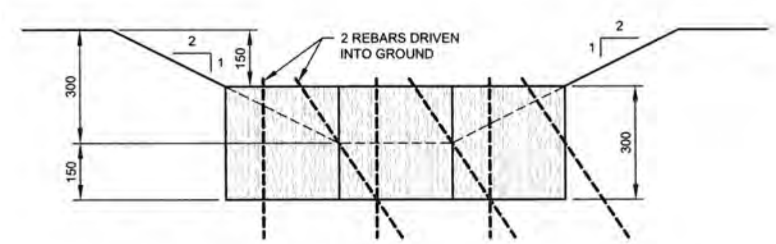
SF **ATTACHING TWO SILT FENCES**

SCALE B



RD **ROCK DAM CROSSING SECTION**

SCALE A

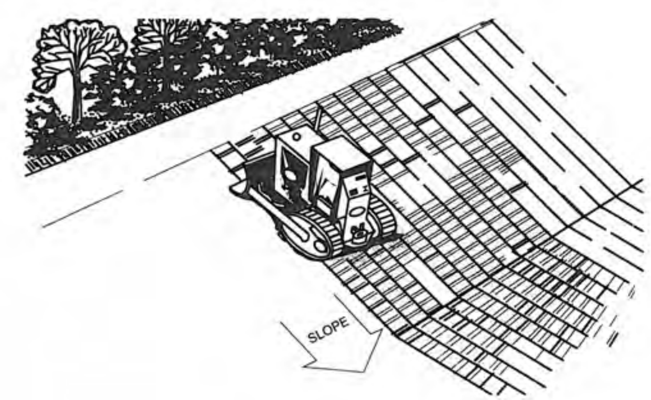


ST **STRAW BALE CROSSING SECTION**

SCALE A

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. THE CONTRACTOR SHALL INSPECT ALL EROSION CONTROL MEASURES PERIODICALLY AND AFTER EACH RUNOFF-PRODUCING RAINFALL EVENT. ANY NECESSARY REPAIRS OR CLEANUP TO MAINTAIN THE EFFECTIVENESS OF THE EROSION CONTROL DEVICES SHALL BE MADE IMMEDIATELY.
3. AN AREA IS CONSIDERED TO HAVE ACHIEVED FINAL STABILIZATION WHEN IT HAS A MINIMUM UNIFORM 70% VEGETATIVE COVER OR OTHER PERMANENT NON-VEGETATIVE COVER TO RESIST ACCELERATED SURFACE EROSION.
4. RIPRAP ONLY REQUIRED WHEN ERODIBLE SOILS HAVE BEEN EXPOSED.
5. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.



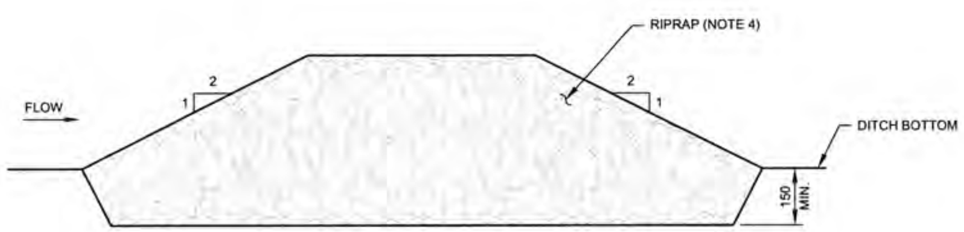
SR **SLOPE ROUGHENING**

NTS

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

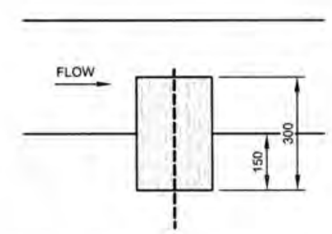
SCALE B 100 50 0 100 200 300 400 500 m

SCALE A 200 100 0 200 400 600 800 1000 m



RD **ROCK DAM PROFILE**

SCALE A



ST **STRAW BALE PROFILE**

SCALE A

PROFESSIONAL PROVINCE OF J. FOGARTY # 44041

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

SEDIMENT AND EROSION CONTROL TYPICAL SECTIONS AND DETAILS SHEET 2 OF 3

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	G007	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

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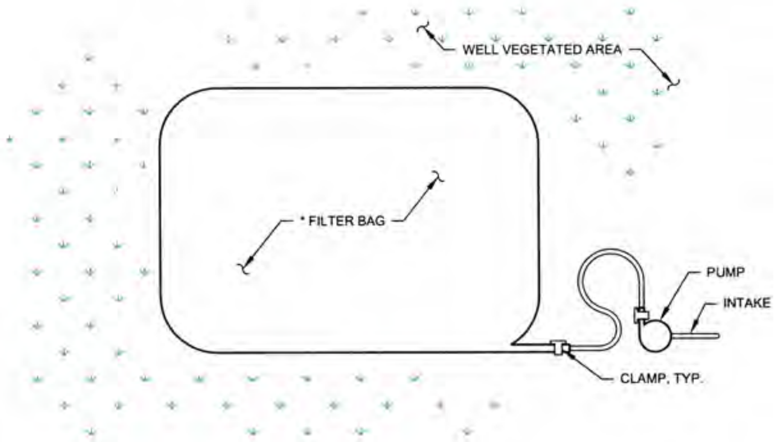
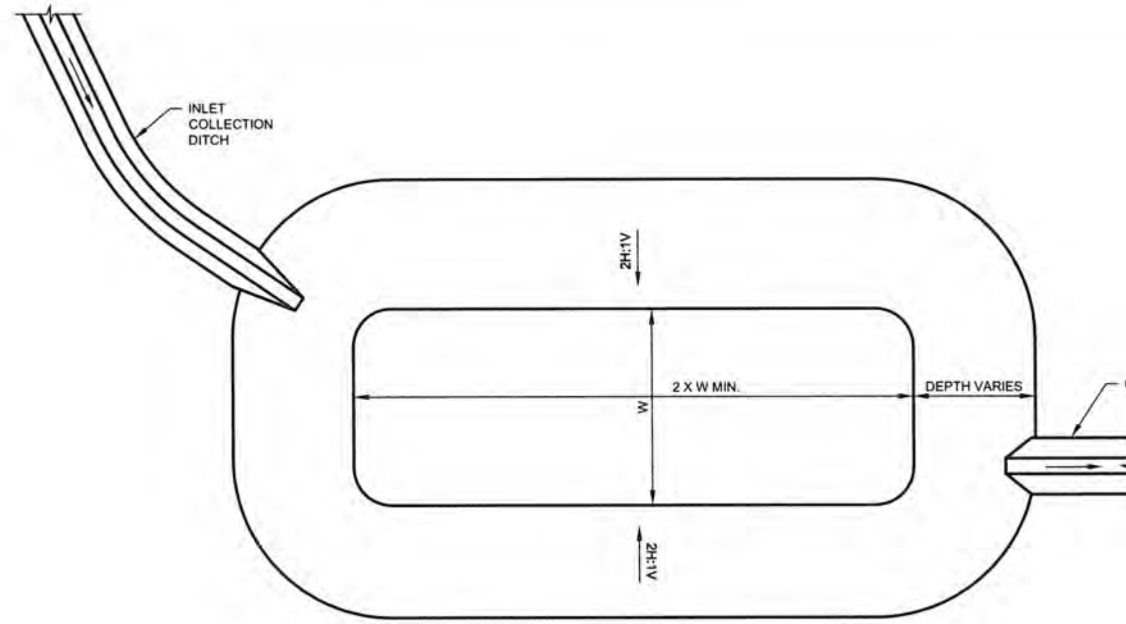
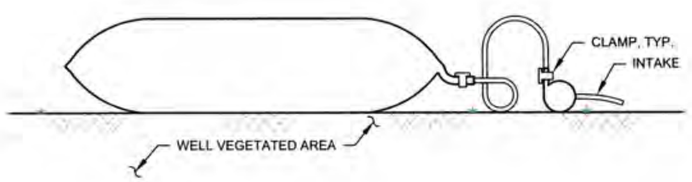


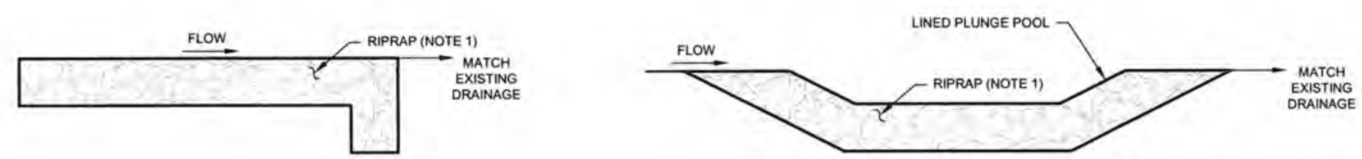
FB - **FILTER BAG PLAN**
SCALE A



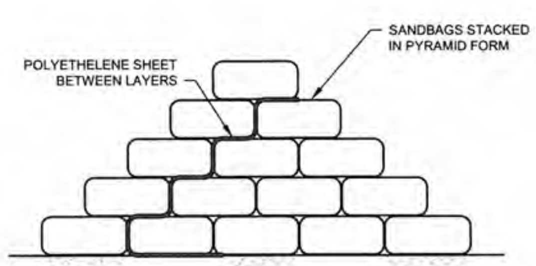
SB - **SEDIMENT BASIN PLAN**
SCALE B



FB - **FILTER BAG ELEVATION**
SCALE A



ED - **ROCK ENERGY DISSIPATOR**
NTS



DS - **TEMPORARY STREAM DIVERSION STRUCTURE**
NTS

ROCK ENERGY DISSIPATOR NOTES:

1. RIPRAP TO BE SPECIFIED DURING DETAILED DESIGN PHASE BASED ON SITE SPECIFIC PARAMETERS.

SEDIMENT BASIN GENERAL NOTES:

1. SEDIMENT BASINS DETAIN STORMWATER RUNOFF FROM A DISTURBED AREA FOR AN EXTENDED TIME, ALLOWING SEDIMENT TO SETTLE.
2. SEDIMENT BASINS MAY REMAIN IN PLACE DURING OPERATIONS, AS INDICATED IN THE PLANS OR AS DIRECTED BY THE ENGINEER, OR SITE ENVIRONMENTAL MONITORING TECHNICIAN.
3. SEDIMENT BASINS MAY HAVE PUMP OR GRAVITY OUTLET CHANNEL TO COLLECTION DITCH.
4. RELEASES FROM SEDIMENT BASINS REQUIRE FURTHER WATER MANAGEMENT/BMPS (EX. PUMPBACK, DISCHARGE TO COLLECTION DITCHES, FILTER BAGS, AND VEGETATED BUFFER STRIPS.)
5. SEDIMENT BASINS TO BE FIELD FIT TO OPTIMIZE CUT AND FILL QUATITIES TO ACHIEVE MINIMUM SPECIFIED DIMENSIONS.

SEDIMENT FILTER BAG GENERAL NOTES:

1. NON-WOVEN GEOTEXTILE FILTER BAG WHICH RETAINS ALL SEDIMENT PARTICLES LARGER THAN 150 MICRONS.
2. PLACE FILTER BAGS ON STABLE OR WELL VEGETATED AREAS WHICH ARE FLATTER THAN 5% AND WILL NOT ERODE WHEN SUBJECTED TO BAG DISCHARGE.
3. CLAMP PUMP DISCHARGE HOSE SECURELY INTO FILTER BAGS.
4. THE PUMPING RATE SHALL BE NO GREATER THAN 750 gpm OR ½ THE MAXIMUM SPECIFIED BY THE MANUFACTURER, WHICHEVER IS LESS. PUMP INTAKES SHOULD BE FLOATING AND SCREENED.
5. WHEN SEDIMENTS FILL ½ THE VOLUME OF A FILTER BAG, IMMEDIATELY REMOVE THAT BAG FROM SERVICE. PROPERLY DISPOSE OF SPENT BAGS WITH THEIR SEDIMENTS. SPARE BAGS SHALL BE KEPT AVAILABLE FOR REPLACEMENT OF THOSE THAT HAVE FILLED.
6. THE DISCHARGE FROM THE FILTER BAG SHOULD NOT PASS THROUGH A DISTURBED AREA OR CAUSE AN EROSION PROBLEM DOWN SLOPE.
7. VEGETATED BUFFER STRIP WILL BE LEFT DOWNSTREAM OF THE FILTER BAG.
8. FILTER BAGS SHALL BE INSPECTED DAILY. IF ANY PROBLEM IS DETECTED PUMPING SHALL CEASE AND NOT RESUME UNTIL THE PROBLEM IS CORRECTED.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE B: 5 2.5 0 5 10 15 20 25 m
SCALE A: 2 1 0 2 4 6 8 10 m

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

SEDIMENT AND EROSION CONTROL TYPICAL SECTIONS AND DETAILS SHEET 3 OF 3

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	G008	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
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REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

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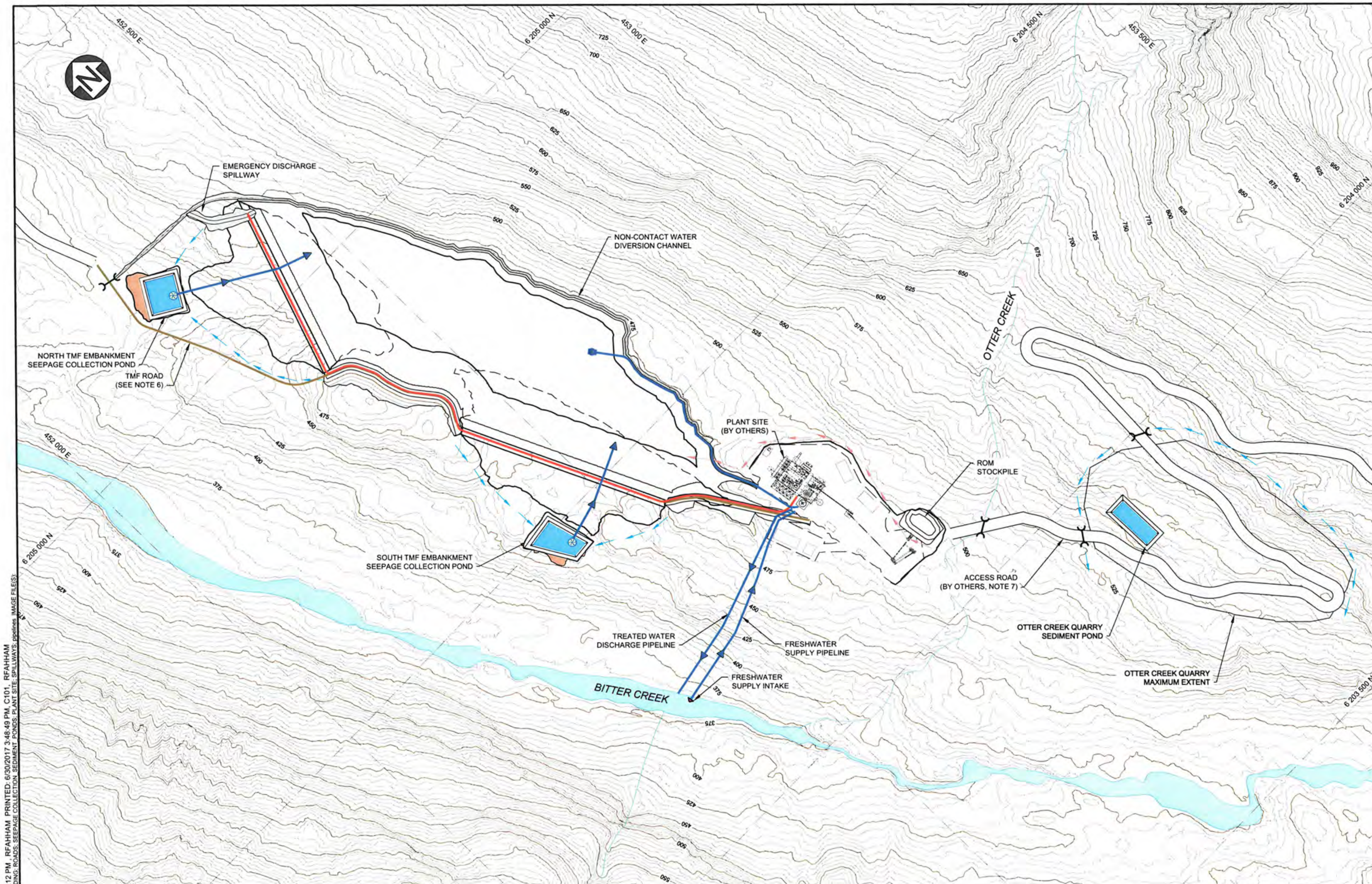

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- SEEPAGE RECYCLE PUMP SYSTEM
- DIVERSION CHANNEL/DITCH
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (MAY 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. FINAL (STAGE 4) TMF LAYOUT SHOWN.
8. ROADS ARE DESIGNED AND COMPLETED BY OTHERS.

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SCALE A 60 30 0 100 200 300 m

PLAN
SCALE A

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C101\C101, 6/30/2017 3:02:12 PM, RFAHHAM PRINTED: 6/30/2017 3:48:49 PM, C101, RFAHHAM
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RED MOUNTAIN UNDERGROUND GOLD PROJECT

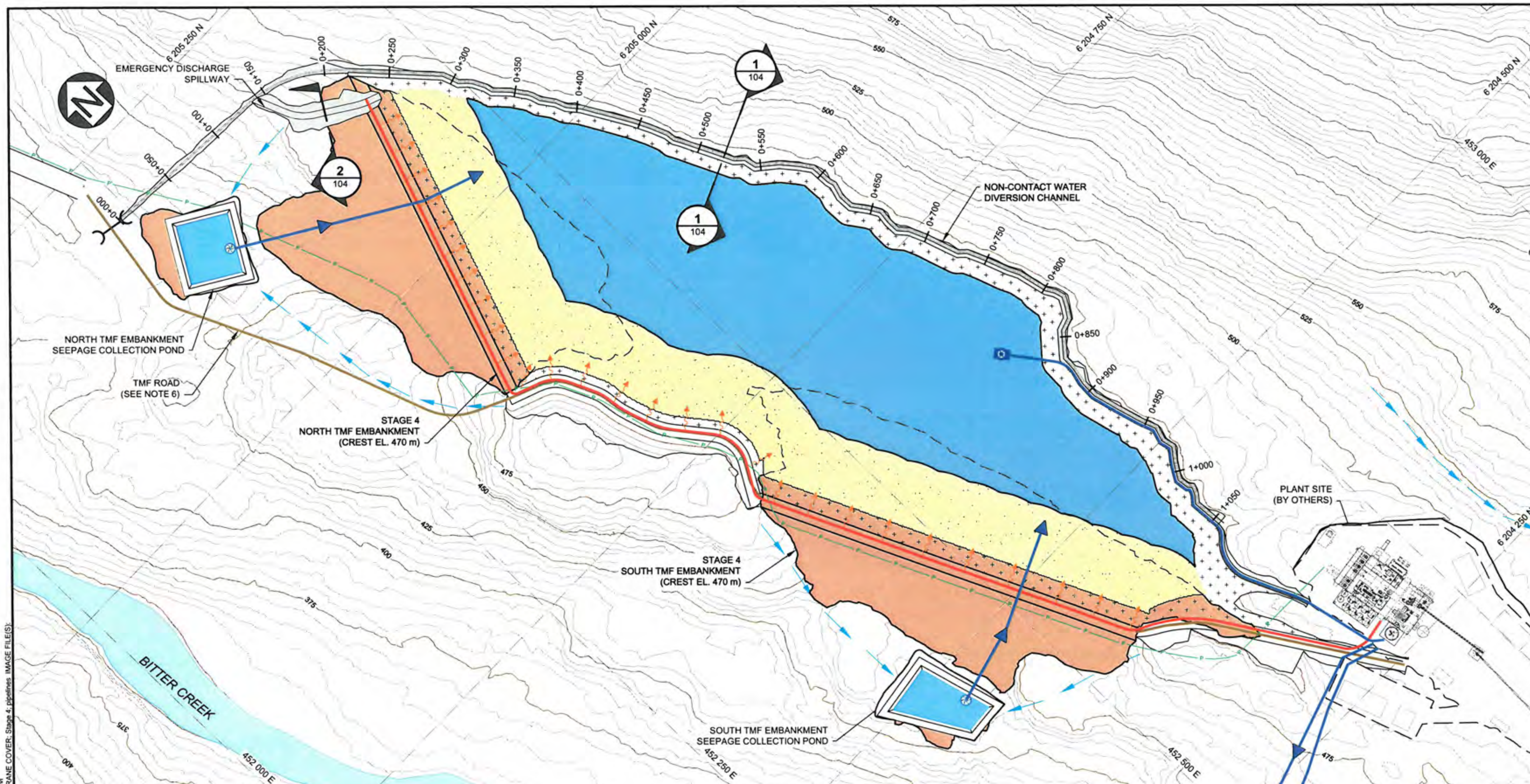
BROMLEY HUMPS TMF
WATER MANAGEMENT STRUCTURES
PLAN

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		
REVISIONS						

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C101	0



PLAN
NON - CONTACT DIVERSION CHANNEL
SCALE A

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- SEEPAGE RECYCLE PUMP SYSTEM
- CULVERT
- DIVERSION CHANNEL/DITCH
- POWER LINE
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (NOVEMBER 2016).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. FINAL (STAGE 4) TMF LAYOUT SHOWN.

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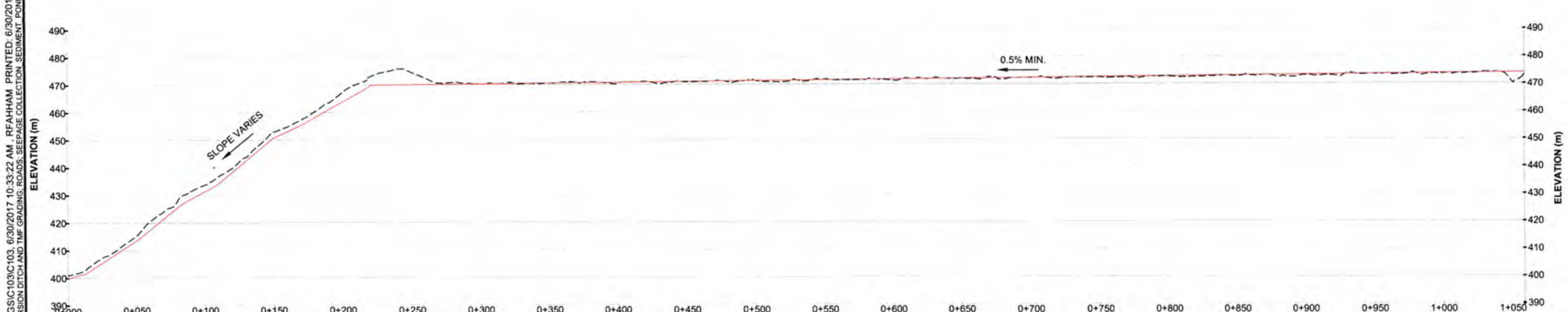
SCALE A 40 20 0 40 80 120 160 200 m



1 PROFILE
HORIZONTAL: SCALE A
VERTICAL: SCALE A

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RED MOUNTAIN GOLD UNDERGROUND PROJECT

BROMLEY HUMPS TMF NON-CONTACT WATER DIVERSION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C103	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

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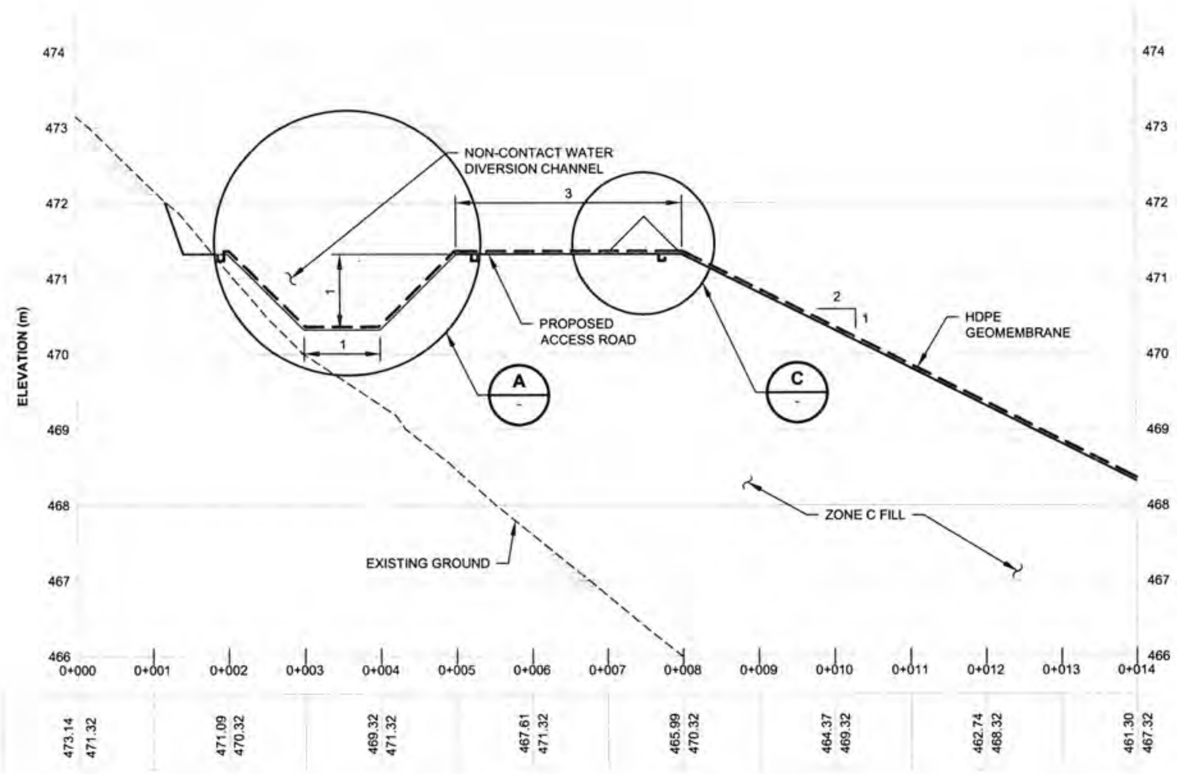

1 / 103 **SECTION STA 0+520**
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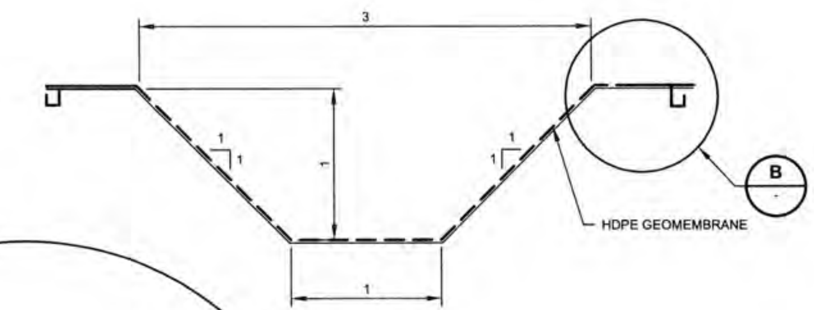

A **DETAIL**
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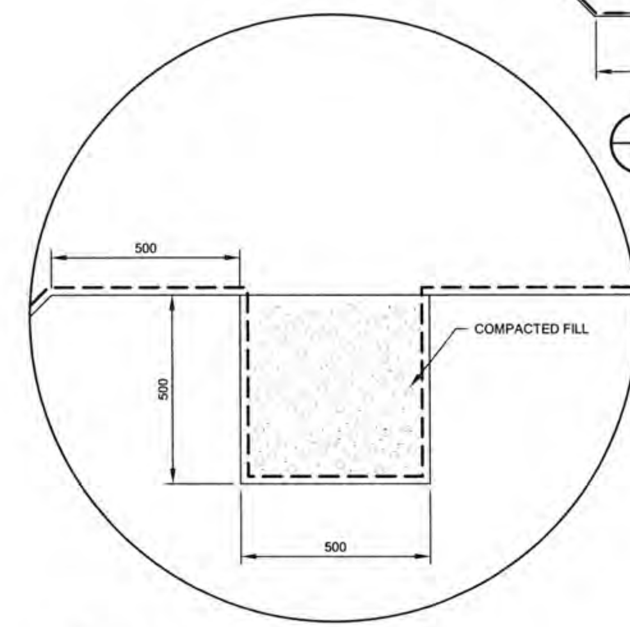
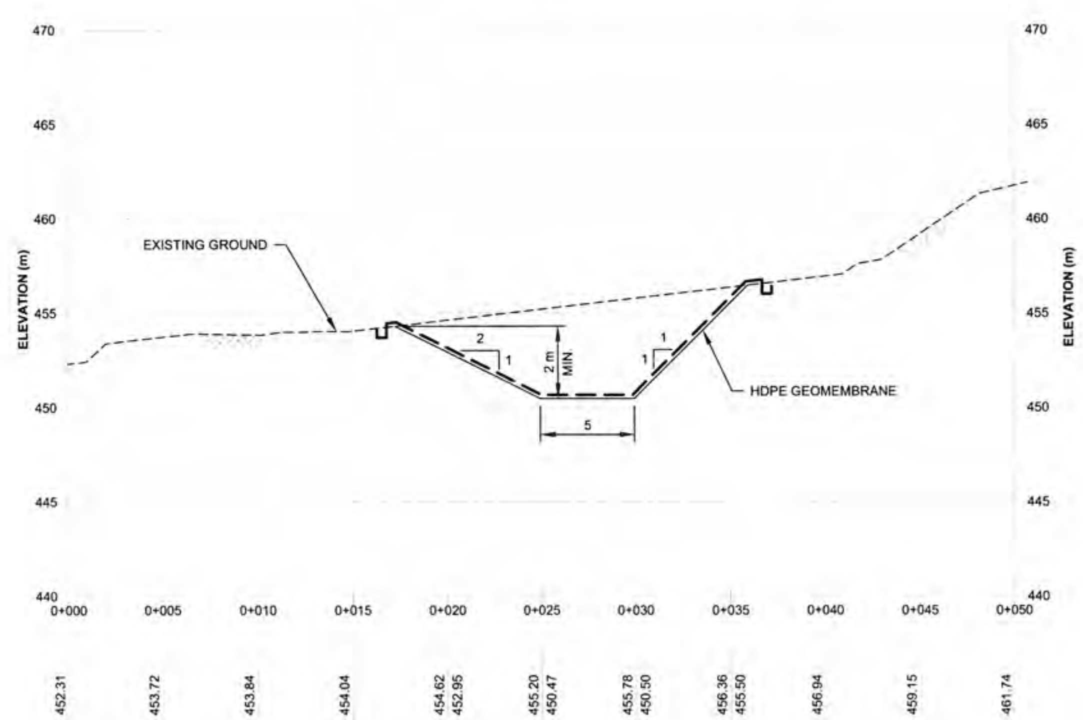


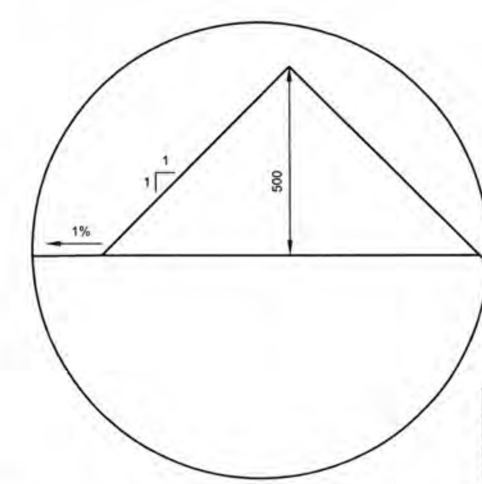
B **ANCHOR TRENCH DETAIL**
NTS

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.



2 / 103 **SECTION**
SCALE C



C **SAFETY BERM DETAIL**
NTS

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SCALE D 0.2 0.1 0 0.2 0.4 0.6 0.8 1 m
SCALE C 4 2 0 4 8 12 16 20 m
SCALE B 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE A 1 0.5 0 1 2 3 4 5 m

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RED MOUNTAIN GOLD UNDERGROUND PROJECT

BROMLEY HUMPS TMF NON-CONTACT WATER DIVERSION CHANNEL SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
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REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

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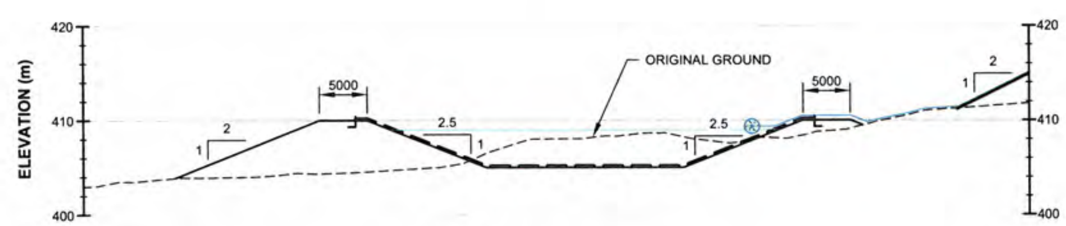

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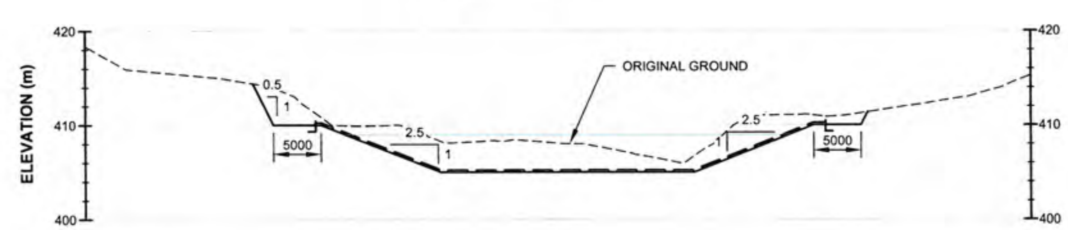

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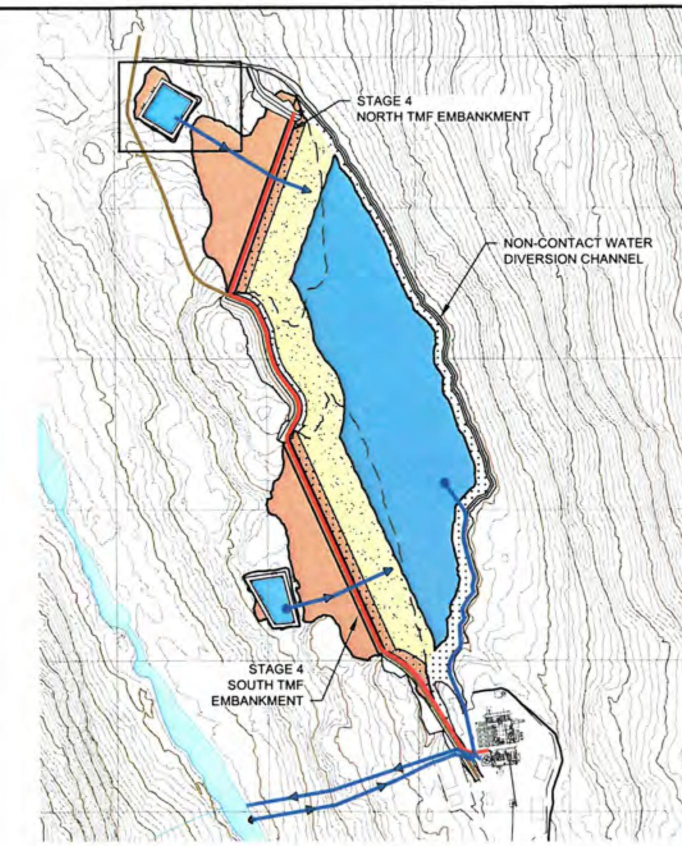

KEY PLAN
NTS

LEGEND:

- POND WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- GEOMEMBRANE
- FLOATING PUMP BARGE
- SEEPAGE RECYCLE PUMP SYSTEM

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL (STAGE 4) TMF LAYOUT SHOWN.

SCALE A 8 4 0 10 20 30 40 m

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
NORTH TMF EMBANKMENT
SEEPAGE COLLECTION POND
PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C105	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

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REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

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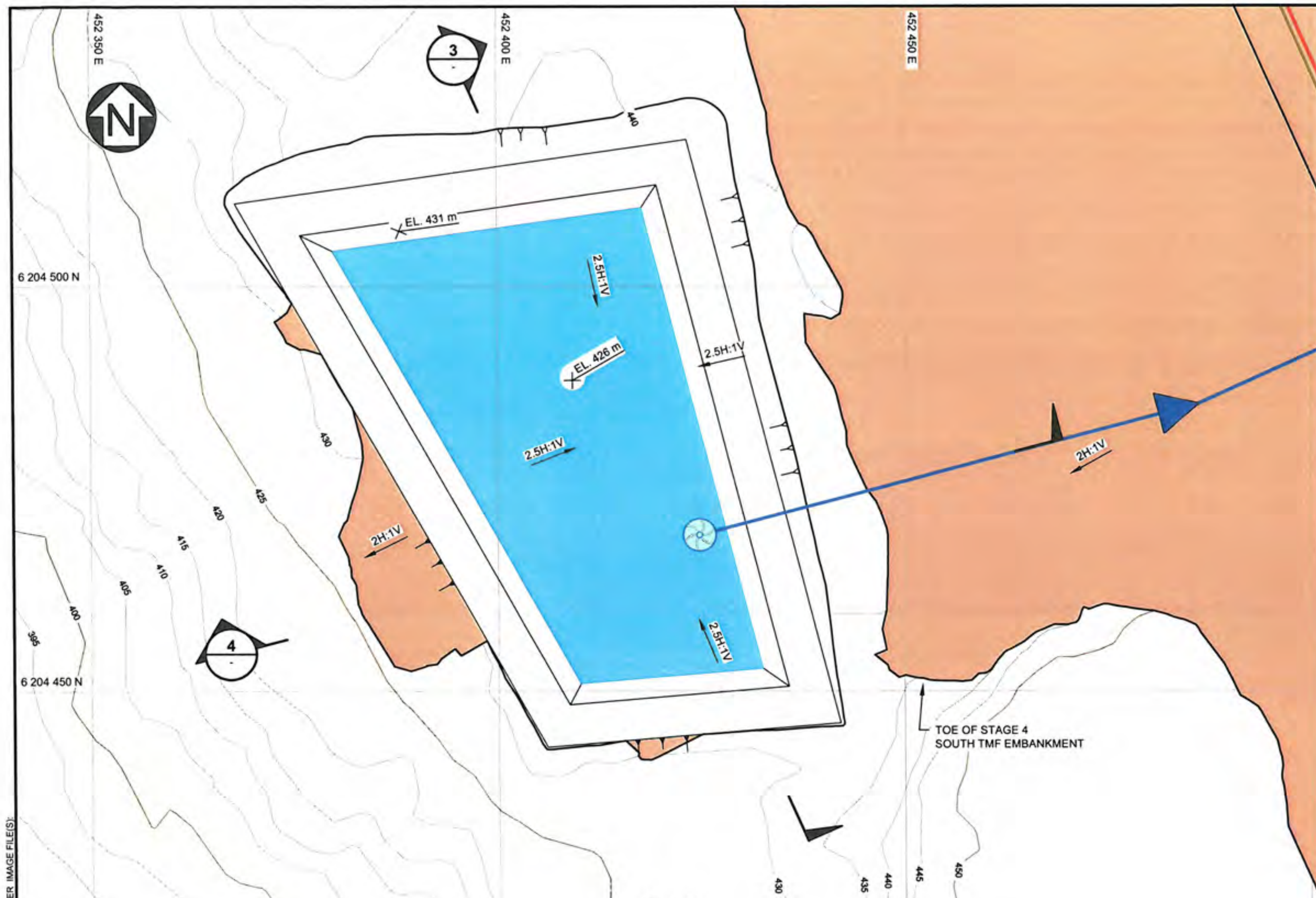
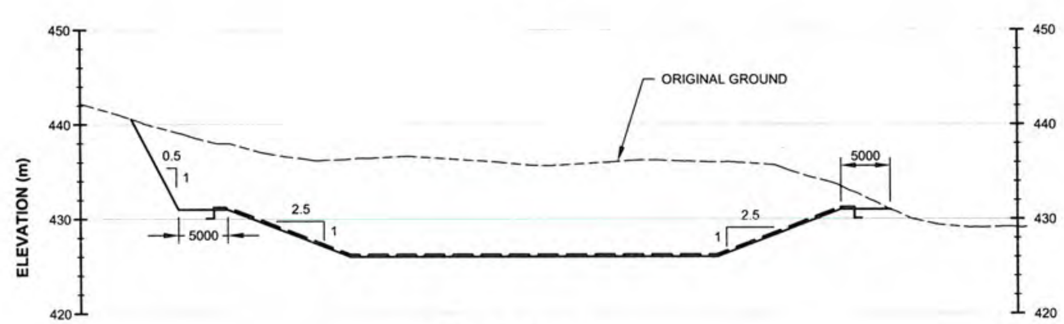
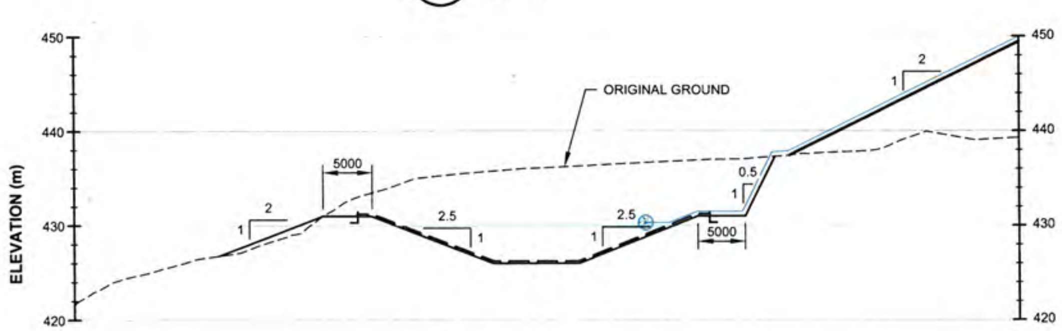


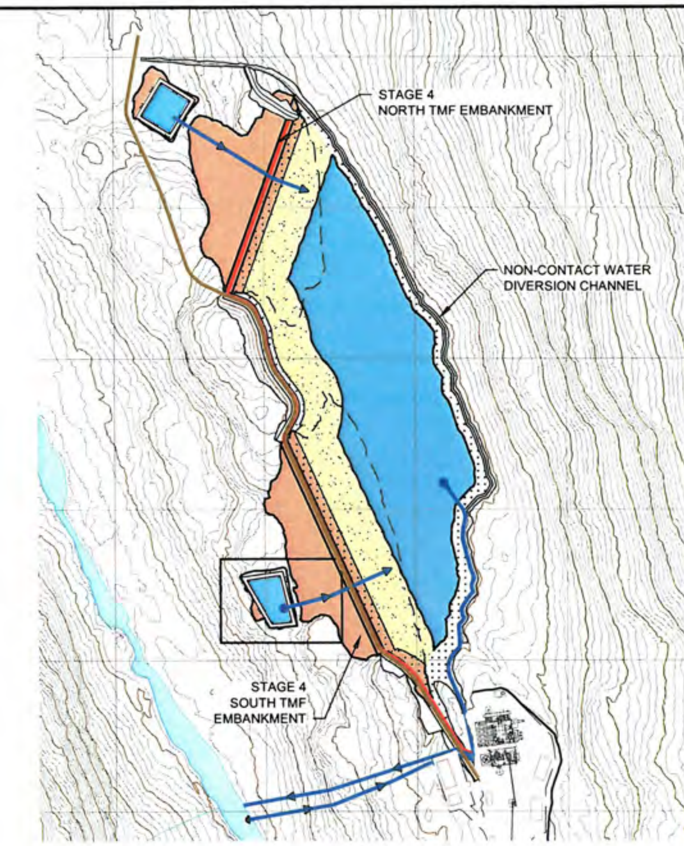
PLAN
SCALE A



SECTION 3
SCALE A



SECTION 4
SCALE A



KEY PLAN
NTS

LEGEND:

- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- GEOMEMBRANE
- FLOATING PUMP BARGE
- SEEPAGE RECYCLE PUMP SYSTEM

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL (STAGE 4) TMF LAYOUT SHOWN.

SCALE A 8 4 0 10 20 30 40 m

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NOT FOR CONSTRUCTION

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THIS DRAWING WAS PREPARED BY KNIGHT PIESOLD LTD. FOR THE ACCOUNT OF THE CLIENT LISTED ON THIS DRAWING. THE MATERIAL ON IT REFLECTS KNIGHT PIESOLD'S BEST JUDGEMENT IN THE LIGHT OF THE INFORMATION AVAILABLE TO IT AT THE TIME OF PREPARATION. ANY USE WHICH A THIRD PARTY MAKES OF THIS DRAWING, OR ANY RELIANCE ON OR DECISIONS TO BE MADE BASED ON IT, ARE THE RESPONSIBILITY OF SUCH THIRD PARTIES. KNIGHT PIESOLD ACCEPTS NO RESPONSIBILITY FOR DAMAGES, IF ANY, SUFFERED BY THE THIRD PARTY AS A RESULT OF DECISIONS MADE OR ACTIONS BASED ON THIS DRAWING. COPIES RESULTING FROM ELECTRONIC TRANSFER OR REPRODUCTION OF THIS DRAWING ARE UNCONTROLLED AND MAY NOT BE THE MOST RECENT REVISION OF THIS DRAWING.

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Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
SOUTH TMF EMBANKMENT
SEEPAGE COLLECTION POND
PLAN AND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C106	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

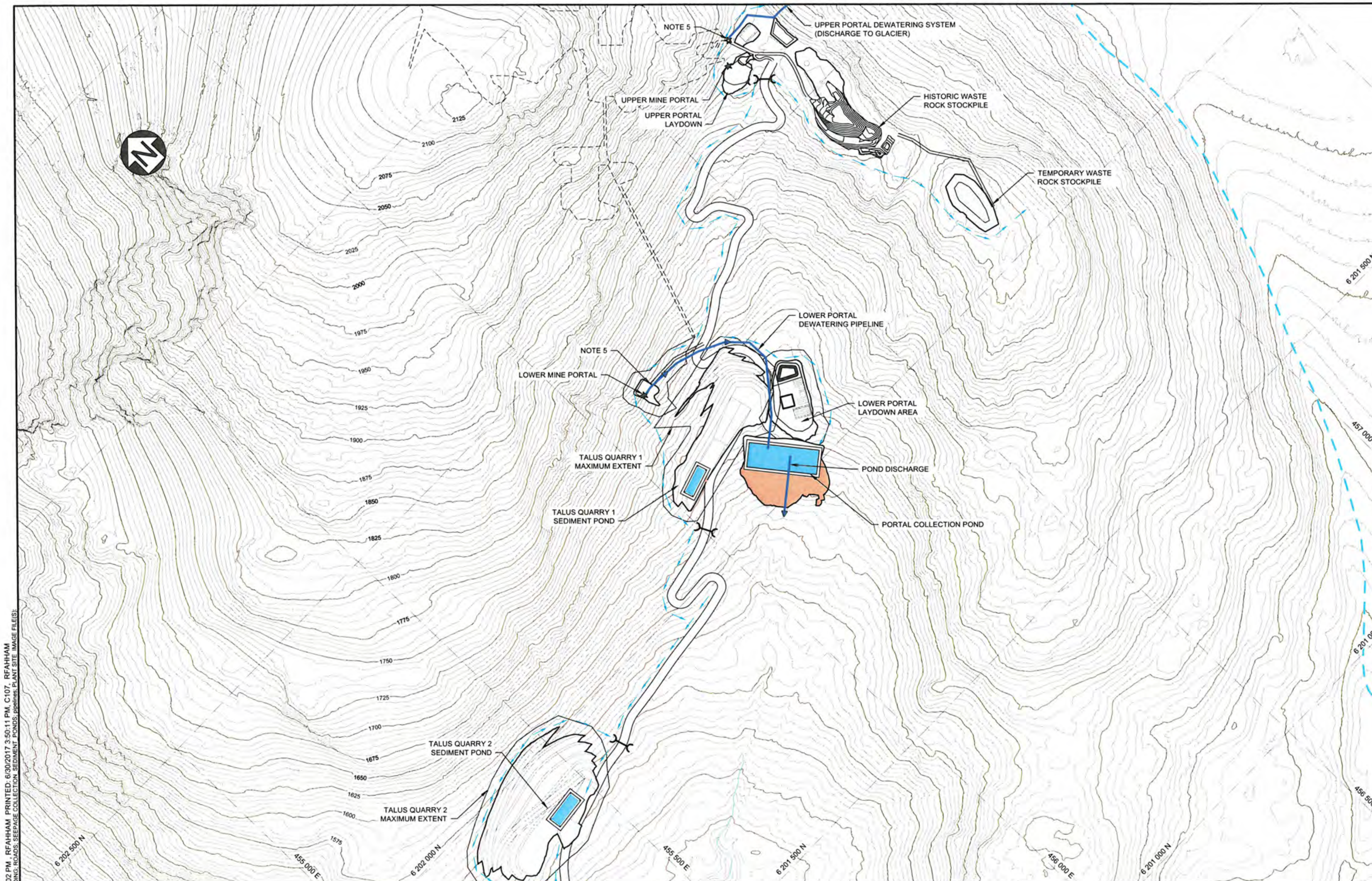
REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS



LEGEND:

- POND WATER
- EXISTING ROAD
- WATER MANAGEMENT PIPELINE
- GLACIER OUTLINE
- DIVERSION DITCH/ CHANNEL
- PORTAL
- CULVERT

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. UNDERGROUND DEWATERING PIPELINE BY OTHERS.

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NOT FOR CONSTRUCTION

SCALE A 80 40 0 100 200 300 400 m

PLAN
SCALE A

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Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

MINE SITE
WATER MANAGEMENT STRUCTURES
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C107	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

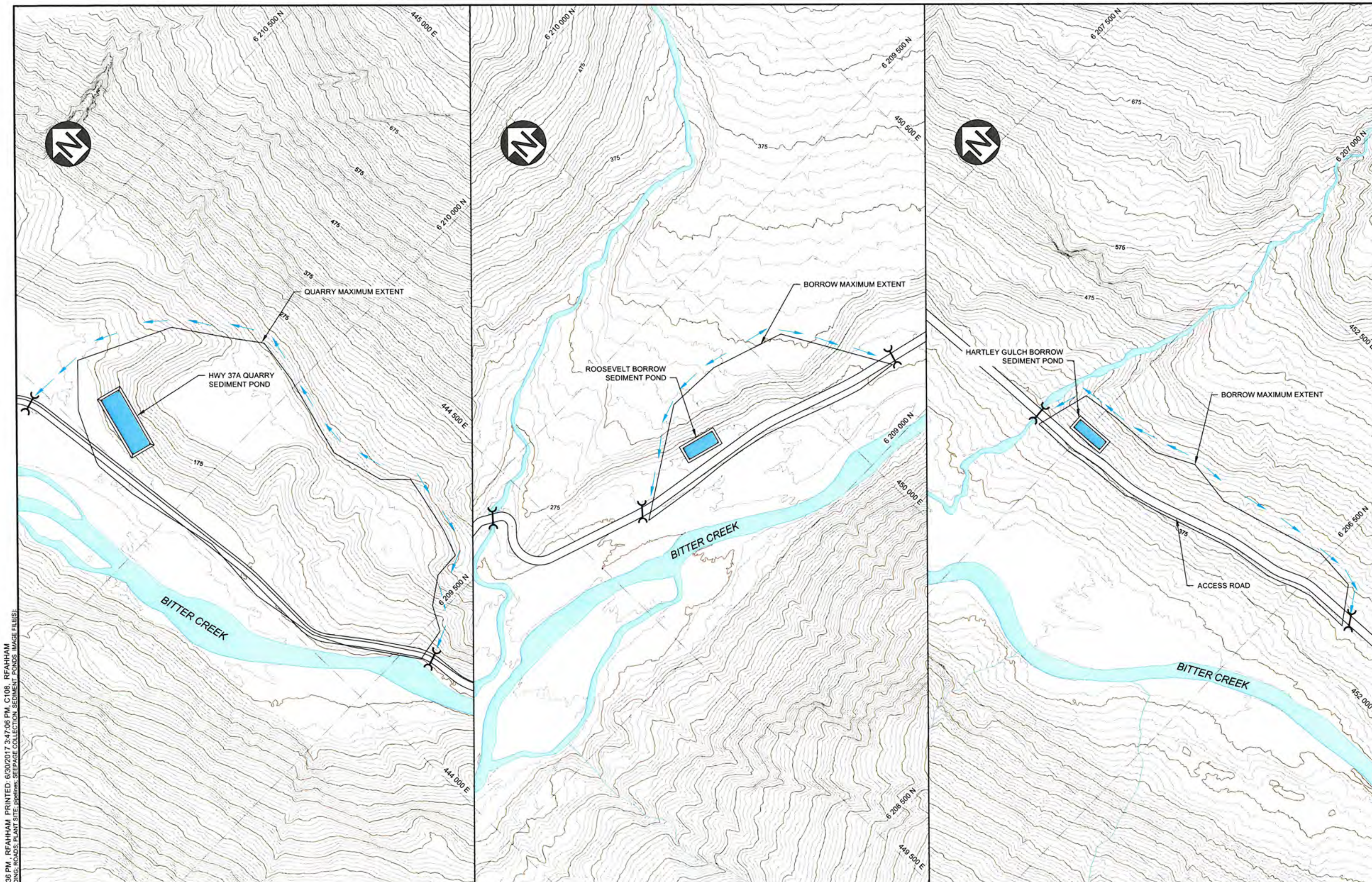
DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

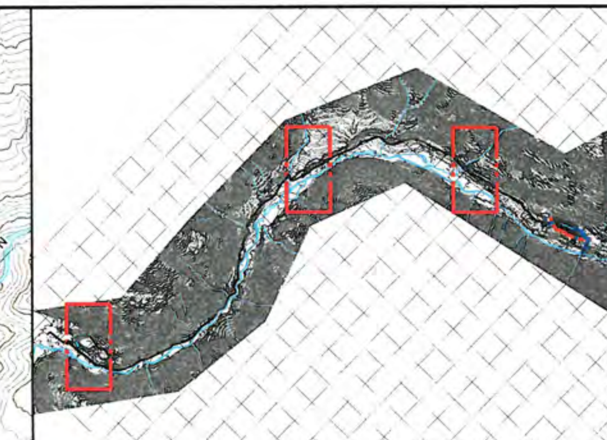
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C107\C107, 6/29/2017 8:36:02 PM, RFAHHAM PRINTED: 6/30/2017 3:50:11 PM, C107, RFAHHAM
XREF FILE(S): CONTOURS - 5 m; Hydro_Stage 1: DIVERSION DITCH AND TMF GRADING; ROADS; SEEPAGE COLLECTION SEDIMENT PONDS; pipeline; PLANT SITE; IMAGE FILE(S):



PLAN
SCALE A



KEY PLAN
SCALE B

LEGEND:

- POND WATER
- EXISTING ROAD
- DIVERSION CHANNEL/DITCH
- CULVERT

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION QUARRY PROVIDED BY JDS MINING (MAY 2017).

FOR INFORMATION ONLY

SCALE B: 1500 750 0 2500 5000 7500 m

SCALE A: 80 40 0 100 200 300 400 m

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		
REVISIONS						

<Original signed by>

PROFESSIONAL ENGINEER
PROVINCE OF BC
J. FOGARTY
44041

<Original signed by>

Knight Piésold
CONSULTING

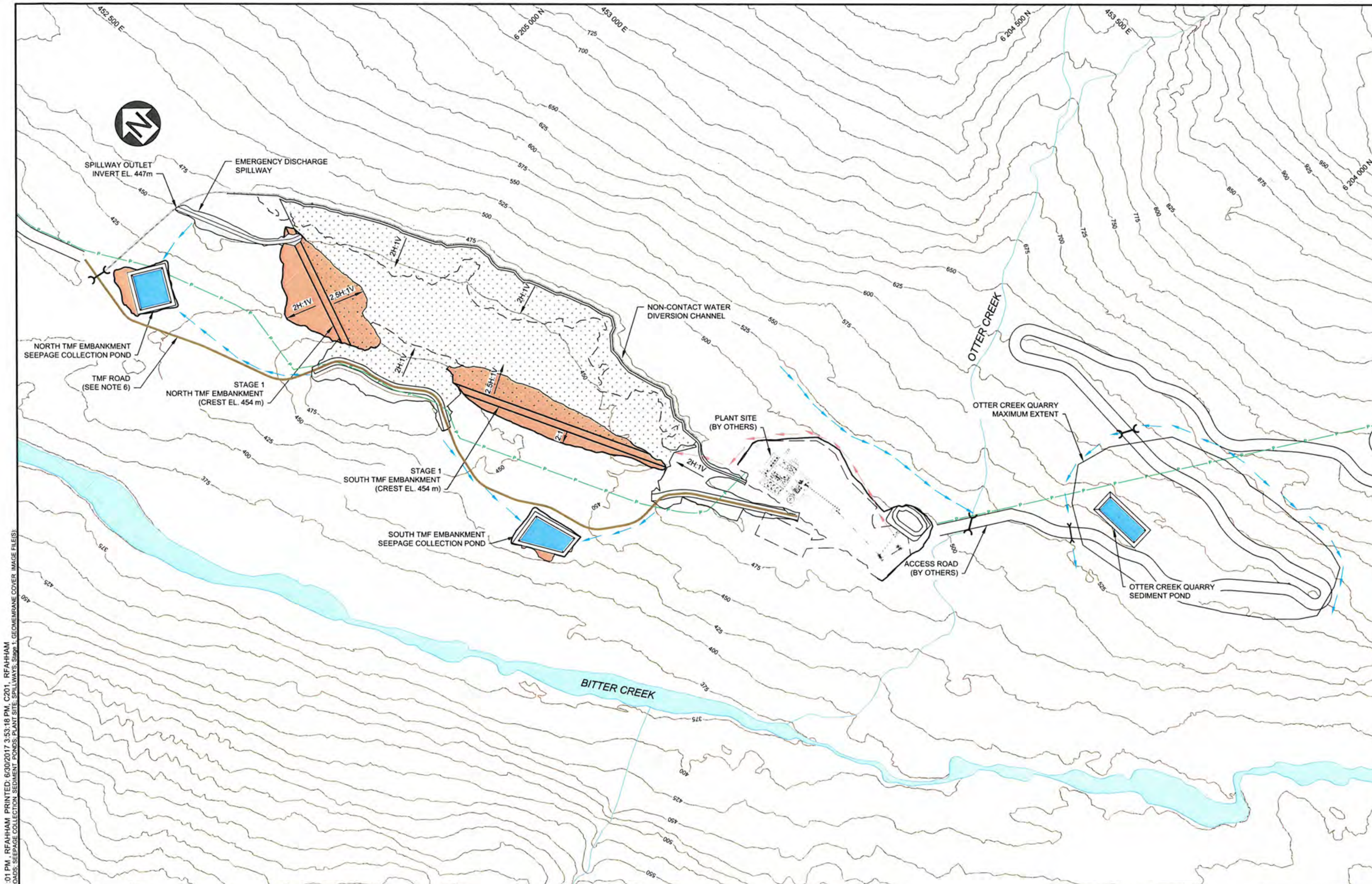
IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BORROW AND QUARRY - WATER MANAGEMENT STRUCTURES PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C108	0

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C108\C108, 6/29/2017 8:13:36 PM, RFAHHAM PRINTED: 6/30/2017 3:47:06 PM, C108, RFAHHAM
XREF FILE(S): CONTOURS - 5 m; Hydro; Stage 1; DIVERSION DITCH AND TMF GRADING; ROADS; PLANT SITE; pipelines; SEEPAGE COLLECTION SEDIMENT PONDS IMAGE FILE(S):



PLAN
SCALE A

LEGEND:

- GEOMEMBRANE
- EMBANKMENT FILL
- WATER
- POWER LINE
- DIVERSION CHANNEL/DITCH
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 60 30 0 100 200 300 m

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PROFESSIONAL PROVINCE OF J. FOGARTY

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Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
GENERAL ARRANGEMENT
STARTUP CONSTRUCTION END OF YEAR - 1

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C201	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

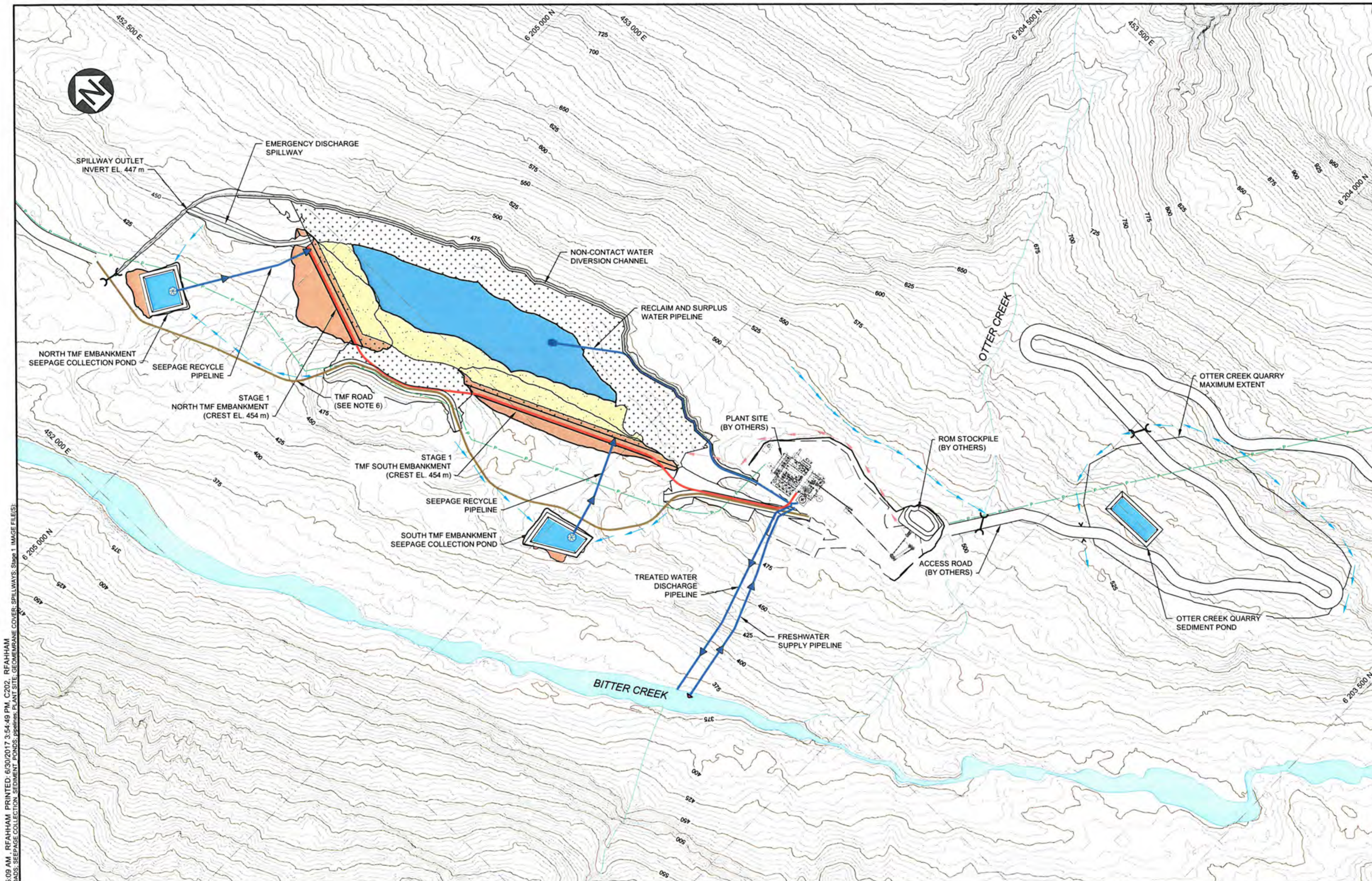
DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C201\C201, 6/29/2017 8:11:01 PM , RFAHHAM PRINTED: 6/30/2017 3:53:18 PM, C201, RFAHHAM
XREF FILE(S): CONTOURS - 5 m; Hydro; DIVERSION DITCH AND TMF GRADING; ROADS; SEEPAGE COLLECTION; SEDIMENT PONDS; PLANT SITE; SPILLWAYS; Stage 1; GEOMEMBRANE COVER IMAGE FILE(S):



LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS 9JDS MINING).
7. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 60 30 0 100 200 300 m

PLAN
SCALE A

– DISCLAIMER –
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PROFESSIONAL PROVINCE OF BRITISH COLUMBIA J. FOGARTY # 44041

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<Original signed by>

Knight Piésold CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
GENERAL ARRANGEMENT
STAGE 1 END OF YEAR 1

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C202	0

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C202\C202, 6/30/2017 11:35:09 AM , RFAHHAM PRINTED: 6/30/2017 3:54:49 PM, C202, RFAHHAM
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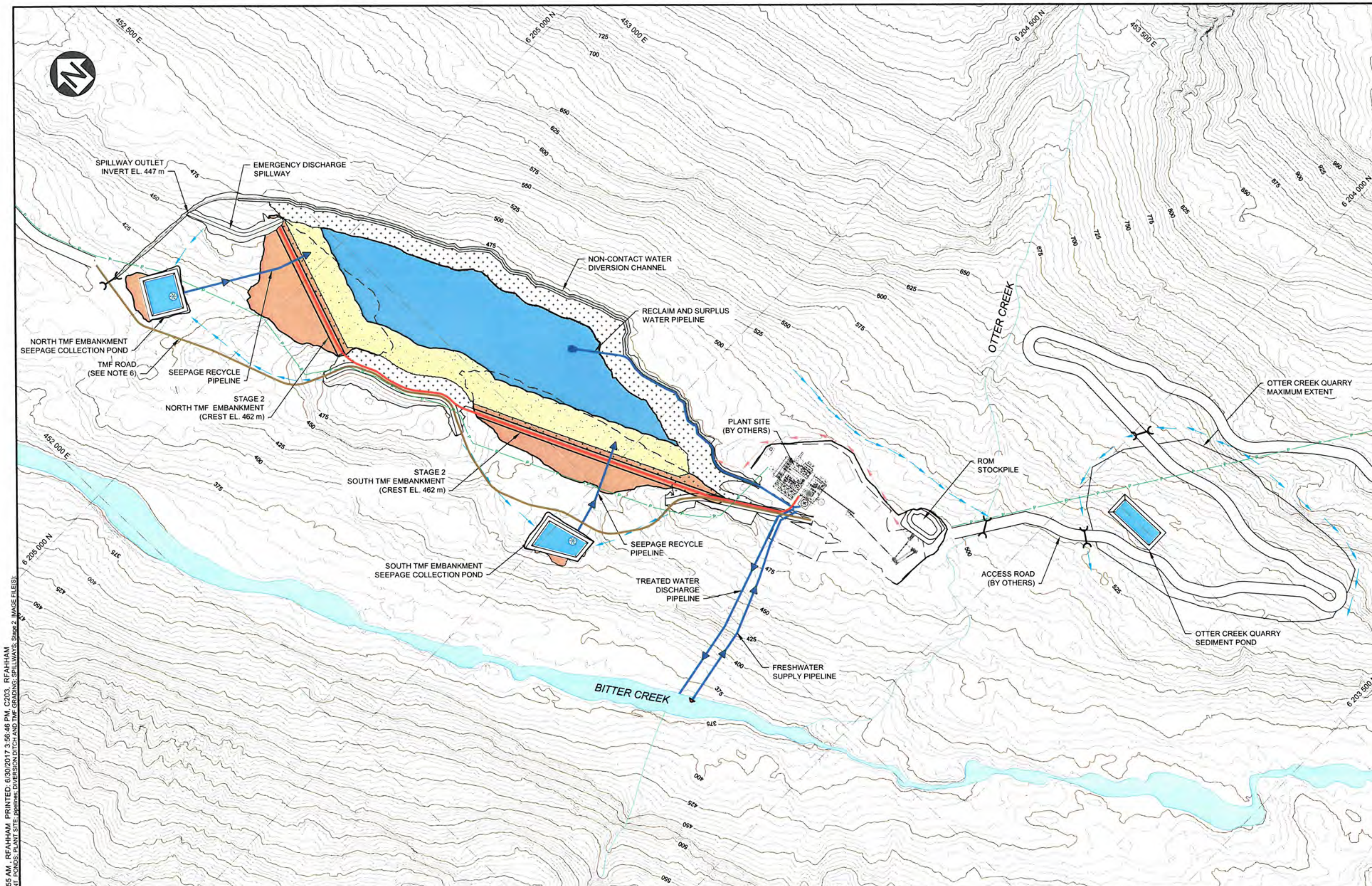

PLAN
SCALE A

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 60 30 0 100 200 300 m

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PROVINCE OF ... J. FOGARTY # 44041

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Knight Piésold CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
GENERAL ARRANGEMENT
STAGE 2 END OF YEAR 3

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C203	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

SAVED: M:\1\01\00594\04\A\cad\DWGS\C203\C203, 6/30/2017 9:32:55 AM, RFAHHAM PRINTED: 6/30/2017 3:56:46 PM, C203, RFAHHAM
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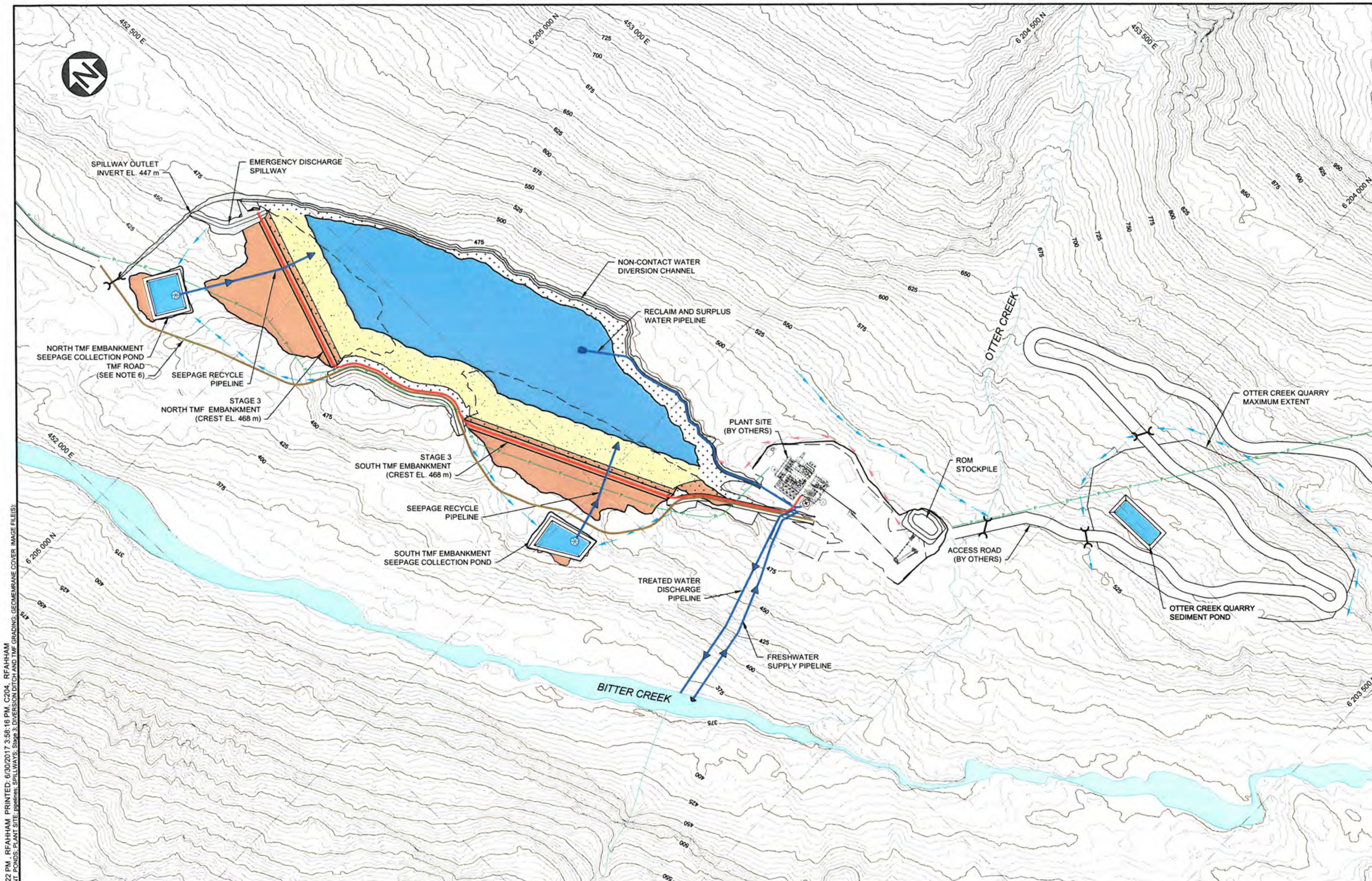

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 60 30 0 100 200 300 m

PLAN
SCALE A

PROFESSIONAL PROVINCE OF ... J. FOGARTY # 44041

<Original signed by>

<Original signed by>

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
GENERAL ARRANGEMENT
STAGE 3 END OF YEAR 5

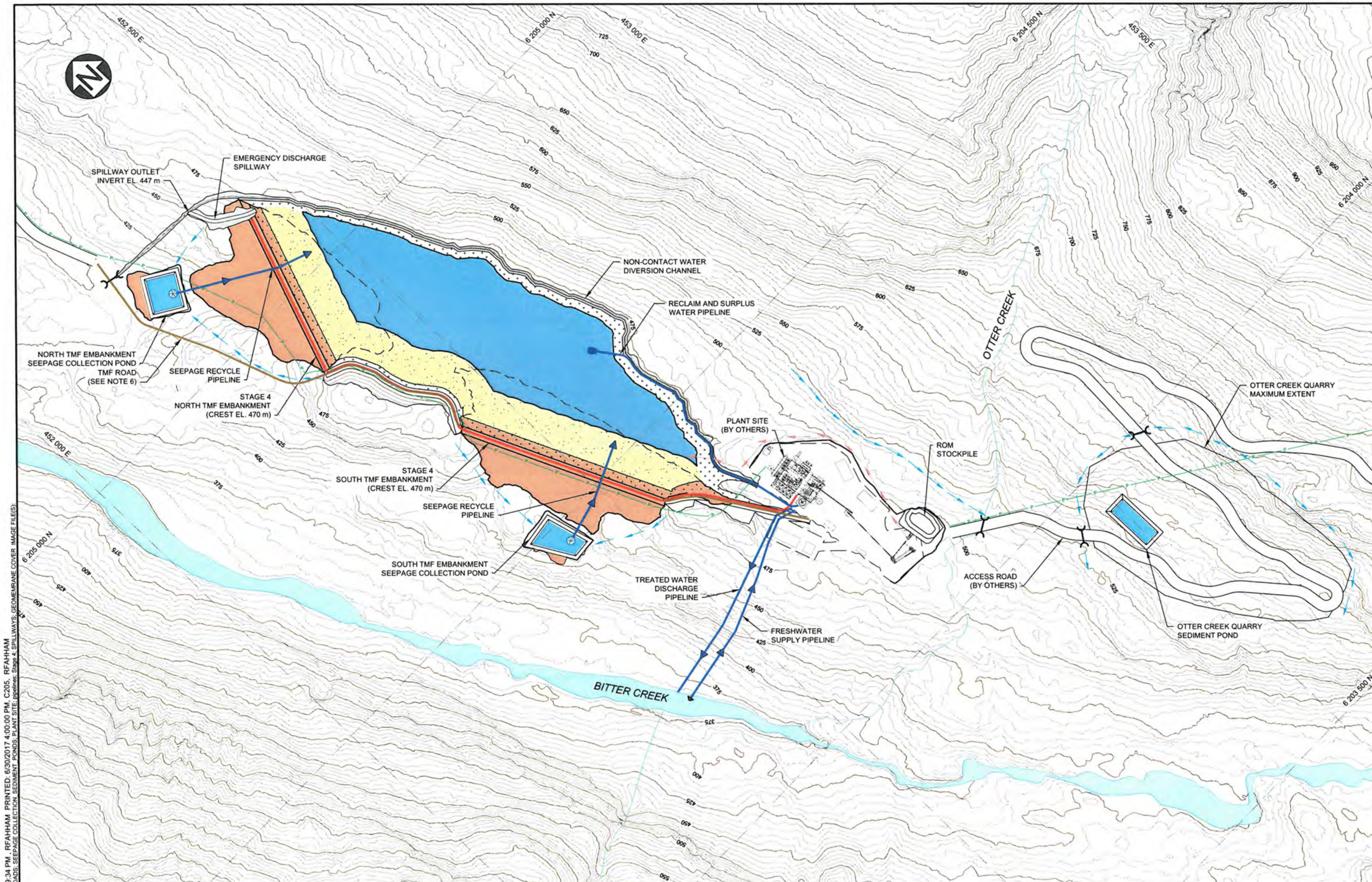
P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C204	0

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		
REVISIONS						

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C204\C204, 6/30/2017 1:51:22 PM, RFAHHAM PRINTED: 6/30/2017 3:58:16 PM, C204, RFAHHAM
XREF FILE(S): CONTOURS - 5 m; Hydro; ROADS; SEEPAGE COLLECTION SEDIMENT PONDS; PLANT SITE; pipelines; SPILLWAYS; Stage 3; DIVERSION DITCH AND TMF GRADING; GEOMEMBRANE COVER IMAGE FILE(S):



LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 60 30 0 100 200 300 m

PLAN
SCALE A

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C205\C205, 6/30/2017 12:19:34 PM, RFAHHAM PRINTED: 6/30/2017 4:00:00 PM, C205, RFAHHAM
XREF FILE(S): Hydro; CONTOURS - 5 m; DIVERSION DITCH AND TMF GRADING; ROADS; SEEPAGE COLLECTION SEDIMENT PONDS; PLANT SITE; pipelines; Stage 4; SPILLWAYS; GEOMEMBRANE COVER IMAGE FILE(S):

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PROFESSIONAL ... PROVINCE OF ... J. FOGARTY # 44041

<Original signed by>

<Original signed by>

Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF GENERAL ARRANGEMENT STAGE 4 END OF YEAR 6

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C205	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

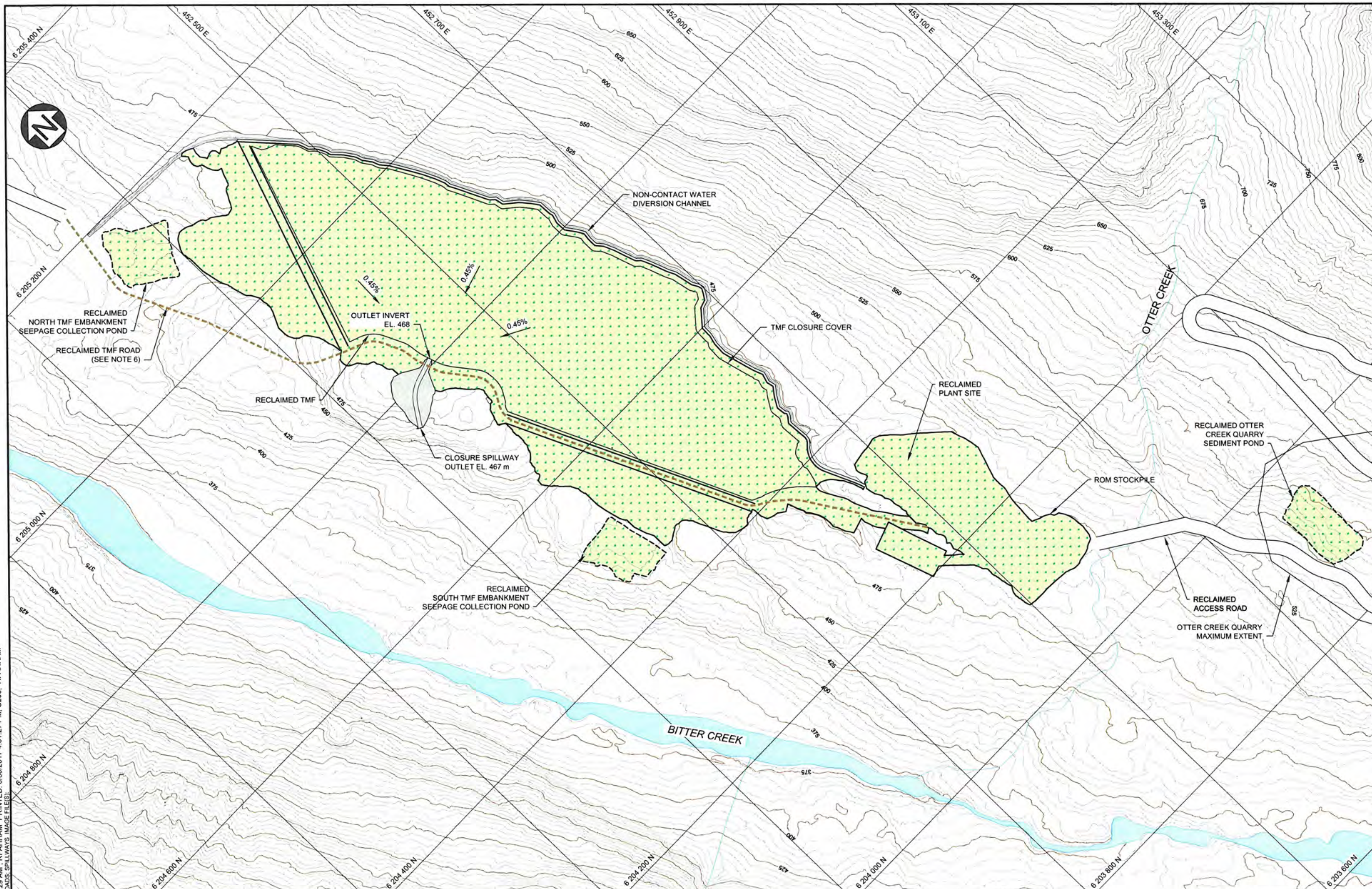
REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS



LEGEND:

RECLAIMED AREA

RECLAIMED ROAD

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (APRIL 2017).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).

FOR INFORMATION ONLY
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SCALE B 40 20 0 40 80 120 160 200 m

SCALE A 50 25 0 50 100 150 200 250 m

PLAN
SCALE A

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PROVINCE OF BC
J. FOGARTY
44041

<Original signed by>

<Original signed by>

Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF GENERAL ARRANGEMENT CLOSURE PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C206	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

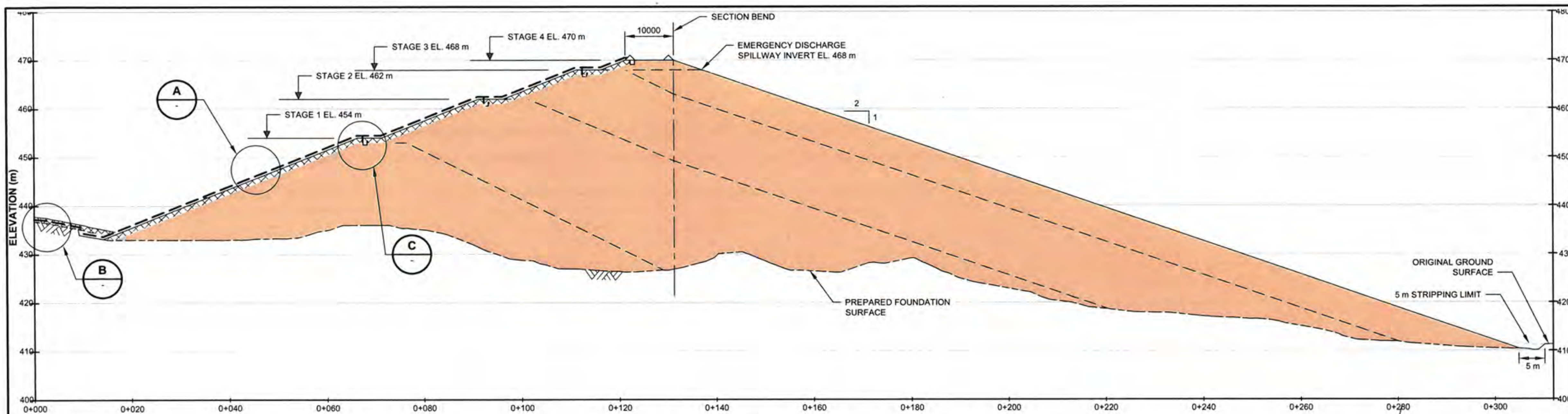
DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

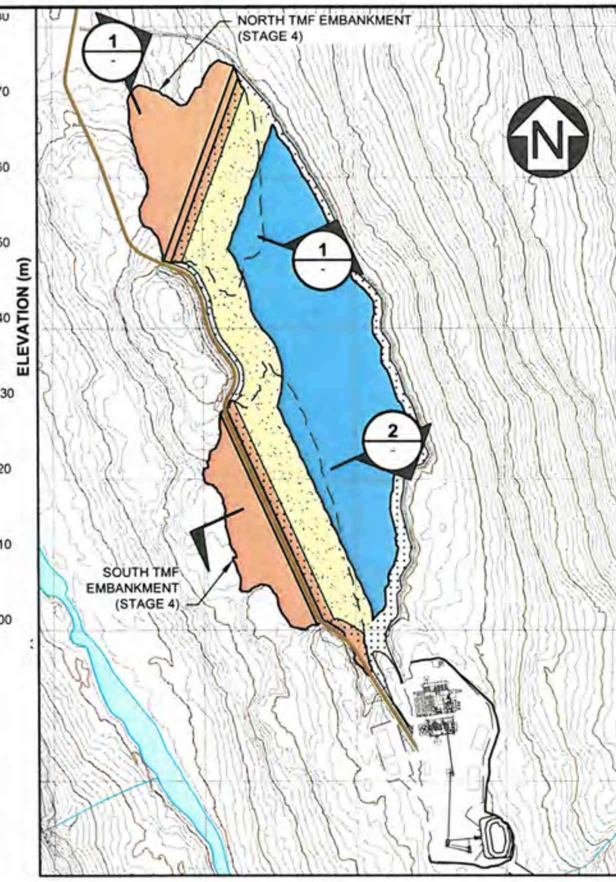
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C206\C206, 6/30/2017 9:27:29 AM , RFAHHAM PRINTED: 6/30/2017 4:01:27 PM, C206, RFAHHAM
XREF FILE(S): Hydro; CONTOURS - 5 m; DIVERSION DITCH AND TMF GRADING; ROADS; SPILLWAYS IMAGE FILE(S):



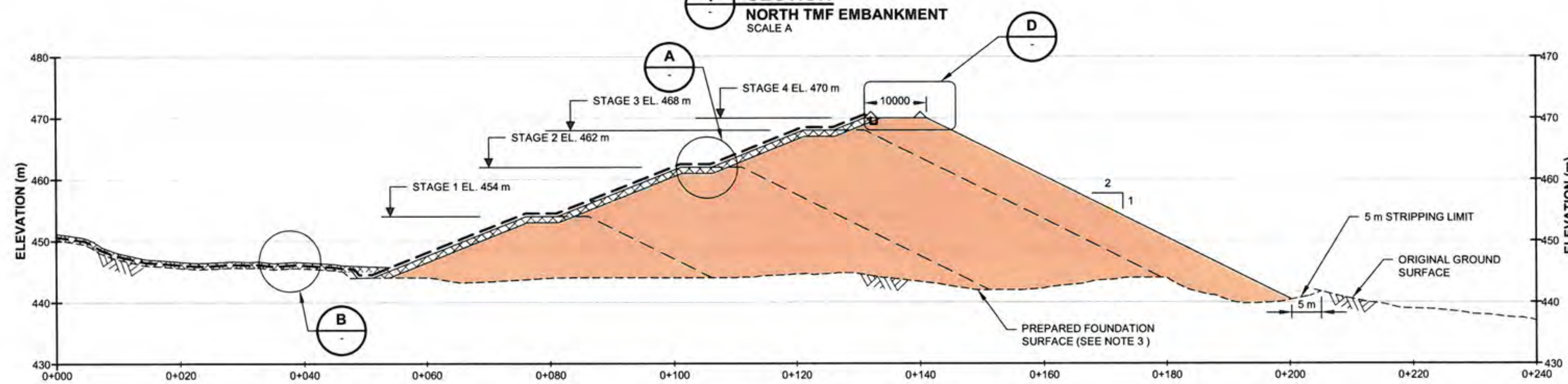
1 SECTION
NORTH TMF EMBANKMENT
SCALE A



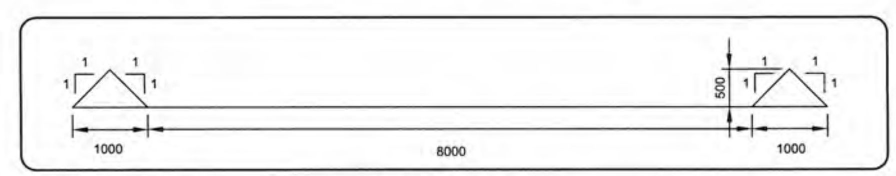
KEYPLAN

LEGEND:

- EMBANKMENT FILL
- ZONE F - FILTER SAND
- HDPE GEOMEMBRANE (SECTION)
- GEOTEXTILE



2 SECTION
SOUTH TMF EMBANKMENT
SCALE A



D DETAIL
NTS

NOTES:

1. TOPOGRAPHY PROVIDED BY JDS ENERGY & MINING INC. (JANUARY 2016).
2. DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

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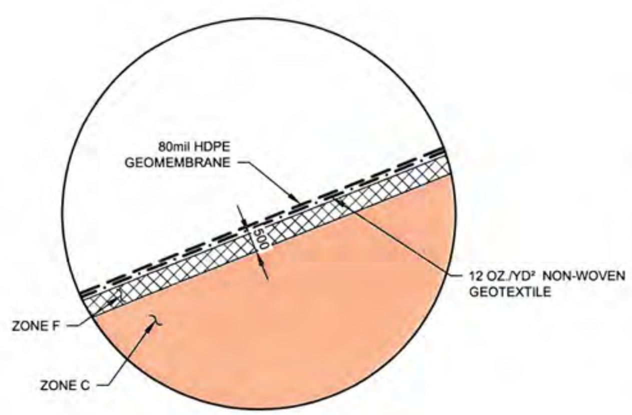
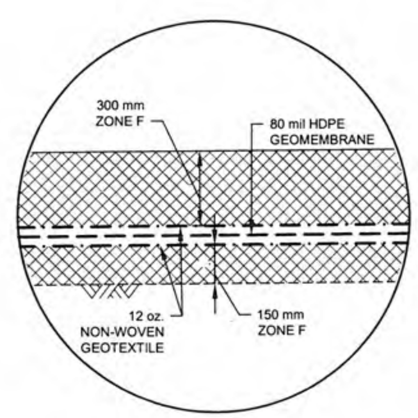
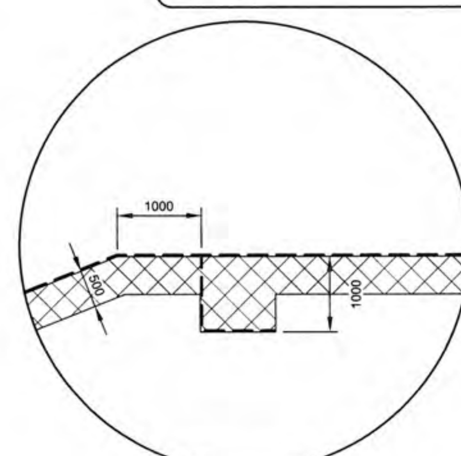
NOT FOR CONSTRUCTION



A DETAIL
NTS



B DETAIL
NTS



C DETAIL
NTS

SCALE A 10 5 0 10 20 30 40 50 m

PROVINCE OF BRITISH COLUMBIA — J. FOGARTY # 44041

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Knight Piésold CONSULTING

IDM MINING LTD.

RED MOUNTAIN GOLD UNDERGROUND PROJECT

TMF EMBANKMENT SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C207	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

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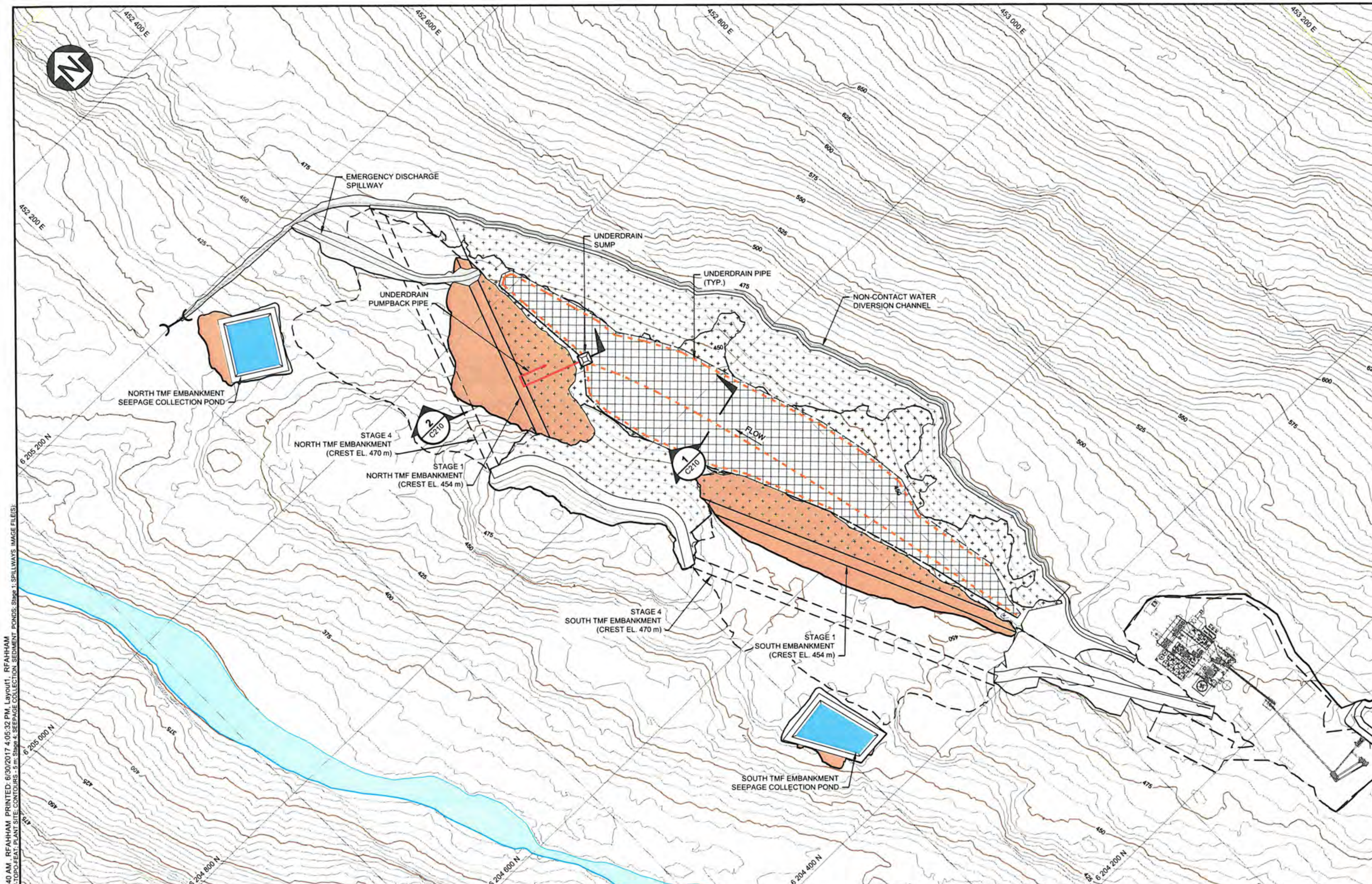
XREF FILE(S): CONTOURS - 5 m; Stage 4; ROADS; V-TOPO-FEAT; PLANT SITE; DIVERSION DITCH AND TMF GRADING; GEOMEMBRANE COVER IMAGE FILE(S):



PLAN
UNDERDRAIN
SCALE A

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- BASIN UNDERDRAIN (ZONE F)
- UNDERDRAIN PIPE (ABOVE GEOMEMBRANE)
- OUTLET PIPE
- CULVERT

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY
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SCALE A 40 20 0 40 80 120 160 200 m

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
TMF BASIN UNDERDRAIN
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C208	0

DRG. NO.	DESCRIPTION
C210	TMF BASIN UNDERDRAIN AND FOUNDATION DRAIN SYSTEMS - SECTIONS

REFERENCE DRAWINGS

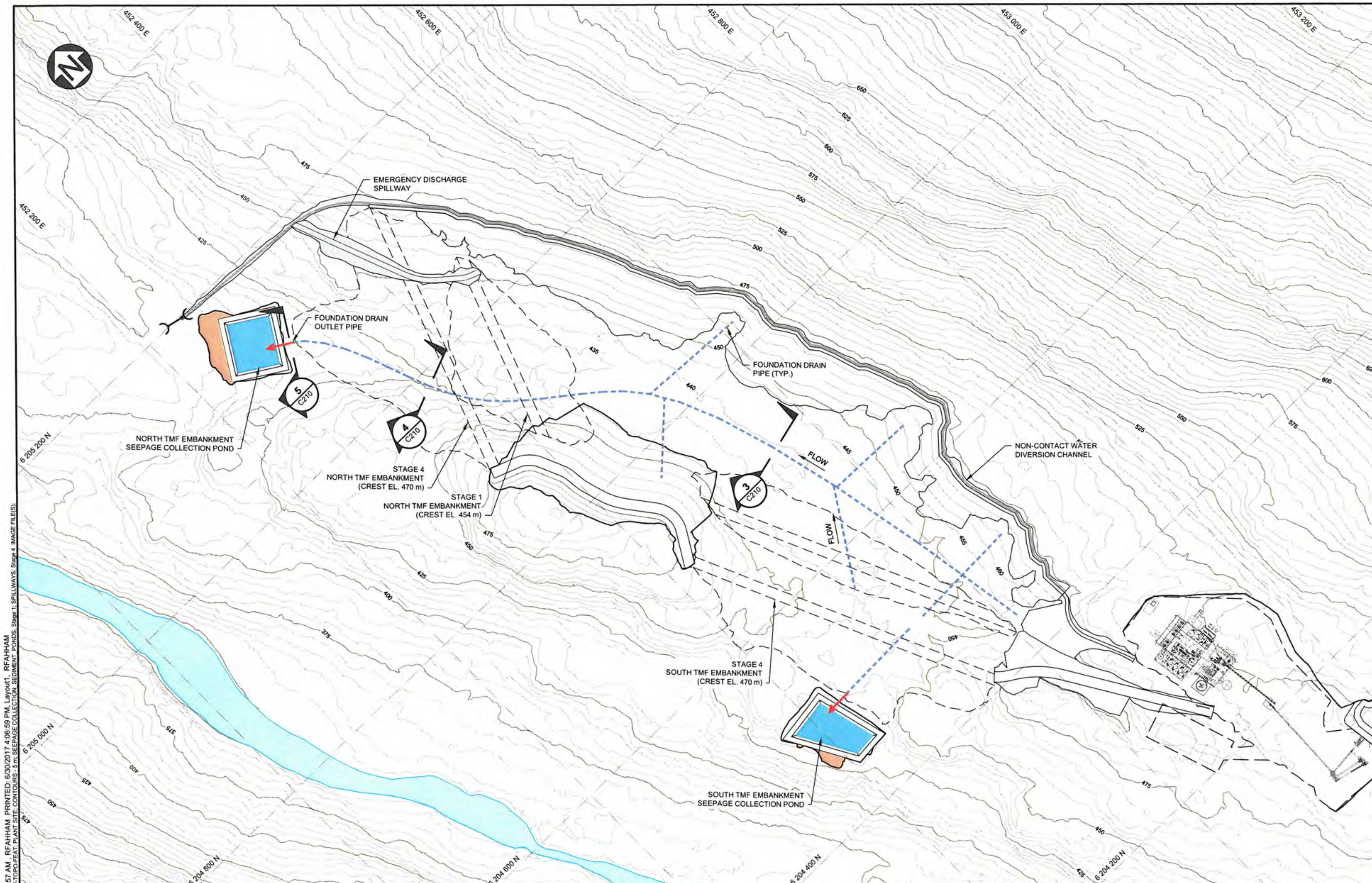
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C208\C208, 6/30/2017 9:34:40 AM, RFAHHAM PRINTED: 6/30/2017 4:05:32 PM, Layout1, RFAHHAM



PLAN
FOUNDATION DRAIN
SCALE A

LEGEND:

- FOUNDATION DRAIN PIPE (BELOW GEOMEMBRANE)
- OUTLET PIPE
- CULVERT

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 40 20 0 40 80 120 160 200 m

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Knight Piésold
CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
TMF FOUNDATION DRAIN
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C209	0

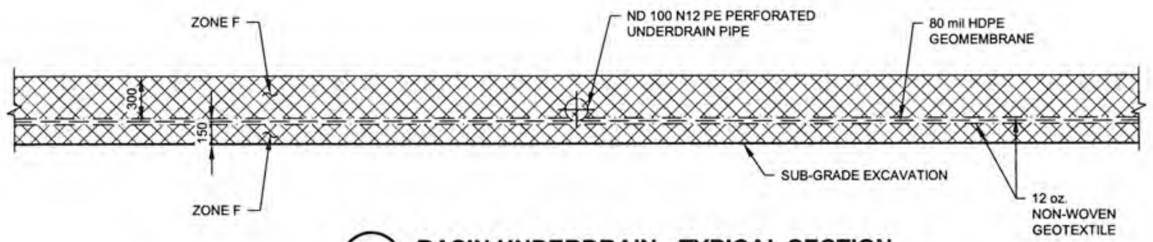
REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C210	TMF BASIN UNDERDRAIN AND FOUNDATION DRAIN SYSTEMS - SECTIONS

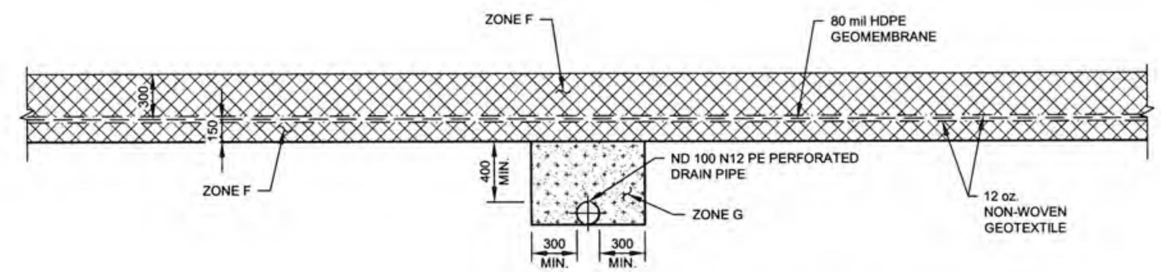
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

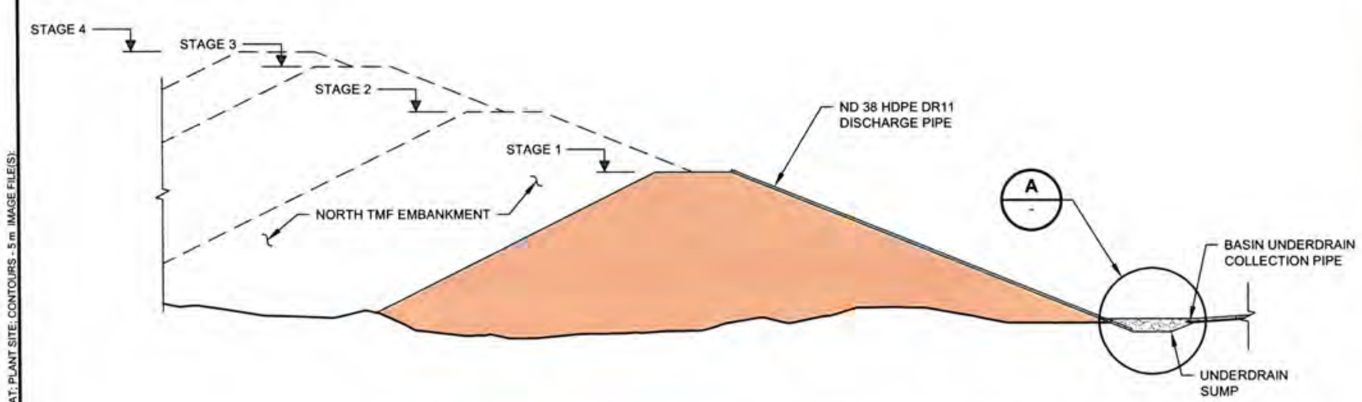
SAVED: M:\1\01\00594\04\A\Acad\DWGS\C209\C209, 6/30/2017 9:34:57 AM , RFAHHAM PRINTED: 6/30/2017 4:06:59 PM, Layout1, RFAHHAM



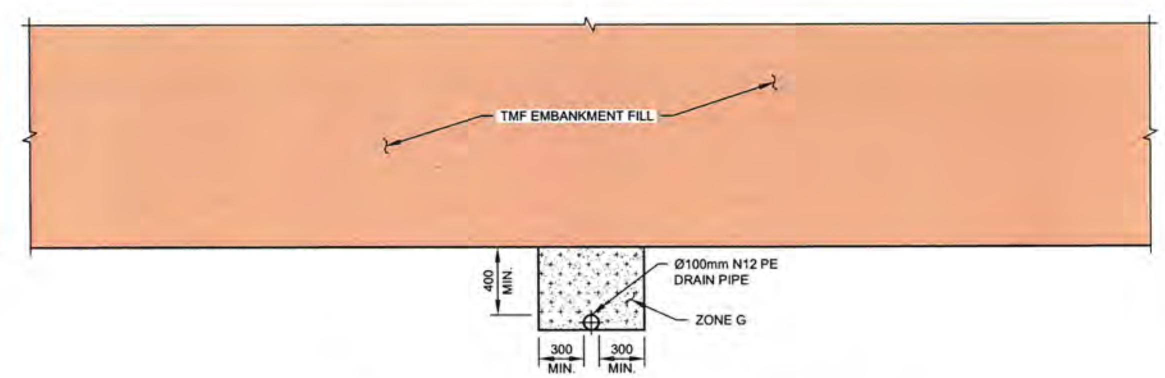
1 (C208) BASIN UNDERDRAIN - TYPICAL SECTION
BASIN FLOOR (ABOVE LINER)
SCALE A



3 (C209) FOUNDATION DRAIN TRENCH - TYPICAL SECTION
BASIN FLOOR (BELOW LINER)
SCALE A



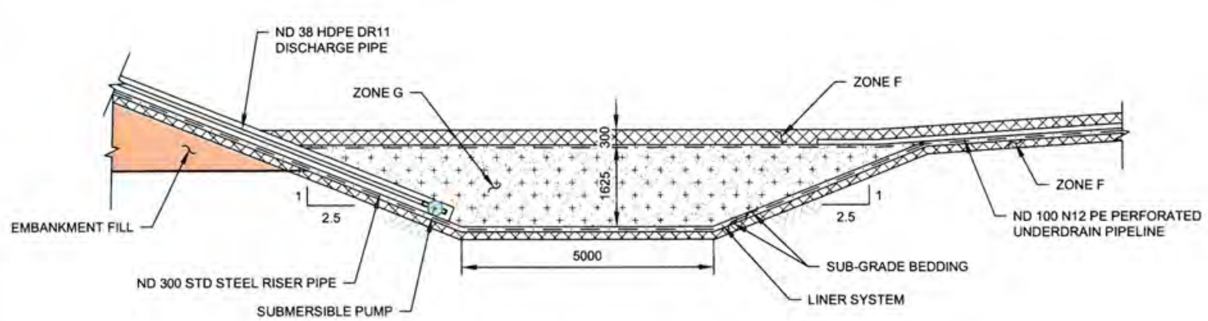
2 (C208) BASIN UNDERDRAIN PUMPBACK SYSTEM - SECTION
SCALE B



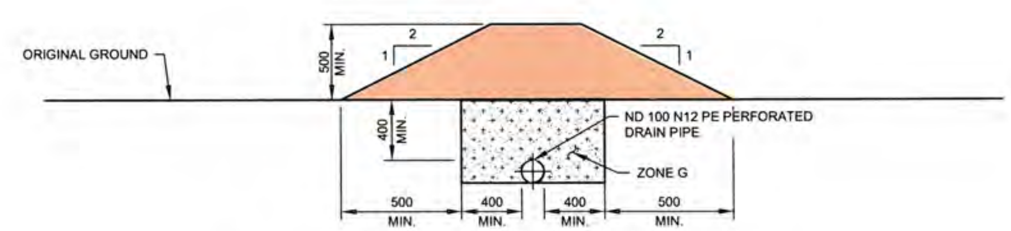
4 (C209) FOUNDATION DRAIN TRENCH - TYPICAL SECTION
BELOW EMBANKMENT FILL
SCALE A

LEGEND:
- EMBANKMENT FILL
- ZONE F - FILTER SAND
- ZONE G - DRAIN GRAVEL
- HDPE GEOMEMBRANE (SECTION)
- GEOTEXTILE

NOTES:
1. ALL DIMENSION ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
2. ENSURE FOUNDATION DRAIN TRENCH IS CONTINUOUSLY GRADED DOWNWARD TOWARDS SEEPAGE COLLECTION POND.



A UNDERDRAIN SUMP DETAIL
NTS



5 (C209) FOUNDATION DRAIN - TYPICAL SECTION
OUTLET PIPE (NO OVERLYING EMBANKMENT FILL)
SCALE A

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A: 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE B: 10 5 0 10 20 30 40 50 m

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<Original signed by>

Knight Piésold CONSULTING

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
TMF BASIN UNDERDRAIN AND FOUNDATION DRAIN SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C210	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
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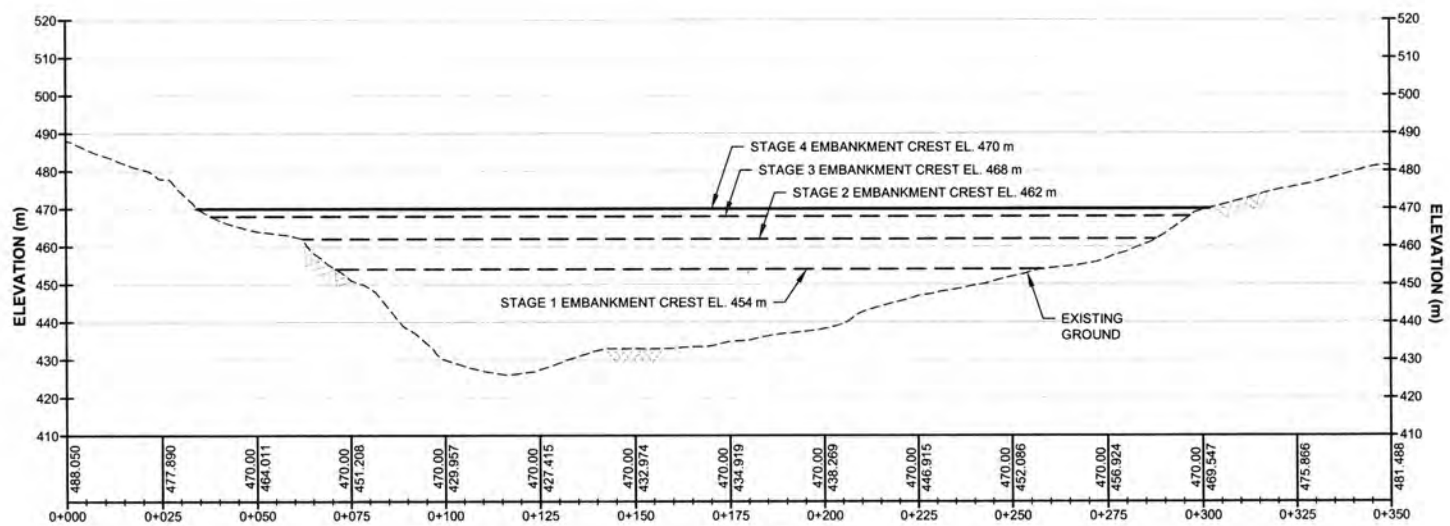
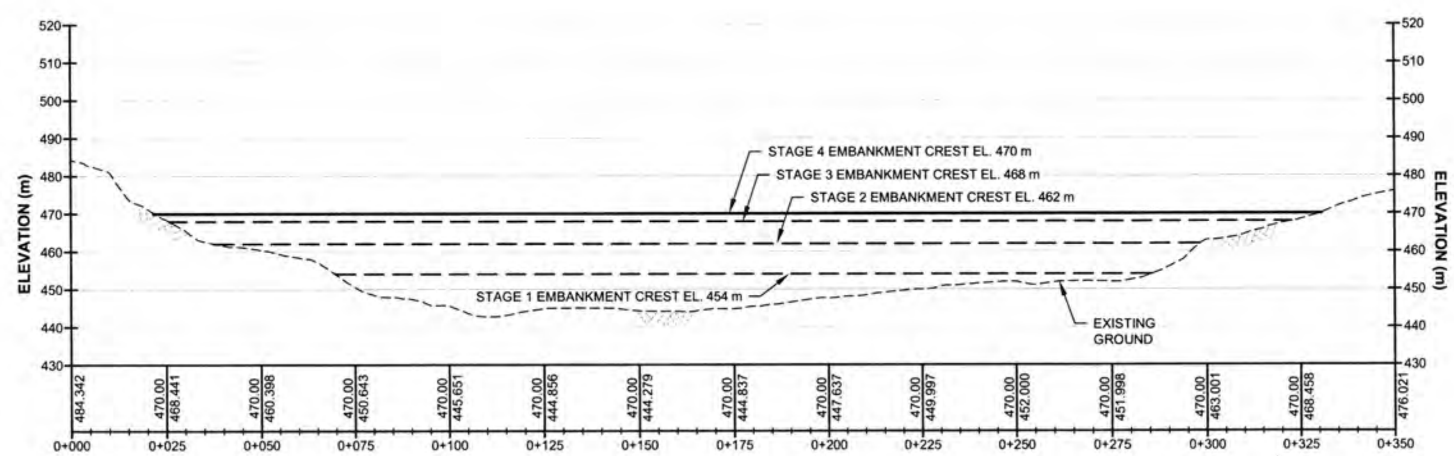
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

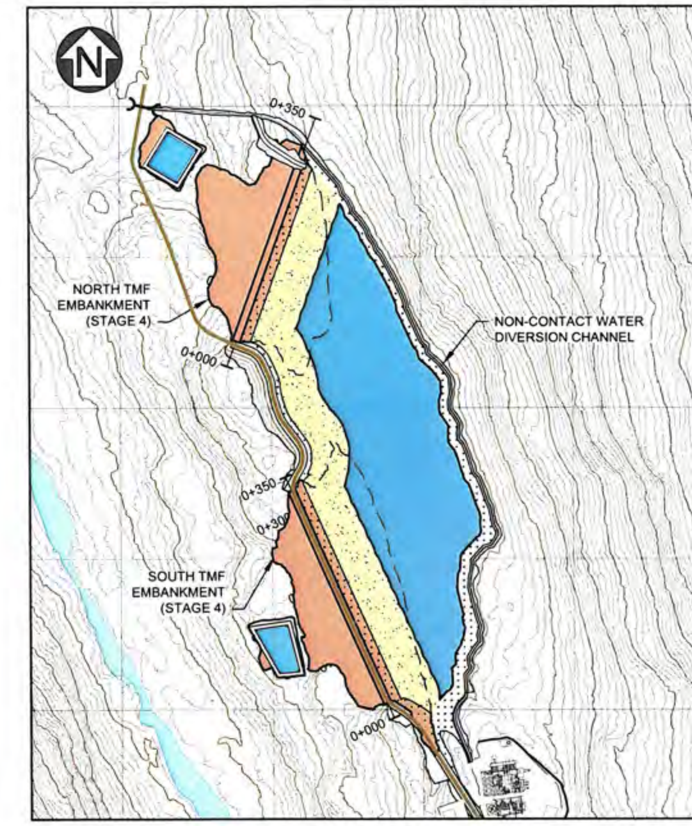
REVISIONS



PROFILE
NORTH TMF EMBANKMENT
SCALE A



PROFILE
SOUTH TMF EMBANKMENT
SCALE A



KEY PLAN

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 20 10 0 20 40 60 80 100 m

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PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA — J. FOGARTY # 44041

<Original signed by>

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IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
TMF EMBANKMENT
PROFILES

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C213	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

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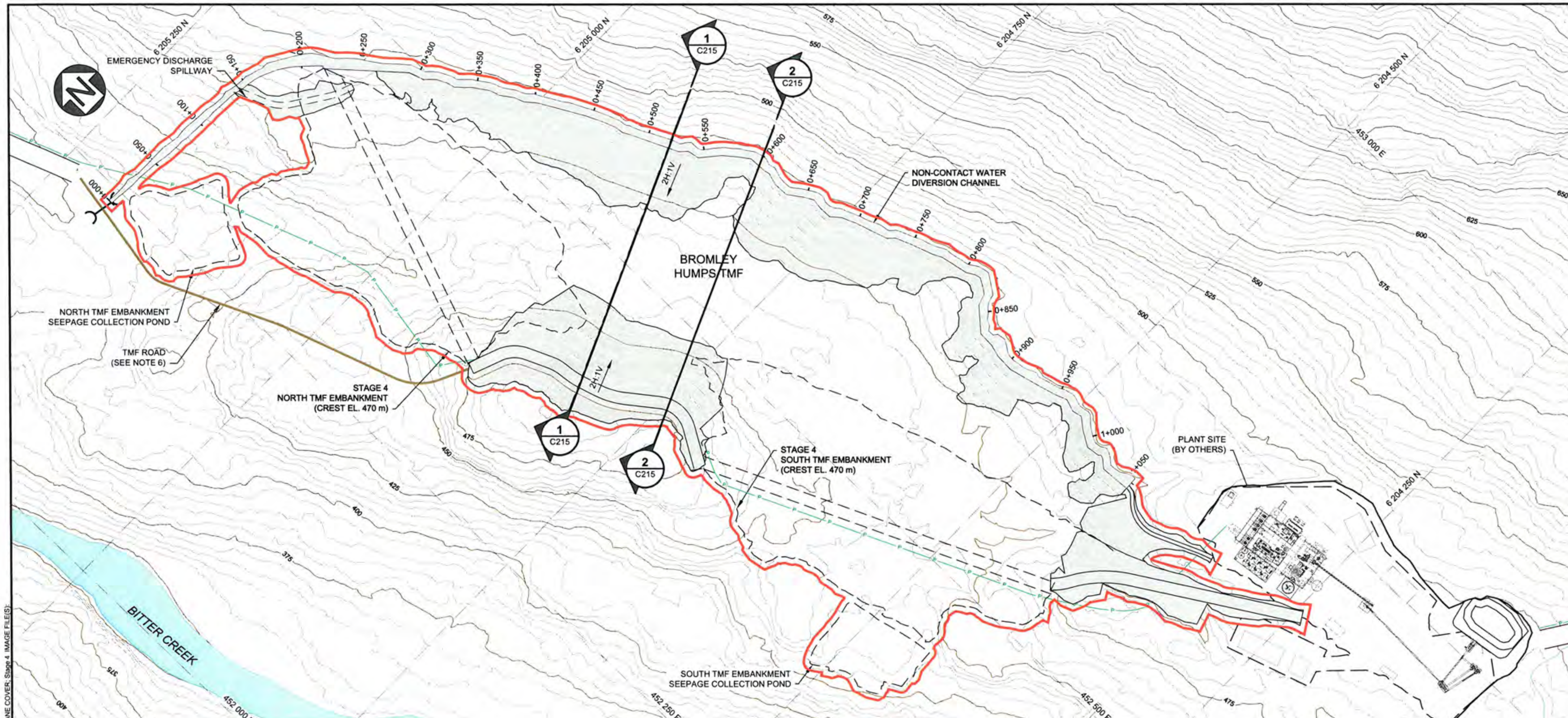

PLAN
SCALE A

LEGEND:

- SITE GRADING FILL
- CULVERT
- POWER LINE
- TMF ROAD
- STRIPPING LIMITS

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. PLANT SITE LOCATION PROVIDED BY JDS MINING (NOVEMBER 2016).
6. FINAL ROAD ALIGNMENT TO BE DESIGNED BY OTHERS (JDS MINING).
7. FINAL (STAGE 4) TMF LAYOUT SHOWN.
8. POWER LINE ALIGNMENT TO BE ADJUSTED BY JDS MINING.

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SCALE A 40 20 0 40 80 120 160 200 m

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RED MOUNTAIN GOLD UNDERGROUND PROJECT

BROMLEY HUMPS TMF
SITE GRADING - PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C214	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

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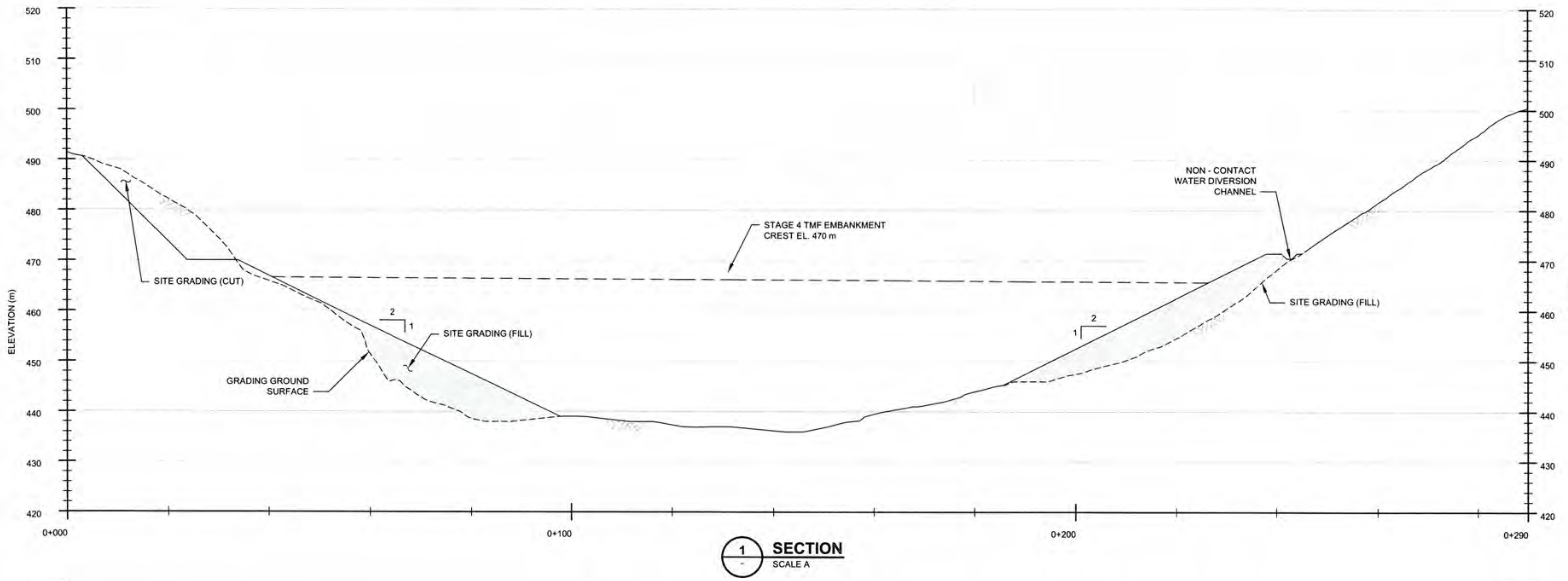
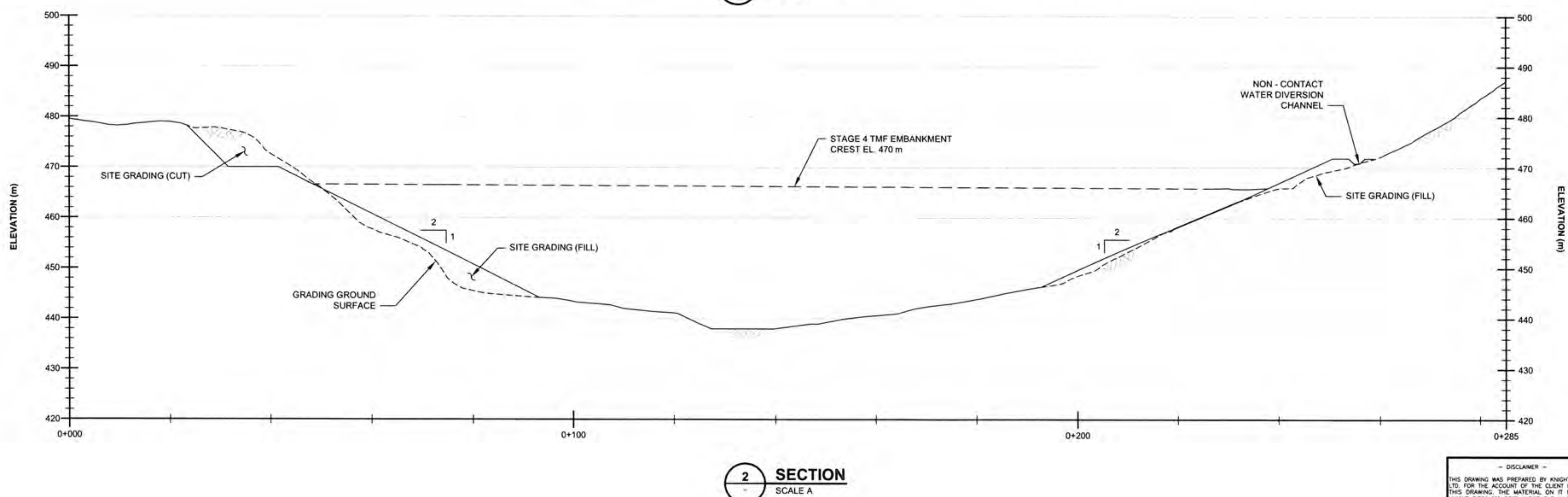


1 SECTION
SCALE A



2 SECTION
SCALE A

LEGEND:

SITE GRADING FILL

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. TOPO PROVIDED BY JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. FINAL (STAGE 4) TMF SHOWN.

FOR INFORMATION ONLY
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SCALE A 10 5 0 10 20 30 40 50 m

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<Original signed by>

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IDM MINING LTD.

RED MOUNTAIN GOLD UNDERGROUND PROJECT

BROMLEY HUMPS TMF
SITE GRADING - SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	C215	0

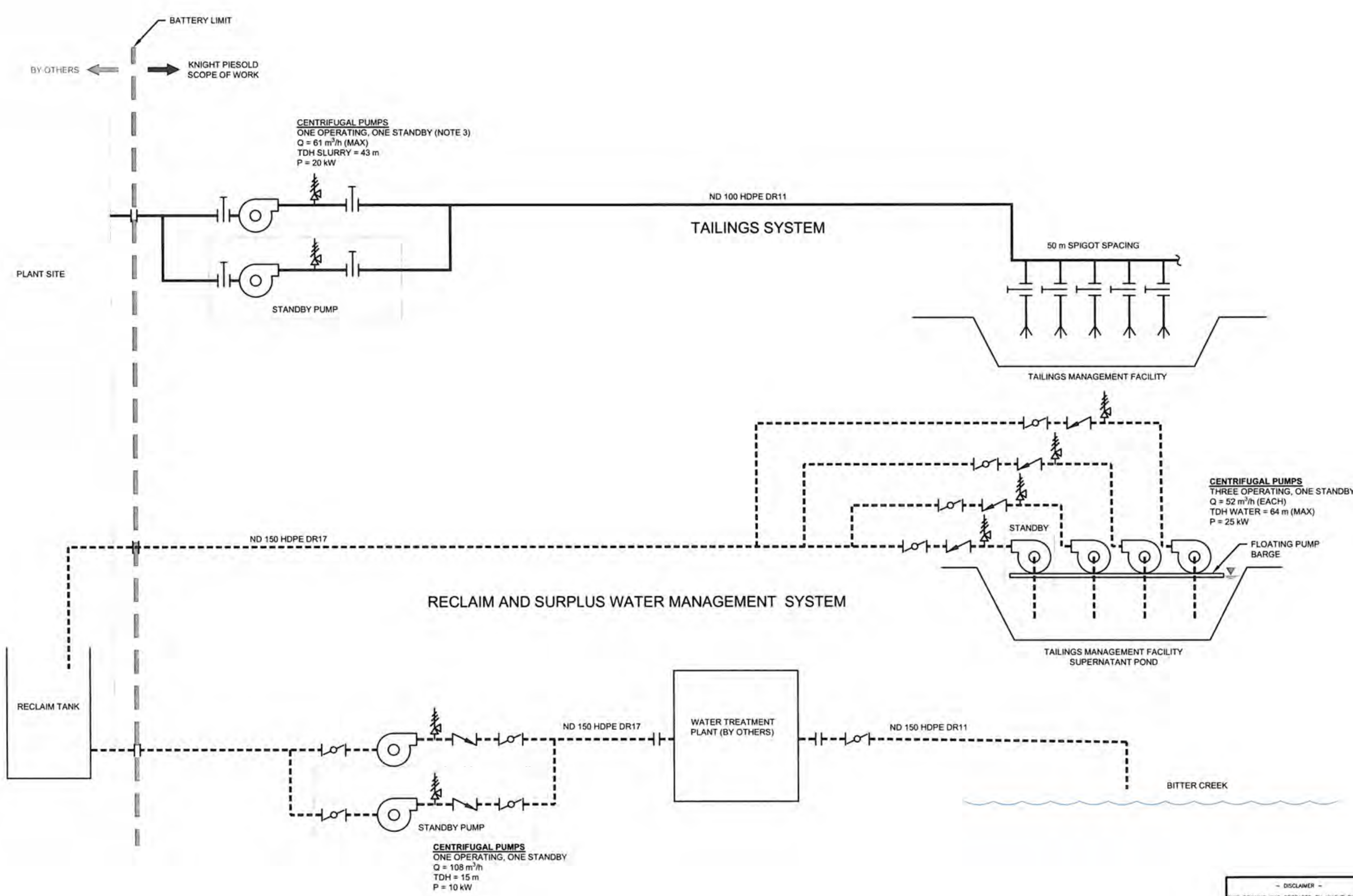
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

SAVED: M:\1\01\00594\04\A\Acad\DWGS\C215\C215, 6/30/2017 2:53:29 PM , RFAHHAM PRINTED: 6/30/2017 4:16:11 PM, Layout1, RFAHHAM



LEGEND:

- TAILINGS PIPELINE
- RECLAIM/RELEASE PIPELINE
- FLANGED CONNECTION
- CHECK VALVE
- BUTTERFLY VALVE
- KNIFE GATE VALVE
- AIR VALVE
- SPIGOT
- CENTRIFUGAL PUMP

NOTES:

1. PIPELINE NOMINAL DIAMETERS ARE IN MILLIMETERS AND PIPE LENGTHS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. AIR RELEASE VALVES TO BE INSTALLED AT HIGH POINTS AND GRADE CHANGES WITH INTERVALS NOT TO EXCEED 600 m, OR AS DIRECTED BY THE ENGINEER. SIZING AND SPECIFICATIONS TO BE COMPLETED NEXT LEVEL OF DESIGN.
3. PUMP CONFIGURATION SHOWN IN YEAR 1. FINAL CONFIGURATION REQUIRES TWO PUMPS IN SERIES PROVIDING 86 m TDH MAXIMUM.
4. SPIGOTS SIZED TO DISCHARGE FULL TAILINGS FLOW.

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<Original signed by>
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IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF
TAILINGS, RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEMS
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	M301	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

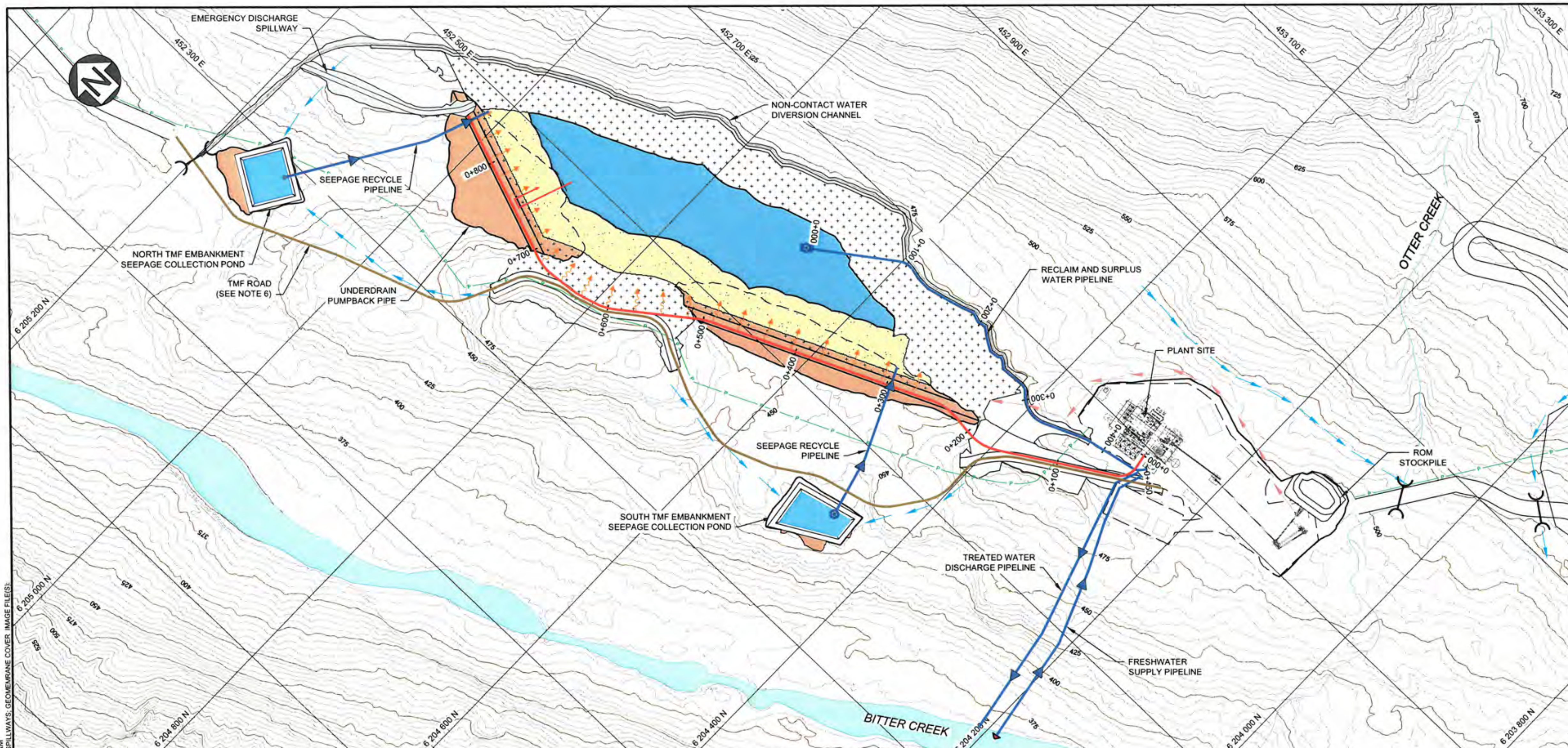
DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

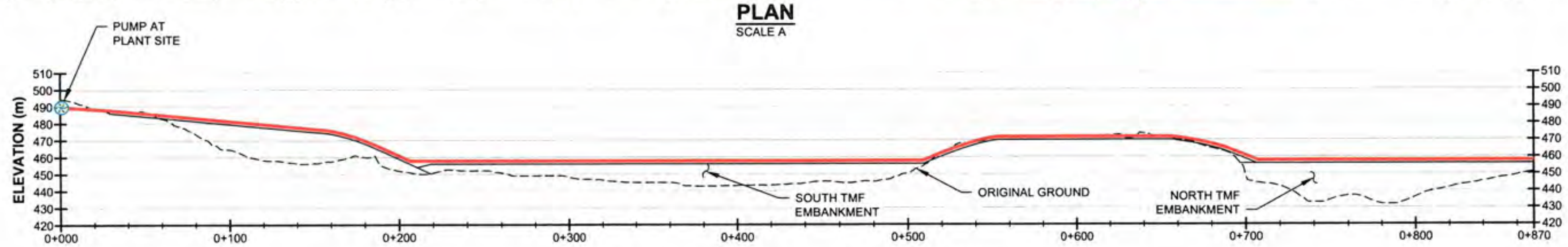
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

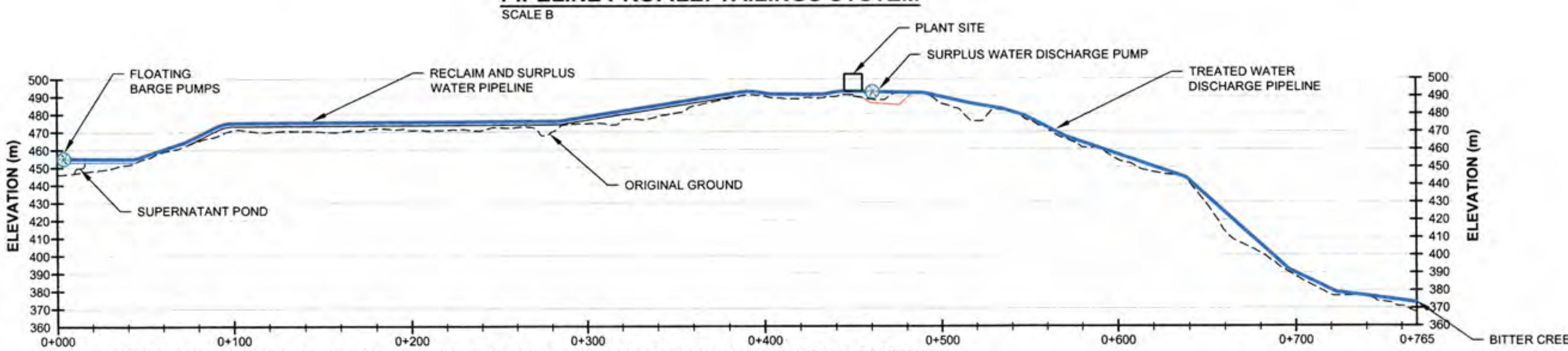
SAVED: M:\1\01\00594\04\A\Acad\DWGS\M301\M301, 6/30/2017 9:32:27 AM , RFAHHAM PRINTED: 6/30/2017 4:26:17 PM, M301, RFAHHAM
XREF FILE(S): IMAGE FILE(S):



PLAN
SCALE A



PIPELINE PROFILE: TAILINGS SYSTEM
SCALE B



PIPELINE PROFILE: RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEM
SCALE B

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- TAILINGS SPIGOT
- CULVERT
- COLLECTION DITCH
- TMF ROAD

NOTES:

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4. ALL ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
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SCALE B: 40 20 0 40 80 120 160 200 m

SCALE A: 50 25 0 50 100 150 200 250 m

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IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF TAILINGS, RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEMS STAGE 1 PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	M310	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

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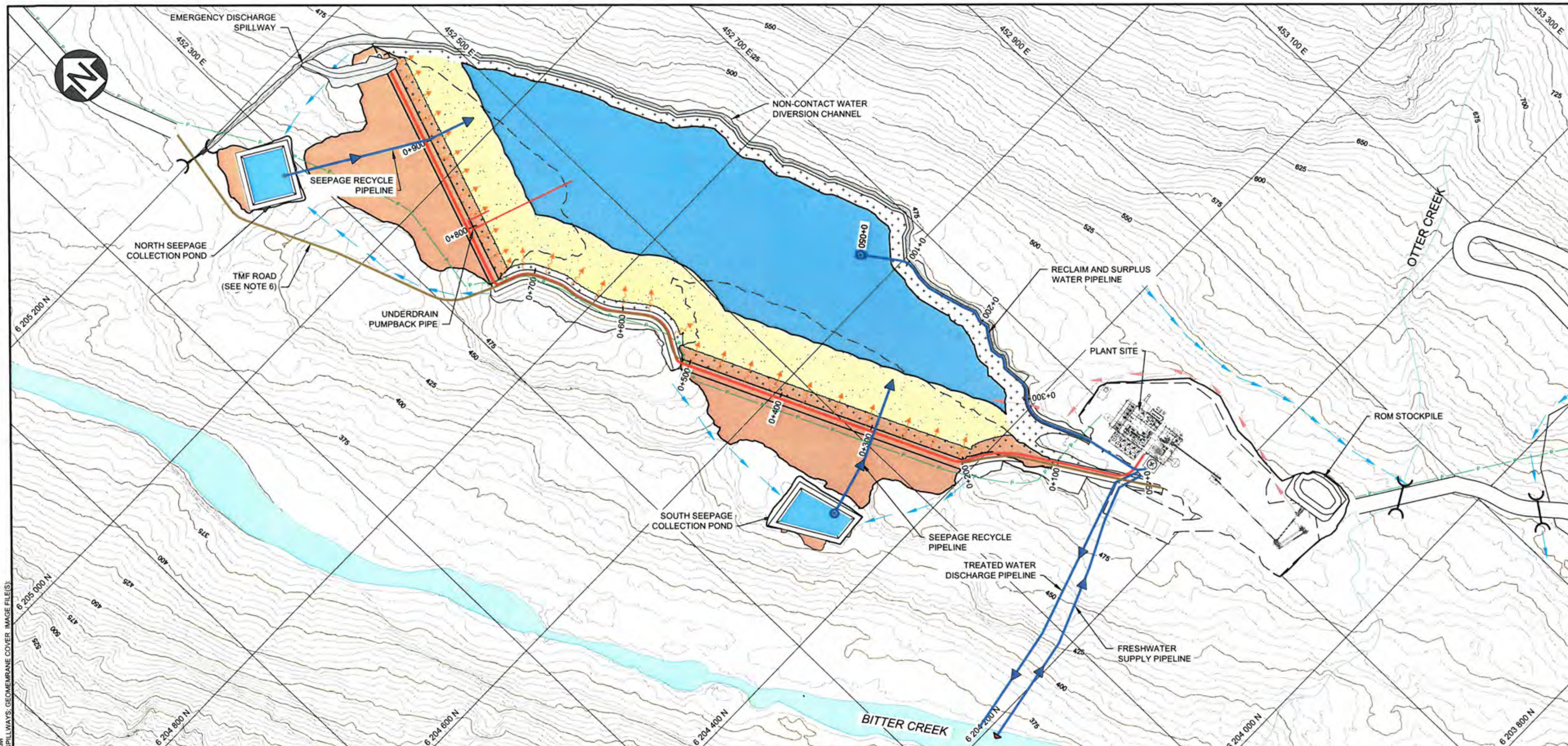
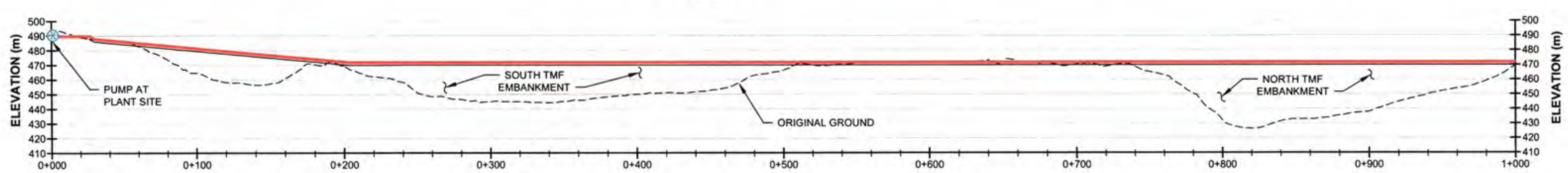
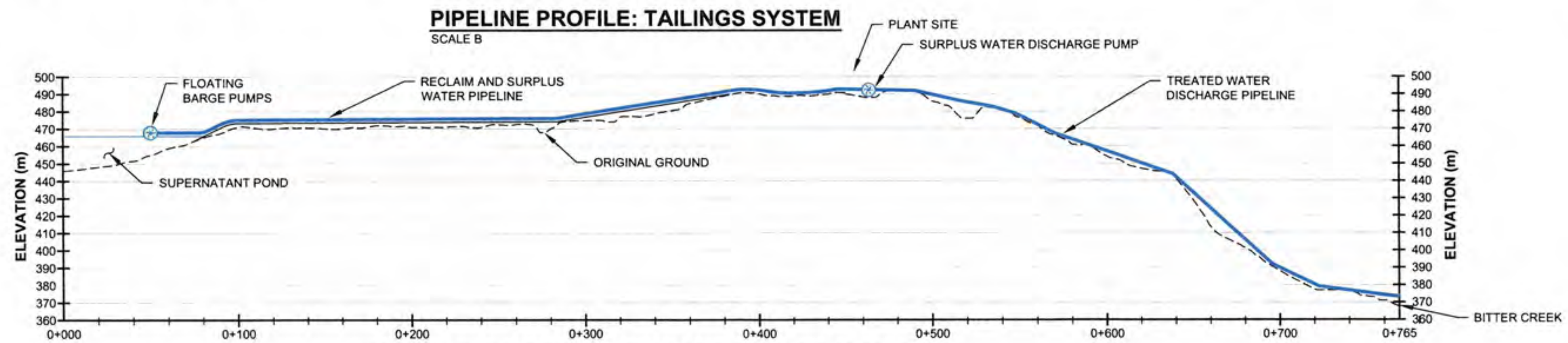


PLAN
SCALE A



PIPELINE PROFILE: TAILINGS SYSTEM
SCALE B



PIPELINE PROFILE: RECLAIM PIPELINE AND SURPLUS WATER MANAGEMENT SYSTEM
SCALE B

LEGEND:

- GEOMEMBRANE
- WATER
- EMBANKMENT FILL
- TAILINGS
- TAILINGS DELIVERY PIPELINE
- WATER MANAGEMENT PIPELINE
- FLOATING PUMP BARGE
- PUMP
- DIVERSION CHANNEL/DITCH
- POWER LINE
- TAILINGS SPIGOT
- CULVERT
- COLLECTION DITCH
- TMF ROAD

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RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF TAILINGS, RECLAIM AND SURPLUS WATER MANAGEMENT SYSTEMS STAGE 4 PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-594/4	M311	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29JUN'17	ISSUED WITH FEASIBILITY STUDY REPORT	JEF	RAF		

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APPENDIX C

STABILITY AND SEEPAGE ANALYSIS RESULTS

(Pages C-1 to C-18)

March 3, 2017

File No.:VA101-00594/04-A.01
Cont. No.:VA17-00261

Mr. Wayne Corso
V.P. Engineering
JDS Energy & Mining (Vancouver)
900 - 999 West Hastings Street
Vancouver, British Columbia
Canada, V6C 2W2

Dear Wayne,

Re: Bromley Humps TMF Seepage and Stability Analysis

1 – INTRODUCTION

Knight Piésold Ltd. (KP) is currently completing the Feasibility Level design of the Bromley Humps Tailings Management Facility (TMF), which will support the Environmental Assessment Application (EAA) for the Red Mountain Underground Gold Project (the Project).

A key component of the design is the assessment of the facility for geotechnical stability under seismic and static loading conditions, and an evaluation of potential seepage from the facility. This letter summarizes the results of the stability and seepage analyses during the construction and operations phase of the TMF.

A separate future analysis will assess seepage and stability of the TMF at closure.

2 – DAM HAZARD CLASSIFICATION

2.1 DAM HAZARD CLASSIFICATION AND DESIGN EVENT DETERMINATION

An assessment of the dam hazard classification was carried out to determine the appropriate design earthquake and flood events for the TMF. Selection of the design earthquake and flood events is based on the classification criteria provided by the Canadian Dam Association Dam Safety Guidelines (CDA, 2013 & 2014).

The TMF dam classification considers the potential incremental consequences of an embankment failure defined as the total damage from an event with dam failure minus the damage that would have resulted from the same event had the dam not failed. Three areas of losses are considered; loss of life, environmental and cultural values, and infrastructure and economics, as shown on Table 2.1 (reproduced from Table 2-1 of Dam Safety Guidelines (CDA, 2013)).

The selection of an Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) is governed by the dam classification. The criteria for selection of dam classification are outlined in Table 2.2 (reproduced from the Guidance Document for Part 10 of the Health, Safety and Reclamation Code for Mines in British Columbia (BC MEM, 2016)).

Table 2.1 Dam Hazard Classification (CDA, 2013)

Dam Class	Population at Risk[1]	Incremental Losses		
		Loss of Life[2]	Environmental and Cultural Values	Infrastructure and Economics
Low	None	0	Minimal short-term loss. No long-term loss.	Low economic losses; area contains limited infrastructure or services.
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat. Loss of marginal habitat only. Restoration in kind highly possible.	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes.
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat. Restoration or compensation in kind highly possible.	High economic losses affecting infrastructure, public transportation, and commercial facilities.
Very High	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat. Restoration or compensation in kind possible but impractical.	Very high economic losses affecting infrastructure or services (e.g., highway, industrial facility, storage facilities for dangerous substances).
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat. Restoration or compensation impossible.	Extreme losses affecting critical infrastructure or services (e.g. hospital, major industrial complex, major storage facilities for dangerous substances).

NOTES:

1. Definitions for population at risk:

   None – No identifiable population at risk, no possibility of loss of life other than through unforeseeable misadventure.

   Temporary – People are only temporarily in the dam-breach inundation zone (e.g. seasonal cottage use, transportation routes, recreation)

   Permanent – Population at risk is ordinarily located in the dam-breach inundation zone (e.g. permanent residents)

2. Implications for loss of life:

   Unspecified – The appropriate level of safety required at a dam where people are temporarily at risk depends on the number of people, exposure time, nature of activity and other conditions. Higher classes could be appropriate depending on requirements.

Table 2.2 Target Levels for Flood and Earthquake Hazards (BC MEM, 2016)

Dam Class	Annual Exceedance Probability (AEP)			
	Water Retaining Dams		Tailings Dams	
	IDF[2,3]	EDGM	IDF[2,3]	EDGM
Low	1/100	1/100	1/3 between 1/975 and PMF[4]	1/2,475[6]
Significant	Between 1/100 and 1/1,000	Between 1/100 and 1/1,000	1/3 between 1/975 and PMF[4]	1/2,475[6]
High	1/3 between 1/1,000 and PMF[4]	1/2,475[6]	1/3 between 1/1,000 and PMF[4]	1/2,475[6]
Very High	2/3 between 1/1,000 and PMF[4]	1/2 Between 1/2,475[6] and 1/10,000 or MCE[7]	2/3 between 1/1,000 and PMF[4]	1/2 Between 1/2,475[6] and 1/10,000 or MCE[7]
Extreme	PMF[4]	1/10,000 or MCE	PMF[4]	1/10,000 or MCE[7]

NOTES:

1. Acronyms: PMF (Probable Maximum Flood), AEP (Annual Exceedance Probability), MCE (Maximum Credible Earthquake)
2. Simple extrapolation of flood statistics beyond 1/1,000 AEP is not acceptable.
3. The Code requires that a facility that stores the inflow design flood use a minimum event duration of 72 hrs.
4. PMF has no associated AEP.
5. Mean values of the estimated range in AEP levels for earthquakes should be used. The earthquakes with the AEP as defined above are input as contributory earthquakes to develop Earthquake Design Ground Motion (EDGM) parameters.
6. The 1/2,475 AEP earthquake has been selected for consistency with seismic design levels given in the National Building Code of Canada (NBCC, 2010).
7. MCE has no associated AEP.

2.2 BROMLEY HUMPS TMF CLASSIFICATION

The TMF embankments have been designed for a HIGH dam safety classification. This classification considered the potential risks to population and potential incremental losses, which include:

- Loss of life (Loss to temporary population only – SIGNIFICANT (no permanent population directly downstream of TMF))
- Environmental and cultural values (Loss to *important* fish habitat with restoration highly possible – **HIGH** (anticipated impacts to Bitter Creek only)), and
- Infrastructure and economics (Losses to seasonal workplaces and infrequently used transportation routes – SIGNIFCANT (no public highway access directly downstream of TMF)).

The dam hazard classification is used to determine the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the TMF embankments. The following design flood and earthquake levels were adopted from the CDA guidelines (CDA, 2013 & 2014) and the BC Mining Code (BC MEM, 2016) for a HIGH dam hazard classification for the construction and operational phases of the project:

- IDF: 1/3 between 1/1,000 year return period event and the Probable Maximum Flood (PMF).
- EDGM: 1/2,475 year return period seismic event.

For a HIGH dam classification during the passive care phase (i.e. post-closure), CDA guidelines recommend that the TMF be designed to withstand the following seismic and precipitation events.

- IDF: 2/3 between the 1/1,000 year return period event and the PMF.
- EDGM: 1/2 between the 1/2,475 year and 1/10,000 year (or Maximum Credible Earthquake) return period seismic events.

The TMF dam hazard classification may be re-evaluated based on the results of the planned TMF Dam Breach Assessment.

3 – MATERIALS AND PARAMETERS

3.1 MATERIAL DESCRIPTIONS

3.1.1 Embankment and Construction Materials

The TMF embankments have been designed with the following design criteria:

- Embankment side slopes of 2.5H:1V upstream and 2H:1V downstream.
- Embankment crest width of 10 m to allow one-way haul truck access with safety berms.
- TMF basin fully lined with a 100 mil HDPE geomembrane, with 16 oz. non-woven geotextile underlay and overlay to protect the liner from puncturing, installed on a processed bedding layer to provide a smooth surface for liner installation.
- Main embankment fill zone (Zone C) constructed using granular fill from local borrow.
- Processed Transition Zone (Zone T) and Filter Zone (Zone F) constructed on upstream embankment face, between the HDPE geomembrane bedding layer and the Zone C fill material. Each zone is approximately 1 m thick built in compacted horizontal lifts.
- An underdrain system will be installed on top of the geomembrane, to promote tailings consolidation, and will be constructed using granular fill from local borrow.

The critical section through the TMF North Embankment (i.e. the largest cross-section through the embankment), is shown on Figure 3.1. The tailings surface corresponds to the final tailings throughput (~2 Mtonnes) plus the supernatant pond volume.

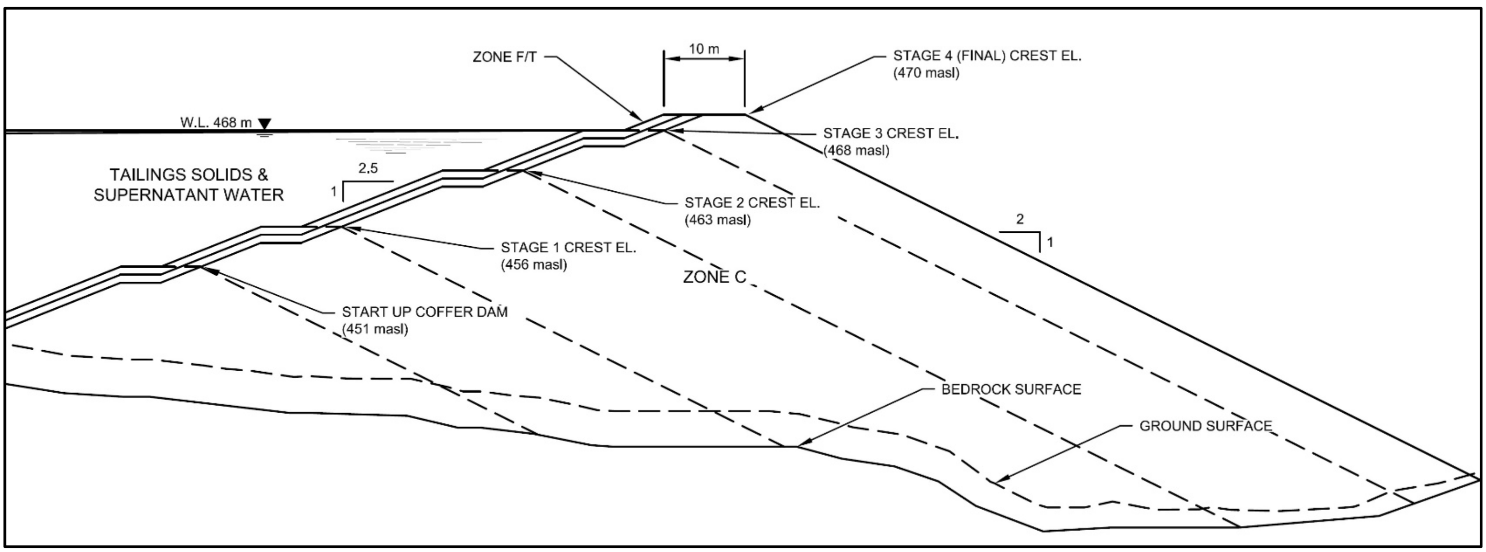

Figure 3.1 TMF North Embankment Critical Section

3.1.2 Tailings Materials

Thickened tailings will be deposited at a nominal solids content of 50% solids content by weight. Laboratory testing of the tailings material is on-going at the time of release of this document, therefore typical values were used for similar tailings (discussed further in Section 3.2.1 and 3.2.2).

3.1.3 Foundation Materials

The foundation conditions at the TMF were assessed based on the geological and geotechnical information presented in the 2016 Site Investigation Report (KP, 2016). Foundation conditions at the TMF embankments encountered an average thickness of overburden of approximately 1-2 m, with prevalent bedrock outcrops. Overburden is predominantly characterized by a layer of colluvium (well graded sandy gravel) overlain by a thin veneer (approx. 10 cm thick) of topsoil and organic material. Some thicker deposits of colluvium are underlain by deposits of glacial till.

Overburden beneath the TMF embankment footprints will be excavated, and the embankments constructed on bedrock.

3.2 MATERIAL PROPERTIES

3.2.1 Material Strength Properties

The material unit weights and effective strength parameters used in the analyses are provided in Table 3.1. Parameters incorporated into the stability analyses are described below:

3.2.1.1 TMF Embankment Fill Materials

The shear strength of the embankment fill is based on a function that defines the variation of shear strength with normal stress. The shear strength of rock materials typically reduces at higher stresses due to the crushing of particle contact points within the material and a reduction in material dilatancy. Shear strength is also related to the density and durability of the material and the particle size distribution. The strength function representative of lower shear strength rockfill (Leps, 1970) was selected based on the assumption that fill may comprise of low density, poorly graded, weak particles.

Bulk unit weights and effective friction angles for Zone F and Zone T materials were based on typical values for similar materials.

3.2.1.2 Thickened Tailings

Bulk unit weight of the tailings was assumed based on experience with similar tailings.

Table 3.1 Material Strength Properties

Material Type	Model	Unit Weight[1] γ kN/m³	Effective Friction[1] ϕ' degrees	Effective Cohesion c' kPa	τ/σ Ratio
Embankment Fill	Shear/Normal Function (Lower Bound Leps)	19	-	-	-
Filter Zone	Mohr-Coulomb	18.5	37	0	-
HDPE Liner Bedding Layer	Mohr-Coulomb	17.5	37	0	-
Transition Zone	Mohr-Coulomb	20	38	0	-
Tailings	S=f(overburden)	19	-	-	0.25

4 – SEISMIC HAZARD EVALUATION

4.1 GENERAL

The Canadian Dam Association Dam Safety Guidelines (CDA, 2014) and the Health Safety and Reclamation Code for Mines in British Columbia (BC MEM, 2017) both state that for tailings dams, the minimum design criteria corresponds to that of the 1/2,475 year return period seismic event (i.e. a 2% probability of exceedance in 50 years) for a Dam Hazard Classification of HIGH or lower..

The following return period events have been selected as the design earthquake events or the various phases of the TMF, based on the dam hazard classification:

- Construction and Operations Phases: 1/2,475 year.
- Passive Care Phase (i.e. Post Closure): 1/2 between 1/2,475 year and 1/10,000 year.

The EDGM for the Passive Care Phase has been adopted as the Maximum Design Earthquake (MDE) for the life of the TMF, while the EDGM for the Construction and Operations Phases will be used as the Operating Basis Earthquake (OBE).

4.2 METHODOLOGY

Spectral accelerations (Sa) and Peak Ground Accelerations (PGA) were obtained for the project site using the Natural Resources Canada Seismic Hazard Calculator (NRCAN, 2015). The calculator provides these parameters for events up to a 1/2,475 year seismic event. To obtain the 1/10,000 year seismic event parameters, the parameters for the 1/475 year and 1/2,475 year return period events were plotted on a log-log scale, and the values extrapolated to estimate the parameters for the 1/10,000 year seismic event, following procedures provided by NRCAN for estimating low-probability return period seismic events (NRCAN, 2016).

The Peak Ground Accelerations for the Project are as follows:

- 1/2,475 year return period seismic event = 0.064g (OBE).
- 1/10,000 year return period seismic event = 0.12g.

The MDE was evaluated as 1/2 between these two events, as follows:

- 1/2 between 1/2,475 year and 1/10,000 year return period seismic events = 0.092g (MDE).

A design earthquake magnitude of 7.5 has been estimated for the MDE.

5 – STABILITY ANALYSIS APPROACH AND METHODOLOGY

5.1 GENERAL

A stability analysis of the critical section through the TMF North Embankment (i.e. the maximum height of the TMF embankment) was completed to investigate the stability under static and seismic loading conditions. A brief discussion of the methodology and design criteria is presented below, with typical cross-sections and results.

5.2 MODELLING APPROACH

The following cases have been evaluated for stability analysis of the TMF:

- Static conditions at the end of construction (i.e. prior to basin filling) for all stages of embankment construction.
- Static conditions post deposition (i.e. long term conditions) for all stages of embankment construction.
- Earthquake loading from the Maximum Design Earthquake (MDE) and Operating Basis Earthquake (OBE) for all stages of embankment construction.

The recommended Factors of Safety (FOS) applicable to the design of the TMF, as per Table 6-2 and Table 6-3 of the Canadian Dam Association's Dam Safety Guidelines (CDA, 2013 & 2014) and Tables 3-1 and 3-2 of the BC Mines Code Guidance Document (BC MEM, 2016) are summarized on Table 5.1:

Table 5.1 Factors of Safety for Slope Stability

Loading Condition	Minimum FOS	Slope
End of construction, prior to filling	1.5	Upstream and downstream
Long term (steady-state seepage, normal reservoir level)	1.5	Downstream
Full or partial rapid drawdown	1.5	Upstream
Psuedo-static	1.0	Upstream and downstream
Post-earthquake	1.2 – 1.3	Upstream and downstream

Rapid drawdown conditions were not analyzed for the TMF as it is a fully lined facility and there would be no change in the pore water pressures within the embankment in the event of a drawdown.

The stability analysis was carried out using the limit equilibrium program SLOPE/W (Geostudio, 2012). This program uses a systematic search to obtain the minimum factor of safety associated with the critical slip surface. The FOS were calculated using the Morgenstern-Price method.

5.3 PIEZOMETRIC LEVELS AND PORE PRESSURE RESPONSE

The TMF is a fully lined facility, therefore it is expected that the TMF embankments will be unsaturated. For conservatism, the groundwater table was assumed to be at the top of the excavated ground surface, at the bedrock-overburden interface, and the piezometric line was fully specified in the model. The groundwater table was encountered at depths of between 10 m to 25 m beneath the TMF North Embankment during recent investigations.

The construction of the embankments could generate excess pore pressures in the overburden under saturated conditions, which could lead to instability of the embankments during operations prior to the dissipation of excess pore pressures. It is therefore assumed that the overburden materials will be excavated and the embankments will be constructed on bedrock.

5.4 SEISMIC STABILITY

Seismic loading was modelled by performing pseudo-static analyses for the MDE, as required by BC MEM regulations and CDA guidelines. Pseudo-static analyses apply a horizontal force (seismic coefficient) to the model to simulate earthquake loading. The horizontal seismic coefficients used in the seismic stability analysis were estimated using the formula developed by Melo and Sharma (2004), K_H = 0.5 x PGA, as follows:

- OBE = 1/2475 year = 0.032g (PGA = 0.064g).
- MDE = 1/2 between 1/2,475 year and 1/10,000 year = 0.046g (PGA = 0.092g).

The minimum required FOS for the pseudo-static analysis and post-earthquake conditions are 1.0 and 1.2 respectively. Satisfying this requirement implies the design earthquake events would result in deformations that are acceptable and do not affect the integrity of the facilities (i.e. are not anticipated to affect required embankment freeboard and HDPE liner integrity).

6 – TMF STABILITY ANALYSIS RESULTS

6.1 GENERAL

The stability analysis for the TMF was based on the critical section through the North TMF Embankment (the larger of the two embankments). The final embankment has a crest elevation of 470 m, and the maximum height of the critical section is approx. 37 m. Steady state conditions for stability were assessed under two hydraulic loading conditions; a normal operating supernatant pond level, and a post-flood event pond level.

6.2 ASSUMPTIONS

The following assumptions were incorporated into the stability analyses for the TMF:

- Foundation conditions were developed using the drillhole logs located along the TMF embankment centreline and within the embankment footprint. The extent of the various units was estimated based on interpolation of the available data and engineering judgement.
- Topsoil and overburden materials below the embankment will be removed prior to construction.
- The embankment fill was assumed to be free-draining.
- Construction materials (excepting tailings) will be non-liquefiable.

6.3 STABILITY RESULTS

The calculated FOS for the TMF section exceed the minimum required FOS for both short term (i.e. end of construction) and long term (i.e. steady-state) stability of the embankment at all stages, during static and seismic conditions. The FOS for each loading condition of the TMF section are presented in Table 6.1. The critical slip surface and FOS for loading conditions and configurations for the final (Stage 4) embankment are shown on Figures 6.1 to 6.4.

Table 6.1 TMF Stability Analysis Results

Slope Stability Conditions	Slip Surface Direction	Required Minimum FOS	FOS for Stage of Construction			
			Starter	Stage 1	Stage 2	Stage 4
Pseudo-static (MDE = 0.092g)	Upstream	**1.0**	1.610	1.610	1.610	1.608
	Downstream	**1.0**	1.778	1.702	1.655	1.659
Post-Earthquake (OBE = 0.064g)	Upstream	**1.2**	1.734	1.732	1.733	1.733
	Downstream	**1.2**	1.894	1.833	1.763	1.762
End of Construction	Upstream	**1.5**	1.897	1.898	1.895	1.895
	Downstream	**1.5**	2.043	1.955	1.898	1.905
Long-term Steady State Conditions (Normal Operating Conditions)	Downstream Only	**1.5**	2.042	1.955	1.902	1.900
Long-term Steady State Conditions (Flood Event Conditions)	Downstream Only	**1.5**	2.045	1.954	1.906	1.902

NOTES:

1. End of construction conditions analyse full stage construction with tailings and pond level representative of end of previous stage of construction.
2. Flood conditions assume pond volume is full to base of emergency discharge spillway in TMF embankment.
3. Assumes overburden excavated prior to construction.

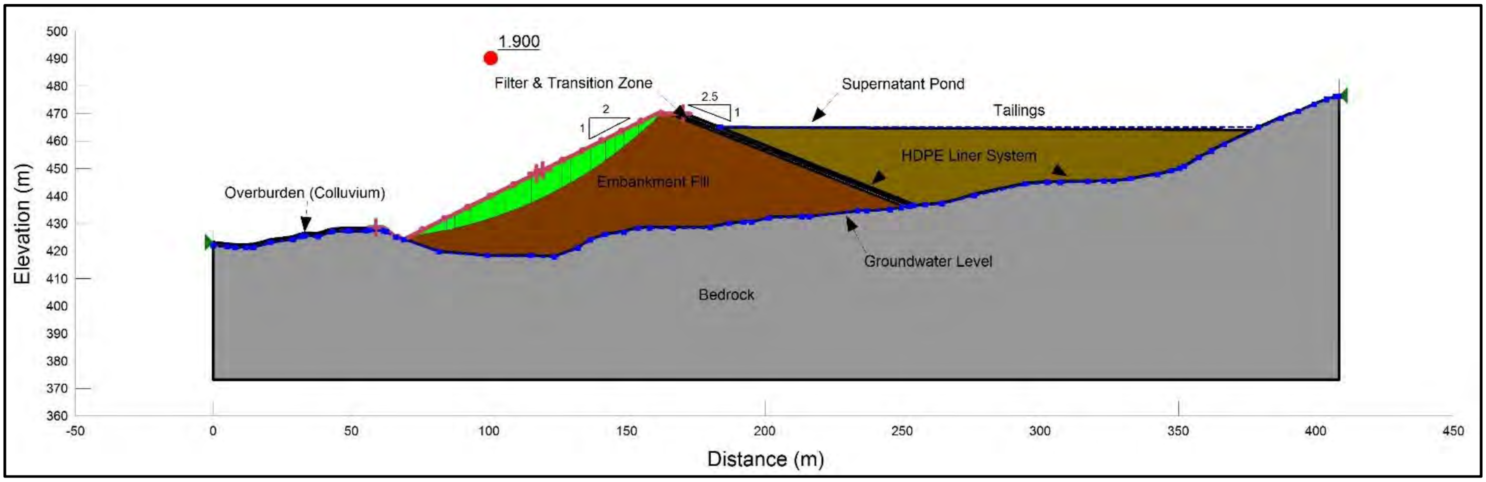

Figure 6.1 Long-Term Steady State Conditions (Normal Operating Conditions)

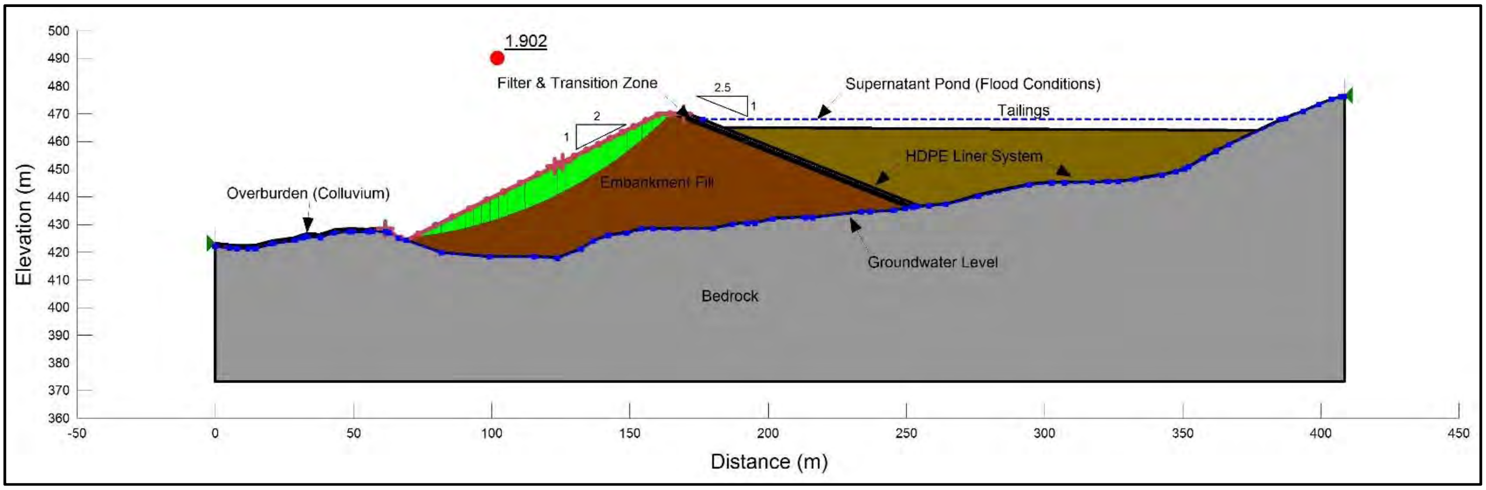

Figure 6.2 Long Term Steady-State Conditions (Post-Flood Conditions)

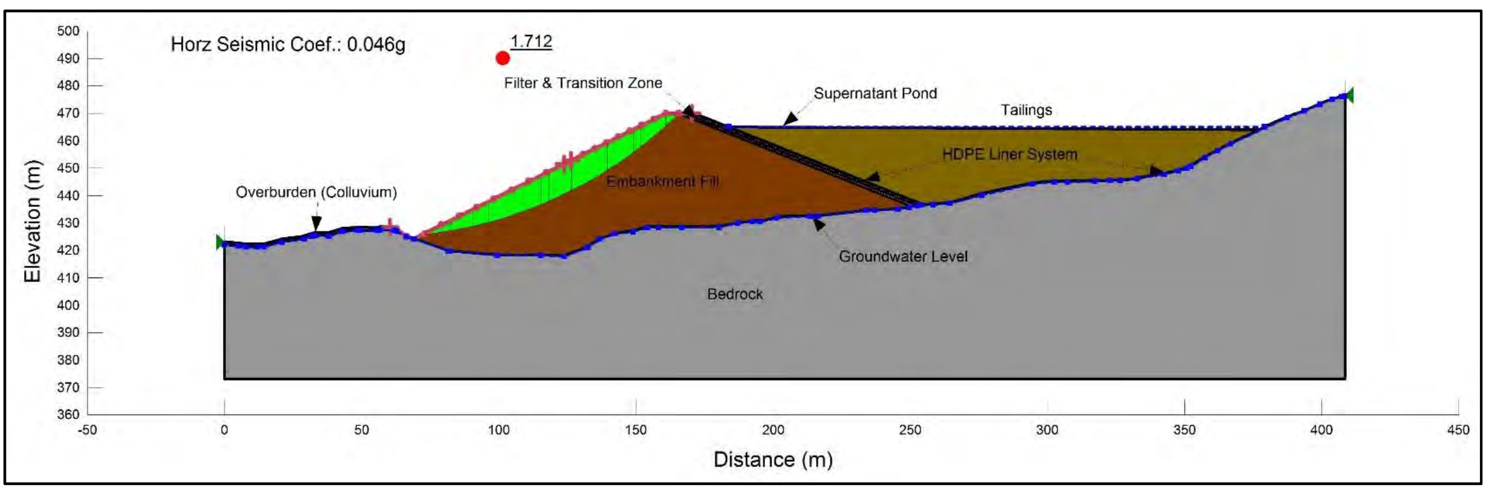

Figure 6.3 Pseudo-Static (MDE) Conditions (Downstream Analysis)

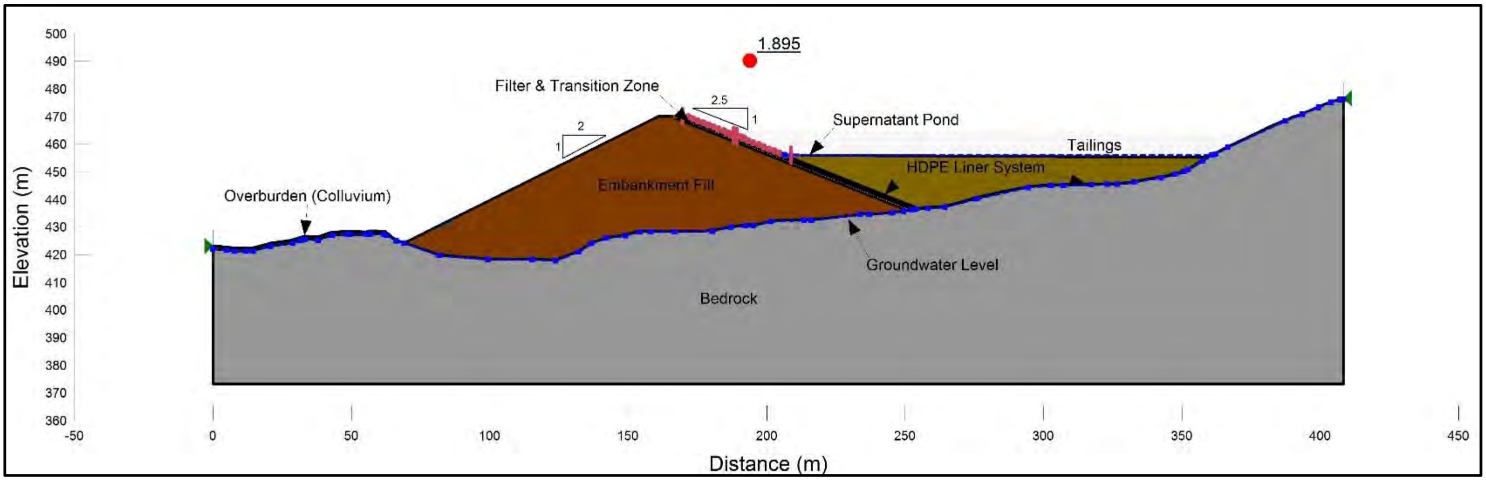

Figure 6.4 Short-Term Conditions (End of Stage Construction) (Upstream Analysis)

6.4 SEISMIC DISPLACEMENTS AND DEFORMATIONS

Seismic displacements and deformations are typically calculated when the FOS under seismic loading conditions is less than 1.0. In this scenario, where the FOS is higher than 1.0, the peak ground acceleration was adjusted until a FOS of 1.0 was achieved (i.e. the yield acceleration) and seismic displacements and deformations estimated along potential slip surfaces using a combination of empirical methods, including:

- Newmark Method (1965)
- Makdisi-Seed Method (1978)
- Bray Method (2007), and
- Swaisgood Method (2003).

Potential deformations resulting from a 1/10,000 year seismic event were calculated using the Newmark (1965), Makdisi-Seed (1978), and Bray (2007) methods, and are predicted to be less than 1 cm while potential crest settlements under seismic loading were estimated to be less than 2 cm using the Swaisgood (2003) method.

The resulting embankment deformations or crest settlements are not large enough to cause a release of stored water or tailings, and the overall stability and integrity of the embankments is maintained.

7 – TMF SEEPAGE ANALYSIS

7.1 METHODOLOGY

The seepage analysis assumes that during the effective life of the liner system, seepage from the TMF would be limited to leakage from potential defects in the HDPE geomembrane. Leakage through the HDPE geomembrane because of defects was estimated using Bernoulli's equation for free flow through an orifice (Giroud and Bonaparte, 1989). This analysis considered one defect (2 mm diameter) per acre (~4,000 m^2) of geomembrane (Giroud and Bonaparte, 1989) having a reasonable potential to exist for various geomembrane installation methods.

The total seepage rate through the geomembrane was calculated by multiplying the results of the analysis by the surface area of the TMF, assuming that a single defect (2 mm diameter) is present for every acre of geomembrane liner (Giroud & Bonaparte, 1989).

The equation has the form:

$$Q = C_B a \sqrt{2gh_w}$$

Where:

- Q = leakage rate through geomembrane defect
- C_B = dimensionless coefficient related to shape of edges of the aperture (assumes C_B = 0.6 for sharp edges)
- a = area of hole in geomembrane (3.1 mm^2 for 2 mm diameter hole)
- g = acceleration due to gravity, and
- h_w = liquid depth on geomembrane

7.2 RESULTS

In summary, the total seepage through the TMF geomembrane liner during operations is estimated to be less than 1 L/s (1.5 US gpm) for a hydraulic head of 15 m or less acting directly on the liner. This is an upper bound estimate assuming unrestricted flow through an orifice as per Giroud & Bonaparte (1989) (i.e. does not consider the effect of liner bedding layer, tailings deposition, etc. on the analysis).

We trust that the information contained within this letter meets your requirements at this time for seepage and stability analyses for the Bromley Humps Tailings Management Facility. Please do not hesitate to contact the undersigned if you have any queries or concerns relating to this letter.

Yours truly,
Knight Piésold Ltd.

PROFESSIONAL PROVINCE OF J. FOGARTY # 44041 BRITISH

<Original signed by> <Original signed by>

Prepared: 3-Mar-2017 Reviewed:

Jim Fogarty, P.Eng. — Project Engineer

Les Galbraith, P.Eng. — Specialist Engineer | Associate

Approval that this document adheres to Knight Piésold Quality Systems <Original signed by>

Attachments:

Appendix A Stability Analysis Results

Copy To: Trevor Herd (JDS), Max Brownhill (BCS), Kelly Sexsmith (SRK)

/jef

APPENDIX A

STABILITY ANALYSIS RESULTS

(Pages A-1 to A-6)

Knight Piésold CONSULTING

TABLE A.1

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
MATERIAL STRENGTH PROPERTIES

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Material Type	Model	Unit Weight[1] γ kN/m^3	Effective Friction[1] ϕ' degrees	Effective Cohesion[1] c' kPa	τ/σ Ratio
Overburden (Colluvium (Well graded sandy gravel with <10% fines))[2]	Mohr-Coulomb	20	33	0	-
Embankment Fill[3]	Shear/Normal Function (Lower Bound Leps)	19	-	-	-
Filter Zone (Well graded clean sand, compacted)	Mohr-Coulomb	18.5	37	0	-
HDPE Liner Bedding Layer (Clean Sand)	Mohr-Coulomb	17.5	37	0	-
Transition Zone (Sandy gravel, dense)	Mohr-Coulomb	20	38	0	-
Tailings (Fine grind (silt) whole ore leach slurry tailings)	S=f(overburden)	19	-	-	0.25

\\KPL\VA-Prj$\1\01\00594\04\A\Correspondence\VA17-00261 - Seepage and Stability Analysis Results\Appendix A\[Appendix A - Stability Results - Rev 0.xlsx]Table A.1

NOTES:

1. UNIT WEIGHT AND EFFECTIVE FRICTION ANGLE ARE TYPICAL VALUES AS PROVIDED BY WWW.GEOTECHDATA.INFO.
2. STRATIGRAPHIC UNITS AS ENCOUNTERED DURING THE 2016 GEOTECHNICAL SITE INVESTIGATION PROGRAM (KP, 2016).
3. SHEAR STRENGTH OF ROCKFILL BASED ON LEPS (1970) AND YANAGUCHI (2012).

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REV	DATE	DESCRIPTION	PREP'D	REV'D

Knight Piésold CONSULTING

TABLE A.2

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS RESULTS FOR TMF CRITICAL SECTION

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Slope Stability Conditions	Slip Surface Direction	Required Minimum Factor of Safety	Stage of Construction			
			Starter	Stage 1	Stage 2	Stage 4
Pseudo-static (MDE = 0.092g)	Upstream	**1.0**	1.670	1.670	1.670	1.669
	Downstream	**1.0**	1.834	1.756	1.708	1.712
Post-Earthquake (OBE = 0.064g)	Upstream	**1.2**	1.734	1.732	1.733	1.733
	Downstream	**1.2**	1.894	1.833	1.763	1.762
End of Construction	Upstream	**1.5**	1.897	1.898	1.895	1.895
	Downstream	**1.5**	2.043	1.955	1.898	1.905
Long-term Steady State Conditions (Normal Operating Conditions)	Downstream Only	**1.5**	2.042	1.955	1.902	1.900
Long-term Steady State Conditions (Flood Event Conditions)	Downstream Only	**1.5**	2.045	1.954	1.906	1.902

\\KPL\VA-Prj$\1\01\00594\04\A\Correspondence\VA17-00261 - Seepage and Stability Analysis Results\Appendix A\[Appendix A - Stability Results - Rev 0.xlsx]Table A.2

NOTES:

1. RAPID DRAWDOWN CONDITIONS NOT CONSIDERED FOR ANALYSIS DUE TO PRESENCE OF HDPE GEOMEMBRANE LINER SYSTEM.
2. ASSUMES THIN OVERBURDEN COVER IS EXCAVATED PRIOR TO CONSTRUCTION.
3. MINIMUM FACTORS OF SAFETY AS PER CANADIAN DAM ASSOCIATION (CDA) DAM SAFETY GUIDELINES (CDA, 2013) AND MINING CODE OF BC (MOE, 2016).
4. END OF CONSTRUCTION CONDITIONS ANALYSE FULL STAGE CONSTRUCTION WITH TAILINGS & POND LEVEL REPRESENTATIVE OF END OF PREVIOUS STAGE.
5. FLOOD CONDITIONS ASSUMES POND VOLUME IS TO BASE OF EMERGENCY SPILLWAY (I.E. 2 m BELOW CREST OF DAM).
6. HORIZONTAL SEISMIC COEFFICIENT USED IN SEISMIC ANALYSIS (1/2 BETWEEN 1/2,475 YEAR AND 1/10,000 YEAR SEISMIC EVENT) ASSUMED TO BE 0.5 x PEAK GROUND ACCELERATION = 0.046g
7. HORIZONTAL SEISMIC COEFFICIENT USED IN POST-EARTHQUAKE ANALYSIS (OBE = 1/2,475 YEAR SEISMIC EVENT) ASSUMED TO BE 0.5 x PEAK GROUND ACCELERATION = 0.032g

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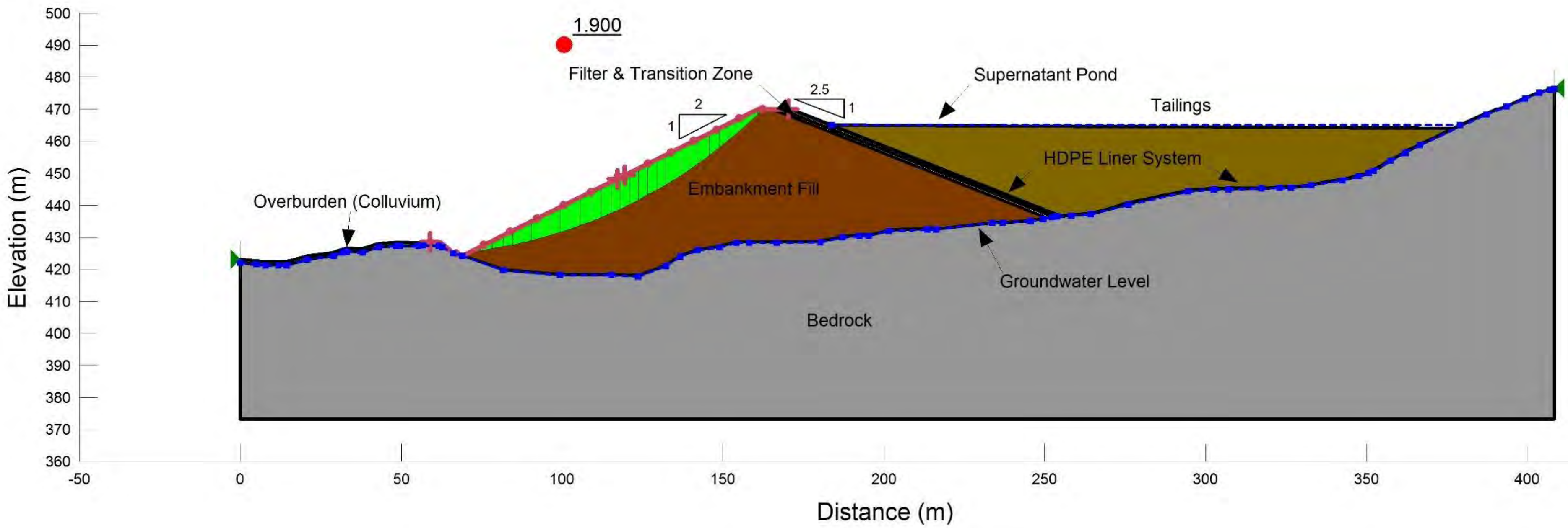


NOTES:

1. A RELATIONSHIP FOR FRICTION ANGLE AND EFFECTIVE STRENGTH WAS DEVELOPED FOR THE EMBANKMENT FILL MATERIAL, BASED ON PUBLISHED INFORMATION ON THE SHEAR STRENGTH PROPERTIES OF ROCKFILL (LEPS, 1970).
2. PHREATIC SURFACES WERE FULLY SPECIFIED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	03MAR'17	ISSUED WITH LETTER	JEF	KDE

IDM MINING LTD.

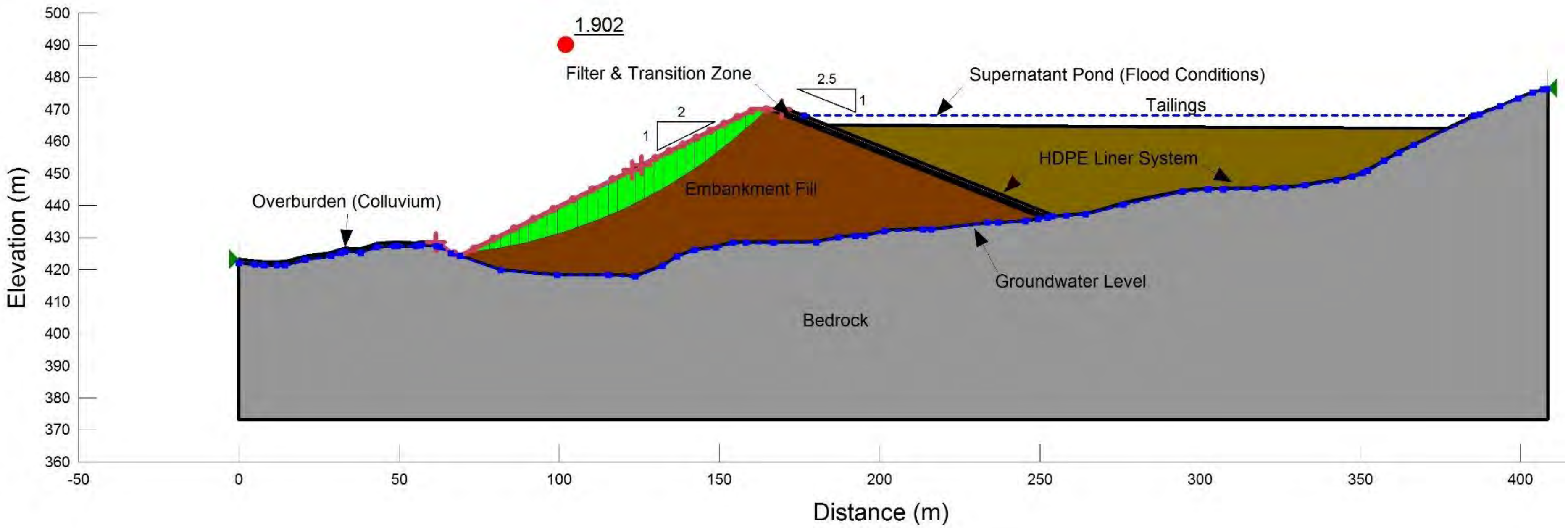
RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
STEADY STATE CONDITIONS
STAGE 4 - NORMAL OPERATING CONDITIONS

Knight Piésold CONSULTING

P/A NO.	REF. NO.
VA101-594/4	VA17-00261

FIGURE A.1 REV 0



NOTES:

1. A RELATIONSHIP FOR FRICTION ANGLE AND EFFECTIVE STRENGTH WAS DEVELOPED FOR THE EMBANKMENT FILL MATERIAL, BASED ON PUBLISHED INFORMATION ON THE SHEAR STRENGTH PROPERTIES OF ROCKFILL (LEPS, 1970).
2. PHREATIC SURFACES WERE FULLY SPECIFIED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	03MAR'17	ISSUED WITH LETTER	JEF	KDE

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
STEADY STATE CONDITIONS
STAGE 4 - FLOOD EVENT CONDITIONS

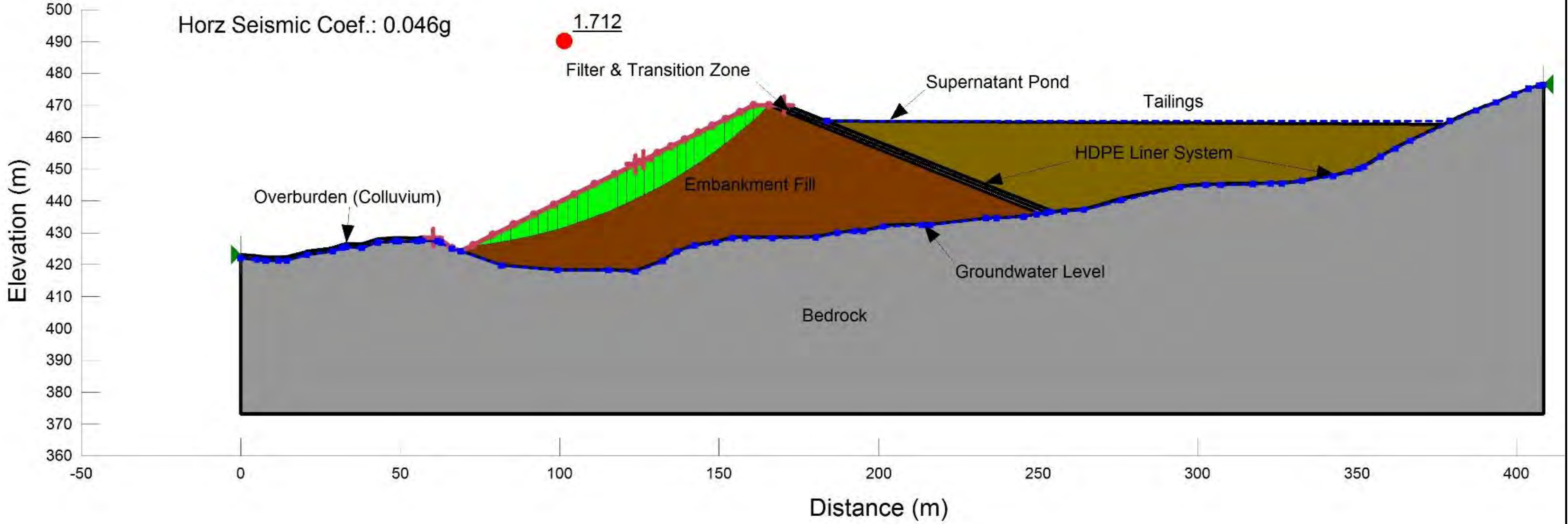
Knight Piésold CONSULTING

P/A NO. VA101-594/4

REF. NO. VA17-00261

FIGURE A.2

REV 0



NOTES:

1. A RELATIONSHIP FOR FRICTION ANGLE AND EFFECTIVE STRENGTH WAS DEVELOPED FOR THE EMBANKMENT FILL MATERIAL, BASED ON PUBLISHED INFORMATION ON THE SHEAR STRENGTH PROPERTIES OF ROCKFILL (LEPS, 1970).
2. PHREATIC SURFACES WERE FULLY SPECIFIED.
3. HORIZONTAL SEISMIC (MDE) LOAD EQUIVALENT TO 0.5 x PEAK GROUND ACCLERATION APPLIED (MELO & SHARMA, 2004).

0	03MAR'17	ISSUED WITH LETTER	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
PSEUDO-STATIC (MDE) ANALYSIS
STAGE 4 - DOWNSTREAM ANALYSIS

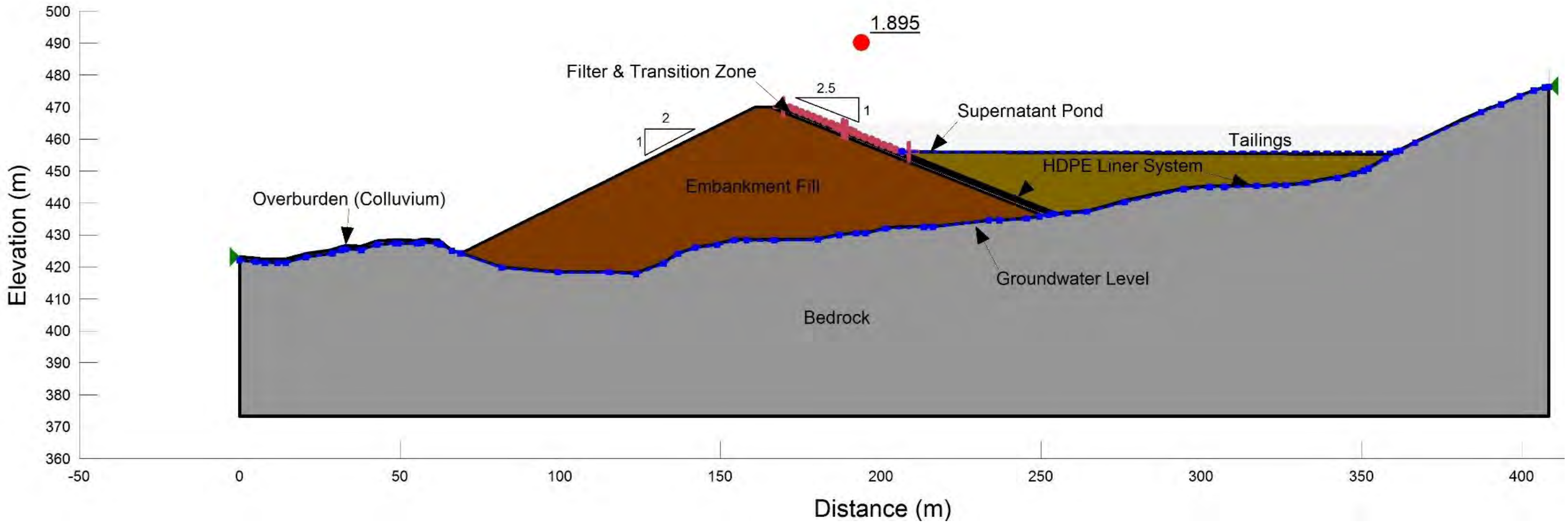
Knight Piésold CONSULTING

P/A NO. VA101-594/4

REF. NO. VA17-00261

FIGURE A.3

REV 0



NOTES:

1. A RELATIONSHIP FOR FRICTION ANGLE AND EFFECTIVE STRENGTH WAS DEVELOPED FOR THE EMBANKMENT FILL MATERIAL, BASED ON PUBLISHED INFORMATION ON THE SHEAR STRENGTH PROPERTIES OF ROCKFILL (LEPS, 1970).
2. PHREATIC SURFACES WERE FULLY SPECIFIED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	03MAR'17	ISSUED WITH LETTER	JEF	KDE

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD PROJECT

BROMLEY HUMPS TMF STABILITY ANALYSIS
STEADY STATE CONDITIONS
STAGE 4 - END OF CONSTRUCTION - UPSTREAM

Knight Piésold CONSULTING

P/A NO.	REF. NO.	
VA101-594/4	VA17-00261	
FIGURE A.4		REV 0

APPENDIX D

TAILINGS LOCATION ALTERNATIVE ASSESSMENT

(Pages D-1 to D-30)

February 17, 2016

File No.:VA101-00594/01-A.01
Cont. No.:VA16-00197

FS 64925
EMS 550121
OHS 550122

Mr. Rob McLeod
President & CEO
IDM Mining Ltd.
1500-409 Granville Street
Vancouver, British Columbia
Canada, V6C 1T2

Dear Rob,

Re: Red Mountain Gold Project - Tailings and Water Management

1 – INTRODUCTION

JDS Energy & Mining Inc. (JDS) is completing a high level review of the Red Mountain Gold Project for IDM Mining Ltd. (IDM). Knight Piésold Ltd. (KP) was retained to complete an options assessment for tailings and water management for the Project, and provide relevant design and cost estimates according to the requirements and information provided by IDM and JDS.

Red Mountain is situated in northwestern British Columbia, approximately 18 km east-northeast of Stewart. The project is located at 55° 57’ N latitude and 129° 42’ W longitude between the Cambria Ice Field and the Bromley Glacier at elevations ranging between 1,500 and 2,000 m. The area is characterized by rugged steep terrain with weather conditions typical of the north coastal mountains.

Climatic conditions at Red Mountain are dictated primarily by its altitude (1,742 masl at the centre of the deposit) and proximity to the Pacific Ocean. Temperatures are moderated year-round by the coastal influence. Precipitation is significant in all months, with October being the wettest. Even at sea level, over one-third of the annual precipitation falls as snow. This proportion is greater at higher elevations, where snow may fall at almost any time of year.

The heavy snowfall, steep terrain and frequently windy conditions are important considerations for tailings and water management. Blizzard conditions are frequent in the immediate vicinity of Red Mountain during winter and avalanches pose a significant threat in the Bitter Creek drainage.

2 – DESIGN CRITERIA

The basic design criteria for the Tailings Management Facility (TMF) options assessment were established with JDS and are summarized in Table 1. A detailed design basis is provided in Appendix A (Table A.1). The design throughput for the mill is currently being investigated and will vary depending on mill location and annual operating time determined suitable for the project. The average mill throughput is assumed to be 1,000 tpd.

Table 1 Design Criteria Summary

Parameter	Units	Value
Average Mill Throughput	tpd	1,000
Design Life	yrs	5
Total Tonnes of Tailings (Design)	Mt	1.4
Year 1 – Tailings Tonnage	Mt	0.3
Year 2 – Tailings Tonnage	Mt	0.2
Year 3 – Tailings Tonnage	Mt	0.3
Year 4 – Tailings Tonnage	Mt	0.3
Year 5 – Tailings Tonnage	Mt	0.3
Tailings Final Settled Dry Density (average)	t/m^3	1.2
Final Required Tailings Storage Volume	Mm^3	1.17
Embankment Crest Width	m	10
Embankment Upstream Slope	-	2.5H:1V
Embankment Downstream Slope	-	2H:1V
Freeboard (Storm Storage, Wave Run-Up & Freeboard)	m	5
2 Year Starter Tailings Tonnage	Mt	0.5
2 Year Starter Dam Storage Capacity	Mm^3	0.42

The following assumptions have also been taken into consideration for this study:

- All embankments will be constructed using material sourced from a local borrow.
- The tailings are potentially acid generating and will be stored subaqueously in a fully lined impoundment.
- There are no limitations on the TMF location within the boundaries of the maps provided.

2.1 TAILINGS TECHNOLOGY

The management of tailings and the tailings technologies utilized depends on multiple specific considerations such as location, climate, topography, environment, tailings geochemistry, processing requirements and throughput. The preferred tailings technology may also incorporate management of Potentially Acid Generating (PAG) waste material to prevent acid generation. Conventional slurry tailings have been chosen as the base case technology to complete this options assessment based primarily on climate and tailings geochemistry. The PAG tailings may need to be stored sub-aqueously to prevent acid generation. An alternative filtered tailings concept has been evaluated and is discussed in Section 5.

2.1.1 Conventional Slurry Tailings

Conventional slurry tailings are typically discharged from the process plant at about 30% to 40% solids by total mass of slurry. These tailings may be pumped, flow by gravity, or some combination of both, depending on the available head and distance through pipelines from the plant to the TMF. The slurry is typically discharged through multiple off-takes from header pipes located around the periphery of the TMF confining embankments. The tailings solids settle and the resulting supernatant water is recovered from the TMF and pumped back for re-use in the process. The coarse fraction of the tailings typically settles rapidly and accumulates closer to the discharge points, forming a gentle "beach" with a slope of about 0.5 to 1%. Finer tailings particles tend to travel further and settle at a flatter slope to, and beneath, the supernatant pond. Selective tailings deposition is typically used to keep the supernatant pond away from the embankments. Conventional slurry tailings disposal also allows for the subaqueous storage of PAG tailings which is an important consideration for this study because the tailings at the Red Mountain Project are PAG tailings.

3 – TMF OPTIONS ASSESSMENT

Several sites were identified as potential locations for storage of conventional slurry tailings. The locations are summarized in Table 2 and shown on Figures B.1 and B.2 in Appendix B.

Table 2 Candidate Tailings Management Facility Locations

Option	Name	Location
1	Cirque - JDS PEA	Base of Red Mountain Cirque - 2014 JDS PEA Location
2	Top of Cirque	Located above the Cirque TMF
3	SRK Side Cirque	Side Cut facility in Cirque proposed by SRK Consulting
4	Bromley Hump	Located downstream of Bromley Glacier
5A	Otter Creek Upper	Adjacent to where Otter Creek meets Bitter Creek
5B	Otter Creek Lower	Downstream of Otter Creek Upper
6	Roosevelt Creek	Terrace where Roosevelt Creek meets Bitter Creek
7	Highway	Confluence of Bitter Creek and Bear River adjacent to Clements Lake.
8	Top of Mountain	Top of Red Mountain

3.1 TMF DEVELOPMENT CONCEPTS

3.1.1 Option 1 – Cirque TMF (JDS PEA Option)

The Cirque TMF is located in the Red Mountain Cirque between the Cambria Ice fields and the Bromley Glacier. The area has an average elevation of approximately 1,500 m and has little vegetation. Foundation conditions consist mainly of talus deposits overlying fractured bedrock. Due to the relatively poor topographical conditions for impoundment capacity and dam construction, a large dam is required to provide sufficient storage. This location was used in the 2014 Preliminary Economic Assessment. Figure B.1 in Appendix B shows a general arrangement layout for Option 1 and a typical embankment section used for the assessment.

3.1.2 Option 2 – Top of Cirque TMF

The Top of Cirque TMF site is also located in the Red Mountain Cirque. The facility is located at approximate El. 1700 m above the Cirque TMF. The steep topographical grade requires an extremely large dam and results in very poor storage efficiency for tailings. This area was considered a possible option due to the close proximity to the portal. Figure B.1 in Appendix B shows a general arrangement for Option 2 and a typical embankment section used for the assessment.

3.1.3 Option 3 – SRK Side Cirque TMF

This option was proposed by SRK Consulting in 2004. The side valley impoundment is located in the Red Mountain Cirque at approximate El. 1,500 m and consists of five separate impoundments terraced along the north and south cirque slopes. The dam is constructed using the upstream method of construction. The design is described in detailing SRK Report “Red Mountain Tailings Options Study, 2004”.

3.1.4 Option 4 – Bromley Hump TMF

The Bromley Hump TMF is situated at the junction of the lower tongue of the Cambria Glacier and the tongue of the Bromley Glacier at approximate El. 800 m. The steep terrain is located on the right bank of Bitter Creek and provides little to no impoundment capacity.

3.1.5 Option 5A and 5B – Otter Creek Upper and Lower TMF

This potential TMF site is located along the north bank of Bitter Creek adjacent to where Otter Creek meets Bitter Creek. The elevated deposit is at an approximate elevation of 450 m. Topographically this area is an efficient tailings storage site with expansion potential. Figure B.1 in Appendix B shows a general arrangement for Option 5A and 5B, and a typical embankment section used for the assessment.

3.1.6 Option 6 – Roosevelt Creek TMF

The Roosevelt Creek TMF site is located on a terrace along the north bank of Bitter Creek at approximate El. 350 m. The topography has a grade of approximately 20-25% and would require a large dam to provide storage. The terrace consists of an outwash deposit of permeable sandy gravel with cobbles and boulders. The site has a potential for avalanches and debris slides. The site is currently not within the project's environmental baseline boundary. Figure B.2 in Appendix B shows a general arrangement for Option 6 and a typical embankment section used for the assessment.

3.1.7 Option 7 – Highway TMF

The Highway TMF is located where Bitter Creek merges with Bear River, and is adjacent to Clements Lake. Clements Lake is Provincial Park and the TMF site is currently not within the project's environmental baseline boundary. Figure B.2 in Appendix B shows a general arrangement for Option 7 and a typical embankment section used for the assessment.

3.2 PRELIMINARY TMF OPTIONS ASSESSMENT

An initial comparisons of key parameters for the TMF options discussed above, was completed to reduce the number of alternatives carried forward to a concept level cost comparison. The comparison has been based on potential storage capacity, expansion potential and dam construction method. Table 3 summarizes the findings of the initial comparison and identifies the options that were advanced to the cost estimate stage.

Table 3 Preliminary TMF Options Assessment

	OPTION								
	1	**2**	**3**	**4**	**5A**	**5B**	**6**	**7**	**8**
Design Storage Requirement of 1.2 Mm3	✓	✓	✓	✗	✓	✗	✓	✓	✗
TMF Expansion Potential	✓	✓	✓	✗	✓	✗	✓	✓	✗
Dam Construction Method	D/S	D/S	U/S	D/S	D/S	D/S	D/S	D/S	D/S
Avalanche Path	✓	✓	✓	✗	✗	✗	✓	✗	✗
Option Advanced to Cost Estimate	✓	✓	✗	✗	✓	✓	✓	✓	✗

NOTES:
1. D/S = Downstream Method of Construction, U/S = Upstream Method of Construction.

Option 3, the option proposed by SRK, is not considered a viable option as it utilizes an upstream method of dam construction. The project is located in an area of high seismicity where the upstream method of embankment construction is not recommended. The cross section included in the SRK Report "Red Mountain Tailings Options Study" details a staged facility with the embankment raise constructed entirely on top of tailings solids. This option has not been advanced further in this study.

Option 4, is located in extremely steep terrain and does not provide the design storage capacity of 1.2 Mm^3. The storage efficiency is extremely poor and is not considered as a viable option for tailings storage. It was not advanced further in this study.

Option 8 is located on Top of Red Mountain and does not provide any area suitable to store the volume of tailings required. Option 8 is therefore not advanced any further in this study.

Option 5B does not provide the design storage capacity but was advanced to the cost estimate stage as a potential location for expansion of Option 5A.

The options that are being considered for tailings and water management are as follows:

- Option 1 – Cirque TMF (JDS PEA)
- Option 2 – Top of Cirque TMF
- Option 5A – Otter Creek Upper TMF
- Option 5B – Otter Creek Lower TMF
- Option 6 – Roosevelt Creek TMF
- Option 7 – Highway TMF

3.3 TMF OPTIONS ASSESSMENT SUMMARY

Table 4 summarizes the basic information that has been used for the preliminary options selection and is divided in starter and final configurations.

Table 4 TMF Options Summary

2 Year Starter Dam (0.5 Mt)	**OPTION**				
	1 Cirque	**2 Top of Cirque**	**5A Otter Creek Upper**	**6 Roosevelt Creek**	**7 Highway**
Dam Crest Elevation (masl)	1465	1705	455	-	120
Embankment Fill Volume (Mm^3)	0.83	1.85	0.2	-	0.74
Maximum Embankment Height (m)	45	55	20	-	20
Storage Efficiency[(1)]	0.6	0.2	2.1	-	1.6
Tailings Transportation	Gravity	Pumping	Gravity	-	Pumping
Final Arrangement (1.4 Mt)	**OPTION**				
	1 Cirque	**2 Top of Cirque**	**5A Otter Creek Upper**	**6 Roosevelt Creek**	**7 Highway**
Dam Crest Elevation (masl)	1475	1720	465	360	135
Embankment Fill Volume (Mm^3)	1.7	5.1	0.58	1.84	2.47
Maximum Embankment Height (m)	55	70	35	35	35
Storage Efficiency[(1)]	0.7	0.2	2.1	0.7	0.2
Tailings Transportation	Gravity	Pumping	Gravity/Pumping	Gravity/Pumping	Pumping

NOTES:
1. Storage efficiency is defined as the relation: TSF Capacity / Embankment fill volume.

3.4 COST ESTIMATE

The conceptual design of each of the selected TMF options has been completed to a level sufficient for comparing the alternatives on an economic basis at a high level. Conceptual level initial capital costs, combined sustaining capital and operating costs have been developed by applying similar rates and assumptions to all alternatives.

For all options it has been assumed that the confining embankments will be constructed with material from a local borrow. There is potential to create additional storage in each facility by developing the borrow area within the TMF impoundment. This has not been considered at this stage except for Option 6 where a cut was required to obtain sufficient capacity in the impoundment. It is also assumed that transition and drainage layers of finer materials will be processed from borrow areas nearby.

Earthworks unit rates were developed from first principles using equipment rental rates from the 2013-2014 Blue Book (B.C. Road Builders & Heavy Construction Association, 2013), equipment capacities and production rates from the Caterpillar Performance Handbook (Caterpillar Inc., 2014) and an assumed labour rate of $104/hr (typical BC labour rate).

All other unit rates (pumps, pipelines, instrumentation, geosynthetics, electrical cables and transformers) were developed from available vendor quotes and from recent and relevant project experience.

Operating costs were developed from a power cost of $0.04/kWh, provided by JDS. Other operating costs include allowances for pump and pipeline maintenance (approximately 2% of total capital cost of pumps and pipelines per year of operation).

An overall summary of the estimated Initial Capital Costs (CAPEX), Sustaining Capital and Operating Costs (OPEX) is shown in Table 5. These costs are in 2016 Canadian Dollars and do not include a contingency factor. A contingency of 50% is typically applied for the TMF at this level of study. Detailed costing tables, including the 50% contingency allowance, for the options listed below, are included in Appendix C.

Table 5 Cost Estimate Summary

TMF OPTION	CONVENTIONAL SLURRY TAILINGS			
	INITIAL CAPITAL (CAD$)	SUSTAINING CAPITAL AND OPERATING COSTS (CAD$)	TOTAL (CAD$)	$/TONNE (CAD$)
Option 1 - Cirque (JDS PEA)	$11,800,000	$9,600,000	**$21,400,000**	**$15.3**
Option 2 - Top of Cirque	$20,800,000	$31,800,000	**$52,600,000**	**$37.6**
Option 5A - Otter Creek Upper	$6,000,000	$5,100,000	**$11,100,000**	**$7.9**
Option 5B - Otter Creek Lower[4]	$8,700,000	$100,000	**$8,800,000**	**$6.3**
Option 6 - Roosevelt Creek	$23,700,000	$200,000	**$23,900,000**	**$17.1**
Option 7 - Highway	$11,000,000	$18,200,000	**$29,200,000**	**$20.9**

NOTES:
1. All prices in CAD$ (Conversion Rate CAD$0.75 = USD$1).
2. Cost of fuel provided by JDS Mining as CAD$1.1/litre.
3. No contingency applied to costs.
4. Option 5B included as an expansion option and does not provide sufficient storage for the design storage of 1.4 Mt of tailings.

3.5 RECOMMENDATIONS

This TMF options assessment indicates that Option 5A (Otter Creek Upper) is likely the preferred location from an engineering and cost perspective. This option is advantageous for the following reasons:

- Lower capital, sustaining and operating costs than all other options, resulting in the lowest cost per tonne.
- Best storage efficiency which therefore requires the smallest embankment volume.
- Expansion potential within the 5A impoundment with additional expansion potential in Option 5B, the Otter Creek Lower impoundment. This potential facility is adjacent to 5A and downstream of the mill making it favorable for tailings deposition.

- The water management required for Option 5A is minimal and is supported by natural drainage. The location is also clear from the Otter Creek avalanche path.
- Golder Associates completed hydrogeological and geotechnical investigations in the Otter Creek area in 1996. The dam sites have several drillholes which would be useful at the next stage of design. Figure B.3 in Appendix B indicates where the geotechnical holes were drilled in the Otter Creek impoundment. Dillhole locations are approximate as no drillhole coordinates were available. The deposit forms part of the lateral moraine feature that extends up to El. 500 m. Grab samples taken at various locations indicate the material is uniform sandy gravel with cobbles and less than 10% fines passing the 75 micron sieve size.
- The Otter Creek TMF and Mill location is also advantageous from a construction schedule and project execution standpoint. Construction could begin on the Mill and TMF while the road between Otter Creek and the mine is being constructed.

4 – TMF DESIGN

The slurry tailings option developed for Option 5A (Otter Creek Upper) provides storage capacity for 1.75 million cubic meters for tailings, process water, storm storage and freeboard to an elevation of 465 m. This will provide storage for 5 years of mine operations. The depth/area/capacity (DAC) relationship for the site to an elevation of 465 m is shown on Figure 1.

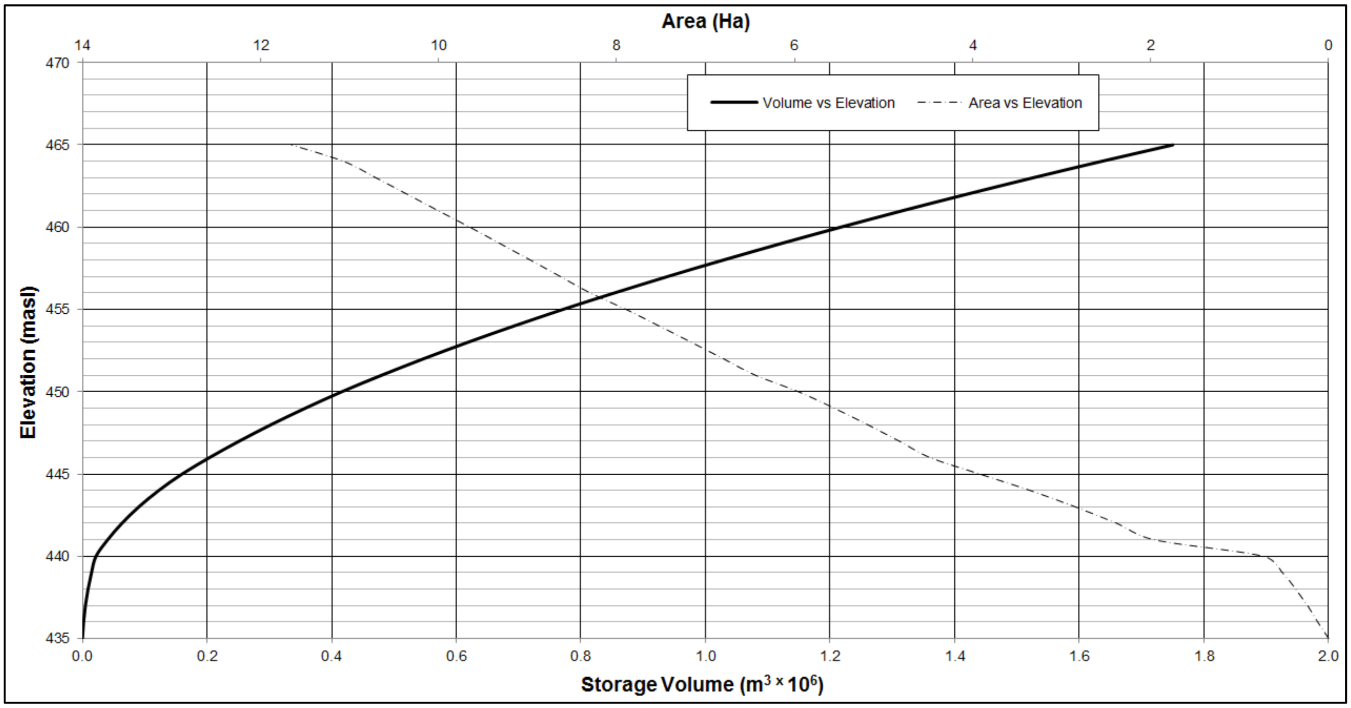


Figure 1 Option 5A Otter Creek Upper TMF Depth-Area-Capacity Relationship

The tailings dam is designed to be a rock-filled structure with granular filter zones on the upstream face. The impoundment and upstream face of the dam will be covered with a geosynthetic liner to minimize seepage of tailings and water into the surrounding area. The filter zones provide a bedding surface for the liner to prevent the migration of fines downstream in the event of liner damage.

Expansion of the TMF would be through the downstream method using locally borrowed materials. An initial starter dam would be constructed to contain the first two years of tailings production in order to minimize upfront capital expenditure. The dam would be raised once over the mine life to increase the storage capacity and maintain a minimum of 5 m freeboard at all times.

The facility would have sufficient freeboard to manage run-off, storm storage and process water. Reclaim water would be recirculated back to the mill and used as process water. A conceptual design and layout for Option 5A is shown on Figure B.4 in Appendix B.

The staged filling schedule for Option 5A is shown on Figure 2.

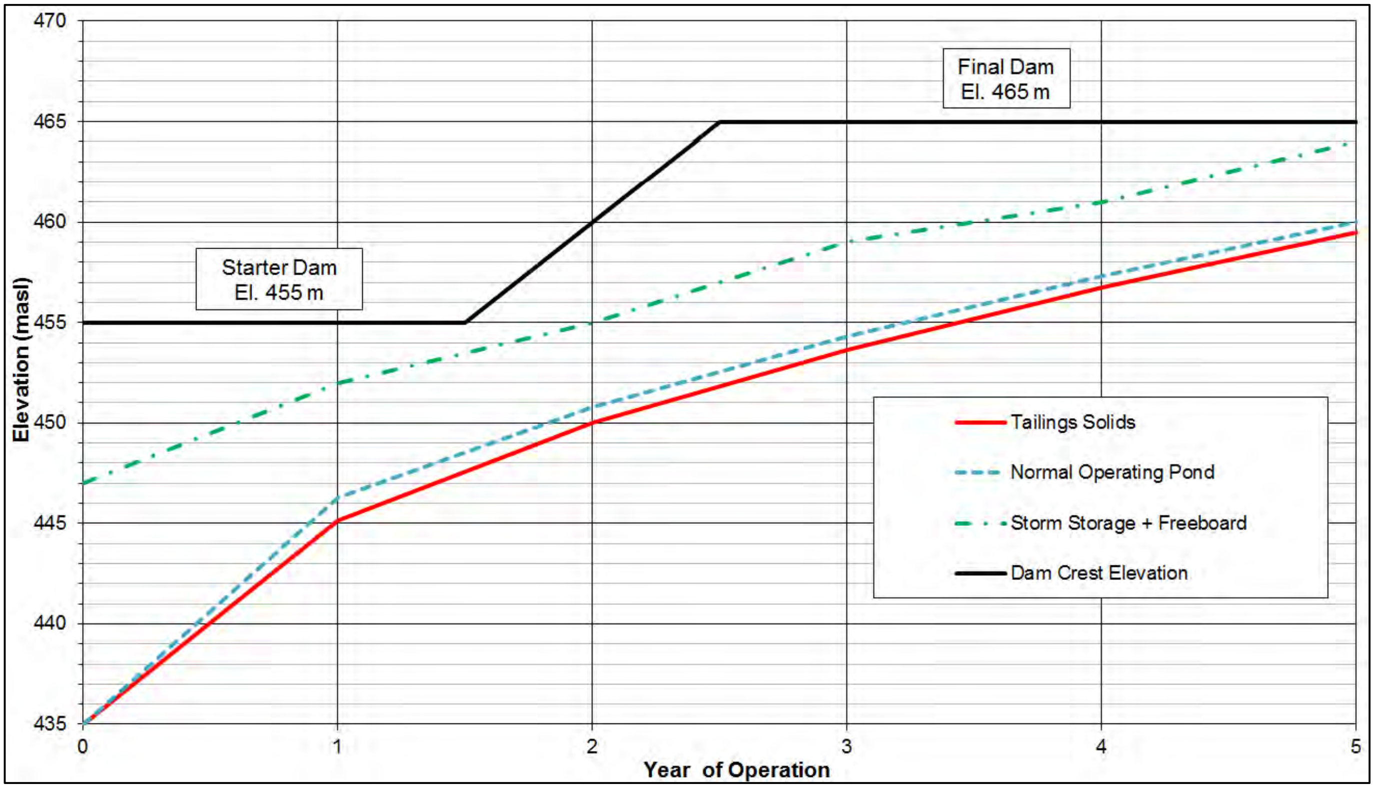


Figure 2 Option 5A Otter Creek Upper Filling Schedule

NOTES:

1. Year 2 tailings production of 200,000 tonnes/year, Year 1,3-5 tailings production of 300,000 tonnes/year (Table A.1).
2. Average settled tailings dry density assumed to be 1.2 t/m^3.
3. Normal operating pond volume included for capacity allowance.
4. The minimum freeboard requirements is assumed to be 5 meters (Includes storm storage, wave run-up and freeboard). This will be confirmed in future design phases.

5 – FILTERED TAILINGS

KP also investigated using filtered tailings technology at the Otter Creek location as an alternative method to manage the tailings.

5.1 FILTERED TAILINGS TECHNOLOGY

Filtered tailings are produced using pressure or vacuum force in presses, drum, or belt filtration units, and are typically dewatered to a moist cake-like consistency. The materials are then transported by conveyors or trucks to a filtered tailings stack where they can be compacted in lifts to improve density, trafficability, and stability. No operating pond is maintained with dewatered or filtered tailings. The filtered tailings stack typically requires buttressing for stability, particularly in seismically active areas.

Filtered tailings management typically requires a separate water management pond for storage of storm water run-off and snowmelt from the TMF surface, as well as for process water storage. There is no storage for water management within the filtered tailings stack facility unlike slurry tailings facilities. Filtered tailings operations may also include back-up systems as the efficiency for filtered operations can be less than conventional tailings.

Filtered tailings do not provide for effective isolation of PAG tailings from oxygen diffusion and potential acid generation. Geochemical stability of the ‘dry’ stack would need to be considered and the PAG tailings may require subaqueous disposal in a separate facility.

5.2 SLURRY TAILINGS & FILTERED TAILINGS MANAGEMENT AT OTTER CREEK

For this study it was assumed that 30% of the tailings are PAG and would require subaqueous disposal in a separate fully lined facility and the remaining 70% would be filtered in a filter plant at the mill and delivered to the TMF via truck/conveyor for storage in an unlined facility.

5.2.1 Design Criteria

The basic design criteria for the slurry and filtered tailings combination facilities is summarized in Table 6.

Table 6 Design Criteria Summary

Parameter	Units	Value
Average Mill Throughput	tpd	1,000
Design Life	yrs	5
Design Total Tonnes of Tailings	Mt	1.4
Tonnes of PAG Tailings	Mt	0.42
Tailings Final Settled Dry Density (average)	t/m^3	1.2
Final Required PAG Tailings Storage Volume	Mm^3	0.35
Tonnes of NAG Tailings	Mt	0.98
Filtered Tailings Dry Density (average)	t/m^3	1.6
Final Required Filtered Tailings Storage Volume	Mm^3	0.62
Embankment Crest Width	m	10
Embankment Upstream Slope	-	2.5H:1V
Embankment Downstream Slope	-	2H:1V
Freeboard (Storm Storage, Wave Run-Up & Freeboard)	m	5

The following assumptions have also been taken into consideration for this study:

- All embankments will be constructed using material sourced from a local borrow.
- PAG tailings are potentially acid generating and will be stored subaqueously in a fully lined impoundment.
- The tailings are to be managed at the Otter Creek TMF location; slurry tailings to be managed at Option 5B (Otter Creek Lower) and filtered tailings to be managed at Option 5A (Otter Creek Upper).
- Option 5B will be fully lined with a geosynthetic liner.
- Only the North Dam of Otter Creek Upper is required to manage the filtered tailings stack.

Table 7 summarizes the basic components of the slurry tailings TMF and the filtered tailings TMF. A conceptual general arrangement for the filtered tailings management option is shown on Figure B.5 in Appendix B.

Table 7 Tailings Management Design Summary

	Option 5B Otter Creek Lower Slurry Tailings	Option 5A Otter Creek Upper Filtered Tailings
Dam Crest Elevation (masl)	420	455
Embankment Fill Volume (Mm^3)	0.4	0.15
Maximum Embankment Height (m)	40	25
Storage Efficiency(1)	1	4.2
Tailings Transportation	Gravity	Truck/Conveyor

5.2.2 Cost Estimate

The conceptual design for TMF has been completed to a level sufficient for an economic basis at a high level. For each facility, conceptual level initial capital costs, combined sustaining capital and operating costs have been developed by applying similar rates and assumptions to all alternatives.

The basis of estimate discussed in Section 3.4 was used to calculate the Capital, Sustaining and Operating Costs for the two facilities. The cost to filter and transport the filtered tailings is not included in this cost estimate and is to be included as part of the mill alternatives assessment managed by JDS Mining. A cost however is included to place and compact the filtered tailings in the facility.

An overall summary of the estimated Initial Capital Costs (CAPEX), Sustaining Capital and Operating Costs (OPEX) is shown in Table 8. These costs are in 2016 Canadian Dollars and do not include a contingency factor. A contingency of 50% is typically applied for the TMF at this level of study. Detailed costing tables, including the 50% contingency allowance, for the options listed below, are included in Appendix D.

Table 8 Cost Estimate Summary (No Contingency)

	INITIAL CAPITAL (CAD$)	SUSTAINING CAPITAL AND OPERATING COSTS (CAD$)	TOTAL (CAD$)	$/TONNE (CAD$)
Option 5B – 30% PAG Slurry Tailings	$8,000,000	$ 100,000	**$8,100,000**	**-**
Option 5A – 70% NAG Filtered Tailings	$1,900,000	$1,200,000	**$3,100,000**	**-**
Total	$9,900,000	$1,300,000	**$11,200,000**	**$8**

5.2.3 Summary

There is no economic advantage associated with filtering the tailings for the Red Mountain Project. The overall tailings management cost is higher than managing conventional slurry tailings at the Otter Creek Upper facility. The additional capital cost of filters and the increased operating cost associated with filtering and transporting tailings would increase the overall cost further. There is additional complexity due to operating two facilities and placing and compacting filtered tailings in an area with high precipitation and snowfall.

6 – CONCLUSION

A high level assessment of tailings and water management options has been completed for the Red Mountain Gold Project. The study was completed for a 5 year mine life that would produce 1.4 Mt of tailings at an average mill throughput of 1,000 tonnes per day. The design mill throughput is currently being investigated and will depend on mill location and annual operating months. Preliminary comparative cost estimates (Initial Capital, Sustaining Capital and Operating Costs) were developed for the major components to assist in the selection of the preferred site for inclusion in future studies.

The assessment indicated that conventional tailings storage in the Otter Creek Upper TMF (Option 5A) is a reasonable base case tailings and water management strategy at the current time. The facility was sized to store 1.2 Mm^3 of tailings but has the potential to be expanded to store 2 Mm^3 of tailings. There is potential to store an additional 0.5 Mm^3 of tailings downstream of this option in TMF Option 5B should the ore reserve increase.

We trust this provides you with the information required at this time. Please contact the undersigned below should you have any questions or require any additional information.

Yours truly,
Knight Piésold Ltd.

<Original signed by>

<Original signed by>

Prepared: Daniel Ruane, P.Eng.
Project Engineer

Reviewed: Ken Embree, P.Eng.
Managing Principal

Approval that this document adheres to Knight Piésold Quality Systems: <Original signed by>

Attachments:

Appendix A	Design Basis
Appendix B	Figures B1-B5
Appendix C	Options Assessment - Conventional Slurry Tailings Cost Estimate Tables
Appendix D	Slurry and Filtered Tailings Cost Estimate Tables

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/dmr

APPENDIX A

DESIGN BASIS

(Page A-1)

Knight Piésold CONSULTING

TABLE A.1

IDM MINING LTD.
RED MOUNTAIN GOLD PROJECT

TMF PRELIMIMNARY ECONOMIC ASSESSMENT
DESIGN BASIS

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ITEM					SOURCE
1.0 GENERAL					
1.1	Project Location	Northwestern British Columbia, 18 km east of the town of Stewart. Project is located adjacent to the Cambria Ice Field and the Bromley Glacier on provincial crown land within the Regional District of Kitimat-Stikine.			Red Mountain Gold Project Description July 2015 - IDM Mining Ltd.
1.2	Site Coordinates	UTM Coordinates 452,450 E and 6,250,325 N (Zone 9 NAD 83) ; 55^{0}59′04″ N, 129°45′37″ W			Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
1.3	Mine Site Elevation	Ranging 1,500 to 2,000 masl			
1.4	Mine Production	Estimated mineable resource = 1.45 million tonnes (Mt)			
		Throughput = 1,000 tonnes per day (year 1-4) and 1,085 tpd (year 5)			
		Mine Life = 5 years			
1.5	Climate Conditions		**Roosevelt Creek**	**Red Mountain Cirque**	Preliminary Assessment Tailings Disposal and Hydrogeology March 1994 - LAC North America Ltd.
		Average Annual Precipitation =	2200 mm	2200 mm	
		Average Annual Snowfall =	900 mm	1500 mm	
		Average Annual Rainfall =	1300 mm	700 mm	
		Average Annual Evapotranspiration and Infiltration =	400 mm	400 mm	
		Average Annual Runoff =	1800 mm	1800 mm	
		Maximum Snowpack =	800 mm	1400 mm	
1.6	Rainfall Storm Events	1 in 50 year 24 hour precipitation =	140 mm	66 mm	
		1 in 100 year 24 hour precipitation =	156 mm	73 mm	
		Probable Maximum Precipitation 24 hr rainfall =	480 mm	250 mm	
2.0 MINE WASTE					
2.1	Tailings	1.4 million tonnes			Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
		Assumed average long-term settled dry density of slurry tailings = 1.2 t/m^3			
		Storage requirements for tailings solids = 1.2 Mm^3			
		Tailings are Potentially Acid Generating (PAG)			
		Subaqueous disposal of tailings to control the acid generating potential of the tailings.			
		Year 1 = 300,000 tonnes, Year 2 = 200,000 tonnes, Year 3 = 300,000 tonnes, Year 4 = 300,000 tonnes, Year 4 = 300,000 tonnes.			
2.2	Waste Rock	1.036 million tonnes			
		Waste Rock is Potentially Acid Generating (PAG).			
		Waste Rock stored in two temporary storage areas located adjacent to the Upper and Lower portals. Waste Rock to be rehandled into the underground as backfill.			
		Year -2 = 150,000 tonnes, Year -1 = 304,000 tonnes, Year 1 = 273,000 tonnes, Year 2 = 197,000 tonnes, Year 3 = 112,000 tonnes.			
3.0 TAILINGS MANAGEMENT FACILITY (TMF)					
3.1	Function	Secure long term storage of approximately 1.2 Mm^3 of tailings and supernatant pond water.			Knight Pieosld Ltd.
3.2	Concept	An earthfill/rockfill embankment constructed using the downstream method of construction using local borrow materials. The impoundment and upstream face of the embankment would be lined with a geosynthetic liner to minimize seepage of tailings water into the surrounding area.			
		Filter zones included in embankment design to provide bedding for the geosynthetic liner and prevent the migration of fine tailings downstream. Suitable sub-base bedding layer beneath geosynthetic liner in the impoundment to provide drainage and prevent damage to the liner.			
3.4	Dam Classification	The Dam Classification for each of the alternate locations and concepts has not yet been carried out. However, it is assumed that all facilities will have at least a HIGH dam classification, as defined by Canadian Dam Association (CDA) "Dam Safety Guidelines" (2007).			
3.5	Inflow Design Flood	Inflow Design Flood (IDF) = The IDF for each alternative has not been calculated. An allowance for storm storage has been included in the freeboard.			
3.6	Design Freeboard	Freeboard for supernatant pond storage, Inflow Design Flood (IDF),wave run-up and freeboard.			
		A minimum 5 m freeboard at all times.			
3.7	Embankment Slopes	Embankment slopes constructed to maximum slope of 2.5H:1V on upstream side to facilitate geomembrane installation and 2H:1V on downstream side for reclamation.			
3.8	Operational Criteria	Expected mill throughput (tailings production rate): 1,000 tpd			
		Flood management: Inflows are contained within the impoundment or managed with spillway			
		Mine water pumped to Tailings Management Facility (TMF)			
		Available water from TMF recycled to mill process.			
		Excess water monitored and treated accordingly.			
3.9	Closure Criteria	The downstream slope of the embankment will be reclaimed with topsoil and revegetated.			'Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
		Tailings will be dewatered and covered by a geosynthetic liner with a 1 m thickness of material placed on top to prevent infiltration. Revegetation of the soil capped to be completed to reduce dusting. Seepage collection and treatment systems will be maintained after closure until water quality is at acceptable levels.			
3.10	Seepage	Seepage will be primarily controlled through the use of a geosynthetic lining system covering the full TMF impoundment. Seepage control will be enhanced by strategic tailings deposition.			Knight Pieosld Ltd.
		Embankment and foundation drains will be installed to dewater any groundwater seeps and to capture potential seepage through the geomembrane lining system.			
		Collected seepage is pumped back to the TMF and monitored.			
3.11	Embankment Crest Width	Minimum of 10 m			
3.12	Seismic Design Criteria	1 in 476 = 0.083 g			Preliminary Assessment Tailings Disposal and Hydrogeology March 1994 - LAC North America Ltd.
		1 in 1,000 = 0.104 g			
		1 in 2,000 = 0.126 g			
		1 in 10,000 = 0.188 g			
3.13	Embankment Stability	Embankment slopes to be 2.5H:1V upstream and 2H:1V downstream to achieve the minimum required Factors of Safety (FOS_{min}) for the following loading conditions:			Knight Pieosld Ltd.
		End of construction (starter dam and dam raises) FOS_{min} = 1.5			
		Long term (at closure) FOS_{min} = 1.5			
		Seismic (Pseudo-static loading condition) FOS_{min} = 1.0			
		Seismic (Post-earthquake loading condition; full liquefaction of tailings assumed) FOS_{min} = 1.5			
3.14	Embankment Instrumentation	Instrumentation to be installed to accomplish the following: - Confirm that the embankments are performing in accordance with the design - Provide early warning of the development of potentially adverse changes.			
		Proposed instruments for the embankments include: - pond level indicator - surface monuments - embankment and foundation vibrating wire piezometers - seepage collection pond inflow weirs			
4.0 TAILINGS DELIVERY AND DISTRIBUTION					
4.1	Function	Transport tailings from the mill process to the TMF			Knight Pieosld Ltd.
4.2	Physical Properties	Tailings Solids Content = 40% by weight			
		Specific Gravity of Solids = 2.7			
4.3	General Criteria	Gravity discharge from mill used where sufficient head is available.			
		Pump stations as required where gravity discharge is not sufficient			
5.0 WATER MANAGEMENT SYSTEM					
6.1	Function	Provide diversion or collection of maximum practicable runoff from adjacent valley slopes and catchment areas to a natural course or to the collection pond, respectively.			Knight Pieosld Ltd.
6.2	Concept	Diversion channels established to divert non-contact water to a natural water course. Collection channels established to collect contact water that will be directed to the TMF for containment and ultimately be pumped to the plant site for use in processing.			
6.3	Dimensions	Trapezoidal cross-section, excavated in rock/overburden cut, or constructed in haul/access road fill.			
		Lining where required for erosion protection or leakage control (shotcrete, riprap, HDPE, etc.)			

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix A\Excel\[Table A.1 Design Basis_ Red Mountain_Rev0.xlsx]Table A.1

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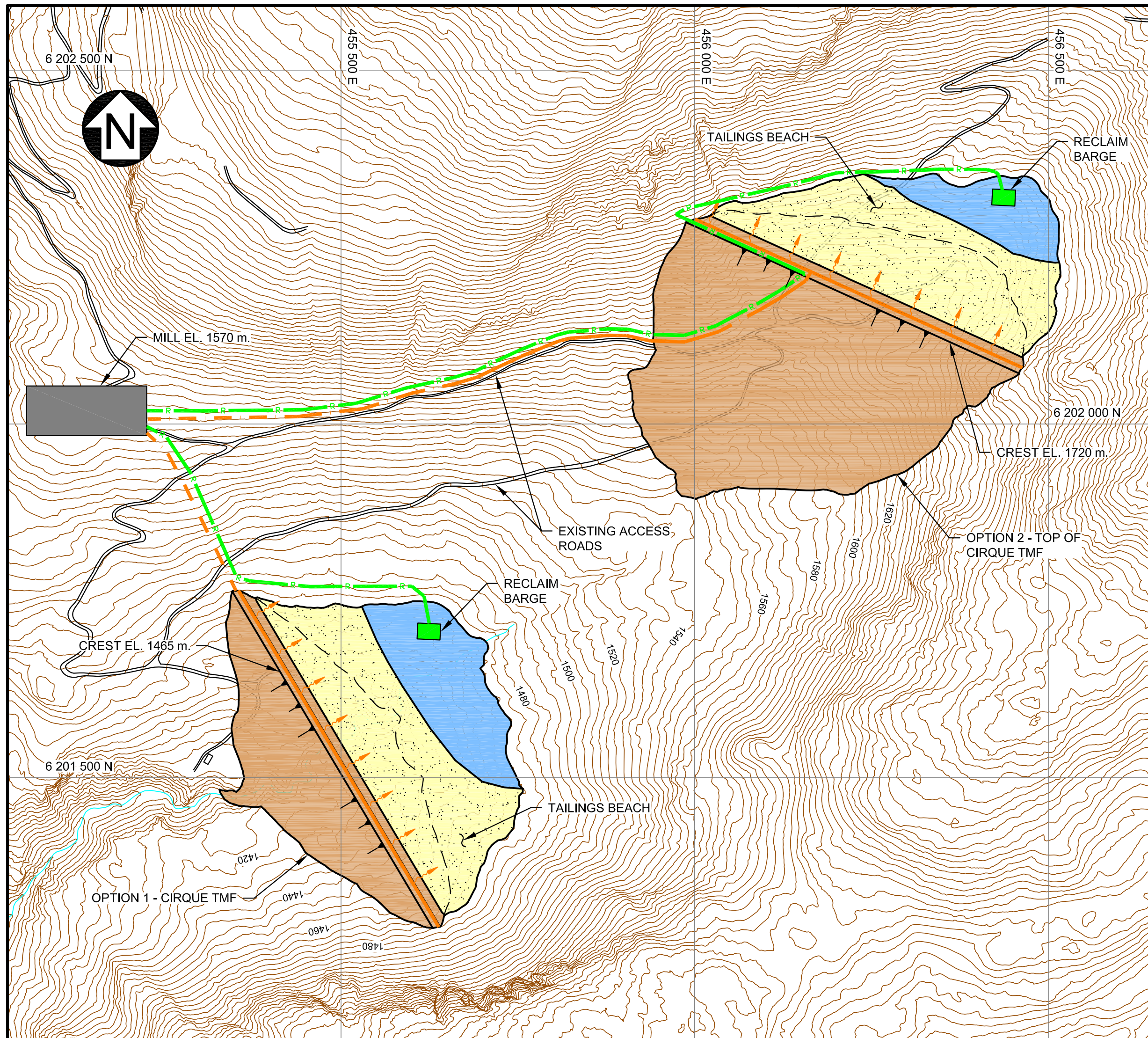
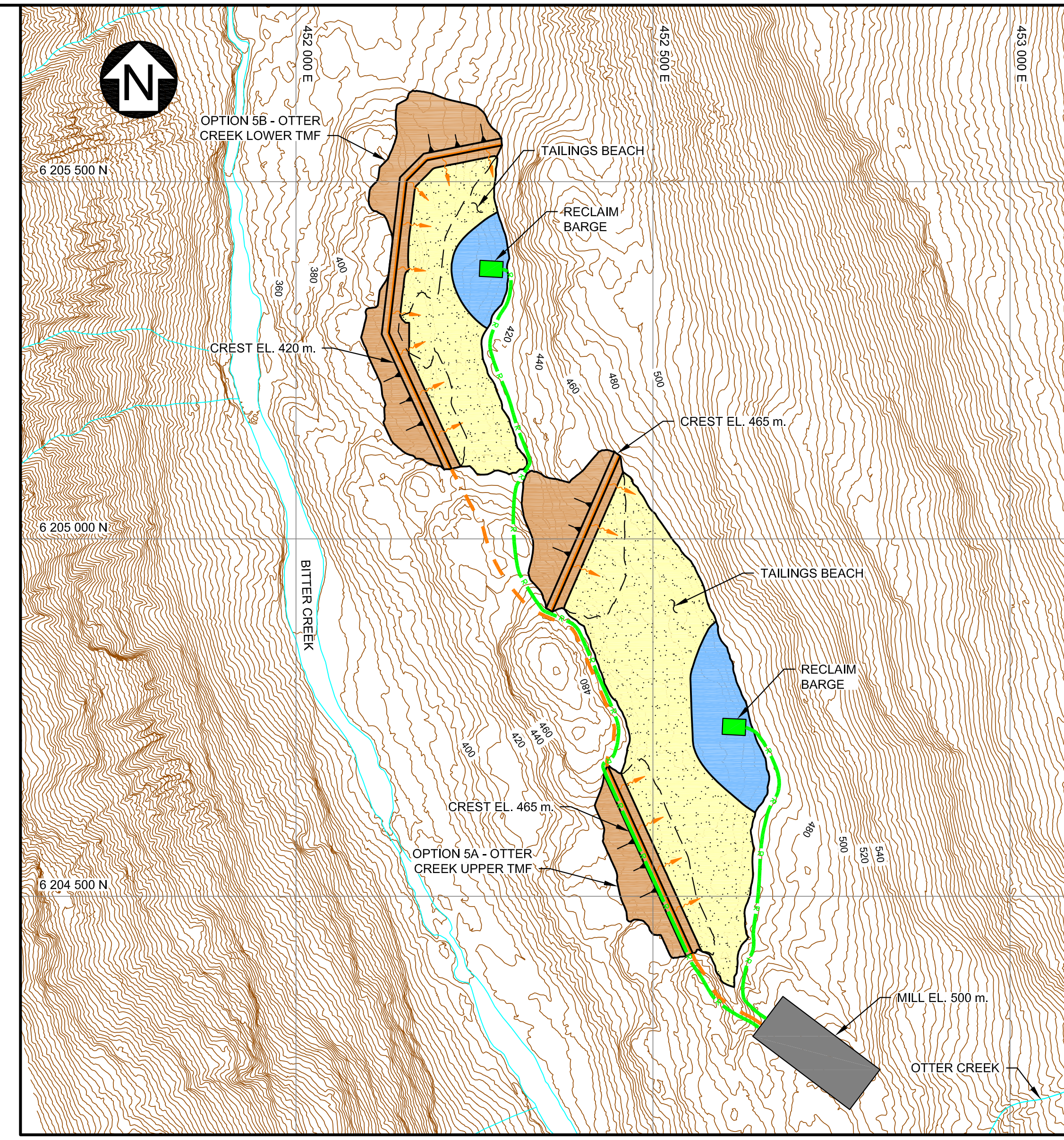
APPENDIX B

FIGURES B.1-B.5

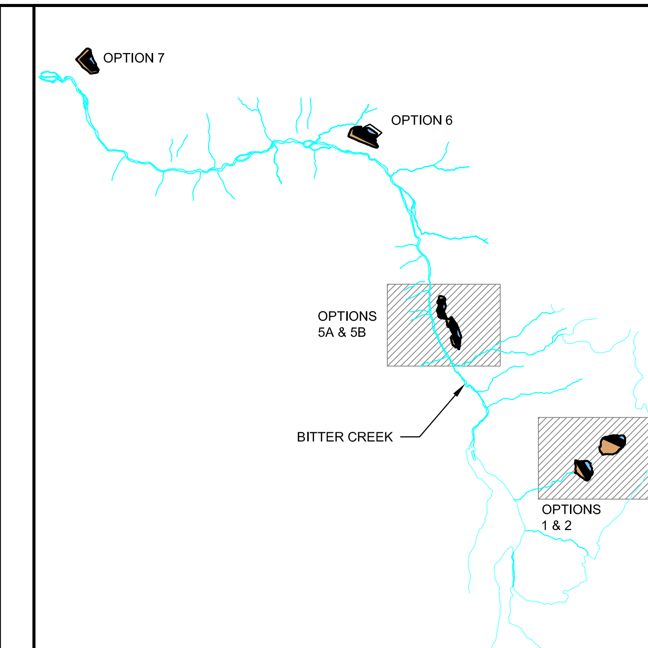
(Pages B-1 to B-5)



PLAN
FINAL TMF OPTION 1 - CIRQUE & OPTION 2 - TOP OF CIRQUE
SCALE A

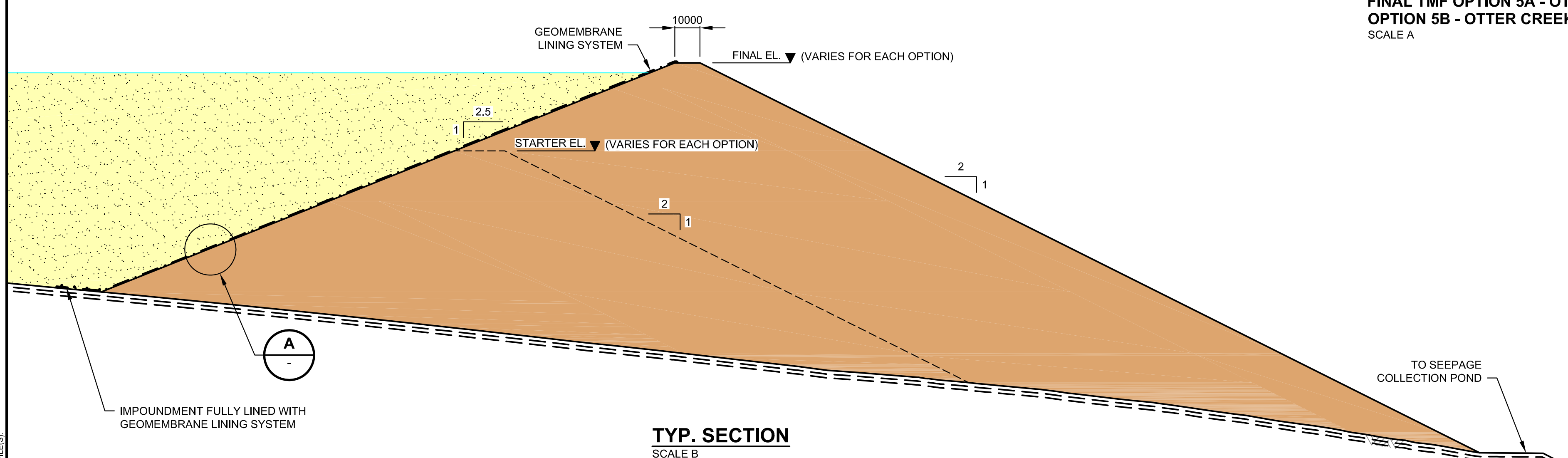


PLAN
FINAL TMF OPTION 5A - OTTER CREEK UPPER & OPTION 5B - OTTER CREEK LOWER
SCALE A



KEY PLAN
NTS

LEGEND:
- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK



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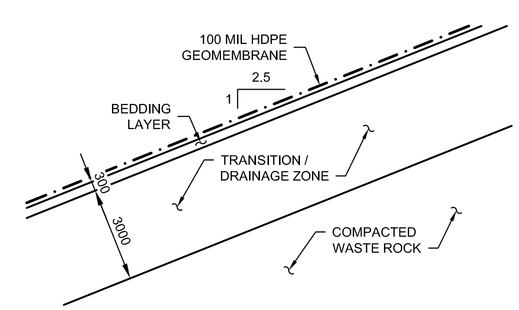

SECTION A
UPSTREAM LINER
NTS

NOTES:
1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).

SCALE B: 25 12.5 0 25 50 75 100 125 m
SCALE A: 100 50 0 100 200 300 400 500 m

IDM MINING LTD.
RED MOUNTAIN GOLD PROJECT
TMF OPTIONS ASSESSMENT
OPTION 1, 2, 5A, & 5B

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197
FIGURE B.1	REV 0

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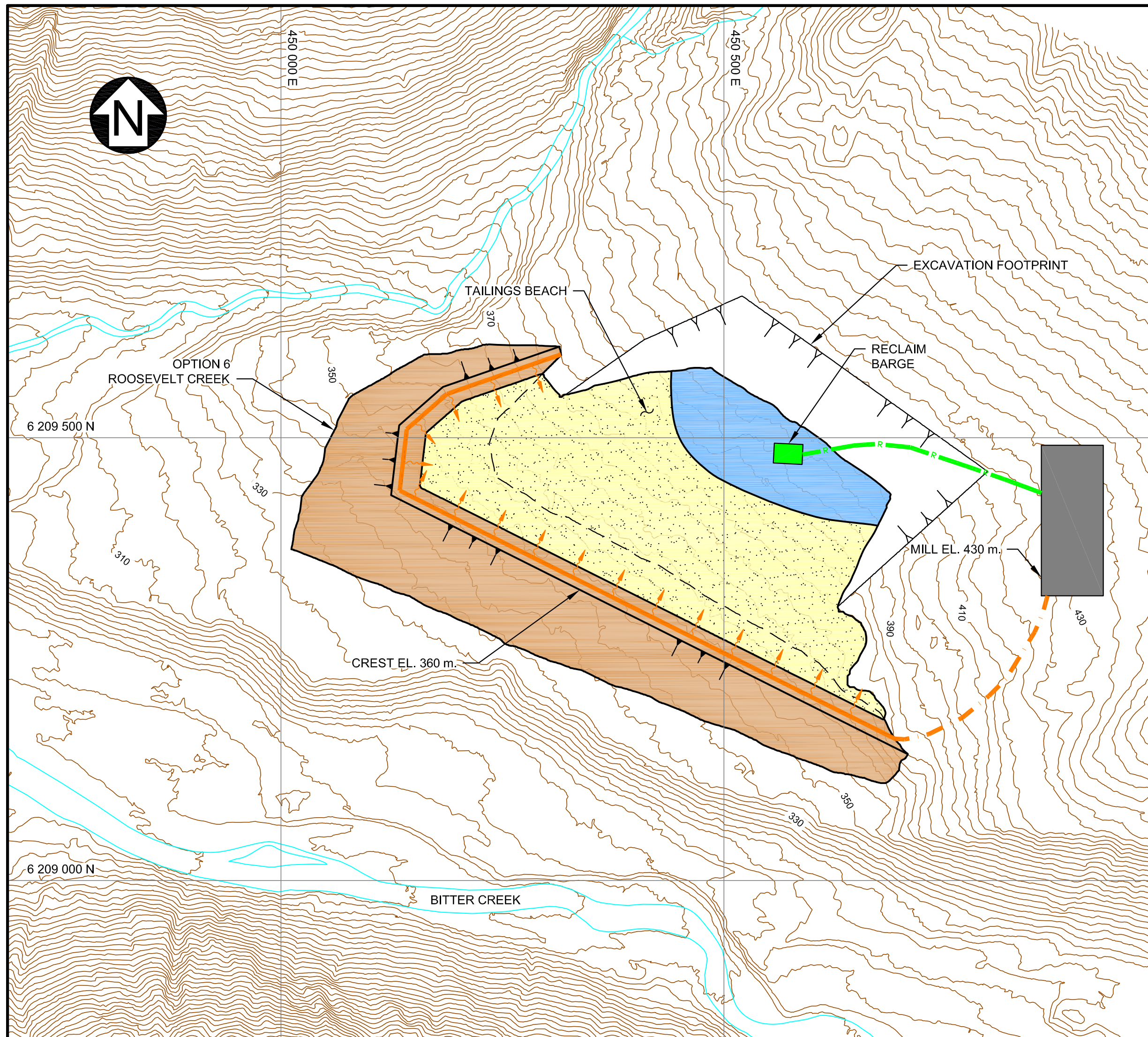

PLAN
FINAL TMF OPTION 6 - ROOSEVELT CREEK
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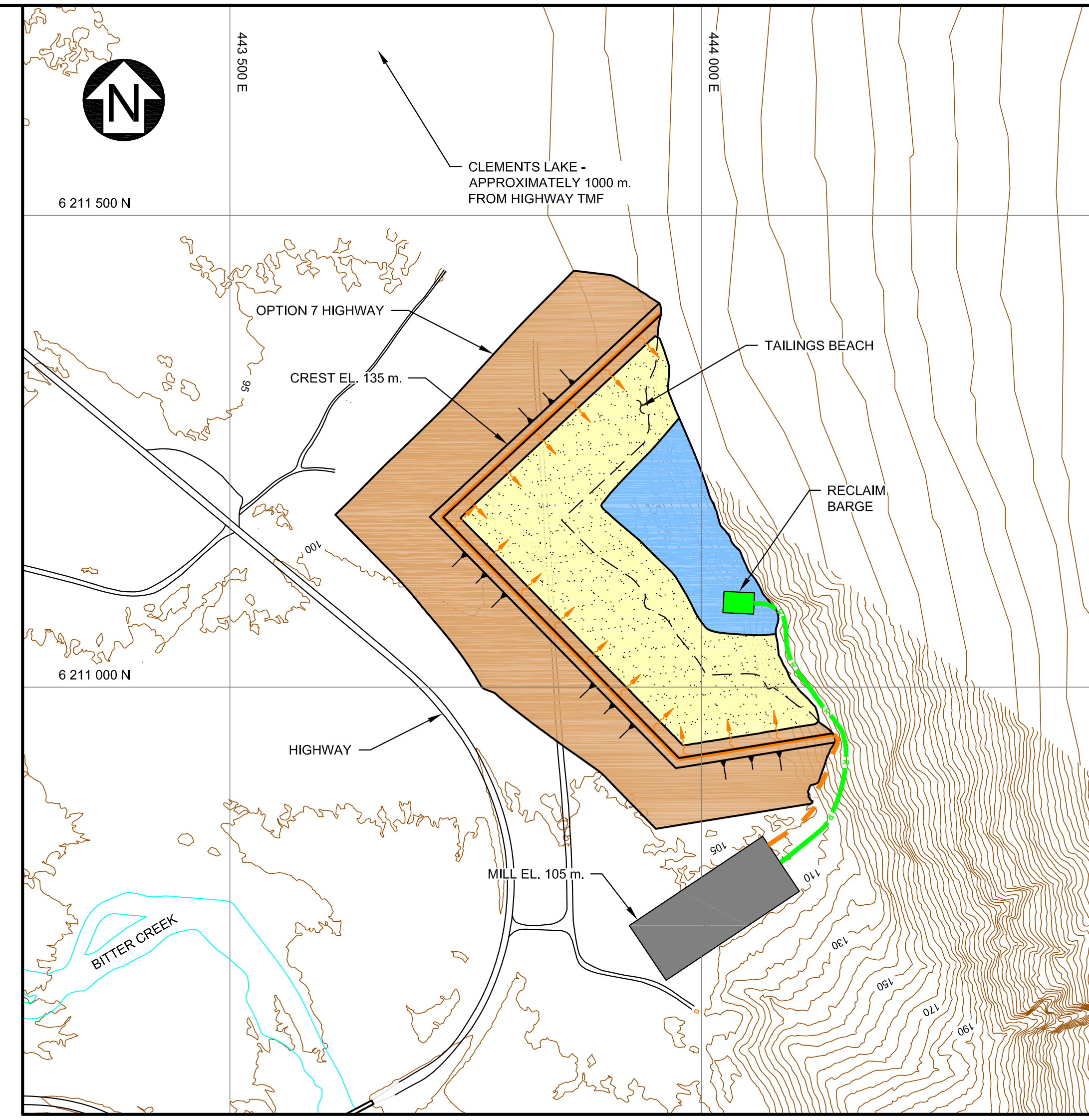

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FINAL TMF OPTION 7 - HIGHWAY
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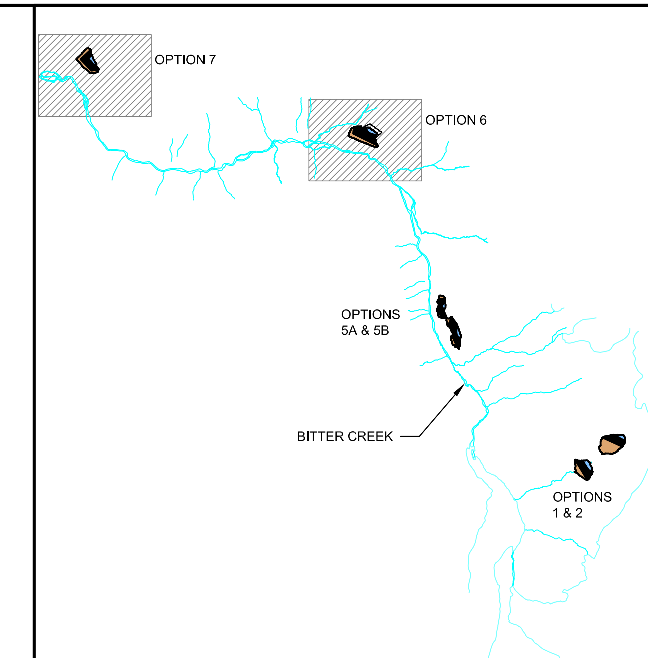


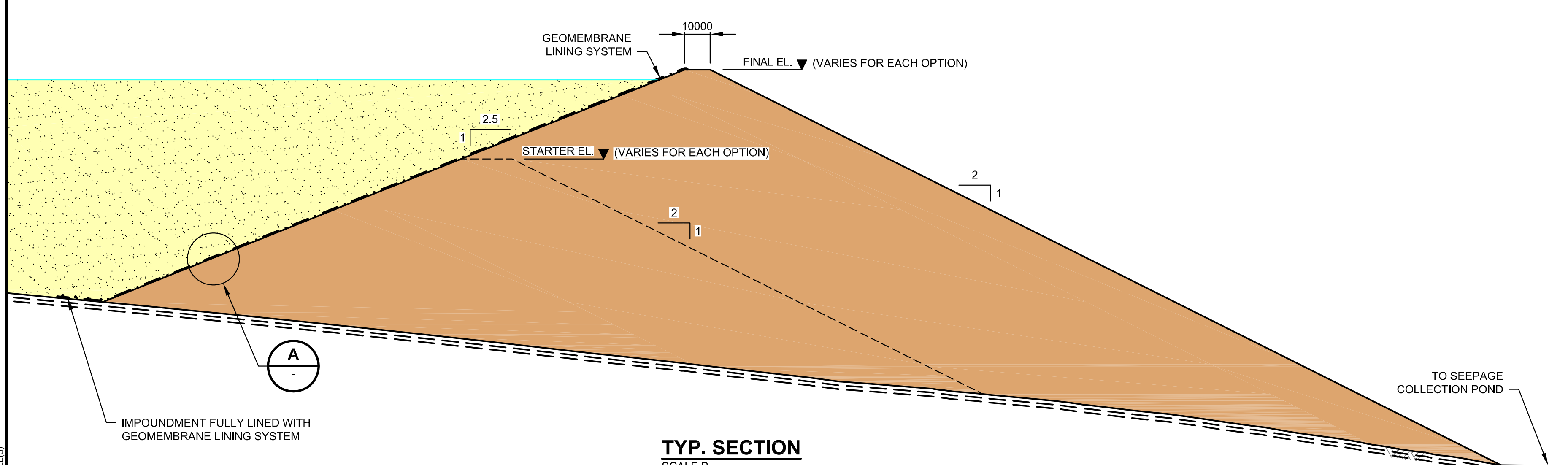
KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).
6. ADDITIONAL 20 m CONTOUR DATA PROVIDED BY IDM MINING FOR OPTION 7 (FEBRUARY 2016).



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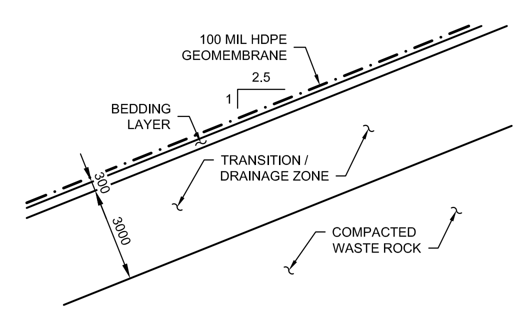

SECTION A
UPSTREAM LINER
NTS

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SCALE A 80 40 0 100 200 300 400 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

TMF OPTIONS ASSESSMENT OPTION 6 & 7

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.2 REV 0

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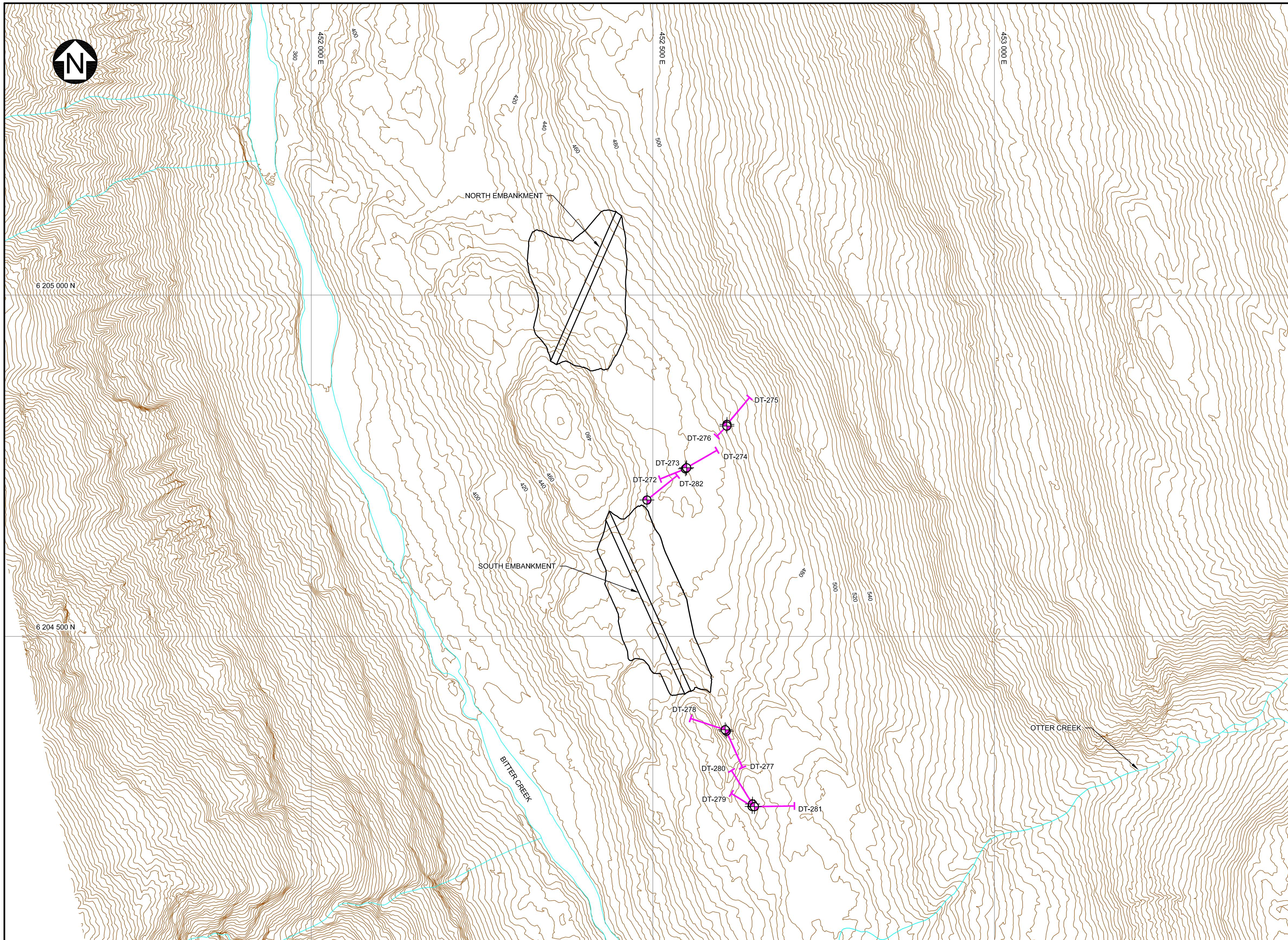

PLAN
SCALE A

KEY PLAN
NTS

LEGEND:

DT-272 — HISTORIC DRILLHOLE (GOLDER ASSOCIATES)

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 60 30 0 100 200 300 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

OTTER CREEK UPPER TMF HISTORIC GEOTECHNICAL & HYDROGEOLOGICAL DRILLHOLE LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.3 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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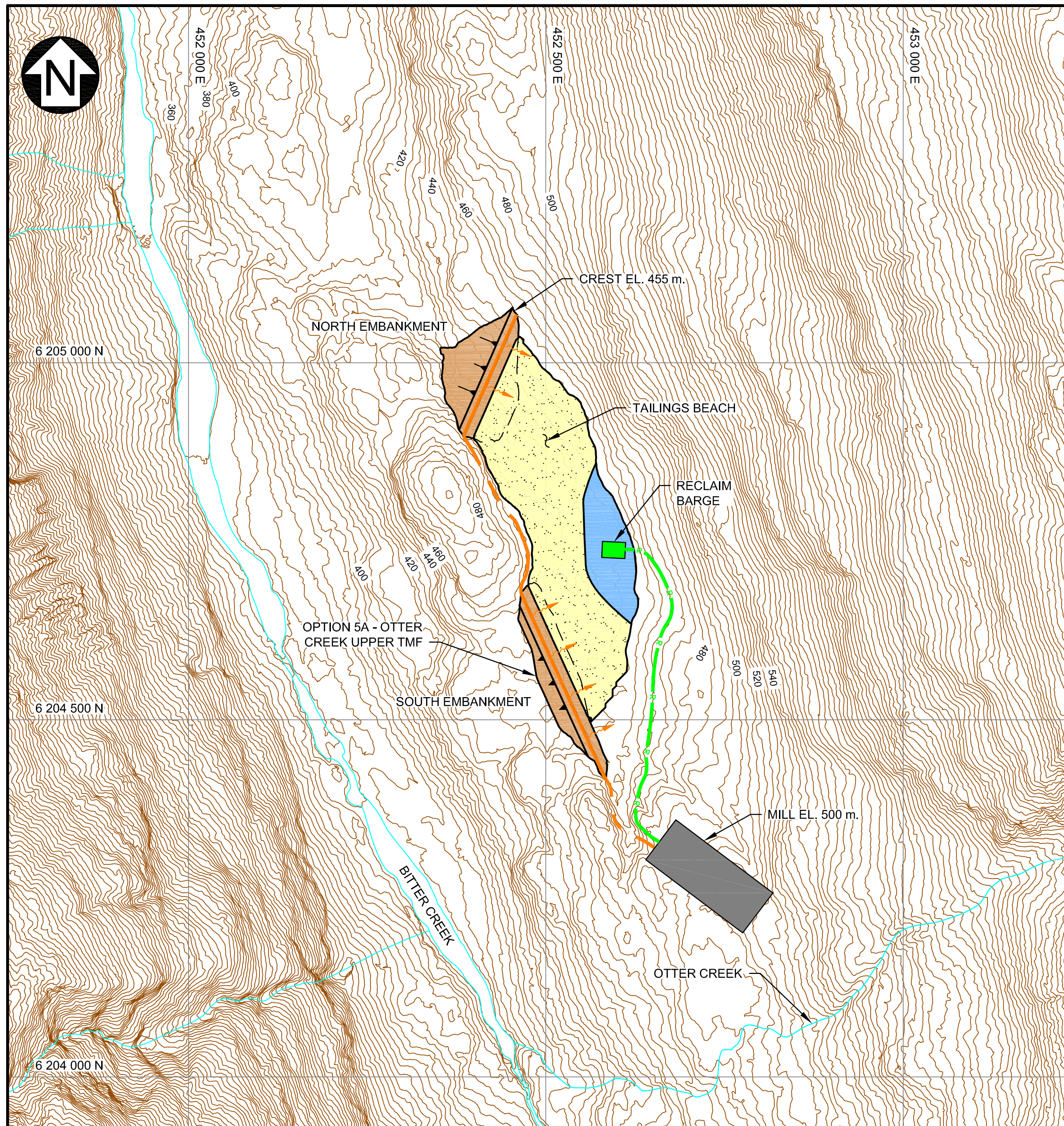
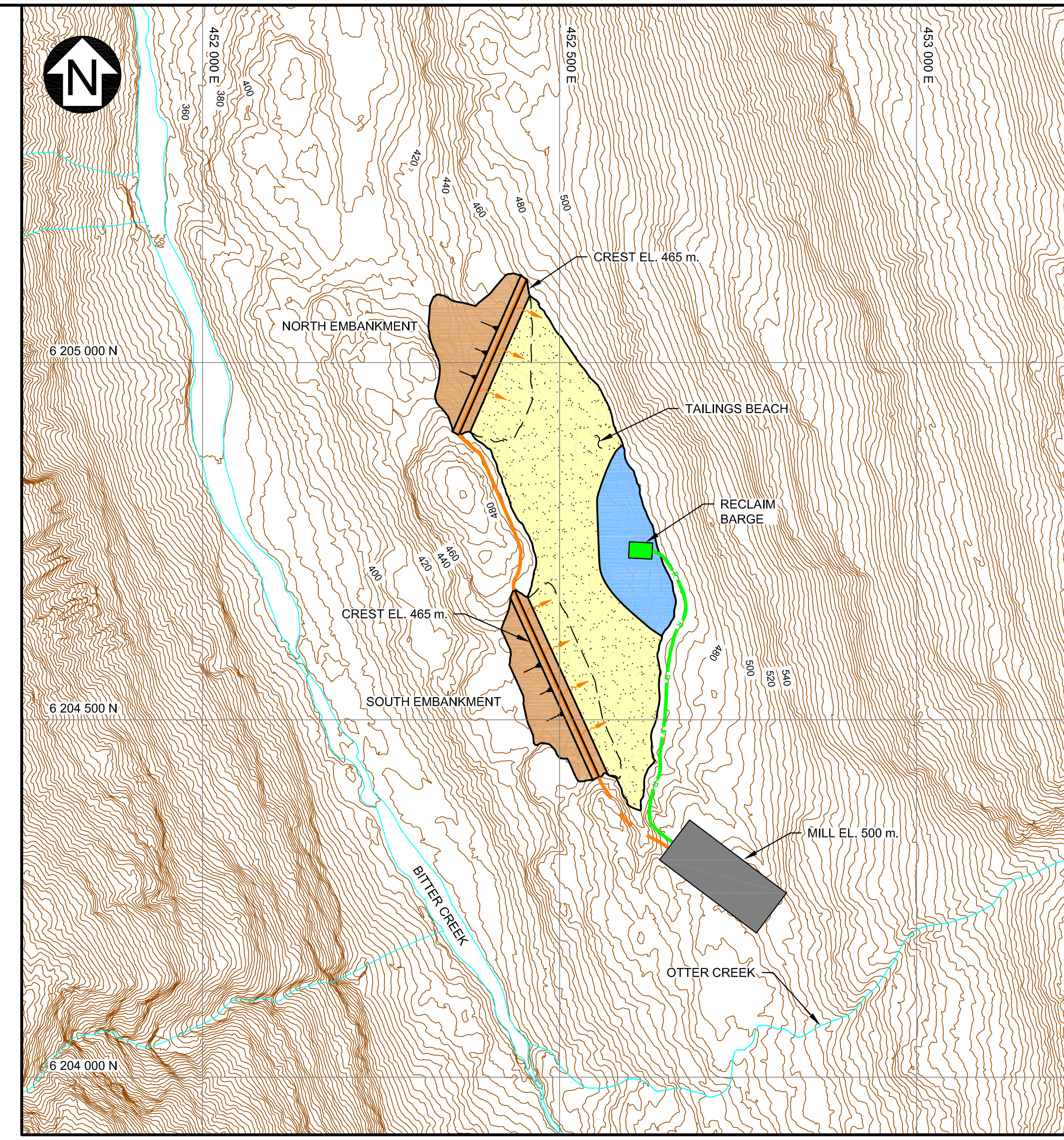
XREF FILE(S): V-TOPO-CONT-5m IMAGE FILE(S):



PLAN
STARTER TMF OPTION 5A
SCALE A



PLAN
FINAL TMF OPTION 5A
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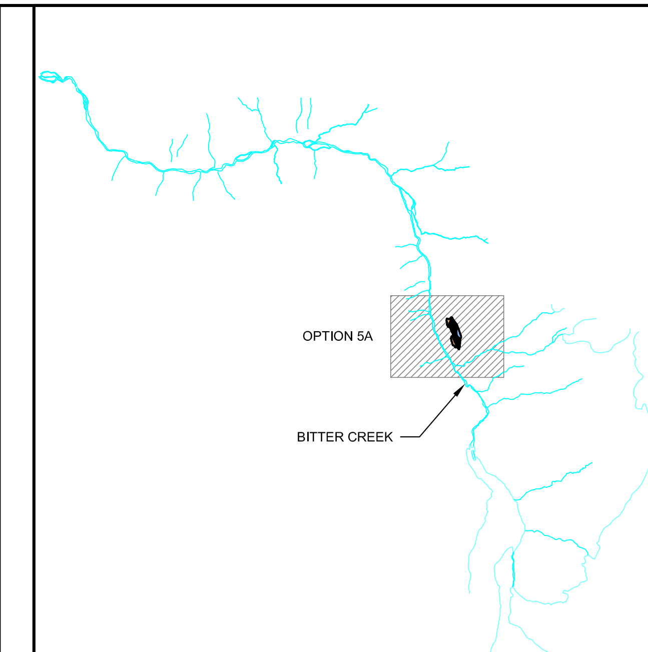


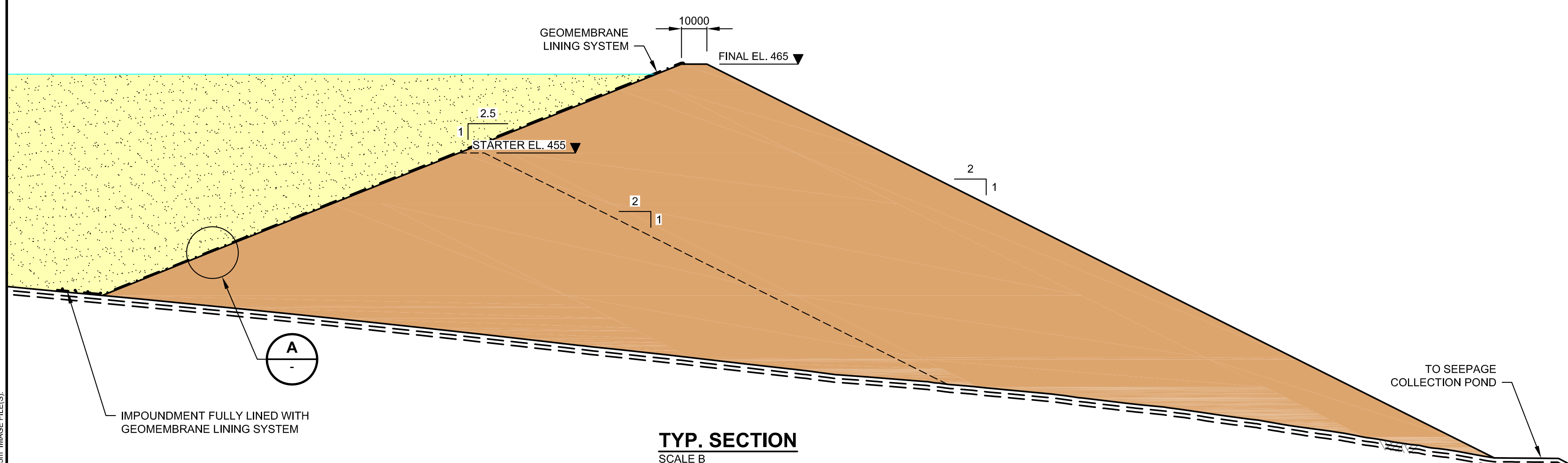
KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).



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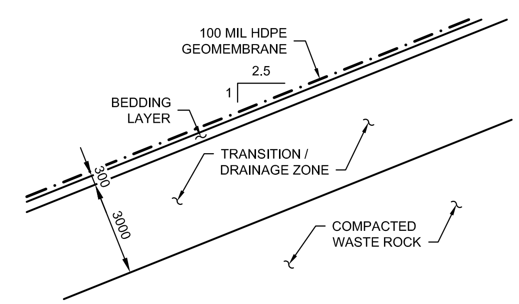


A - SECTION
UPSTREAM LINER
NTS

SCALE B: 25 12.5 0 25 50 75 100 125 m
SCALE A: 100 50 0 100 200 300 400 500 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	17FEB'16	ISSUED WITH LETTER	DMR	ELG	KDE

IDM MINING LTD.

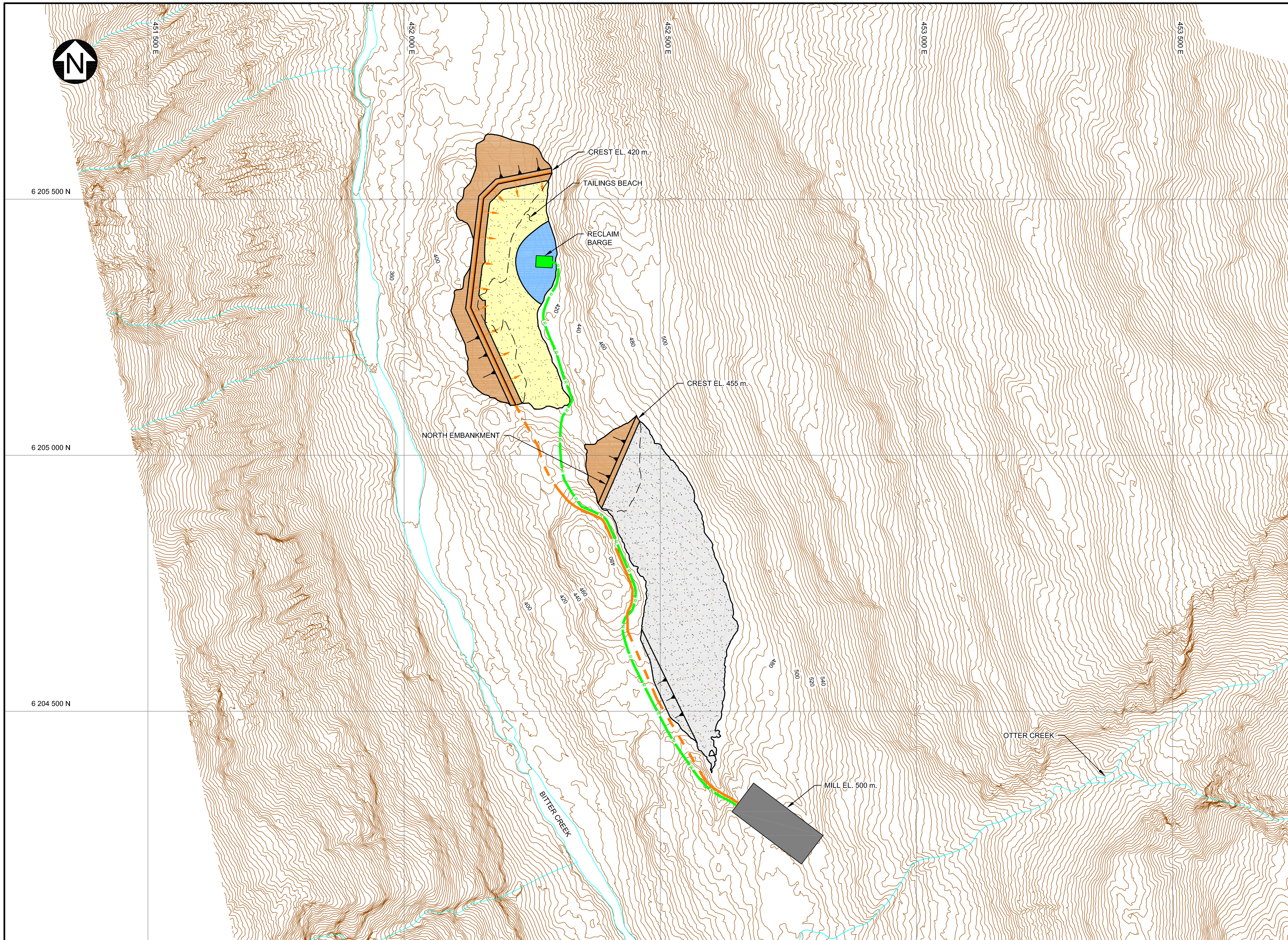
RED MOUNTAIN GOLD PROJECT

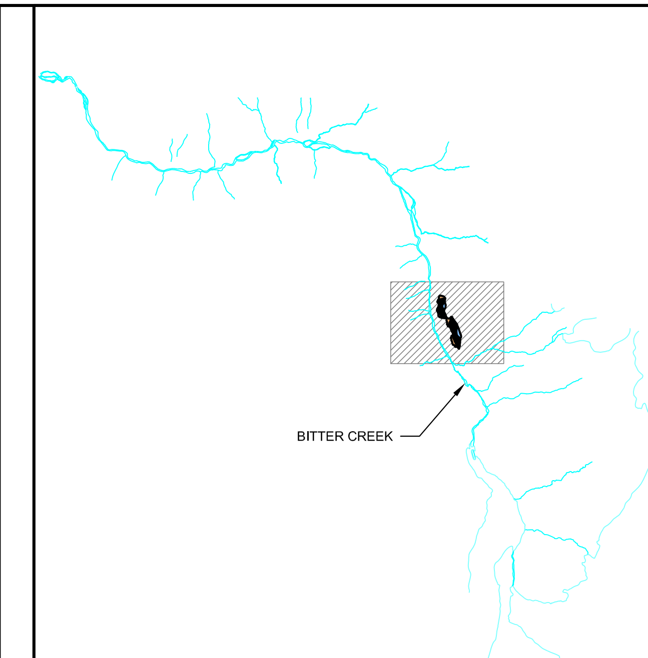
**OPTION 5A
OTTER CREEK UPPER
CONCEPTUAL DESIGN**

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.4 REV 0





KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- FILTERED TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FEBRUARY 2016).

SCALE A 80 40 0 100 200 300 400 m

PLAN
SCALE A

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

OTTER CREEK SLURRY & FILTERED TAILINGS CONCEPTUAL LAYOUT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.5 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	17FEB'16	ISSUED WITH LETTER	DMR	ELG	KDE

SAVED: M:\1\01\00594\01\A\Acad\FIGS\B05, 2/17/2016 4:10:40 PM , EGUEVARRA PRINTED: 2/17/2016 4:19:41 PM, Fig. B.5, EGUEVARRA
XREF FILE(S): v-TOPO-CONT-5m IMAGE FILE(S):

APPENDIX C

OPTIONS ASSESSMENT - CONVENTIONAL SLURRY TAILINGS COST ESTIMATE TABLES

(Pages C-1 to C-6)

TABLE C.1

IDM MIINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 1 - CIRQUE TMF (JDS PEA OPTION)

Print Feb/15/16 15:50:52

Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	105,000	$ 210,000	50,000	$ 100,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	52,500	$ 262,500	25,000	$ 125,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	830,000	$ 7,470,000	870,000	$ 7,830,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	65,000	$ 910,000	37,500	$ 525,000	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	21,750	$ 304,500	11,250	$ 157,500	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	72,500	$ 7,975	37,500	$ 4,125	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	72,500	$ 906,250	37,500	$ 468,750	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	72,500	$ 290,000	37,500	$ 150,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	750	$ 5,625	125	$ 938	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	450	$ 6,300	75	$ 1,050	
	SUB-TOTAL ITEM 1100				**$ 10,423,150**		**$ 9,487,363**	**$19,910,513**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	900	$ 45,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 9,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	600	$ 30,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 6,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	1,000	$ 500,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	600	$ 150,000	60	$ 15,000	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	10.5	$ 10,500	5	$ 5,000	
	SUB-TOTAL ITEM 1300				**$ 900,000**		**$ 15,000**	**$915,000**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-		-	$ 4,500	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 3,000	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 11,783,150**		**$ 9,561,063**	**$21,344,213**
	Contingency	50%			$ 5,891,575		$ 4,780,531	$10,672,106
	TOTAL INITIAL CAPITAL				**$ 17,674,725**			**$17,674,725**
	TOTAL SUSTAINING CAPITAL						**$ 14,341,594**	**$14,341,594**
	TOTAL TMF COSTS				**$ 17,674,725**		**$ 14,341,594**	**$32,016,319**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.1 - Option 1 - Preliminary Scoping Study.xlsx]Table C.1

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

TABLE C.2

IDM MIINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 2 - TOP OF CIRQUE TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	118,000	$ 236,000	103,000	$ 206,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	59,000	$ 295,000	59,000	$ 295,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	1,850,000	$ 16,650,000	3,275,000	$ 29,475,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	76,200	$ 1,066,800	53,800	$ 753,200	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	15,300	$ 214,200	12,075	$ 169,050	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	51,000	$ 5,610	40,250	$ 4,428	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	51,000	$ 637,500	40,250	$ 503,125	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	51,000	$ 204,000	40,250	$ 161,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	800	$ 6,000	250	$ 1,875	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	480	$ 6,720	150	$ 2,100	
	SUB-TOTAL ITEM 1100				**$ 19,371,830**		**$ 31,695,778**	**$51,067,608**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,600	$ 80,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 16,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	1,700	$ 85,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 17,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 448,000**		**$ -**	**$448,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	600	$ 300,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,025	$ 256,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	11.8	$ 11,800	10.3	$ 10,300	
	SUB-TOTAL ITEM 1300				**$ 806,250**		**$ -**	**$806,250**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1501	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 8,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 8,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 67,700**	**$67,700**
	SUBTOTAL				**$ 20,746,080**		**$ 31,763,478**	**$52,509,558**
	Contingency	50%			$ 10,373,040		$ 15,881,739	$26,254,779
	TOTAL INITIAL CAPITAL				**$ 31,119,120**			**$31,119,120**
	TOTAL SUSTAINING CAPITAL						**$ 47,645,216**	**$47,645,216**
	TOTAL TMF COSTS				**$ 31,119,120**		**$ 47,645,216**	**$78,764,336**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.2 - Option 2 - Preliminary Scoping Study.xlsx]Table C.2

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR

TABLE C.3

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 5A - OTTER CREEK UPPER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	95,000	$ 190,000	50,000	$ 100,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	47,500	$ 237,500	25,000	$ 125,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	200,000	$ 1,800,000	375,000	$ 3,375,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	38,000	$ 532,000	39,000	$ 546,000	
1122	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	24,600	$ 344,400	10,950	$ 153,300	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	82,000	$ 9,020	36,500	$ 4,015	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	82,000	$ 1,025,000	36,500	$ 456,250	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	82,000	$ 328,000	36,500	$ 146,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	670	$ 5,025	270	$ 2,025	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	402	$ 5,628	162	$ 2,268	
	SUB-TOTAL ITEM 1100				**$ 4,526,573**		**$ 5,034,858**	**$9,561,431**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,000	$ 50,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 10,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	500	$ 25,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 5,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	500	$ 250,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	720	$ 180,000	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	9.5	$ 9,500	5	$ 5,000	
	SUB-TOTAL ITEM 1300				**$ 930,000**		**$ -**	**$930,000**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 2,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 5,916,573**		**$ 5,093,558**	**$11,010,131**
	Contingency	50%			$ 2,958,287		$ 2,546,779	$5,505,066
	TOTAL INITIAL CAPITAL				**$ 8,874,860**			**$8,874,860**
	TOTAL SUSTAINING CAPITAL						**$ 7,640,337**	**$7,640,337**
	TOTAL TMF COSTS				**$ 8,874,860**		**$ 7,640,337**	**$16,515,197**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.3 - Option 5A - Preliminary Scoping Study.xlsx]Table C.3

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

TABLE C.4

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 5B - OTTER CREEK LOWER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	480,000	$ 4,320,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	80,000	$ 1,120,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	20,400	$ 285,600	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	68,000	$ 7,480	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	68,000	$ 850,000	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	68,000	$ 272,000	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	1	$ 52,083	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 7,308,243**		**$ 52,083**	**$7,360,326**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 75	1,600	$ 120,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 24,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 75	1,300	$ 97,500	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 19,500	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 511,000**		**$ -**	**$511,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	-	$ -	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	830	$ 207,500	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 707,500**		**$ -**	**$707,500**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	273	$ 10,917	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 4,063	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 10,417	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 30,396**	**$30,396**
	SUBTOTAL				**$ 8,646,743**		**$ 82,479**	
	Contingency	50%			$ 4,323,371		$ 41,240	$4,364,611
	TOTAL INITIAL CAPITAL				**$ 12,970,114**			**$12,970,114**
	TOTAL SUSTAINING CAPITAL						**$ 123,719**	**$123,719**
	TOTAL TMF COSTS				**$ 12,970,114**		**$ 123,719**	**$13,093,833**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.4 - Option 5B - Preliminary Scoping Study.xlsx]Table C.4

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.
3. OPTION 5B INCLUDED AS AN EXPANSION OPTION AND DOES NOT PROVIDE SUFFICENT STORAGE FOR THE DESIGN STORAGE OF 1.4 MTONNES OF TAILINGS

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
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TABLE C.5

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 6 - ROOSEVELT CREEK TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	215,000	$ 430,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	107,500	$ 537,500	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	1,841,000	$ 16,569,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	125,000	$ 1,750,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	41,310	$ 578,340	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	137,700	$ 15,147	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	137,700	$ 1,721,250	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	137,700	$ 550,800	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	1,175	$ 8,813	-	$ -	
1152	Process, Load, Haul, Place, Spread and Compact	m3	$ 14	705	$ 9,870	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 22,220,720**		**$ 125,000**	**$22,345,720**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,200	$ 60,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 12,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	300	$ 15,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 3,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	800	$ 400,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,205	$ 301,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	21.5	$ 21,500	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 1,001,250**		**$ -**	**$1,001,250**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 6,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 1,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 23,681,970**		**$ 183,700**	
	Contingency	50%			$ 11,840,985		$ 91,850	$11,932,835
	TOTAL INITIAL CAPITAL				**$ 35,522,954**			**$35,522,954**
	TOTAL SUSTAINING CAPITAL						**$ 275,550**	**$275,550**
	TOTAL TMF COSTS				**$ 35,522,954**		**$ 275,550**	**$35,798,504**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.5 - Option 6 - Preliminary Scoping Study.xlsx]Table C.5

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR

TABLE C.6

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 7 - HIGHWAY TMF

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Item Number	Description	Units	Unit Cost	Initial Capital Quantity	Initial Capital Cost	Sustaining Capital & Operating Costs Quantity	Sustaining Capital & Operating Costs Cost	Total Life of Mine
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	90,000	$ 180,000	76,250	$ 152,500	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	45,000	$ 225,000	38,125	$ 190,625	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	740,000	$ 6,660,000	1,730,000	$ 15,570,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	96,000	$ 1,344,000	91,000	$ 1,274,000	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	16,875	$ 236,250	11,805	$ 165,270	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	56,250	$ 6,188	39,350	$ 4,329	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	56,250	$ 703,125	39,350	$ 491,875	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	56,250	$ 225,000	39,350	$ 157,400	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	800	$ 6,000	200	$ 1,500	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	480	$ 6,720	120	$ 1,680	
	SUB-TOTAL ITEM 1100				**$ 9,642,283**		**$ 18,134,179**	**$27,776,461**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,000	$ 50,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 10,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	400	$ 20,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 4,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 334,000**		**$ -**	**$334,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	725	$ 362,500	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,065	$ 266,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	9	$ 9,000	7.625	$ 7,625	
	SUB-TOTAL ITEM 1300				**$ 878,750**		**$ -**	**$878,750**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 2,000	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,200**	**$58,200**
	SUBTOTAL				**$ 10,975,033**		**$ 18,192,379**	
	Contingency	50%			$ 5,487,516		$ 9,096,189	$14,583,706
	TOTAL INITIAL CAPITAL				**$ 16,462,549**			**$16,462,549**
	TOTAL SUSTAINING CAPITAL						**$ 27,288,568**	**$27,288,568**
	TOTAL TMF COSTS				**$ 16,462,549**		**$ 27,288,568**	**$43,751,117**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.6 - Option 7 - Preliminary Scoping Study.xlsx]Table C.6

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

APPENDIX D

SLURRY AND FILTERED TAILINGS COST ESTIMATE TABLES

(Pages D-1 to D-3)

TABLE D.1

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

OTTER CREEK
SLURRY & FILTERED TAILINGS COMBINATION
PRELIMINARY COST ESTIMATE SUMMARY - 50% CONTINGENCY

Description	Initial Capital Costs	Sustaining Capital	Total
Option 5B - 30% PAG Slurry Tailings	$11,891,000	$124,000	$12,015,000
Option 5A - 70% NAG Filtered Tailings	$2,726,000	$1,685,000	$4,411,000
TOTAL	$14,617,000	$1,809,000	$16,426,000

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0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
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TABLE D.2

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

30 % PAG CONVENTIONAL SLURRY TAILINGS
OPTION 5B - OTTER CREEK LOWER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	400,000	$ 3,600,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	80,000	$ 1,120,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	20,400	$ 285,600	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	68,000	$ 7,480	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	68,000	$ 850,000	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	68,000	$ 272,000	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	1	$ 52,083	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 6,588,243**		**$ 52,083**	**$6,640,326**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 75	1,600	$ 120,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 24,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 75	1,300	$ 97,500	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 19,500	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 511,000**		**$ -**	**$511,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	-	$ -	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	830	$ 207,500	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 707,500**		**$ -**	**$707,500**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	273	$ 10,917	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 4,063	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 10,417	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 30,396**	**$30,396**
	SUBTOTAL				**$ 7,926,743**		**$ 82,479**	$8,009,222
	Contingency	50%			$ 3,963,371		$ 41,240	$4,004,611
	TOTAL INITIAL CAPITAL				**$ 11,890,114**			**$11,890,114**
	TOTAL SUSTAINING CAPITAL						**$ 123,719**	**$123,719**
	TOTAL TMF COSTS				**$ 11,890,114**		**$ 123,719**	**$12,013,833**

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NOTES:

1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.
3. OPTION 5B INCLUDED AS AN EXPANSION OPTION AND DOES NOT PROVIDE SUFFICENT STORAGE FOR THE DESIGN STORAGE OF 1.4 MTONNES OF TAILINGS

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

TABLE D.3

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

70% NAG FILTERED TAILINGS
OPTION 5A - OTTER CREEK Upper TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	145,000	$ 1,305,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	-	$ -	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	-	$ -	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	-	$ -	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	-	$ -	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	-	$ -	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2	$ 100,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 1,758,163**		**$ 100,000**	**$1,858,163**
1200	**Filtered Tailings Distribution System**							
1210	Filtered Tailings Delivery (Haul/Place/Spread/Compact/Grade)	m3	$ 2		$ -	620,000	$ 1,023,000	
	SUB-TOTAL ITEM 1200				**$ -**		**$ 1,023,000**	**$1,023,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500		$ -	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
1360	Water Polishing Pond	LS	$ 250,000	2	$ 500,000	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 58,650**		**$ -**	**$58,650**
	SUBTOTAL				**$ 1,816,813**		**$ 1,123,000**	$2,939,813
	Contingency	50%			$ 908,406		$ 561,500	$1,469,906
	TOTAL INITIAL CAPITAL				**$ 2,725,219**			**$2,725,219**
	TOTAL SUSTAINING CAPITAL & OPERATING COSTS						**$ 1,684,500**	**$1,684,500**
	TOTAL TMF COSTS				**$ 2,725,219**		**$ 1,684,500**	**$4,409,719**

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NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

APPENDIX E

TAILINGS BEST AVAILABLE TECHNOLOGY (BAT) ASSESSMENT

(Pages E-1 to E-95)

IDM MINING LTD.
RED MOUNTAIN PROJECT



TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT

PREPARED FOR:

IDM Mining Ltd.
1500 - 409 Granville Street
Vancouver, British Columbia, V6C 1T2

PREPARED BY:

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VA101-594/4-1
Rev 0
June 30, 2017

Knight Piésold
CONSULTING
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IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
VA101-594/4-1

Rev	Description	Date
0	Issued in Final	June 30, 2017

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Knight Piésold
CONSULTING

EXECUTIVE SUMMARY

The Red Mountain Underground Gold Project (the Project) is a proposed gold mine being developed by IDM Mining Ltd. (IDM). The Project is located approximately 18 km east-northeast of Stewart, BC. This report presents a tailings Best Available Technology (BAT) assessment to support the Feasibility Study (FS) and Environmental Assessment Application (EAA) for the Tailings Management Facility (TMF). The assessment incorporates the results from the TMF Location Assessment Study undertaken in February 2016, which identified the Bromley Humps Upper Site as the preferred TMF location.

The proposed mine includes a mill throughput of 1,000 tonnes per day over a 6 year mine life for a total ore production of 1.95 million tonnes. The mill tailings will be delivered to the TMF in a single stream. Test results indicate the tailings are potentially acid generating and will become metal leaching after approximately 20 years of exposure to atmospheric conditions (oxidation).

The BAT assessment considered the following three tailings technologies and management strategies for the Bromley Humps TMF:

- Candidate 1: Thickened Tailings
- Candidate 2: Ultra-thickened Cemented Tailings, and
- Candidate 3: Filtered Tailings.

Environmental, technical, social and economic assessment criteria were considered in the assessment. Each criteria was assigned a relative weight according to its importance in its specific category. Higher weights indicate greater relative importance and reflect the site conditions and issues relative to the proposed development. The weightings were developed by KP with input from IDM, JDS Energy & Mining Inc. (JDS) and Brownhill Consulting Services (BCS). Ratings were developed to compare the criteria. General ratings of “Preferred”, “Acceptable” and “Least Preferred” were assigned to the site specific criteria of each candidate. Scores of 3, 2 and 1 were associated with the ratings, respectively.

The weighted results of the assessment are as follows:

- Candidate 1 (Thickened Tailings) had the highest rating of the three alternatives, achieving a weighted score of 1.39
- Candidate 2 (Cemented Tailings) had the second highest score of 1.30, and
- Candidate 3 (Filtered Tailings) had the lowest score of the three alternatives with a score of 1.26.

The BAT assessment recommends Candidate 1: thickened tailings management. The main factors for this conclusion are as follows:

- The tailings deposition and water management strategy is operationally simpler than the other candidates.
- Process and runoff water is contained within the same facility. Water for mill reclaim and surplus water treatment and release is sourced from the supernatant pond in the TMF.
- No additional mill processes are required.
- There is a lower risk of operational problems (complications due to climactic conditions, etc.).
- A greater ability to mitigate ARD/ML generation potential with continuous tailings deposition, wetting of the beach surface and maintenance of a pond within the facility.

TABLE OF CONTENTS

PAGE

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

Acid Rock Drainage .... ARD
Best Available Technology .... BAT
Brownhill Consulting Services .... BCS
British Columbia .... BC
Environmental Assessment Application .... EAA
Feasibility Study .... FS
IDM Mining Ltd. .... IDM
JDS Energy & Mining Inc. .... JDS
Knight Piésold Ltd. .... KP
Liquid Limit LL
Mean Annual Precipitation .... MAP
Metal Leaching .... ML
Meters above sea level .... masl
Million tonnes .... Mt
Non Potentially Acid Generating .... non-PAG
Potentially Acid Generating .... PAG
Positive Displacement .... PD
Preliminary Economic Assessment .... PEA
Plasticity Index .... PI
Plastic Limit .... PL
Qualitative Multiple Accounts Assessment .... QMAA
Red Mountain Underground Gold Project .... the Project
SRK Consulting .... SRK
Tailings Management Facility .... TMF
Tonne per day .... tpd
Tonnes per cubic metre .... t/m^3

1 – INTRODUCTION

1.1 GENERAL

The Red Mountain Underground Gold Project (the Project) is a proposed gold mine being developed by IDM Mining Ltd. (IDM). The Project is located approximately 18 km east-northeast of Stewart, BC. This report presents a tailings Best Available Technology (BAT) assessment to support the Feasibility Study (FS) and Environmental Assessment Application (EAA) for the Tailings Management Facility (TMF). The BAT assessment builds upon the tailings management concepts developed in the '*Waste and Water Management Design for Preliminary Economic Assessment'* that was prepared Knight Piésold Ltd. (KP) in June 2016 (KP, 2016a) in support of the Preliminary Economic Assessment (PEA). The BAT assessment also incorporates the results from the TMF Location Assessment Study (KP, 2016b) undertaken in February 2017, which identified the Bromley Humps Upper Site as the Preferred TMF Location.

The proposed mine includes a mill throughput of 1,000 tonnes per day (tpd) over a six year mine life for a total ore production of 1.95 million tonnes (Mt). The mill tailings will be delivered to the TMF in a single stream. Test results indicate the tailings are potentially acid generating (PAG) and will become metal leaching (ML) after approximately 20 years of exposure to atmospheric conditions (oxidation).

1.2 SCOPE

This report summarizes the tailings characterization test results and the BAT assessment for the Project. The assessment is based on the current mine design and operating criteria, and considers the Project setting and tailings test results. The report may be updated as the Project progresses through permitting and design and as additional information becomes available.

The BAT assessment does not include or address management of waste rock material. This will be undertaken by JDS Energy & Mining Inc. (JDS) who are leading the ongoing feasibility studies and are responsible for management of the waste rock material on site.

1.3 PROJECT DESCRIPTION

The Project deposit is located in Red Mountain Cirque, at elevations ranging between 1,500 and 2,000 meters above sea level (masl). The proposed TMF and process plant site are situated in the Bitter Creek valley, at the Bromley Humps area, approximately 7 km northwest of the underground portal, at elevations ranging between 400 and 500 masl.

The Project site is characterized by rugged, steep terrain with sparse overburden cover, prevalent bedrock outcrops and weather conditions typical of the north coastal BC mountains. Climatic conditions at Red Mountain are dictated primarily by its altitude and proximity to the Pacific Ocean. Temperatures are moderated year-round by the coastal influence. The region is characterized by high precipitation with a mean annual precipitation (MAP) of 1,847 mm. Over one-third of the annual precipitation falls as snow. This proportion is greater at higher elevations. Avalanches are a concern in the Bitter Creek drainage, where the TMF is situated. The heavy snowfall, steep terrain and frequent windy conditions are important considerations for tailings and water management.

The water balance conducted for the FS and EAA indicates there is sufficient water to meet the mill requirements without the need for additional make-up water. A water surplus in the range of 0.2 to 0.3 million m^3 per year was estimated based on a range of annual precipitation values (KP, 2017).

1.4 TMF LOCATION ASSESSMENT

KP conducted a TMF location assessment to identify the preferred TMF location in February, 2016 (KP, 2016b).The assessment was completed with input from JDS and considered factors such as mine planning and infrastructure, tailings storage capacity, future expansion potential, and embankment configuration. The assessment results are attached as Appendix A.

The location assessment considered the use of conventional slurry tailings as the tailings technology base case. The assessment identified nine TMF options in eight different sites. Three alternatives failed the Phase 1 pre-screening and were eliminated from contention. The remaining six TMF locations, described below, were advanced to the Phase 2 trade-off and comparison assessment.

Option 1 – Cirque TMF (JDS PEA Option)

The Cirque TMF is located in the Red Mountain Alpine Area between the Cambria Ice fields and the Bromley Glacier. The area has an average elevation of approximately 1,500 m and has little vegetation. Foundation conditions consist mainly of talus deposits overlying fractured bedrock. Due to the relatively poor topographical conditions for impoundment capacity and dam construction, a large dam is required to provide sufficient storage. There are also concerns related to weather and snow accumulation for this option. This location was used in the 2014 Preliminary Economic Assessment.

Option 2 – Top of Cirque TMF

The Top of Cirque TMF site is located in the Red Mountain Alpine Area. The facility is located at approximate El. 1700 m above the Option 1 (Cirque) TMF. The steep topography requires an extremely large dam and results in very poor storage efficiency for tailings. There are also concerns related to weather and snow accumulation for this option. This area was originally considered a possible option due to the close proximity to the portal.

Option 5A and 5B – Bromley Humps TMF (Formerly Otter Creek Upper and Lower TMF)

The Bromley Humps TMF site is located along the north bank of Bitter Creek adjacent to the confluence of Otter Creek and Bitter Creek at an approximate elevation of 450 m. Topographically this area is a more efficient tailings storage site. An additional cell downstream of the North TMF Embankment provides additional expansion potential. The Bromley Humps TMF is more protected and winter operations are expected to be safer and more reliable at this location.

Option 6 – Roosevelt Creek TMF

The Roosevelt Creek TMF site is located on a terrace along the north bank of Bitter Creek at approximate El. 350 m. The topography slopes at approximately 20-25% and a large dam would be required to provide storage. The terrace consists of an outwash deposit of permeable sandy gravel with cobbles and boulders. The site has a potential for avalanches and debris slides. The site is currently not within the Project’s environmental baseline study boundary.

Option 7 – Highway TMF

The Highway TMF is located where Bitter Creek merges with Bear River, and is adjacent to Clements Lake. Clements Lake is Provincial Park and the TMF site is currently not within the Project's environmental baseline study boundary.

Results

The TMF location assessment identified that Option 5A, the Bromley Humps Upper TMF, is the preferred location for storage of tailings. This option is advantageous for the following reasons:

- Located at a lower elevation, therefore more favourable climatic conditions. Winter operations are expected to be safer and more reliable at a lower elevation.
- Clear from the Otter Creek avalanche path.
- Provides the best storage efficiency of the alternatives.
- Mill and TMF are in close proximity to each other (approx. 500 m), with Mill at a higher elevation than the TMF resulting in lower energy requirements for pumping.
- More favourable water management strategies compared to other options (deep groundwater levels, favourable topography for non-contact water diversion, etc.)
- Could be developed in combination with Option 5B, the lower TMF impoundment, for additional capacity.
- Geotechnical and Hydrogeological Site Investigations in the area were completed in 2016 by KP and in 1996 by Golder Associates in this area.
- TMF and Mill location is advantageous from a construction schedule and project execution standpoint. Construction could begin on the Mill and TMF while the road between Otter Creek and the mine is being constructed.
- Lower capital, sustaining and operating costs than other options.

2 – TAILINGS PROPERTIES AND CHARACTERISTICS

2.1 GENERAL

Tailings samples for testing were generated from metallurgical testwork on ore samples from two zones within the deposit: the Marc and AV zones. Geotechnical testing was conducted on tailings samples at the KP Soils Laboratory in Denver, Colorado, and tailings filtration testwork was completed by Tenova TAKRAF in Burnaby, BC.

2.2 TAILINGS TESTING DESIGN CRITERIA

Milling will be conducted at a production rate of 1,000 tpd (year round). JDS conducted a mill process optimization that identified a mill grind size of 25 μm (i.e. 80% passing the No.500 (25 micron) sieve) as the preferred grind.

The tailings testwork assumed the tailings are thickened at the mill to a slurry solids content of 50% by weight before being pumped to the TMF. The tailings will be conveyed in a single overland pressure pipeline and discharged from the TMF embankments via spigoted offtakes.

2.3 TESTWORK SUMMARY

2.3.1 Geotechnical Testwork Summary

The geotechnical testing program was conducted to evaluate the physical characteristics of the tailings materials. Testing was completed on two tailings samples provided by JDS: AV Master Comp and Marc Master Comp. The test program included index testing to enable geotechnical classification of the materials, and slurry settling, air drying and consolidation testing to determine the characteristics of the tailings following deposition for a range of possible field conditions.

The index test results were similar for both samples and the tailings can be generally described as an inorganic silt with low plasticity (PL = 25, LL = 30-31, PI = 5-6). The specific gravity of the tailings solids was determined to be 3.095 for the AV tailings, and 3.031 for the Marc tailings.

Slurry settling (or sedimentation) tests provide an estimate of the density the tailings slurry will settle in a sub-aqueous environment, under undrained and drained conditions. The tests provide an indication of the tailings dry density achieved in the TMF after settling and before any significant consolidation or air drying occurs. Air drying tests were carried out on tailings samples to estimate the effect of air drying after initial slurry settling and removal of supernatant water. Slurry consolidometer tests were carried out to provide information on the consolidation, compressibility and permeability characteristics over a wide range of confining stresses corresponding to expected field conditions. The tests were completed on the AV and Marc tailings at a design solids content of 50%.

A complete report on the results of the geotechnical testing program is included in the Project FS.

2.3.2 Consolidation Modelling

Consolidation modelling was completed using a one dimensional finite difference computer model and the results from the geotechnical test program. The model predicts the magnitude and rate of tailings consolidation, the amount of consolidation seepage (i.e. water losses from the tailings mass) and the corresponding average dry density of the tailings mass. Each model was completed assuming both a fully drained base and an impermeable base. Outputs from tailings consolidation modelling can be used to refine embankment height requirements, provide input to the tailings deposition strategy to correspond with operational and closure objectives, and facilitate water management planning, operational water balance modelling, watershed modelling and associated water chemistry predictions.

Results of the consolidation modelling indicate the average dry density of the tailings mass increases over time, from approximately 1.21 tonnes/m^3 at Year 1, to 1.30 tonnes/m^3 at the end of operations, and 1.36 tonnes/m^3 at the beginning of the reclamation period (i.e. 2 years post-operations). Post closure consolidation of the tailings is estimated to reduce the average thickness of the tailings mass by less than 1 m.

Consolidation modelling was completed based on the TMF layout, design, and tailings deposition strategy from the Feasibility Design of Tailings and Water Management by KP (KP, 2017). This assumes that conventional thickened tailings were discharged from the embankments.

2.3.3 Tailings Thickening Testwork

A laboratory testing program was conducted by Tenova TAKRAF to confirm the filtration characteristics, suitability for filtered tailings, and to determine the pre-leach thickener parameters.

The thickening tests, which were undertaken to determine the pre-leach thickener required for the system, included:

- Flocculent preparation and screening
- Settling
- Compaction
- Rheology
- Dynamic thickening, and
- Static thickening.

Thickener testwork and Delkor methodology for thickener selection considers three zones operating in a thickener:

1. Clarified Liquor Zone
2. Settling Zone, and
3. Compaction Zone.

The testwork concluded that a thickener of diameter 18 m with a tank wall of 3 m and slope of 9° would be required to achieve the desired solids content and water recovery in the thickener underflow.

2.3.4 Filtration Testwork

The pressure filtration testwork consisted of preparing a filter cake through a three-stage process. Cake washing, an optional fourth stage, was not considered for this program. The three stages included:

1. *Filling and dewatering stage:* Feed slurry is introduced to the filter press by the feed pump. Solids are trapped by the filter cloth and filtrate is discharged via a plate drainage grid connected

to the corner ports. The filtration rates and final cake moisture contents can be optimized by increasing the feed pressure produced by the feed pump.

2. *Membrane squeezing stage (membrane filter press only):* This is a mechanical squeezing of the filter cake formed in the chamber through the use of air or water. The cake is compressed when a rubber membrane bulges with water/air and pressed against the cake, reducing cake volume to create space for air drying/air blowing. Filter cakes are squeezed up to 16 bar pressure based on the application.
3. *Air blowing stage:* This is the final dewatering stage to remove entrained water between interstitial particles that cannot be removed by mechanical squeezing. Compressed air is blown through the cake in the filtrate channel. Regulation of the blowing medium is controlled by blowing pressure and time. The cake is kept compressed by membranes during blowing to avoid cracks in the filter cake.

The following design parameters were developed by Tenova TAKRAF from the testwork results:

- Filtered tailings dry density: 1.72 t/m3
- Feed filling pressure: 6-10 bar
- Filtration pressure: >10 bar
- Filtration time: 6 minutes (includes fill time)
- Air blowing pressure: 10 bar
- Air blowing time: 4 minutes, and
- Estimated total cycle time: 15.57 minutes.

The testwork concluded that Project tailings were suitable for filtered tailings production using a recessed plate filter press design. The press would consist of a 1,500 mm plate of depth 40 mm with 99 chambers for filter cake production.

3 – TAILINGS TECHNOLOGY ASSESSMENT

3.1 GENERAL

This section evaluates the BAT for tailings management at Bromley Humps TMF location. The BAT can be defined as the most suitable, site specific tailings technology and management strategy for the Project based on the tailings characteristics and the TMF location. The overall objective of the BAT Assessment is to identify "*the site specific combination of technologies and techniques that most effectively reduce the physical, geochemical, ecological and social risks associated with tailings storage during all stages of operation and closure*" (BC MEM, 2016).

3.2 PAG CLASSIFICATION

Potentially Acid Generating (PAG) tailings require additional care to manage the acid generation potential. Geochemical testing of the tailings, conducted by SRK, indicate the tailings are PAG and are anticipated to become Metal Leaching (ML) after approximately 20 years of exposure to oxidation. Tailings are still acceptable for sub-aerial disposal, however, maintaining a degree of saturation will be important to mitigate the acid generation risk. Saturation can be achieved through management of the TMF supernatant pond or application of new layers of tailings to prevent prolonged oxidation of the exposed beach.

3.3 TAILINGS TECHNOLOGIES

Mine tailings are described by their approximate solids content at delivery. Tailings can be produced according to a range known as the tailings continuum, shown on Figure 3.1.

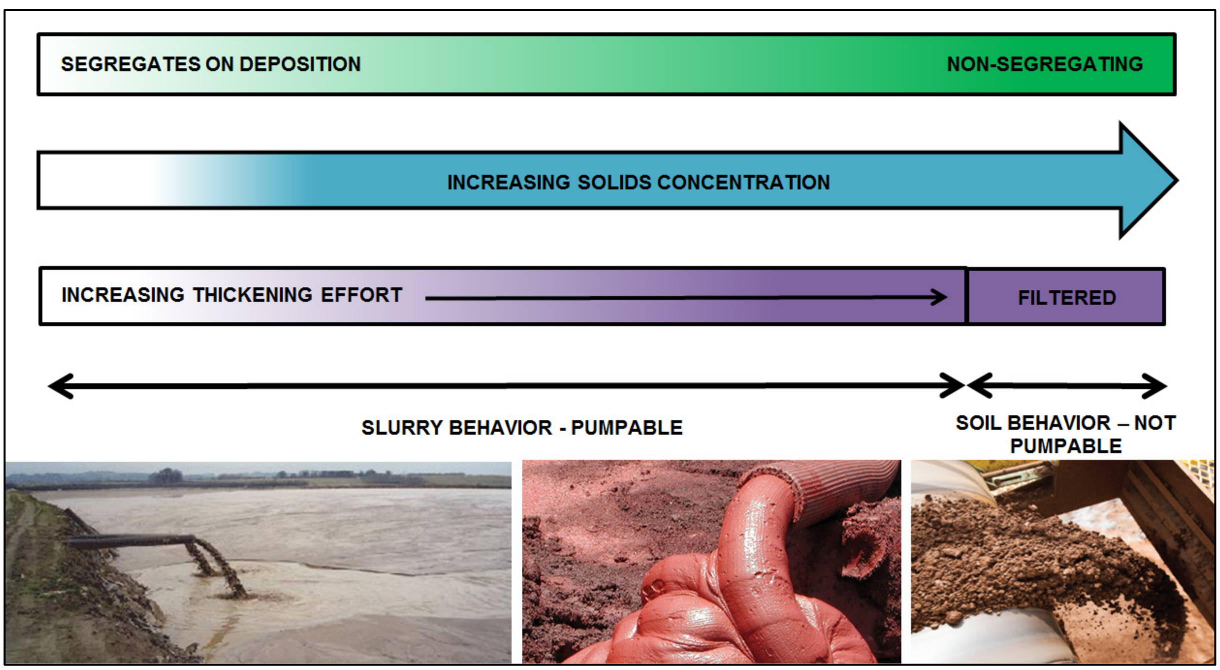

Figure 3.1 Tailings Continuum

The continuum qualitatively describes the tailings solids content, the thickening effort (and/or dewatering effort) required, the method of conveyance, and segregation potential of the tailings.

Certain points within the tailings continuum are recognized as "tailings technologies" for this assessment. The five tailings storage technologies discussed in this section include:

- Conventional Slurry Tailings
- Thickened Slurry Tailings
- Ultra-Thickened (Paste) Tailings
- Cemented Tailings, and
- Filtered Tailings.

3.3.1 Conventional Slurry Tailings

Conventional slurry tailings are discharged from the mill at about 20 to 35% solids (by weight). The tailings may be pumped by centrifugal pumps, flow by gravity, or a combination thereof. Slurry is discharged through off-takes along the embankments or around the perimeter of the TMF to optimize basin filling and control the location of the supernatant pond. Segregation occurs in the tailings, with coarser particles settling out near the discharge points to form tailings beaches, while the fines are transported further. Supernatant water and runoff are reclaimed for processing.

Subaqueous deposition of conventional slurry tailings is commonly used for tailings which are PAG to preclude oxidation. Subaqueous disposal typically incorporates point discharge of slurry tailings beneath the supernatant pond water surface. The concept is that tailings solids settle on the bottom of the TSF and remain under a water cover in perpetuity.

Conventional slurry tailings disposal is well suited to project sites that operate with a surplus water balance and for facilities that contain PAG or ML waste materials that require saturation to prevent adverse chemical reactions. The largest costs associated with conventional slurry tailings disposal are associated with embankment construction, lining systems, and water management, including diversions and water reclaim systems. Although conventional slurry is the most water intensive tailings disposal option, it is operationally the simplest method provided water management is addressed adequately.

3.3.2 Conventional Thickened Tailings

Thickening is used to increase the solids content to a solids content of approx. 40 to 55% by weight. The excess process water generated during the thickening process is typically reused in the mill. Thickened tailings can be transported in smaller diameter pipelines for the equivalent mill throughput, but may require greater pumping pressures. Centrifugal pumps are typically used; however booster pump stations may be required with higher densities and longer pipelines. Tailings deposition is similar to conventional slurry tailings. Supernatant water and runoff is reclaimed from the TMF supernatant pond for processing.

Capital costs for tailings transport and water reclaim systems may be lower than for conventional slurry tailings; however the cost of the thickeners and tailings pumps must be considered and may offset the capital cost savings related to pipeworks. Operating costs are typically higher due to thickener maintenance, the addition of flocculants, higher pump energy requirements, etc. Thickened tailings are appropriate for sites that require extensive pumping, or sites that require more water conservation.

3.3.3 Ultra-Thickened (Paste) Tailings

The ultra-thickened tailings technology requires additional thickening or additives to increase the solids content to about 60 to 75% by weight. Ultra-thickened tailings are sometimes referred to as paste tailings; however the term paste is only relevant if certain yield stress criteria are met.

Ultra-thickening results in greater water recovery at the mill and less water delivered to the TMF. The tailings flowrate is less and therefore conveyed in smaller pipeline sizes, however greater pumping pressures may be required and positive displacement (PD) pumps are typically used. Reclaim pumping requirements are usually low because less water is delivered to the TMF with the tailings. A separate water management pond is likely required for a ultra-thickened tailings facility for management of storm water from the TMF.

Capital costs for tailings pipelines may be lower than for thickened or conventional tailings; however, the cost of additional thickening/flocculants and tailings pumps must be considered. PD pumps are significantly more expensive to purchase in comparison to the centrifugal pumps. Operating costs are typically higher for an ultra-thickened tailings system when compared to thickened or conventional tailings disposal.

Ultra-thickened tailings are most appropriate for sites that operate in a significant water deficit and require a high level of water conservation, i.e. where water supply is significantly limited or prohibitively expensive.

3.3.4 Cemented Tailings

A variation of ultra-thickened tailings is cemented tailings, which utilize cement, fly ash or slag additives to create a non-flowable, low permeability tailings mass once the tailings are deposited and have settled. Cemented tailings are typically deposited as underground backfill for mining stopes and voids.

Cemented tailings with higher slurry solids content are produced in gravity thickeners (paste plant) with the addition of flocculants to increase the rate of sedimentation and enhance liquid-solids separation. A large proportion of the recoverable process water is reclaimed in the thickeners and the remaining tailings are mixed with cement, fly ash or slag and transported to the TMF by pumping.

PD pumps are required to transport ultra-thickened cemented tailings. These pumps are significantly more expensive to purchase in comparison to the centrifugal pumps typically used for conventional slurry or thickened tailings delivery. A separate water management pond is likely required for a cemented tailings facility for management of storm water from the TMF.

3.3.5 Filtered Tailings

Mechanical dewatering of tailings can be used to remove process water to a point at which the tailings behave like a soil. A partially saturated filter cake is developed for disposal in a filtered tailings stack. Mechanical dewatering of the tailings can be achieved through a variety of technologies including vacuum and pressure filtration processes. Filtered tailings are typically dewatered to a moisture content of approximately 15% and placed and compacted in thin lifts. Filtering and transport of dewatered tailings by conveyor or haul truck can be costly in comparison to pipeline disposal of tailings slurry. In addition, a contingency alternative method for tailings discharge is required (i.e. pipeline system and/or emergency dump pond in the event of a filter system failure).

Depending on the angle of repose of the final filtered tailings, confining berms and buttresses may be required to construct the filtered tailings stack. In some cases, full TMF embankments may be required to contain the filtered tailings in a safe and efficient manner.

A separate water management pond is required to store process water and storm water runoff from the surface of the TMF as the water cannot be stored on the filtered tailings in order to maintain the mass in an unsaturated condition. The water management pond must be large enough to manage storm water runoff and to provide a buffering volume for fluctuations in process water requirements and periods of low rainfall and/or runoff, such as during winter operations.

A key requirement for filtered tailings is maintaining the stack in a relatively dry (unsaturated) condition, which is a challenge in wet environments. Continued snow removal would be required during the winter months to allow for on-going tailings placement and to reduce the impacts of snowmelt during the freshet period. Excessive moisture may be present in the stack and can result in high pore pressures with stability problems. The operational complexity and high capital and operating costs, coupled with the risks of reactive tailings management, are critical issues that may require additional design measures.

3.4 ALTERNATIVES ASSESSMENT CANDIDATES

The following three points on the tailings continuum were selected for evaluation in the BAT Assessment.

- ***Candidate 1 – Conventional Thickened Tailings (current design and base case) –*** Thickened tailings delivered in one stream to a lined TMF.
- ***Candidate 2 – Ultra thickened Cemented Tailings –*** Ultra-thickened cemented tailings delivered in one stream to a lined TMF.
- ***Candidate 3 – Filtered Tailings –*** Tailings trucked, placed and compacted in thin lifts, forming a tailings stack.

Two of the tailings continuum points identified in Section 3.3, Conventional slurry and Ultra-thickened (without cement), were not included in the assessment. Conventional slurry tailings was excluded as the mill process optimization study identified a tailings solids content of 50% (thickened slurry) could be achieved using the regular mill process. Pumping tailings at a lower solids content and higher flowrate was therefore considered inefficient. Ultra-thickened tailings (without cement) was not included in the assessment due to the operating and processing similarities with the ultra-thickened cemented tailings alternative. Ultra-thickened cemented tailings was preferred for inclusion in the assessment due to its increased performance as a non-flowable, non-segregating mass.

3.4.1 Candidate 1: Conventional Thickened Tailings

Candidate 1 is a conventional thickened tailings impoundment. The tailings are gravity thickened as part of the routine mill circuit to approximately 50% solids by weight and subsequently delivered to the TMF in a single overland pipeline.

The tailings material segregates upon deposition with the coarsest particles settling near the discharge spigots and finer particles settling farther downslope on the tailings beaches. The sub-aerially deposited tailings will form a beach with a slope of approximately one percent near the discharge points. Finer tailings particles are carried out to the supernatant pond in suspension and settle over time. The sub-aqueous portion of the beach will have an initial slope ranging between three to five percent, gradually becoming flatter. The continuous discharge and deposition of new layers of tailings on the beach surface promotes wetting of the tailings mitigating acid generation potential.

Water released from the thickened slurry will accumulate in the lowest area of the TMF forming the supernatant pond. The size of the supernatant pond requires management to provide adequate retention time to allow finer tailings particles to settle out before the water is pumped back to the site for reuse. The pond also promotes saturation of the tailings that limits tailings oxidation and acid generation. Seepage from the facility will be managed with a low-permeability geosynthetic liner, a basin underdrain system, and a foundation drain system.

The lined facility is expanded using the downstream embankment construction method with material from local borrow sources. The pond is kept away from the embankments using selective tailings deposition to develop beaches adjacent to the embankments. The tailings beaches enhance stability and reduce potential seepage from the TMF.

The closure plan includes removal of the supernatant pond and installation of a closure cap with a geosynthetic liner to preclude oxidation, therefore limiting acid generation potential. The closure plan also includes a graded waste rock or overburden cover to promote all run-off through spillways constructed in the embankments, and a revegetated topsoil cover on the final graded closure cover.

Basic design criteria for Candidate 1 are summarized below:

- Design solids content: 50% solids by weight
- Average dry density: 1.3 t/m^3, and
- TMF tailings volume: 1.5 Mm^3.

A preliminary general arrangement for Candidate 1 is presented in Figure 3.2.

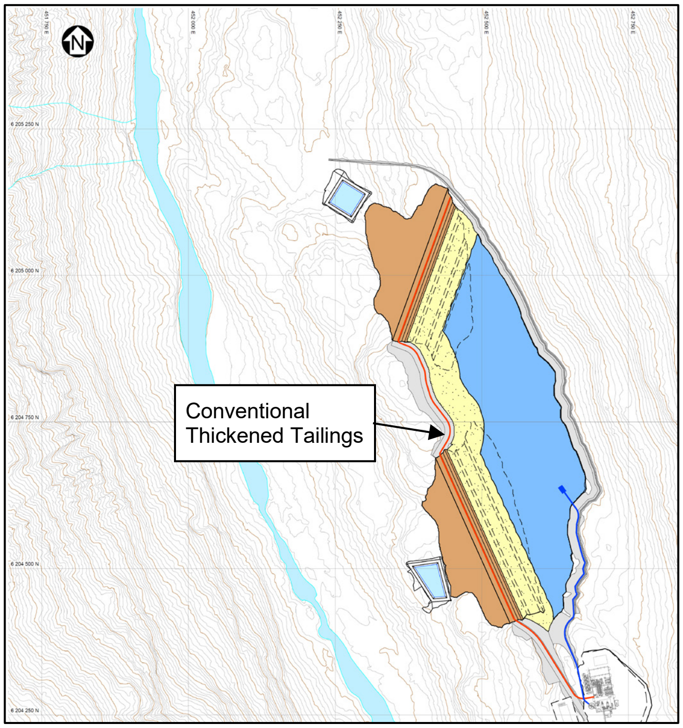

Figure 3.2 General Arrangement - Candidate 1 Conventional Thickened Tailings

Advantages of Candidate 1 include:

- A simplified mill process. A pre-leach thickener recovers water for re-use in the mill.
- A simplified tailings deposition and water management strategy. The process water is contained within one facility and used for mill reclaim.
- A lower risk of operational problems due to climatic factors (snow and cold weather).
- A greater ability to mitigate ARD/ML generation potential with continuous tailings deposition, wetting of the beach surface and maintenance of a pond within the facility.

Disadvantages of Candidate 1 include:

- Thickened tailings may be mobilized in the event of a dam failure, and could impact the downstream environment
- Trafficability on the TMF for closure capping will be more challenging, and
- A surplus TMF water balance requires active management of excess water in the supernatant pond.

3.4.2 Candidate 2: Ultra-thickened Cemented Tailings

Candidate 2 is an ultra-thickened cemented tailings impoundment. The tailings are thickened at the mill using specialized tailings thickener tanks and flocculants to approximately 70% solids by weight. Cement additive is mixed into the tailings at the mill site before being discharged to the TMF in a single overland pipeline with PD pumps. Seepage from the TMF will be managed with a low-permeability geosynthetic liner, a basin underdrain system, and a foundation drain system. The lined TMF would be expanded using the downstream construction method, with material from local borrow sources. The non-segregating behavior associated with the ultra-thickened cemented tailings enables the facility to develop relatively steep beach slopes of between two to six percent. These steeper slopes can become difficult to maintain during periods of high rainfall or higher than specified water content of the tailings.

Theoretically, there is no TMF supernatant pond or water reclaim system required for ultra-thickened cemented tailings operations as all recoverable process water is reclaimed in the thickeners at the plant site. A small pond collecting minimal tailings bleed water, however, is likely to form within the facility. Storm water runoff will also contribute to the formation of a pond within the facility. A separate water management pond will likely be required to store additional process water for reuse in the plant to provide a buffering volume for fluctuations in process water requirements, and supply makeup water during periods of low rainfall (i.e. winter operation). The associated dam(s) and basin would require appropriate design and construction to prevent seepage losses.

The closure plan includes removal of the smaller supernatant pond and installation of a closure cap which includes a geosynthetic liner to preclude oxidation therefore limiting acid generation potential, a graded waste rock or overburden cover to promote all run-off through spillways constructed in the embankments, and a revegetated topsoil cover on the final graded closure cover.

Basic design criteria for Candidate 2 are summarized below:

- Design solids content: 70% solids by weight
- Average dry density: 1.6 t/m^3, and
- TMF tailings volume: 1.25 Mm^3.

A preliminary general arrangement for Candidate 2 is presented in Figure 3.3.

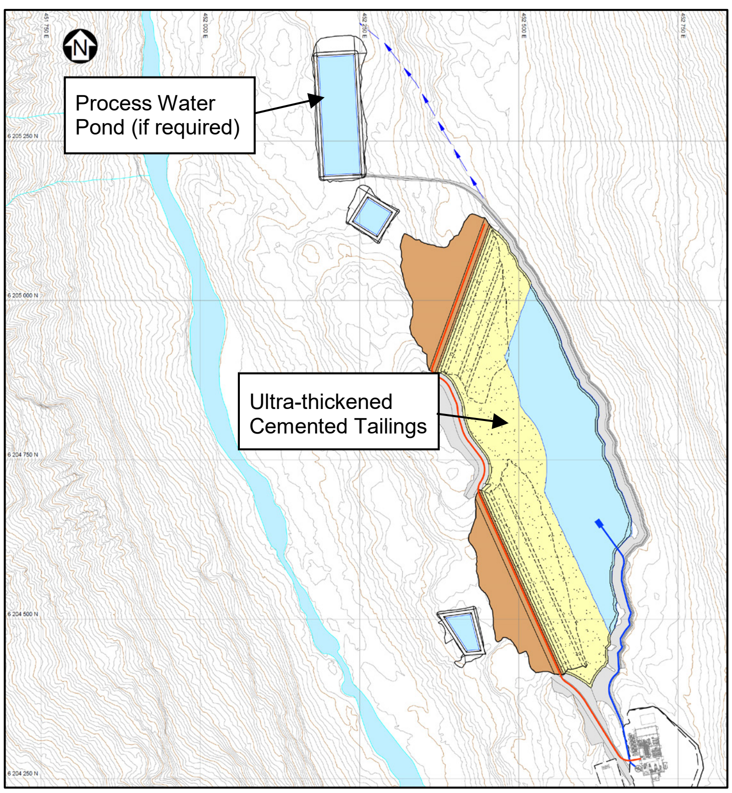

Figure 3.3 General Arrangement - Candidate 2 Ultra-thickened Cemented Tailings

Advantages of Candidate 2 include:

- Cemented tailings are non-flowable and not considered to pose a risk of mobilization in the event of a dam failure due to the non-segregating nature of the tailings mass.
- A smaller supernatant pond is likely to form as all available process water recovered in the mill.
- A greater ease of trafficability on the TMF for closure cover construction.
- A higher average dry density is anticipated, increasing storage capacity of the TMF.

Disadvantages of Candidate 2 include:

- An additional mill process requirement of a paste plant adds complexity and capital and operating costs.
- The addition of cement or other additives to the tailings material increases operating costs.
- An additional process water pond will likely be required.
- Positive displacement pumping is required to discharge thickened and cemented tailings a distance of 400 m from Process Plant site (El. 490 masl) to TMF (El. 470 masl).

3.4.3 Candidate 3: Filtered Tailings

Candidate 3 consists of a filtered tailings stack for management of tailings. The tailings are dewatered at the mill using either vacuum or pressure filtration units to a solids content of approximately 85% solids by weight. The dewatered tailings are delivered to the TMF in trucks or by conveyor. The filtered tailings stack would be constructed in compacted lifts, with a low permeability geosynthetic liner to manage seepage. A separate water management pond will be required to manage process water. The filtered tailings facility will require a confining embankment, or buttress due to the fine grind size and low angle of repose of the filtered tailings.

A separate water management pond is required for filtered tailings operations to store process water before reuse in the plant and manage storm water runoff from the TMF as the filtered tailings should be maintained in an unsaturated condition. The pond must be capable of handling both flows, of providing a buffering volume for fluctuations in process water requirements, and of supplying makeup water during periods of low rainfall (e.g. during winter months).

The moist tailings solids placed in the stack are unlikely to remain dry during periods of high rainfall or snowmelt, such as spring freshet. Snow removal is required throughout the winter to allow for ongoing tailings placement and to reduce the impacts of the snowmelt in the spring. A contingency stacking location is required to allow for placement of tailings during periods of heavy snow, extremely cold weather, and heavy rainfall, as the conditions on the primary stack may not be suitable for tailings placement.

The closure plan for the filtered tailings facility includes progressive reclamation with a geosynthetic liner to preclude oxidation therefore limiting acid generation potential and placement of cover soil to promote re-vegetation.

Basic design criteria for Candidate 3 are summarized below:

- Design solids content: 85% solids by weight
- Average dry density: 1.72 t/m^3, and
- TMF tailings volume: 1.16 Mm^3.

A preliminary general arrangement of Candidate 3 is presented in Figure 3.4.

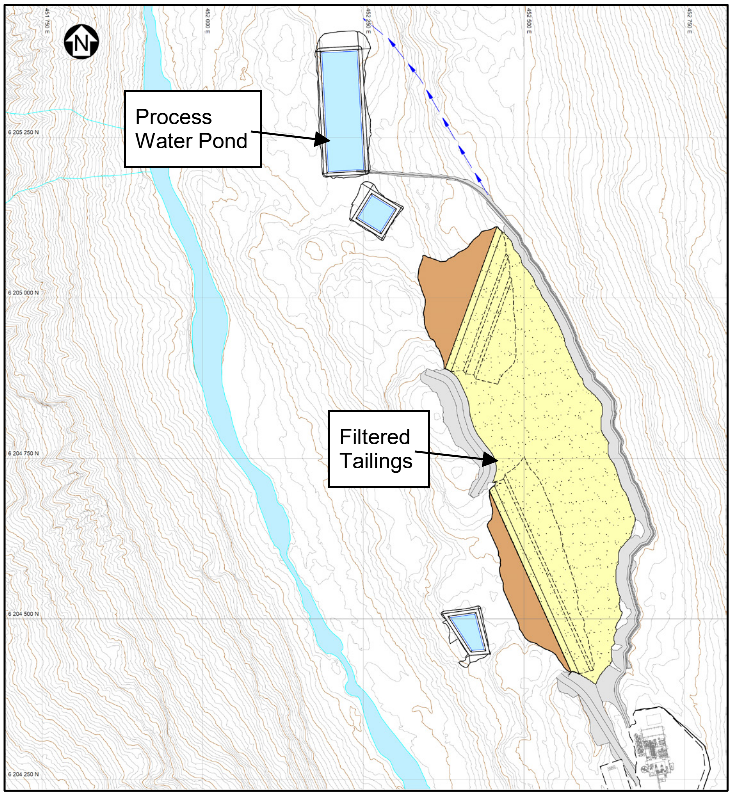

Figure 3.4 General Arrangement - Candidate 3 Filtered Tailings

Advantages of Candidate 3 include:

- The filtered tailings will not be mobilized in the event of any buttress or embankment failure.
- A greater ease of trafficability on the filtered tailings surface for closure cover construction.
- A high tailings dry density is expected (based on the filtration testwork results), increasing TMF storage capacity.

Disadvantages of Candidate 3 include:

- Management the filtered tailings will likely be challenging due to the high mean annual precipitation and cold temperatures in the winter months.
- Aggressive water management strategies will be required to maintain filtered tailings in an unsaturated state.
- An additional mill process requirement of a paste plant and filter plant adds significant capital and operating costs.
- A separate water management pond is required.
- The exposed filtered tailings increase the rate of oxidation, therefore increasing acid-generating potential and accelerating the metal-leaching rate compared to saturated tailings.
- Significant confining embankments are still required for filtered tailings mass due to low angle of repose of filtered tailings due to small grain size (<25 μm).

3.5 ASSESSMENT RATING AND RANKING

3.5.1 Assessment Criteria

A Qualitative Multiple Accounts Assessment (QMAA) was completed to evaluate the candidates for tailings management presented above. The QMAA used four assessment categories to compare the relative merits and risks of each tailings management strategy. The categories were divided into sub-categories, which were further divided into assessment criteria. The QMAA categories included:

- Environmental – This category assesses the likely impact to the environment, specifically considering the disturbance footprint area, impacts to water quality, flora and fauna, chemical stability of the stored tailings, and reclamation. Candidates that are easier to reclaim, minimize the need for active management in closure, and can achieve a suitable final land use are preferred.
- Technical – This category identifies and assesses the constructability, long-term operational viability, operational complexity, and potential for future expansion. It also considers potential concerns relating to permitting as candidates that are uncommon, or unconventional may be more difficult to permit and can result in extended permitting timelines.
- Social – This category considers the safety characteristics of tailings storage, and the ability to limit the effect of the proposed technology on the community. It also includes the safety of workers on site.
- Economic – This category assesses overall expected costs. Higher costs may be considered acceptable if the expenditure improves the performance in other categories. Alternatives that have the potential to significantly affect profitability or viability of the operation are less preferable.

The categories, sub-categories and criteria are summarized in Table 3.1.

Table 3.1 Categories, Sub-Categories and Criteria

Category	Sub-Category	Criteria
Environmental	Surface and Ground Water	Chemical Stability
		Groundwater Quality
		Surface Water Quality
	Environmental Impacts	Physical Properties of Proposed TMF
		Closure
		Flora & Fauna & Land Use
Technical	Construction and Operation Considerations	Constructability
		Complexity of Operation
		Containment Design
		Complexity of Water Management
		Average Annual Water Balance Impacts
	Optimization and Permitting Considerations	Future Expansion Potential
		Proven Technology
Social	Health and Safety	Safety Considerations
	Effect on Existing Community	Public Acceptance
		Cultural Heritage
Economic	Cost	Schedule
		Capital Costs
		Operating and Maintenance Costs
		Closure and Reclamation Costs

Each category, sub-category and criteria was assigned a relative weight according to its importance in its specific category by KP, and in consultation with JDS, IDM and Brownhill Consulting Services (BCS). The tiered weighting system was developed to remove bias that may be caused by having different numbers of matrix sub-categories and evaluation indicators in the model.

Table B.1 provides the weights for the categories, sub-categories and criteria listed above. Higher weights indicate greater relative importance and reflect the site conditions and issues relative to the proposed development.

3.5.2 Methodology

The three tailings technology candidates were ranked and scored for each of the assessment criteria based on a qualitative scale “Preferred” (3), “Acceptable” (2) and “Least Preferred” (1). Table 3.2 summarizes the ratings, descriptions and scores.

Table 3.2 Ratings and Descriptions

Rating	Environmental	Technical	Social	Economic	Score
Preferred	Lower impact to the environment	Conditions are thoroughly understood, design objectives are feasible	Negligible impact to the health and safety of the community or workers	Lower impact to project costs	3
Acceptable	Impact to the environment with feasible mitigation	Conditions are known to be challenging, however design objectives are feasible	Impact to the health and safety of the community or workers with feasible mitigation	Cost to implement is anticipated to be within project budget, however may be a risk to the project in different market conditions	2
Least Preferred	Impact to the environment with challenging mitigation	Design objectives or requirements add potential risk to the project	Impact to the health and safety of the community or workers with challenging mitigation	Higher impact to project costs anticipated to pose a risk to the project	1

The candidate scores for each criteria were then multiplied by the criteria weight factors and summed to determine the total weighted score for the criteria. The combined total weighted score for each sub-category was multiplied by the sub-category weight factor and summed to determine the total weighted score for each category.

A summary of the candidate ratings and scores are presented in Tables B.2 and Table B.3. The final candidate scores are summarized on Table B.4. The highest score represents the highest ranked option. The maximum possible score is 3 and the minimum possible score is 1.

3.6 RESULTS OF ASSESSMENT

3.6.1 Unweighted Assessment

The results from the rankings assessment were totalled for each candidate to determine the total score for each candidate prior to category weightings being applied. The results of the assessment are summarized in Table 3.3, and these results are as follows:

- Candidate 1 (thickened tailings) had the highest score of the three alternatives, achieving an unweighted score of 46.
- Candidate 2 (ultra-thickened cemented tailings) had the second highest score of 38.
- Candidate 3 (filtered tailings) had the lowest score of 35.

Table 3.3 Alternatives Assessment Results – Unweighted Analysis

Category	**Candidate 1** *Thickened Slurry Tailings*	**Candidate 2** *Ultra-thickened Cemented Tailings*	**Candidate 3** *Filtered Tailings*
Environmental	11	12	13
Technical	18	13	10
Social	7	5	6
Economic	10	8	6
Results	**46**	**38**	**35**
Ranking	**1**	**2**	**3**

3.6.2 Weighted Assessment

The category and sub-category weightings were applied to the results of the assessment to remove bias from the assessment, as described above, and these results are as follows:

- Candidate 1 (thickened tailings) had the highest score of the three alternatives, achieving a weighted score of 1.39.
- Candidate 2 (ultra-thickened cemented tailings) had the second highest score of 1.30.
- Candidate 3 (filtered tailings) had the lowest score of 1.26.

The results of the assessment are summarized in Table 3.4.

Table 3.4 Alternatives Assessment Results – Weighted Analysis

Category	**Candidate 1** *Thickened Slurry Tailings*	**Candidate 2** *Ultra-thickened Cemented Tailings*	**Candidate 3** *Filtered Tailings*
Environmental	1.63	1.76	1.71
Technical	1.19	0.86	0.82
Social	1.00	0.60	0.80
Economic	1.25	1.00	0.75
Results	**1.39**	**1.30**	**1.26**
Ranking	**1**	**2**	**3**

Given the maximum possible score of 3 and the lowest possible score of 1, the resultant scores for each candidate are close (i.e. within 6% of each other).

3.6.3 Sensitivity Analysis – Economic Criteria

A sensitivity analysis was performed to determine whether the scoring of the economic criteria impacted the results of evaluation. The economic scores were removed from the assessment; however, the overall result remained unchanged.

The rankings and scores excluding the economic criteria are as follows:

- Candidate 1 (thickened tailings) had the highest score of the three alternatives, achieving a weighted score of 1.41
- Candidate 2 (ultra-thickened cemented tailings) had the second highest score of 1.33, and

- Candidate 3 (filtered tailings) had the lowest score of 1.31.

The results of the sensitivity analysis are summarized in Table 3.5.

Table 3.5 Alternatives Assessment Results – Weighted Analysis – Economics Excluded

Category	**Candidate 1** *Thickened Slurry Tailings*	**Candidate 2** *Ultra-thickened Cemented Tailings*	**Candidate 3** *Filtered Tailings*
Environmental	1.63	1.76	1.71
Technical	1.19	0.86	0.82
Social	1.00	0.60	0.80
Results	**1.41**	**1.33**	**1.31**
Ranking	**1**	**2**	**3**

3.7 RANKING EVALUATION CONCLUSION

The results of the three assessments (unweighted, weighted and sensitivity analysis) have all concluded that Candidate 1, thickened tailings, is the preferred tailings technology for tailings disposal at the Project. The unweighted analysis identified a rating score difference of 24% between the three candidates; 17% between the top two candidates - Candidate 1 and Candidate 2. The weighted and sensitivity analysis however reduced the rating score differences to 9% and 7% respectively between the three candidates.

4 – CONCLUSION AND RECOMMENDATIONS

Candidate 1 (thickened tailings) was identified as the preferred option in this BAT assessment. This candidate is a conventional thickened tailings facility. The tailings are delivered in a single stream and selectively discharged from the embankments to maintain beach slope development. The supernatant pond is operated to remove surplus water while retaining sufficient volume to provide storm storage, meet process water requirements and maintain a degree of saturation within the tailings mass.

The main factors for this conclusion are as follows:

- The tailings deposition and water management strategy is simple relative to the other candidates.
- The process water is contained within the same facility and used for mill reclaim.
- No additional mill processes are required.
- There is a lower risk of operational problems (complications due to climactic conditions, etc.).
- There is a greater ability to maintain a degree of saturation within the tailings mass to reduce exposure of the tailings to oxidation and to limit ARD/ML generation potential.

Opportunities for optimization of Candidate 1 include:

- Refinement of tailings deposition strategies including tailings solids content.
- Incorporation of drainage measures to promote densification and consolidation of deposited tailings.
- Confirmation of water management requirements and operating practices.
- Confirmation of geochemical characteristics.

5 – REFERENCES

Knight Piésold Ltd. (KP, 2016a). *Waste and Water Management Design for Preliminary Economic Assessment*. VA101-594/04-1 Rev.0. Prepared for IDM Mining Ltd., June 13, 2016.

Knight Piésold Ltd. (KP, 2016b). *Red Mountain Gold Project – Tailings and Water Management Location Assessment.* KP Letter Report VA16-00197. February 17, 2016.

Knight Piésold Ltd. (KP, 2017). *Red Mountain Underground Gold Project – Water Balance Report*. VA101-594/04-2 Rev.A. Prepared for IDM Mining Ltd., May 26, 2017.

SRK Consulting (Canada) Inc. (SRK). 2017. *Red Mountain Underground Gold Project – Baseline Climate and Hydrology Report*. Report prepared for IDM Mining. February 2017.

6 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

PROFESSIONAL PROVINCE OF J. FOGARTY # 44041 BRIT... COLU... ENGI...

<Original signed by>

Prepared: 30-Jun-17

Jim Fogarty, P.Eng.
Project Engineer

<Original signed by>

Reviewed:

Ken Embree, P.Eng.
Managing Principal

Approval that this document adheres to Knight Piésold Quality Systems: <Original signed by>

APPENDIX A

KP LETTER VA16-00197

(Pages A-1 to A-30)

February 17, 2016

File No.:VA101-00594/01-A.01
Cont. No.:VA16-00197

FS 64925
EMS 550121
OHS 550122

Mr. Rob McLeod
President & CEO
IDM Mining Ltd.
1500-409 Granville Street
Vancouver, British Columbia
Canada, V6C 1T2

Dear Rob,

Re: Red Mountain Gold Project - Tailings and Water Management

1 – INTRODUCTION

JDS Energy & Mining Inc. (JDS) is completing a high level review of the Red Mountain Gold Project for IDM Mining Ltd. (IDM). Knight Piésold Ltd. (KP) was retained to complete an options assessment for tailings and water management for the Project, and provide relevant design and cost estimates according to the requirements and information provided by IDM and JDS.

Red Mountain is situated in northwestern British Columbia, approximately 18 km east-northeast of Stewart. The project is located at 55° 57' N latitude and 129° 42' W longitude between the Cambria Ice Field and the Bromley Glacier at elevations ranging between 1,500 and 2,000 m. The area is characterized by rugged steep terrain with weather conditions typical of the north coastal mountains.

Climatic conditions at Red Mountain are dictated primarily by its altitude (1,742 masl at the centre of the deposit) and proximity to the Pacific Ocean. Temperatures are moderated year-round by the coastal influence. Precipitation is significant in all months, with October being the wettest. Even at sea level, over one-third of the annual precipitation falls as snow. This proportion is greater at higher elevations, where snow may fall at almost any time of year.

The heavy snowfall, steep terrain and frequently windy conditions are important considerations for tailings and water management. Blizzard conditions are frequent in the immediate vicinity of Red Mountain during winter and avalanches pose a significant threat in the Bitter Creek drainage.

2 – DESIGN CRITERIA

The basic design criteria for the Tailings Management Facility (TMF) options assessment were established with JDS and are summarized in Table 1. A detailed design basis is provided in Appendix A (Table A.1). The design throughput for the mill is currently being investigated and will vary depending on mill location and annual operating time determined suitable for the project. The average mill throughput is assumed to be 1,000 tpd.

Table 1 Design Criteria Summary

Parameter	Units	Value
Average Mill Throughput	tpd	1,000
Design Life	yrs	5
Total Tonnes of Tailings (Design)	Mt	1.4
Year 1 – Tailings Tonnage	Mt	0.3
Year 2 – Tailings Tonnage	Mt	0.2
Year 3 – Tailings Tonnage	Mt	0.3
Year 4 – Tailings Tonnage	Mt	0.3
Year 5 – Tailings Tonnage	Mt	0.3
Tailings Final Settled Dry Density (average)	t/m^3	1.2
Final Required Tailings Storage Volume	Mm^3	1.17
Embankment Crest Width	m	10
Embankment Upstream Slope	-	2.5H:1V
Embankment Downstream Slope	-	2H:1V
Freeboard (Storm Storage, Wave Run-Up & Freeboard)	m	5
2 Year Starter Tailings Tonnage	Mt	0.5
2 Year Starter Dam Storage Capacity	Mm^3	0.42

The following assumptions have also been taken into consideration for this study:

- All embankments will be constructed using material sourced from a local borrow.
- The tailings are potentially acid generating and will be stored subaqueously in a fully lined impoundment.
- There are no limitations on the TMF location within the boundaries of the maps provided.

2.1 TAILINGS TECHNOLOGY

The management of tailings and the tailings technologies utilized depends on multiple specific considerations such as location, climate, topography, environment, tailings geochemistry, processing requirements and throughput. The preferred tailings technology may also incorporate management of Potentially Acid Generating (PAG) waste material to prevent acid generation. Conventional slurry tailings have been chosen as the base case technology to complete this options assessment based primarily on climate and tailings geochemistry. The PAG tailings may need to be stored sub-aqueously to prevent acid generation. An alternative filtered tailings concept has been evaluated and is discussed in Section 5.

2.1.1 Conventional Slurry Tailings

Conventional slurry tailings are typically discharged from the process plant at about 30% to 40% solids by total mass of slurry. These tailings may be pumped, flow by gravity, or some combination of both, depending on the available head and distance through pipelines from the plant to the TMF. The slurry is typically discharged through multiple off-takes from header pipes located around the periphery of the TMF confining embankments. The tailings solids settle and the resulting supernatant water is recovered from the TMF and pumped back for re-use in the process. The coarse fraction of the tailings typically settles rapidly and accumulates closer to the discharge points, forming a gentle “beach” with a slope of about 0.5 to 1%. Finer tailings particles tend to travel further and settle at a flatter slope to, and beneath, the supernatant pond. Selective tailings deposition is typically used to keep the supernatant pond away from the embankments. Conventional slurry tailings disposal also allows for the subaqueous storage of PAG tailings which is an important consideration for this study because the tailings at the Red Mountain Project are PAG tailings.

3 – TMF OPTIONS ASSESSMENT

Several sites were identified as potential locations for storage of conventional slurry tailings. The locations are summarized in Table 2 and shown on Figures B.1 and B.2 in Appendix B.

Table 2 Candidate Tailings Management Facility Locations

Option	Name	Location
1	Cirque - JDS PEA	Base of Red Mountain Cirque - 2014 JDS PEA Location
2	Top of Cirque	Located above the Cirque TMF
3	SRK Side Cirque	Side Cut facility in Cirque proposed by SRK Consulting
4	Bromley Hump	Located downstream of Bromley Glacier
5A	Otter Creek Upper	Adjacent to where Otter Creek meets Bitter Creek
5B	Otter Creek Lower	Downstream of Otter Creek Upper
6	Roosevelt Creek	Terrace where Roosevelt Creek meets Bitter Creek
7	Highway	Confluence of Bitter Creek and Bear River adjacent to Clements Lake.
8	Top of Mountain	Top of Red Mountain

3.1 TMF DEVELOPMENT CONCEPTS

3.1.1 Option 1 – Cirque TMF (JDS PEA Option)

The Cirque TMF is located in the Red Mountain Cirque between the Cambria Ice fields and the Bromley Glacier. The area has an average elevation of approximately 1,500 m and has little vegetation. Foundation conditions consist mainly of talus deposits overlying fractured bedrock. Due to the relatively poor topographical conditions for impoundment capacity and dam construction, a large dam is required to provide sufficient storage. This location was used in the 2014 Preliminary Economic Assessment. Figure B.1 in Appendix B shows a general arrangement layout for Option 1 and a typical embankment section used for the assessment.

3.1.2 Option 2 – Top of Cirque TMF

The Top of Cirque TMF site is also located in the Red Mountain Cirque. The facility is located at approximate El. 1700 m above the Cirque TMF. The steep topographical grade requires an extremely large dam and results in very poor storage efficiency for tailings. This area was considered a possible option due to the close proximity to the portal. Figure B.1 in Appendix B shows a general arrangement for Option 2 and a typical embankment section used for the assessment.

3.1.3 Option 3 – SRK Side Cirque TMF

This option was proposed by SRK Consulting in 2004. The side valley impoundment is located in the Red Mountain Cirque at approximate El. 1,500 m and consists of five separate impoundments terraced along the north and south cirque slopes. The dam is constructed using the upstream method of construction. The design is described in detailing SRK Report “Red Mountain Tailings Options Study, 2004”.

3.1.4 Option 4 – Bromley Hump TMF

The Bromley Hump TMF is situated at the junction of the lower tongue of the Cambria Glacier and the tongue of the Bromley Glacier at approximate El. 800 m. The steep terrain is located on the right bank of Bitter Creek and provides little to no impoundment capacity.

3.1.5 Option 5A and 5B – Otter Creek Upper and Lower TMF

This potential TMF site is located along the north bank of Bitter Creek adjacent to where Otter Creek meets Bitter Creek. The elevated deposit is at an approximate elevation of 450 m. Topographically this area is an efficient tailings storage site with expansion potential. Figure B.1 in Appendix B shows a general arrangement for Option 5A and 5B, and a typical embankment section used for the assessment.

3.1.6 Option 6 – Roosevelt Creek TMF

The Roosevelt Creek TMF site is located on a terrace along the north bank of Bitter Creek at approximate El. 350 m. The topography has a grade of approximately 20-25% and would require a large dam to provide storage. The terrace consists of an outwash deposit of permeable sandy gravel with cobbles and boulders. The site has a potential for avalanches and debris slides. The site is currently not within the project's environmental baseline boundary. Figure B.2 in Appendix B shows a general arrangement for Option 6 and a typical embankment section used for the assessment.

3.1.7 Option 7 – Highway TMF

The Highway TMF is located where Bitter Creek merges with Bear River, and is adjacent to Clements Lake. Clements Lake is Provincial Park and the TMF site is currently not within the project's environmental baseline boundary. Figure B.2 in Appendix B shows a general arrangement for Option 7 and a typical embankment section used for the assessment.

3.2 PRELIMINARY TMF OPTIONS ASSESSMENT

An initial comparisons of key parameters for the TMF options discussed above, was completed to reduce the number of alternatives carried forward to a concept level cost comparison. The comparison has been based on potential storage capacity, expansion potential and dam construction method. Table 3 summarizes the findings of the initial comparison and identifies the options that were advanced to the cost estimate stage.

Table 3 Preliminary TMF Options Assessment

	OPTION								
	1	**2**	**3**	**4**	**5A**	**5B**	**6**	**7**	**8**
Design Storage Requirement of 1.2 Mm3	✓	✓	✓	×	✓	×	✓	✓	×
TMF Expansion Potential	✓	✓	✓	×	✓	×	✓	✓	×
Dam Construction Method	D/S	D/S	U/S	D/S	D/S	D/S	D/S	D/S	D/S
Avalanche Path	✓	✓	✓	×	×	×	✓	×	×
Option Advanced to Cost Estimate	✓	✓	×	×	✓	✓	✓	✓	×

NOTES:
1. D/S = Downstream Method of Construction, U/S = Upstream Method of Construction.

Option 3, the option proposed by SRK, is not considered a viable option as it utilizes an upstream method of dam construction. The project is located in an area of high seismicity where the upstream method of embankment construction is not recommended. The cross section included in the SRK Report "Red Mountain Tailings Options Study" details a staged facility with the embankment raise constructed entirely on top of tailings solids. This option has not been advanced further in this study.

Option 4, is located in extremely steep terrain and does not provide the design storage capacity of 1.2 Mm^3. The storage efficiency is extremely poor and is not considered as a viable option for tailings storage. It was not advanced further in this study.

Option 8 is located on Top of Red Mountain and does not provide any area suitable to store the volume of tailings required. Option 8 is therefore not advanced any further in this study.

Option 5B does not provide the design storage capacity but was advanced to the cost estimate stage as a potential location for expansion of Option 5A.

The options that are being considered for tailings and water management are as follows:

- Option 1 – Cirque TMF (JDS PEA)
- Option 2 – Top of Cirque TMF
- Option 5A – Otter Creek Upper TMF
- Option 5B – Otter Creek Lower TMF
- Option 6 – Roosevelt Creek TMF
- Option 7 – Highway TMF

3.3 TMF OPTIONS ASSESSMENT SUMMARY

Table 4 summarizes the basic information that has been used for the preliminary options selection and is divided in starter and final configurations.

Table 4 TMF Options Summary

2 Year Starter Dam (0.5 Mt)	**OPTION**				
	1 Cirque	**2 Top of Cirque**	**5A Otter Creek Upper**	**6 Roosevelt Creek**	**7 Highway**
Dam Crest Elevation (masl)	1465	1705	455	-	120
Embankment Fill Volume (Mm^3)	0.83	1.85	0.2	-	0.74
Maximum Embankment Height (m)	45	55	20	-	20
Storage Efficiency[(1)]	0.6	0.2	2.1	-	1.6
Tailings Transportation	Gravity	Pumping	Gravity	-	Pumping
Final Arrangement (1.4 Mt)	**OPTION**				
	1 Cirque	**2 Top of Cirque**	**5A Otter Creek Upper**	**6 Roosevelt Creek**	**7 Highway**
Dam Crest Elevation (masl)	1475	1720	465	360	135
Embankment Fill Volume (Mm^3)	1.7	5.1	0.58	1.84	2.47
Maximum Embankment Height (m)	55	70	35	35	35
Storage Efficiency[(1)]	0.7	0.2	2.1	0.7	0.2
Tailings Transportation	Gravity	Pumping	Gravity/Pumping	Gravity/Pumping	Pumping

NOTES:
1. Storage efficiency is defined as the relation: TSF Capacity / Embankment fill volume.

3.4 COST ESTIMATE

The conceptual design of each of the selected TMF options has been completed to a level sufficient for comparing the alternatives on an economic basis at a high level. Conceptual level initial capital costs, combined sustaining capital and operating costs have been developed by applying similar rates and assumptions to all alternatives.

For all options it has been assumed that the confining embankments will be constructed with material from a local borrow. There is potential to create additional storage in each facility by developing the borrow area within the TMF impoundment. This has not been considered at this stage except for Option 6 where a cut was required to obtain sufficient capacity in the impoundment. It is also assumed that transition and drainage layers of finer materials will be processed from borrow areas nearby.

Earthworks unit rates were developed from first principles using equipment rental rates from the 2013-2014 Blue Book (B.C. Road Builders & Heavy Construction Association, 2013), equipment capacities and production rates from the Caterpillar Performance Handbook (Caterpillar Inc., 2014) and an assumed labour rate of $104/hr (typical BC labour rate).

All other unit rates (pumps, pipelines, instrumentation, geosynthetics, electrical cables and transformers) were developed from available vendor quotes and from recent and relevant project experience.

Operating costs were developed from a power cost of $0.04/kWh, provided by JDS. Other operating costs include allowances for pump and pipeline maintenance (approximately 2% of total capital cost of pumps and pipelines per year of operation).

An overall summary of the estimated Initial Capital Costs (CAPEX), Sustaining Capital and Operating Costs (OPEX) is shown in Table 5. These costs are in 2016 Canadian Dollars and do not include a contingency factor. A contingency of 50% is typically applied for the TMF at this level of study. Detailed costing tables, including the 50% contingency allowance, for the options listed below, are included in Appendix C.

Table 5 Cost Estimate Summary

TMF OPTION	CONVENTIONAL SLURRY TAILINGS			
	INITIAL CAPITAL (CAD$)	SUSTAINING CAPITAL AND OPERATING COSTS (CAD$)	TOTAL (CAD$)	$/TONNE (CAD$)
Option 1 - Cirque (JDS PEA)	$11,800,000	$9,600,000	**$21,400,000**	**$15.3**
Option 2 - Top of Cirque	$20,800,000	$31,800,000	**$52,600,000**	**$37.6**
Option 5A - Otter Creek Upper	$6,000,000	$5,100,000	**$11,100,000**	**$7.9**
Option 5B - Otter Creek Lower[4]	$8,700,000	$100,000	**$8,800,000**	**$6.3**
Option 6 - Roosevelt Creek	$23,700,000	$200,000	**$23,900,000**	**$17.1**
Option 7 - Highway	$11,000,000	$18,200,000	**$29,200,000**	**$20.9**

NOTES:
1. All prices in CAD$ (Conversion Rate CAD$0.75 = USD$1).
2. Cost of fuel provided by JDS Mining as CAD$1.1/litre.
3. No contingency applied to costs.
4. Option 5B included as an expansion option and does not provide sufficient storage for the design storage of 1.4 Mt of tailings.

3.5 RECOMMENDATIONS

This TMF options assessment indicates that Option 5A (Otter Creek Upper) is likely the preferred location from an engineering and cost perspective. This option is advantageous for the following reasons:

- Lower capital, sustaining and operating costs than all other options, resulting in the lowest cost per tonne.
- Best storage efficiency which therefore requires the smallest embankment volume.
- Expansion potential within the 5A impoundment with additional expansion potential in Option 5B, the Otter Creek Lower impoundment. This potential facility is adjacent to 5A and downstream of the mill making it favorable for tailings deposition.

- The water management required for Option 5A is minimal and is supported by natural drainage. The location is also clear from the Otter Creek avalanche path.
- Golder Associates completed hydrogeological and geotechnical investigations in the Otter Creek area in 1996. The dam sites have several drillholes which would be useful at the next stage of design. Figure B.3 in Appendix B indicates where the geotechnical holes were drilled in the Otter Creek impoundment. Dillhole locations are approximate as no drillhole coordinates were available. The deposit forms part of the lateral moraine feature that extends up to El. 500 m. Grab samples taken at various locations indicate the material is uniform sandy gravel with cobbles and less than 10% fines passing the 75 micron sieve size.
- The Otter Creek TMF and Mill location is also advantageous from a construction schedule and project execution standpoint. Construction could begin on the Mill and TMF while the road between Otter Creek and the mine is being constructed.

4 – TMF DESIGN

The slurry tailings option developed for Option 5A (Otter Creek Upper) provides storage capacity for 1.75 million cubic meters for tailings, process water, storm storage and freeboard to an elevation of 465 m. This will provide storage for 5 years of mine operations. The depth/area/capacity (DAC) relationship for the site to an elevation of 465 m is shown on Figure 1.

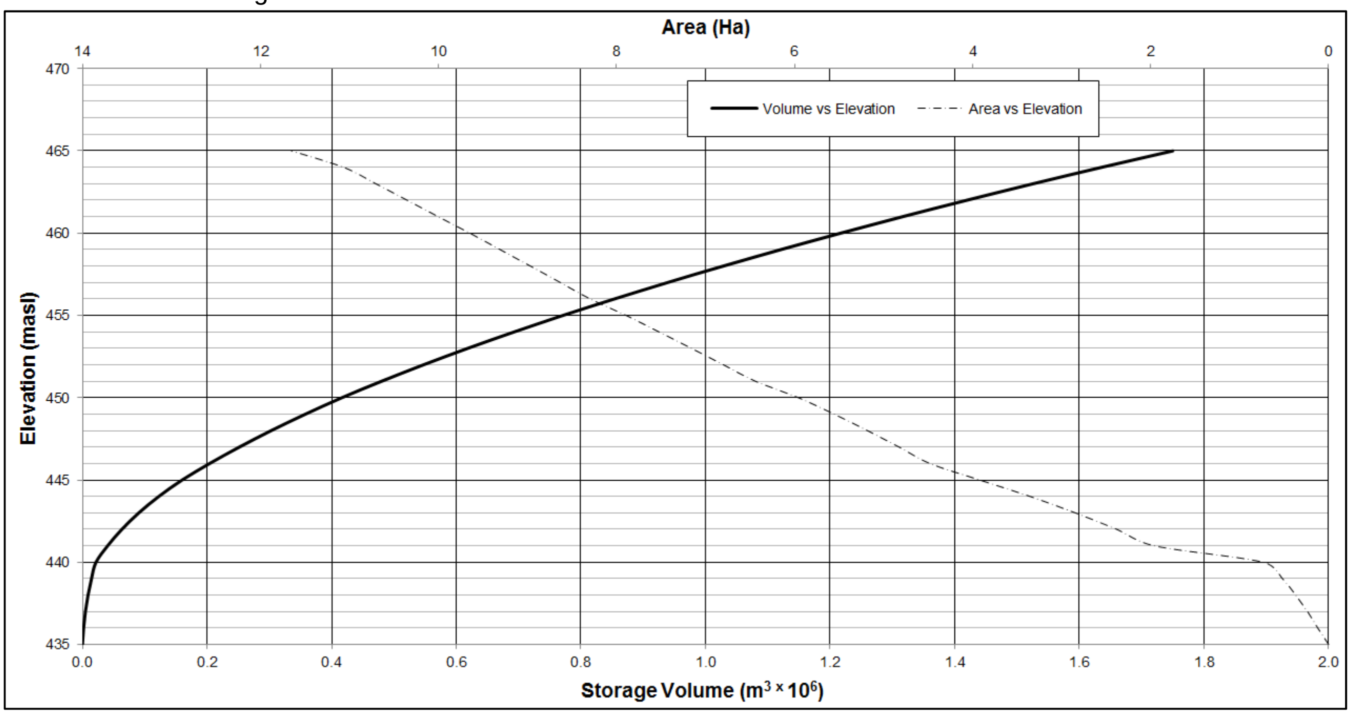

Figure 1 Option 5A Otter Creek Upper TMF Depth-Area-Capacity Relationship

The tailings dam is designed to be a rock-filled structure with granular filter zones on the upstream face. The impoundment and upstream face of the dam will be covered with a geosynthetic liner to minimize seepage of tailings and water into the surrounding area. The filter zones provide a bedding surface for the liner to prevent the migration of fines downstream in the event of liner damage.

Expansion of the TMF would be through the downstream method using locally borrowed materials. An initial starter dam would be constructed to contain the first two years of tailings production in order to minimize upfront capital expenditure. The dam would be raised once over the mine life to increase the storage capacity and maintain a minimum of 5 m freeboard at all times.

The facility would have sufficient freeboard to manage run-off, storm storage and process water. Reclaim water would be recirculated back to the mill and used as process water. A conceptual design and layout for Option 5A is shown on Figure B.4 in Appendix B.

The staged filling schedule for Option 5A is shown on Figure 2.

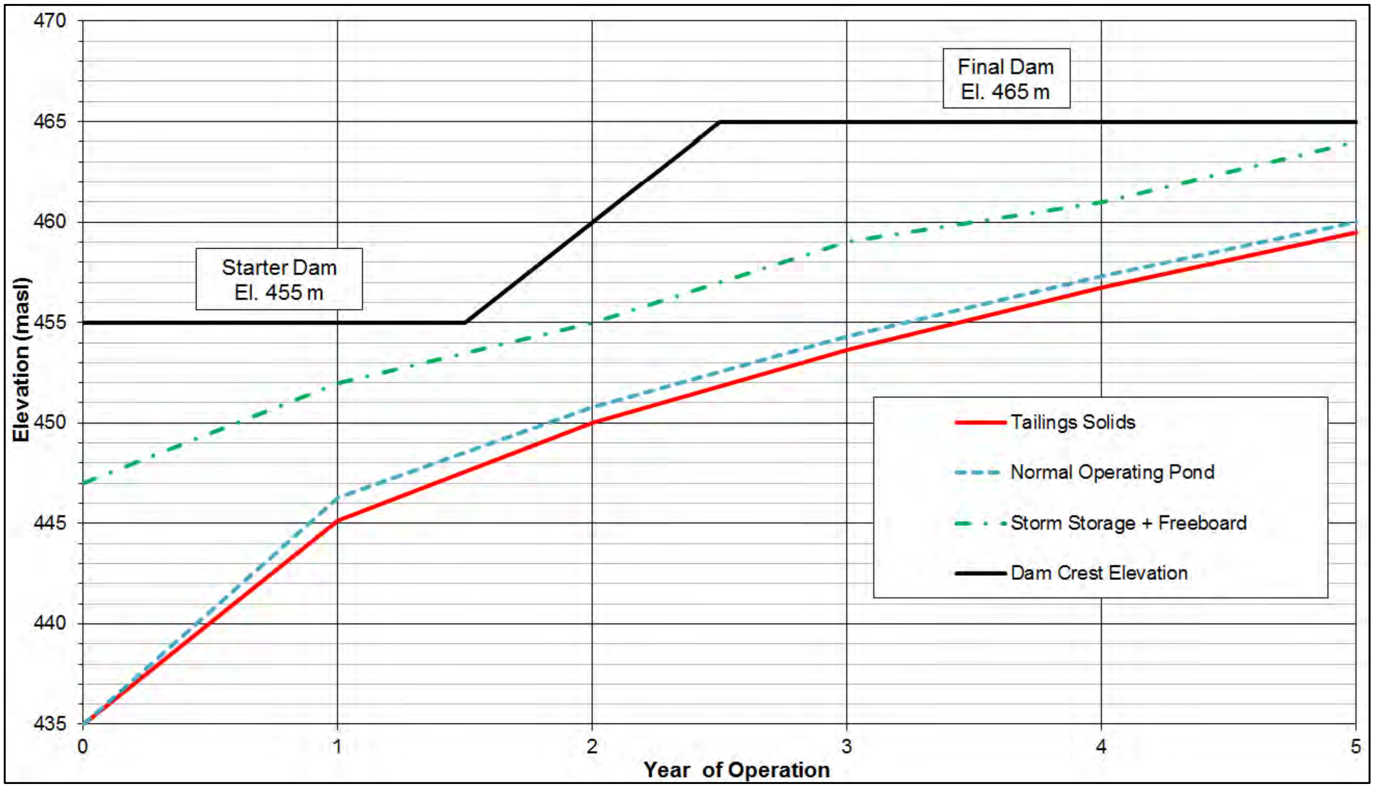

Figure 2 Option 5A Otter Creek Upper Filling Schedule

NOTES:

1. Year 2 tailings production of 200,000 tonnes/year, Year 1,3-5 tailings production of 300,000 tonnes/year (Table A.1).
2. Average settled tailings dry density assumed to be 1.2 t/m^3.
3. Normal operating pond volume included for capacity allowance.
4. The minimum freeboard requirements is assumed to be 5 meters (Includes storm storage, wave run-up and freeboard). This will be confirmed in future design phases.

5 – FILTERED TAILINGS

KP also investigated using filtered tailings technology at the Otter Creek location as an alternative method to manage the tailings.

5.1 FILTERED TAILINGS TECHNOLOGY

Filtered tailings are produced using pressure or vacuum force in presses, drum, or belt filtration units, and are typically dewatered to a moist cake-like consistency. The materials are then transported by conveyors or trucks to a filtered tailings stack where they can be compacted in lifts to improve density, trafficability, and stability. No operating pond is maintained with dewatered or filtered tailings. The filtered tailings stack typically requires buttressing for stability, particularly in seismically active areas.

Filtered tailings management typically requires a separate water management pond for storage of storm water run-off and snowmelt from the TMF surface, as well as for process water storage. There is no storage for water management within the filtered tailings stack facility unlike slurry tailings facilities. Filtered tailings operations may also include back-up systems as the efficiency for filtered operations can be less than conventional tailings.

Filtered tailings do not provide for effective isolation of PAG tailings from oxygen diffusion and potential acid generation. Geochemical stability of the 'dry' stack would need to be considered and the PAG tailings may require subaqueous disposal in a separate facility.

5.2 SLURRY TAILINGS & FILTERED TAILINGS MANAGEMENT AT OTTER CREEK

For this study it was assumed that 30% of the tailings are PAG and would require subaqueous disposal in a separate fully lined facility and the remaining 70% would be filtered in a filter plant at the mill and delivered to the TMF via truck/conveyor for storage in an unlined facility.

5.2.1 Design Criteria

The basic design criteria for the slurry and filtered tailings combination facilities is summarized in Table 6.

Table 6 Design Criteria Summary

Parameter	Units	Value
Average Mill Throughput	tpd	1,000
Design Life	yrs	5
Design Total Tonnes of Tailings	Mt	1.4
Tonnes of PAG Tailings	Mt	0.42
Tailings Final Settled Dry Density (average)	t/m^3	1.2
Final Required PAG Tailings Storage Volume	Mm^3	0.35
Tonnes of NAG Tailings	Mt	0.98
Filtered Tailings Dry Density (average)	t/m^3	1.6
Final Required Filtered Tailings Storage Volume	Mm^3	0.62
Embankment Crest Width	m	10
Embankment Upstream Slope	-	2.5H:1V
Embankment Downstream Slope	-	2H:1V
Freeboard (Storm Storage, Wave Run-Up & Freeboard)	m	5

The following assumptions have also been taken into consideration for this study:

- All embankments will be constructed using material sourced from a local borrow.
- PAG tailings are potentially acid generating and will be stored subaqueously in a fully lined impoundment.
- The tailings are to be managed at the Otter Creek TMF location; slurry tailings to be managed at Option 5B (Otter Creek Lower) and filtered tailings to be managed at Option 5A (Otter Creek Upper).
- Option 5B will be fully lined with a geosynthetic liner.
- Only the North Dam of Otter Creek Upper is required to manage the filtered tailings stack.

Table 7 summarizes the basic components of the slurry tailings TMF and the filtered tailings TMF. A conceptual general arrangement for the filtered tailings management option is shown on Figure B.5 in Appendix B.

Table 7 Tailings Management Design Summary

	Option 5B Otter Creek Lower Slurry Tailings	Option 5A Otter Creek Upper Filtered Tailings
Dam Crest Elevation (masl)	420	455
Embankment Fill Volume (Mm^3)	0.4	0.15
Maximum Embankment Height (m)	40	25
Storage Efficiency[(1)]	1	4.2
Tailings Transportation	Gravity	Truck/Conveyor

5.2.2 Cost Estimate

The conceptual design for TMF has been completed to a level sufficient for an economic basis at a high level. For each facility, conceptual level initial capital costs, combined sustaining capital and operating costs have been developed by applying similar rates and assumptions to all alternatives.

The basis of estimate discussed in Section 3.4 was used to calculate the Capital, Sustaining and Operating Costs for the two facilities. The cost to filter and transport the filtered tailings is not included in this cost estimate and is to be included as part of the mill alternatives assessment managed by JDS Mining. A cost however is included to place and compact the filtered tailings in the facility.

An overall summary of the estimated Initial Capital Costs (CAPEX), Sustaining Capital and Operating Costs (OPEX) is shown in Table 8. These costs are in 2016 Canadian Dollars and do not include a contingency factor. A contingency of 50% is typically applied for the TMF at this level of study. Detailed costing tables, including the 50% contingency allowance, for the options listed below, are included in Appendix D.

Table 8 Cost Estimate Summary (No Contingency)

	INITIAL CAPITAL (CAD$)	SUSTAINING CAPITAL AND OPERATING COSTS (CAD$)	TOTAL (CAD$)	$/TONNE (CAD$)
Option 5B – 30% PAG Slurry Tailings	$8,000,000	$ 100,000	**$8,100,000**	**-**
Option 5A – 70% NAG Filtered Tailings	$1,900,000	$1,200,000	**$3,100,000**	**-**
Total	$9,900,000	$1,300,000	**$11,200,000**	**$8**

5.2.3 Summary

There is no economic advantage associated with filtering the tailings for the Red Mountain Project. The overall tailings management cost is higher than managing conventional slurry tailings at the Otter Creek Upper facility. The additional capital cost of filters and the increased operating cost associated with filtering and transporting tailings would increase the overall cost further. There is additional complexity due to operating two facilities and placing and compacting filtered tailings in an area with high precipitation and snowfall.

6 – CONCLUSION

A high level assessment of tailings and water management options has been completed for the Red Mountain Gold Project. The study was completed for a 5 year mine life that would produce 1.4 Mt of tailings at an average mill throughput of 1,000 tonnes per day. The design mill throughput is currently being investigated and will depend on mill location and annual operating months. Preliminary comparative cost estimates (Initial Capital, Sustaining Capital and Operating Costs) were developed for the major components to assist in the selection of the preferred site for inclusion in future studies.

The assessment indicated that conventional tailings storage in the Otter Creek Upper TMF (Option 5A) is a reasonable base case tailings and water management strategy at the current time. The facility was sized to store 1.2 Mm^3 of tailings but has the potential to be expanded to store 2 Mm^3 of tailings. There is potential to store an additional 0.5 Mm^3 of tailings downstream of this option in TMF Option 5B should the ore reserve increase.

We trust this provides you with the information required at this time. Please contact the undersigned below should you have any questions or require any additional information.

Yours truly,
Knight Piésold Ltd.

<Original signed by>

<Original signed by>

Prepared: Daniel Ruane, P.Eng.
Project Engineer

Reviewed: Ken Embree, P.Eng.
Managing Principal

Approval that this document adheres to Knight Piésold Quality Systems:

Attachments:

Appendix A	Design Basis
Appendix B	Figures B1-B5
Appendix C	Options Assessment - Conventional Slurry Tailings Cost Estimate Tables
Appendix D	Slurry and Filtered Tailings Cost Estimate Tables

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/dmr

APPENDIX A

DESIGN BASIS

(Page A-1)

TABLE A.1

IDM MINING LTD.
RED MOUNTAIN GOLD PROJECT

TMF PRELIMIMNARY ECONOMIC ASSESSMENT
DESIGN BASIS

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ITEM					SOURCE
1.0 GENERAL					
1.1	Project Location	Northwestern British Columbia, 18 km east of the town of Stewart. Project is located adjacent to the Cambria Ice Field and the Bromley Glacier on provincial crown land within the Regional District of Kitimat-Stikine.			Red Mountain Gold Project Description July 2015 - IDM Mining Ltd.
1.2	Site Coordinates	UTM Coordinates 452,450 E and 6,250,325 N (Zone 9 NAD 83) ; 55°59′04″ N, 129°45′37″ W			Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
1.3	Mine Site Elevation	Ranging 1,500 to 2,000 masl			
1.4	Mine Production	Estimated mineable resource = 1.45 million tonnes (Mt)			
		Throughput = 1,000 tonnes per day (year 1-4) and 1,085 tpd (year 5)			
		Mine Life = 5 years			
1.5	Climate Conditions		**Roosevelt Creek**	**Red Mountain Cirque**	Preliminary Assessment Tailings Disposal and Hydrogeology March 1994 - LAC North America Ltd.
		Average Annual Precipitation =	2200 mm	2200 mm	
		Average Annual Snowfall =	900 mm	1500 mm	
		Average Annual Rainfall =	1300 mm	700 mm	
		Average Annual Evapotranspiration and Infiltration =	400 mm	400 mm	
		Average Annual Runoff =	1800 mm	1800 mm	
		Maximum Snowpack =	800 mm	1400 mm	
1.6	Rainfall Storm Events	1 in 50 year 24 hour precipitation =	140 mm	66 mm	
		1 in 100 year 24 hour precipitation =	156 mm	73 mm	
		Probable Maximum Precipitation 24 hr rainfall =	480 mm	250 mm	
2.0 MINE WASTE					
2.1	Tailings	1.4 million tonnes			Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
		Assumed average long-term settled dry density of slurry tailings = 1.2 t/m^3			
		Storage requirements for tailings solids = 1.2 Mm^3			
		Tailings are Potentially Acid Generating (PAG)			
		Subaqueous disposal of tailings to control the acid generating potential of the tailings.			
		Year 1 = 300,000 tonnes, Year 2 = 200,000 tonnes, Year 3 = 300,000 tonnes, Year 4 = 300,000 tonnes, Year 4 = 300,000 tonnes.			
2.2	Waste Rock	1.036 million tonnes			
		Waste Rock is Potentially Acid Generating (PAG).			
		Waste Rock stored in two temporary storage areas located adjacent to the Upper and Lower portals. Waste Rock to be rehandled into the underground as backfill.			
		Year -2 = 150,000 tonnes, Year -1 = 304,000 tonnes, Year 1 = 273,000 tonnes, Year 2 = 197,000 tonnes, Year 3 = 112,000 tonnes.			
3.0 TAILINGS MANAGEMENT FACILITY (TMF)					
3.1	Function	Secure long term storage of approximately 1.2 Mm^3 of tailings and supernatant pond water.			Knight Pieosld Ltd.
3.2	Concept	An earthfill/rockfill embankment constructed using the downstream method of construction using local borrow materials. The impoundment and upstream face of the embankment would be lined with a geosynthetic liner to minimize seepage of tailings water into the surrounding area.			
		Filter zones included in embankment design to provide bedding for the geosynthetic liner and prevent the migration of fine tailings downstream. Suitable sub-base bedding layer beneath geosynthetic liner in the impoundment to provide drainage and prevent damage to the liner.			
3.4	Dam Classification	The Dam Classification for each of the alternate locations and concepts has not yet been carried out. However, it is assumed that all facilities will have at least a HIGH dam classification, as defined by Canadian Dam Association (CDA) "Dam Safety Guidelines" (2007).			
3.5	Inflow Design Flood	Inflow Design Flood (IDF) = The IDF for each alternative has not been calculated. An allowance for storm storage has been included in the freeboard.			
3.6	Design Freeboard	Freeboard for supernatant pond storage, Inflow Design Flood (IDF),wave run-up and freeboard.			
		A minimum 5 m freeboard at all times.			
3.7	Embankment Slopes	Embankment slopes constructed to maximum slope of 2.5H:1V on upstream side to facilitate geomembrane installation and 2H:1V on downstream side for reclamation.			
3.8	Operational Criteria	Expected mill throughput (tailings production rate): 1,000 tpd			
		Flood management: Inflows are contained within the impoundment or managed with spillway			
		Mine water pumped to Tailings Management Facility (TMF)			
		Available water from TMF recycled to mill process.			
		Excess water monitored and treated accordingly.			
3.9	Closure Criteria	The downstream slope of the embankment will be reclaimed with topsoil and revegetated.			'Preliminary Economic Assessment Report - Red Mountain Gold Project - JDS Mining
		Tailings will be dewatered and covered by a geosynthetic liner with a 1 m thickness of material placed on top to prevent infiltration. Revegetation of the soil capped to be completed to reduce dusting. Seepage collection and treatment systems will be maintained after closure until water quality is at acceptable levels.			
3.10	Seepage	Seepage will be primarily controlled through the use of a geosynthetic lining system covering the full TMF impoundment. Seepage control will be enhanced by strategic tailings deposition.			Knight Pieosld Ltd.
		Embankment and foundation drains will be installed to dewater any groundwater seeps and to capture potential seepage through the geomembrane lining system.			
		Collected seepage is pumped back to the TMF and monitored.			
3.11	Embankment Crest Width	Minimum of 10 m			
3.12	Seismic Design Criteria	1 in 476 = 0.083 g			Preliminary Assessment Tailings Disposal and Hydrogeology March 1994 - LAC North America Ltd.
		1 in 1,000 = 0.104 g			
		1 in 2,000 = 0.126 g			
		1 in 10,000 = 0.188 g			
3.13	Embankment Stability	Embankment slopes to be 2.5H:1V upstream and 2H:1V downstream to achieve the minimum required Factors of Safety (FOS_{min}) for the following loading conditions:			Knight Pieosld Ltd.
		End of construction (starter dam and dam raises) FOS_{min} = 1.5			
		Long term (at closure) FOS_{min} = 1.5			
		Seismic (Pseudo-static loading condition) FOS_{min} = 1.0			
		Seismic (Post-earthquake loading condition; full liquefaction of tailings assumed) FOS_{min} = 1.5			
3.14	Embankment Instrumentation	Instrumentation to be installed to accomplish the following: - Confirm that the embankments are performing in accordance with the design - Provide early warning of the development of potentially adverse changes.			
		Proposed instruments for the embankments include: - pond level indicator - surface monuments - embankment and foundation vibrating wire piezometers - seepage collection pond inflow weirs			
4.0 TAILINGS DELIVERY AND DISTRIBUTION					
4.1	Function	Transport tailings from the mill process to the TMF			Knight Pieosld Ltd.
4.2	Physical Properties	Tailings Solids Content = 40% by weight			
		Specific Gravity of Solids = 2.7			
4.3	General Criteria	Gravity discharge from mill used where sufficient head is available.			
		Pump stations as required where gravity discharge is not sufficient			
5.0 WATER MANAGEMENT SYSTEM					
6.1	Function	Provide diversion or collection of maximum practicable runoff from adjacent valley slopes and catchment areas to a natural course or to the collection pond, respectively.			Knight Pieosld Ltd.
6.2	Concept	Diversion channels established to divert non-contact water to a natural water course. Collection channels established to collect contact water that will be directed to the TMF for containment and ultimately be pumped to the plant site for use in processing.			
6.3	Dimensions	Trapezoidal cross-section, excavated in rock/overburden cut, or constructed in haul/access road fill.			
		Lining where required for erosion protection or leakage control (shotcrete, riprap, HDPE, etc.)			

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix A\Excel\[Table A.1 Design Basis_ Red Mountain_Rev0.xlsx]Table A.1

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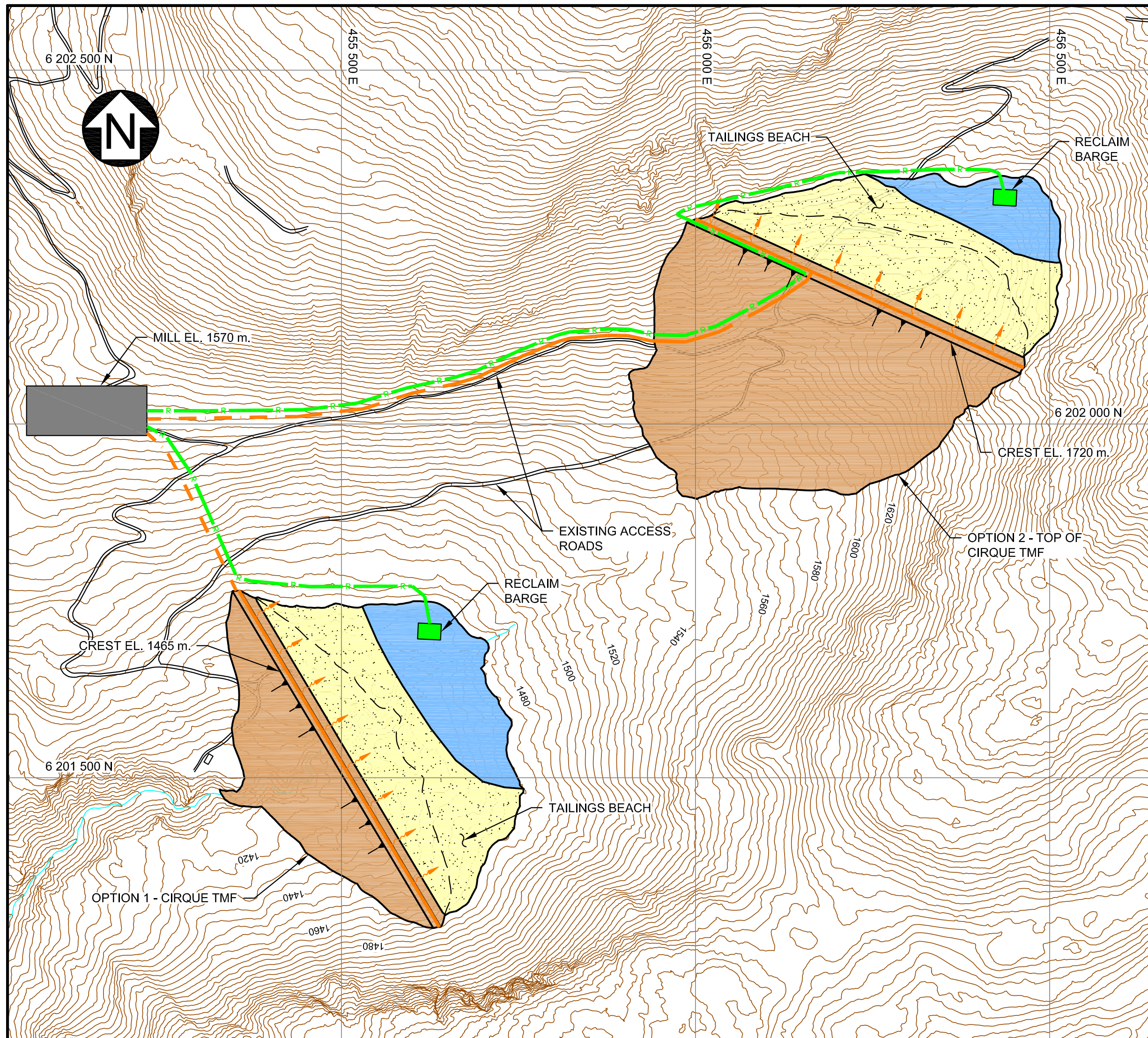
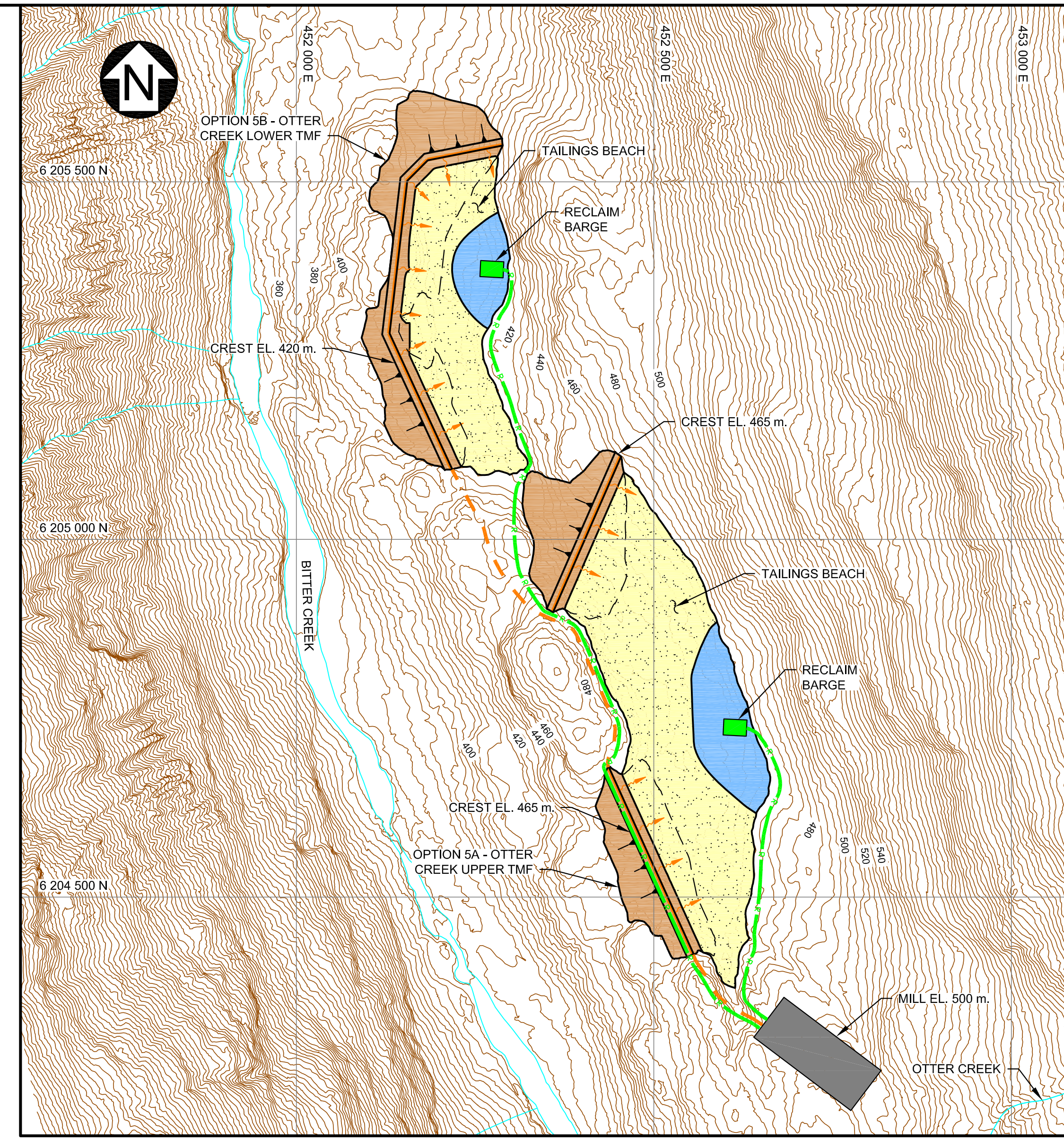
APPENDIX B

FIGURES B.1-B.5

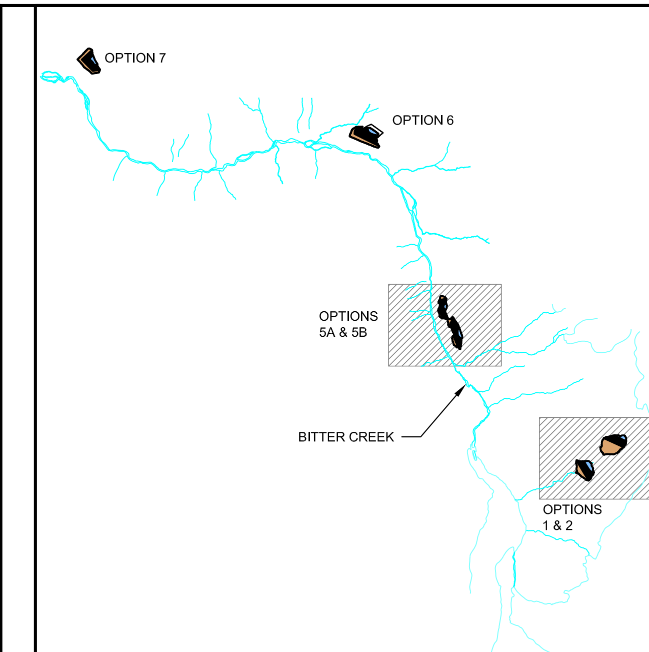
(Pages B-1 to B-5)



PLAN
FINAL TMF OPTION 1 - CIRQUE & OPTION 2 - TOP OF CIRQUE
SCALE A



PLAN
FINAL TMF OPTION 5A - OTTER CREEK UPPER & OPTION 5B - OTTER CREEK LOWER
SCALE A



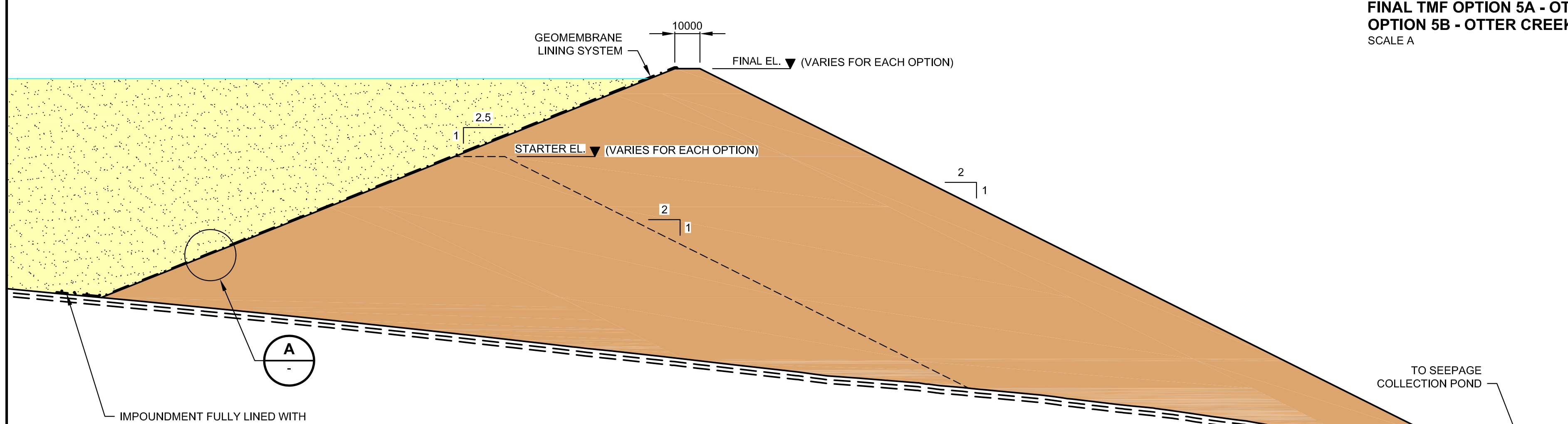
KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).



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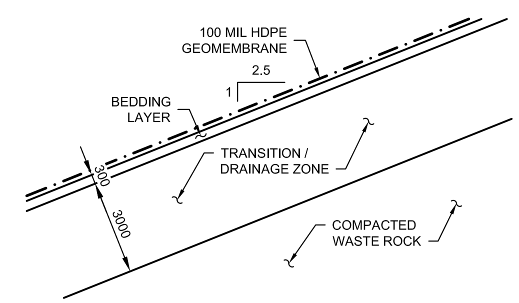

A / - SECTION
UPSTREAM LINER
NTS

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SCALE A: 100 50 0 100 200 300 400 500 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

TMF OPTIONS ASSESSMENT
OPTION 1, 2, 5A, & 5B

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197
FIGURE B.1	REV 0

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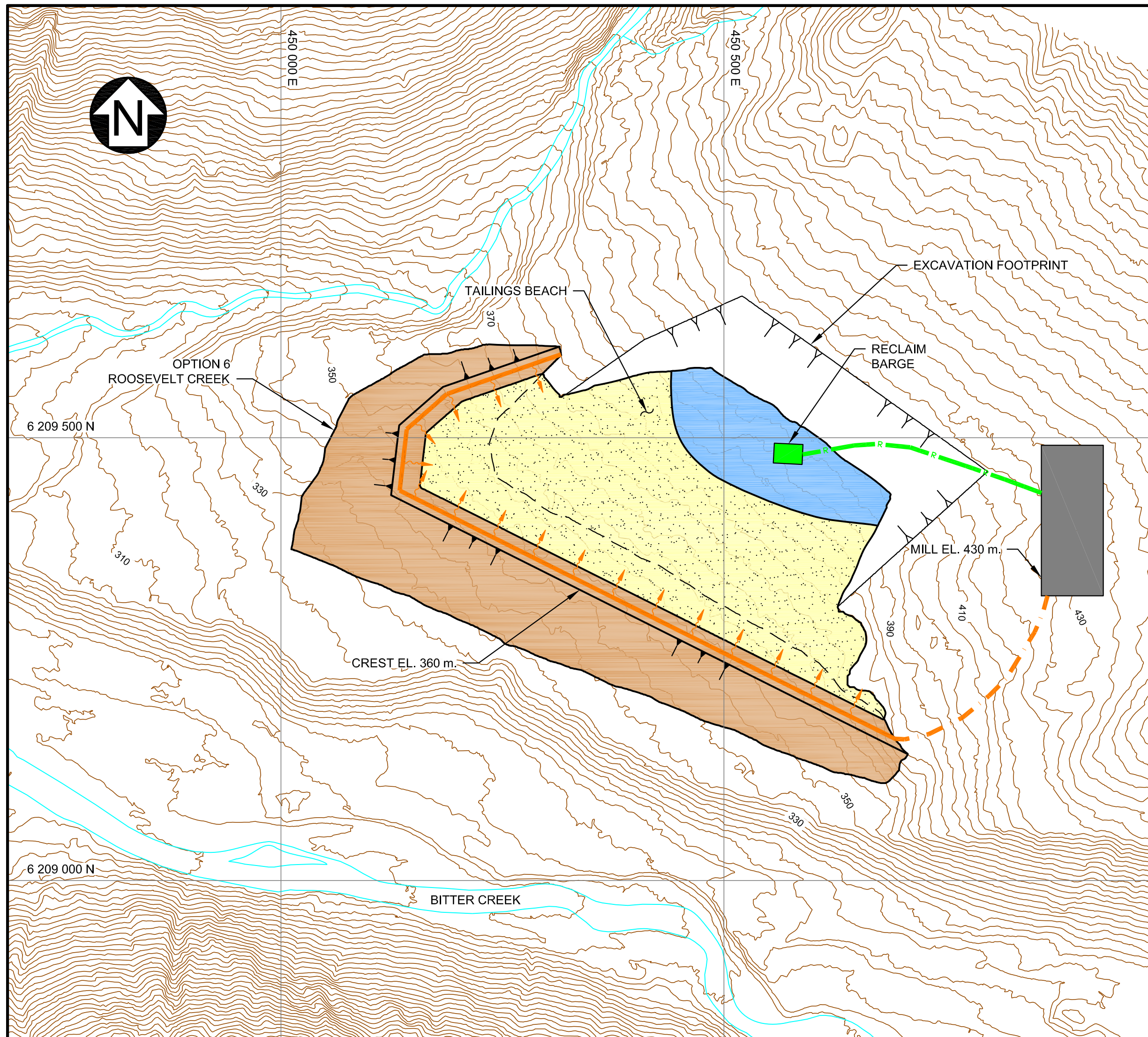

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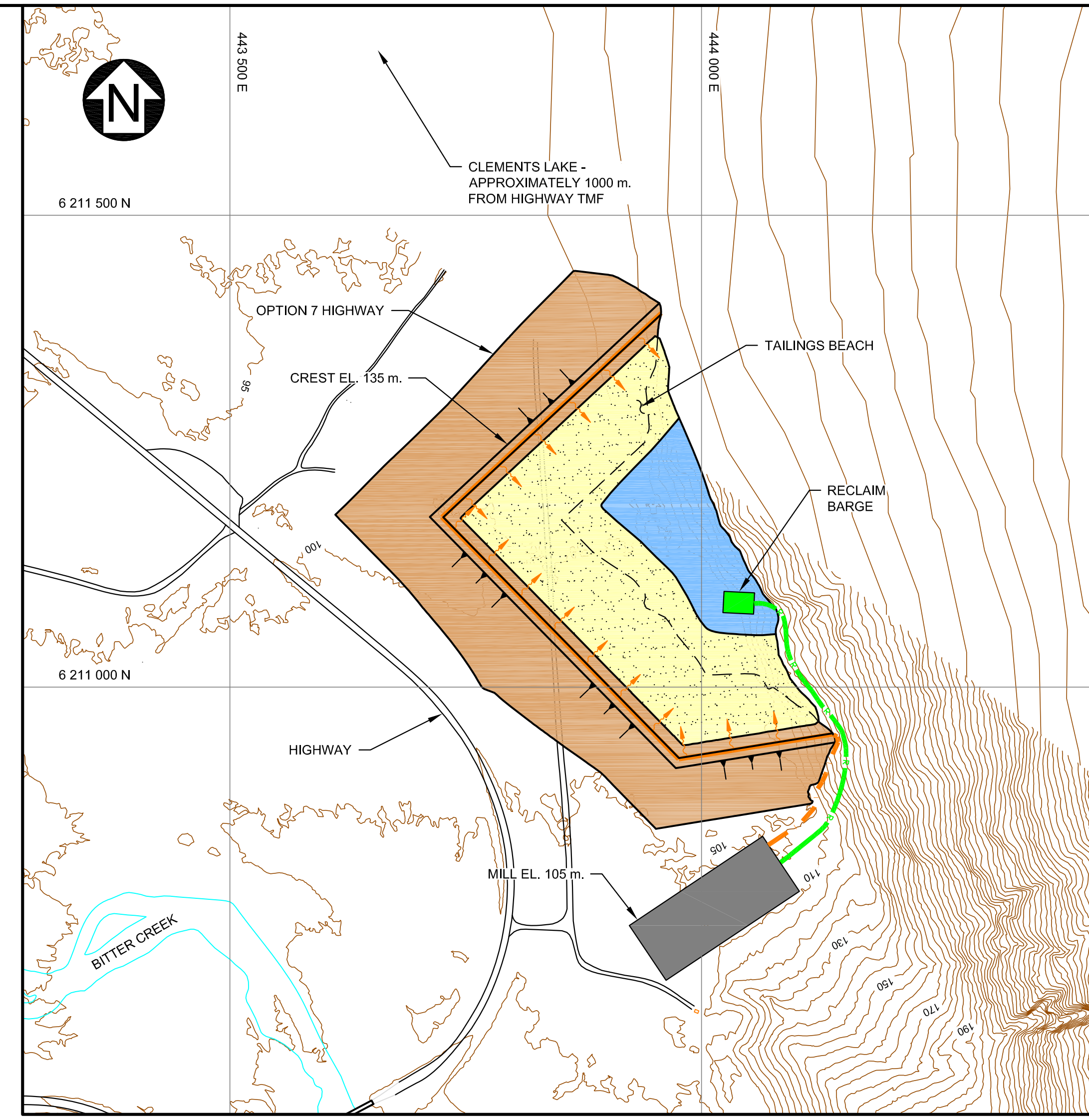
FINAL TMF OPTION 6 - ROOSEVELT CREEK
SCALE A



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FINAL TMF OPTION 7 - HIGHWAY
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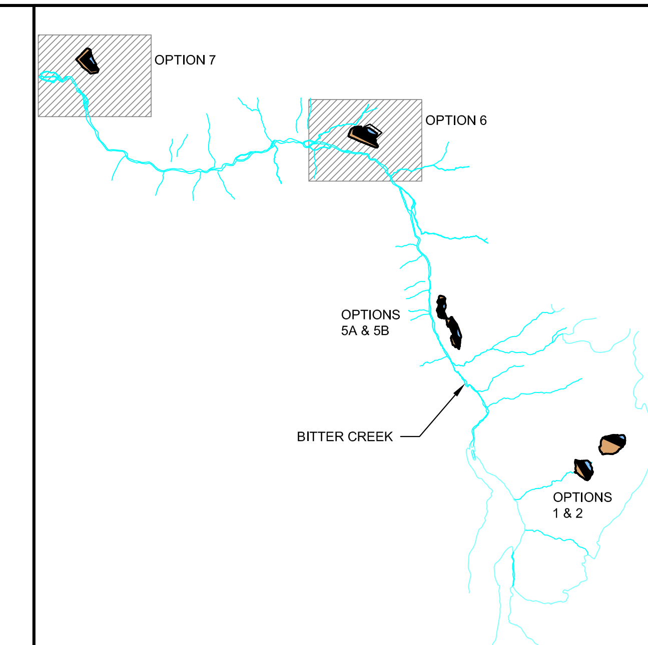


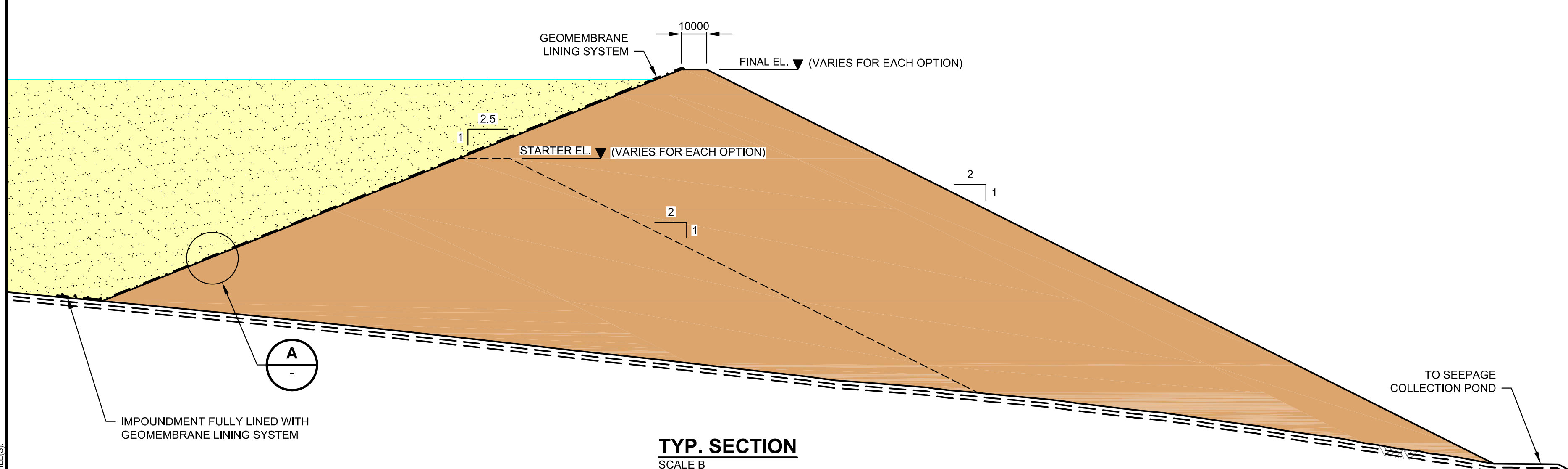
KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).
6. ADDITIONAL 20 m CONTOUR DATA PROVIDED BY IDM MINING FOR OPTION 7 (FEBRUARY 2016).



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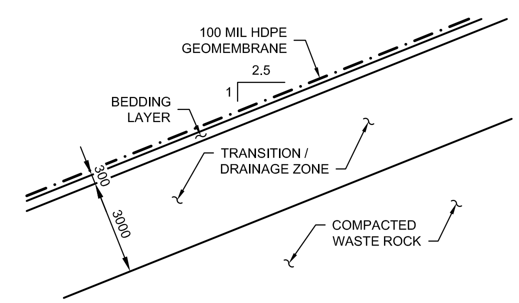

SECTION A -
UPSTREAM LINER
NTS

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SCALE A: 80 40 0 100 200 300 400 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

TMF OPTIONS ASSESSMENT
OPTION 6 & 7

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.2 REV 0

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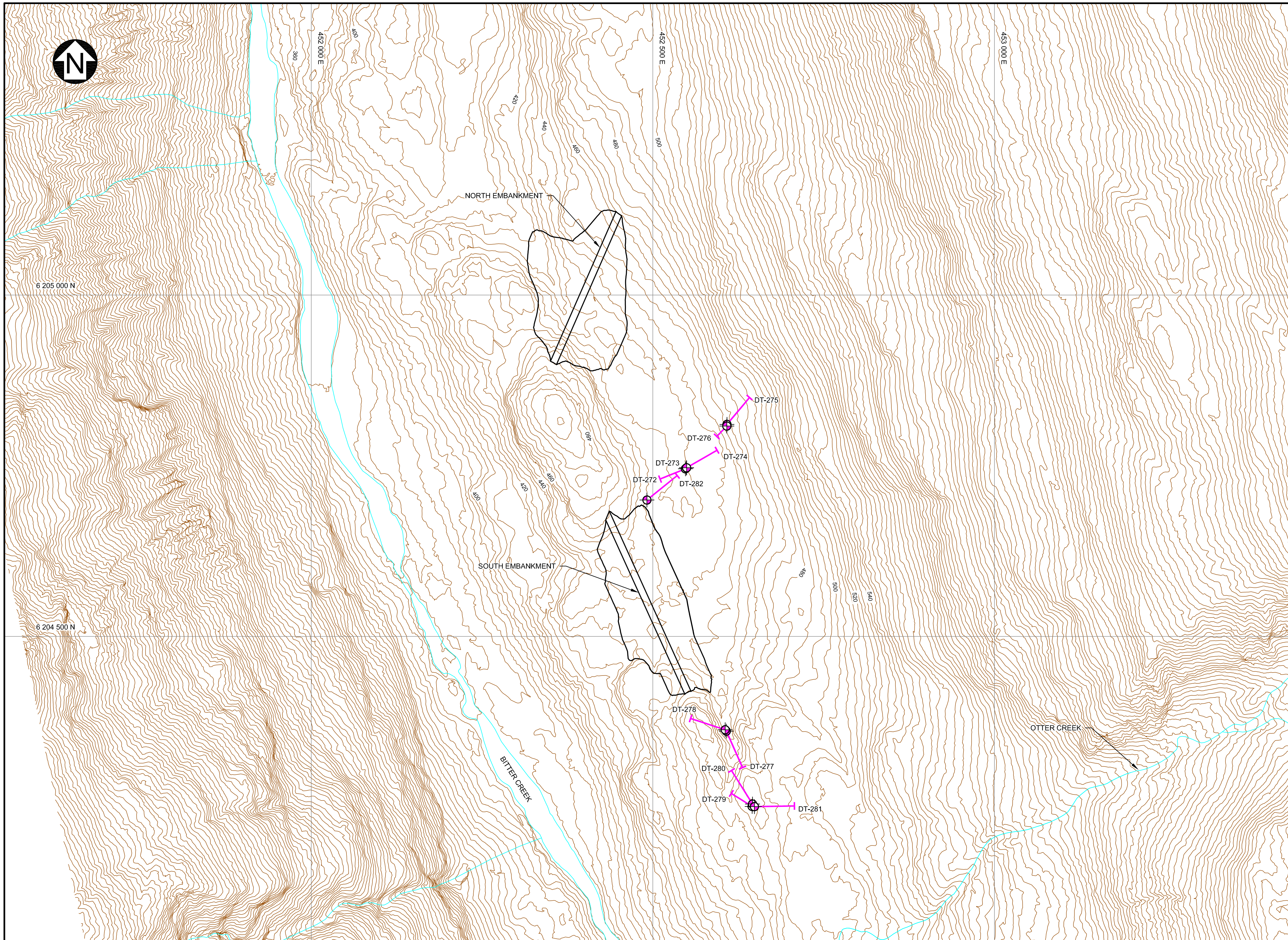

PLAN
SCALE A

KEY PLAN
NTS

LEGEND:

DT-272 — HISTORIC DRILLHOLE (GOLDER ASSOCIATES)

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.

SCALE A 60 30 0 100 200 300 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

OTTER CREEK UPPER TMF HISTORIC GEOTECHNICAL & HYDROGEOLOGICAL DRILLHOLE LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.3 REV 0

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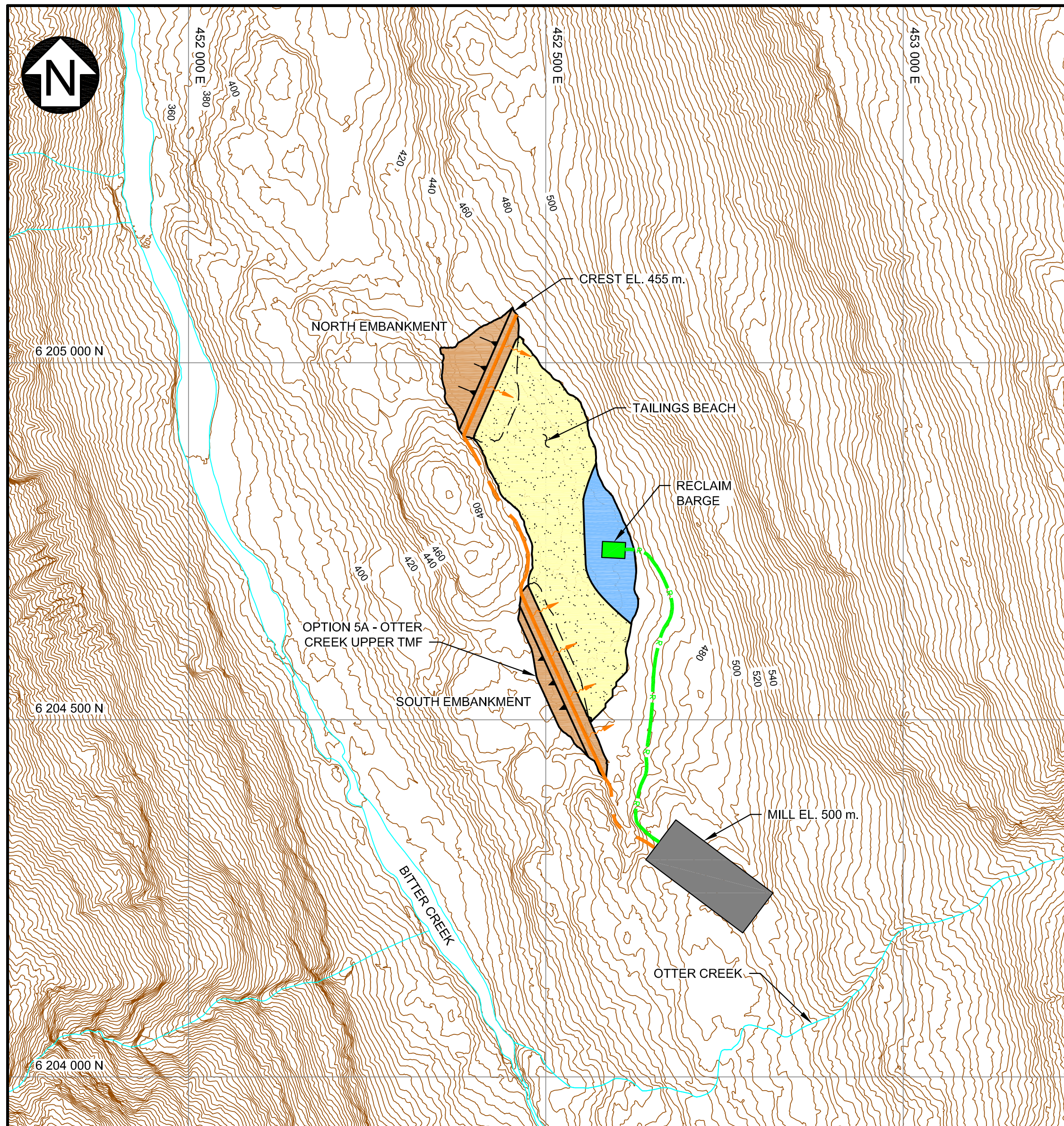

PLAN
STARTER TMF OPTION 5A
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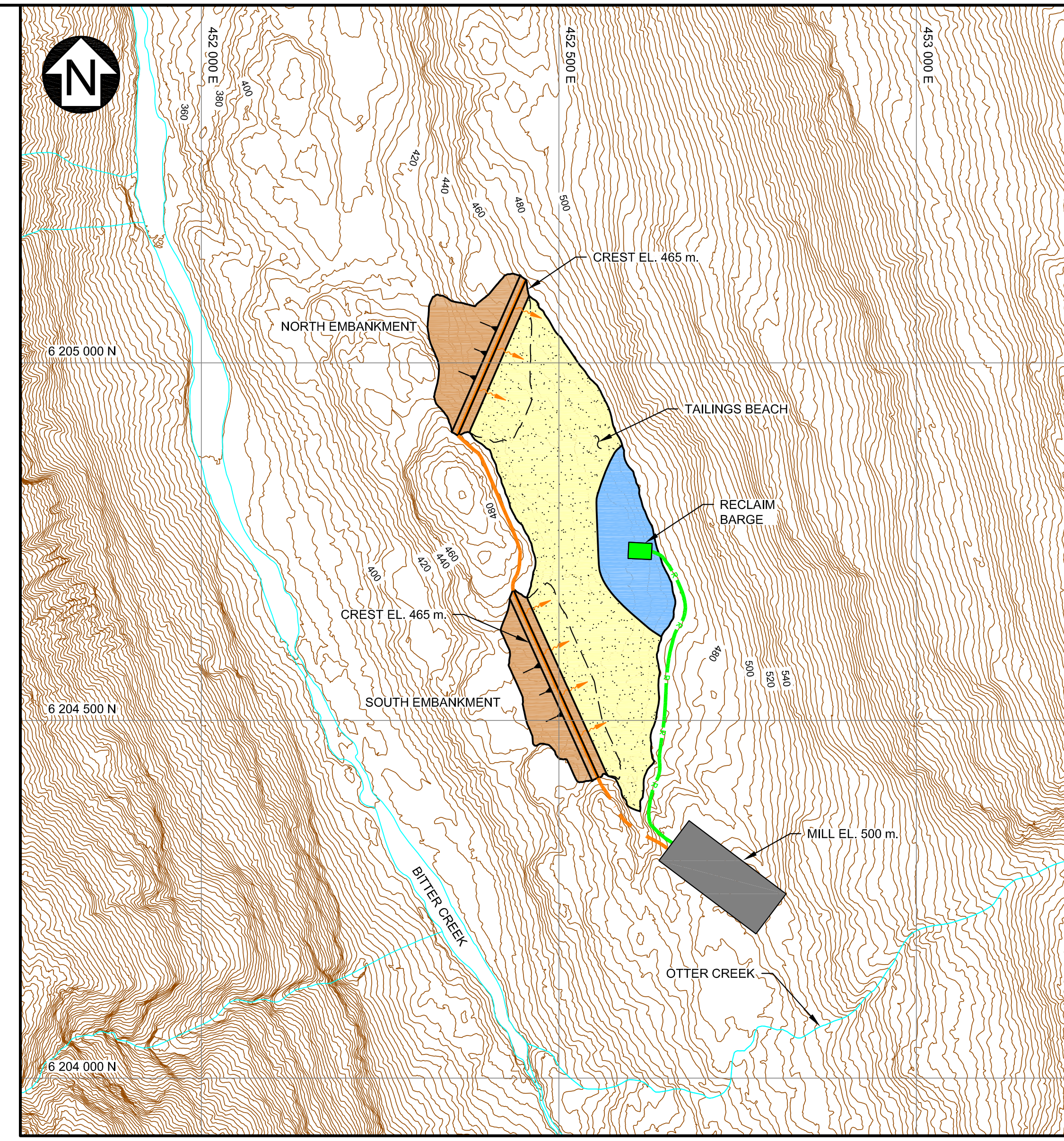

PLAN
FINAL TMF OPTION 5A
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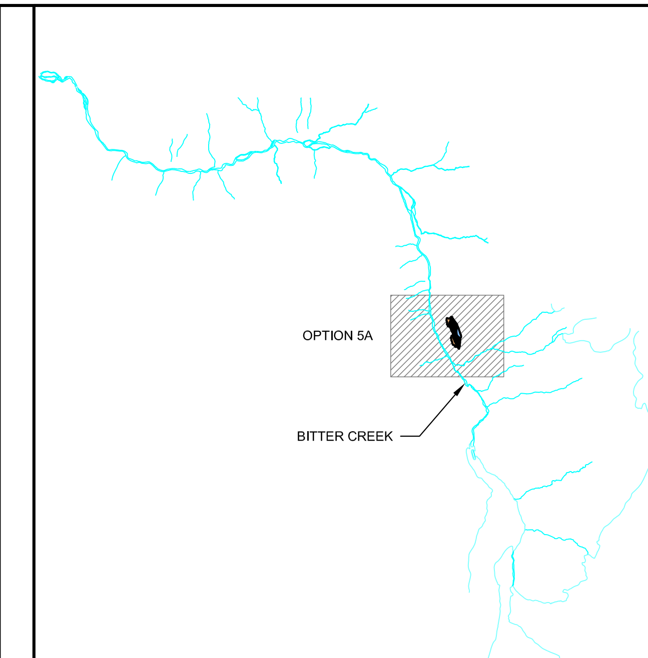
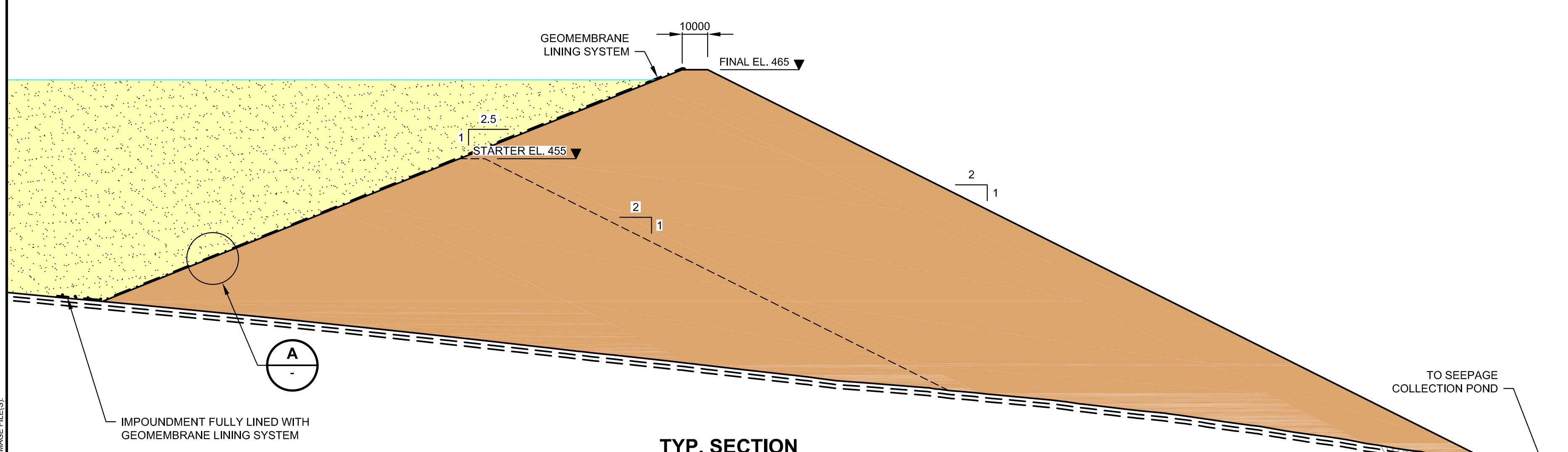


KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK



TYP. SECTION
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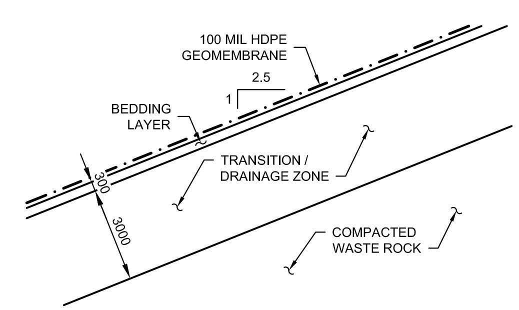

A - SECTION
UPSTREAM LINER
NTS

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FERUARY 2016).

SCALE B: 25 12.5 0 25 50 75 100 125 m
SCALE A: 100 50 0 100 200 300 400 500 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

OPTION 5A
OTTER CREEK UPPER
CONCEPTUAL DESIGN

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.4 REV 0

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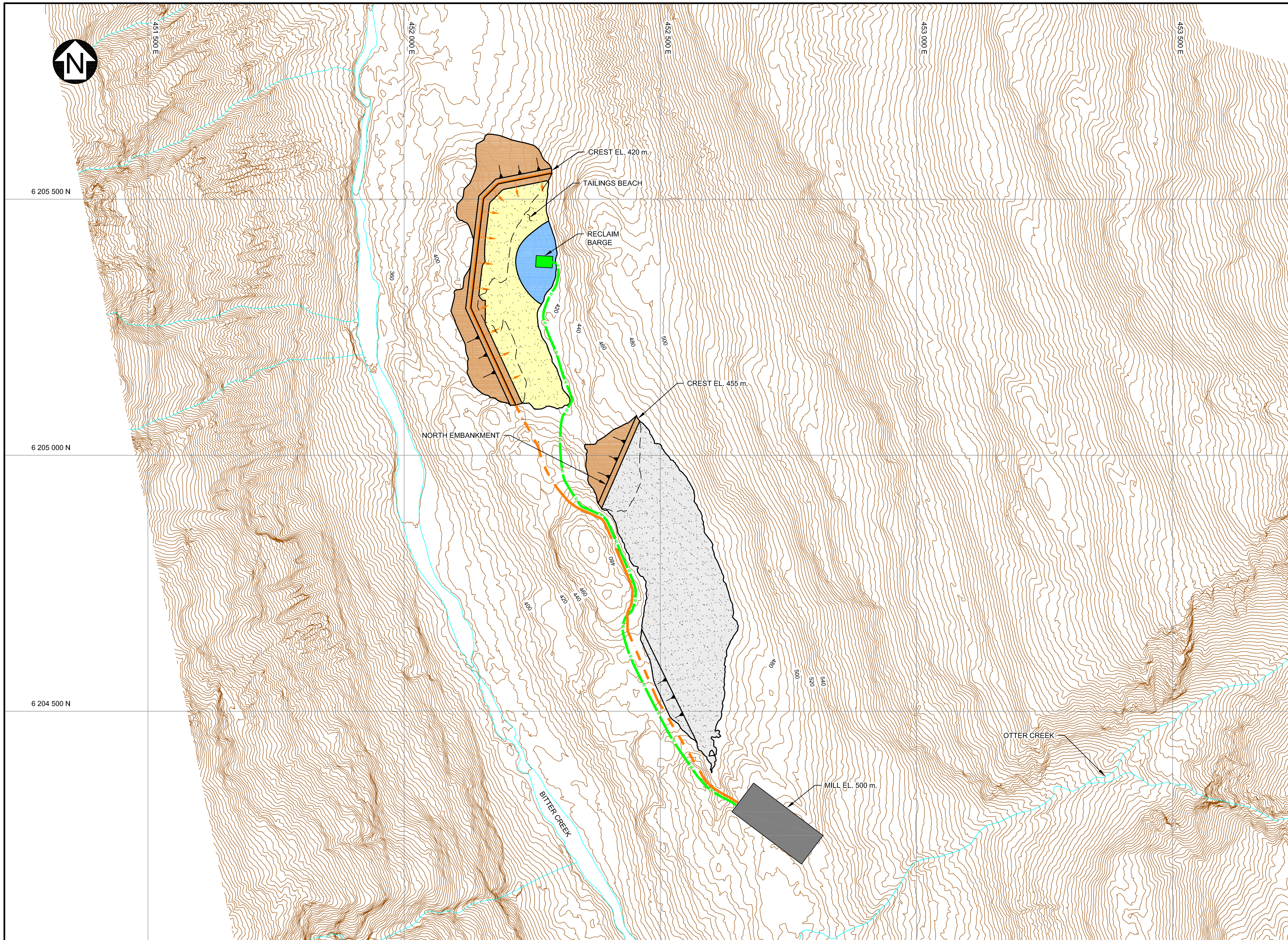
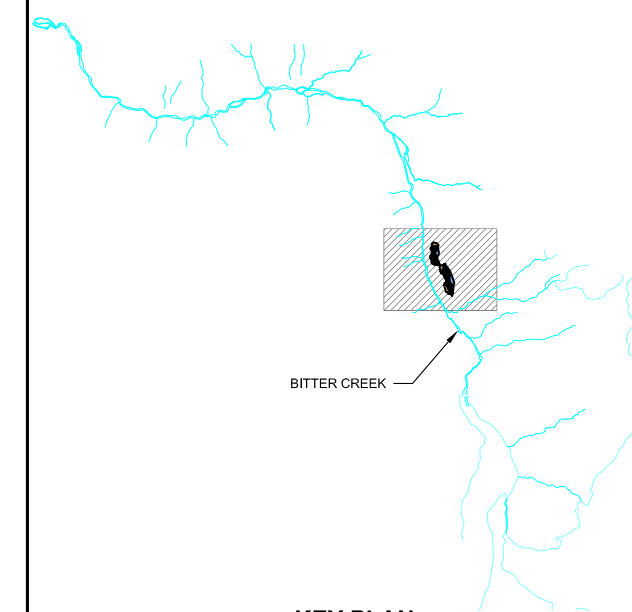


PLAN
SCALE A



KEY PLAN
NTS

LEGEND:

- EMBANKMENT
- FILTERED TAILINGS
- WATER
- RECLAIM PIPELINE
- TAILINGS PIPELINE
- EXISTING ROAD
- CREEK

NOTES:

1. COORDINATE GRID IS UTM NAD 83 ZONE 9.
2. PLAN RECEIVED BASED ON TOPO FROM JDS MINING (JANUARY 2016).
3. CONTOUR INTERVAL IS 5 METRES.
4. DIMENSIONS AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
5. MILL LOCATION PROVIDED BY JDS MINING (FEBRUARY 2016).

SCALE A 80 40 0 100 200 300 400 m

IDM MINING LTD.

RED MOUNTAIN GOLD PROJECT

OTTER CREEK
SLURRY & FILTERED TAILINGS
CONCEPTUAL LAYOUT

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-594/01	VA16-00197

FIGURE B.5 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	17FEB'16	ISSUED WITH LETTER	DMR	ELG	KDE

SAVED: M:\1\01\00594\01\A\Acad\FIGS\B05, 2/17/2016 4:10:40 PM , EGUEVARRA PRINTED: 2/17/2016 4:19:41 PM, Fig. B.5, EGUEVARRA
XREF FILE(S): V-TOPO-CONT-5m IMAGE FILE(S):

APPENDIX C

OPTIONS ASSESSMENT - CONVENTIONAL SLURRY TAILINGS COST ESTIMATE TABLES

(Pages C-1 to C-6)

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TABLE C.1

IDM MIINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 1 - CIRQUE TMF (JDS PEA OPTION)

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	105,000	$ 210,000	50,000	$ 100,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	52,500	$ 262,500	25,000	$ 125,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	830,000	$ 7,470,000	870,000	$ 7,830,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	65,000	$ 910,000	37,500	$ 525,000	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	21,750	$ 304,500	11,250	$ 157,500	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	72,500	$ 7,975	37,500	$ 4,125	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	72,500	$ 906,250	37,500	$ 468,750	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	72,500	$ 290,000	37,500	$ 150,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	750	$ 5,625	125	$ 938	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	450	$ 6,300	75	$ 1,050	
	SUB-TOTAL ITEM 1100				**$ 10,423,150**		**$ 9,487,363**	**$19,910,513**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	900	$ 45,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 9,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	600	$ 30,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 6,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	1,000	$ 500,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	600	$ 150,000	60	$ 15,000	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	10.5	$ 10,500	5	$ 5,000	
	SUB-TOTAL ITEM 1300				**$ 900,000**		**$ 15,000**	**$915,000**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-		-	$ 4,500	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 3,000	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 11,783,150**		**$ 9,561,063**	**$21,344,213**
	Contingency	50%			$ 5,891,575		$ 4,780,531	$10,672,106
	TOTAL INITIAL CAPITAL				**$ 17,674,725**			**$17,674,725**
	TOTAL SUSTAINING CAPITAL						**$ 14,341,594**	**$14,341,594**
	TOTAL TMF COSTS				**$ 17,674,725**		**$ 14,341,594**	**$32,016,319**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.1 - Option 1 - Preliminary Scoping Study.xlsx]Table C.1

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

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TABLE C.2

IDM MIINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 2 - TOP OF CIRQUE TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	118,000	$ 236,000	103,000	$ 206,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	59,000	$ 295,000	59,000	$ 295,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	1,850,000	$ 16,650,000	3,275,000	$ 29,475,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	76,200	$ 1,066,800	53,800	$ 753,200	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	15,300	$ 214,200	12,075	$ 169,050	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	51,000	$ 5,610	40,250	$ 4,428	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	51,000	$ 637,500	40,250	$ 503,125	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	51,000	$ 204,000	40,250	$ 161,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	800	$ 6,000	250	$ 1,875	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	480	$ 6,720	150	$ 2,100	
	SUB-TOTAL ITEM 1100				**$ 19,371,830**		**$ 31,695,778**	**$51,067,608**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,600	$ 80,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 16,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	1,700	$ 85,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 17,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 448,000**		**$ -**	**$448,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	600	$ 300,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,025	$ 256,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	11.8	$ 11,800	10.3	$ 10,300	
	SUB-TOTAL ITEM 1300				**$ 806,250**		**$ -**	**$806,250**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1501	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 8,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 8,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 67,700**	**$67,700**
	SUBTOTAL				**$ 20,746,080**		**$ 31,763,478**	**$52,509,558**
	Contingency	50%			$ 10,373,040		$ 15,881,739	$26,254,779
	TOTAL INITIAL CAPITAL				**$ 31,119,120**			**$31,119,120**
	TOTAL SUSTAINING CAPITAL						**$ 47,645,216**	**$47,645,216**
	TOTAL TMF COSTS				**$ 31,119,120**		**$ 47,645,216**	**$78,764,336**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.2 - Option 2 - Preliminary Scoping Study.xlsx]Table C.2

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold
CONSULTING

TABLE C.3

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 5A - OTTER CREEK UPPER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	95,000	$ 190,000	50,000	$ 100,000	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	47,500	$ 237,500	25,000	$ 125,000	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	200,000	$ 1,800,000	375,000	$ 3,375,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	38,000	$ 532,000	39,000	$ 546,000	
1122	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	24,600	$ 344,400	10,950	$ 153,300	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	82,000	$ 9,020	36,500	$ 4,015	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	82,000	$ 1,025,000	36,500	$ 456,250	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	82,000	$ 328,000	36,500	$ 146,000	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	670	$ 5,025	270	$ 2,025	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	402	$ 5,628	162	$ 2,268	
	SUB-TOTAL ITEM 1100				**$ 4,526,573**		**$ 5,034,858**	**$9,561,431**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,000	$ 50,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 10,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	500	$ 25,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 5,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	500	$ 250,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	720	$ 180,000	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	9.5	$ 9,500	5	$ 5,000	
	SUB-TOTAL ITEM 1300				**$ 930,000**		**$ -**	**$930,000**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 2,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 5,916,573**		**$ 5,093,558**	**$11,010,131**
	Contingency	50%			$ 2,958,287		$ 2,546,779	$5,505,066
	TOTAL INITIAL CAPITAL				**$ 8,874,860**			**$8,874,860**
	TOTAL SUSTAINING CAPITAL						**$ 7,640,337**	**$7,640,337**
	TOTAL TMF COSTS				**$ 8,874,860**		**$ 7,640,337**	**$16,515,197**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.3 - Option 5A - Preliminary Scoping Study.xlsx]Table C.3

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

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TABLE C.4

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 5B - OTTER CREEK LOWER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	480,000	$ 4,320,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	80,000	$ 1,120,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	20,400	$ 285,600	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	68,000	$ 7,480	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	68,000	$ 850,000	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	68,000	$ 272,000	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	1	$ 52,083	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 7,308,243**		**$ 52,083**	**$7,360,326**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 75	1,600	$ 120,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 24,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 75	1,300	$ 97,500	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 19,500	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 511,000**		**$ -**	**$511,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	-	$ -	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	830	$ 207,500	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 707,500**		**$ -**	**$707,500**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	273	$ 10,917	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 4,063	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 10,417	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 30,396**	**$30,396**
	SUBTOTAL				**$ 8,646,743**		**$ 82,479**	
	Contingency	50%			$ 4,323,371		$ 41,240	$4,364,611
	TOTAL INITIAL CAPITAL				**$ 12,970,114**			**$12,970,114**
	TOTAL SUSTAINING CAPITAL						**$ 123,719**	**$123,719**
	TOTAL TMF COSTS				**$ 12,970,114**		**$ 123,719**	**$13,093,833**

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NOTES:

1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.
3. OPTION 5B INCLUDED AS AN EXPANSION OPTION AND DOES NOT PROVIDE SUFFICENT STORAGE FOR THE DESIGN STORAGE OF 1.4 MTONNES OF TAILINGS

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE C.5

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 6 - ROOSEVELT CREEK TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	215,000	$ 430,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	107,500	$ 537,500	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	1,841,000	$ 16,569,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	125,000	$ 1,750,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	41,310	$ 578,340	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	137,700	$ 15,147	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	137,700	$ 1,721,250	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	137,700	$ 550,800	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	1,175	$ 8,813	-	$ -	
1152	Process, Load, Haul, Place, Spread and Compact	m3	$ 14	705	$ 9,870	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 22,220,720**		**$ 125,000**	**$22,345,720**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,200	$ 60,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 12,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	300	$ 15,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 3,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 340,000**		**$ -**	**$340,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	800	$ 400,000	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,205	$ 301,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	21.5	$ 21,500	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 1,001,250**		**$ -**	**$1,001,250**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 6,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 1,500	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,700**	**$58,700**
	SUBTOTAL				**$ 23,681,970**		**$ 183,700**	
	Contingency	50%			$ 11,840,985		$ 91,850	$11,932,835
	TOTAL INITIAL CAPITAL				**$ 35,522,954**			**$35,522,954**
	TOTAL SUSTAINING CAPITAL						**$ 275,550**	**$275,550**
	TOTAL TMF COSTS				**$ 35,522,954**		**$ 275,550**	**$35,798,504**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.5 - Option 6 - Preliminary Scoping Study.xlsx]Table C.5

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE C.6

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

CONVENTIONAL SLURRY TAILINGS
OPTION 7 - HIGHWAY TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	90,000	$ 180,000	76,250	$ 152,500	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	45,000	$ 225,000	38,125	$ 190,625	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	740,000	$ 6,660,000	1,730,000	$ 15,570,000	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	96,000	$ 1,344,000	91,000	$ 1,274,000	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	16,875	$ 236,250	11,805	$ 165,270	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	56,250	$ 6,188	39,350	$ 4,329	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 12.5	56,250	$ 703,125	39,350	$ 491,875	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	56,250	$ 225,000	39,350	$ 157,400	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2.5	$ 125,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 7.5	800	$ 6,000	200	$ 1,500	
1152	Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	480	$ 6,720	120	$ 1,680	
	SUB-TOTAL ITEM 1100				**$ 9,642,283**		**$ 18,134,179**	**$27,776,461**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 50	1,000	$ 50,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 10,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 50	400	$ 20,000	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 4,000	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 334,000**		**$ -**	**$334,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	725	$ 362,500	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	1,065	$ 266,250	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	1	$ 250,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	1	$ 50,000	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	9	$ 9,000	7.625	$ 7,625	
	SUB-TOTAL ITEM 1300				**$ 878,750**		**$ -**	**$878,750**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	655	$ 26,200	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 2,000	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 25,000	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 58,200**	**$58,200**
	SUBTOTAL				**$ 10,975,033**		**$ 18,192,379**	
	Contingency	50%			$ 5,487,516		$ 9,096,189	$14,583,706
	TOTAL INITIAL CAPITAL				**$ 16,462,549**			**$16,462,549**
	TOTAL SUSTAINING CAPITAL						**$ 27,288,568**	**$27,288,568**
	TOTAL TMF COSTS				**$ 16,462,549**		**$ 27,288,568**	**$43,751,117**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix C\Excel Files\[Table C.6 - Option 7 - Preliminary Scoping Study.xlsx]Table C.6

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

APPENDIX D

SLURRY AND FILTERED TAILINGS COST ESTIMATE TABLES

(Pages D-1 to D-3)

Knight Piésold CONSULTING

TABLE D.1

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

OTTER CREEK
SLURRY & FILTERED TAILINGS COMBINATION
PRELIMINARY COST ESTIMATE SUMMARY - 50% CONTINGENCY

Description	Initial Capital Costs	Sustaining Capital	Total
Option 5B - 30% PAG Slurry Tailings	$11,891,000	$124,000	$12,015,000
Option 5A - 70% NAG Filtered Tailings	$2,726,000	$1,685,000	$4,411,000
TOTAL	$14,617,000	$1,809,000	$16,426,000

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0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE D.2

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

30 % PAG CONVENTIONAL SLURRY TAILINGS
OPTION 5B - OTTER CREEK LOWER TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	400,000	$ 3,600,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	80,000	$ 1,120,000	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	20,400	$ 285,600	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	68,000	$ 7,480	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	68,000	$ 850,000	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	68,000	$ 272,000	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	1	$ 52,083	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 6,588,243**		**$ 52,083**	**$6,640,326**
1200	**Conventional Tailings Distribution System**							
1210	Tailings Distribution System							
1211	4" Dia. HDPE DR21 Tailings Delivery Pipeline	m	$ 75	1,600	$ 120,000	-	$ -	
1212	Tailings Distribution Fittings and Valves	%	20%	-	$ 24,000	-	$ -	
1220	Reclaim Water System							
1221	Reclaim Water Pumps/Barge	ea.	$ 250,000	1	$ 250,000	-	$ -	
1222	4" Dia. HDPE DR21 Reclaim Water Pipeline	m	$ 75	1,300	$ 97,500	-	$ -	
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	-	$ 19,500	-	$ -	
	SUB-TOTAL ITEM 1200				**$ 511,000**		**$ -**	**$511,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500	-	$ -	-	$ -	
1320	Seepage Collection Ditch	m	$ 250	830	$ 207,500	-	$ -	
1330	Seepage Management Pond (Seepage recovery and recycle system)	LS	$ 250,000	2	$ 500,000	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 707,500**		**$ -**	**$707,500**
1400	**Electrical**							
1410	Reclaim Water System							
1411	Reclaim Water System - Powerline	m	$ 100	500	$ 50,000	-	$ -	
1412	Reclaim Water System - Transformers and Switchgears	LS	$ 50,000	1	$ 50,000	-	$ -	
1413	Reclaim Water System - Electrical House with PLC & MCC	LS	$ 20,000	1	$ 20,000	-	$ -	
	SUB-TOTAL ITEM 1400				**$ 120,000**		**$ -**	**$120,000**
1500	**Operating Costs**							
1510	Tailings Distribution System							
1511	Conventional Tailings Distribution System - Pipeline Maintenance	%	2%	-	$ -	-	$ 5,000	
1520	Reclaim Water System							
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40	-	$ -	273	$ 10,917	
1522	Reclaim Water System - Pipeline Maintenance	%	2%	-	$ -	-	$ 4,063	
1523	Reclaim Water System - Pump Maintenance	%	2%	-	$ -	-	$ 10,417	
	SUB-TOTAL ITEM 1400				**$ -**		**$ 30,396**	**$30,396**
	SUBTOTAL				**$ 7,926,743**		**$ 82,479**	$8,009,222
	Contingency	50%			$ 3,963,371		$ 41,240	$4,004,611
	TOTAL INITIAL CAPITAL				**$ 11,890,114**			**$11,890,114**
	TOTAL SUSTAINING CAPITAL						**$ 123,719**	**$123,719**
	TOTAL TMF COSTS				**$ 11,890,114**		**$ 123,719**	**$12,013,833**

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NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.
3. OPTION 5B INCLUDED AS AN EXPANSION OPTION AND DOES NOT PROVIDE SUFFICENT STORAGE FOR THE DESIGN STORAGE OF 1.4 MTONNES OF TAILINGS

0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE D.3

IDM MINING INC.
RED MOUNTAIN GOLD PROJECT

70% NAG FILTERED TAILINGS
OPTION 5A - OTTER CREEK Upper TMF

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Item Number	Description	Units	Unit Cost	Initial Capital		Sustaining Capital & Operating Costs		Total Life of Mine
				Quantity	Cost	Quantity	Cost	
1000	**Tailings Management Facility**							
1100	**TMF Earthworks**							
1110	Foundation Preparation							
1111	Clearing/Grubbing of TMF Footprint	m2	$ 2	86,500	$ 173,000	-	$ -	
1112	Topsoil Stripping of TMF Footprint	m3	$ 5	43,250	$ 216,250	-	$ -	
1120	Material Development and Fill Placement							
1121	Rockfill - Drill, Blast, Load, Haul and Place, Spread and Compact (within 500 m)	m3	$ 9	145,000	$ 1,305,000	-	$ -	
1122	Transition Zone - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	-	$ -	-	$ -	
1123	Bedding Layer - Process, Load, Haul, Place, Spread and Compact (within 500 m)	m3	$ 14	-	$ -	-	$ -	
1130	Lining of TMF Embankment							
1131	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2	$ 0.1	-	$ -	-	$ -	
1132	100 mil HDPE Liner - Supply, Deliver and Install	m2	$ 13	-	$ -	-	$ -	
1133	Non-woven 16 oz. Geotextile - Supply and Install	m2	$ 4	-	$ -	-	$ -	
1140	Geotechnical Instrumentation	LS	$ 50,000	1	$ 50,000	2	$ 100,000	
1150	Embankment Underdrain System							
1151	Perforated CPT Pipe, Fittings	m	$ 8	875	$ 6,563	-	$ -	
1152	600 mm x 1000 mm Drainage Layer - Process, Load, Haul, Place, Spread and Compact	m3	$ 14	525	$ 7,350	-	$ -	
	SUB-TOTAL ITEM 1100				**$ 1,758,163**		**$ 100,000**	**$1,858,163**
1200	**Filtered Tailings Distribution System**							
1210	Filtered Tailings Delivery (Haul/Place/Spread/Compact/Grade)	m3	$ 2		$ -	620,000	$ 1,023,000	
	SUB-TOTAL ITEM 1200				**$ -**		**$ 1,023,000**	**$1,023,000**
1300	**TMF Water Management**							
1310	Diversion and Runoff Collection Channels	m	$ 500		$ -	-	$ -	
1340	Construction Dewatering Allowance	LS	$ 50,000	1	$ 50,000	-	$ -	
1350	Sediment & Erosion Control BMP's	ha	$ 1,000	8.65	$ 8,650	-	$ -	
1360	Water Polishing Pond	LS	$ 250,000	2	$ 500,000	-	$ -	
	SUB-TOTAL ITEM 1300				**$ 58,650**		**$ -**	**$58,650**
	SUBTOTAL				**$ 1,816,813**		**$ 1,123,000**	$2,939,813
	Contingency	50%			$ 908,406		$ 561,500	$1,469,906
	TOTAL INITIAL CAPITAL				**$ 2,725,219**			**$2,725,219**
	TOTAL SUSTAINING CAPITAL & OPERATING COSTS						**$ 1,684,500**	**$1,684,500**
	TOTAL TMF COSTS				**$ 2,725,219**		**$ 1,684,500**	**$4,409,719**

M:\1\01\00594\01\A\Correspondence\VA16-00197\Appendix D\Excel Files\[Option 5B - Preliminary Scoping Study.xlsx]Table D.3

NOTES:
1. ALL PRICES IN CAD$ (CONVERSION RATE CAD$0.75 = USD$1).
2. COST OF FUEL PROVIDED BY JDS MINING AS CAD$1.1/L.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	16FEB'16	ISSUED WITH LETTER VA16-00197	JEF	DMR

APPENDIX B

BAT ASSESSMENT TABLES AND FIGURES

(Pages B-1 to B-10)

Knight Piésold
CONSULTING

TABLE B.1

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
CATEGORY, SUB-CATEGORY AND CRITERIA WEIGHTS

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Category	Sub-Category	Criteria	Category Weight	Sub-Category Weight	Criteria Weight
Environmental	Surface and Ground Water	Chemical Stability	5	5	5
		Groundwater Quality			2
		Surface Water Quality			2
	Environmental Impacts	Physical Properties of Proposed TMF		5	5
		Closure			2
		Flora & Fauna & Land Use			1
Technical	Construction and Operation Considerations	Constructability	3	5	5
		Complexity of Operation			5
		Containment Design			4
		Complexity of Water Management			4
		Average Annual Water Balance Impacts			3
	Optimization and Permitting Considerations	Future Expansion Potential		4	5
		Proven Technology			3
Social	Health and Safety	Safety Considerations	1	5	5
	Effect on Existing Community	Public Acceptance		5	5
		Cultural Heritage			5
Economic	Cost	Schedule	1	5	5
		Capital Costs			5
		Operating and Maintenance Costs			3
		Closure and Reclamation Costs			3

\\KPL\VA-Prj$\1\01\00594\04\A\Report\1 - Tailings BAT Alternatives Assessment\Rev 0\Appendix B - Tables B1-B4\[Tables B1-B4_RevB (KP Methodology).xlsx]ReadMe_First

NOTE(S):

1. GREATER WEIGHTS INDICATE GREATER RELATIVE IMPORTANCE.

0	30JUN'17	ISSUED WITH REPORT VA101-594/4-1	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D

Knight Piésold CONSULTING

TABLE B.2

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
HIGH-LEVEL RATING

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Criteria	Candidate 1 Thickened Tailings		Candidate 2 Ultra-thickened Cemented Tailings		Candidate 3 Filtered Tailings	
	Description	Rating	Description	Rating	Description	Rating
Enviromental						
Chemical Stability of PAG Tailings	● 100% of tailings is considered PAG. ● Water cover on potentially acid generating tailings tailings will mitigate ARD. ● Tailings mass is fully saturated due to lined facility. ● Tailings is anticipated to be metal leaching (ML) after 20 years if exposed to oxidation. ● Low permeability cover included in closure plan.	***Acceptable***	● 100% of tailings is considered PAG. ● Water cover on potentially acid generating tailings tailings will mitigate ARD. ● Tailings mass is fully saturated due to lined facility. ● Tailings is anticipated to be metal leaching (ML) after 20 years if exposed to oxidation. ● Low permeability cover included in closure plan.	***Acceptable***	● 100% of tailings is considered PAG. ● Tailings mass maintained in unsaturated condition, increasing oxidation and ARD generation. ● Low permeability cover included in closure plan. ● Tailings is anticipated to be metal leaching (ML) after 20 years.	***Least Preferred***
Groundwater Quality	● Low permeability liner will limit seepage to the downstream environment.	***Acceptable***	● Low permeability liner will limit seepage to the downstream environment.	***Acceptable***	● Filtered tailings stack will include low permeability liner to limit seepage to the downstream environment. ● Unsaturated tailings will also limit seepage to downstream environment. ● Unsaturated tailings increase the risk of ML/ARD from tailings mass.	***Acceptable***
Surface Water Quality	● Site water to be managed within slurry TMF, low risk of impact to surface water quality.	***Acceptable***	● Site water to be managed within TMF, low risk of impact to surface water quality. ● Separate pond for water management potentially required.	***Least Preferred***	● Separate pond for water management of filtered tailings required. ● No supernatant water stored on TMF, although confining embankments for tailings may store some water under high precipitation conditions.	***Preferred***
Physical Properties of Proposed TMF	● Slurry tailings material can be mobilized in the event of a dam failure.	***Least Preferred***	● Cement addition provides more stable tailings mass, less susceptible to liquefaction and unlikely to mobilize in the event of a dam failure (non-flowable and non-segregating).	***Preferred***	● Filtered tailings behaves in a soil-like behavior enabling stacking of tailings in an unsaturated, stable state.	***Preferred***
Closure	● Constructing closure cover on the thickened tailings facility is feasible but challenging.	***Least Preferred***	● Constructing closure cover on the cemented facility is feasible.	***Acceptable***	● Constructing closure cover on the filtered facility is feasible. ● Progressive reclamation of the filtered tailings stack may be possible.	***Preferred***
Flora, Fauna & Land Use	● All tailings contained within single TMF. ● Process water reclaimed from TMF supernatant pond.	***Preferred***	● All tailings contained within single TMF. ● Additional process water pond may be required.	***Acceptable***	● Separate pond for water management of filtered tailings. ● Separate process water pond may be required for make-up water.	***Least Preferred***

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TABLE B.2

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
HIGH-LEVEL RATING

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Criteria	Candidate 1 Thickened Tailings		Candidate 2 Ultra-thickened Cemented Tailings		Candidate 3 Filtered Tailings	
	Description	Rating	Description	Rating	Description	Rating
Technical						
Constructability	• Single TMF required. • No additional process water pond required. • More challenging closure cover construction.	***Preferred***	• Single TMF required. • Cemented tailings will allow easier closure cover construction. • Separate process water pond may be required.	***Acceptable***	• Separate process water pond may be required. • PAG nature of tailings requires lining of TMF regardless of filtered tailngs. • Low angle of repose due to fine grind size requires confining embankments.	***Least Preferred***
Complexity of Operation	• Thickener underflow required for tailings production.. • Gravity discharge potential for tailings distribution, short distance from Process Plant.	***Preferred***	• Thickener and cement addition required to produce tailings. • Positive Displacement pumps required to pump tailings from Process Plant to TMF.	***Acceptable***	• Thickener and filter presses required to produce filtered tailings. • Low angle of repose of filtered tailings require confining embankments • Filtered tailings transported by trucks, placed and compacted.	***Least Preferred***
Containment Design	• Requires two embankments.	***Preferred***	• Requires two embankments. • Separate process water pond may be required.	***Acceptable***	• Requires two embankments for filtered tailings facility. • Additional facility required for process water.	***Least Preferred***
Water Management Complexity	• System of ditches to route non-contact water around TMF. • System of ditches and ponds with pump back systems to collect seepage and surface runoff water back to TMF supernatant pond. • Process water reclaimed from TMF supernatant pond.	***Preferred***	• System of ditches to route non-contact water around TMF. • System of ditches and ponds with pump back systems to collect seepage and surface runoff water back to TMF supernatant pond. • Process water reclaimed from TMF supernatant pond to maximum extent possible, but separate process water pond may be required to provide sufficient water for use in process.	***Acceptable***	• System of ditches to route non-contact water around TMF. • Separate water management system required to manage runoff from filtered tailings stack. • Separate process water pond may be required to provide sufficient water for use in process.	***Least Preferred***
Average Annual Water Balance	• Average annual water surplus is similar for all options.	***Acceptable***	• Average annual water surplus is similar for all options. • Reduced water in tailings as a result of higher solids content has negligible impact to overall inputs to TMF due to high precipitation in area.	***Acceptable***	• Smaller process water pond for just PAG tailings not expected to provide sufficient reclaim water for use in process.	***Least Preferred***
Future Expansion Potential	• Downstream Option 5B from KP Options Assessment may be used as an expansion cell.	***Least Preferred***	• Embankment crests may be raised to provide additional capacity. • Downstream Option 5B from Options Assessment may be used as an expansion cell.	***Acceptable***	• Increased tailings density from compacted tailings results in more expansion potential within facility footprint. • Downstream Option 5B from Options Assessment may be used as an expansion cell (depending on process water pond location).	***Preferred***
Proven Technology	• Thickened tailings a proven technology for most operational mine sites.	***Preferred***	• Cemented tailings relatively new technology but becoming more common. • Limited success in application of ultra-thickened tailings in the past.	***Least Preferred***	• Filtered tailings proven technology for low throughput operations, concerns remain about suitability for wetter climates.	***Acceptable***

TABLE B.2

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
HIGH-LEVEL RATING

Print Jun-30-17 11:09:06

Criteria	Candidate 1 Thickened Tailings		Candidate 2 Ultra-thickened Cemented Tailings		Candidate 3 Filtered Tailings	
	Description	**Rating**	**Description**	**Rating**	**Description**	**Rating**
Social						
Health and Safety Considerations	• Relatively straightforward process and deposition strategy with thickener underflow and centrifugal pumping. • No high-pressure pipelines required or dangerous inhalant substances to be added by workers during process.	***Preferred***	• High pressure pipelines required to pump cemented tailings is a potential worker hazard. • Cement addition is a potential hazard to workers.	***Least Preferred***	• Increased mine haul truck traffic to construct filtered tailings facility is a potential worker hazard. • Dust generation potential from unsaturated filtered tailings is a potential hazard.	***Acceptable***
Public Acceptance	• Recent mine failures have led to uncertainties surrounding suitability of slurry tailings impoundments. • Thickened tailings may alleviate concerns over conventional slurry tailings.	***Least Preferred***	• Cemented tailings perceived as more stable than slurry tailings (conventional or thickened). • Relatively unknown technology.	***Acceptable***	• Filtered tailings considered most stable tailings technology.	***Preferred***
Cultural Heritage	• Single facility footprint reduces risk of impacting culturally significant areas within project footprint.	***Preferred***	• Single facility footprint reduces risk of impacting culturally significant areas within project footprint. • Separate process water pond may be required which could impact culturally significant areas within project footprint.	***Acceptable***	• Tailings facilities and separate process water pond facility increases risk of impacting culturally significant areas within project footprint.	***Least Preferred***
Economic						
Mining Schedule	• Thickened tailings disposal unlikely to impact project schedule.	***Preferred***	• Operational unavailability of paste plant or cement during maintenance or downtime may impact project schedule.	***Acceptable***	• Operational unavailability of filter plant during maintenance or downtime may impact project schedule. • Inefficiency of filter plant may impact project schedule. • Challenges posed by periods of high precipitation (wet climate) which may affect deposition of filtered tailings. • Challenges with filtered tailings deposition during winter months may include requirements for snow removal, potential for ice lenses to form in the tailings mass.	***Least Preferred***
Capital Cost	• Slurry tailings do not require any additional processing. • Potential for gravity discharge of tailings, particularly in early years of operations means tailings pump system can be deferred to sustaining capital, reducing initial capital. • Cost associated with starter dam construction.	***Preferred***	• Cemented tailings require tailings paste plant, positive displacement pumps and cement thickening plant to produce ultra-thickened cement tailings. • Potential for additional costs relating to construction of process water pond (if required). • Cost associated with starter dam construction.	***Acceptable***	• Filtered tailings require construction of filter plant in addition to regular ore processing. • Reduced embankment construction costs for anticipated smaller TMFembankments for filtered tailings containment. • Additional costs for construction of process water pond.	***Least Preferred***

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TABLE B.2

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
HIGH-LEVEL RATING

Print Jun-30-17 11:09:06

Criteria	Candidate 1 Thickened Tailings		Candidate 2 Ultra-thickened Cemented Tailings		Candidate 3 Filtered Tailings	
	Description	Rating	Description	Rating	Description	Rating
Operating Cost	• Thickened tailings can potentially be gravity discharged a short distance to the TMF directly after processing at the Process Plant, particularly during earlier years of operation, resulting in negligible cost.	***Preferred***	• Higher pumping costs associated with use of PD pumps and paste plant to produce cemented tailings, however Process Plant is a short distance to TMF.	***Acceptable***	• Operating costs associated with operation of filter plant. • Operating costs associated with haul and placement of non-PAG tailings in filtered tailings stack. • Higher reclaim costs due to distance between process water pond (downstream of TMF) and Process Plant Site.	***Least Preferred***
Closure Cost	• Trafficability and construction of the closure cover on the slurry tailings impoundment will be more challenging.	***Least Preferred***	• Improved trafficability expected for construction of closure cover on cemented tailings TMF.	***Acceptable***	• Improved trafficability expected for construction of closure cover on filtered tailings TMF. • No waste rock cover required for placement as mass is considered stable.	***Preferred***

\\KPL\VA-Prj$\1\01\00594\04\A\Report\1 - Tailings BAT Alternatives Assessment\Rev 0\Appendix B - Tables B1-B4\[Tables B1-B4_RevB (KP Methodology).xlsx]Table B2 High-Level Rating

NOTES:

1. ALL FACILITIES ARE ASSUMED TO BE LINED WITH A LOW PERMEABILITY GEOSYNTHETIC LINER.

0	30JUN'17	ISSUED WITH REPORT VA101-594/4-1	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D

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TABLE B.3

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
NUMERICAL RESULTS OF HIGH-LEVEL RATING (UNWEIGHTED)

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Categories and Criteria	Candidates		
	Candidate 1 *Conventional Thickened Tailings*	**Candidate 2** *Ultra-thickened Cemented Tailings*	**Candidate 3** *Filtered Tailings*
Environmental			
Chemical Stability	2	2	1
Groundwater Quality	2	2	2
Surface Water Quality	2	1	3
Physical Characteristics and Impacts	1	3	3
Closure	1	2	3
Flora, Fauna & Land Use	3	2	1
TOTAL ENVIRONMENTAL	**11**	**12**	**13**
Technical			
Constructability	3	2	1
Complexity of Operation	3	2	1
Containment Design	3	2	1
Water Management Complexity	3	2	1
Average Annual Water Balance Impacts	2	2	1
Future Expansion Potential	1	2	3
Proven Technology	3	1	2
TOTAL TECHNICAL	**18**	**13**	**10**
Social			
Health and Safety Considerations	3	1	2
Public Acceptance	1	2	3
Cultural Heritage	3	2	1
TOTAL SOCIAL	**7**	**5**	**6**
Economic			
Schedule	3	2	1
Capital Cost	3	2	1
Operating Cost	3	2	1
Closure Cost	1	2	3
TOTAL ECONOMIC	**10**	**8**	**6**
UNWEIGHTED RESULTS	**46**	**38**	**35**

\\KPL\VA-Prj$\1\01\00594\04\A\Report\1 - Tailings BAT Alternatives Assessment\Rev 0\Appendix B - Tables B1-B4\[Tables B1-B4_RevB (KP Methodology).xlsx]Table B3 High-

NOTES:

1. THE MAXIMUM POSSIBLE SCORE FOR EACH CRITERIA IS 3 AND THE MINIMUM POSSIBLE SCORE IS 1.

0	30JUN'17	ISSUED WITH REPORT VA101-594/4-1	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D

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TABLE B.4

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS BEST AVAILABLE TECHNOLOGY ASSESSMENT
WEIGHTED SCORING SUMMARY

Print Jun-30-17 11:09:06

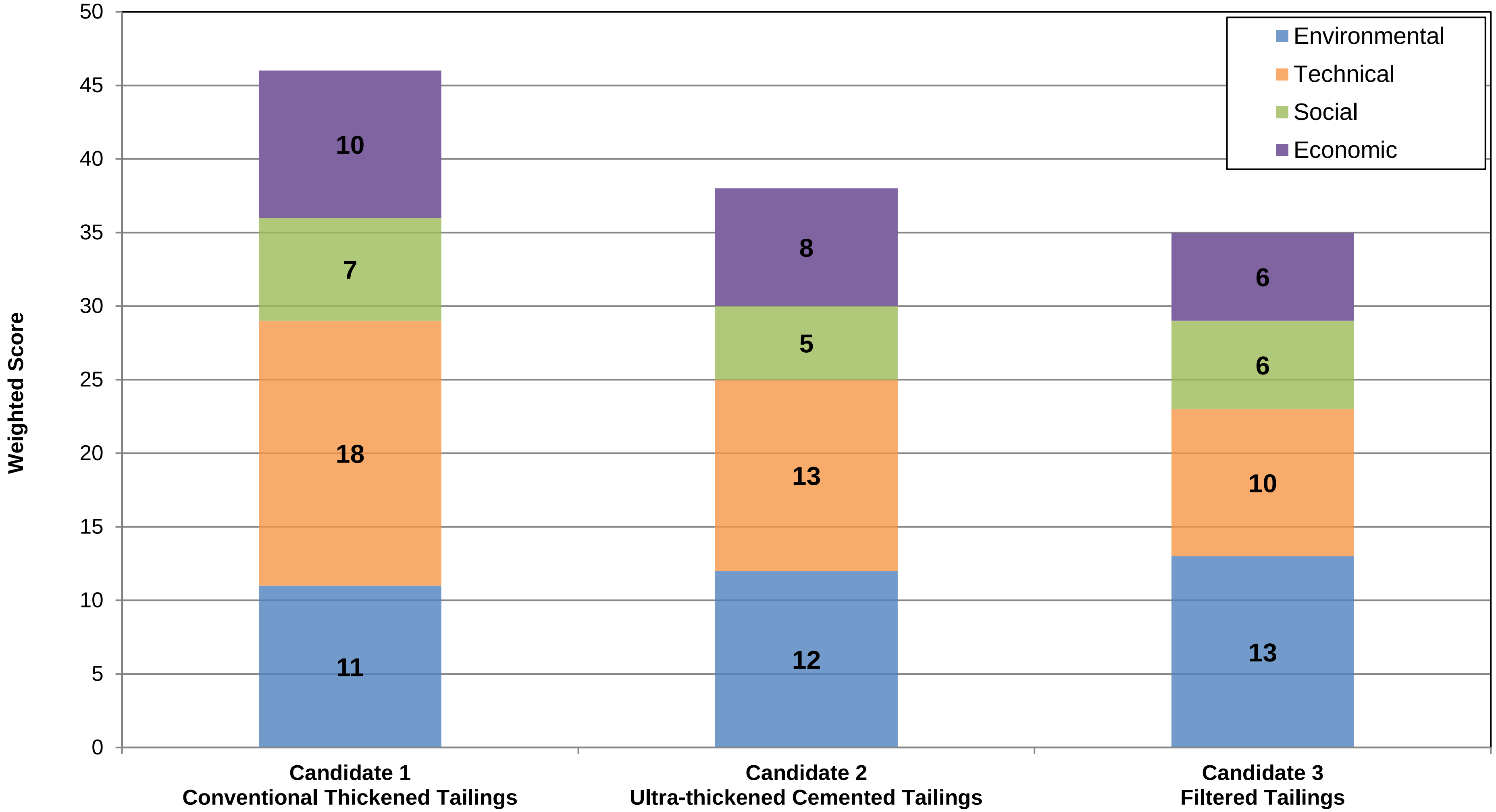
Category	Sub-Category	Criteria	Candidate 1 *Conventional Thickened Tailings*			Candidate 2 *Ultra-thickened Cemented Tailings*			Candidate 3 *Filtered Tailings*		
Environmental	Surface and Ground Water	Chemical Stability	2.00	1.63	1.39	1.78	1.76	1.30	1.67	1.71	1.26
		Groundwater Quality									
		Surface Water Quality									
	Environmental Impacts	Physical Characteristics and Impacts	1.25			1.75			1.75		
		Closure									
		Flora, Fauna & Land Use									
Technical	Construction and Operation Considerations	Constructability	1.33	1.19		0.95	0.86		0.48	0.82	
		Complexity of Operation									
		Containment Design									
		Complexity of Water Management									
		Average Annual Water Balance Impacts									
	Optimization and Permitting Considerations	Future Expansion Potential	1.00			0.75			1.25		
		Proven Technology									
Social	Health and Safety	Health and Safety Considerations	1.20	1.00		0.40	0.60		0.80	0.80	
	Effect on Existing Community	Public Acceptance	0.80			0.80			0.80		
		Cultural Heritage									
Economic	Cost	Schedule	1.25	1.25		1.00	1.00		0.75	0.75	
		Capital Costs									
		Operating and Maintenance Costs									
		Closure and Reclamation Costs									

\\KPL\VA-Prj$\1\01\00594\04\A\Report\1 - Tailings BAT Alternatives Assessment\Rev 0\Appendix B - Tables B1-B4\[Tables B1-B4_RevB (KP Methodology).xlsx]ReadMe_First

NOTES:

1. RESULTS REFLECT WEIGHTING OF CRITERIA, SUB-CATEGORIES AND CATEGORIES.
2. THE MAXIMUM POSSIBLE SCORE IS 3 AND THE MINIMUM POSSIBLE SCORE IS 1.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	30JUN'17	ISSUED WITH REPORT VA101-594/4-1	JEF	KDE



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REV	DATE	DESCRIPTION	PREP'D	RVW'D

IDM MINING LTD.

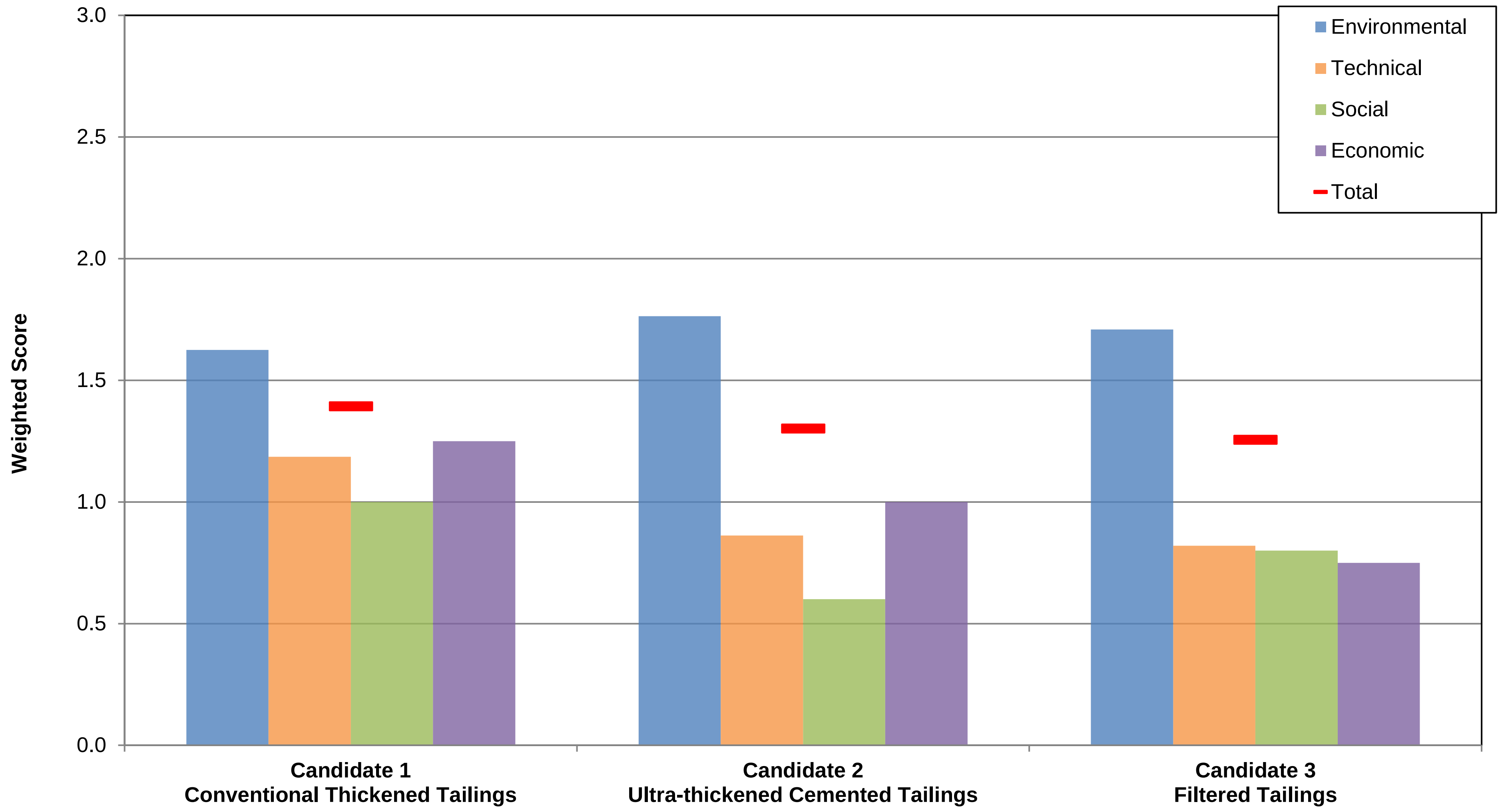
RED MOUNTAIN UNDERGROUND GOLD

TAILINGS BEST AVAILABLE TECHNOLOGY RESULTS OF HIGH-LEVEL ASSESSMENT UNWEIGHTED ASSESSMENT

Knight Piésold CONSULTING

P/A NO. VA101-594/4 | REF. NO. 1

FIGURE B.1 | REV 0



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REV	DATE	DESCRIPTION	PREP'D	RVW'D

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD

TAILINGS BEST AVAILABLE TECHNOLOGY RESULTS OF HIGH-LEVEL ASSESSMENT

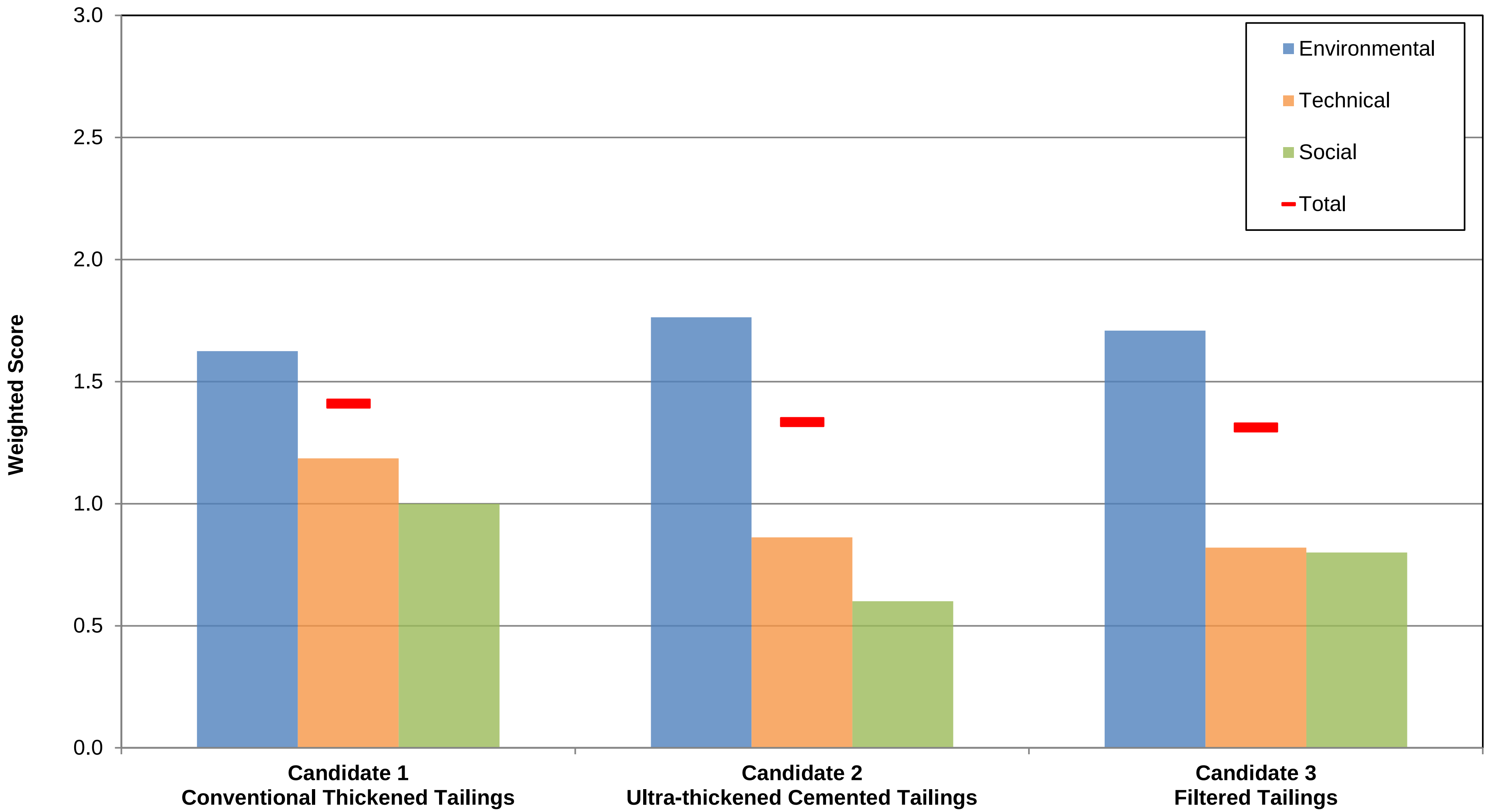
Knight Piésold CONSULTING

P/A NO. VA101-594/4

REF. NO. 1

FIGURE B.2

REV 0



0	30JUN'17	ISSUED WITH REPORT VA101-594/4-1	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D

IDM MINING LTD.

RED MOUNTAIN UNDERGROUND GOLD

TAILINGS BEST AVAILABLE TECHNOLOGY RESULTS OF HIGH-LEVEL ASSESSMENT ECONOMIC CATEGORY EXCLUDED

Knight Piésold CONSULTING

P/A NO. VA101-594/4

REF. NO. 1

FIGURE B.3

REV 0

APPENDIX C

TAILINGS FILTRATION TESTWORK RESULTS

(Pages C-1 to C-23)

Customer	**Knight Piésold Ltd.**
Contact Details	**Jim Fogarty,** P.Eng , Project Engineer jfogarty@knightpiesold.com
Place	Suite 1400, 750 West Pender St. Vancouver, BC, Canada V6C 2T8 D: 604.685.0543
Category	Mining
Application	Pre-Leach Thickening and Tailings Disposal
Project No. or Name	Red Mountain
Test Unit	Thickening & F.A.S.T Filter Press
Test Location	TAKRAF Canada Inc. 6929 Royal Oak Avenue, Burnaby, BC V5J 4J3 Canada P+1 604 451 7767
Test work Date	May , 2017
Test Engineer	Joey De Guzman

CONTENTS

1. INTRODUCTION

Knight Piésold Ltd. through the coordination with JDS Mining has awarded TAKRAF Canada Inc. to conduct the solid-liquid separation testing for Red Mountain project. For the purpose of this study and the availability of sample, the client had requested Base Met Labs to prepare samples for this study. Three (3) slurry samples were received by TAKRAF staff.

2. OBJECTIVE & SCOPE OF TEST WORK

The objective of the test work is to determine the Pre-Leach thickener operating parameters and to determine whether the tailings material is suitable for filtration. The scope of the test programme includes flocculant selection, settling tests, optimum dilution tests, flocculant dose tests, compaction tests, rheology, and rise rate or thickener loading selection. It includes the selection filter press operating parameters and equipment design.

3. TEST SUMMARY AND CONCLUSION

a. Pre-Leach Thickening

We selected an **18m** Pre-Leach Thickener with 3m tank wall and a floor slope of 9 degrees. The final underflow density of 55% solids is achievable in two (2) hours retention time. To maintain a stable thickener operation we recommend a feed dilution of 8% solids, a flocculent dose of 20 to 25 g/t AF304HH or its equivalent and a rise rate of 2.1 to 2.3 $m^3/m^2/h$ and a solids loading of 0.19 to 0.23 TPH/m^2.

b. Pressure Filtration

We investigated the possibility of producing a 'dry stackable' tailings product using one (1) unit of Fluid Actuated Screw Technology (F.A.S.T.) Filter presses model **F.A.S.T. FP 1500/99/40/10/R/A** (1500mm plate, 99 chambers, 40mm chamber depth, 10 bar feeding pressure, Recessed Plate, Opening all at once). The achievable cake moisture is 16.5% to 18.5%. The estimated total cycle time is 16 minutes.

4. CLIENT PROCESS DATA & REQUIREMENTS

Table 1: Process Data and Requirements

	Description	**Sample**
Process Data	Solid SG	2.82
	Liquid SG	1.00
	Slurry pH	7.0
	Slurry Temperature	ambient
	P_{80}	25 microns
Thickener Process	Solid Flow (TPH)	45
	Slurry Flow (m^3/h)	541
	Slurry SG	1.23877
	Slurry % Solids	40 %
	Overflow	<200 ppm
	Underflow	55% solids
Filter Press Feed	Thickener Underflow	55% or more
Filter Press Cake	Cake Moisture	Dry Stackable

SETTLING AND THICKENING

Static and Dynamic Tests

5. GENERAL PROCEDURES (SETTLING AND THICKENING)

SAMPLE PREPARATION

Normally the samples are received as slurries with separate process water for dilution. In some cases the samples are received as wet or partially dried cake; in this case tap water is used for dilution if process water is not available. Homogenized slurry (50 to 60% solids (w/w)) is prepared as the main stock sample for flocculant selection, settling and compaction. The pH and temperature are adjusted according to the process condition.

FLOCCULANT PREPARATION AND SCREENING

The flocculants used throughout the test program are prepared by dissolving 0.30 g flocculant in 300 mL of tap water giving a stock solution of 1.0 g/L. Then a fresh 0.5 g/L solution of flocculant is prepared each day for testing by further diluting a portion of the stock sample with additional tap water. Flocculant screening is performed for different flocculants preferably the client's recommendation as well as non-ionic flocculants and anionic flocculants.

Test samples are prepared as 500 mL samples containing 15% w/w solids by diluting the stock slurry with process water. The slurry is homogenized with a plunger and 15 g/t of flocculant is added via syringe. The slurry is mixed with four strokes of the plunger and the settling rate recorded. The turbidity (in NTU) of the overflow liquor for each test is taken 10 min. after flocculant addition and measured using an Oakton T-100 Turbid meter. Flocculant selection is based on fast settling rate and low turbidity of overflow.

SETTLING TESTS

Representative samples are prepared in 1000 mL graduated cylinders at different percent solids (i.e. 10%, 12.5%, and 15% solids (w/w)) by diluting the appropriate volume of the concentrated stock sample with process water. These samples are tested for settling with the addition of the selected flocculant at various flocculant doses. Once prepared the samples are homogenized with a plastic plunger. The flocculant is then added via syringe and mixed into the slurry with four strokes of the plunger.

The settling rate is recorded and the Total Suspended Solids or TSS (in ppm) in the overflow is measured; this is done by collecting approximately 120 mL of the liquor from a depth of 8-10 cm below the liquor-air interface with a tube-fitted pipette after 10 min. of settling and filtering through a Whatman #5 (2.5 µm) filter paper. In some cases the turbidity is measured instead of TSS. Graphs from tests data are generated to show the effect of flocculant dose on the settling rate and overflow clarity at differing feed dilutions.

COMPACTION TESTS

Compaction tests are performed using 2000 mL samples containing 20% to 30% w/w solids. Two tests are performed over a 24 hour period, one with rakes and one without, with the addition of flocculant to both.

RHEOLOGY

The liquor from the raked compaction test is removed and the compacted slurry is collected in a 500 mL beaker. The slurry is homogenized by stirring and then tested for rheology (Sheared). The remaining sample is then diluted with approximately 5-15 mL of process water, homogenized by stirring, and the Yield Stress measured. This rheology (Sheared) step is repeated 7 to 8 times to obtain yield stress and % solid data.

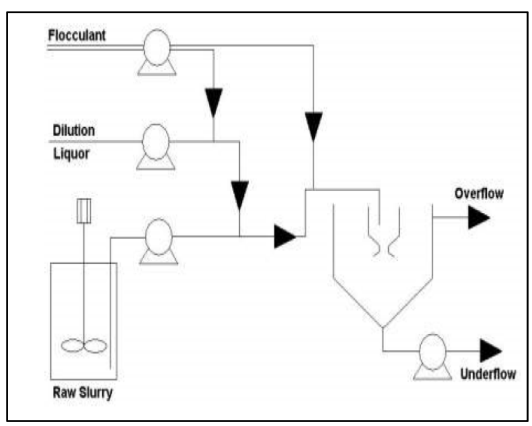
The liquor from the un-raked compaction test is removed and the compacted slurry is collected in a 500 ml beaker. The liquid is allowed to drain through a filter by gravity and then the slurry or paste is tested for rheology (un-sheared). The remaining sample is then diluted with approximately 5-15 mL of process water, homogenized by gentle stirring, and the Yield Stress measured. This rheology (un-sheared) step is repeated 7 to 8 times to obtain yield stress and % solid data.

Yield Stress determination is performed using a HAAKE Viscometer 550 fitted with a FL-100 vane starting from this high solids concentration. Once the Yield Stress is recorded small amount of sample (30-50 g) is dried to confirm the % solid concentration.

DYNAMIC THICKENING TESTS

The starting parameters for dynamic test work are selected based on the results of the static thickening test work. The liquor rise rates for the dynamic test are selected and calculated from these data; then the feed pump is then set as per estimated flow. Feed slurry is drawn from an agitated container using a peristaltic pump and is fed into the feedwell of the test unit; the flocculant is injected into the feed line prior to its delivery into the test unit.

The main variables during these tests are flocculant addition rate and solids loading or rise rate. A bed of solids is allowed to build until it reaches the bottom of the feedwell; an overflow sample is collected before it reaches this limit. At the completion of this test, the feed slurry is turned off, and then the flocculant pump, and finally the dilution liquor pump. The solids bed is allowed to compress under raked conditions for a predetermined amount of time before starting the underflow pump. A representative sample from the underflow discharge is taken for analysis.



6. STATIC THICKENING – FLOCCULANT SCREENING

c. Sample Preparation

Three (3) slurry samples were received; JW Master, AV Master and Marc Master. A composite sample was prepared from these samples for Settling and Filtration tests.

Table 2: Settling & Thickening Tests Parameters

DESCRIPTION		COMMENTS
Sample Received	Wet Slurry	Prepared by Base Met Labs
Process Liquid	Process Water	pH 7.0
Temperature / pH	25-30 / 7	
Flocculants	polyacrylamide	
SG Solids / SG Liquid	2.82 / 1.0	
P80	25 microns	

d. Initial Flocculant Screening

Homogenized slurry was prepared from slurry using tap water as process liquid. Samples were prepared at 18% solids in 500mL cylinders by diluting the stock slurry with process water. Flocculants were added via syringe at a dose of 20 g/t. Sample pulps were mixed using a plunger and the settling rates recorded. We selected AF 304HH as it gave a clear overflow.

Table 3: Initial Flocculant Screening Tests Data

Project Name	Red Mountain
Company Name	
Test Performed By	JDG
Test Date	
Sample	

Sample Data	Stock Sample
Sample Nº	1
Slurry R.D.	1.4343
Solids S.G.	2.8160
Liquid S.G.	1
% Solids	46.95%
Slurry Temperature	
Slurry pH	7

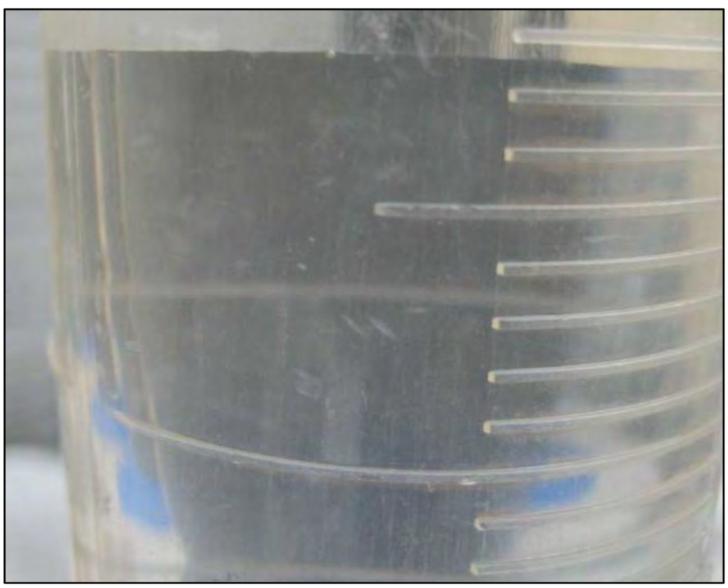
Sample N°								
Test N°		T1	T2	T3	T4	T5	T6	T7
Pulp Mass	(gr)	564	564	566	566	566	564	566
Pulp Vol.	(ml)	500	500	500	500	500	500	500
Pulp Density	(gr/ml)	1.128	1.128	1.132	1.132	1.132	1.128	1.132
% Solids	(%)	17.6%	17.6%	18.1%	18.1%	18.1%	17.6%	18.1%
Mass of Solids	(gr)	99	99	102	102	102	99	102
Floc. Name		MF 10	MF156	AF 304	AF 304HH	MF 333	MF 351	MF 1011
Floc. Conc.	(g/l)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Floc.Dose	(g/ton)	20	20	20	20	20	20	20
Floc. Vol.	(ml)	4.0	4.0	4.1	4.1	4.1	4.0	4.1
Settling Rate	(m/h)							
Clarity	(ppm)							
Turbidity	(NTU)	NC	NC	NC	Clear	NC	NC	NC

e. Initial Flocculant Screening – Overflow Quality

Below is the comparison of the overflow of samples as stated in Table 3.

NOT CLEAR

SLIGHTLY TURBID



CLEAR

Figure 1: Initial Flocculant Screening Overflow Quality

7. STATIC THICKENING – FLOCCULANT DOSE AND DILUTION

a. Settling Tests

Settling tests were done at 8%, 10%, 14% and 15% solids dilution in 500mL cylinders by diluting the stock slurry containing 47% solids with process water. Tests were done at different flocculants dose between 15 to 25 g/ton of AF304HH. Sample pulps were mixed using a plunger after flocculant addition and the settling rates were recorded. Based on the visual quality of the overflow samples the feed dilution should be about 8% solids.

Table 4: Flocculant Dose at Different Dilution

Project Name	Red Mountain
Company Name	0
Test Performed By	JDG
Test Date	
Sample	0

Sample Data	Stock Sample
Sample N°	1
Slurry R.D.	1.4343
Solids S.G.	2.8160
Liquid S.G.	1
% Solids	47.0%
Slurry Temperature	
Slurry pH	
Chosen Floc	AF304HH
Sample N°	

Test N°		T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
Pulp Mass	(gr)	524	526	528	536	534	532	550	550	550	556	554	552
Pulp Vol.	(ml)	500	500	500	500	500	500	500	500	500	500	500	500
Pulp Density	(gr/ml)	1.048	1.052	1.056	1.072	1.068	1.064	1.1	1.1	1.1	1.112	1.108	1.104
% Solids	(%)	7.1%	7.7%	8.2%	10.4%	9.9%	9.3%	14.1%	14.1%	14.1%	15.6%	15.1%	14.6%
Mass of Solids	(gr)	37	40	43	56	53	50	78	78	78	87	84	81
Floc. Conc.	(g/l)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Floc.Dose	(g/ton)	15	20	25	15	20	25	15	20	25	15	20	25
Floc. Vol.	(ml)	1.1	1.6	2.2	1.7	2.1	2.5	2.3	3.1	3.9	2.6	3.3	4.0
Settling Rate	(m/h)	2.12	2.21	2.3	1.4	1.58	1.94	1.04	1.04	1.04	0.68	0.95	0.77
Clarity	(ppm)												
Turbidity	(NTU)	NC	C	C	ST	ST	NC	NC	NC	NC	NC	NC	NC

b. Settling Tests - Overflow Quality and Flocculant Dose

The overflow samples below were clearer from the tests with 20 to 25 g/t AF304HH flocculant. We also observed that samples with 8% solids generated better overflow quality.

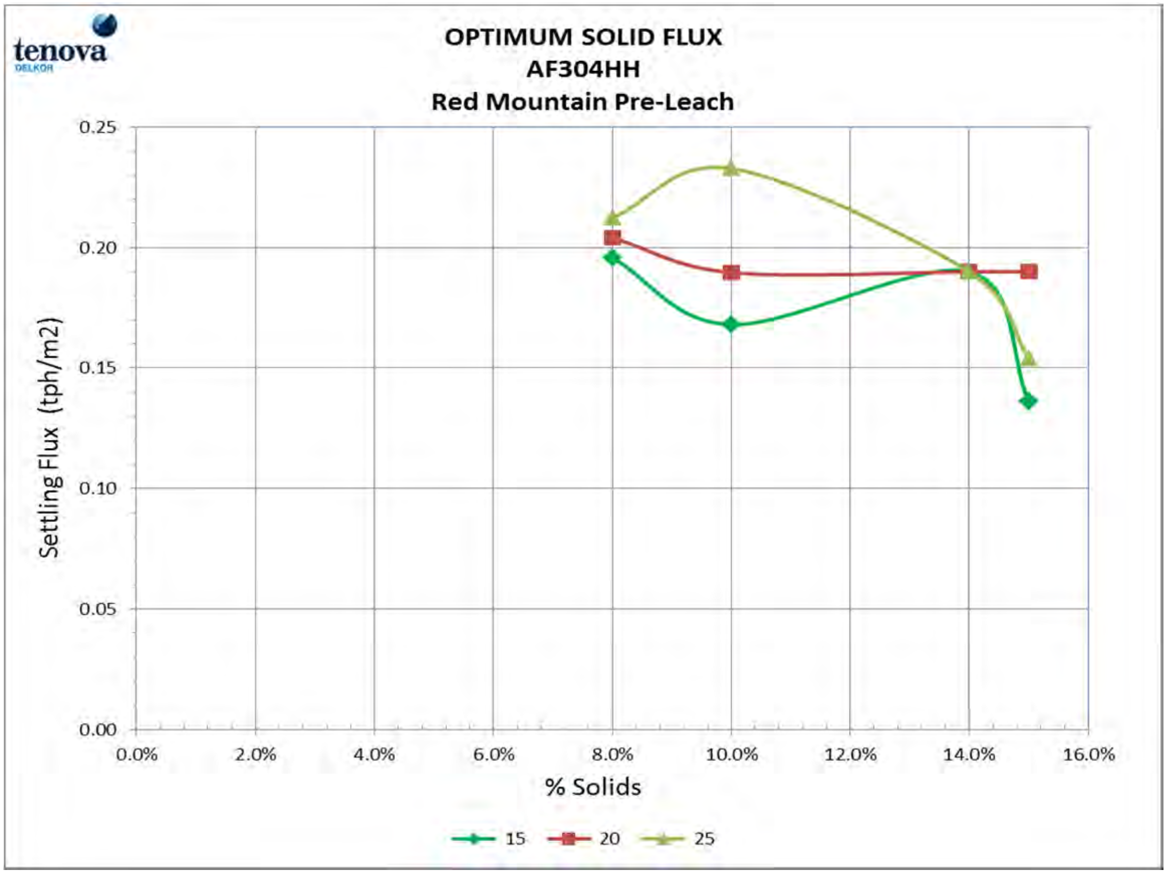
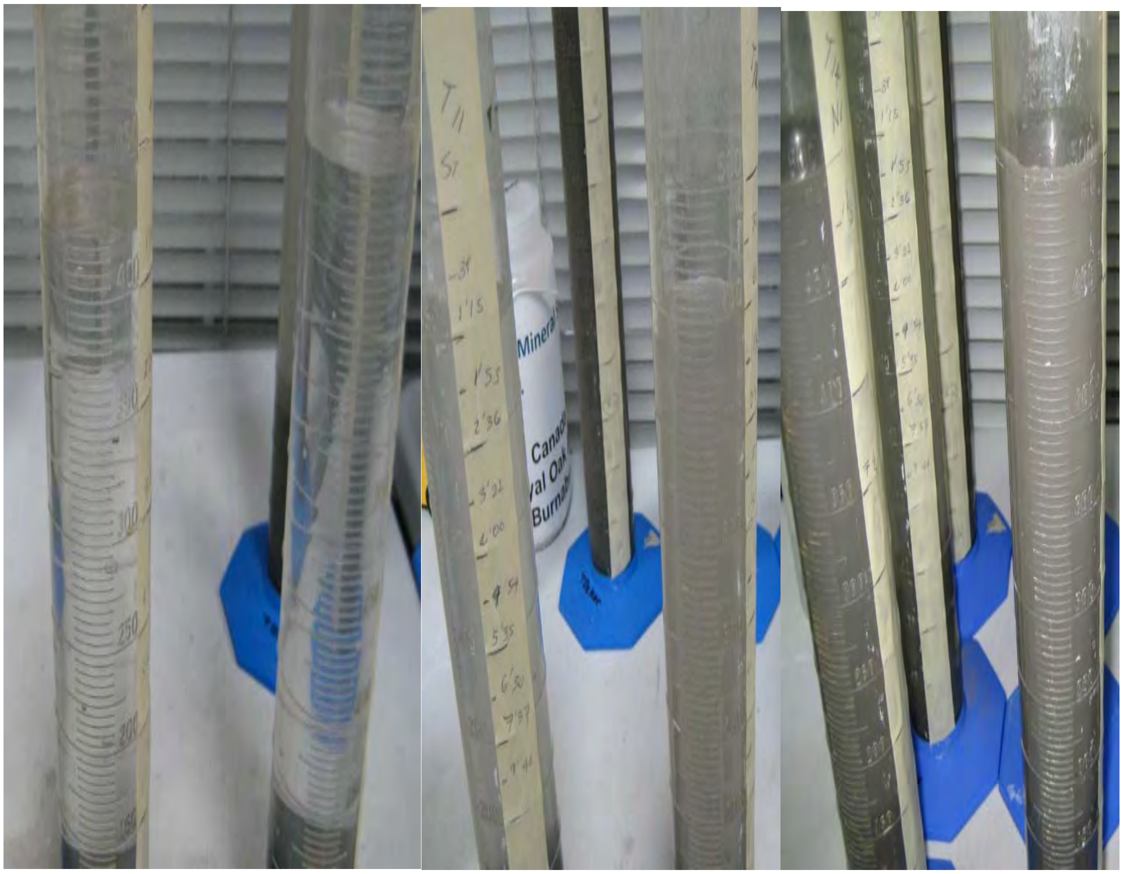


Figure 2: Settling Rate Curves



Tests 9 & 10 Tests 11 & 12 Tests 13 & 14

Figure 3: Overflow Clarity Comparison

c. Optimum Dilution

The optimum dilution is between 8 to 10% solids as shown below. However, considering the overflow clarity we recommend 8% solids Feedwell dilution.

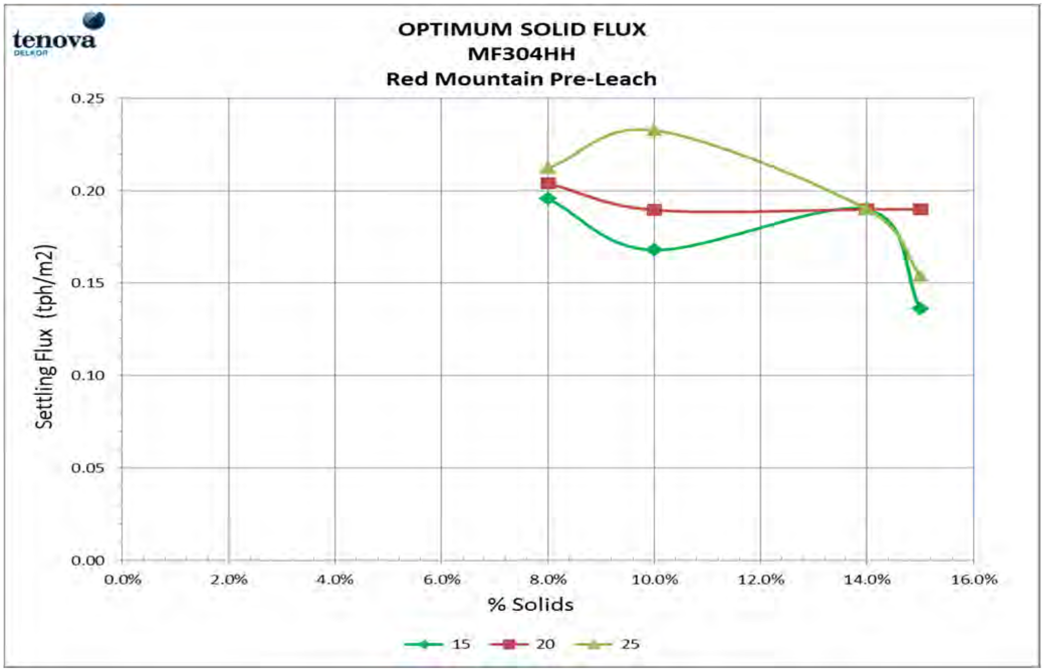


Figure 4: Optimum Dilution Curves

8. STATIC THICKENING – COMPACTION TESTS

a. Underflow Density

Compaction test was performed using 2000 mL samples containing 20% w/w solids over a 3-hour period. AF304HH flocculant (0.5 g/L concentration) was added at 25 g/t dose. The pulp was mixed well with the flocculant using a plunger and the compaction tests were done using rakes. The expected underflow density of 55% solids was achieved in two (2) hours.

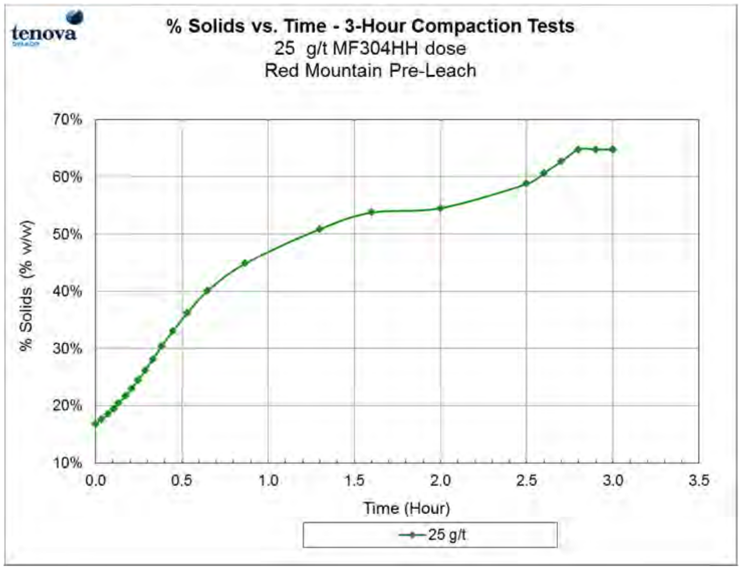


Figure 5: Compaction Tests Curves

b. Rheology

The thickener underflow density of 55% solids is expected to have a yield stress of 20 Pa.

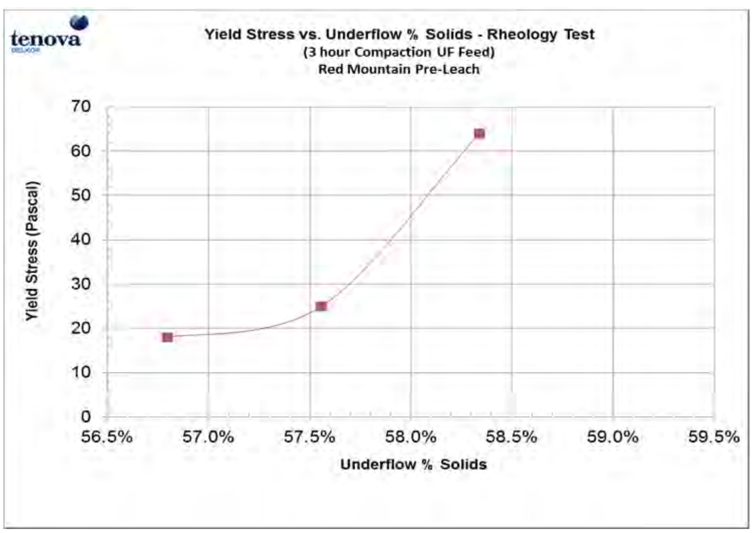


Figure 6: Yield Stress Curves

9. CONCLUSION & EQUIPMENT SIZING – PRELEACH THICKENER

Delkor methodology for thickener selection considers that there are three zones operating in a thickener:

- The Clarified Liquor Zone, where clarified liquor rises to the overflow launder and leaves the thickener, and
- The Settling Zone, comprised of Free Settling and Hindered Settling Zones, where the design constraint is that the solid free settling rate must be greater than that of the rising volume of liquid in the tank, and
- The Compaction Zone, where the rate of compaction of flocculated solid is the design constraint, accompanied by and associated with the maximum achievable compaction.

Below are the details of the process parameters for thickening and our equipment selection.

Table 5: Equipment Selection

PROCESS PARAMETERS	DETAILS
Feed Solids / % Solids in Feed	45 TPH / 40%
SG Solids / Liquid	2.82 / 1.0
pH / Temperature ^{O}C	7 / ambient
P_{80}	25 microns
Feed Dilution	8% Solids
Flocculant	AF304HH
Flocculant Dose	20 to 25 g/t
Thickener Overflow	<200 ppm
Rise Rate	2.1 to 2.3 $m^3/m^2/h$
Solids Loading	0.19 to 0.23 TPH/m^2
Retention Time	2 hours
Thickener Underflow	55% Solids
Yield Stress	20 Pa (min)
PRELEACH THICKENER DESIGN	
Thickener Diameter	**18m**
No. of Units	1
Tank Wall / Slope	3m / 9 degrees

PRESSURE FILTRATION

F.A.S.T FILTER PRESS

(Fluid Actuated Screw Technology)

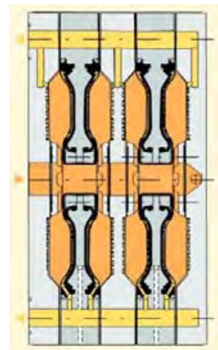
10. GENERAL DESCRIPTION OF PRESSURE FILTRATION-PROCESS FLOW DIAGRAM

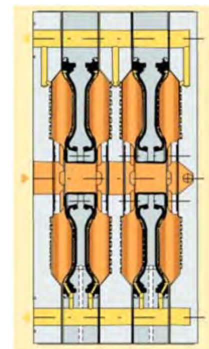
The filtration steps in a filter press are shown in the below schematic. Cake washing is an optional and is not described in this case.

Filling/Dewatering stage:

For straightforward dewatering applications the feed slurry is introduced into the Filter Press by the feed pump.

The solids are trapped by the filter cloth and the filtrate is discharged via the plate drainage grid which is connected to the corner ports. The driving force for filtration is generated by the Filter Press feed pump and filtration rates or final moistures can be improved by increasing the feed pressure.

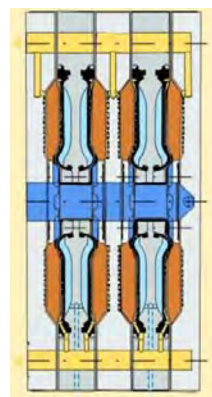




Membrane Squeezing (Membrane Filter Press)

This Option is available in Membrane Type Filter Press. Membrane Squeezing is a mechanical squeezing of the filter cake formed inside the chamber by means of air or Water. Cake is compressed when rubber membrane bulges with water/air and pressed against cake. This reduces the cake volume inside the chamber giving space for air drying/blowing operation

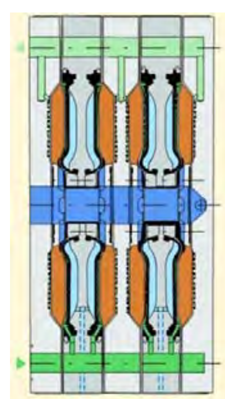
Filter cakes are squeezed up to 16 bar pressure based on application.



Air Blowing through the cake:

The final stage of dewatering is done by blowing the air through the cake. The water between the interstitial particles is entrained and cannot be removed by mechanical squeezing. The configuration of the corner port valves ensures a plug-flow through the filter cake.

Compressed air will be blown through the cake through the filtrate channel. Regulation of blowing medium is done by blowing pressure and time. During the blowing cake is kept compressed by membranes to avoid cracks in filter cake.



11. TEST UNIT & PFD

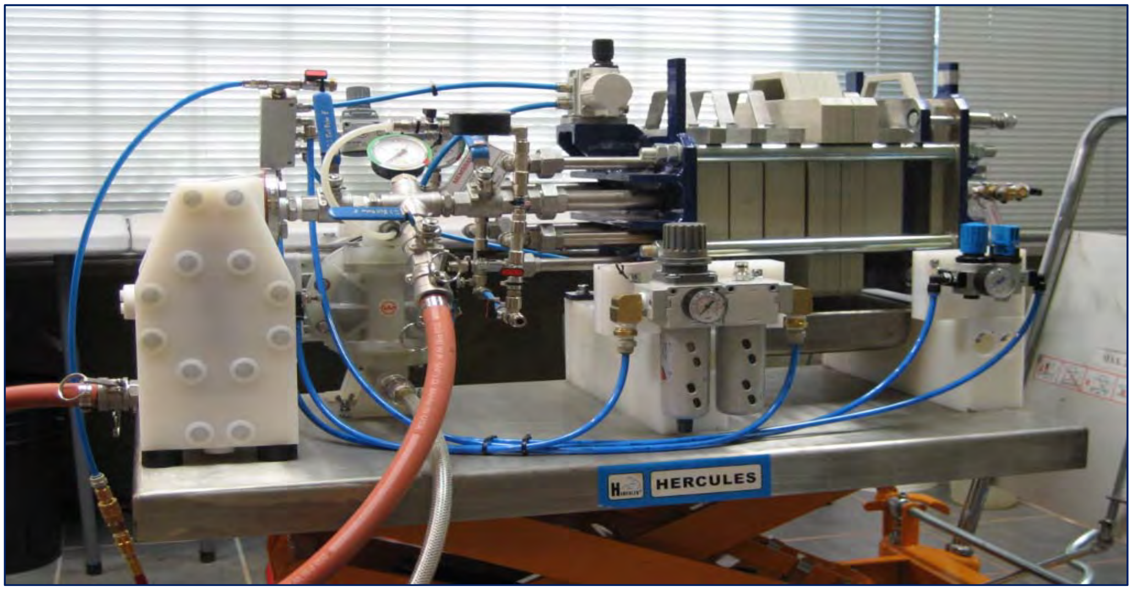


Figure 7: F.A.S.T. Filter Press

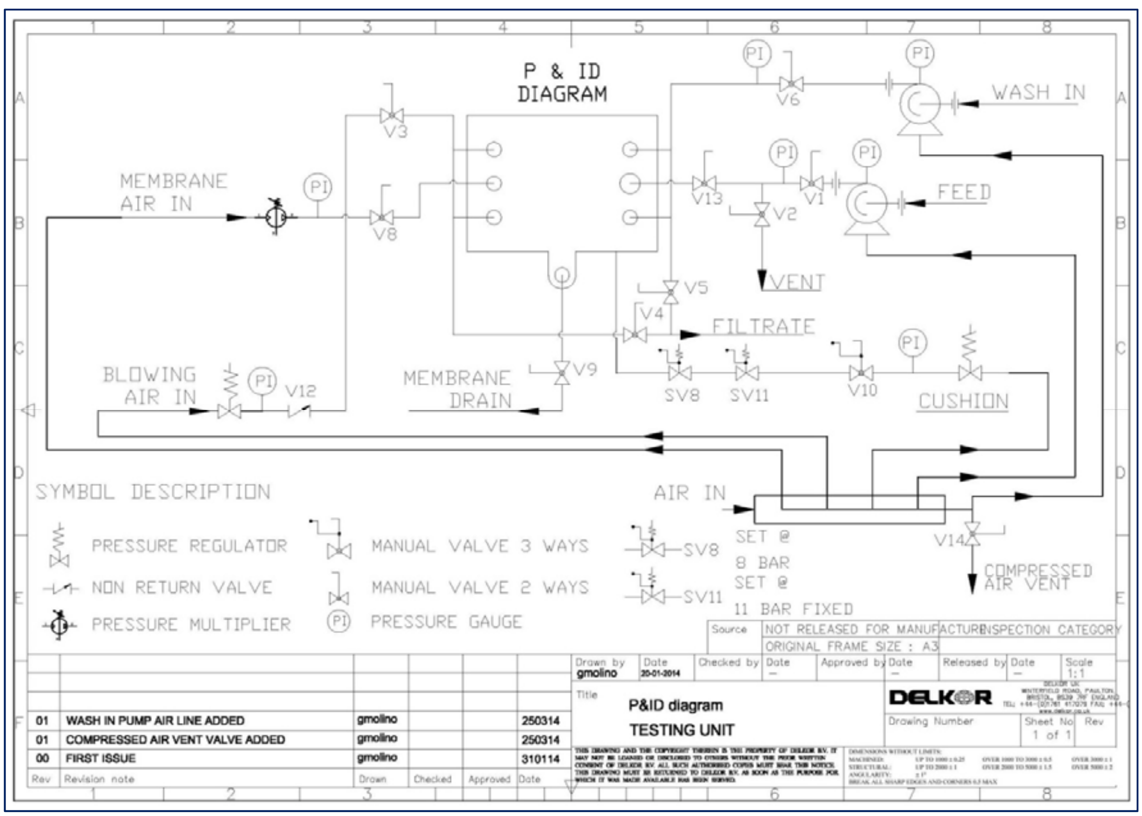


Figure 8: F.A.S.T. Filter Press P&ID

12. TEST RESULTS & DESCRIPTION – FINAL TAILINGS

Table 6: Final Tailings Feed

Process Data	Tailings
Solid SG / Liquid SG	2.82 kg/l / 1.00 kg/l
Slurry SG	1.707 kg/l
% Solids	65.78 %
Slurry pH / Temperature	9.5 / ambient
Filter Cloth	0083-T50 (Polypropylene)
Air Permeability (CFM/ft^2) / (l/dm^2/min)	(1) / (5)
Filter Area – 2 sides (m^2)	0.015707963
Feed & Filtration Pressure	10 bars

Table 7: Test Data – Final Tailings

Description	T1	T2	T3	T4	T5
Chamber Depth (mm)	**60**	**60**	**60**	**30**	**60**
Fill Time (minutes)	0.35	0.22	0.22	0.33	0.35
Fill + Filtration Time - minutes	4.0	5.1	4.95	3.63	5.0
Pre-Squeeze Pressure / Time	NA	10 / 1.15	NA	10 / 1	NA
Air Blow Pressure (Bar) / Time	NA	10 / 5.43	NA	10 / 4	10 / 5
Final Squeeze Pressure / Time	NA	12 /1	12 / 3	12 /1	NA
Final Cake Thickness (mm)	**60**	**60**	**60**	**30**	**60**
Final Cake Moisture	21.97%	18.91%	20.35%	16.21%	18.40%
Cake Wet Weight (g)	1038	994	1022	506	1000
Cake Wet bulk Density	2.20	2.11	2.17	2.15	2.12
Cake Dry Bulk Density	1.72	1.71	1.73	1.8	1.73
Overall Filter Time (minutes)	5.8	12.7	8.0	9.5	10.1
Overall Filtration Rate (kg/m^2.h)	538.08	242.74	391.10	170.48	307.59

Notes:

1. **Cake Properties** – each test was evaluated for 'dry stackable' properties by visual inspection.
2. **Overall Filtration Rates –** Actual equipment sizing will include technical times (i.e. press open/close, plate shaking, etc.)

a. Filtration curve- Filtration Rate versus Filtration Time

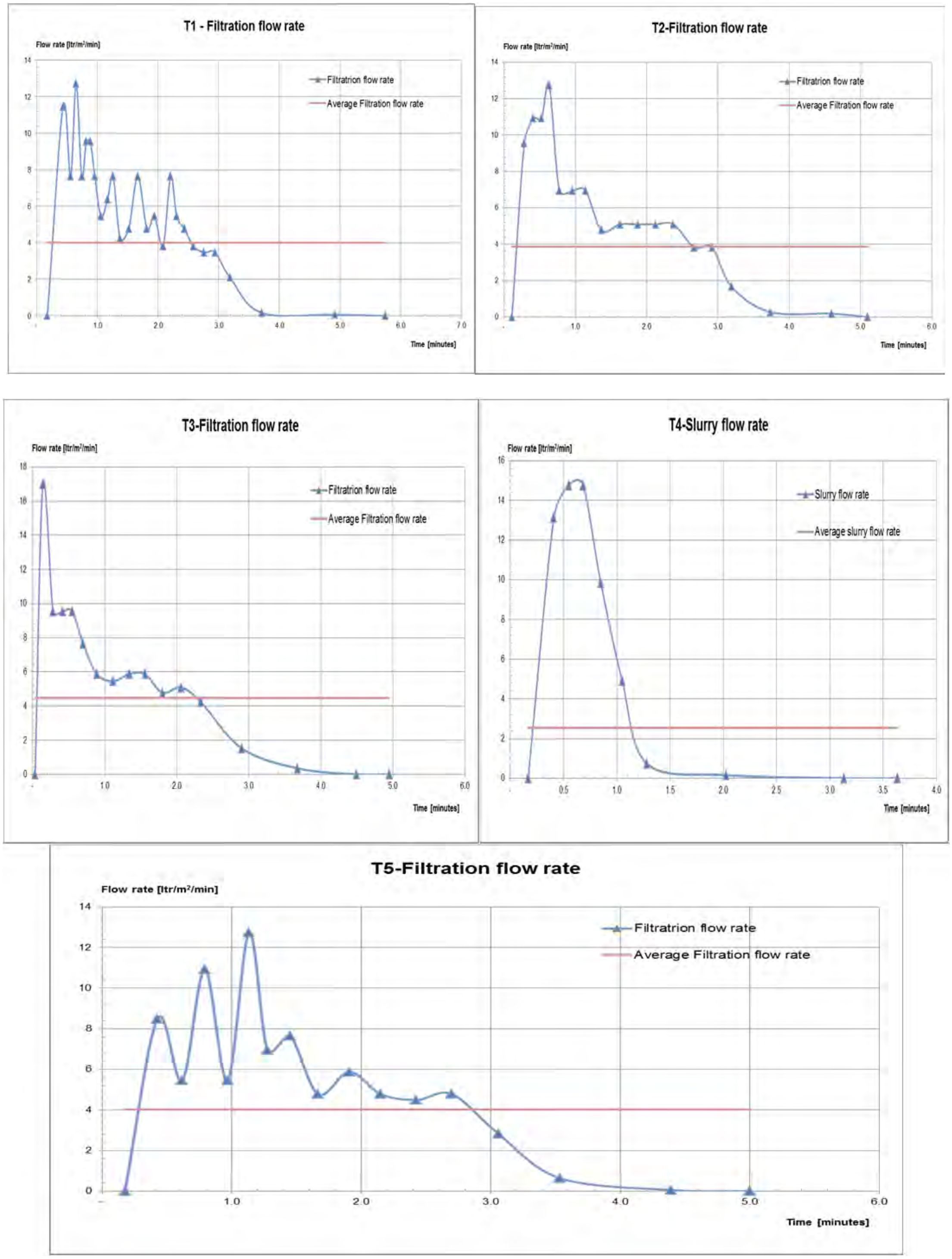


Figure 9: Filtration Curves

b. Filter Cake

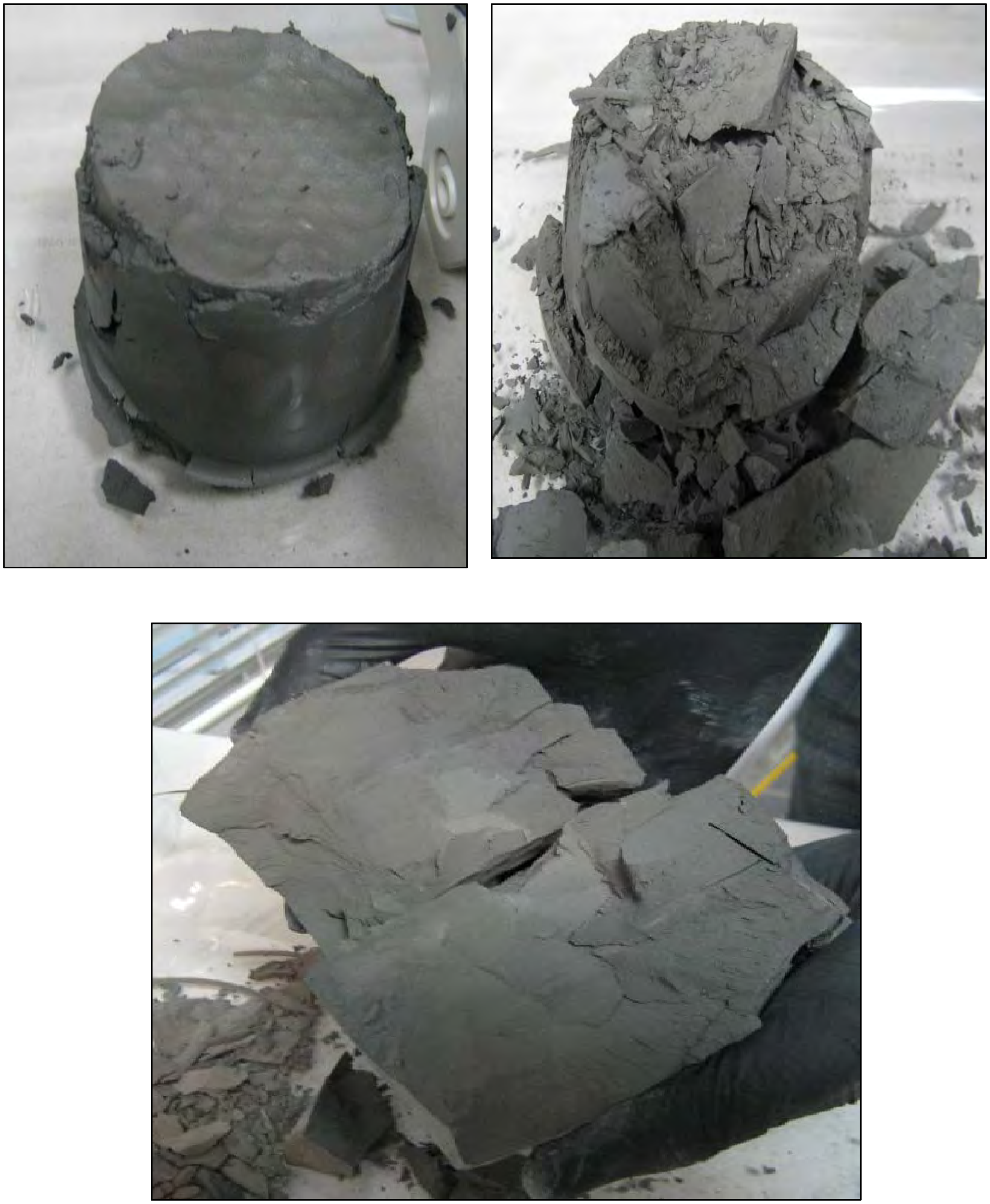
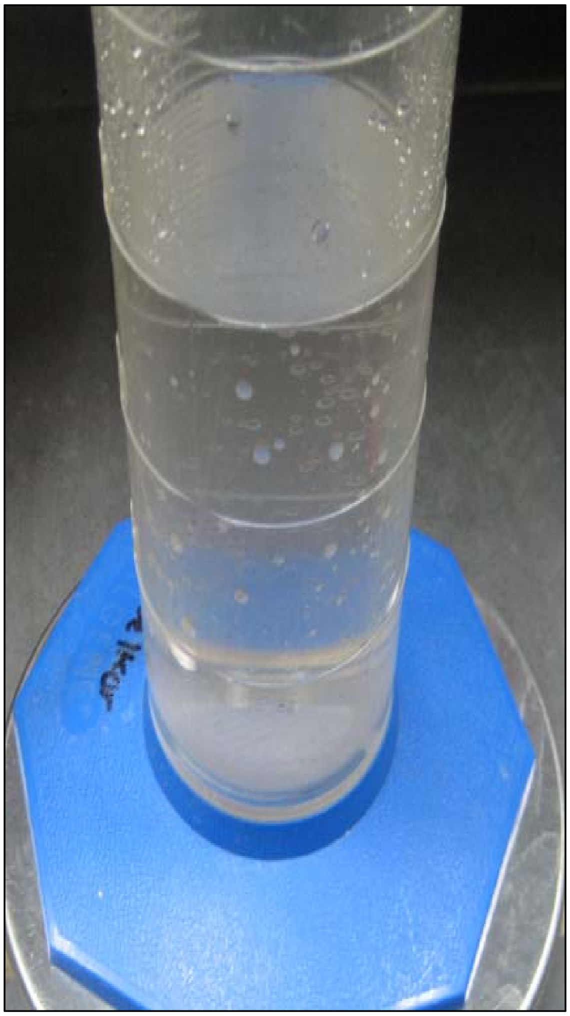


Figure 10: Filter Cakes

c. Filtrate & Filter Cloth



FILTRATE

FILTER CLOTH

Figure 11: Filtrate & Filter Cakes

13. DATA ANALYSIS – PRESSURE FILTRATION

Table 8: Design Consideration

ITEM	Parameters	Design Consideration
1	Feed Pressure	The Filter Press can be designed at low Feed Pressure if other parameters are considered to reduce the final cake moisture such as membrane squeeze and air blowing
		Designing the Filter Press at high Feed Pressure (>10 bar) is an option if a recessed type is offered and eliminating other parameters such as membrane squeeze and air blowing. This will save the cost of CAPEX and OPEX.
2	High Feed Pressure versus Air Blowing	A difference of 3.57% cake moisture if air blowing is applied
3	High Feed Pressure versus Membrane Squeeze	A difference of 1.62% cake moisture if membrane squeeze is applied.
4	60mm versus 30mm Chamber depth	A difference of 2.70% cake moisture using thinner chamber

14. CONCLUSION & EQUIPMENT SIZING – PRESSURE FILTRATION

The objective to generate 'dry-stackable' tailings material for Red Mountain project was achieved considering our initial evaluation. We selected a Recessed plate filter press design for this application.

Table 9: Equipment Selection

PROCESS PARAMETERS	DETAILS
Feed Solids / % solids	45 TPH / 55 to 60% THK UF
SG Solids / Liquid / P_{80}	2.82 / 1.0 / 25 microns
pH / Temperature ^{O}C	7 to 8 / ambient
Cake Moisture	16.5% - 18.5%
EQUIPMENT DESIGN	
Filter type	**RECESSED PLATE**
No. of Units / Equipment Model	One (1) - FP1500/99/40/10/R/A
Plate / No. of Chambers / Depth	1500mm / 99 / 40mm
DESIGN PARAMETERS	
Cake Dry Bulk Density	1.72
Closing and Opening Times	Design driven
Feed Filling Pressure	6 to 10 bars
Filling Time	Design driven
Filtration Pressure	> 10 bars
Filtration Time	6 minutes including fill time
Air Blow Pressure	10 bars (initial)
Air Blow Time	4 minutes
Core Blowing, Cushion Deflation, Shaking, cloth Washing Time	Design driven
Estimated Cycle Time	15.57 minutes

APPENDIX F

WATER MANAGEMENT STRATEGIES REPORT

(Pages F-1 to F-36)

29.18 Site Water Management Plan

29.18.1 Introduction

The Site Water Management Plan (SWMP) outlines IDM's strategies to responsibly manage surface water at the Project. The phases of the Project development that will be addressed in the SWMP include:

- Construction;
- Operation; and
- Closure and Reclamation.

The SWMP is considered to be a living document that will be updated periodically during subsequent stages of design and construction. Updates will supersede any prior description of site wide water management for the Project.

29.18.2 Scope and Objectives

The primary objective of the SWMP is to describe the Project facilities and strategies that will be implemented by IDM for managing surface water throughout the Project site.

Two types of surface water are identified for the site:

- Contact water, which is affected by mine workings or disturbed areas (groundwater inflows from the underground mine, waste rock, ore stockpile, quarry areas, tailings, laydown areas, etc.); and

- Non-contact water, which is runoff from undisturbed areas.

The objectives of the SWMP are to:

- Divert all non-contact water, as technically possible, around the Project footprint to Bitter Creek, Otter Creek, or Goldslide Creek, or their tributaries;

- Collect all contact water that does not meet total suspended solids (TSS) or other water quality objectives and direct it to collection ponds;

- Safely release water that meets TSS and water quality objectives; and

- Utilize groundwater dewatering systems to allow underground mining operations to progress safely.

Water will be managed with the objective of minimizing erosion in areas disturbed by mining activities and preventing the release of untreated contact water that could adversely affect the quality of receiving waters.

Water management structures are presented on Figure 29.18-1, Figure 29.18-2, and Figure 29.18-3. The details of these figures are discussed in the sections that follow.

Figure 29.18-1: Mine Site Water Management Structures

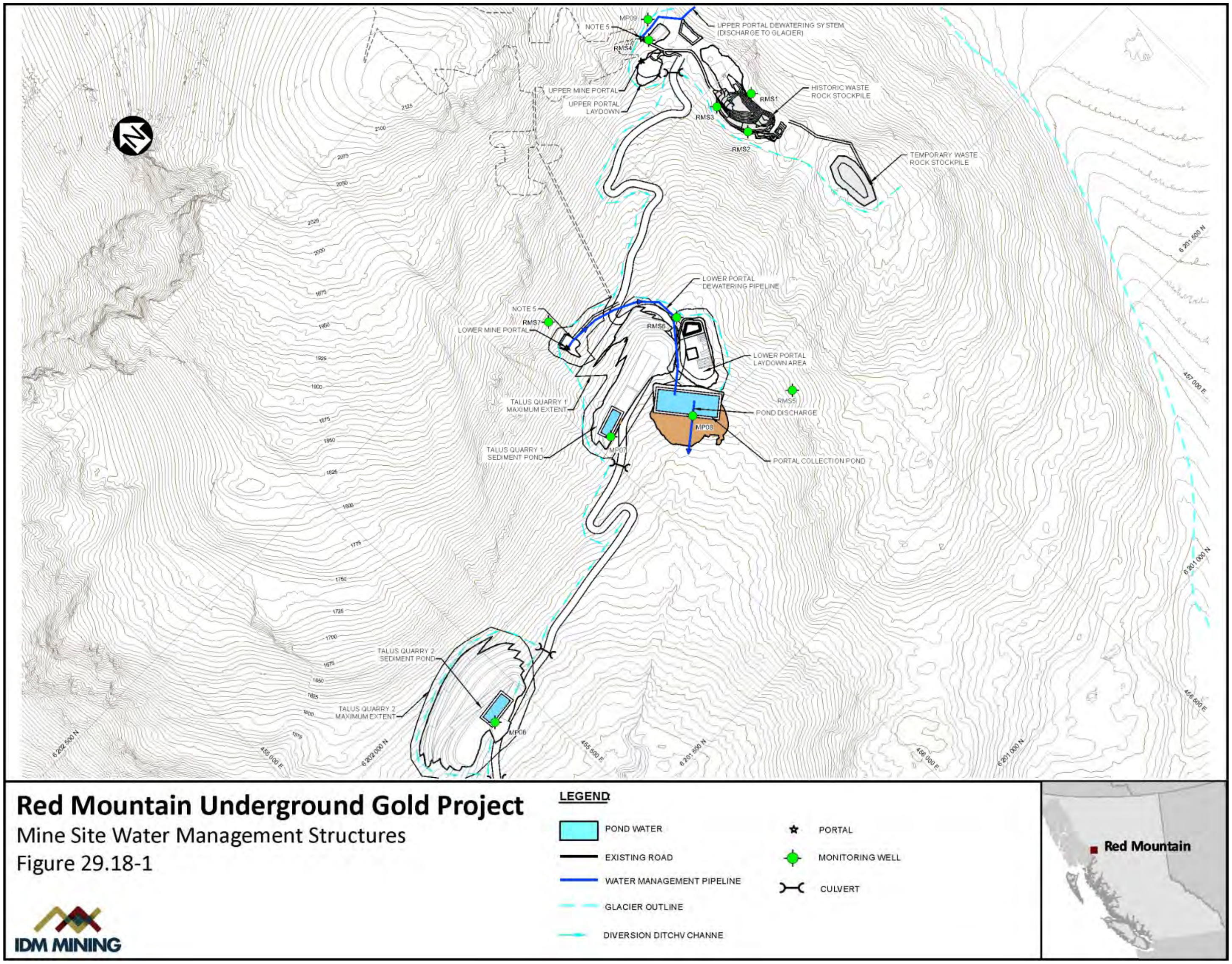


Figure 29.18-2: Bromley Humps Water Management Structures

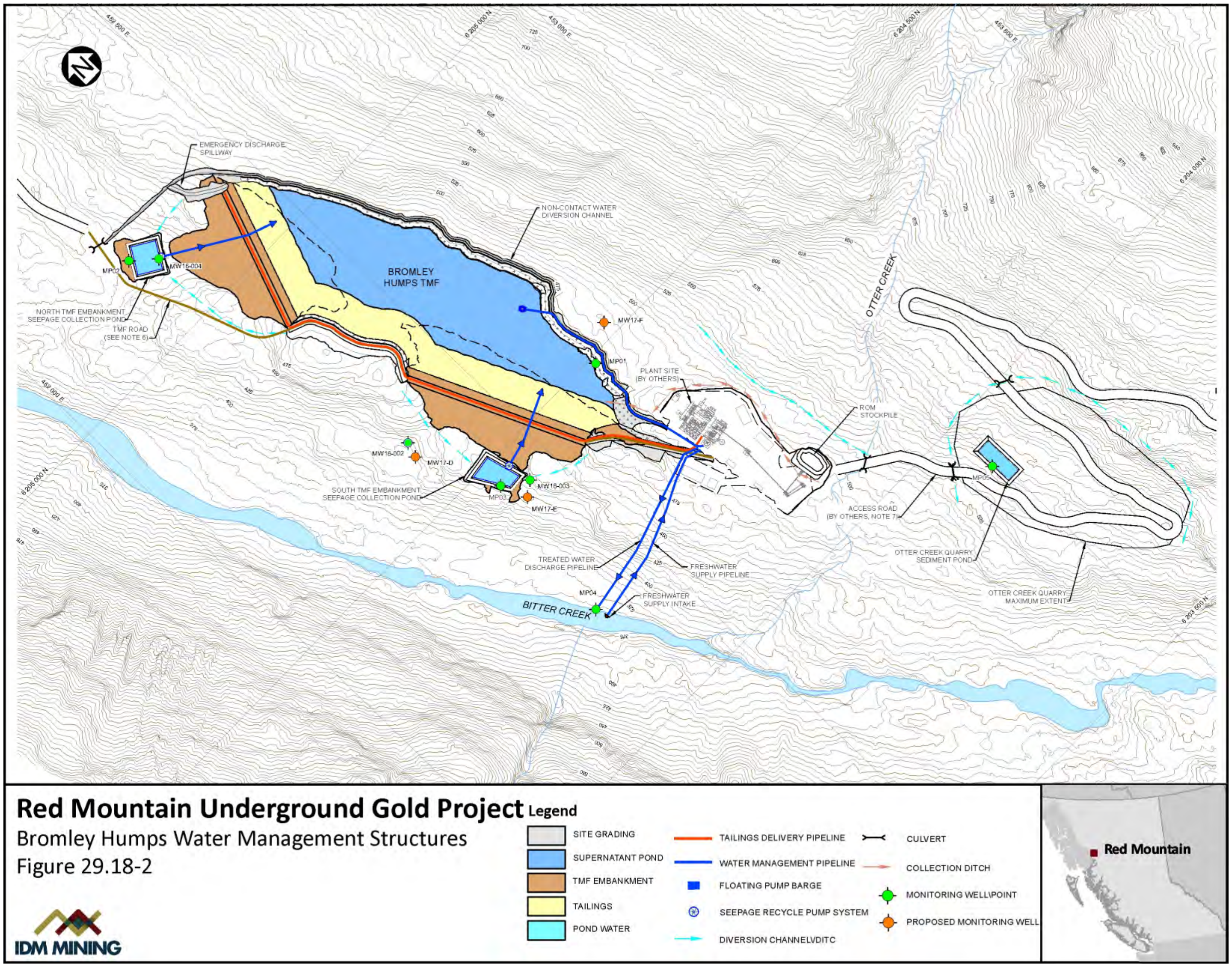
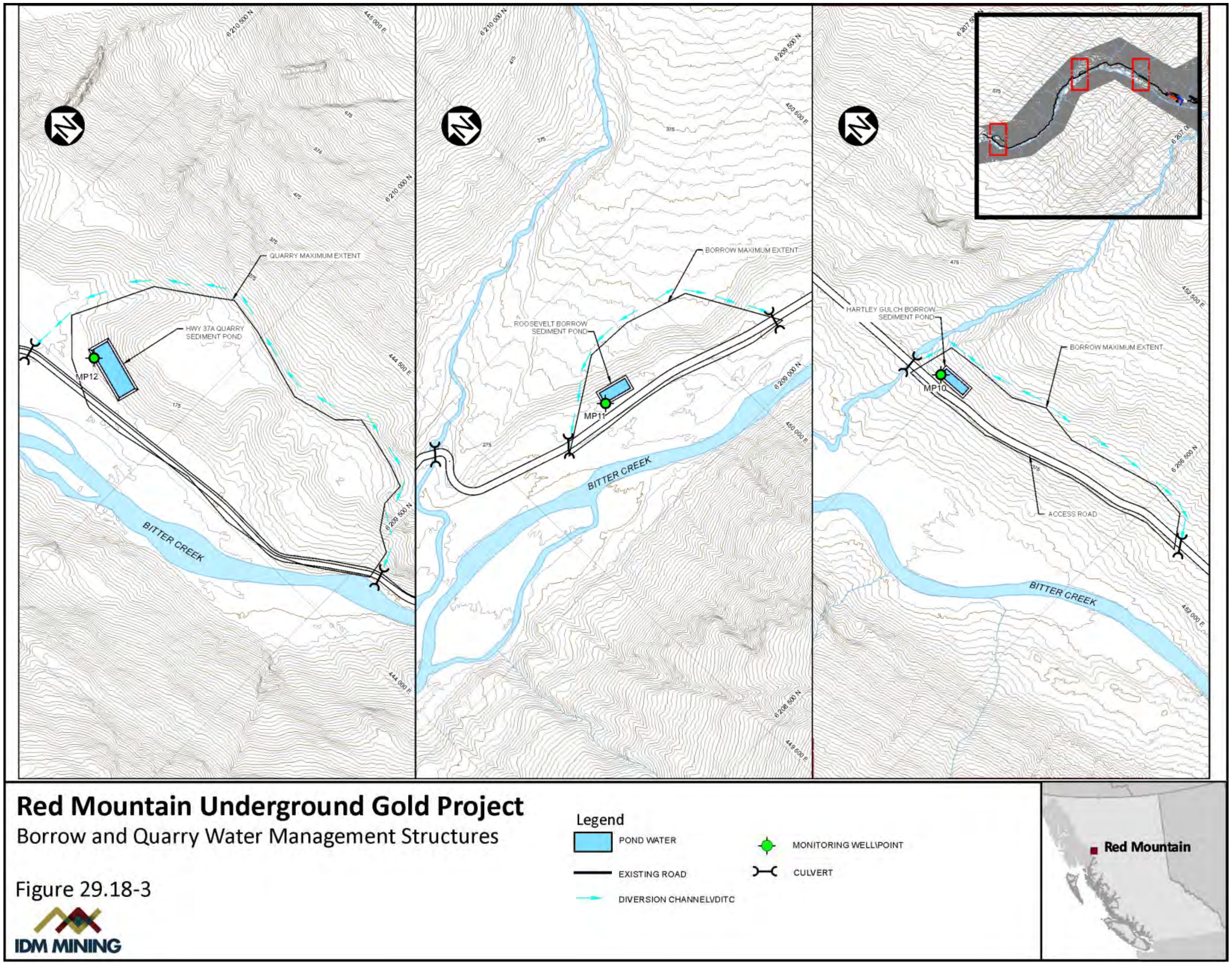


Figure 29.18-3: Borrow and Quarry Water Management Structures



29.18.3 Applicable Legislation and Guidelines

The relevant legislation and guidelines applicable to the SWMP include:

- BC *Mines Act* (1996a);
  - the Code (BC MEM 2017);
- BC *Environmental Management Act* (2003a);
- *Federal Fisheries Act* (1985a);
- *Canada Water Act* (1985);
- BC *Water Sustainability Act* (2016);
- Canadian *Environmental Protection Act* (1999);
- Canadian Water Quality Guidelines (CCME 2007, 2012);
- BC Approved Water Quality Guidelines (BC MOE, 2006, 2006, 2008, 2009, 2012); and
- MMER (SOR/2002-222).

29.18.4 Climate and Hydrology

29.18.4.1 Regional Climate and Hydrology

The Project area is characterized by steep mountainous terrain with incised glaciated valleys, and is situated at the toe of the Bromley Glacier. Orographically induced precipitation is expected due to the topographic variation of the area.

The Tailings Management Facility (TMF) and Process Plant are located at Bromley Humps, at an elevation of approximately 400 – 500 metres above sea level (masl). This area likely experiences more rainfall versus snowfall than the underground mine portals, situated at approximately 1,500 – 2,000 masl.

The baseline hydrometeorology data for the Project were presented by SRK Consulting Inc. (SRK) in the report "Red Mountain Underground Gold project – Baseline Climate and Hydrology" (SRK 2017a). Climate data from Environment Canada's (EC) Stewart Airport station were used in the SRK report to describe and quantify the meteorological characteristics of the Project area. The key data required for the SWMP are summarized in the sections that follow.

29.18.4.2 Mean Annual Precipitation

The long-term mean annual precipitation (MAP) for Bromley Humps was estimated using an orographic factor of 2.4% per 100 m of elevation change from the Mine Site to Bromley Humps, as presented in Knight Piésold Ltd (KP) Memo, "Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs", which is included as Appendix-A with the KP Water Balance Report (Knight Piésold Ltd. 2017). An "Adjusted Case" MAP was estimated for the Project using PRISM (Daly. C. et al, 2002), a historical statistical climate data mapping tool from UBC. Both cases were used in water balance analyses and reporting to provide a range of anticipated conditions at the Project site.

The MAP for the Mine Site is estimated by SRK to be 1,847 millimetres per year (mm/yr; SRK, 2017a). The MAP for Bromley Humps was estimated to be 1,457 mm/yr using the orographic factor described above. The Adjusted Case MAPs were estimated to be 2,635 mm/yr at the Mine Site and 2,084 mm/yr at Bromley Humps.

The MAP distribution of rainfall to snowfall (as snow water equivalent) varies depending on elevation.

The monthly distribution of precipitation was estimated in the SRK memorandum, "Snowmelt Analysis at Red Mountain Project Based on Elevation" (SRK 2017b), and was adjusted by KP for the purpose of water management planning. The results are summarized for Bromley Humps and the Mine Site in Table 29.18-1 and Table 29.18-2. These percentages were applied to the MAPs above to produce monthly rainfall and snowfall estimates for water balance analyses.

Table 29.18-1: Monthly Precipitation Statistics for Bromley Humps, 500 masl

Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of Annual Total	11.9	7.4	6.6	4.9	3.9	3.6	4.2	6.6	11.4	15.8	12.3	11.6
% Precipitation as Rain / Month	80	77	83	100	97	98	100	100	100	98	85	77

Table 29.18-2: Monthly Precipitation Statistics for the Mine Site, 1500 masl

Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
% of Annual Total	11.9	7.4	6.6	4.9	3.9	3.6	4.2	6.6	11.4	15.8	12.3	11.6
% Precipitation as Rain / Month	3	1	6	7	51	95	100	100	99	70	15	5

29.18.4.3 Return Period Frequency

Rain on snowpack storm events are not expected to be the critical events for design since the maximum effective combined rainfall intensity and snowmelt rates in the fall, winter, or spring periods are estimated to be less than the equivalent effective rainfall intensities in summer months for the small basins considered for the design areas. Snowmelt events are also considered unlikely to produce peak discharges of the same order of magnitude as for the fall storms.

The design rainfall storm events were developed using the Intensity Duration Frequency (IDF) data for the Stewart A station, which was assumed to apply to the Mine Site at an elevation of 1,500 masl. The return period events shown in Table 29.18-3 are adjusted based on the ratio of mean annual precipitation estimates, as outlined in the KP Memorandum, "Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs", and are to be used in design to represent site conditions at Bromley Humps. IDFs for the Mine Site are presented in Table 29.18-4.

Table 29.18-3: Intensity-Duration Frequencies for Bromley Humps, 500 masl

	1	2	5	10	25	50	100	200	PMP
24 Hour Rainfall (mm)	70	81	108	122	143	157	172	183	530

Notes:
1. Source: SRK, 2017a
2. Values not provided in the SRK reference were interpolated using the Gumbel Distribution from the provided return period storm events.

Table 29.18-4: Intensity-Duration Frequencies for the Mine Site, 1,500 masl

	1	2	5	10	25	50	100	200	PMP
24 Hour Rainfall (mm)	58	67	89	101	118	130	142	151	481

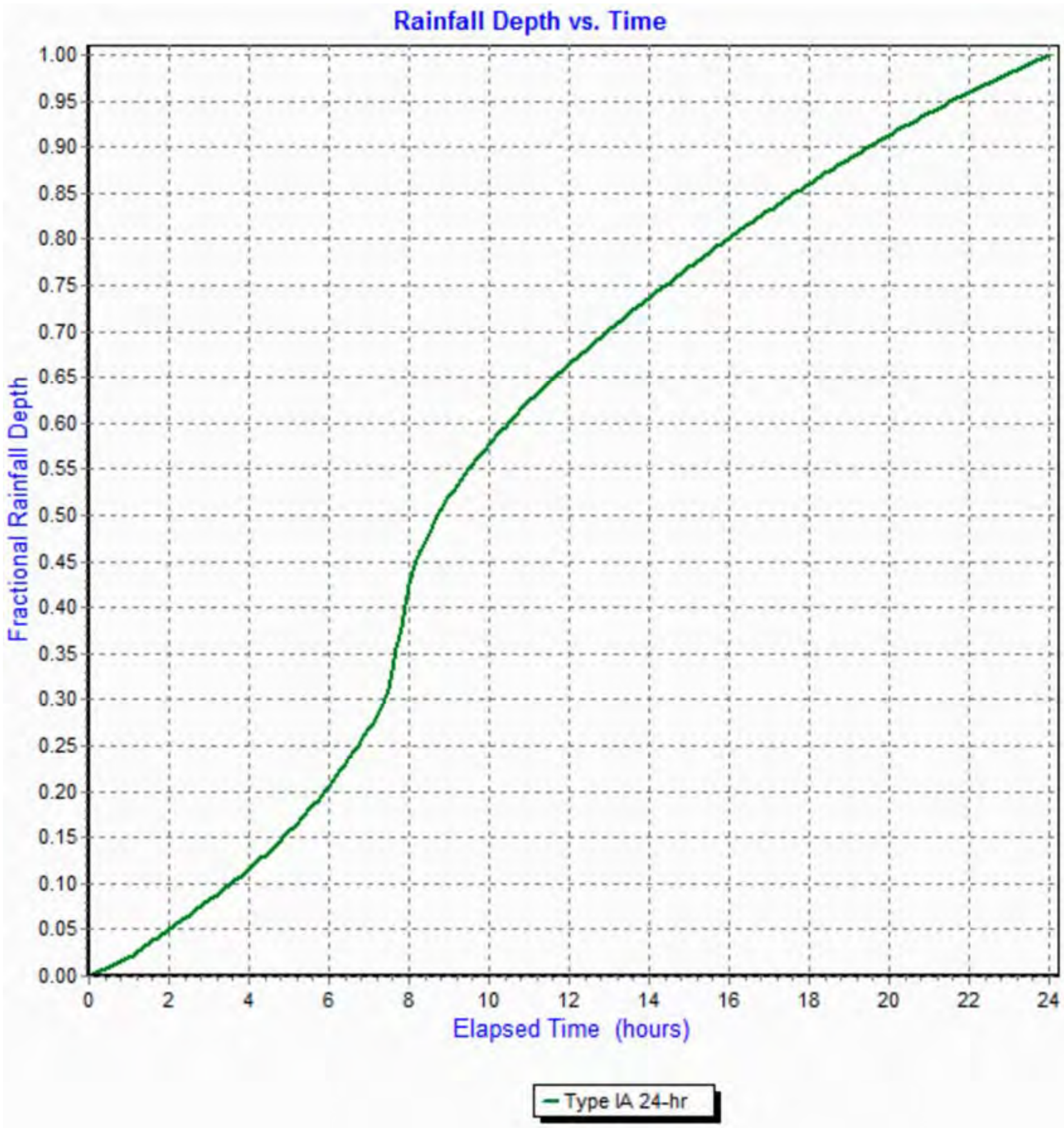
Notes:
1. Source: SRK, 2017a
2. Values not provided in the SRK reference were interpolated using the Gumbel Distribution from the provided return period storm events.

29.18.4.4 Runoff Modelling

Storm peak flow estimates will be calculated using suitable rainfall-runoff modelling software such as HydroCAD® (HydroCAD, 2015), based on the following:

- Rainfall depths based on Table 29.18-3 and Table 29.18-4;
- The 24-hour storm distribution derived from SCS Storm Type 1A unit hydrograph, or an approximated hydrograph for other storm durations Figure 29.18-4);
- Time of concentration will be calculated using either:
  - SCS curve number/lag time method for overland flow and flow velocity for channel flow;
  - BC Ministry of Environment (BCMOE) equation (Coulson, 1991); or
- SCS curve numbers according to the vegetation, surface treatment, and hydrologic soil group for each contributing catchment (HydroCAD, 2015).

Figure 29.18-4: SCS Type 1A 24-Hour Unit Hydrograph (HydroCAD, 2015)



29.18.5 Relevant Project Activities

29.18.5.1 Water Management – General Site Runoff

Mine infrastructure and upstream catchments for the Project were delineated based on 1 m topography data and available footprints of facilities. The total infrastructure area, not including roads and collection and sediment pond areas, is estimated to be 401,000 m^2 at Bromley Humps and 265,000 m^2 at the Mine Site. There will also be an additional 388,000 m^2 in borrow and quarries downstream of Bromley Humps.

Contact and non-contact water are managed separately throughout the Project. Contact water is contained in collection ponds and the TMF and is transferred through collection ditches and pipelines. Groundwater inflows from the underground mine are considered contact water as well. Non-contact water is diverted off-site through diversion ditches, berms, and culverts.

General site drainage measures include collection and diversion structures that will be used throughout the Project site. Measures for road drainage include collection ditches, diversion ditches, culverts alongside or through roads, and clear span bridges. The design criteria for temporary and permanent general site drainage structures are:

- Temporary structure design flow event: Peak flow resulting from the 1 in 10 year, 24-hour rainfall event; and

- Permanent structure design flow event: Peak flow resulting from the 1 in 200 year, 24-hour rainfall event, or smaller if necessary due to topographical constraints with appropriate contingency measures if the flow event surpasses the design flow, such as routing overtopping flow toward the TMF.

Guidelines for design and layout of drainage diversion and collection ditches are as follows:

- Ditches will be designed as open channels to pass design flows without overtopping for the given design return period;

- Ditches will be lined where needed to resist erosion (materials include, but are not limited to, grass, riprap, concrete, steel, and HDPE);

- The minimum ditch slope will be -0.5%, but preferably greater than -1% to avoid sedimentation; and

- Ditches will include a minimum freeboard of 300 mm.

Riprap will be designed using the following methods:

- U.S. Army Corps of Engineers (USACE, 1994);
- Smith and Kells (Smith and Kells, 1995);
- Robinson (Robinson et al., 1998); and
- Khan and Ahmad (Khan and Ahmad, 2011).

The calculated D50 will include a factor of safety of 1.2.

Sediment control ponds will be designed in accordance with the “Guidance for Assessing the Design, Size and Operation of Sedimentation Ponds Used in Mining”, prepared by the BC Ministry Environment (BCMOE, 2015).

The Erosion and Sediment Control Plan is described in detail in Section 29.9, and will be implemented along with erosion control measures described in this section.

29.18.5.1.1 Discharge Criteria

Contact runoff from site facilities is assumed to contain suspended solids due to the erosion of ground surfaces as well as oils and grease from heavy equipment. Discharge water quality for concentrations of suspended sediment, nutrients, metals, and pH levels will meet the Federal Metal Mining Effluent Regulations (MMER, 2016) and additional criteria that will be established using provincial and federal water quality guidelines.

29.18.5.1.2 Acid Rock Drainage and Metal Leaching

Geochemical characteristics of overburden, waste rock, ore, tailings, and quarry materials at the Project have been developed by SRK to ascertain the Acid Rock Drainage (ARD) and/or Metal Leaching (ML) potential through each phase of the Project. The water management strategies outlined in this report have been developed to manage each type of rock, overburden. or tailings based on these geochemical characteristics.

29.18.5.2 Water Management – Construction Activities

Construction activities are expected to elevate TSS in runoff. Specific surface water control elements and measures will be implemented to minimize erosion and prevent sediment discharge into surrounding areas. Surface water sediment mobilization and erosion will be managed throughout the site by:

- Installing sediment controls prior to construction activities;
- Limiting the disturbance to the minimum practical extent;
- Reducing water velocity across the ground, particularly on exposed surfaces and in areas where water concentrates;
- Progressively rehabilitating disturbed land and constructing drainage controls to improve the stability of rehabilitated land;
- Applying slope roughening to the surface in rehabilitation areas to promote infiltration;
- Protecting natural drainages and watercourses by applying erosion control BMPs, such as collection and diversion ditches, sediment traps, and sediment ponds;
- Restricting access to rehabilitated areas; or
- Constructing surface drainage controls to intercept surface runoff.

Subsurface water will be controlled by the use of sump pits, wells, or removable pumping stations to draw down the natural water table and provide dry stable construction areas. Excavations will be kept stable and workable by pumping water collected in the excavation sump pits to sediment control devices, such as temporary holding ponds, sediment basins, or sediment filter bags where required. A flocculent may be used, if required, for settling clay or silt particles that may exceed water quality discharge requirements. An adaptive management approach will be implemented that allows sediment and erosion control works to be field fit to suit conditions encountered during construction.

29.18.5.3 Water Management – Mine Operations

The objective of water management during operations is to protect groundwater and surface water resources while meeting the Project water demands for mine waste management and providing water to the Process Plant to support processing.

The main sources of water contributing to water supply and site water management during the operations phase are described below.

29.18.5.3.1 Tailings Management Facility

The TMF will be used to manage tailings solids and supernatant water from the slurry tailings discharge process. The TMF is located north of the Process Plant site at Bromley Humps.

Contact runoff water in the TMF area will be routed to the TMF via appropriate grading of the areas, or with pumping. The TMF has a geomembrane liner to minimize seepage, and seepage from the facility will be collected in sumps and pumped back to the TMF.

Collected runoff from the Process Plant area, ROM Stockpile, and seepage from the facility will be managed in the TMF prior to being used in the Process Plant for mill water requirements or being discharged if the volume is in surplus. Surplus water will be treated at the Water Treatment Plant as detailed in the SRK memo “Conceptual Mine Contact Water Treatment Process for Red Mountain” (SRK, 2017c).

29.18.5.3.2 North TMF Embankment Seepage Collection Pond

The North TMF Embankment Seepage Collection Pond will be used to manage seepage and flows from TMF basin underdrain at the North TMF embankment. Surface runoff from the North TMF Embankment and a small local area will also be collected. Potential seepage from the TMF (through defects in the geomembrane) has been conservatively estimated at 32,000 m^3/year, and 40% (13,000 m^3/yr or 0.4 L/s) is assumed to report to the North TMF Embankment Seepage Collection pond. The seepage collection systems for the North TMF Embankment are assumed to be 80% efficient with the remaining 20% assumed to be unrecoverable and therefore report to the downstream receiving environment. Seepage collection will be optimized during detailed design and may result in a higher recover efficiency.

29.18.5.3.3 South TMF Embankment Seepage Collection Pond

The South TMF Embankment Seepage Collection Pond will be used to manage seepage from the South TMF embankment. Surface runoff from the South TMF Embankment and a small local area will also be collected. Potential seepage from the TMF (through defects in the geomembrane) has been conservatively estimated at 32,000 m^3/year, and 60% (19,000 m^3/yr or 0.6 L/s) is assumed to report to the North TMF Embankment Seepage Collection pond. The seepage collection systems for the South TMF Embankment are assumed to be 80% efficient with the remaining 20% assumed to be unrecoverable and therefore report to the downstream receiving environment. Seepage collection will be optimized during detailed design and may result in a higher recover efficiency.

29.18.5.3.4 Process Plant Site

The Process Plant site is located on the southern boundary of Bromley Humps, near Otter Creek. Contact runoff water from the Process Plant area and the ROM Stockpile will be routed toward the TMF via appropriate grading and collection ditching.

29.18.5.3.5 TMF Diversion Ditch

Non-contact runoff upslope of the TMF pond will be diverted north of the Project to discharge to Bitter Creek. The ditch will convey up to a 1 in 5-year peak runoff, with an extra 0.3 m of freeboard. In the event that inflows exceed the 5 m^3/s design capacity of the diversion ditch, excess water will spill over the ditch berm into the TMF. The storm storage criteria in the TMF (i.e. the environmental design flood) has the capacity to manage this additional potential inflow from the diversion ditch during peak runoff events.

29.18.5.3.6 Existing Upper Mine Portal

Dewatering of the Upper Mine Portal will be achieved from start of operations to Year 1.5 via pumping with the discharge to the glacier east of the portal, outside of the Project area.

The Upper and Lower Mine Portals will be physically connected after Year 1.5 through to closure, and therefore there will be no more surplus water from the Upper Mine Portal after Year 1.5.

Runoff from facilities adjacent to the Upper Mine Portal will be directed east to the nearby glacier via diversion ditches.

29.18.5.3.7 Lower Mine Portal

Dewatering of the Lower Mine Portal will be achieved by routing surplus water to the Portal Collection Pond and discharged to Goldslide Creek.

29.18.5.3.8 Portal Collection Pond

The Portal Collection Pond (PCP) will collect pumped surplus water from the Lower Mine Portal, as well as runoff from the lower laydown area. The PCP is located near the lower laydown area, upslope from Goldslide Creek. Surplus water from the PCP will discharged to Goldslide Creek.

29.18.5.3.9 Talus Quarry Sediment Ponds

The Talus Quarry Sediment Ponds (TQSPs) will collect contact runoff from the Talus Quarry areas. Surface runoff will be routed to the sediment ponds via appropriate grading of the area or sumps and pumps. Surplus water from the TQSPs will discharge to Goldslide Creek.

29.18.5.3.10 Additional Quarry Sediment Ponds

In addition to the two Talus Quarries above, there are four additional borrow and quarry areas that will be used for source materials for the Project:

- Otter Creek Quarry;
- Roosevelt Borrow;
- Hartley Gulch Borrow; and
- Highway 37A Quarry.

Sediment ponds will collect contact runoff from each of the quarry areas. Surface runoff will be routed to the sediment ponds via appropriate grading of the area or sumps and pumps, and upslope non-contact runoff will be diverted around the quarry areas. Surplus water from the sediment ponds will discharge to Bitter Creek.

29.18.5.4 Water Management – Mine Closure

The primary objectives of the closure and reclamation activities will be to return the Project area to a self-sustaining state, protecting the downstream environment, and managing surface water. This will be accomplished through active and passive closure phases. Active closure is defined as the period during which water quality objectives are achieved by active management on site. Passive closure is when the site facilities have been reclaimed, water quality is suitable for release, and the final water regime reaches a steady-state.

29.18.6 Monitoring Program

29.18.6.1 Monitoring Locations

Water quality monitoring sites fall into two categories: surface water monitoring sites and groundwater monitoring sites. The locations of monitoring sites for the Project are presented on Figure 29.18-5, Figure 29.18-6, and Figure 29.18-7. Monitoring locations are detailed in Table 29.18-5.

Figure 29.18-5: Mine Site Water Monitoring Locations

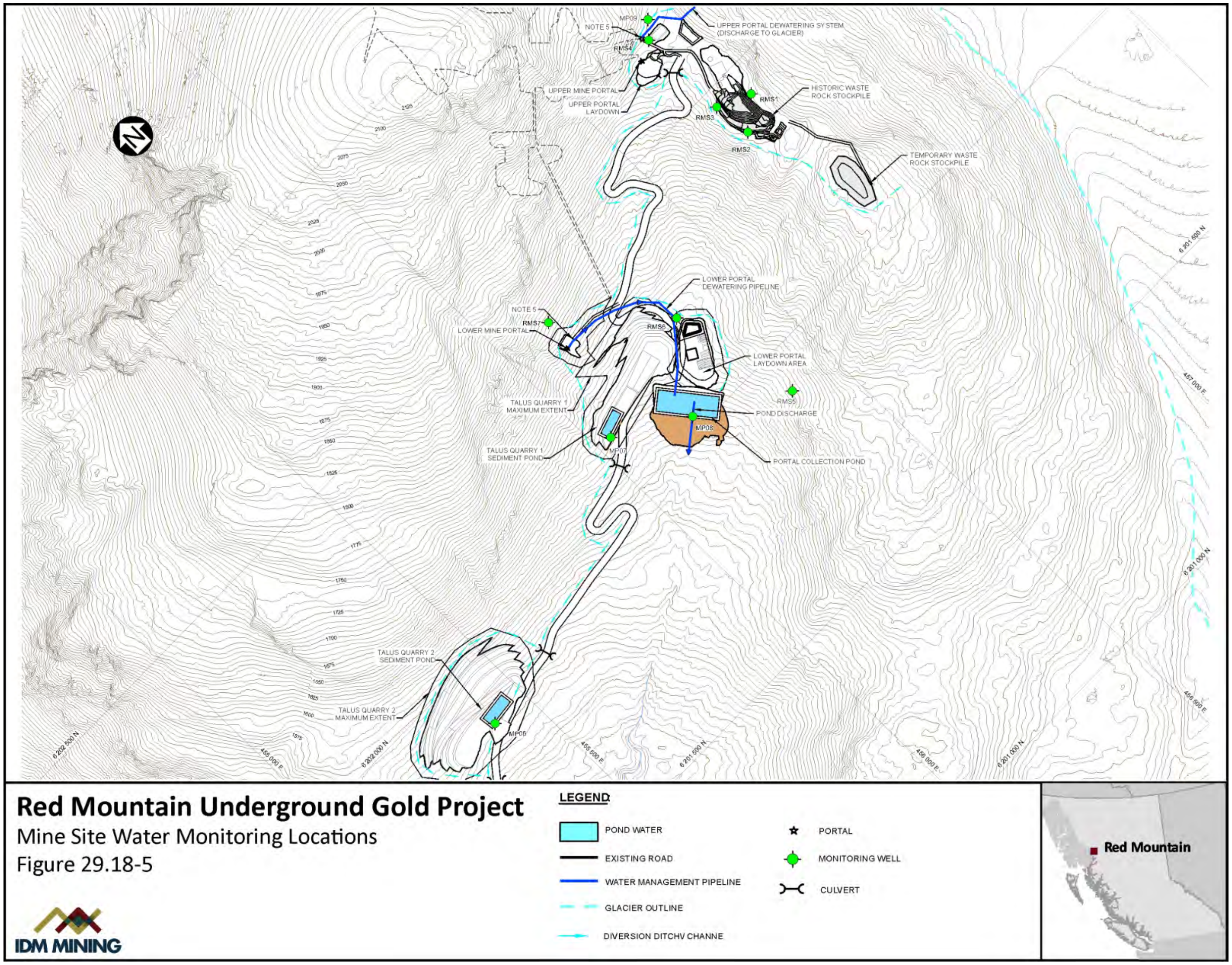


Figure 29.18-6: Bromley Humps Water Monitoring Locations

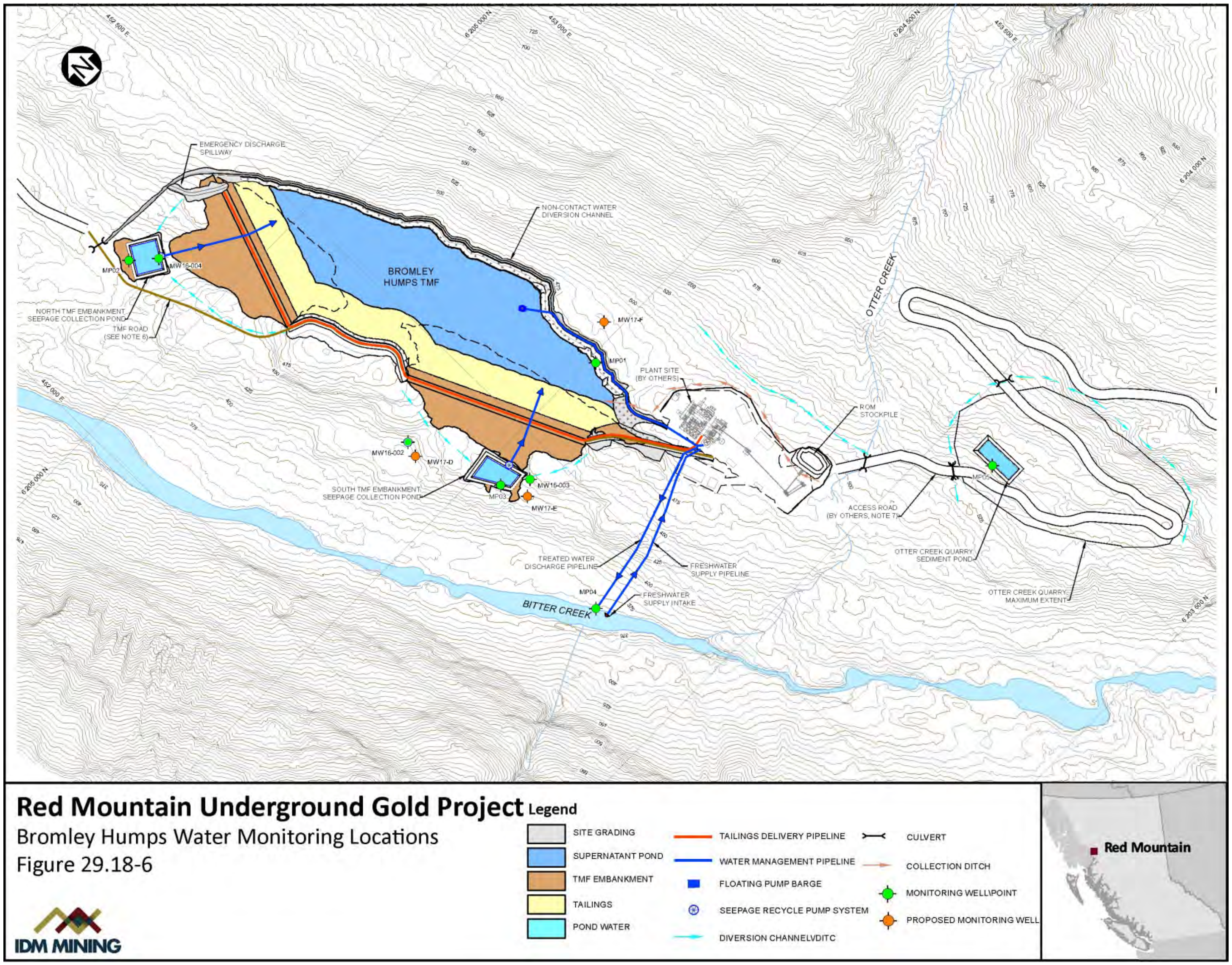


Figure 29.18-7: Borrow and Quarry Water Monitoring Locations

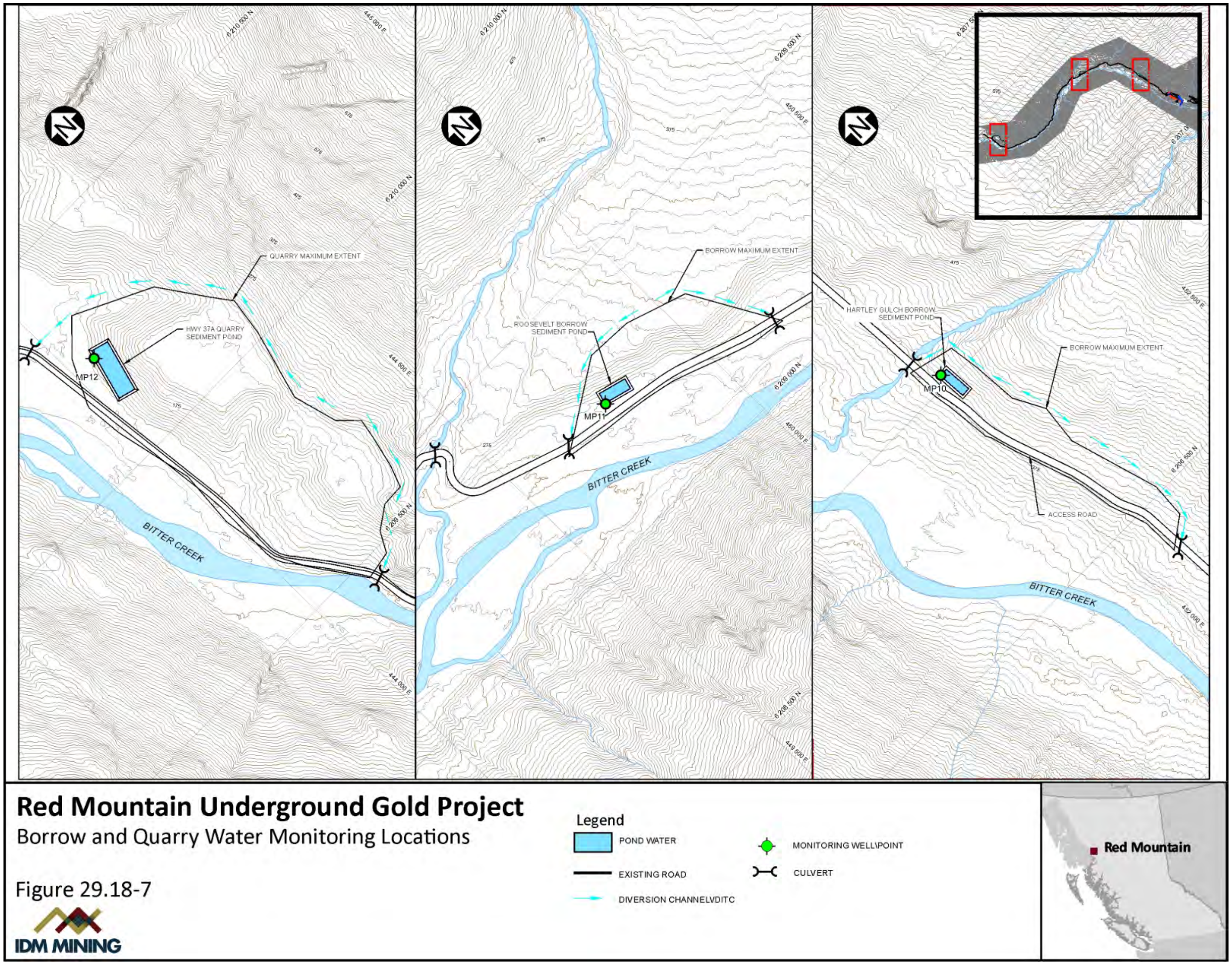


Table 29.18-5: Surface and Groundwater Monitoring Locations

Station Name	Northing (m)	Easting (m)	Description
MP01	452,656	6,204,487	Monitoring point at TMF supernatant pond
MP02	452,247	6,205,147	Monitoring point at North Embankment Seepage Collection Pond
MP03	452,406	6,204,459	Monitoring point at South Embankment Seepage Collection Pond
MP04	452,370	6,204,208	Monitoring point for water treatment discharge to Bitter Creek
MP05	452,985	6,203,907	Monitoring point at Otter Creek Quarry Sediment Pond
MP06	455,409	6,201,870	Monitoring point at Talus Quarry 2 Sediment Pond
MP07	456,036	6,202,125	Monitoring point at Talus Quarry 1 Sediment Pond
MP08	456,194	6,202,028	Monitoring point at Portal Collection Pond
MP09	456,750	6,202,704	Monitoring point for Upper Portal Dewatering Discharge to Glacier (ending Operations Phase Year 1.5)
MP10	451,999	6,207,021	Monitoring point at Hartley Gulch Borrow Sediment Pond
MP11	449,760	6,209,255	Monitoring point at Roosevelt Borrow Sediment Pond
MP12	444,057	6,210,235	Monitoring point at HWY37A Quarry Sediment Pond
MW17-D	452,343	6,204,591	Proposed monitoring well west of South Embankment
MW17-E	452,423	6,204,412	Proposed monitoring well southwest of South Embankment
MW17-F	452,713	6,204,523	Proposed monitoring well east of TMF supernatant pond
MW16-002	452,351	6,204,616	Monitoring well near TMF South Embankment
MW16-003	452,446	6,204,431	Monitoring well near TMF South Embankment
MW16-004	452,283	6,205,114	Monitoring well near TMF North Embankment
RMS1	456,790	6,202,428	Seep on east side of waste rock pile
RMS2	456,725	6,202,375	Seep on southwest side of waste rock pile
RMS3	456,717	6,202,462	Seep on northwest side of waste rock pile
RMS4	456,718	6,202,671	Ponded water in underground decline
RMS5	456,386	6,201,910	Artesian drillhole on steep southern side of cirque
RMS6	456,324	6,202,203	Artesian drillhole on southern side of cirque
RMS7	456,121	6,202,398	Artesian drillhole on northern side of cirque

29.18.6.2 Surface Water Monitoring Program

The success of the SWMP is dependent on monitoring of implemented BMPs. The Contractor, Field Engineers, and Environmental Monitoring Technicians will inspect erosion control measures periodically and after each significant runoff-producing rainfall event.

Silt fences, sediment traps/basins, ditches, culverts, and sediment control ponds will be visually inspected for the following:

- Excess sediment build-up;
- Structural/physical integrity; and
- Anticipated wear and tear.

Sediment removal and proper disposal will be performed as required.

Inspections to confirm that the mitigation measures identified in this document are implemented satisfactorily are as follows:

- Visual inspections to monitor the effectiveness of sediment and erosion control and runoff collection measures on a regular basis (daily or weekly as appropriate);

- Monitor treated effluent discharges on a weekly basis for key indicators (i.e., TSS and turbidity) and monthly sampling using in-situ monitoring devices (pH, temperature, specific conductivity) as well as laboratory analysis for parameters listed in the permits issued by the regulatory agencies;

- Periodically sample runoff at active construction and operations areas to monitor discharge concentrations with respect to discharge water quality permit limits;

- Recording daily and monthly water consumption; and

- Monitoring of water quantity and quality will occur during dewatering activities.

Volume of water transferred will be measured on a continuous basis using appropriate flow meters. Field turbidity and TSS will be monitored as required. As data become available, a TSS and turbidity curve will be generated to manage dewatering activities. Water transferred during dewatering activities will meet a TSS or turbidity threshold similar to the MMER and provincial permit limits for TSS.

During construction, the emphasis of monitoring will be on the implementation and success of mitigation at construction areas. Toward the end of the Construction Phase, Operation Phase monitoring activities will be implemented and monitoring will shift to include the relevant aspects of operations. Operation Phase activities beginning before the end of the Construction Phase will include the installation of operation phase water management facilities, milling, pre-stripping and mining of underground facilities, and the development of waste rock stockpiles.

In addition to the above efforts during construction, the following is proposed for monitoring during the Operation Phase:

- Recording daily and monthly water consumption;
- Regular visual monitoring of operations phase water management facilities;
- Visual inspections and monitoring of construction areas;
- Daily monitoring of the tailings discharge and the supernatant water level within the reclaim barge;
- Monitoring of effluents prior to discharge in relation to the criteria identified for various effluents;
- Underground mine inflows will be sampled to verify water quantity predictions and verify storage requirements; and
- Monitoring of mine contact water discharges as prescribed by a study design developed under the MMER and/or provincial permits.

Closure monitoring at receiving waters will be measured against water quality objectives. The following items are planned for monitoring during closure:

- Regular inspections to confirm that closure activities are being undertaken as identified in the final approved Mine Closure and Reclamation Plan;
- Construction-type monitoring is undertaken during decommissioning activities; and
- TMF water quality monitoring until water quality guidelines are met.

Post-closure monitoring is expected to be required after completion of closure activities. Post-closure monitoring is expected to include:

- Water quality sampling at mine contact water discharge locations in accordance with water quality objectives; and
- Final environmental effects monitoring studies in accordance with water quality objectives needed to obtain status as a recognized closed mine from Environment Canada and/or the BC Provincial Ministry of Energy and Mines.

A summary of the surface water monitoring stations, parameters and sample frequency are presented in Table 29.18-6.

Table 29.18-6: Surface Water Monitoring Parameters

Monitoring Location	Description	Parameters and Frequency
MP01	Monitoring point at TMF supernatant pond	Flow: During emergency discharge only, 1 minute intervals TSS and In-Situ: Monthly Anions and Nutrients: Monthly Total and Dissolved Organic Carbon: Monthly Total and Dissolved Metals: Monthly
MP02	Monitoring point at North Embankment Seepage Collection Pond	Flow: During emergency discharge only, 1 minute intervals TSS and In-Situ: Monthly Anions and Nutrients: Monthly Total and Dissolved Organic Carbon: Monthly Total and Dissolved Metals: Monthly
MP03	Monitoring point at South Embankment Seepage Collection Pond	Flow: During emergency discharge only, 1 minute intervals TSS and In-Situ: Monthly Anions and Nutrients: Monthly Total and Dissolved Organic Carbon: Monthly Total and Dissolved Metals: Monthly
MP04	Monitoring point for water treatment discharge to Bitter Creek	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily (Development of Turbidity / TSS Calibration Curve) Anions and Nutrients: Weekly Total and Dissolved Organic Carbon: Weekly Total and Dissolved Metals: Weekly
MP05	Monitoring point at Otter Creek Quarry Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly
MP06	Monitoring point at Talus Quarry 2 Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly

Monitoring Location	Description	Parameters and Frequency
MP07	Monitoring point at Talus Quarry 1 Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly
MP08	Monitoring point at Portal Collection Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily (Development of Turbidity / TSS Calibration Curve) Anions and Nutrients: Weekly Total and Dissolved Organic Carbon: Weekly Total and Dissolved Metals: Weekly
MP09	Monitoring point for Upper Portal Dewatering discharge to glacier (ending Operations Phase Year 1.5)	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily (Development of Turbidity / TSS Calibration Curve) Anions and Nutrients: Weekly Total and Dissolved Organic Carbon: Weekly Total and Dissolved Metals: Weekly
MP10	Monitoring point at Hartley Gulch Borrow Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly
MP11	Monitoring point at Roosevelt Borrow Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly

Monitoring Location	Description	Parameters and Frequency
MP12	Monitoring point at HWY37A Quarry Sediment Pond	Flow: Continuous, 15 minute intervals TSS and In-Situ: Daily until development of Turbidity / TSS Calibration Curve, daily starting two days prior to discharge thereafter Anions and Nutrients: Daily until established, then quarterly Total and Dissolved Organic Carbon: Daily until established, then quarterly Total and Dissolved Metals: Daily until established, then quarterly

29.18.6.3 Groundwater Monitoring Program

Groundwater quality and quantity monitoring will be conducted during the Construction and Operations Phases at existing and proposed monitoring locations, as per Figure 29.18-5, Figure 29.18-6, and Figure 29.18-7. The Water Quality Monitoring Program and sampling methods will be based on protocols described in the following documents:

- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Version 2. (British Columbia Ministry of Environment 2016); and
- British Columbia Field Sampling Manual (BC MWLAP 2013).

Sampling parameters will be consistent with those collected for the baseline study by SRK Consulting (SRK, 2017d). A summary of the groundwater monitoring stations, parameters and sampling frequency are presented in Table 29.18-7.

Table 29.18-7: Groundwater Monitoring Parameters

Station Name	Description	Monitoring Type and Frequency
MW17-D	Proposed monitoring well west of South Embankment	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
MW17-E	Proposed monitoring well southwest of South Embankment	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly

Station Name	Description	Monitoring Type and Frequency
MW17-F	Proposed monitoring well east of TMF supernatant pond	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
MW16-002	Monitoring well near TMF south embankment	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
MW16-003	Monitoring well near TMF south embankment	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
MW16-004	Monitoring well near TMF north embankment	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS1	Seep on east side of waste rock pile	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS2	Seep on southwest side of waste rock pile	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS3	Seep on northwest side of waste rock pile	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS4	Ponded water in underground decline	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly

Station Name	Description	Monitoring Type and Frequency
RMS5	Artesian drillhole on steep southern side of cirque	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS6	Artesian drillhole on southern side of cirque	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly
RMS7	Artesian drillhole on northern side of cirque	Flow: Continuous, hourly intervals TSS and In-Situ: Quarterly Anions and Nutrients: Quarterly Total and Dissolved Organic Carbon: Quarterly Total and Dissolved Metals: Quarterly

29.18.7 Reporting Requirements

Reporting requirements will be developed and described in the BC provincial permits to be issued by MOE and MEM. These reporting requirements will also be aligned with those outlined in the MMER (2015) regulations, which state that the owner or operator of a mine will submit an effluent monitoring report for all tests and monitoring conducted during each calendar quarter to the authorization officer within 45 days after the end of each quarter.

The effluent monitoring report will include:

- Tests for acute lethality for rainbow trout and Daphnia magna;
- The concentration and monthly mean concentration of deleterious substances contained in effluent samples;
- The pH of the effluent samples;
- Whether a composite or grab sample collection method was used for each effluent sample;
- The number of days that effluent was deposited during each month of the calendar quarter;
- The total volume of effluent deposited during each month of the reporting quarter;
- The mass loading of the deleterious substances; and
- The results of the effluent characterization.

If no effluent is deposited in a calendar quarter, the report needs only to include a statement to that effect. Each report will be submitted electronically via the Effluent Regulatory Reporting Information System (ERRIS) in the format provided by Environment and Climate Change Canada.

The Environmental Superintendent or Mine Manager will notify an inspector without delay if the results of the effluent monitoring tests conducted indicate that the limits are being, or have been, exceeded, the pH of the effluent is less than 6.0 or greater than 9.5, or effluent is or has been acutely lethal.

The Environmental Superintendent will be responsible for providing a written report of the test results to the inspector within 30 days after the tests have been completed.

29.18.8 Roles and Responsibilities

Environmental management at the Project is the responsibility of all site personnel, including employees and contractors. This philosophy will be communicated to all Project site personnel. Table 29.18-8 lists some basic roles and responsibilities of the SWMP.

It should be noted that refinement and confirmation of the organizational structure will emerge as the permitting process progresses.

Table 29.18-8: Water Management Plan Roles and Responsibilities

Title	Responsibilities Within This Plan
Mine Manager	A Mine Manager will: • Ensure that this water management plan is implemented; • Ensure all applicable execution plans, and relevant drawings are approved for use with this water management plan; • Coordinate as required with the Mine Supervisor and other contractor construction managers to ensure that the water management efforts are coordinated; • Monitor and report all daily activities; and • Make the shutdown decision if necessary, advised by the Mine Supervisor.
Mine Supervisor	A Mine Supervisor will: • Ensure that this water management plan is implemented; • Coordinate dewatering as required with the Area Foremen and other contractor superintendents; • Ensure erosion and sediment controls are in place; • Maintain all erosion and sediment controls by means of manual labor and adequate equipment; • Monitor and report as applicable; • Ensure all dewatering structures are built and maintained; and • Advise the Mine Manager to shut down specific works if deemed necessary.

Title	Responsibilities Within This Plan
Qualified Environmental Professional	A QEP or Professional Engineer will be appointed to review and approve the implementation of the onsite erosion and sediment control (ESC) measures including activities associated with: • Stripping, grading and site preparation; • Erosion control: storm water management; • Erosion control: temporary soil stabilization; and • Sediment control.

29.18.9 Review of Plan Effectiveness

The Environmental Manager or designate will conduct regular evaluations of the monitoring activities. This plan may be updated if additional methods for monitoring are found to be more appropriate.

The QA/QC for relevant monitoring programs will include the preparation of a standard operating procedure (SOP) for each of the activities within the program and auditing operations against this plan and any relevant SOPs.

APPENDIX G

WATER BALANCE REPORT

(Pages G-1 to G-37)

IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT



WATER BALANCE REPORT

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VA101-594/4-2
Rev 1
August 4, 2017

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IDM MINING LTD.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

WATER BALANCE REPORT
VA101-594/4-2

Rev	Description	Date
0	Issued in Final	June 30, 2017
1	Updated for Revised Water Management Plan	August 4, 2017

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EXECUTIVE SUMMARY

The Red Mountain Underground Gold Project (the Project) is a proposed gold and silver mine located in northwestern British Columbia, 18 km east of the town of Stewart, on provincial crownland within the Regional District of Kitimat-Stikine. The underground mine portal is located in the alpine (the Mine Site) between the Cambria Ice Field and the Bromley Glacier at elevations ranging between 1,500 and 2,000 metres above sea level (masl). The Tailings Management Facility (TMF) and Process Plant site are located at Bromley Humps, at elevations ranging between 400 and 500 masl. A feasibility design of the TMF and water management features for the Mine Site has been completed by Knight Piésold Ltd. (KP), which includes a water balance modeling exercise using GoldSim© software. The water balance model was executed with two mean annual precipitation estimates (base case and adjusted case) and stochastic climatic conditions (mean, abnormally wet, and abnormally dry), producing six sets of results.

The main objectives of the water balance are as follows:

- Estimate the volume of surplus water from the TMF that requires removal and treatment on an annual basis
- Estimate monthly discharge volumes from the TMF required to minimize surplus and avoid deficits
- Estimate monthly runoff volumes from the Mine Site, and
- Estimate monthly discharge volumes from the underground mine workings.

This report presents the resultant TMF pond volumes when an equal discharge rate for 8 months per year (March to October) is employed. The results presented herein contain a moderate amount of uncertainty, based on the availability of data used to estimate the hydrometeorology parameters. There are opportunities to further refine the water balance at the next level of design for the Project.

The main findings of the base case water balance model under mean climatic conditions are as follows:

- The TMF supernatant pond operates with a surplus each year of operations, which is managed by treating and discharging eight months of the year. The maximum discharge rate is 44,400 m^3/month during Year 2 of operations, which is an annual total of 355,200 m^3.

The main findings of the adjusted case water balance model under mean climatic conditions are as follows:

- The TMF supernatant pond operates with a surplus each year of operations, which is managed by treating and discharging eight months of the year. The maximum discharge rate is 65,000 m^3/month during Year 3 of operations, which is an annual total of 520,000 m^3.

The report also contains a summary of estimated runoff reporting to the various water management ponds and sediment ponds.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ABBREVIATIONS

Red Mountain Underground Gold Project	the Project
DEM	digital elevation model
EDF	environmental design flood
JDS	JDS Energy & Mining Inc.
KP	Knight Piésold Ltd.
MAP	mean annual precipitation
masl	metres above sea level
PAG	potentially acid generating
PRISM	Parameter-elevation Regressions on Independent Slopes Model
ROM	run of mine
SRK	SRK Consulting Inc.
TMF	tailings management facility
tpd	tonnes per day

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Red Mountain Underground Gold Project (the project) is a proposed gold and silver mine located in northwestern British Columbia, 18 km east of the town of Stewart, on provincial crownland within the Regional District of Kitimat-Stikine. The underground mine workings are located in the Mine Site between the Cambria Ice Field and the Bromley Glacier at elevations ranging between 1,500 and 2,000 meters above sea level (masl). The Tailings Management Facility (TMF) and Process Plant site are located at Bromley Humps, at lower elevations ranging between 400 and 500 masl.

The general arrangements for Bromley Humps, the Mine Site and additional borrows and quarries are shown on Figures 1.1, 1.2, and 1.3.

1.2 SCOPE OF REPORT

This report provides a summary of the water balance scenarios modelled and the results obtained. This document is intended to provide an overview of the water management plan for the Project, to assist in planning the process operations, and to provide an assessment of the potential for surface water surplus or deficit conditions that may occur during the mine operation.

The main objectives of the water balance exercise are as follows:

- Estimate the volume of surplus water from the TMF that requires removal and treatment on an annual basis
- Estimate monthly discharge volumes from the TMF required to minimize surplus and avoid deficits
- Estimate monthly runoff volumes from the Mine Site, and
- Estimate monthly discharge volumes from the underground mine workings.

Knight Piésold CONSULTING

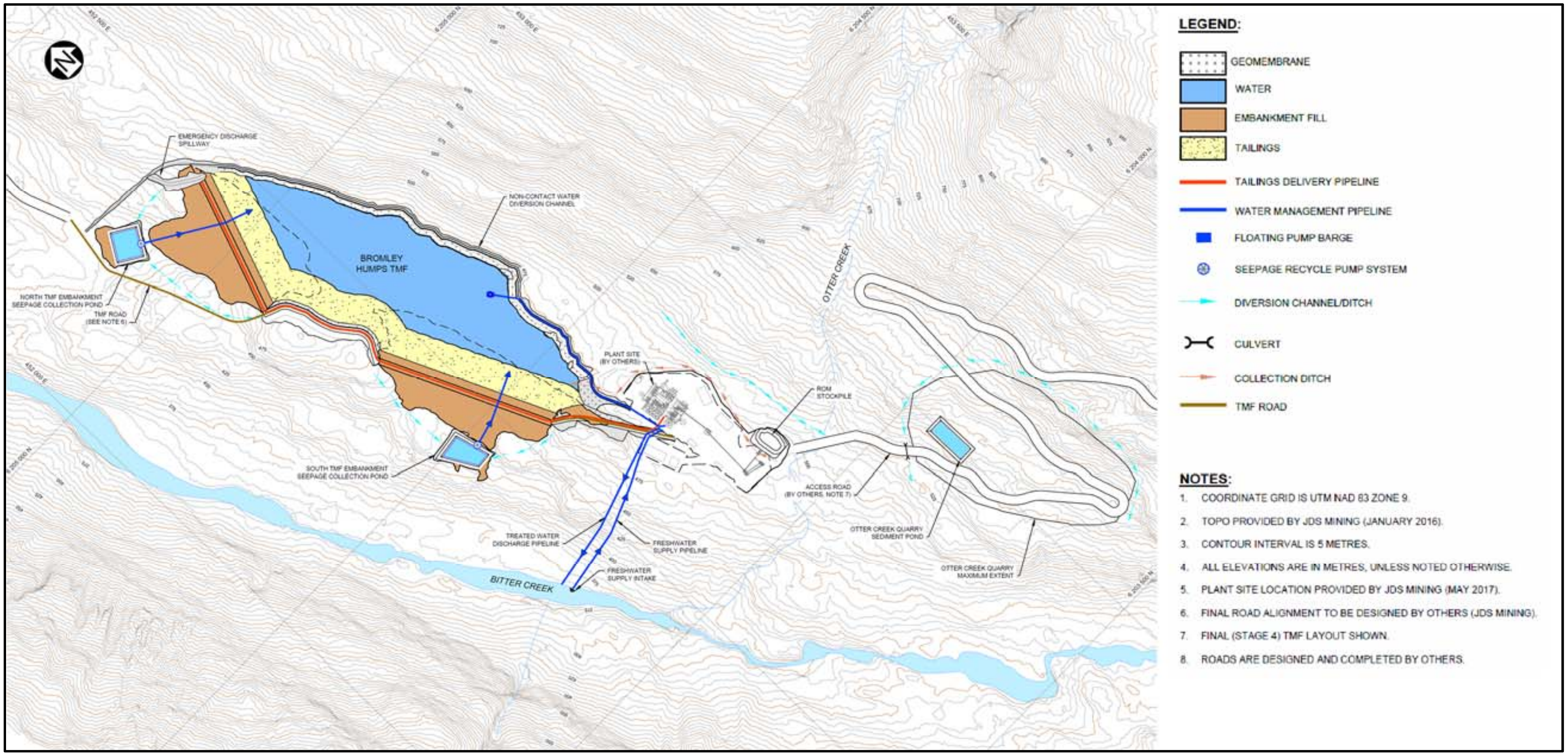

Figure 1.1 Bromley Humps General Arrangement

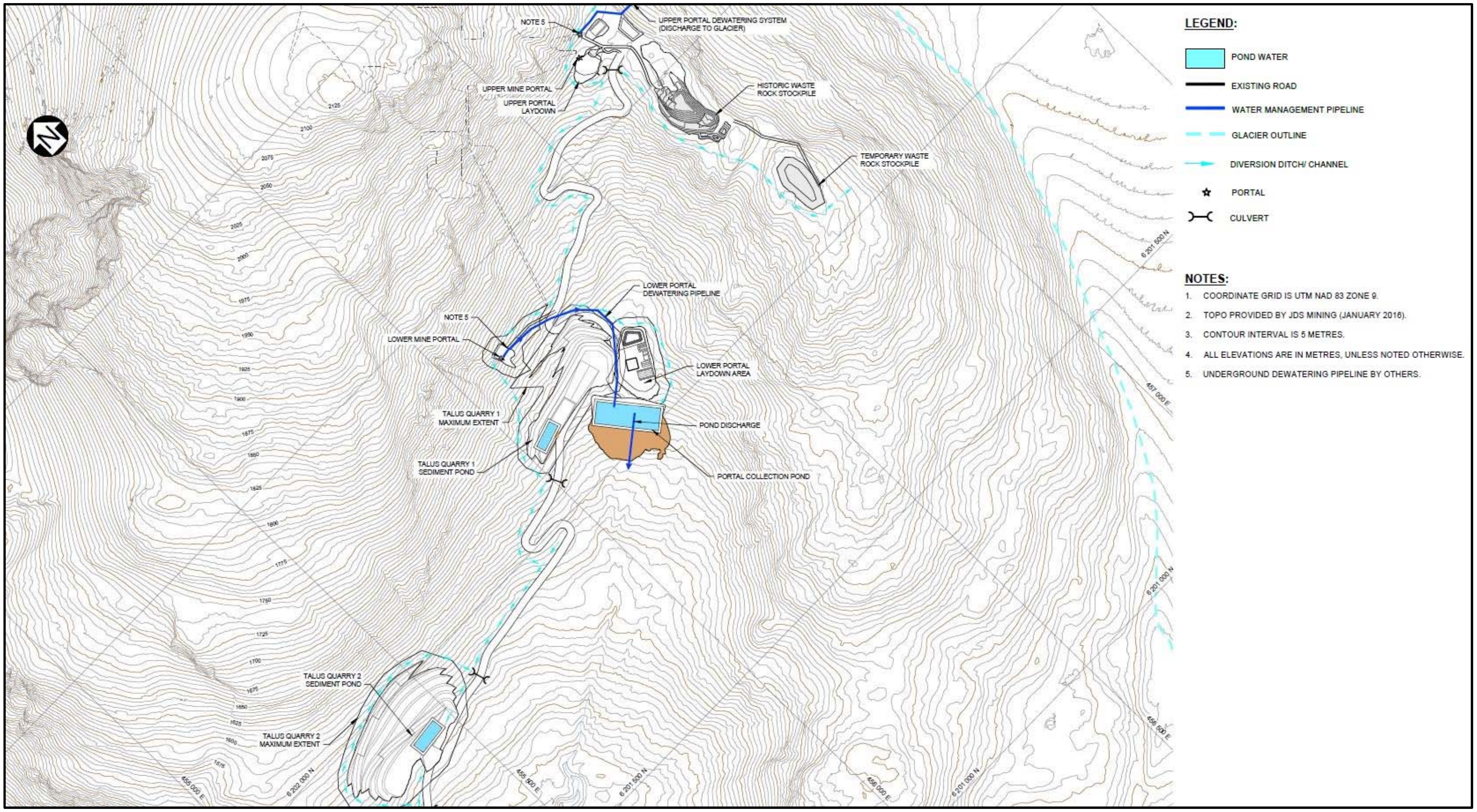

Figure 1.2 Mine Site General Arrangement

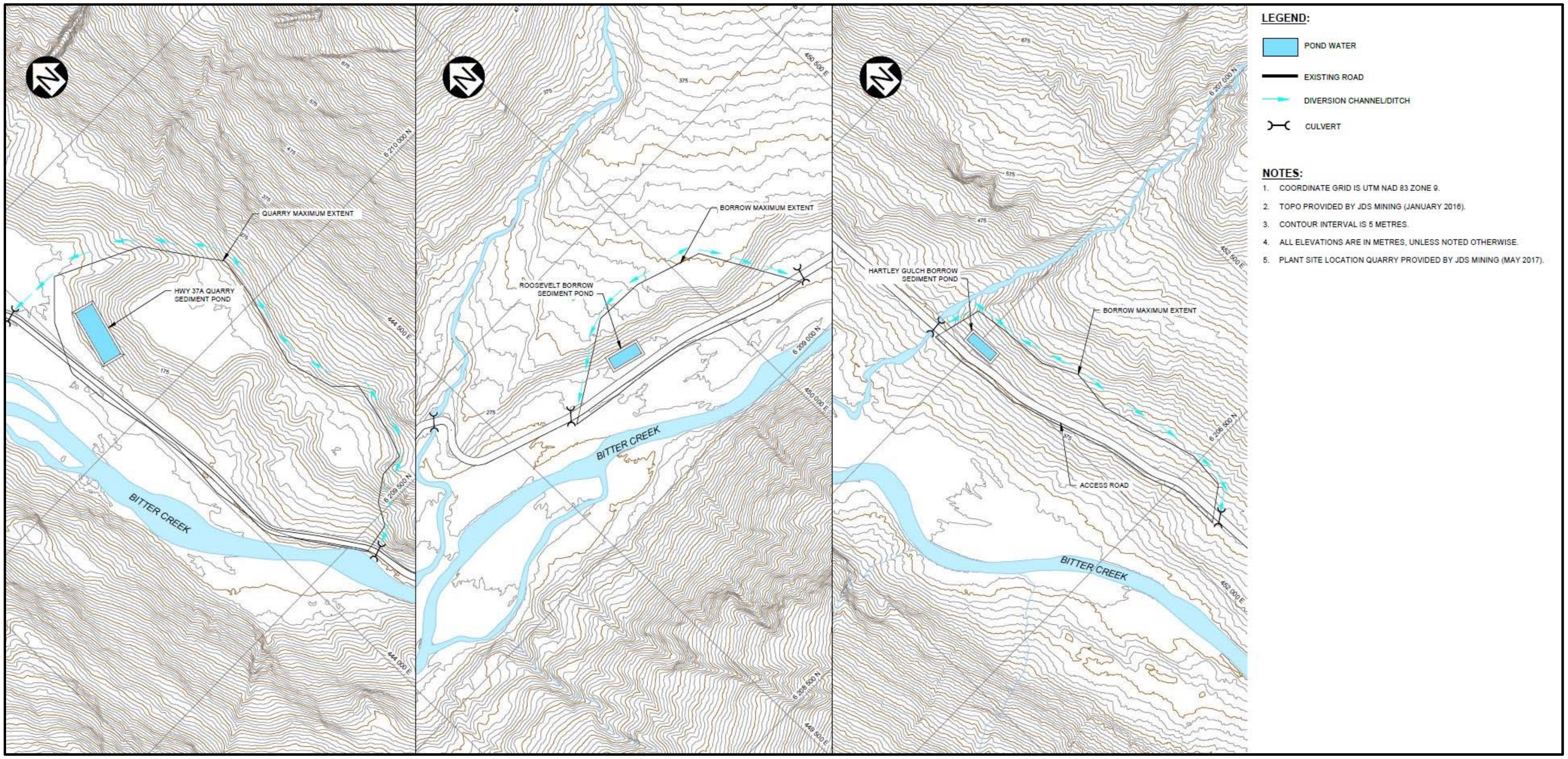

Figure 1.3 Borrows and Quarries General Arrangement

1.3 MODELLED SCENARIOS

Two mean annual precipitation (MAP) estimates emerged during the feasibility study, and were both used for the water balance modeling exercise, referred to as the "base case" and the "adjusted case". The base case estimate is based on the MAP suggested in the *Baseline Climate and Hydrology Report* (SRK, 2017a) at elevation 1,500 masl (the Mine Site), with a 2.4% orographic adjustment from the Mine Site to Bromley Humps. The adjusted case uses a MAP determined from a PRISM model, with the same orographic adjustment of 2.4% from the Mine Site to Bromley Humps. PRISM, or Parameter-elevation Regressions on Independent Slopes Model, is a climate analysis system that uses point data, a digital elevation model (DEM), and other spatial datasets to generate gridded estimates of annual, monthly, and event-based climatic parameters. The details of the MAP determined from the PRISM model are presented in KP Memorandum *Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs,* included as Appendix A in this report. The same monthly precipitation distribution (as a percentage of MAP), and monthly rainfall and snowfall distributions were used for both cases.

Both cases were executed stochastically to produce the mean, abnormally wet (95th percentile), and abnormally dry (5th percentile) results. A gamma distribution was assumed for the precipitation data in the stochastic models and a Monte Carlo simulation was executed using 10,000 iterations in GoldSim©. The estimated monthly volumes reporting to the Project, and the resulting effects on the volumes in the facilities, have been presented in terms of probability of occurrence for the three climatic scenarios:

- **Scenario 1 – Mean**: The results correspond to average monthly climatic conditions.
- **Scenario 2 – 95th Percentile (Abnormally Wet):** The results correspond to abnormally wet conditions, and represent the climatic conditions to be exceeded once every 20 years, on average.
- **Scenario 3 – 5th Percentile (Abnormally Dry):** The results correspond to abnormally dry conditions, and represent the climatic conditions expected to be exceeded 19 out of 20 years, on average (i.e. volumes will not exceed these values more than once every 20 years, on average).

This produced a total of six sets of results from the water balance.

2 – PARAMETERS AND ASSUMPTIONS

2.1 GENERAL

Modelling parameters for both cases are presented in Table 2.1, and are described in the following sections. The catchment areas were determined from the Project topographic information as provided by JDS Energy & Mining Inc. (JDS), and are summarized on Figure 1.1 and under Items 2.0, 2.1, and 2.2 of Table 2.1.

Table 2.1 Water Balance Parameters

Parameter	Units	Value	Source
1.0 Hydrometeorology (Bromley Humps, 500 masl)			
Mean Annual Precipitation (base case, adjusted case)	mm	1,457 / 2,084	SRK Hydrometeorology Report, 2017a and KP Memo (VA17-00512)
Mean Annual Evapotranspiration	mm	42.4	SRK Hydrometeorology Report, 2017a
Runoff Coefficient (Undisturbed)	%	70	KP Assumption
Runoff Coefficient (Disturbed)	%	90	KP Assumption
Runoff Coefficient (Pond Surfaces)	%	100	KP Assumption
Runoff Coefficient (Stockpiles)	%	70	KP Assumption
Runoff Coefficient (Embankments)	%	80	KP Assumption
Runoff Coefficient (TMF Beaches)	%	75	KP Assumption
Runoff Coefficient (Process Plant Area)	%	90	KP Assumption
Diversion Ditch Efficiency	%	80	KP Assumption
1.1 Hydrometeorology (Mine Site, 1500 masl)			
Mean Annual Precipitation (base case, adjusted case)	mm	1,847 / 2,635	SRK Hydrometeorology Report, 2017a and KP Memo (VA17-00512)
Mean Annual Evapotranspiration	mm	31.3	SRK Hydrometeorology Report, 2017a
Runoff Coefficient (Undisturbed)	%	70	KP Assumption
Runoff Coefficient (Disturbed)	%	90	KP Assumption
Runoff Coefficient (Pond Surfaces)	%	100	KP Assumption
Runoff Coefficient (Stockpiles)	%	70	KP Assumption
2.0 Bromley Humps Catchment Areas (Final Year, full footprint)			
TMF Pond	m^2	110,000	Site topography
Area Reporting to TMF	m^2	131,400	Site topography
Area Reporting to Diversion Ditch	m^2	1,050,000	Site topography

Parameter	Units	Value	Source
Undiverted Area Reporting to TMF	m^2	10,800	Site topography
Area of ROM Stockpile (Maximum)	m^2	2,000	Site topography
Area Reporting to the North Embankment Seepage Collection Pond	m^2	30,000	Site topography
Area of North Embankment (Maximum)	m^2	17,900	
Area of the North Embankment Seepage Collection Pond (Maximum)	m^2	3,200	Site topography
Area Reporting to the South Embankment Seepage Collection Pond	m^2	22,800	Site topography
Area of South Embankment (Maximum)	m^2	15,400	Site topography
Area of the South Embankment Seepage Collection Pond (Maximum)	m^2	3,200	Site topography
2.1 Mine Site Catchment Areas (Final Year, full footprint)			
Area of Talus Quarries Reporting to Sediment Collection Ponds	m^2	96,000	Site topography
Area of Stockpile Reporting to Portal Collection Pond (Lower)	m^2	1,700	Site topography
Area of Lower Substation and Laydown Areas	m^2	16,700	Site topography
Area of Portal Collection Pond	m^2	6,300	Site topography
Area of Upper Stockpile (runoff routed to glacier)	m^2	1,300	Site topography
Area of Upper Laydown Areas (runoff routed to glacier)	m^2	71,300	Site topography
2.2 Quarry and Borrow Areas (Final Year, full footprint)			
Otter Creek Rock Quarry	m^2	63,200	Site topography
Roosevelt Borrow	m^2	58,900	Site topography
Hartley Gulch Borrow	m^2	56,100	Site topography
HWY 37A Quarry	m^2	238,900	Site topography
Topsoil Stockpile	m^2	18,400	Site topography

Parameter	Units	Value	Source
3.0 Process Plant			
Dry Ore Production	tpd	1,000	JDS
Tailings Solids Content	%	50	JDS
Tailings Specific Gravity	-	3.1	KP Lab Testing
Final Settled Tailings Density	t/m^3	1.3	KP Lab Testing
Water in Ore	m^3/hr	2.38	Process Diagram from JDS
Moisture in Tailings	m^3/hr	57.29	Process Diagram from JDS
Reclaim Water Required	m^3/hr	40.91	Process Diagram from JDS
Minimum Fresh Water Required	m^3/hr	14.0	Process Diagram from JDS

Estimates of Red Mountain groundwater inflows (SRK, 2017c) are summarized in Table 2.2. The base case peak inflow rate of 6,000 m^3/day was split between the Upper (60%) and Lower (40%) portals.

Table 2.2 Groundwater Inflow Rates

Portal	Groundwater Inflow (m^3/month)
Upper (60% of total)	108,000
Lower (40% of total)	72,000

2.2 HYDROMETEROLOGY

The climate in the Project area is characterized by rugged, steep, terrain with weather conditions typical of the northern coastal mountains with cool short summers, cold winters, and no notable dry seasons. Annual mean temperatures range from approximately -6.4°C in December and January to 6.9°C in August. (SRK, 2017a).

The rainfall and evapotranspiration distributions used for the water balance are based on long-term records from Stewart Airport (SRK, 2017b), with orographic factors applied to the rainfall to account for the steep topography between Bromley Humps and the Mine Site, as outlined in the supporting memorandum in Appendix A. Two estimates, base case and adjusted case, were used for MAP: 1,457 mm and 2,084 mm for Bromley Humps, and 1,847mm and 2,635 mm for the Mine Site, respectively. The mean monthly rainfall and snowfall distributions, as well as evapotranspiration amounts for the base case are shown in Table 2.3 and Table 2.4 for Bromley Humps and the Mine Site, respectively. The mean monthly hydrometeorological distributions for the adjusted case are shown in Table 2.5 and Table 2.6 for Bromley Humps and the Mine Site, respectively.

The wettest month is typically October, with an average precipitation of between 230 mm (base case) and 329 mm (adjusted case) at the TMF area, most of which falls as rain. The lowest precipitation month is typically June, with an average precipitation of between 52 mm (base case) and 75 mm (adjusted case) at the TMF area. The highest evapotranspiration occurs in July in both cases.

Table 2.3 Bromley Humps Monthly Hydrometeorological Parameters (Base Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	173	138	36	0
February	108	84	21	4
March	96	79	20	26
April	71	71	2	59
May	57	55	0	88
June	52	51	0	88
July	61	62	0	96
August	96	99	0	81
September	167	171	0	41
October	230	225	1	19
November	179	153	22	7
December	169	131	35	0
Annual	**1,457**	**1,319**	**138**	**509**

Table 2.4 Mine Site Monthly Hydrometeorological Parameters (Base Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	219	5	214	0
February	137	1	136	3
March	121	7	114	19
April	90	7	83	44
May	72	37	35	65
June	66	62	4	65
July	77	77	0	71
August	121	121	0	60
September	211	208	3	30
October	291	205	86	14
November	227	34	193	5
December	214	10	204	0
Annual	**1,847**	**773**	**1,073**	**376**

Table 2.5 Bromley Humps Monthly Hydrometeorological Parameters (Adjusted Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	247	197	52	0
February	155	120	29	4
March	137	113	28	26
April	102	101	3	59
May	81	79	0	88
June	75	73	0	88
July	87	88	0	96
August	137	142	0	81
September	238	245	0	41
October	329	322	2	19
November	256	219	32	7
December	242	187	50	0
Annual	**2,084**	**1,886**	**198**	**509**

Table 2.6 Mine Site Monthly Hydrometeorological Parameters (Adjusted Case)

Month	Total Precipitation (mm)	Rainfall (mm)	Snowfall Water Equivalent (mm)	Evapotranspiration (mm)
January	313	8	305	0
February	196	1	194	3
March	173	10	163	19
April	128	10	119	44
May	103	52	51	65
June	94	89	5	65
July	110	110	0	71
August	173	173	0	60
September	301	297	5	30
October	415	292	123	14
November	324	48	276	5
December	305	14	292	0
Annual	**2,635**	**1,104**	**1531**	**376**

2.3 SEEPAGE CONSIDERATIONS

It was assumed for the water balance modeling exercise that the TMF has two seepage collection systems; one downslope of the North Embankment and one downslope of the South Embankment. Seepage is captured in each seepage collection pond with an assumed capture rate of 80%. The collected seepage is pumped back to the TMF.

2.4 PROCESS PLANT

The tailings properties used in the water balance are listed in Table 2.1 Item 3.0.

The Project will produce approximately 2 million tonnes of ore over the life of mine. The tailings are assumed to be potentially acid generating (PAG) and thus will be stored subaqueously to control the onset of acid generation. The tailings are estimated to have a specific gravity of 3.1, and contain 50% solids by weight. As such there is 501,900 m^3 of water in the slurry reporting to the TMF each year. The assumed annual process water requirement was 358,400 m^3, sourced from the TMF, with the remaining 143,500 m^3 from external freshwater sources and moisture in ore.

3 – WATER MANAGEMENT ASSUMPTIONS

3.1 GENERAL OPERATIONS

The water management system includes the following facilities:

Tailings Management Facility

- The TMF will be used to manage tailings solids and the supernatant pond from the single stream process. The TMF is located at Bromley Humps.
- Contact runoff in the TMF area will be routed to the TMF via appropriate grading of the area, or with pumping.
- Seepage from the facility will be collected in collection ponds and pumped back to the TMF.
- Collected runoff and seepage will be managed in the TMF prior to being used in the Process Plant for millwater requirements, and/or being discharged if the volume is in surplus. Surplus water will be treated at a Water Treatment Plant.

North TMF Embankment Seepage Collection Pond

- The North Embankment Seepage Collection Pond will be used to manage seepage from the North TMF Embankment and flows from the TMF Foundation Drain.
- Surface runoff from the North TMF Embankment and a small local area is collected in addition to the embankment seepage.
- The seepage collection systems for the North TMF Embankment are assumed to be 80% efficient, with the remaining 20% assumed to be unrecoverable and therefore report to the downstream receiving environment.

South TMF Embankment Seepage Collection Pond

- The South TMF Embankment Seepage Collection Pond will be used to manage seepage from the South TMF Embankment.
- Surface runoff from the South TMF Embankment and a small local area is collected in addition to the embankment seepage.
- The seepage collection systems for the South TMF Embankment are assumed to be 80% efficient, with the remaining 20% assumed to be unrecoverable and therefore report to the downstream receiving environment.

Process Plant

- The Process Plant is located on the southern boundary of Bromley Humps, near Otter Creek.
- Runoff from the Process Plant area and the ROM Stockpile will be routed towards the TMF via appropriate grading and a system of collection ditches.

Non-Contact Water Diversion Channel

- Non-contact runoff upslope of the TMF pond will be diverted north of the Project to discharge to Bitter Creek.

Upper Portal

- Dewatering of the Upper Portal will be achieved from start of mine operations to Year 1.5 via pumping discharge to the glacier east of the Upper Portal, outside of the Project area.

- The Upper and Lower Portals will be physically connected from Year 1.5 through to closure and mine dewatering will therefore report to the Lower Mine Portal for removal starting in Year 1.5.

Lower Portal

- Dewatering of the Lower Portal will be achieved by routing surplus to the Portal Collection Pond.
- Additional surplus will report from the Upper to Lower Portal from Year 1.5 through to closure, as they will be physically connected at this point in time.

Portal Collection Pond

- The Portal Collection Pond will collect pumped surplus from the Lower Portal, as well as stockpile and laydown areas from which runoff is routed via appropriate grading. The Portal Collection Pond is located near the Lower Portal Laydown, upslope from Goldslide Creek.
- The Portal Collection Pond will discharge to Goldslide Creek.

Talus Quarry Sediment Ponds

- The Talus Quarry Sediment Pond 1 and 2 will collect contact runoff from their respective Talus Quarry areas.
- Surplus from the Talus Quarry Sediment Ponds will discharge to Goldslide Creek.

Topsoil Stockpile Sediment Pond

- The Topsoil Stockpile sediment pond will collect contact runoff from the Topsoil Stockpile area.
- Surplus from the sediment pond will discharge to Bitter Creek.

Otter Creek Rock Quarry Sediment Pond

- The Otter Creek Rock Quarry Sediment Pond will collect contact runoff from the Otter Creek Quarry area.
- Surplus from the sediment pond will discharge to Bitter Creek.

Roosevelt Borrow Sediment Pond

- The Roosevelt Borrow Sediment Pond will collect contact runoff from the Roosevelt Borrow area.
- Surplus from the sediment pond will discharge to Bitter Creek.

Hartley Gulch Borrow Sediment Pond

- The Hartley Gulch Borrow Sediment Pond will collect contact runoff from the Hartley Gulch Borrow area.
- Surplus from the sediment pond will discharge to Bitter Creek.

HWY 37A Quarry Sediment Pond

- The HWY 37A Quarry Sediment Pond will collect contact runoff from the HWY 37A Quarry area.
- Surplus from the sediment pond will discharge to Bitter Creek.

The water management schematic for Bromley Humps (Year -1 to Year 6) is presented on Figure 3.1, and the Mine Site on Figure 3.2 for Year -1 to Year 1.5, and Figure 3.3 for Year 1.5 to Year 6, and additional Borrows and Quarries on Figure 3.4.

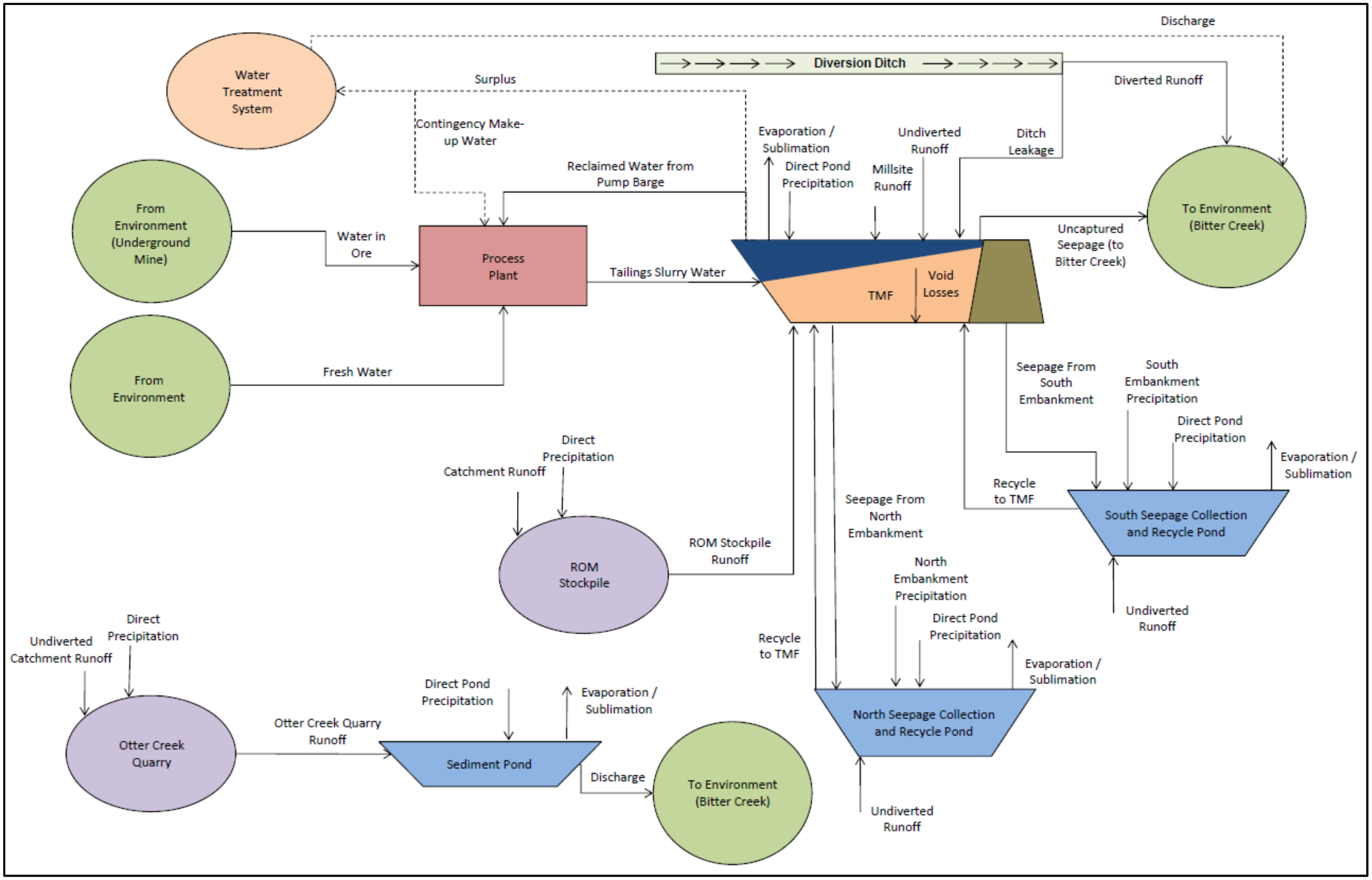

Figure 3.1 Bromley Humps Water Management Schematic (Year -1 to Year 6)

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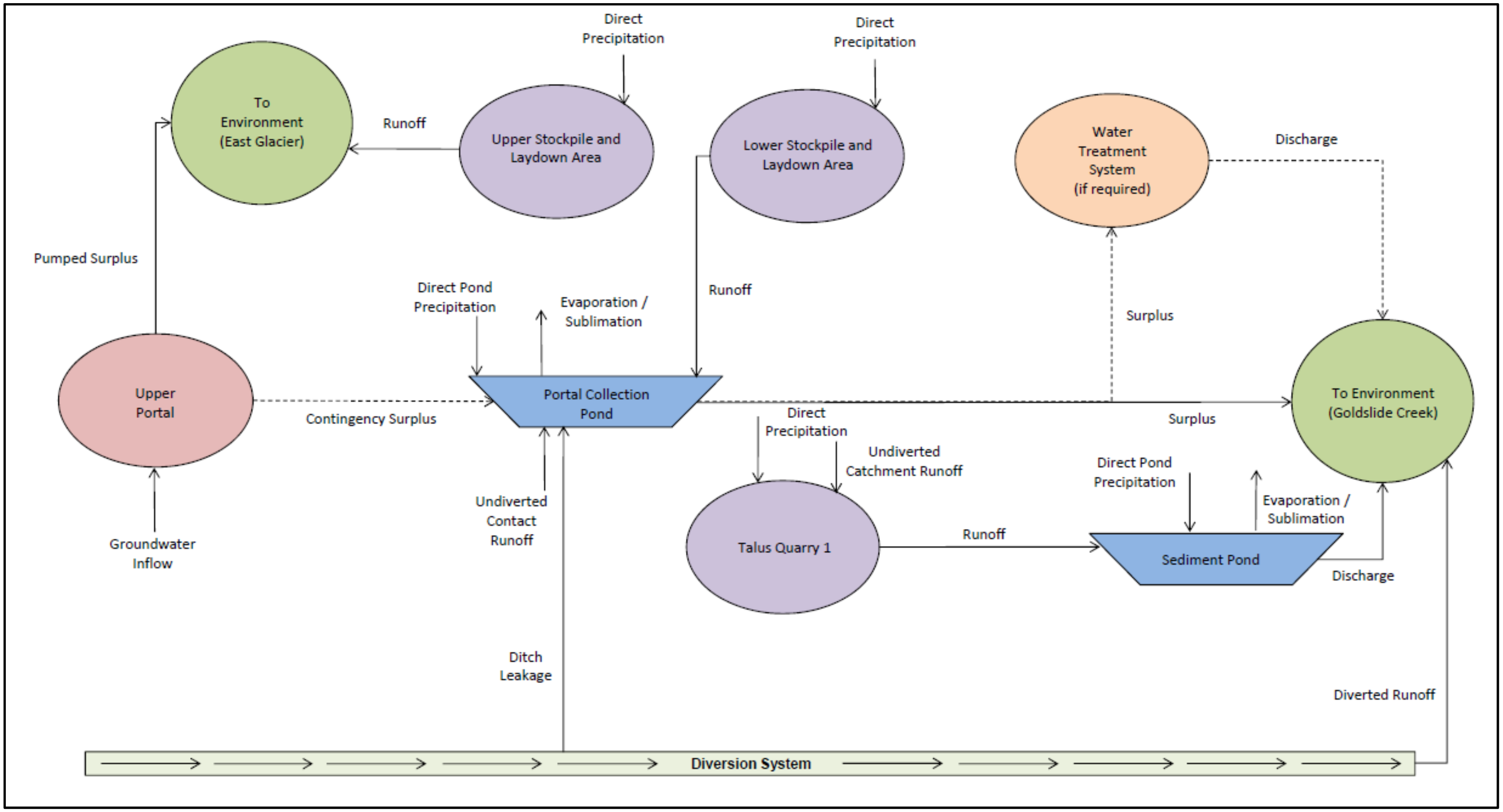

Figure 3.2 Mine Site Water Management Schematic (Year -1 to Year 1.5)

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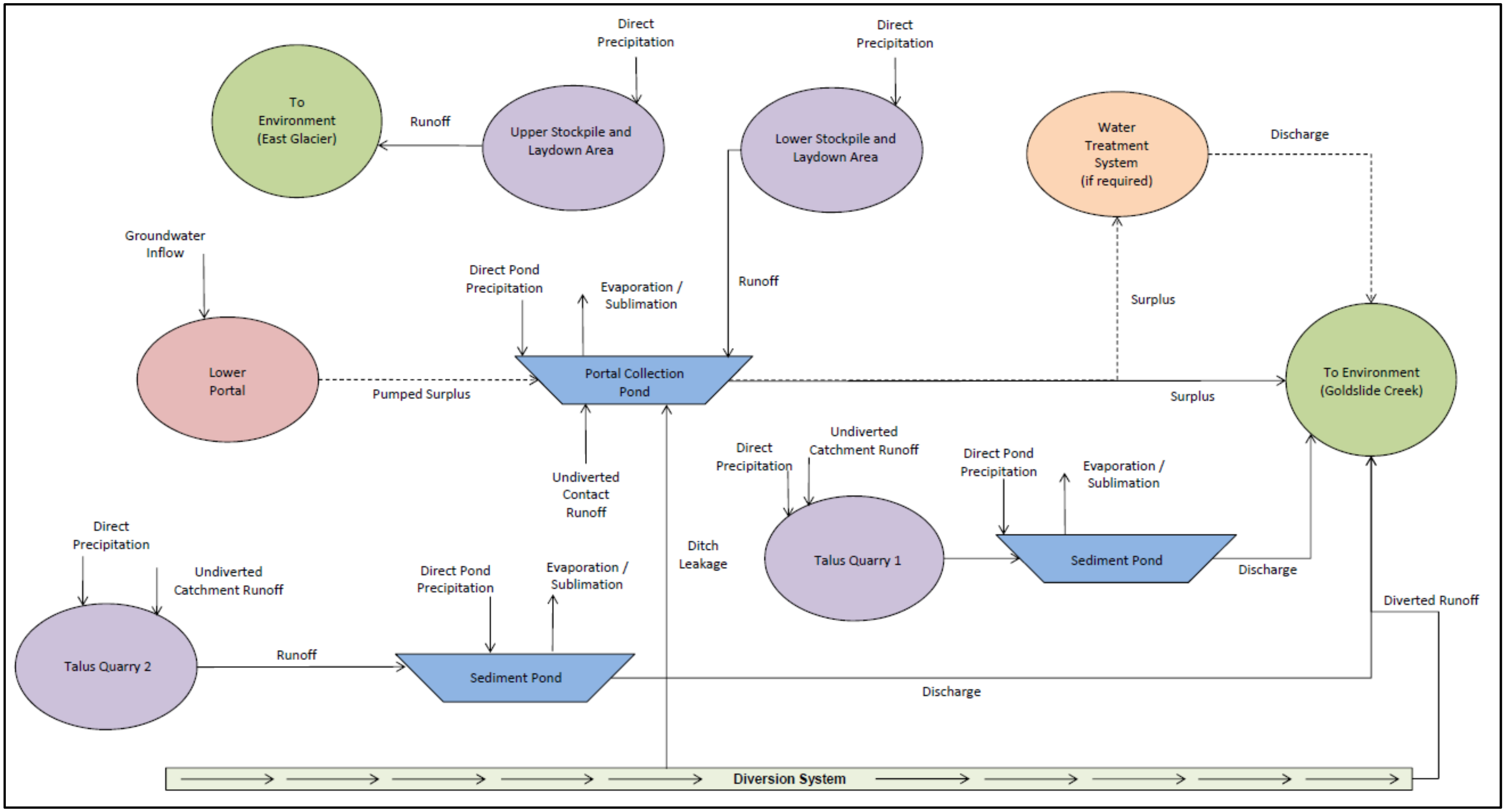

Figure 3.3 Mine Site Water Management Schematic (Year 1.5 to Year 6)

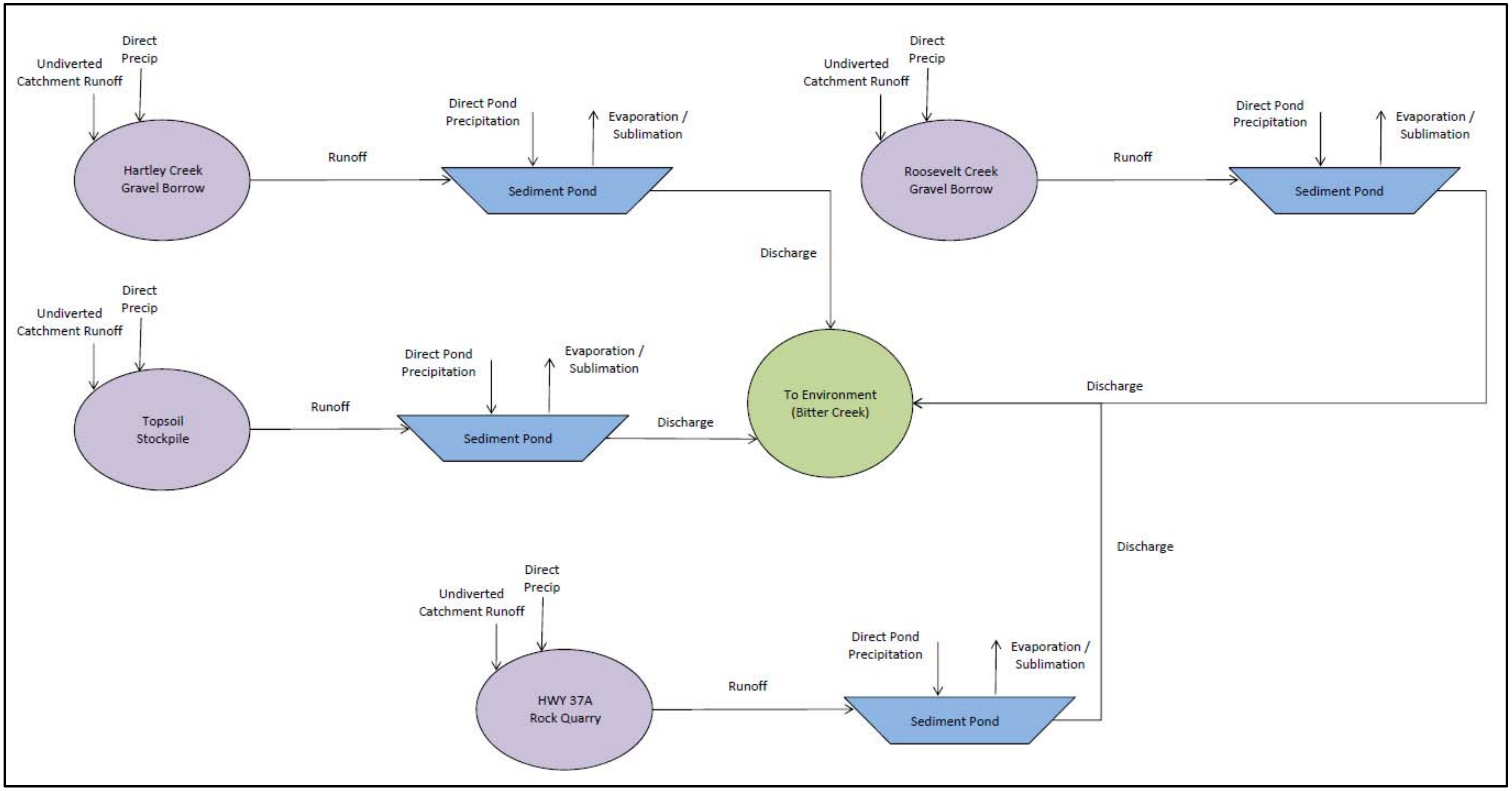

Figure 3.4 Additional Borrow and Quarry Schematic (Year -1 to Year 6)

4 – RESULTS

4.1 GENERAL

The preliminary water balance results, for both cases and all three climatic conditions considered, suggest that the site is in an annual water surplus. The water balance is sensitive to the hydrometric input assumptions and uncertainty in the inputs, and therefore this should be considered when using the results for planning purposes. The input variables that have the greatest influence on the results at Bromley Humps are the MAP, and the millwater requirements.

The monthly surplus volumes will be managed with an active discharge scheme to prevent unscheduled surplus discharge and maintain a manageable supernatant pond volume. The discharge is assumed to be pumped to the Water Treatment Plant, and then released to Bitter Creek. The base case and adjusted case modeled discharge rates are summarized in Table 4.1 and Table 4.2, respectively.

Table 4.1 Base Case Discharge Rates

Month, Year	Discharge (m^3/month)
March through October, Year 1	10,200
March through October, Year 2	44,400
March through October, Year 3	40,000
March through October, Year 4	22,000
March through October, Year 5	40,000
March through October, Year 6	35,000

Table 4.2 Adjusted Case Discharge Rates

Month, Year	Discharge (m^3/month)
March through October, Year 1	30,000
March through October, Year 2	50,000
March through October, Year 3	65,000
March through October, Year 4	35,000
March through October, Year 5	60,000
March through October, Year 6	56,000

The discharge rates are assumed to be constant during the eight month window of March through October, with zero discharge from November through February.

The water management plan could be potentially optimized further during the detailed design phase by reviewing catchment areas contributing to the TMF and determine if additional diversions could be incorporated to reduce the overall areas reporting to the TMF.

4.2 BASE CASE

The monthly TMF pond volume, discharge rates, surplus volume and deficit volume are shown on Figure 4.1. The pond volume, under average climatic conditions, fluctuates between 22,000 and 280,000 m^3. The surplus and deficit volumes are shown for the average climatic condition only, as the discharge rates can only be applied to this climatic condition in the model. The surplus and deficit volumes are a result of the discharge rates, and therefore it is anticipated that the pond will potentially be in a deficit condition under abnormally dry conditions in some years and in a surplus condition under abnormally wet conditions in other years.

The expected annual runoff from the Mine Site and various quarries is shown in Table 4.3.

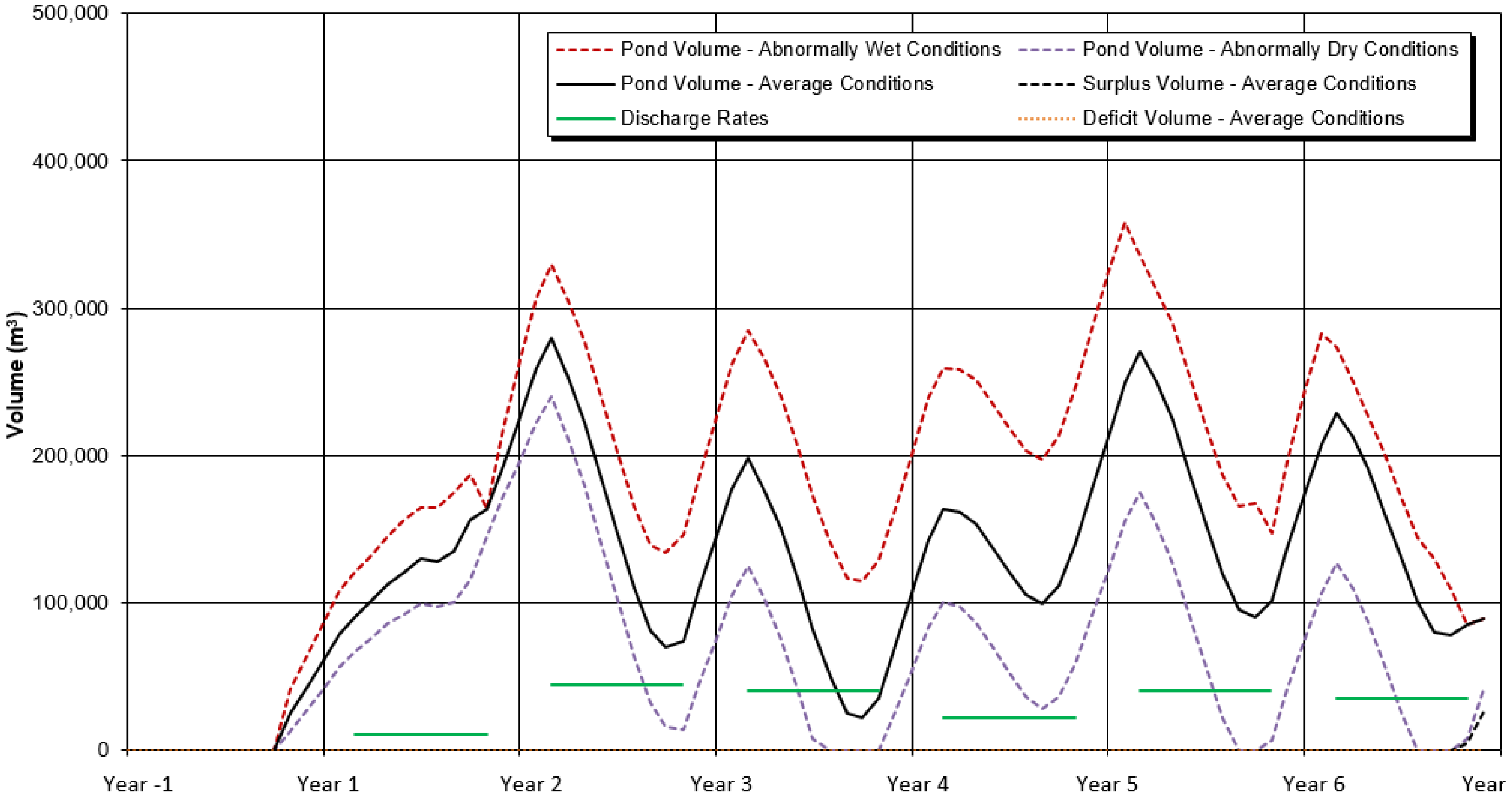

Figure 4.1 Base Case: TMF Facility Volumes

Table 4.3 Base Case: Auxiliary Water Management Facilities Mean Annual Inflow Volumes

Facility	Estimated Annual Inflow (m^3/year)
Portal Collection Pond	2,300,000
Talus Quarry 1 Sediment Pond	289,000
Talus Quarry 2 Sediment Pond	305,000
Topsoil Stockpile Sediment Pond	23,000
Otter Creek Rock Quarry Sediment Pond	80,000
Roosevelt Borrow Sediment Pond	77,000
Hartley Gulch Borrow Sediment Pond	72,000
HWY 37A Quarry Sediment Pond	294,000

4.3 ADJUSTED CASE

The monthly TMF pond volume, discharge rates, surplus volume and deficit volume are shown on Figure 4.2. The pond volume, under average climatic conditions, fluctuates between 9,000 and 336,000 m^3. The surplus and deficit volumes are shown for the average climatic condition only, as the discharge rates can only be applied to this climatic condition in the model. The surplus and deficit volumes are a result of the discharge rates, and therefore it is anticipated that the pond will potentially be in a deficit condition under abnormally dry conditions in some years and in a surplus condition under abnormally wet conditions in other years.

The expected annual runoff from the Mine Site and various quarries is shown in Table 4.4.

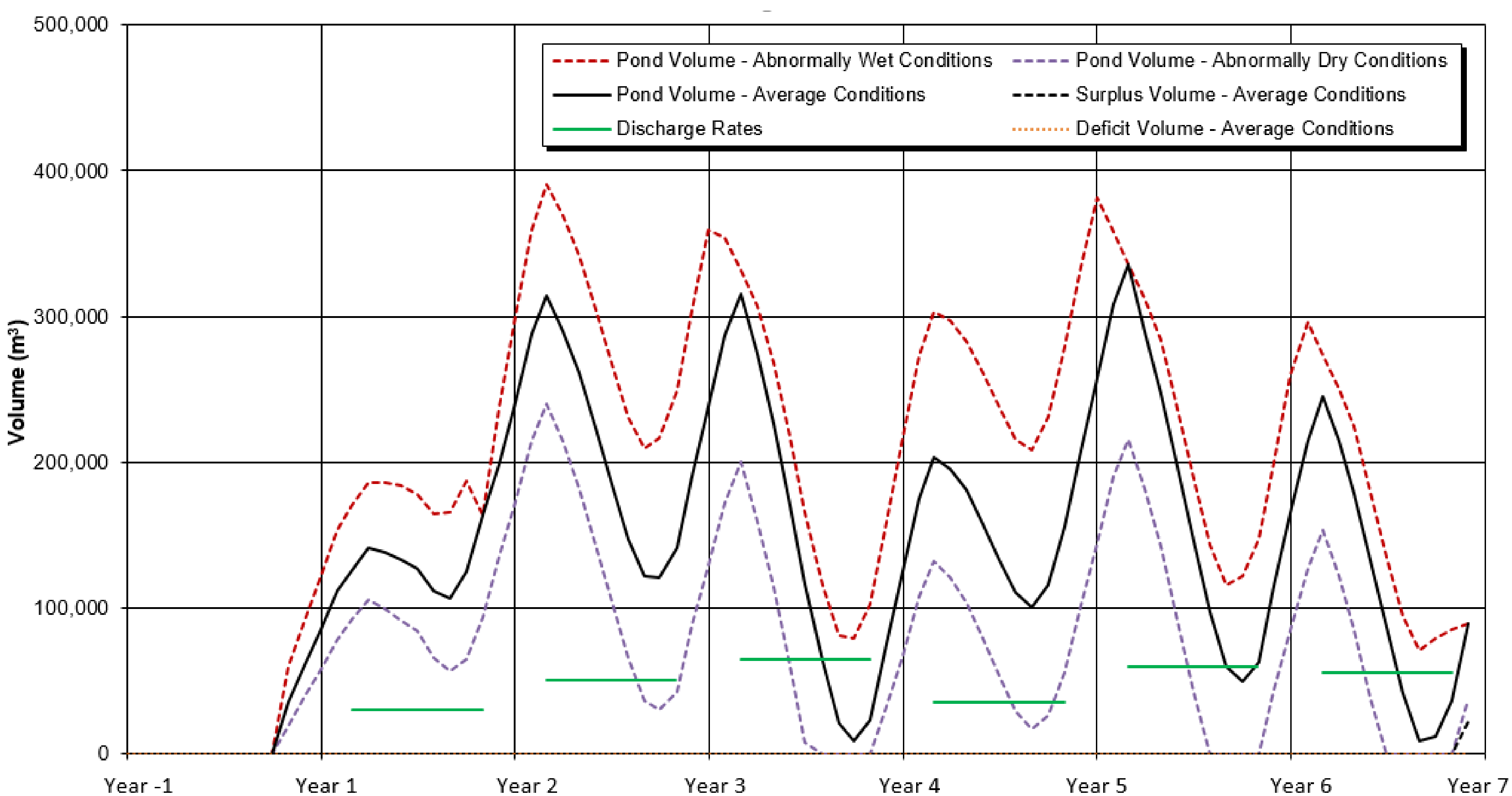

Figure 4.2 Adjusted Case: TMF Facility Volumes

Table 4.4 Adjusted Case: Auxiliary Water Management Facilities Mean Annual Inflow Volumes

Facility	Estimated Annual Inflow (m^3/year)
Portal Collection Pond	2,300,000
Talus Quarry 1 Sediment Pond	346,000
Talus Quarry 2 Sediment Pond	365,000
Topsoil Stockpile Sediment Pond	32,000
Otter Creek Rock Quarry Sediment Pond	112,000
Roosevelt Borrow Sediment Pond	107,000
Hartley Gulch Borrow Sediment Pond	100,000
HWY 37A Quarry Sediment Pond	412,000

4.4 CONCLUSIONS

The above results suggest the TMF is expected to operate in a surplus condition and will be managed by discharging between 10,200 m^3 per month and 44,400 m^3 per month under the base case average conditions. The TMF will discharge between 30,000 m^3 per month and 65,000 m^3 per month under the adjusted case average conditions.

The average annual inflow to the Portal Collection Pond is estimated at 1.8 million m^3 while only the Upper Portal is operational and 2.3 million m^3 from years two through six when both the Upper and Lower Portals are operational. These results are nearly identical for the base and adjusted cases, as shown in Table 4.3 and Table 4.4, because the primary inflows to the pond are from the portals, which do not depend on the precipitation models and are representative of groundwater flows.

The results presented herein contain a moderate amount of uncertainty based on the availability of data used to estimate the hydrometeorology parameters. Inputs and runoff routing in the water balance should be refined during the detailed design phase of the Project.

5 – REFERENCES

Knight Piésold Ltd. (KP), 2017a. *Bromley Humps TMF Seepage and Stability Analysis.* KP Ref. No. VA17-00261. Prepared for IDM Mining Ltd., March 2017.

Knight Piésold Ltd. (KP). 2017b. *Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs.* KP Ref. No. VA17-00512. Prepared for IDM Mining Ltd., April 2017.

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SRK Consulting Inc. (SRK). 2017b. *Snowmelt Analysis at Red Mountain Project Based on Elevation*. December 2016.

6 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

PROFESSIONAL PROVINCE ENGINEER

<Original signed by> UST 4, 2017

Prepared:

Justin Murray, P.Eng.
Project Engineer

<Original signed by>

Reviewed:

Mediha Hodzic, P.Eng.
Project Engineer

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Reviewed:

Greg Smyth, B.Sc.
Project Manager | Associate

Approval that this document adheres to Knight Piésold Quality Systems: <Original signed by>

APPENDIX A

ADDITIONAL ANALYSIS ON PRECIPITATION ESTIMATES FOR ENGINEERING DESIGN AND WATER BALANCE INPUTS

(Pages A-1 to A-5)

Knight Piésold
CONSULTING

www.knightpiesold.com

MEMORANDUM

To:	Mr. Jim Fogarty	Date:	April 20, 2017
Copy To:	Violeta Martin, Justin Murray, Mediha Hodzic	File No.:	VA101-00594/04-A.01
From:	Jaime Cathcart	Cont. No.:	VA17-00512

Re: Additional Analysis on Precipitation Estimates for Engineering Design and Water Balance Inputs

SRK developed precipitation values for the Red Mountain Project, which are presented in the Red Mountain Underground Gold Project – Baseline Climate and Hydrology Report (SRK 2017). Due to the limited site and applicable regional climate and streamflow datasets that were available to SRK for the hydrometeorological assessment, there is considerable uncertainty associated with the precipitation values developed to date. This memorandum presents the rationale used by KP to select mean annual precipitation (MAP) and extreme precipitation values for the Project that will be used for water balance modelling, water management design, and dam safety considerations. These values differ somewhat from the values presented by SRK, primarily due to the quantification of an orographic factor. While SRK's hydrometeorological assessment did not explicitly account for an orographic effect at the Red Mountain Project site, it was acknowledged in their report that theoretically there should be a relationship between elevation and MAP. We have built upon their baseline assessment and developed a rationale for estimating precipitation values for different elevations in the project area.

Baseline Estimates (SRK 2017)

The values presented in the SRK Baseline Climate and Hydrology Report (SRK 2017) are as follows:

Precipitation. The regional meteorological station daily precipitation most representative with the site is Stewart A with a MAP of 1847 mm/yr.

Intensity duration frequency data for Stewart A provides an average intensity of 5.9 mm/hr for a 24-hour, 100-year return period event. The annual probable maximum precipitation of Stewart A was estimated to be 481 mm.

Table 4-6: Intensity-Duration-Frequency (IDF) Data for Red Mountain

Storm Duration		Average Intensity (mm/hr)					
		Return Period (yrs)					
min	hours	2	5	10	25	50	100
5	0.08	24.7	35.3	42.2	51	57.5	64
10	0.17	17.1	22.6	26.3	30.9	34.4	37.8
15	0.25	13.8	17.7	20.2	23.4	25.8	28.1
30	0.50	9.5	11.5	12.8	14.5	15.7	16.9
60	1	7.1	8.4	9.3	10.3	11.1	11.9
120	2	5.9	7.2	8	9.1	9.9	10.6
360	6	4.5	5.5	6.2	7.1	7.8	8.4
720	12	3.6	4.5	5.1	5.9	6.4	7
1440	24	2.8	3.7	4.2	4.9	5.4	5.9

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All precipitation estimates generated by SRK for the site are predicated on the assumption that precipitation conditions (other than the proportions of rain and snow) at Environment Canada's (EC) Stewart Airport climate station, which is located at sea level approximately 15 km northwest of the project site, are directly representative of conditions in the project area at an elevation of 1500 m. This conclusion is based on the similarity between concurrent precipitation records for the Stewart A station (elevation 7 m) and the project's Redmount climate station (elevation 1498 m), and the results of a regional assessment of climate data that showed no correlation between precipitation and elevation. It should also be noted that these regional studies indicated MAP estimates for the project of 2110 mm and 2012 mm. Neither of these values include orographic factors, but both are larger than the selected value of 1847 mm, which suggests that 1847 mm is towards the lower end of the range of likely true values.

Concurrent Precipitation Records

The concurrent precipitation records for the Stewart A and Redmount climate stations are shown in Table 1.

Table 1 Concurrent Precipitation Data

Date	Redmount (mm)	Stewart A (mm)
Aug 2015	155.4	217.7
Sep 2015	179.3	217.4
Oct 2015	349.6	389.9
Mar 2016	250.6	61.9
Apr 2016	160.6	163.8
May 2016	128.9	96.1

The precipitation values measured at the two stations are reasonably similar, with the Stewart values generally higher, other than in May 2016, and during March 2016 when the Redmount value is undoubtedly confounded by snowmelt into the gauge. The total precipitation values for the five months excluding March 2016 are 1085 mm for Stewart A and 974 mm for Redmount. The concern with this comparison is with the shortness of the record (only 5 months) and the unknown quality of the Redmount data. The quality is of particular concern because the data have been collected by an automated station in a remote high elevation location, where gauge under-catch is likely to be substantial due to station exposure to high winds. SRK's regional assessment of under-catch at EC stations concludes that there is "no important regional effect in the annual values associated with under-catch," but this conclusion is not applicable for the Project because under-catch is very site and station specific, and the Redmount station is 1300 m higher and very likely far more exposed than even the highest regional station considered. Consequently, the potential for under-catch for the Redmount station is likely much greater than for any of the regional stations considered.

Orographic Effects

SRK's conclusion that conditions at Stewart are directly representative of conditions at Redmount, despite the considerable elevation difference between the two stations (~1500 m), is inconsistent with generally expected patterns merits some review. It is possible that conditions in the project area are generally drier than in Stewart, given that the project is inland from Stewart and the two locations are separated by a topographic feature that may reduce the moisture delivery of marine air masses. However, given the very large difference in elevation between the two stations and the strong orographic patterns that are typical in coastal mountainous areas of BC, it would be unusual for the two stations to have essentially the same mean annual precipitation.

The finding that there is no correlation between precipitation and elevation is contrary to well-documented and scientifically justified precipitation patterns in the coastal mountainous regions of British Columbia (Pike et. al., 2010; Loukas and Quick, 1994; Loukas, 1993; Hogg and Carr, 1985). It is recognized that this pattern is not evident in the regression analysis completed by SRK, but the analysis is hampered by the particulars of the available regional dataset, and in particular the large distances (relative to localized effects) between the stations and their narrow range in elevation. The SRK regression model, which involved correlating the specifics of 42 regional climate stations within a 400 km radius of the site, found that precipitation was strongly correlated with distance from the coast but not with elevation. A review of the dataset, however, indicates that almost all the stations are situated within a very narrow elevation band (75% of the stations are under 100 m elevation and 93% are under 230 m elevation). As such, any orographic effect would be minor, confounded by other factors, and difficult to detect. In Coastal BC, climate zones are very localized, and in order to distinguish the orographic effect over relatively small changes in elevation, the stations would have to be discretized into fairly narrow bands according to distance from the coast, and even then it would likely be difficult because of very localized effects.

As an alternative means of estimating precipitation values for the site, values were obtained from the PRISM climate generation feature on the ClimateBC website. PRISM (Parameter-elevation Regressions on Independent Slopes Model) is a climate analysis system that uses point data, a digital elevation model (DEM), and other spatial datasets to generate gridded estimates of annual, monthly, and event-based climatic parameters (Daly et al. 1994). The PRISM system produced the following mean annual precipitation (MAP) values (1981-2010 climate normal period) for different elevations at the project site:

Table 2 PRISM Precipitation Estimates for the Project Site

Elevation (m)	MAP (mm)
500	2084
1000	2359
1500	2635
2000	2911

This result suggests that precipitation at the site is considerably greater than at Stewart, which has a MAP of 1867 mm (1981-2010 climate normal), and that precipitation varies with elevation at a rate of approximately 2.4% per 100 m. The Stewart MAP of 1867 mm from PRISM is very similar to the Stewart MAP of 1847 mm reported by SRK (2017).

Another method used for evaluating potential orographic precipitation effects in the project area was to develop a simple water balance model for Goldslide Creek, quantify the precipitation necessary to generate the streamflow in that creek, and then determine the orographic effect required to produce that precipitation knowing the difference in elevation between the Goldslide Creek basin and the Redmount climate station. This approach resulted in a MAP estimate of 2066 mm for the Goldslide Creek basin, which has an average elevation of 1756 m. When compared to SRK's MAP estimate of 1846 mm at 1500 m, the difference corresponds to an orographic effect of 4.5% per 100 m.

The water balance approach is predicated on the assumption that SRK's estimates of both the mean annual runoff (MAR) for Goldslide Creek and the MAP for the Redmount station are correct. Given the large uncertainty in these values, there is accordingly considerable uncertainty in the orographic estimate. It must be noted, however, that the PRISM based MAP and orographic values also have considerable uncertainty, since they are based on algorithms that are not particularly well calibrated for the project area due to the lack of relevant climate data. Nonetheless, based on years of experience with estimating hydrometeorological parameters in Coastal BC, and an understanding that orographic effects are often in the order of 3%/100 m for very steep drainages, it is believed that the PRISM based orographic value of 2.4%/100 m is likely more realistic than the water balance based value of 4.5%/100 m.

Mean Annual Precipitation (MAP)

The MAP for the project area is estimated by SRK to be 1847 mm at an elevation of 1500 m (SRK 2017). Assuming this value is correct, an equivalent value at an elevation of 500 m can be developed by applying the orographic factor of 2.4% per 100 m orographic, as discussed above. This results in a MAP value of 1457 mm at 500 m elevation.

Using PRISM, alternate estimates of the MAP at 500 m and 1500 m were determined to be 2084 mm and 2635 mm, respectively.

It is strongly recommended that the mine water balance be assessed with both sets of values since they are both reasonably plausible: Case (i) MAP = 1457 mm at 500 m and 1847 mm at 1500 m; Case (ii) MAP = 2084 mm at 500 m and 2635 mm at 1500 m.

Intensity-Duration-Frequency (IDF) Values

The IDF values provided by SRK for the site, as listed in Table 4-6 in the report (SRK 2017), and as shown above, are from the Stewart A climate station, as published by EC. These values are presented in the report as being generally applicable for the site, with no mention of variation with elevation. However, the onshore upslope flow of maritime air typically produces greater precipitation at higher elevations both in terms of MAP and extreme precipitation. This phenomenon is reflected by the orographic augmentation factors provided in the Rainfall Frequency Atlas for Canada (Hogg and Carr, 1984), which, for coastal mountainous areas in BC, specifies very general factors of 1.5 for durations of 2 hours or less, 1.8 for durations of 2 to 11 hours, and 2.0 for durations of 12 hours or more. KP, however, only uses 24 hour values for design purposes, and since MAP is highly correlated to 24 hour extreme precipitation (Cathcart, 2001), a reasonable approach for adjusting the base 24 hour extreme values is to use ratios of MAP. Accordingly, and recognizing the uncertainty in the MAP estimates, as discussed previously, the prudently conservative approach of using MAP estimates from PRISM was adopted for calculating ratios in this analysis.

For example, since the PRISM based MAP estimate is 2084 mm at elevation 500 m in the Project area, and since the SRK IDF values correspond to precipitation conditions at Stewart, which SRK has computed as having a MAP of 1847 mm, the orographic factor required to adjust the 24 hour extreme values to elevation 500 m at the site is 2084 mm/1847 mm, which is 1.13. Accordingly, the 100 year 24 hour extreme precipitation intensity (from Table 4-6, SRK 2017) at 500 m is 5.9 mm/hr x 1.13, or 6.7 mm/hr at the site. This translates to a 100 year 24 hour precipitation depth of 160 mm. Similarly, for the TSF catchment area with an average elevation of 820 m, the PRISM based MAP estimate is 2260 mm, and therefore the corresponding ratio is 1.22 and the estimated 100 year 24 hour precipitation total is 5.9 mm/hr x 24 hr x 1.22 = 173 mm. It is interesting to note that these ratios are considerably smaller than the general factors provided in the Rainfall Frequency Atlas of Canada.

Probable Maximum Precipitation (PMP)

The 24 hour PMP for the site is estimated by SRK to be 481 mm (SRK 2017). As with other estimates, this is not specified for any particular elevation, but it is inferred in the report that it is for the Redmount climate station, which is at an elevation of approximately 1500 m. The report states that this value was calculated based on 41 years of extreme 24 hour rainfall data for the Stewart A climate station. It is not clear exactly how these data were compiled, since the IDF values published by EC, as provided in the SRK report, are based on only 33 years of record. Using this dataset, however, the PMP estimated using the Herschfield equation is 435 mm.

The watershed that would drain into the TSF during a PMP event has an average elevation of 820 m (the planned diversion ditch above the TSF is assumed to not function during this event). As mentioned in the IDF discussion, the MAP ratio corresponding to this elevation is 1.22, so applying this factor to the PMP of 435 mm results in an orographically adjusted PMP value of 435 mm x 1.22 = 531 mm (or 530 mm).

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Summary

To conclude, the following precipitation values are recommended for water balance and engineering design calculations:

MAP: The MAP at an elevation of 500 m (approximate average elevation of the area draining into the TSF below the diversion ditch) has been estimated to be between 1457 mm and 2084 mm. The MAP at an elevation of 1500 m (approximate average elevation of the Alpine Area) has been estimated to be between 1847 mm and 2635 mm. It is strongly recommended that the mine water balance be assessed with both sets of values since they are both reasonably plausible: Case (i) MAP = 1457 mm at 500 m, and 1847 mm at 1500 m; Case (ii) MAP = 2084 mm at 500 m, and 2635 mm at 1500 m.

IDF Values: To estimate IDF values for specific elevations in the project area, the values provided by SRK should be adjusted according to factors determined on the basis of ratios of MAP. The SRK values correspond to a MAP of 1847 mm. The MAP for specific elevations at the site should be determined from the PRISM map (http://www.climatewna.com/ClimateBC_Map.aspx) for the 1981-2010 climate normal period.

PMP: The 24 hour PMP suitable for determining the 24 hour probable maximum flood (PMF) for the TSF is 530 mm. This PMP is for the TSF catchment area with an average elevation of 820 m.

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APPENDIX H

MATERIAL TAKE-OFFS

(Pages H-1 to H-4)

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TABLE H.1

IDM MINING INC.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS AND WATER MANAGEMENT FEASIBILITY LEVEL DESIGN
MATERIAL TAKE OFFS AND BILL OF QUANTITIES

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Item Number	Description	Units	Unit Rate	Initial Capital Quantities	Sustaining Capital Quantities						Closure & Reclamation Quantities	Total Life of Mine
				Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7+	
1000	**Tailings Management Facility**											
1100	**TMF Earthworks**											
1110	Foundation Preparation											
1111	Clearing/Grubbing of TMF Footprint - 10 m Offset	m2		148,435	20,830	0	21,620	0	11,075	0	0	**201,960**
1112	Topsoil Stripping of TMF Footprint (150 mm Average Thickness) - 10 m Offset	m3		22,265	3,125	0	3,243	0	1,661	0	0	**30,294**
1113	Overburden Stripping of TMF Footprint (1,000 mm Average Thickness) - 10 m Offset	m3		148,435	20,830	0	21,620	0	11,075	0	0	**201,960**
1114	TMF Side Slopes Shaping - Cut - Drill, Blast	m3		27,635	0	0	0	0	0	0	0	**27,635**
1115	TMF Side Slopes Shaping - Fill (Zone C) - Load, Haul, Place, Spread and Compact (within 500 m)	m3		179,885	0	0	0	0	0	0	0	**179,885**
1120	North TMF Embankment - Bulk Earthworks											
1121	Bedrock Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 500 m)	m3		102,640	0	0	0	0	0	0	0	**102,640**
1122	Granular Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 5 km)	m3		0	161,470	0	194,540	0	109,840	0	0	**465,850**
1123	Filter Zone (Zone F) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		3,333	2,746	0	2,391	0	653	0	0	**9,122**
1130	South TMF Embankment - Bulk Earthworks											
1131	Bedrock Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 500 m)	m3		49,275	0	0	0	0	0	0	0	**49,275**
1132	Granular Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 5 km)	m3		0	108,010	0	142,095	0	85,800	0	0	**335,905**
1133	Filter Zone (Zone F) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		4,430	4,194	0	3,080	0	764	0	0	**12,467**
1140	TMF Basin Floor - Bulk Earthworks											
1141	Granular Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 500 m) - Assume 300 mm over 30% of Basin Floor	m3		3,850	0	0	0	0	0	0	0	**3,850**
1142	Bedding Layer (Zone F) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		13,400	0	0	0	0	0	0	0	**13,400**
1150	TMF Basin Geosynthetic Installation											
1151	Surface Preparation for Geomembrane Liner Installation - S/C/Moisture Condition	m2		101,125	13,875	0	9,450	0	5,320	0	0	**129,770**
1152	80 mil HDPE Liner - Supply, Deliver and Install	m2		101,125	13,875	0	9,450	0	5,320	0	0	**129,770**
1153	Non-woven 12 oz./yd^2 Geotextile - Supply and Install	m2		202,250	27,750	0	18,900	0	10,640	0	0	**259,540**
1154	1000 mm x 1000 mm Liner Anchor Trench - Process, Load, Haul, Place, Spread and Compact	m		1,700	525	0	560	0	570	0	0	**3,355**
1160	TMF Embankment Spillway											
1161	80 mil HDPE Geomembrane Liner - Supply, Deliver and Install	m2		2,080	1,695	0	1,375	0	1,255	0	0	**6,405**
1162	Non-woven 12 oz./yd^2 Geotextile - Supply and Install	m2		2,080	1,695	0	1,375	0	1,255	0	0	**6,405**
1163	Material Cut - Within Footprint - Load, Haul	m3		2,705	2,900	0	2,040	0	1,750	0	0	**9,395**
1170	Geotechnical Instrumentation											
1171	Survey Monuments	ea.	$ 2,000.00	2	2	0	2	0	4	0	0	**10**
1180	TMF Foundation Drain System											
1181	100 mm Diameter N12 PE Perforated Drain Pipe	m	$ 7.50	1,000	0	0	0	0	0	0	0	**1,000**
1182	Drainage Layer (Zone T) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		280	0	0	0	0	0	0	0	**280**
1190	TMF Underdrain System											
1191	100 mm Diameter N12 PE Perforated Drain Pipe	m	$ 7.50	790	0	0	0	0	0	0	0	**790**
1192	Filter Sand Drainage Blanket (Zone F) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		11,060	0	0	0	0	0	0	0	**11,060**
1193	Basin Drain Sump (Zone T) - Load, Haul, Place, Spread and Compact (within 5 km)	m3		335	0	0	0	0	0	0	0	**335**
1194	Riser Pipe Fill (Zone C) - Load, Haul, Place, Spread and Compact (within 5 km)	m3		0	100	0	130	0	70	0	0	**300**

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MATERIAL TAKE OFFS AND BILL OF QUANTITIES

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Item Number	Description	Units	Unit Rate	Initial Capital Quantities	Sustaining Capital Quantities						Closure & Reclamation Quantities	Total Life of Mine
				Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7+	
1200	**TMF Tailings Distribution and Reclaim Systems**											
1210	Tailings Distribution System											
1211	20 kW Centrifugal Tailings Pump with VFD (54 m3/hr +-12% @ 43 m TDH) (1 operational + 1 standby)	ea.	$ 25,000.00	2	0	0	1	0	0	0	0	**3**
1212	100 mm Dia. HDPE DR11 Tailings Distribution Pipeline	m	$ 41.20	860	136	91	141	96	136	100	0	**1,560**
1213	100 mm Dia. HDPE DR11 Tailings Discharge Spigots (50 m spacing)	m	$ 41.20	80	10	10	10	10	10	10	0	**140**
1214	Tailings Distribution Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1220	Reclaim Water System											
1215	Reclaim Water Barge	LS	$ 1,000,000.00	1	0	0	0	0	0	0	0	**1**
1221	25 kW Centrifugal Water Pump (52 m3/hr @ 64 m TDH) (3 operational + 1 standby)	ea.	$ 20,000.00	4	0	0	0	0	2	0	0	**6**
1222	150 mm Dia. HDPE DR17 Process Water Reclaim Pipeline	m	$ 50.43	450	45	45	45	45	45	45	0	**720**
1223	Reclaim Water Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1230	Surplus Water Management System											
1231	10 kW Centrifugal Water Pump (108 m3/hr @ 15 m TDH) (1 operational + 1 standby)	ea.	$ 5,000.00	2	0	0	0	0	2	0	0	**4**
1232	150 mm Dia. HDPE DR17 Surplus Water Pipeline	m	$ 50.43	450	45	45	45	45	45	45	0	**720**
1233	150 mm Dia. HDPE DR11 Surplus Water Pipeline	m	$ 55.47	100	10	10	10	10	10	10	0	**160**
1234	Reclaim Water Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1300	**TMF Water Management**											
1310	TMF Non-Contact Water Diversion Channel											
1311	80 mil HDPE Geomembrane Liner - Supply, Deliver, Install	m2		4,875	0	0	0	0	0	0	0	**4,875**
1320	Seepage Collection Ditches	m	$ 250.00	750	0	0	0	0	0	0	0	**750**
1330	North TMF Embankment Seepage Collection Pond											
1331	Embankment Construction - Material Cut/Fill - Within Footprint - Load, Haul, Place, Spread, Compact	m3		7,025	0	0	0	0	0	0	0	**7,025**
1332	80 mil HDPE Geomembrane Liner - Supply, Deliver, Install	m2		1,930	0	0	0	0	0	0	0	**1,930**
1333	25 kW Centrifugal Water Pump (65 m3/hr @ 75 m TDH) (1 operational)	ea.	$ 20,000.00	1	0	0	0	0	1	0	0	**2**
1334	125 mm Dia. HDPE DR17 Seepage Water Pipeline	m	$ 44.38	245	25	25	25	25	25	25	0	**392**
1335	Discharge Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1340	South TMF Embankment Seepage Collection Pond											
1341	Embankment Construction - Material Cut/Fill - Within Footprint - Load, Haul, Place, Spread, Compact	m3		23,370	0	0	0	0	0	0	0	**23,370**
1342	80 mil HDPE Geomembrane Liner - Supply, Deliver, Install	m2		1,750	0	0	0	0	0	0	0	**1,750**
1343	15 kW Centrifugal Water Pump (51 m3/hr @ 50 m TDH) (1 operational)	ea.	$ 15,000.00	1	0	0	0	0	1	0	0	**2**
1344	125 mm Dia. HDPE DR17 Seepage Water Pipeline	m	$ 44.38	165	17	17	17	17	17	17	0	**264**
1345	Discharge Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1350	Construction Dewatering Allowance	LS	$ 50,000.00	4	1	0	1	0	1	0	0	**7**
1360	Sediment & Erosion Control BMP's	ha	$ 1,000.00	16	2	0	2	0	1	0	0	**21**
1370	TMF Underdrain System Wet Well											
1371	2 kW (typ.) Portable Submersible Wet Well Pump (1 operational)	ea.	$ 3,500.00	1	0	0	0	0	1	0	0	**2**
1372	38 mm Dia. HDPE DR11 Basin Drain Discharge Pipeline	m	$ 30.97	70	22	0	16	0	6	0	0	**114**
1373	300 mm Dia. STD Steel Wet Well Riser Pipeline	m	$ 400.00	60	22	0	16	0	6	0	0	**104**
1374	TMF Underdrain Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**

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Item Number	Description	Units	Unit Rate	Initial Capital Quantities	Sustaining Capital Quantities						Closure & Reclamation Quantities	Total Life of Mine
				Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7+	
1400	**Site Water Management**											
1410	Alpine Area Diversion Ditches	m	$ 350.00	855	1,025	680	0	0	0	0	0	**2,560**
1420	250 mm Dia. HDPE DR13.5 Pipeline Upper Portal Dewatering Pipeline (from Adit to Discharge on Cambria Ice Field)	m	$ 85.18	140	0	0	0	0	0	0	0	**140**
1430	250 mm Dia. HDPE DR13.5 Pipeline Lower Portal Dewatering Pipelines (from Adit to Lower Portal Collection Pond)	m	$ 85.18	0	0	450	0	0	0	0	0	**450**
1440	Lower Portal Collection Pond											
1441	Embankment Construction - Material Cut/Fill - Within Footprint - Load, Haul, Place, Spread, Compact	m3		0	0	63,170	0	0	0	0	0	**63,170**
1442	80 mil HDPE Geomembrane Liner - Supply, Deliver, Install	m2		0	0	5,985	0	0	0	0	0	**5,985**
1443	100 kW Vertical Turbine Pump (330 m3/hr @ 54 m TDH)	ea.	$ 50,000.00	0	0	2	0	0	0	0	0	**2**
1444	Pump Pontoon/Barge	ea.	$ 100,000.00	0	0	1	0	0	0	0	0	**1**
1445	250 mm Dia. HDPE DR17 Discharge Pipeline	m	$ 85.18	0	0	70	7	7	7	7	0	**98**
1446	Discharge Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1450	ROM Stockpile Collection Ditch											
1451	Collection Ditch to TMF	m	$ 350.00	300	0	0	0	0	0	0	0	**300**
1460	Freshwater Supply System (from Bitter Creek)											
1461	10 kW Submersible Pump/Motor (14 m3/hr @ 134 m TDH) with Steel Pipe Sleeve	ea.	$ -	1	0	0	0	1	0	0	0	**2**
1462	75 mm Dia. HDPE DR11 Freshwater Supply Pipeline	m	$ 85.18	350	35	35	35	35	35	35	0	**560**
1463	Pipeline Fittings and Valves	%	20%	20%	20%	20%	20%	20%	20%	20%	0%	**20%**
1470	Sediment Ponds											
1471	Talus Quarry 1 - Sediment Pond - Material Cut	m3		0	0	1,480	0	0	0	0	0	**1,480**
1472	Talus Quarry 2 - Sediment Pond - Material Cut	m3		0	0	2,525	0	0	0	0	0	**2,525**
1473	Otter Creek Quarry - Sediment Pond - Material Cut	m3		0	2,740	0	0	0	0	0	0	**2,740**
1474	Roosevelt Creek Borrow Pit - Sediment Pond - Material Cut	m3		0	2,525	0	0	0	0	0	0	**2,525**
1475	Hartley Gulch Borrow Pit - Sediment Pond - Material Cut	m3		0	1,785	0	0	0	0	0	0	**1,785**
1476	Highway 37A Quarry - Sediment Pond - Material Cut	m3		0	12,185	0	0	0	0	0	0	**12,185**
1477	Sediment Pond Dewatering Pump - 1 kW (typ.) Portable Submersible Pump	ea.	$ 2,000.00	0	4	2	0	0	0	0	0	**6**
1478	Sediment Pond Dewatering Pipeline - 38 mm Dia. HDPE DR11 Dewatering Pipeline	m	$ 30.97	0	200	100	0	0	0	0	0	**300**
1479	Construction Dewatering Allowance (per Pond)	LS	$ 50,000.00	0	4	2	0	0	0	0	0	**6**
1500	**Operating Costs**											
1510	Tailings Distribution System											
1511	Tailings Distribution System - Pumping Costs	MWhr	$ 40.00	0	161	161	161	161	161	161	0	**967**
1511	Tailings Distribution System - Pipeline Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	0%	**2%**
1512	Tailings Distribution System - Pump Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1520	Reclaim Water System											
1521	Reclaim Water System - Pumping Costs	MWhr	$ 40.00	0	657	657	657	657	657	657	657	**4,599**
1522	Reclaim Water System - Pipeline Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1523	Reclaim Water System - Pump Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1532	Surplus Water Management System											
1533	Surplus Water Management System - Pumping Costs	MWhr	$ 40.00	0	88	88	88	88	88	88	88	**613**
1534	Surplus Water Management System - Pipeline Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1535	Surplus Water Management System - Pump Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1530	TMF Underdrain System											
1531	TMF Underdrain System - Pumping Costs	MWhr	$ 40.00	0	1	1	1	1	1	1	1	**7**
1532	TMF Underdrain System - Pipeline Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**
1533	TMF Underdrain System - Pump Maintenance	%	2%	0%	2%	2%	2%	2%	2%	2%	2%	**2%**

Knight Piésold
CONSULTING

TABLE H.1

IDM MINING INC.
RED MOUNTAIN UNDERGROUND GOLD PROJECT

TAILINGS AND WATER MANAGEMENT FEASIBILITY LEVEL DESIGN
MATERIAL TAKE OFFS AND BILL OF QUANTITIES

Print Jun/30/17 15:42:11

Item Number	Description	Units	Unit Rate	Initial Capital Quantities	Sustaining Capital Quantities						Closure & Reclamation Quantities	Total Life of Mine
				Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7+	
1540	Lower Portal Collection Pond											
1541	Lower Portal Collection Pond - Pumping Costs	MWhr	$ 40.00	0	0	613	613	613	613	613	35	**3,101**
1542	Lower Portal Collection Pond - Pipeline Maintenance	%	2%	0%	0%	2%	2%	2%	2%	2%	2%	**2%**
1543	Lower Portal Colelction Pond - Pump Maintenance	%	2%	0%	0%	2%	2%	2%	2%	2%	2%	**2%**
1550	Seepage Management System Pumping Costs	MWhr	$ 40.00	0	3	3	3	3	3	3	3	**20**
1560	Sediment Pond Pumping Costs	MWhr	$ 40.00	0	1	1	1	1	1	1	1	**7**
1600	**Closure and Reclamation**											
1610	TMF Closure and Reclamation											
1611	80 mil HDPE Geomembrane - Supply, Deliver and Install	m2		0	0	0	0	0	0	0	130,000	**130,000**
1612	Bedding Layer (Zone F) - Process, Load, Haul, Place, Spread and Compact (within 5 km)	m3		0	0	0	0	0	0	0	39,000	**39,000**
1613	Granular Fill (Zone C) - Load, Haul and Place, Spread and Compact (within 5 km)	m3		0	0	0	0	0	0	0	294,790	**294,790**
1614	Topsoil Cover at Closure	m3		0	0	0	0	0	0	0	20,196	**20,196**
1615	Surface Revegetation at Closure	m2		0	0	0	0	0	0	0	201,960	**201,960**
1616	Reclaim Barge and Pump Removal	ea.		0	0	0	0	0	0	0	7	**7**
1617	Reclaim and Surplus Water Pipeline Removal	m	$ 34.58	0	0	0	0	0	0	0	1,000	**1,000**
1618	Tailings Distribution Pipeline Removal	m	$ 29.65	0	0	0	0	0	0	0	1,080	**1,080**
1620	TMF Closure Spillway											
1621	Material Cut - Within Footprint - Load, Haul	m3	$ 5.00	0	0	0	0	0	0	0	24,800	**24,800**
1622	80 mil HDPE Geomembrane Liner - Supply, Deliver and Install	m2		0	0	0	0	0	0	0	1,130	**1,130**
1623	Non-woven 12 oz./yd^2 Geotextile - Supply and Install	m2		0	0	0	0	0	0	0	1,130	**1,130**
1630	North TMF Embankment Seepage Collection Pond											
1631	80 mil HDPE Geomembrane Liner Removal	m2	$ 5.00	0	0	0	0	0	0	0	1,930	**1,930**
1632	Embankment Regrading	m3		0	0	0	0	0	0	0	7,025	**7,025**
1633	HDPE Pipeline Removal	m	$ 32.17	0	0	0	0	0	0	0	245	**245**
1634	Pump Removal	ea.		0	0	0	0	0	0	0	1	**1**
1640	South TMF Embankment Seepage Collection Pond											
1641	80 mil HDPE Geomembrane Liner Removal	m2	$ 5.00	0	0	0	0	0	0	0	1,750	**1,750**
1642	Embankment Regrading	m3		0	0	0	0	0	0	0	23,370	**23,370**
1643	HDPE Pipeline Removal	m	$ 32.17	0	0	0	0	0	0	0	165	**165**
1644	Pump Removal	ea.		0	0	0	0	0	0	0	1	**1**
1650	Lower Portal Collection Pond											
1651	80 mil HDPE Geomembrane Liner Removal	m2	$ 5.00	0	0	0	0	0	0	0	5,985	**5,985**
1652	Embankment Regrading	m3		0	0	0	0	0	0	0	63,170	**63,170**
1653	HDPE Pipeline Removal	m	$ 43.80	0	0	0	0	0	0	0	70	**70**
1654	Pump Removal	ea.		0	0	0	0	0	0	0	2	**2**
1655	Barge/Pontoon Removal	ea.		0	0	0	0	0	0	0	1	**1**
1660	ROM Stockpile Collection Ditch											
1661	Collection Ditch to TMF Removal	m		0	0	0	0	0	0	0	300	**300**
1670	Upper Portal Dewatering Pipeline Removal	m	$ 43.80	0	0	140	0	0	0	0	0	**140**
1680	Lower Portal Dewatering Pipeline Removal	m	$ 43.80	0	0	0	0	0	0	0	450	**450**
1690	Diversion Ditch Removal	m		0	0	0	0	0	0	0	3,610	**3,610**

\\KPL\VA-Prj$\1\01\00594\04\A\Report\4 - Feasibility Design Report\Rev 0\Appendices\Appendix H - MTO's\[Material Take Offs_r0.xlsx]Table H.1

NOTES:
1. QUANTITIES ARE NEAT LINE QUANTITIES WITH NO WASTE OR OVERLAP OF MATERIALS ASSUMED
2. ALLOWANCES FOR PIPELINE FITTINGS AND VALVES ASSUMED AS 20% OF TOTAL PIPELINE COSTS
3. ALLOWANCES FOR PUMP AND PIPELINE MAINTENANCE ASSUMED AS 2% OF TOTAL PUMP AND PIPELINE COSTS ANNUALLY.

0	30JUN'17	ISSUED FOR INFORMATION	JEF	KDE
REV	DATE	DESCRIPTION	PREP'D	RVW'D