TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT



TAILINGS STORAGE FACILITY DESIGN

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VA101-460/3-5
Rev 0
September 12, 2017

Knight Piésold
CONSULTING
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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY DESIGN
VA101-460/3-5

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EXECUTIVE SUMMARY

The Black Butte Copper Project is a proposed copper mine being developed by Tintina Resources Inc. (TRI). The Project is located 32 km north of White Sulphur Springs, Montana. The mine permit boundary encompasses 763.9 hectares (1,887.7 acres) of land composed of long-term mining leases on private ranch lands and 100% owned federal mining claims. The Project involves mining 13.2 Mt of high-grade ore using underground mining methods at a rate of approximately 3,300 tpd over 15 years. Approximately 45% of the tailings produced in milling will be used underground as backfill and the remaining 55% will be stored on surface.

Knight Piésold Ltd. (KP) completed the feasibility level design of the tailings storage facility to support the mine operating permit (MOP) application process. Tailings stored on surface will be thickened with cement and fly ash or slag prior to deposition in the Cemented Tailings Facility (CTF) to create a non-flowable, low permeability tailings mass. Process water will be stored in a separate Process Water Pond (PWP) and water that collects in the CTF will be pumped to the PWP for storage. The feasibility design was based on the preferred locations for the waste and water management facilities, as determined with TRI. All design work completed by KP and presented in this document was completed under the supervision of Ken Brouwer, P.E., the Engineer of Record for the CTF. Ken Brouwer is a registered Professional Engineer in the State of Montana (License 10020PE) with over 30 years of experience specializing in mining waste management.

This feasibility design was completed using the October 2015 production schedule (developed by AMEC and Tetra Tech) as the design basis. Ultra-thickened tailings with a solids content of 79% will be pumped from the mill for storage at the CTF. The tailings will have 0.5% to 2% by weight cement, fly ash, or slag additives. The CTF has been sized to permanently store 3.56 Mm^3 of tailings, 0.35 Mm^3 of waste rock, with provision for short term storage of storm water. The CTF will be operated with a minimal volume of water that will report to a collection sump and be pumped to the PWP.

The CTF has a HIGH hazard rating based on Montana State, FEMA and ICOLD guidelines for a HIGH hazard classification dam. The Inflow Design Flood (IDF) used to design the water management systems and size the CTF for storm water storage is the Probable Maximum Flood (PMF). The design earthquake event is the 1 in 10,000 year event.

The CTF utilizes a single embankment to close off the natural topographic containment to the west. A cut-fill balance will be achieved through impoundment shaping to provide the required storage capacity and embankment fill materials. The CTF has a double liner system comprising a 7.6 mm high flow geonet layer sandwiched between layers of 100 mil High Density Polyethylene (HDPE) geomembrane. An internal basin drain will be incorporated above the geomembrane liner system to allow the collection of tailings bleed water and maintain low hydrostatic head on the geomembrane. The basin drain will be connected to a wet well sump and reclaim pump system in the CTF. Tailings bleed water and accumulated storm water will be pumped from the CTF to the PWP where it will be stored and used as process make-up water, or treated and disposed. Water from storm events, including the IDF, will be temporarily stored in the CTF and transferred to the PWP as quickly as possible, once the storage capacity in the PWP is available. The CTF will be constructed in two stages; the Stage 1 impoundment will provide storage for all pre-production development waste rock and 4 years of operational production. The second and final stage will be constructed in the fourth year of operations and provides the remaining 11 years of tailings storage capacity.

The PWP will have sufficient capacity to contain all process water requirements for the mill, the PMF event water reporting directly to the PWP, and storm water reporting to the CTF (up to the 1 in 500 year 24 hour storm event).

The CTF excavation will locally encounter the groundwater table. Foundation drains will be constructed beneath the CTF geomembrane to minimize hydrostatic head against the bottom geomembrane, and to collect groundwater flow and potential seepage beneath the impoundments. This water will be delivered to foundation drain collection ponds for pumping back to the CTF. None of the other mine facility excavations are anticipated to intercept the groundwater table.

Geotechnical instrumentation will be installed in the CTF embankment fill and foundation. The instrumentation will be monitored as part of the detailed monitoring plan to be developed for the facilities. The monitoring will be carried out to assess performance and to identify any conditions that differ from those assumed during design and analysis. Amendments to the ongoing designs and/or remediation work can be implemented to respond to changing conditions, should the need arise.

The primary objective of reclamation and closure activities will be to ensure physical and chemical stability of the CTF and ensure that acceptable downstream water quality is maintained. Closure and reclamation will focus on removal of surface infrastructure aside from the CTF and the CTF diversion channel, and covering exposed tailings. Additional closure work will involve progressive reclamation and revegetation of the embankments and any other disturbed surfaces.

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ABBREVIATIONS

ARM ... Administrative Rules of Montana
ARD ... acid rock drainage
BBCP or the Project ... Black Butte Copper Project
CTF ... Cemented Tailings Facility
DNRC ... Department of Natural Resources
EDGM ... earthquake design ground motion
FEMA ... Federal Emergency Management Agency
HDPE ... High Density Polyethylene
PWP ... Process Water Pond
FOS ... Factor of Safety
ICOLD ... International Commission on Large Dams
masl ... meters above sea level
MCA 82-4-3 ... Montana Code Annotated, Title 82, Chapter 4, Part 3
MCE ... Maximum Credible Earthquake
MDE ... Maximum Design Earthquake
MDEQ ... Montana Department of Environmental Quality
MOP ... Mine Operating Permit
Mt ... million tonnes
NCWR ... Non-Contact Water Reservoir
PGA ... Peak Ground Acceleration
PMP ... Probable Maximum Precipitation
PMF ... Probable Maximum Flood
PWP ... Process Water Pond
QPP ... Quantitative Performance Parameter
SB 409 ... Senate Bill 409
TOMS ... Tailings Operation, Maintenance, and Surveillance
tpd ... tonnes per day
TRI ... Tintina Resources Inc.
TT ... Tetra Tech
WTP ... Water Treatment Plant

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

The Black Butte Copper Project (the Project) is a proposed copper mine being developed by Tintina Resources Inc. (TRI). It is located approximately 32 km north of White Sulphur Springs, Montana. The mine permit boundary encompasses 763.9 hectares (1,887.7 acres) of land consisting of long-term mining leases on private ranch lands. The site is approximately 5 km west of U.S. Highway 89, and is accessible by maintained gravel roads.

The deposit is located within an extensive dolomitic shale-hosted series of bedded sulphide zones that occur at multiple levels down to a depth of 750 m. A total of 13.2 Mt of high-grade ore will be extracted using underground mining methods at a rate of approx. 3,300 tpd over a 15 year mine life. Approximately 45% of the tailings generated from milling will be used underground as backfill and the remaining 55% will be stored as cemented paste on surface in the Cemented Tailings Facility (CTF).

Knight Piésold Ltd. (KP) has completed feasibility level designs of the waste and water management facilities. Other consultants involved in the project include Tetra Tech (TT) as the lead consultant and process designer, AMEC as the underground mine and backfill design engineer and Geomin Resources Inc. (GRI) overseeing environmental and mine permitting.

1.2 BACKGROUND

TRI prepared a Preliminary Economic Assessment (PEA) in 2011, which was updated in 2013. As part of the initial PEA development, KP completed a tailings management facility alternatives assessment (KP Ref. No. VA101-460/01-2 Rev 1, February 22 2012) and prepared pre-feasibility level designs and cost estimates for a 2-stage, HDPE lined TMF (KP Ref. No. VA101-460/01-1 Rev 3, May 3 2013). The feasibility level design described herein, with drawings included in Appendix D, was completed concurrently with ongoing mine design and planning and used the production schedule developed by AMEC and Tetra Tech, last updated in October 2015.

KP completed a site investigation (SI) program in 2015 to collect data in support of the feasibility design. All data collected during this program is included in KP Report “2015 Geotechnical Site Investigation Report” (KP Ref. No. VA101-460/03-1, Rev 4, July 6 2017). The SI factual report is provided in Appendix A.

1.3 SCOPE OF REPORT

KP developed the feasibility level design for the Cemented Tailings Facility (CTF). The CTF consists of a double HDPE geomembrane lined impoundment that will contain all tailings to be stored on surface and all waste rock brought to surface, with additional capacity to store water from a Probable Maximum Flood event that reports directly to the CTF. The CTF also has an additional minimum of 2 m (6.6 feet) of freeboard.

A Process Water Pond (PWP) was also designed to store process water and a portion of the contact water for the mine site. The PWP consists of a double HDPE geomembrane lined impoundment that will contain all process water for mill use, contact storm water run-off, and storm event contact water from the CTF (up to and including the 1 in 500 year 24 hour storm event). Design details of the PWP are not presented in this report, but are presented in KP Report "Waste and Water Management Design for MOP Application (KP Ref. No. VA101-460/03-2, Rev 8, July 6, 2017).

Specific items included in the CTF design are listed below:

- Embankment and basin lining systems, including a basin drain.
- Foundation drains and seepage collection and water return systems.
- Diversion channels above the CTF to intercept runoff and direct it to an energy dispersal structure downstream of the CTF. The channels are sized for the PMF event. Water from the diversion channel settlement ponds will be allowed to flow into the wetlands downstream, as it is non-contact water.
- Reclaim water pumps and pipelines to transfer water from the CTF to the PWP.
- Tailings delivery pumps and pipelines to deliver cemented tailings from the mill to the CTF.

This report presents a summary of the design work and drawings developed for the CTF, including assumptions and identified risks or opportunities. All design work completed by KP and presented in this document was completed under the supervision of Ken Brouwer, P.E., the Engineer of Record for the CTF. Ken Brouwer is a registered Professional Engineer in the State of Montana (License 10020PE) with over 30 years of experience specializing in mine waste management.

1.4 MCA 82-4-3

Montana State Legislature passed legislation on April 5, 2015 as a governing legislative document for metal mining in the State of Montana. The requirements listed in the new legislature were incorporated into the Montana Code Annotated, under Title 82. Minerals, Oil, and Gas, Chapter 4. Reclamation, Part 3. Metal Mine Reclamation (MCA 82-4-3). All requirements of MCA 82-4-3 will be addressed for the ongoing design, construction and operation of the Project. The intent of the bill is to ensure that tailings storage facilities are designed, operated, monitored, and closed in a manner that:

- Meets state of practice engineering design standards
- Uses applicable, appropriate, and current technologies and techniques as is practicable given site-specific conditions and concerns, and
- Provides protection of human health and the environment.

Key components of MCA 82-4-3 that pertain to the CTF design include:

- MCA 82-4-375 – Engineer of Record (EOR) selection and duties
- MCA 82-4-376 – Tailings storage facility design document, and
- MCA 82-4-377 – Independent Review Panel (IRP) selection and duties.

1.4.1 Engineer of Record

Ken Brouwer, P.E., of KP is the designated EOR for the CTF. He is a registered Professional Engineer in the State of Montana (License 10020PE) with over thirty years of engineering experience. Mr. Brouwer's areas of expertise include geotechnical investigations, tailings management, dam design, construction management, hydrogeological evaluation, rock mechanics, heap leach pads, water management, regulatory liaison and permitting support.

A letter of confirmation stating Ken Brouwer as the EOR is included in Appendix B (KP letter VA15-03202, October 2, 2015).

1.4.2 Tailings Storage Facility Design Document

This report is the design document for the CTF. It meets all criteria required in MCA 82-4-376, and is compliant with other relevant sections of the MCA 82-4-3 legislation.

1.4.3 Independent Review Panel

An Independent Review Panel (IRP) consisting of three independent review engineers or scientists has been selected to review the design and construction of the CTF. The IRP is responsible for reviewing the design document, underlying analysis, and assumptions and ensuring these are compliant with MCA 82-4-376. The IRP assesses the practicable application of current technology in the proposed design, submits comments and indicates any recommended modifications.

The members of the IRP are:

- Mr. Peter Lighthall
- Mr. Jim Swaisgood, and
- Dr. Dirk Van Zyl.

2 – SITE CHARACTERISTICS

2.1 TOPOGRAPHY AND VEGETATION

The Project is located at approximately 1,700 to 1,850 masl (5,578 to 6,070 feet above mean sea level) in relatively flat grassland surrounded by semi-mountainous area. Vegetation consists primarily of grass and low lying shrubs with sparse woodlands along select hilltops that have been left by local ranching activities.

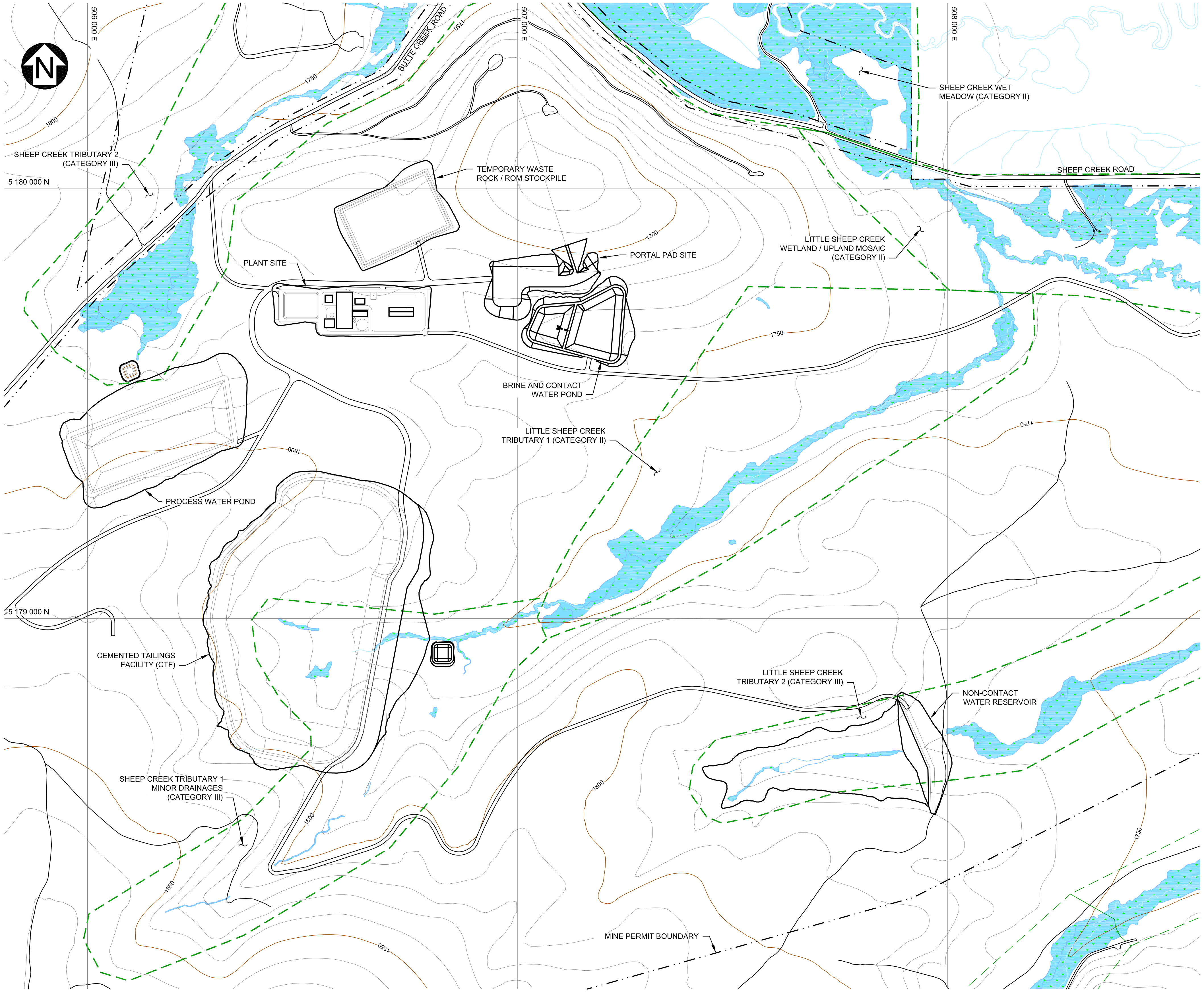
2.1.1 Wetlands Categorization

Westech Environmental Services Inc. under contract to TRI has prepared wetland delineation maps and wetlands are further categorized based on their functionality using the Montana Wetland Assessment Method (Berglund and McEldowney, 2008). This system rates the functionality of the wetlands using up to 12 functions or values, including:

- Plant and animal habitat
- Flood attenuation
- Long and short term water storage and groundwater discharge/recharge
- Food chain support (aquatic and terrestrial)
- Uniqueness, and
- Recreation or education potential.

Functional points are summed up and expressed as a percentage of the possible total score. This score is combined with other criteria (such as wetland size and geomorphology) and the overall wetland is ranked into one of four categories. Category I wetlands have the highest overall ranking that a wetland can receive, with Category IV wetlands receiving the lowest overall score.

The majority of wetlands within the Project area are Category II and III. Figure 2.1 shows the distribution of wetlands throughout the Project area.



PLAN
SCALE A

LEGEND:

CTF ALTERNATE CELL LOCATION

MINE PERMIT BOUNDARY

TRIBUTARY WATERSHED BOUNDARY

WETLANDS

NOTES:

1. TOPOGRAPHIC BASE MAP FROM 2011 AERIAL LIDAR SURVEY WITH MAP PROJECTION: UTM ZONE 12N AND MAP DATUM: NAD83.
2. CONTOUR INTERVAL IS 10 METERS.
3. ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. WETLAND AREAS WITHIN THE CTF WILL BE BACKFILLED DURING CONSTRUCTION.

SCALE A 100 50 0 100 200 300 400 500 m

TINTINA RESOURCES INC.

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GENERAL ARRANGEMENT WITH WETLAND CATEGORIES

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-460/3	5

FIGURE 2.1 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	31AUG'17	ISSUED WITH REPORT	JEF	PP/WAL	KDE

SAVED: M:\1\01\00460\03\A\Acad\FIGS\B12_r0, 8/31/2017 9:17:17 AM , WLAHODA PRINTED: 8/31/2017 9:17:50 AM, Layout, WLAHODA
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2.2 CLIMATE AND PRECIPITATION

Meteorology estimates for the Project site were obtained using a combination of long term regional data, and site specific data collected by TRI. An analysis of the available meteorological data was completed by KP and presented in the memorandum "Black Butte Copper Project Meteorology Data Analysis Update" (KP Ref. No. VA15-02445, May 27, 2015).

The mean annual temperature for the Project site is estimated to be 1.9 °C (34.5 °F). The coldest months are December through February, when the mean monthly temperatures range from -7.8 to -10.2 °C (18 to 50.4 °F), with lows in the range of -20 to -30 °C (-4 to 22 °F). Mean monthly temperatures are below zero from November through March. The warmest months are June through August, when the mean monthly temperatures range from 10.1 to 16.5 °C, and may reach extremes of 35 to 40 °C.

The mean annual precipitation for the Project site is estimated to be 416 mm (16.4 in.). The wettest months are May and June, with mean monthly precipitation values of 58 and 72 mm (2.3 to 2.8 in.), respectively. The driest months are January and February, with mean monthly precipitation values of 20 and 17 mm (0.79 to 0.70 in.), respectively. Based on the mean monthly temperature values, it is expected that most precipitation falls as snow between November and March. The spring freshet, caused by rain and snowmelt, occurs primarily during April and May as temperatures increase.

The mean annual pond evaporation for the Project site is estimated to be 514 mm (20.2 in.), which is 98 mm (3.9 in.) greater than the mean annual precipitation. The highest mean monthly pond evaporation is estimated to occur during July (113 mm) (4.4 in.). No evaporation is expected from November through to March. The annual pattern of monthly pond evaporation estimates is consistent with the temperature pattern, whereby the highest monthly temperatures coincide with the highest pond evaporation.

2.3 GEOLOGY

2.3.1 Regional Geology

The copper deposits of Black Butte occur in middle Proterozoic sediments of the Belt Supergroup, which are extensively exposed in an eastward protrusion of the Rocky Mountain chain called the Helena salient in central Montana (Zieg and Leitch 1993).

During formation of the Belt Basin, a deep water middle Proterozoic calcareous shale facies (Newland Formation) deposited in an embayment, known as the Helena embayment, which extended in a trough-like fashion east into the craton through central Montana (Godlewski and Zieg 1984). The northern boundary of the deeper water portion of the Helena embayment lay along the southern flank of the Little Belt Mountains north of White Sulphur Springs, Montana. During the Cretaceous Laramide orogeny, renewed faulting along the ancestral northern margin of the Helena embayment formed the Volcano Valley thrust fault (Winston 1986). The bedded massive sulphides of the Black Butte are concentrated along the northern margin of the Helena embayment along the Volcano Valley Fault zone.

2.3.2 Local Bedrock Geology

The Newland Shale hosts the Black Butte massive sulphides and consists of a lower dolomitic shale-dominated part which measures approximately 760 m (2,460 feet) thick and an upper carbonate-dominated part approximately 350 m (1,148 feet) thick. The shale was deposited as microturbidites in a sub-wavebase depositional setting. Debris flow conglomerates punctuate the section along the northern margin of the embayment. Though in places the lower Newland shale shows ubiquitous bedded pyrite throughout, more typically sulphides are concentrated in several discrete stratigraphic horizons of greater lateral extent.

2.4 QUATERNARY FAULTING POTENTIAL

A geological study was completed by Whitehall Geogroup Inc. to determine if there is any Quaternary faulting activity in the general area of the CTF (Whitehall, 2017). The study comprised a review of existing geological mapping and LIDAR scanning data, as well a targeted mapping program completed by Whitehall Geogroup Inc.

Previous studies in this area have mapped faults that offset the Proterozoic to earliest Eocene rocks, but the youngest documented activity on these faults occurred during the late Cretaceous and early Eocene. Geologic mapping done by others and in this study indicates that there is no evidence of these older faults or any new faults being active during the Quaternary. This conclusion is supported by LiDAR data analysis and geologic field observations of Cenozoic deposits in the project area, which indicate that the deposits are not disrupted by faulting.

This report is included in Appendix J.

2.5 HYDROGEOLOGICAL CONDITIONS

In-situ hydrogeological testing was completed in March and May of 2015 as part of a site investigation program. A total of 59 falling head response tests were conducted in relatively shallow weathered and competent bedrock throughout the Project area (maximum test depth approximately 30 m (98.5 feet)). A total of 12 tests were completed in weathered bedrock, and the remainder in fresh bedrock. Groundwater levels recorded during testing typically ranged from 5 to 10 m (16 to 32.8 feet) below surface.

Tests completed in weathered bedrock indicate that it has moderate permeability with hydraulic conductivities in the range of $6x10^{-8}$ to $2x10^{-5}$ m/sec. The average measured permeability for weathered bedrock is $9x10^{-7}$ m/sec. Tests completed in fresh bedrock across the project area typically show a low to moderate permeability with hydraulic conductivities estimated in the range of $1x10^{-9}$ to $1x10^{-}6$ m/sec. The average permeability of the fresh bedrock is $4x10^{-7}$ m/sec based on the completed tests.

3 – TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT

3.1 GENERAL

An assessment of tailings management technologies and facility locations was performed to determine the most suitable solution for tailings and site-wide water management. Several storage methods have been successfully employed at operating mines throughout the world, including sub-aqueous slurry deposition, ultra-thickened (paste) tailings disposal and dewatered (dry-stack) tailings. The purpose of the alternatives assessment was to identify the advantages and disadvantages of the disposal methods and use that information to determine the preferred tailings management method and a preferred tailings depositional location for the Project.

3.2 SELECTION CRITERIA

Storage methodologies were reviewed during a group session involving KP, TRI, TT and GRI in February 2015. Multiple options for tailings management were assessed with the following considerations:

- Technical: the suitability of the engineered elements of the proposed options for the site conditions and the requirements of the Project.
- Economic: high level assessment of the cost magnitude associated with the proposed options.
- Environmental impacts: qualitative considerations including disturbance areas, dust control, flood event and seepage control, and impact on the local wetlands and watershed.
- Public (socio-economic) concerns: consideration of available feedback provided to TRI from landowners, local residents, and non-governmental organizations.
- Construction, operation, and closure: integration of the tailings management facility with other mine site facilities.

The group discussion identified three potential tailings management options for the Project:

- Sub-aqueous deposition of slurry tailings
- Dewatered (dry-stack) tailings with a separate process water storage pond, and
- Cemented tailings with a separate process water storage pond.

The overburden throughout the project area typically exists as a thin veneer and the near surface bedrock exhibits a relatively high permeability. Therefore it was determined that the TMF and related contact water control structures would be lined, regardless of the selected management option.

3.2.1 Sub-Aqueous Tailings Disposal

Sub-aqueous deposition of slurry tailings is a common method of tailings management. Tailings slurry is pumped or gravity fed to an impoundment and discharged into the facility from offtakes located along the embankment(s) or around the perimeter of the facility. The coarse fraction of the tailings tends to settle more rapidly and accumulates closer to the discharge points, forming a gentle beach with a typical slope of about 1%. Finer tailings particles tend to travel further and settle at a flatter slope. Selective tailings deposition is used to keep the supernatant pond away from the embankments to enhance stability and reduce potential seepage from the facility. For the storage of potentially acid generating (PAG) tailings, the supernatant pond provides coverage of the tailings solids to prevent or minimize the onset of acid generation. The supernatant water released during the initial settling of the solids is typically reclaimed to the process plant for re-use. The tailings continue to settle and consolidate over time releasing more water; this additional supernatant water would be collected and recycled to the extent possible.

The tailings slurry can also be thickened prior to deposition. Thickened tailings can be pumped to the facility using centrifugal pumps up to a certain slurry density, which can reduce the required pumping power. Positive displacement pumps are required at a very high slurry density. These are power intensive and significantly impact capital and operating costs.

A supernatant pond acts as the primary water management pond and provides capacity for storm runoff, a buffering volume for variability of climatic conditions and storage for process water during periods of low rainfall and/or runoff (e.g. winter operations).

3.2.2 Dewatered (Dry Stack) Tailings

Dewatered tailings are produced using pressure or vacuum force in presses, drum or belt filtration units. These tailings are typically dewatered to a moist cake-like consistency with a water content sufficiently low to achieve partial saturation of the tailings solids. The dewatered tailings cannot be pumped at this density and are transported by conveyors or trucks to a ‘dry’ stack where they can be compacted in lifts to enhance density, trafficability and stability.

Dewatered tailings typically do not require an embankment, although a rockfill buttress is needed around the perimeter of the stack to maintain geotechnical stability and prevent erosion by surface water runoff. Based on the relatively high permeability of the near surface bedrock at the Black Butte site, it was assumed that a lined impoundment would be required for dewatered (dry-stack) tailings storage.

The cost of operating a dewatered tailings facility is typically higher than a conventional sub-aqueous slurry tailings facility; however, process water recovery is more efficient and can prove beneficial at sites where make-up water is expensive or difficult to obtain. Winter operations in cold climates can present challenges for a dewatered tailings facility. Snow and ice accumulation on the stack and wind-blown dusting can worsen in winter months, and freeze-drying and other frost processes can loosen the placed tailings. During wetter seasons, infiltration can result in rapid degradation of trafficability of the tailings surface and may prevent adequate compaction. The dewatered tailings stack may be susceptible to instability due to ice lenses or localized liquefaction if the pile becomes saturated due to rainfall, snow entrainment, or percolation from runoff.

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 would be required throughout the winter to allow for on-going tailings placement and to reduce the impacts of the snowmelt in the spring. Allowances would need to be made for placement of tailings at an alternative location during periods of heavy snow, extremely cold weather, and heavy rainfall, as the conditions on the stack may not be suitable for tailings placement.

A separate process water management pond is required to store process water and storm water runoff from the surface of the facility, as water cannot be stored on the dry stack. The water management pond would need to 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. The associated dam(s) and basin would require appropriate lining to prevent seepage losses.

3.2.3 Cemented Tailings

Cemented tailings are a variation of ultra-thickened (paste) tailings with cement, fly ash or slag additives to create a non-flowable, low permeability tailings mass once the tailings are deposited and have set up. Cemented tailings are typically deposited as underground backfill for mining stopes and voids. TRI plans to use approximately 45% of the tailings as underground backfill for the Project and the remaining 55% will be stored on surface.

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. Therefore, 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 storage facility by pumping via pipelines. Cemented tailings typically do not segregate during or after deposition and therefore produce only minimal amounts of bleed water after being delivered to the facility.

Positive displacement pumps are often required to transport ultra-thickened cemented tailings. These pumps are significantly more expensive to purchase and operate when compared to the centrifugal pumps typically used for conventional sub-aqueous slurry tailings transport.

A separate process water management pond (PWP) will be required to store process water and storm water runoff. The PWP would need to 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.

3.2.4 Preferred Tailings Management Option

Cemented tailings disposal was selected as the preferred tailings management option for the Project for the following reasons:

- Cemented tailings will be produced for underground mine backfill and surface deposition of these tailings can use the thickening plant, cement plant (located on the northwest corner of the mill pad), and some components of the pump and pipeline systems.
- The tailings will form a non-flowable tailings mass after they have set up, which will provide a stable tailings mass comparable to a dry stack tailings.
- The tailings will be low permeability (in the order of 8×10^{-8} m/sec, based on lab testing of straight tailings with no binding agents) to reduce potential seepage rates through the lining system. The CTF can be operated with a minimal volume of impounded water through use of the water reclaim and sump systems, which significantly reduces the risk of seepage occurring (due to very low hydrostatic heads on the liners) when compared to conventional sub-aqueous tailings deposition.
- Water recovery from mill processes is maximized at the thickening plant, reducing the overall volume of water trapped in tailings voids and losses from evaporation.
- Cemented tailings will allow for a much faster reclamation schedule.

3.3 FACILITY LOCATION ASSESSMENT

A high level locations assessment was completed using the modelling software Muck3D (Minebridge Software Inc. 2013). Several iterations of the CTF, PWP and NCWR were modelled with the intent to minimize the impact on wetlands, and minimize embankment fill volume while maintaining a material cut-fill balance for construction of the facilities.

The results of the assessment showed that the optimum location for the CTF is in a broad, shallow valley south of the mill. This location is approximately 380 m (1,247 feet) upstream of Category I wetlands areas, and the shallow topography surrounding the facility allows easy access for construction and operations. Some Category III wetlands (0.17 hectares (0.42 acres) and approximately 200 m (656 feet) of streams) are located within the footprint of the CTF and will be backfilled during construction. The area of wetlands and streams to be filled during the construction of the CTF is shown on Figure 2.1.

4 – DESIGN BASIS

4.1 GENERAL

The design basis and process criteria used for the design and analysis of the CTF are based on the available information and operational requirements confirmed with TRI. The design basis for pertinent portions of the design, construction and operations of the waste and water management facilities are discussed in the following sections.

A detailed project design basis summary is included in Appendix C of this report.

4.2 DESIGN STANDARDS

The design basis and criteria for the waste and water management facilities have been developed to satisfy both US and international standards. Design standards are based on the relevant state and federal guidelines for the construction and operation of a dam in Montana. The following regulations and guidelines were used to develop the design standards for the Project:

- Montana Code Annotated, Title 82. Minerals, Oil, and Gas, Chapter 4. Reclamation, Part 3. Metal Mine Reclamation (MCA 82-4-3)
- Administrative Rules of Montana (ARM)
- Federal Emergency Management Agency (FEMA), and
- International Commission on Large Dams (ICOLD).

4.2.1 MCA 82-4-376

Section 376 of MCA 82-4-3 details the requirements for the tailings storage facility design document, including criteria for the design earthquake event and IDF. MCA 82-4-376 states that new dams operating in Montana must be designed to withstand either the Maximum Credible Earthquake Event (MCE), or the 1 in 10,000 year earthquake event, whichever is greater. New dams operating in Montana must also be built to handle the Probable Maximum Flood (PMF) event.

4.2.2 ARM Guidelines

The dam hazard determination described in the ARM is based on the consequences of dam failure (not the condition, probability, or risk of failure). According to ARM Chapter 16.14, a dam must be classified as a high hazard if the impoundment capacity is approx. 60,000 m^3 (50 acre-feet) or larger and it is determined that a loss of human life is likely to occur within the breach flooded area as a result of failure of the dam. The CTF has a capacity exceeding 60,000 m^3 and local landowners have semi-permanent settlements downstream of the facilities that could be impacted by a dam failure.

The ARM specifies the following with respect to earthquake and flood criteria for high hazard dams:

- The design must be such that the most severe earthquake that can be reasonably anticipated will not cause catastrophic failure and loss of life.
- Spillway conveyance for high hazard dams will be based on estimated loss of life downstream from the dam caused by spillway failure. The minimum inflow design flood for a dam where the estimated loss of life in the event of a breach is greater than or equal to 1,000 persons shall be the Probable Maximum Flood (PMF).

4.2.3 FEMA Guidelines

The US Department of Homeland Security published federal guidelines for dam safety (FEMA, 2004). The guidelines include a hazard potential classification system which categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests. Improbable loss of life exists where persons are only temporarily in the potential inundation area. For instance, this hazard potential classification system does not contemplate the improbable loss of life of the occasional recreational user of the river and downstream lands, passer-by, or non-overnight outdoor user of downstream lands. The FEMA hazard potential classification system is summarized in Table 4.1.

Table 4.1 FEMA Hazard Potential Classification

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None Expected	Low and generally limited to owner
Significant	None Expected	Yes
High	Probable. One or more expected.	Yes (but not necessary for this classification)

FEMA guidelines specify the inflow design flood (IDF) required for dams in Montana. The design of dams that have a “significant” or “high” hazard classification should have an IDF based on the PMF. A smaller flood may be selected for design if a “low” hazard potential class is assigned. However, all dams should be designed to withstand a relatively large flood without failure even when there is apparently no downstream hazard involved under present conditions of development.

The final selection of the Maximum Design Earthquake (MDE) considers whether or not the dam must be capable of resisting the controlling Maximum Credible Earthquake (MCE) without catastrophic failure, such as uncontrolled release of a reservoir, although severe damage or economic loss may occur. For high hazard potential classification dams, the MDE usually is equated with the controlling MCE. However, for low or significant potential classification hazard dams the MDE may be determined based on faults active in Holocene time, or according to other agency specified criteria.

4.2.4 ICOLD Guidelines

ICOLD recommends that for major tailings dams, where failure could result in loss of life and extensive property damage, seismic analysis should be based on the MCE (ICOLD, 1989). Damage of the dam is acceptable as long as the integrity and stability of the dam is maintained and the release of the impounded water and/or tailings is prevented.

The design of major tailings dams, where failure could result in loss of life and extensive property damage, should be based on the PMF. For closed circuit tailings dams, where no discharge is permitted, the tailings dam must provide sufficient freeboard to allow storage of the PMF in addition to normal operational tailings pond containment volumes.

4.3 HAZARD POTENTIAL CLASSIFICATION

The CTF is considered to have a high hazard potential classification for expected loss of life and extensive property damage in the event of embankment failure. The mine site itself is located within privately owned ranch land, and is upstream of Sheep Creek (a tributary of the Smith River system) and associated wetlands; both of which present potential for economic and environmental losses in the event of a failure.

Based on this hazard classification, the IDF for the CTF is the PMF, and the MDE is the 1 in 10,000 year earthquake event.

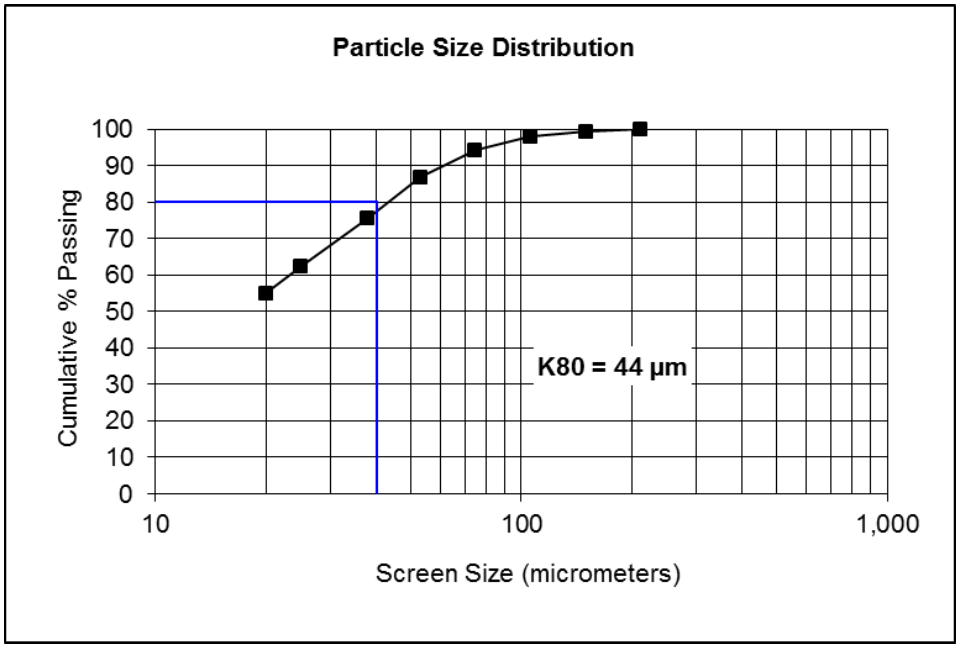
4.4 TAILINGS AND SEEPAGE WATER CHARACTERISTICS

4.4.1 Physical Characteristics

Physical testing was conducted on samples of tailings obtained from metallurgical testing. Index and consolidation testing was conducted to characterize the physical properties and estimate the settled dry density of the cemented tailings deposited into the CTF. Rheology and strength testing was also completed on tailings samples. Based on the test work, the following tailings properties have been adopted for the feasibility design:

- Solids content by weight: 79%.
- Specific gravity of the tailings solids: 3.77.
- Average settled dry density: 2.0 t/m^3.
- Approximate grain size of the tailings: approximately 94% of the tailings pass the 75 micron (No. 200) sieve, and 55% of tailings pass the 20 micron (No.636) sieve. A gradation curve is shown in Figure 4.1.

Binding agents (a mix of 0.5% to 2% cement, fly ash or slag by weight for surface deposition) will be added to the tailings to create a non-flowable mass once the tailings are deposited and have set up.



NOTES:

1. Tailings gradation curve is based on average values from lab test results provided by International Metallurgical and Environmental Inc., October 2015.

Figure 4.1 Tailings Gradation

The results of the physical tailings characterization test work are presented in Appendix E of this report.

4.4.2 Tailings Geochemistry

The geochemical characteristics of the tailings were tested by Enviromin Inc. (Enviromin) from 2012 through 2016 (Enviromin 2012; 2017). Static and kinetic testing of both neat tailings and tailings with binder additives were tested for whole rock metal analysis, acid base accounting and net acid generation (to assess the acid generation potential of the tailings. Results of the static testing of raw tailings indicate that this material is likely to produce acidic drainage, and contains elevated levels of sulfur and metals (Enviromin, 2017).

4.4.3 Seepage Water Geochemistry

A predicative water quality model was developed by Enviromin in order to predict the quality of water that would report to the CTF seepage collection system (Enviromin 2017). The framework for the predictive water quality model for the CTF is based on the following:

- Rain and snow-melt water as precipitation will react with the cemented paste tailing surface, dissolving oxidation products including acidity, sulfate, and metals.
- This water will mix with water produced during consolidation of cemented paste tailings.
- The water will then migrate through and react with waste rock placed in the constructed basin drain and access ramp prior to collecting in the sump.

Water quality has been predicted for year 6 of tailings production and again for early closure prior to placement of the geosynthetic cap, overlying fill material, and construction of the vegetated cover.

The water quality predicted at year six of tailings production is acidic (pH 4) with elevated sulfate and metal concentrations. More acidity and metals are contributed by the surface of cemented tailings than the co-deposited waste rock or access ramp/rock basin drain, whereas most sulfate comes from the wet paste and the waste rock contribution. The minerals predicted to precipitate during operations include alunite, barite, jarosite, and quartz.

During operations, all water from the CTF will report to the PWP where it will mix with water from the mill process, make-up water from the water treatment plant or from underground mine dewatering, and from direct precipitation and run-on to the PWP.

4.5 SEISMICITY

MCA 82-4-376 requires that new tailings dams in Montana be able to withstand the greater of either the 1 in 10,000 year earthquake event, or the MCE. The 1 in 10,000 year earthquake event was adopted as the MCE for this site. The 1 in 10,000 year event corresponds to a Peak Ground Acceleration (PGA) of 0.35 g, as defined using the 2008 USGS National Seismic Hazard Mapping (NSHM) project database for the 1 in 10,000 year return period. Recently, a probabilistic seismic hazard analysis was conducted using the USGS 2014 NSHM Seismic Source Model to estimate the 1 in 10,000 year earthquake event, which corresponds to a PGA of 0.26g. To comply with MCA 82-4-3 guidelines the MDE and Earthquake Design Ground Motion (EDGM) has been defined as the 1 in 10,000 year earthquake event.

5 – CEMENTED TAILINGS FACILITY

5.1 DESIGN CONCEPTS

The CTF is sized to store 55% of all tailings generated in the mill over the 15 year mine life and 100% of waste rock brought to surface. The feasibility design was performed concurrently to the mine design and planning and used the October 2015 production schedule as the design basis.

The CTF has a storage capacity of 4.3 Mm^3 (5.6 Myd^3), which include 3.56 Mm^3 (4.65 Myd^3) of cemented tailings (7.12 Mt at a settled density of 2 t/m^3), 0.35 Mm^3 (0.46 Myd^3) of waste rock (0.7 Mt at a density of 2.0 t/m^3), with additional capacity for temporary storage of storm water up to and including the PMF flood event of 0.3 Mm^3 (0.4 Myd^3). The volume of tailings stored also accounts for the removal of 1.41 Mt of concentrate from the 13.2 Mt of ore.

The PWP is designed to store water from the CTF for a 24 hour storm up to and including the 1 in 500 year event. A wet well sump and pump system within the CTF will be used to transfer water from the CTF to the PWP, and will be designed to pump out water from the 1 in 100 year 24 hour storm event over a 10-day period. The PWP will not have capacity to store the PMF event volumes for both the CTF and PWP. The CTF will have capacity to store runoff and direct precipitation from the PMF event until there is capacity in the PWP to pump the water from the CTF.

5.2 EMBANKMENT STAGING

The CTF will be developed in two stages throughout the life of the mine. This offers the following advantages:

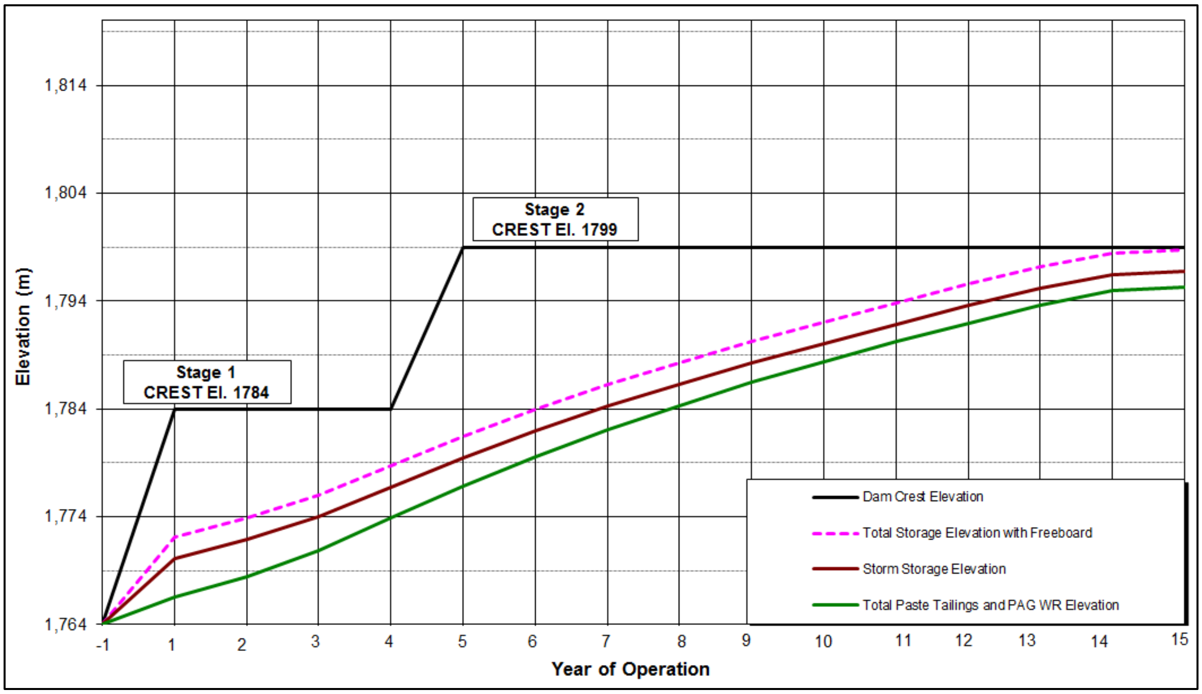
- The ability to reduce initial capital costs and defer some capital expenditures until the mine is operating.
- The ability to refine design, construction, and operating methodologies as experience is gained with local conditions and constraints.
- The ability to adjust plans at a future date to remain current with evolving best practice (engineering and environmental).
- To allow the observational as built 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.

Stage 1 will be constructed with the liner system installed to El. 1,784 m (5,853 feet) prior to commencement of milling operations. The Stage 1 CTF will provide storage for 5 years of surface tailings deposition and waste rock placement. It is anticipated that a surplus of fill material will be available at the completion of the Stage 1 construction phase. This excess material will be placed and compacted on the CTF embankment in preparation for the Stage 2 construction to El. 1,799 m (5,902 feet). Additional surplus material will be stockpiled for use in closure of the CTF.

Construction of Stage 2 will occur during years 4 to 5. All remaining stripping and grubbing, excavation, and fill placement will occur during this time, as well as the installation of the liner system to the ultimate crest elevation of El. 1,799 m (5,902 feet).

The preliminary filling schedule and embankment stages are shown on Figure 5.1. 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, and
- Tailings surface slopes.



NOTES:

1. Filling schedule based on preliminary production schedule from Tetra Tech (Oct. 2015) and includes storage of 55% total tailings and 0.7 Mt of waste rock.
2. Waste rock will be generated in Year 1 as the mine decline ramp is excavated, stockpiling of ore will begin in Year 2, and processing of ore will begin in Year 3.
3. Storm storage volume is estimated on the basis of containing a PMF event.
4. A minimum freeboard of 2 m will be maintained to control wave run-up.

Figure 5.1 CTF Filling Schedule

5.3 CTF LINING SYSTEM AND SEEPAGE CONTROL

The CTF is fully lined and with a double liner system that consists of a layer of 7.6 mm (0.3 in.) high-flow geonet sandwiched between layers of 100 mil HDPE geomembrane. The liner system is placed to cover the full interior of the CTF basin with an underlying prepared subgrade comprising processed material obtained from impoundment shaping.

The seepage control measures incorporated into the CTF are as follows:

- Two layers of 100 mil HDPE geomembrane encompassing a sandwiched layer of high-flow geonet will cover the entire CTF basin and upstream face of the embankment. The geomembrane is intended to be impermeable, with seepage only possible through defects that may occur during fabrication and/or installation. Any seepage through the upper geomembrane will be collected and transferred via the geonet layer to a seepage collection sump and pump system at the north end of the embankment.

- The tailings are low permeability with a hydraulic conductivity in the order of 8×10^{-8} m/sec. The tailings are highly thickened prior to deposition, and most of the remaining interstitial water will hydrate the cement and remain trapped in the tailings, with limited bleed water.
- A basin drain will be constructed above the geomembrane to maintain low head on the geomembrane, thereby minimizing the potential for seepage.
- Minimal water will collect in the facility. Runoff, precipitation and limited bleed water from the tailings will be directed to a water reclaim system within the impoundment. Water from the reclaim system will be pumped to the PWP for storage and mill use.
- A foundation drain will be constructed to collect groundwater and potential seepage flow beneath the geomembrane sub-grade bedding layer. The foundation drain will empty into a collection pond and water will be pumped into the CTF, where it will be subsequently collected by the water reclaim system and transferred to the PWP. Alternatively water from the foundation drain pond could be pumped directly to the water treatment plant for treatment prior to discharge.

5.4 CTF BASIN DRAIN

A basin drain will be installed in the CTF (above the geomembrane) consisting of sub-grade bedding fill material and waste rock generated from the mine and surface construction during the pre-production phase. It will be connected to the wet well sump and pump system in the CTF. The basin drain will collect tailings bleed water and any water that percolates through the tailings mass and convey it to the water reclaim system to be pumped to the PWP. This will facilitate a low phreatic level within the tailings mass and will reduce the head on the geomembrane liner, which is an effective measure to minimize potential seepage through any small defects in the geomembrane.

The basin drain consists of a layer of pre-production waste rock placed over the sub-grade bedding layer that overlies the HDPE geomembrane, across the entire basin floor. The waste rock will have the same material specifications as the Embankment Fill (as shown on Drawing C0003) and therefore will be a free draining material. The CTF basin floor will be graded at a minimum of 0.5% towards the water reclaim system sump. Details of the basin drain are shown in shown in Section “1” of Drawing C2006.

5.5 CTF FOUNDATION DRAIN

The CTF foundation drain has been designed to collect groundwater flows and seepage below the CTF geomembrane, and to convey all collected flows to a foundation drain collection pond downstream of the CTF.

The CTF foundation drain has the following components:

- Drains on the CTF cut slopes
- Drains on the CTF Basin Floor
- Drains beneath CTF Embankments (areas of fill), and
- Outlet drain.

The foundation drain comprises an interconnected grid of perforated pipes of various diameter along with surrounding drainage gravel to collectively manage groundwater inflows.

The foundation drains flow to the foundation drain collection pond located at the downstream toe of the CTF embankment. Collected water will be pumped into to the CTF and subsequently transferred to the PWP. The collection pond will be a 100 mil HDPE geomembrane lined pond with a submersible turbine pump. An HDPE pipeline will convey the flows from the pond to the CTF. Alternatively water from the foundation drain pond could be pumped directly to the water treatment plant for treatment prior to discharge.

Details of the CTF foundation drain, including pipeline lengths, sizes, and minimum required thicknesses of drainage gravel are shown on Drawings C2004 and C2006. Details of the foundation drain collection pond are shown on C6330. Details of the foundation drain collection pond pump system are shown on Drawings C6300, C6310, and C6330.

5.6 EMBANKMENT CROSS SECTION

The CTF has a single embankment to close off the east end of the impoundment, allowing for natural topographic containment to the west. The CTF will be constructed using a cut-fill balance, where excavated materials from impoundment shaping will provide the required storage capacity and fill material for the confining embankment.

The embankment is a homogeneous rockfill embankment. The internal (upstream) slope of the embankment will be constructed at a 2.5H:1V slope to facilitate geomembrane placement. The external (downstream) slope will also be constructed at a 2.5H:1V slope to facilitate concurrent reclamation of the embankment during operations. The embankment crest width will be 10 m to allow working space for tailings and reclaim water pipelines and traffic. The maximum embankment height is approximately 46 m on the downstream side, with an upstream embankment height of 35 m.

Embankment fill will be general fill sourced from excavation as part of the CTF impoundment shaping. The material is expected to consist of fresh to moderately weathered rockfill with topsoil and subsoil overburden material removed.

The geomembrane composite system will be placed on a sub-grade bedding material that will provide a protective layer between the geomembrane and natural ground or embankment fill materials. The sub-grade bedding material will be primarily sourced from weathered bedrock and select fresh rock will be processed as necessary to meet the required material specifications. Non-woven geotextile fabric will be placed between the geomembrane and sub-grade bedding.

The CTF plan is shown on Drawing C2001. The CTF sections and details are shown on Drawing C2003.

5.7 EMBANKMENT FREEBOARD

Tailings will be deposited strategically via offtakes along the western and southern basin perimeter. The CTF will be maintained with a minimal or negligible volume of stored water, and the tailings surface will be developed to direct any surface water from precipitation towards the wet well sump and pump system.

Under these conditions, sufficient storage capacity will be available to contain all surface tailings, waste rock, runoff, and precipitation (up to and including the design storm (PMF) event) while maintaining a minimum freeboard of 2 m (6.6 feet). Construction will be staged such that the minimum freeboard requirement is maintained, even during the design storm (PMF) event.

5.8 SEEPAGE COLLECTION SUMP

The seepage collection system will collect seepage through the upper HDPE geomembrane and direct it through the geonet, via gravity, to a sump and pump system at a low point in the CTF basin. Water collected in the sump will be pumped through a discharge pipe to the embankment crest and returned to the CTF. An underlying sub-grade bedding layer will be installed to protect the lining system.

The seepage collection system between the HDPE geomembrane layers will consist of a sump filled with drainage gravel that is deep enough to allow the effective operation of a submersible pump that can be raised and lowered through a protective pipe. The bottom of the pipe will be perforated (in the sump) for pump operation. An additional drain pipe is included for redundancy. The pump will have a high/low water level primer to control pumping (switch on when the water level reaches a high water mark and switch off when the water level reaches the low water mark).

Potential seepage through the lower geomembrane will be intercepted by the CTF Foundation Drain, as discussed in Section 5.5.

Details of the CTF Liner and Seepage Reclaim System are shown on Drawings C6200, C6210, C6220 and C6230.

5.9 WATER RECLAIM SYSTEM

The water reclaim system serves two purposes:

- To allow the removal of water that may be released from the cemented tailings (minimal bleed water expected) and conveyed to the reclaim system by the basin drain.
- To allow the collection and removal of precipitation and runoff (surface water) in the CTF.

All collected water will be pumped to the PWP.

The water reclaim system consists of a wet well sump that will extend to surface. The CTF basin drain will be integrated with the reclaim sump to promote flow to the sump.

The sump comprises a lined depression filled with drainage gravel in the low point of the CTF. The sump will be deep enough to allow the effective operation of a submersible pump that can be raised and lowered through a protective pipe. The drainage gravel will be covered with waste rock to facilitate water flow to the sump, and help prevent migration of tailings fines into the drainage gravel.

The bottom of the pipe will be perforated (in the sump) for pump operation. The pipe will extend in a channel on the embankment face to the embankment crest and will be surrounded by a layer of drainage gravel to allow water infiltration into the system. An additional drain pipe is included for redundancy. The drainage gravel will be surrounded by suitable fill material sourced from excavation of the impoundment. Sub-grade bedding material will be placed to protect the geomembrane. The internal slope of the CTF will be 3H:1V at the sump location to facilitate the placement of drainage gravel and sub-grade bedding materials.

The drainage gravel used to construct the wet well sump and foundation drain will be free draining; durable crushed rock which will be sourced from either select granodiorite fill excavated during impoundment shaping, or quarried from local off-site sources as needed. In addition, processed (crushed and screened) waste rock from pre-production mining could be utilized to help construct the wet well sump as long as these materials are durable and free draining.

The wet well pump will have a high/low water level primer to switch on when the water level in the sump reaches the high water level mark, and switch off when the water level reaches the low water level mark. The system has been designed to pump out a 1 in 100 year 24-hr rainfall event over a period of 10 days (approximately 20 L/s (5.3 gal./s)) through a HDPE pipeline to the southeast corner of the PWP (a pipeline length of approximately 730 m (2,395 feet)).

Details of the CTF Reclaim System are shown on Drawings C6200, C6210, C6220 and C6230.

5.10 TAILINGS DELIVERY AND DEPOSITION

Tailings will be delivered from the mill to the south end of the CTF via an 8-inch PN150 steel pipeline. This delivery system and location is the "Option 3" pipeline route as defined in a separate tailings pipeline and alternatives report by MG Engineering Inc. and KP (MG, 2016), included in Appendix H. The pipeline will run along the west crest of the impoundment and discharge tailings at the southernmost point of the CTF. The pipeline will consist of a double-walled containment system between the mill site and the CTF to capture and contain tailings in the event of a pipeline leak. Double walled containment will not be required on the CTF crest as tailings will flow into the CTF in the event of a leak.

The Project will be operating in freezing temperatures for a significant portion of each year. Freezing of the pipeline will prevent flow of tailings, and risks rupturing the pipeline due to the crystallization expansion of any water within the line. The pipeline will be insulated to protect against freezing. Additionally, the pipeline will be flushed with water and drained when not in use to prevent freezing and/or plugging.

The tailings delivery system is shown on Drawing C6100.

5.11 WASTE ROCK CO-DISPOSAL

5.11.1 Waste Rock Characteristics

The mine plan indicates that 411,537 t of waste rock will be generated during the first two years of operations (pre-production and ramp up), and 706,525 t of waste rock will be generated over the life of the mine. The waste rock has acid generation and metal leaching potential, and will be stored on a lined temporary waste rock storage pad with seepage collection during the pre-production phase of mining. The waste rock will be subsequently moved to the CTF to construct the basin drain during construction of the CTF, and later co-disposed with the tailings in the CTF during production mining and milling operations.

The waste rock from pre-production will be transferred into the CTF after installation of the geomembrane across the basin floor has been completed and once the sub-grade bedding layer has been placed above the lining system. A portion of the waste rock may be crushed and/or screened, if required to create free draining rock fill, and spread over the entire basin floor to create the basin drain prior to beginning tailings deposition, as described in Section 5.4. Excess waste rock will be placed on the basin drain, as needed.

Waste rock will be delivered to and stored in the CTF during operations and integrated with the basin drain and reclaim systems. Waste rock generated throughout the life of the mine will be selectively placed in the CTF around the water reclaim system, in order to promote drainage into the reclaim sump. A ramp will be constructed into the basin of the CTF so that waste rock can be hauled into the impoundment by haul trucks and spread with a dozer. This ramp will be constructed with a mix of excavated general fill material, and waste rock from the pre-production period.

Waste rock will be intermittently generated throughout the life of the mine, with an additional 200,000 t (approximately) produced during mining operations. The haul ramp into the CTF basin will be maintained to facilitate waste rock placement throughout the life of the mine. The waste rock will extend up the slopes of the CTF basin or alternatively be placed marginal to the ramp access. Sub-grade bedding material made from processed excavation material will be placed as needed on the geomembrane prior to waste rock deposition to protect the liner system. The exposed waste rock pile will incorporate 2H:1V slopes. The waste rock placement will be staged such that the working surface and water reclaim system will not become inundated by tailings deposition.

The conceptual design of the waste rock co-disposal system is illustrated in Drawing C2008.

6 – SEEPAGE AND STABILITY ANALYSES

6.1 STABILITY ANALYSES

Stability analyses of the CTF embankment were completed to investigate stability under static and seismic loading conditions. The methodology and design criteria are presented below, with typical cross-sections and results.

6.1.1 Modelling Approach

The stability analyses were carried out using the limit equilibrium computer program SLOPE/W (Geostudio, 2012). This program uses a systematic search to obtain the minimum factor of safety from a number of potential slip surfaces. Factors of safety were calculated using the Morgenstern-Price Method.

6.1.2 Design Criteria

KP targeted a minimum factor of safety of 1.5 as the design criteria for the stability analyses, in accordance with MCA 82-4-376 design requirements. MCA 82-4-376 defines the minimum acceptable factor of safety under static loading conditions as 1.3 during construction, 1.5 for long-term operations closure, and 1.2 for post closure seismic scenarios. A factor of safety of 1.2 is acceptable for post-earthquake (seismic) loading conditions provided that the resulting embankment deformations or crest settlements are not large enough to cause a release of stored water or tailings, and that the overall stability and integrity of the embankment is maintained. The target factor of safety used by KP for the design of the Project facilities exceeds MCA 82-4-376 guidelines and is considered to be suitably conservative.

6.1.3 Material Strength Parameters

The material unit weights and effective strength parameters used in the analyses are provided in Table 6.1 and Table 6.2. These parameters are based on information collected during the 2015 site investigation completed by KP (KP Ref. No. VA101-460/03-1).

Table 6.1 Soil Strength Parameters

Material Type	Model	Unit Weight (kN/m^3)	Undrained Shear Strength (kPa)
Fresh Shale Rockfill (Embankment Fill)	Shear/Normal Function (Lower Leps)	21	-
Tailings + 0.5-2% Additives	Mohr-Coulomb	22	45

NOTES:
1. Additives to include cement, fly ash and/or slag.

Table 6.2 Rock Strength Parameters

Material Type	Model	Unit Weight (kN/m^3)	GSI -	UCS (MPa)	m_i -	D -
Shale (Highly Weathered)	Generalized Hoek-Brown Criteria	22	30	10	6	0
Shale (Moderately Weathered)	Generalized Hoek-Brown Criteria	23	40	40	6	0
Shale (Fresh)	Generalized Hoek-Brown Criteria	24	50	50	6	0

6.1.4 CTF Stability Analyses

The factors of safety were evaluated for the following cases during steady-state conditions:

- End of Construction (static only)
- During Operations (static and seismic), and
- Post-Closure (static and seismic).

The CTF stability analysis is based on the maximum cross section through the main (eastern) CTF embankment. Analyses were carried out for the following CTF embankment configurations:

- Final embankment (Crest El. 1,799 m (5,902 feet), approximately 46 m high) with no tailings deposition and no retained water (upstream and downstream failure mode).
- Final embankment (Crest El. 1,799 m (5,902 feet)) with tailings deposition and storm storage up to El. 1,781 m (5,843 feet) (upstream and downstream failure mode).
- Final embankment (Crest El. 1,799 m (5,902 feet)) with full tailings and storm storage up to El. 1,797 m (5,896 feet) (downstream failure mode only).

The cross-section used in the CTF stability analyses is shown on Figure 6.1. The factors of safety for the CTF are shown on Table 6.3. The CTF embankment exceeds the factor of safety requirement for all cases modelled.

Table 6.3 Results of CTF Stability Analyses

Slip Surface Direction	End of Construction	Operating Conditions		Post-Closure	
	No tailings	*Tailings to El. 1,781 m*		*Tailings to El. 1,797 m*	
	Static	**Static**	**Seismic**	**Static**	**Seismic**
Required Minimum Factor of Safety	**1.3**	**1.5**	**1.2**	**1.5**	**1.2**
Upstream	2.5	2.5	1.6	n/a	n/a
Downstream	2.3	2.3	1.5	2.3	1.5

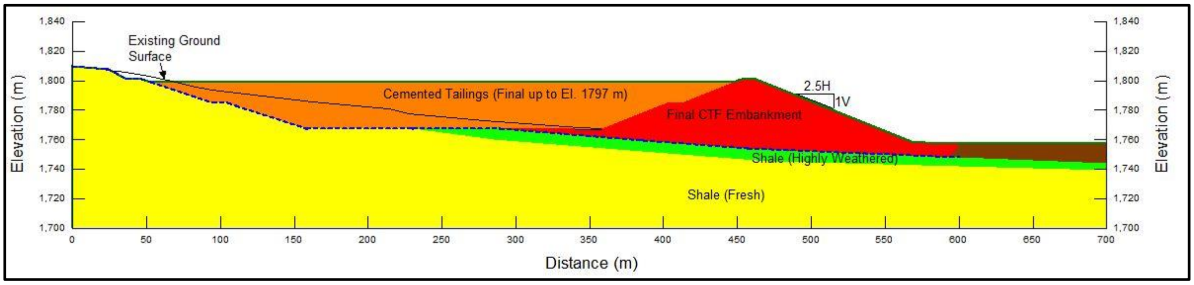


Figure 6.1 CTF Typical Cross-Section

6.1.4.1 Seismic Analysis Results

The calculated FOS of the CTF under seismic conditions exceeds the target minimum FOS of 1.2, as shown on Table 6.3. Due to the high FOS achieved with this design under seismic conditions, as well as various aspects of the foundation conditions, the following analyses were not considered necessary to complete:

- Assessment of potential liquefaction of tailings or foundation – The tailings are cemented and considered a non-flowable mass, and the embankment is constructed of free draining rock fill that is not considered susceptible to liquefaction.
- Loss of material strength – The analyses showed that the CTF exceeds the required FOS for seismic conditions, therefore no loss of material strength is expected.
- Settlement – No significant settlement of the embankment is expected during a seismic event.
- Ground displacement – The CTF embankment will be constructed on bedrock (a mixture of fresh and weathered), and is not expected to deform, creep or displace during an earthquake event. The embankment is not anticipated to exhibit any displacement as the stability analyses shows that it exceeds the target FOS for seismic events.
- The potential for secondary failure modes – The analyses showed that the CTF exceeds the required FOS for seismic events, indicating that the risk of failure, primary or secondary, is not credible.

6.2 SEEPAGE ANALYSES

This section provides a brief discussion on potential seepage rates during operations of the CTF.

6.2.1 Modelling Approach

Seepage through the geomembrane liner systems of the CTF was modelled using both empirical seepage rate equations and numerical modelling. Empirical methods were based on Giroud and Bonaparte (1988) and numerical modelling was completed using the 2D finite element computer programme SEEP/W (Geostudio, 2012).

6.2.2 CTF Seepage Analyses

The lining system in both facilities will limit the majority of potential seepage from the facility to flow through potential defects in the geomembrane. Leakage through the lining systems was modelled using Giroud and Bonaparte leakage rate equations, which assume a number of defects per hectare for various geomembrane installation methods. This assessment was carried out to estimate potential leakage flow rates through the lined facilities during operations of the CTF.

The double-lined system of the CTF was modelled in two separate analyses. The first analysis evaluated seepage from the cemented tailings through the upper liner into the geonet. This seepage rate was estimated by modelling a vertical column that represents a unit area of the geomembrane with a single defect, tailings and ponded water. This scenario conservatively represents the CTF in a post storm event condition, where water will be temporarily stored within the CTF until it is pumped to the PWP. The seepage rate through the liner was calculated by multiplying the results of the model by the surface area of the CTF assuming a single 2 mm defect is present for every 0.4 hectares (1.0 acre) of geomembrane (Giroud & Bonaparte, 1989a & 1989b, and Giroud, 1997). The estimated potential seepage rate from the CTF to the geonet under the fully saturated condition modelled is approximately $2x10^{-7}$ m^3/s or 16 L/day, however the CTF will be operated with a minimal volume of stored water so the actual seepage rate is anticipated to be negligible.

The analysis of the lower CTF geomembrane modelled the head pressures present between the upper and lower geomembrane (the thickness of the geonet) with defect density of two 2 mm defects per hectare of the geomembrane (US EPA, 1992). The estimated potential maximum seepage through the bottom geomembrane layer to the foundation drain is in the order of $3x10^{-6}$ m^3/s, which exceeds the estimated seepage from the upper liner by an order of magnitude. Therefore, total potential seepage from the facility will be limited by the upper liner at a rate of 16 L/day, and even then only under conditions where the CTF is inundated with water for a prolonged period of time. Seepage through the CTF Liner System will be collected in the CTF Foundation Drain (discussed in more detail in Section 5.5).

7 – CONSTRUCTION

7.1 GENERAL

Earthworks construction activities will include access/haul roads, borrow area preparation, borrow excavation, foundation preparation, subgrade preparation, embankment fill placement, liner bedding and transition filter material processing and placement, installation of the geotextiles and HDPE geomembranes throughout the basin footprint of the CTF and installation of instrumentation. Additional construction activities will include installation of pumps and pipelines.

The embankment will be constructed with fill material excavated from the CTF basin as part of the cut-fill construction method and impoundment shaping. The majority of this fill is shale rockfill, with minor amounts of granodiorite rockfill and overburden. Haul roads providing access to the CTF will be constructed early on during the construction phase to provide access for the construction fleet. The CTF basin has been designed such that the CTF cut will provide supplementary construction material for other facilities on site.

It is anticipated that a contractor would be responsible for foundation preparation, basin shaping, liner bedding placement, geomembrane installation, and installation of instrumentation, sumps, pumps and pipelines. It is assumed that weathered bedrock excavated from the CTF basin will be used for liner bedding material. Sand and gravel used for construction of the CTF drainage sumps will be sourced from local borrow areas, or otherwise generated by selective crushing of fresh (unweathered) granodiorite bedrock.

It is anticipated that construction of the CTF will commence 18 to 24 months prior to production mining in year 2. Completion of the basin floor of the CTF will be prioritized so that waste rock from the temporary pad can be used to construct the basin drain concurrently with construction of the remainder of the CTF.

Construction material specifications are presented in Drawing C0003.The grading plan, liner system layout plan, typical sections, and details for the CTF are illustrated on Drawing C2001 to C2011. Construction layouts and details for surface water management structures are shown on Drawings C5001 to C5006. Plans, sections, and details for tailings and water delivery pipeline and pump systems are presented on Drawings C6000 to C6520.

7.1.1 Construction Management Plan

A site specific construction management plan will be developed for the CTF during the detailed design phase. This plan will detail the frequency of construction fill material sampling, the quality control test schedule, and the fill material parameters and levels of acceptability. The amount of oversight for the management plan will be presented in the management plan, along with the required qualifications for the oversight personnel.

The roles of the EOR and IRP will be defined as part of the construction management plan. The IRP will be required to review the plan and approve their described role in the management of the construction phase.

7.2 FOUNDATION PREPARATION

Site investigations completed at the facilities were used to characterize the subsurface conditions and to estimate the foundation preparation requirements. Throughout the property, the area is characterized by a thin veneer of topsoil overlying weathered, rippable bedrock to depths ranging from 2 to 10 m (6.6 to 32.8 feet).

The topsoil and sub-soil layers are typically 0.5 to 1.1 m (1.6 to 3.6 feet) thick, respectively, with an average combined thickness of 0.9 m (2.95 feet) based on recent March 2017 work by Westech Environmental Services, Inc. (Westech, 2017). Topsoil is typically 0.3 m (1 foot) thick. Subsoil averages 0.6 m (2 feet) thick. These soil units will be stripped and stockpiled separately prior to foundation excavation and grading. The fresh bedrock is considered suitable for use as general fill material in embankments. Weathered bedrock and overburden will be excavated, separated, and selectively used for liner bedding or embankment fill.

7.3 BASIN EXCAVATION, SHAPING, AND SUBGRADE PREPARATION

Basin excavation and shaping activities will be carried out prior to or during Stage 1 construction. Basin and impoundment slopes will be prepared for geomembrane deployment following basin shaping activities. Crushed weathered bedrock (including granodiorite) and overburden will be utilized as fill for basin shaping, subgrade preparation and liner bedding.

The CTF basin will be graded to the final dimensions in preparation for the future installation of the geomembrane to avoid the risk of damaging portions of exposed geomembrane during ongoing work on the basin slopes. This includes the ripping, drilling and blasting of bedrock (if required) and placement of fill in certain areas within the basin to achieve the grades and surfaces required for the installation of the geomembrane.

It is anticipated that the CTF cut will extend below the groundwater table. Erosion control and dewatering measures (including surface water diversions) will be implemented on an as needed basis to manage groundwater seepage into the construction site. The foundation drains will be installed in the CTF during this phase of construction. Sections of the foundation drains that underlie the embankments will be constructed first because the embankments will be constructed with material sourced from impoundment shaping. The foundation drain design will be modified based on observed water flows to maximize the collection capability of the system. The foundation drains for the CTF are illustrated on Drawing C2004, with details provided on Drawings C2006.

The CTF grading plan is illustrated on Drawing C2001.

7.4 GEOMEMBRANE AND GEONET INSTALLATION

The 100 mil HDPE geomembrane layers will be placed over the entire CTF basin footprint and on the upstream slopes of the CTF embankment. The HDPE geomembrane 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 the lower and above the upper geomembrane layers to protect the geomembrane system. The wind speed data from site shows that permanent ballast on the liner system is not required.

The high drainage capacity geonet liner will be placed between the two HDPE geomembrane layers at the CTF. The geonet will be placed using approved methods and procedures that ensure minimum of handling, adequate temporary and permanent anchoring. Placement will be completed in such a manner such that all primary flow paths through the geonet are unimpeded, which includes no driving of mine fleet over the geonet without adequate protective fill covering.

A primary objective of the Quality Assurance and Quality Control (QA/QC) procedures 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.

7.5 CTF BASIN DRAIN

The basin drain will be constructed above the HDPE geomembrane within the CTF basin. Non-woven geotextile will be placed over the floor of the CTF basin to provide abrasion protection of the geomembrane, and a protective layer of sub-grade bedding will be placed on top of the geotextile. Next, approximately 160,000 t of waste rock from pre-production will be removed from the temporary storage pad near the mine adit, hauled to the CTF basin and placed in layers to construct a drainage layer for the basin drain and facilitate movement of mine fleet traffic within the basin. The remaining 340,000 t (approx.) of waste rock may either be placed (without crushing and screening) over the basin drain to increase its thickness, as shown on Drawings C2008, or substituted for general rock fill to construct the CTF haul ramp. Waste rock may be also crushed and screened to construct the sub-grade bedding layer overlying the CTF HDPE lining system if required.

7.6 STOCKPILES

Organics and deleterious materials will be removed from the embankment and basin footprint areas and will be placed with the topsoil stockpiles outside of the final limits of the waste and water management facilities. Soils will be stored in separate stockpiles for topsoil and subsoil that will be used in closure. The material to be placed in these stockpiles will be used for future reclamation activities as required. However until such time, the outer surface will be graded and/or contoured to ensure adequate runoff characteristics and to minimize erosion potential. The stockpiled materials will be seeded and re-vegetated using native grasses to minimize run-off erosion and loss of material from wind erosion. Silt fences will be installed downstream as required to prevent release of sediment to the environment. Sumps will be placed around the perimeter of stockpiles for use in reclamation.

Excavated rock fill from the CTF diversion channel will be stored in reclamation material stockpiles for use in site-wide closure.

Oversize boulders from the CTF basin excavation will be separated and stockpiled for use as rip-rap in where required throughout the mine site.

7.7 MATERIAL QUANTITIES

The Stage 1 cut volume for the CTF will generate more fill than required for the construction of the Stage 1 CTF embankment. Excess cut material will be placed according to the embankment fill specifications on the embankment during the Stage 1 construction. Stage 2 construction will consist primarily of liner installation, as all embankment fill will be placed and compacted during Stage 1. All opportunities for concurrent reclamation or revegetation will be completed as soon as practicable.

Material used to construct the bedding layers and drainage sumps would be processed by the contractor using local borrow/quarry areas or suitable processed fill provided by the mine.

All liners and geosynthetics will be purchased as needed prior to construction and stored on site.

A summary of the cut-fill quantities required for construction and closure are presented in Table 7.1. A breakdown of the fill material and geosynthetics quantities required for the construction of the CTF are summarized in Table 7.2. A bulking factor of 20% (after compaction) has been applied to the fill volumes, based on the average unit weight of 26 kN/m^3 for the bedrock and an anticipated compaction density of 20 to 22 kN/m^3.

For ongoing construction, the contractor will complete foundation preparation work, construct the remainder of the Stage 2 CTF embankment and supply and install additional required geosynthetics.

Table 7.1 CTF Cut and Fill Quantities

Activity	Cut Volume (1) (m^3)	Available Fill Material (2) (m^3)	Total Fill Required (m^3)	Net Surplus Volume (m^3)
Construction	1,870,000	1,591,000	1,358,000	552,000
Closure	0	0	404,000	-404,000
Total	**1,870,000**	**1,591,000**	**1,762,000**	**148,000**

NOTES:

1. The cut volume includes topsoil and subsoil volumes.
2. Available construction material assumes a 20% bulking factor for excavated materials.
3. Embankment fill volume ancillary waste and water management facilities will be recovered and used at closure for the CTF capping layer.
4. Available construction material volume utilizes subsoil (0.6 m) and topsoil (0.3 m) thickness estimates from Westech Environmental Services Inc. (2017).
5. The construction cut and fill volumes in this table only consider the CTF.
6. The volumes of the materials listed in this table exclude pre-production waste rock.

It is anticipated that approximately 552,000 m^3 (722,000 yd^3) of surplus fill material will be available at the end of the CTF construction. This will be added to the fill stockpiles on site or used for construction of other mine site facilities as required. The cut fill balance of all facilities will be refined during future design phases.

Table 7.2 CTF Construction Material Quantities

Material Type	Volume
Embankment Fill (m^3)	1,337,000
Sub-grade Bedding Placed Above Liner System (m^3)	44,000
Sub-grade Bedding Placed Below Liner System (m^3)	78,000
Drainage Gravel (m^3)	8,800
Filter Sand (m^3)	300
100 mil HDPE Geomembrane (m^2)	452,000
7.6 mm High Flow Geonet (m^2)	226,000
Non-woven Geotextile (m^2)	452,000

NOTES:

1. Construction material quantities are approximate, based on surface areas and volumes modelled in Civil 3D.
2. Construction material quantities do not include materials required for closure.
3. Smaller scale structures requiring embankment fill, sub-grade bedding, or drainage gravel less than 1,000 m^3 in volume are not explicitly included.

7.8 INSTRUMENTATION

Instrumentation will be installed in the CTF embankment fill and underlying foundations and monitored during construction and ongoing operations to assess performance and to identify any conditions which 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 will be installed:

- Vibrating Wire Piezometers - The basin drain and wet well sump and pump system in the CTF will be designed to minimize head on the impoundment liner. This will reduce the potential for seepage from the facility. Vibrating wire piezometers will be installed above the liner at select locations to measure the pore water pressures within the tailings and monitor the performance of the drainage management systems.
- Survey Monuments and Vibrating Wire Settlement Cells - Regular surveying will help evaluate the performance of the embankments with respect to movement, settling, etc. Survey monuments may be installed on the embankment crests following construction to monitor potential deflections along the slope and crest. Periodic surveying of the monument locations will provide early warning of movements. Vibrating wire settlement cells may also be installed in the embankment fill and foundations.
- Inclinometers - Inclinometers installed at the CTF embankment will provide additional detection and tracking of any subsurface movements. The inclinometers will be installed during construction, and be oriented to intersect critical slip surfaces as delineated in the stability analyses.

The instrumentation plans and details are shown on Drawings C2010 and C2011.

8 – WATER MANAGEMENT

8.1 WATER BALANCE

A monthly operational water balance was prepared for the Project. The volume of water in the CTF and ancillary facilities were estimated on a monthly basis in the model over 15 years, including 1 year for pre-production and 14 years of operations. Special consideration was given to the water volumes reporting to the PWP as it is the primary storage facility for contact water for both the CTF and PWP on site. Meteorological parameters for the model were developed using site specific data in conjunction with regional data as described in KP memo VA15-02445 (KP, 2015). The water balance model uses the determined mean monthly precipitation and evaporation values as inputs for each year. The mill requirements and outputs, along with miscellaneous freshwater requirements (truck wash, dust control etc.) were provided to KP by TT. The mill water requirements were provided as annual rates occurring when the mill is in full production.

8.1.1 Sensitivity Analysis of Climatic Variability

The water balance results were calculated on a mean monthly basis as well as on an annual basis for each year. The scenario modelled includes a PWP start-up volume of 120,000 m^3, with mean monthly precipitation conditions for the life of mine. Three separate scenarios were modeled using the life-of-mine water balance in order to obtain an understanding of the water requirements of the PWP during operations while considering the dynamic nature of the local climatology. The model was run deterministically for the mean case, and stochastically for the wet (95th percentile) and dry (5th percentile) cases. The estimated monthly volumes reporting to the proposed mine site, and the resulting effects on the volumes in the PWP, have been presented in terms of probabilities of occurrence for three scenarios:

- **Scenario 1 – Mean:** The results correspond to mean monthly climatic conditions.
- **Scenario 2 – 95th Percentile (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 (Dry):** The results correspond to abnormally dry conditions, and represent the climatic conditions expected to be exceeded 19 years out of 20, on average (i.e. volumes will not exceed these values once every 20 years, on average).

8.1.2 Water Balance Results

The objective of the water management plan is to maintain a minimum monthly pond volume of approximately 120,000 m^3 within the PWP, while not encroaching on the storm storage that will be maintained above a volume of 200,000 m^3. Direct precipitation and run-on onto the PWP facility is required to be pumped directly to the Water Treatment Plant (WTP) and released back into the watershed, therefore the PWP will be replenished as needed with water from the underground mine workings. No make-up water will be required in years 1 and 2 as ore processing in the mill is not anticipated to start until year 3.

The annual make-up water requirements and surface water transfer volumes for the mean, wet, and dry scenarios are presented in Table 8.1.

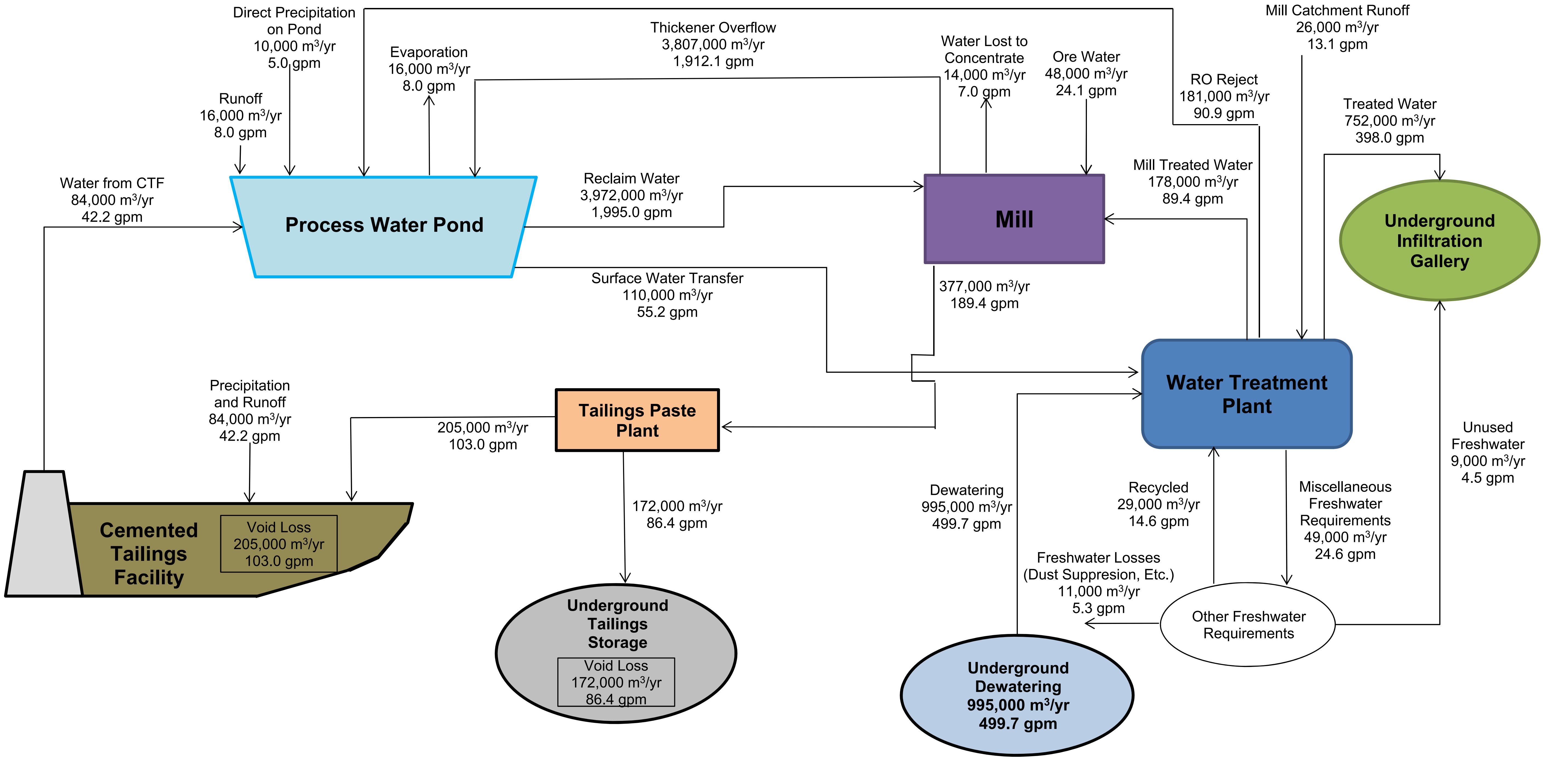
Table 8.1 Annual Make-Up Water Requirements

Year	Total Groundwater to PWP (m^3)	Surface Water Transfer from PWP to WTP (m^3)		
		Mean	Wet	Dry
1	0	0	0	0
2	0	0	0	0
3	109,000	107,000	227,000	32,000
4	142,000	110,000	231,000	35,000
5	178,000	110,000	232,000	34,000
6	181,000	110,000	232,000	34,000
7	184,000	110,000	230,000	35,000
8	181,000	110,000	234,000	34,000
9	188,000	110,000	235,000	35,000
10	193,000	110,000	232,000	35,000
11	190,000	110,000	233,000	34,000
12	186,000	110,000	232,000	34,000
13	185,000	110,000	230,000	34,000
14	141,000	110,000	231,000	34,000
15	56,000	110,000	232,000	35,000

It is necessary to supplement the PWP with make-up water from the underground source in order to achieve the design minimum pond volume based on the water balance and the conditions outlined in this letter. The results of the scenarios modeled are outlined below:

- All Scenarios - Average annual groundwater make-up required to sustain the minimum pond volume = 163,000 m^3
- Scenario 1 (Mean Conditions) - Average annual surface water volume transferred from the PWP to the WTP = 170,000 m^3
- Scenario 2 (Wet Year) - Average annual surface water volume transferred from the PWP to the WTP = 232,000 m^3, and
- Scenario 3 (Dry Year) - Average annual surface water volume transferred from the PWP to the WTP = 34,000 m^3.

A detailed summary of the water balance is provided in Appendix F of this report. A schematic of the annual water balance (using the Year 6 – Mean Case as an example) is shown on Figure 8.1.



NOTES:
1. ALL WATER VOLUMES ARE EXPRESSED IN UNITS OF CUBIC METRES PER YEAR AND GPM EQUIVALENTS.
2. WATER IN TAILINGS PASTE IS ASSUMED TO BE UNRECOVERABLE.
3. SEEPAGE IS ASSUMED TO BE ZERO AS THE FACILITIES ARE LINED.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
4	26APR'17	ISSUED WITH REPORT	BW	MH

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

ANNUAL WATER BALANCE SCHEMATIC
MEAN CASE - YEAR 6

Knight Piésold CONSULTING

P/A NO. VA101-460/3 | REF. NO. 5

FIGURE 8.1 | REV 4

8.2 STORM WATER MANAGEMENT

8.2.1 General

The 24 hour design storm events for the Project (at El. 1,737 m) are presented on Table 8.2.

Table 8.2 Storm Event Summary

Return Period (years)	24 Hour Storm Event (mm)
2	35
5	49
10	58
15	64
20	67
25	70
50	79
100	88
200	96
500	108

The probable maximum precipitation (PMP) event is estimated to be 560 mm (22 in.). The PMF is the result of the PMP (560 mm (22 in.)) combined with a 1 in 100 year snow accumulation (290 mm (11.4 in.)), resulting in a PMF of 850 mm (33.5 in.) of equivalent rainfall.

The Project facilities were designed for the PMF based on the high hazard potential classification.

8.2.2 Surface Water Diversion Channels

The primary objective of the diversion channel is to maximize the collection of non-contact runoff from the catchments upstream of the CTF and convey it around the facility for discharge to the downstream environment. The diversion channel reduces the amount of runoff contributing to the CTF by diverting the upstream catchment, which in turn reduces the storm water storage requirements, and reduces overall consumptive water use. Diversion of non-contact water also reduces flow impacts downstream of the Project.

All sections of the diversion channels for the CTF have been designed to carry the predicted peak flow generated during a PMF 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 ditches.

The channels will be constructed with side slopes of 2H:1V. Excavated fill material will be placed alongside the channels as berms, or used as construction material along the fill sections of the diversion channels. It is currently assumed that the channels will be predominantly cut in rock and will need little erosion protection. Where erosion protection is required (e.g. sections of deep overburden or filled downslopes) engineered soil stabilization (e.g. concrete filled or vegetated geocell products) or riprap will be used to prevent erosion of the channel bed during high flows. The base width of the various channel sections ranges from 1.0 m to 2.5 m (3.3 to 8.2 feet), while the channel depth ranges from 1.2 m to 2.5 m (3.9 to 8.2 feet). The channels were sized to maintain 0.3 m (1 foot) of freeboard during the storm event.

Steel pipe bridges will be constructed to allow tailings delivery and reclaim water pipelines to pass over the diversion channel.

An energy dissipation structure is included to reduce the runoff velocities and energy at the outlet of the diversion ditch. A spreading transition still basin was chosen as the design concept for the energy dissipater, which includes the following components:

- Spreading transition
- Chute blocks at the entrance to the stilling basin
- Basin blocks, and
- End sill.

Construction details are illustrated on Drawings C5001 to C5004.

8.3 EROSION CONTROL BEST MANAGEMENT PRACTICES

Best Management Practices (BMPs) are incorporated to control 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.

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

- **Vegetation Management and Re-vegetation:** Natural vegetation is one of the best and most cost effective methods of reducing the potential for erosion and sedimentation by keeping soil secure and providing ground cover to buffer raindrop impacts.
- **Mulching:** Application of a uniform protective layer of straw, wood fiber, wood chips, or other acceptable material on the soil surface of a seeded area allows for the immediate protection of the seed bed during re-vegetation. Mulching can be used in areas that require temporary or permanent covers.
- **Rolled Erosion Control Products:** Geosynthetic or organic materials composed of two layers of coarse mesh with a central layer of permeable fibres can be used to cover un-vegetated cut or fill slopes when vegetation or mulching alone is unsuccessful.
- **Slope Roughening:** Cut and fill slopes can be roughened with tracked machinery or other means to reduce run-off velocities, increase water infiltration rates, and helps facilitate future re-vegetation. It is simple, inexpensive and provides immediate short-term erosion control for bare soil where vegetative cover is not yet established.
- **Re-contouring:** This method can reduce the effect of erosion by shortening the length of the accumulation and movement of water as well as decreasing the overall slope angles. Re-contouring and slope roughening are beneficial as they are easily planned and constructed on site.
- **Silt Fencing:** This is a perimeter control BMP used to intercept sheet flow runoff in conjunction with other BMPs. Typical silt fencing comprises a geotextile fabric anchored to posts driven into the ground and promotes sediment control by filtering water that passes through the fabric and

increases short term retention time, allowing suspended sediments to settle. Silt fences will be placed parallel to slope contours in order to maximize ponding efficiency.

- **Temporary Sediment Traps and Sediment Basins:** A sediment trap/basin is a temporary structure used to detain runoff from small drainage areas (generally < 2 hectares) to allow sediment to settle out. A sediment trap/basin can be created by excavating a basin, utilizing an existing depression, or constructing a small dam on a slight slope downward from the work area.
- **Filter Bags:** Filter bags are generally constructed from a sturdy non-woven geotextile capable of filtering particles larger than 150 microns. Filter bags are typically installed at the discharge end of pumped diversions, via fabric flange fittings, to remove fine grained materials before discharging to the environment.
- **Flocculants:** Flocculation systems are installed in sediment control ponds and use chemical or natural additives (e.g. corn starch, chitosan, guar gum, etc.) to accelerate the natural settling process as sediment-laden water flows through the pond, and reduces the required pond retention time.
- **Collection Ditches:** A collection ditch intercepts contact water runoff from disturbed areas and diverts it to a stabilized area where it can be effectively managed. Coarse non-acid generating rock and equipment to build ditches and dams are easily obtained on site, and require little further maintenance, making them effective improvements.
- **Diversion Ditches:** Diversion ditches are constructed up-gradient of disturbed areas to intercept clean surface water runoff and discharge it through a stabilized outlet designed to handle the expected runoff velocities and flows from the ditch without scouring.
- **Culverts:** Culverts are used in tandem with collection or diversion ditches to pass water flow beneath disturbed areas, typically roadways, to prevent the erosion of these constructed structures.
- **Waterbars:** Waterbars serve to reduce sheet flow and surface erosion of areas of exposed soil and/or roads by diverting runoff towards a stable vegetated area or collection ditch. Waterbars may require regular maintenance when subjected to frequent traffic crossings.

Typical designs of several BMPs are illustrated on Drawings C5005 and C5006.

9 – DAM BREACH RISK ASSESSMENT

A dam breach risk assessment was completed in compliance with MCA 82-4-376. This dam breach risk assessment presents an examination of foundation and embankment instability, overtopping, and internal erosion and piping for the CTF. The assessment considered loading during maximum normal operating conditions, and additional loading from seismic events, flood events, and malfunctions of the reclaim water and tailings distribution systems.

The likelihood of embankment failure and uncontrolled loss of tailings due to foundation and slope instability under static conditions is “Very Low”. The risk assessment considered the seepage and stability analyses completed for the CTF design, which included conservative assumptions related to material properties and pore pressure conditions.

Overtopping of the embankment would only be credible for severe flood events and for large earthquake-induced deformation. The risk of flood-induced overtopping is very low, and is managed by maintaining the prescribed design freeboard for the life of the mine. The design freeboard comprises storm storage freeboard and additional minimum freeboard (2 m) for wave run-up. The storm storage freeboard is based on the PMF, which is theoretically the largest flood resulting from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur at the project site. An earthquake could potentially induce deformations and settlement of the embankment crest, which could theoretically lead to a potential loss of freeboard and overtopping. However this has a very low probability of occurrence as the CTF is designed to withstand the 1 in 10,000 year earthquake event, and would have to be simultaneously flooded by a storm event at the time of failure. The risk of earthquake-induced deformation leading to overtopping is very low.

Internal erosion and piping of the embankment under normal operating conditions is not a credible failure mode. The primary sources of water for seepage are temporary flooding from precipitation/storm events and groundwater flows beneath the CTF. Groundwater flows will be conveyed beneath the impoundment via the foundation drain system. Water temporarily impounded in the CTF (such as precipitation) will be safely contained until it is removed via the water reclaim system. Lastly, the embankment fill materials used to construct the CTF will be free draining rockfill, and not susceptible to piping and erosion.

Table 9.1 summarizes the risk ratings for the hazard categories.

Table 9.1 Summary of Risk Ratings

Hazard	Failure Mode	Likelihood		Consequences
		Probability of Loading Conditions	Probability of Failure	
Foundation and Slope Instability	Normal Operating Conditions	Likely	Very Low	Moderate
	Earthquake Events	Very Rare	Very Low	Moderate
	Flood Events	Very Rare	Very Low	Moderate
Overtopping	Normal Operating Conditions	Certain	Not Credible	-
	Pipeline Rupture	Likely	Not Credible	-
	Earthquake Events	Very Rare	Very Low	Moderate
	Flood Events	Very Rare	Very Low	Moderate
Internal Erosion and Piping	Normal Operating Conditions	Certain	Not Credible	-
	Precipitation / Flood Events	Certain	Not Credible	-

9.1 CONCLUSIONS

The probability of failure for the various hazards (foundation and slope instability, overtopping, internal erosion and piping) is either not credible or “Very Low”. The CTF is designed for the storage of non-flowable cemented tailings, and is not a water retaining impoundment. Therefore the resulting consequences of failure for the credible but “Very Low” probability items are “Moderate”. This indicates an overall “Very Low” risk related to a breach of the CTF.

The Dam Breach Risk Assessment is presented in detail in KP Memorandum “Black Butte Copper Project – CTF Dam Breach Risk Assessment” (KP Ref. No. VA17-01339, August 11 2017). This memo is included in Appendix G.

10 – OPERATIONS AND MONITORING

10.1 GENERAL

Proper operation, monitoring and record keeping are a critical part of all waste and water management facilities. The requirements for proper operation and monitoring will be active and ongoing for the waste and water management systems described in this report.

A Tailings Operations, Monitoring and Surveillance (TOMS) Manual has been prepared for the waste and water management systems (KP Ref. No. VA101-460/03-4, Rev 0, July 2017). This document will be reviewed and updated on an ongoing basis (i.e. during the initial construction program and operations). The TOMS Manual outlines regular monitoring, inspection and reporting requirements as well as emergency response measures in the event of upset operating conditions. The TOMS Manual should be referenced for all operations and monitoring activities relating to the CTF and ancillary waste and water control structures.

General comments on operations and monitoring are provided below. Details of the operations and monitoring plan are provided in the TOMS Manual, which is included in Appendix I of this report.

10.1.1 Quantitative Performance Parameters

Quantitative Performance Parameters (QPPs) are parameters that can be easily measured and evaluated on-site without complex calculation or data interpretation. QPPs are a good reference to quickly assess the performance of the facilities.

Details regarding the QPPs are presented in the TOMS Manual. The QPPs presented therein will be expanded throughout the development of the Project as it progresses through construction and operations.

10.2 OPERATIONS

10.2.1 General

Activities to be carried out during operation of the CTF will include monitoring and commissioning of the foundation drain, seepage collection and sump and pump systems, as well as construction/extension and management of tailings discharge pipeworks, basin drain, water reclaim systems and pipeworks, and seepage recycle systems. In addition, concurrent reclamation of the downstream embankment slopes can be undertaken for all facilities following the completion of final embankment construction.

10.2.2 Tailings Delivery and Deposition

Tailings will be delivered at 79% solids content (approx. by weight) via pump and dual containment pipeline from the mill to the CTF. Tailings will be deposited using spigot offtakes positioned at the southern end of the CTF. Northward sloping beaches will be developed through selective spigot placement over the life of the mine that will direct surface water following precipitation events towards the wet well sump at the north end of the facility. The formation of a permanent pond on the surface of the CTF is not anticipated.

Details of the tailings delivery system are shown on Drawing C6100, and in Appendix H of this report.

10.2.3 Foundation Drains

The foundation drains will be constructed early and will become operational shortly after commencing construction of the CTF. Groundwater, meteoric water, and seepage infiltrating the foundation of the CTF will be collected by the foundation drain and directed into the foundation drain collection pond. Water will be pumped back from the pond to the CTF, for temporary storage and subsequent transfer to the PWP. Alternatively water can be pumped directly from the foundation drain ponds to the water treatment plant prior to discharge.

Water quality from the foundation drains will be tested on a regular basis by TRI to monitor the effectiveness of the CTF liner system.

10.2.4 Basin Drain and Water Reclaim System

The CTF will be operated with a minimal pond, with temporary ponding of water forming only following storm events. The basin drain will convey water that percolates through the tailings mass to the wet well sump and reclaim system, while surface water will report directly to the sump system. The reclaim pumps will be operated on an as-needed basis to transfer water from the CTF to the PWP for mill use.

10.3 MONITORING

Extensive monitoring will be undertaken as part of the ongoing operation of the facilities. Monitoring of the CTF and ancillary works will provide important input for performance evaluation and refinement of operating practices. 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 - This includes items such as tailings deposition locations, checks on pipe joints and pipe integrity, performance of pumps and valves, embankment freeboard, water levels in sumps and 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 - This includes items such as:
  - Tailings solids content
  - Tonnes or tons of tailings deposited
  - Groundwater monitoring well sampling and testing
  - Analyzing piezometer levels within the tailings mass
  - Analyzing settlement gauge data
  - Analyzing inclinometer data
  - Reviewing tailings level and density surveys
  - Surveying the tailing beach slopes
  - Confirming the supernatant pond volume

  - Monitoring movement monuments
  - Completing embankment surveys, and
  - Water flow measurements.
- Water Quality and Compliance Monitoring – this includes items such as:
  - Ongoing baseline surface and groundwater flow and water quality sampling, and
  - Facility water quality monitoring sampling.

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 with regards 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.

Complete details of the monitoring program in included in the TOMS Manual. The monitoring program includes requirements for annual EOR inspections, and periodic reviews by the IRP, as discussed below. The TOMS manual is included in Appendix I.

10.3.1 Annual EOR Inspections (Operations, Closure, and Post-Closure)

As per MCA 82-4-381, the EOR will inspect the tailings impoundment annually during operations or as required during closure pursuant to a reclamation plan under MCA 82-4-336. The requirements for the annual inspection are as follows:

- The EOR will prepare a report describing the scope of the inspection and actions recommended to ensure the impoundment is being properly operated and maintained.
- The EOR will submit the report to TRI and Montana Department of Environmental Quality (MDEQ) and immediately notify MDEQ and TRI if the facility presents an imminent threat or the potential for an imminent threat to human health or the environment.

Annual inspections by the EOR will continue for a post-closure period until the reclamation has been deemed complete and the bond released. Should a change in the designated EOR before this time occur than TRI will select a new EOR within 90 days, and MDEQ must be informed of the change in writing.

10.3.2 Periodic IRP Reviews

As per MCA 82-4-380, at least every 5 years TRI must assemble an IRP review in accordance with the IRP requirements (MCA 82-4-377). The IRP must conduct the following:

- Inspect the CTF and ancillary facilities.
- Review the TOMS Manual and records collected in association with the Manual.
- Interview people with responsibilities identified in the TOMS Manual.
- Review EOR annual inspection reports, corrective actions, records associated with construction, and any other aspect, plan, record, document, design, model, or report related to the facility that the IRP needs to ensure that the facility is constructed, operated, and maintained as designed and is functioning, can be closed as intended, and meets acceptable engineering standards.
- The IRP will prepare a report detailing the scope of review and include any recommendations resulting from the review.
- The IRP will immediately notify MDEQ and TRI if there is an imminent threat to human health or the environment.
- The final review report must be signed by each IRP member and provided to MDEQ and TRI.

TRI will provide all documents and records necessary for the IRP to complete the periodic review. Periodic inspections by the IRP will continue for a post-closure period until the reclamation has been deemed complete and the bond released.

10.3.3 Water Quality Sampling and Analysis

A sampling and analysis plan for water quality and facility operational and closure compliance monitoring is included in the Mine Operating Permit Application.

11 – RECLAMATION AND CLOSURE

11.1 GENERAL

Reclamation and closure of the CTF will be structured to meet the requirements of the Montana Metal Mine Reclamation Act. Reclamation of disturbed areas will be carried out during operations to the maximum extent practicable. The objectives of the reclamation plan are to return the site to pre-mining conditions and obtain all pre-mining beneficial land uses, which includes stabilizing disturbed areas to prevent soil loss, minimizing visual impacts, and preventing air and water pollution. This will be accomplished through surface drainage, progressive reclamation of downstream embankment slopes and interim revegetation of borrow areas using approved seed mixes. Final reclamation of the CTF will include the following:

- **Dewatering:** Natural drying and evaporation will reduce the moisture content in the tailings. Cement, fly ash or slag added to the tailings during thickening will stiffen the tailings after deposition and create a stable, non-flowable mass. At closure, all surface water will be pumped out of the CTF, including the sump and foundation drain collection pond and treated at the on-site water treatment plant. Additional dewatering measures will be considered if required by site conditions at the time of closure.
- **Shaping:** Shaping of the tailings surface may be required for closure. Shaping may be accomplished by selective tailings deposition or placement of general fill material to create a self-draining topographic surface suitable for capping and closure of the CTF.
- **Cover:** Sub-grade bedding material may need to be placed above the tailings and general fill to provide a protective layer for HDPE geomembrane placement, depending on the material that forms the final upper surface (i.e. not required for a smooth tailings surface).
- **Capping:** The CTF will be covered with a 100 mil HDPE geomembrane which will be welded to the existing liner system. The geomembrane cover will be capped off with non-reactive rockfill and overburden, which will be stockpiled during initial construction and operations, and graded to control runoff. The capping layer will be a minimum of 1,000 mm (40 in.) thick to comply with state guidelines for reclamation and closure, and will also serve to provide a stable platform for topsoil cover and revegetation. The cover material must be sized so that the geomembrane is not damaged during placement.
- **Embankment Excavation and Contouring:** Ancillary waste and water management structures will be deconstructed in order to restore the site to as close to the pre-mining conditions as possible. Embankment fill from these structures will supply material used to provide a capping layer for the CTF as needed.
- **Revegetation:** Revegetation measures include soil replacement using the stockpiled topsoil, seedbed preparation and seeding with approved seed mixes. A soil cover of 700 mm (27.5 in.) thickness (180 mm (7 in.) topsoil and 520 mm (20.4 in.) sub-soil) will be placed over the regraded tailings and rockfill surface, as well as in mosaic patterns on the embankment slopes (internal and external). The soil cover will be revegetated with approved seed mixes, with revegetated slopes not exceeding 50 m (164 feet) in length before being interrupted by a rocky zone. These rocky zones will be placed asymmetrically across the slope.

Final reclamation of the CTF will include decommissioning of the foundation drain collection pond and connecting the foundation drain outlet pipe to the underground infiltration gallery draining to wetlands located immediately east of the CTF. The foundation drain collection pond will have the liner removed and hauled to an off-site disposal or recycling center. All disturbed ground will be re-contoured and re-vegetated. The deactivated and reclaimed CTF, along with the CTF diversion channel will be the only remaining structures on site at the completion of the final reclamation phase.

11.2 POST-CLOSURE MONITORING

The goals of the reclamation plan for the waste and water management facilities are to achieve long term stability of each facility site or remaining embankment, to develop a self-sustaining productive vegetative cover over the cemented tailings mass and synthetic liners, and to ensure long term protection of the surrounding environment. In order to document the success in achieving these goals, a post-closure monitoring program will be developed. The CTF is designed to be geotechnically stable at closure and the post-closure monitoring program will confirm the design performance. This monitoring program will include geotechnical monitoring, hydrogeological monitoring, re-vegetation monitoring, erosion control, and the continuation of approved water quality monitoring plans.

Geotechnical monitoring will include survey monuments on the crest and downstream slopes of all remaining embankments, as well as on fill material used to cap the CTF at closure. These monuments will require surveying at regular intervals in order to indicate any settlement or movement in the facilities. Inclinometer measurements will also be recorded simultaneously as part of the geotechnical monitoring program. Following closure, all monuments and inclinometers will be monitored until no noticeable additional settlement movement takes place within a 12-month period. The monitoring schedule is provided in the TOMS Manual (Appendix I).

Additional monitoring will include the ongoing monitoring of the pore pressures within the basin drain, and wet well sump and pump system in the CTF. This will include monitoring of the vibrating wire piezometers installed during operations, as well as any others required at closure. The piezometers will be monitored regularly during operations and for a post-closure period until the reclamation has been deemed complete by DEQ and the bond released.

Annual reviews by the EOR will be continue to be conducted in the Post-Closure phase, as described in Section 10.3.1 of this report. Periodic IRP reviews will be conducted at a minimum of every 5 years, as described in Section 10.3.2 of this report. These inspections for a post-closure period until the reclamation has been deemed complete and the bond released.

During operations, a surface and groundwater quality monitoring program will be conducted in order to determine seasonal and temporal changes in the foundation drain flows and receiving water quality from the CTF. This program will be carried out to confirm compliance with downstream receiving water quality requirements and to project changes in the groundwater quality over time. The program will consist of sampling and analyses of:

- Foundation drain flows
- Water from the CTF collection sump, and
- Monitoring wells located throughout the mine site, especially those down gradient from the CTF.

The analyses will be as per the approved water quality monitoring plan, which has been developed by others for inclusion in the Mine Operating Permit Application. Monitoring conducted over the life of the mine will indicate whether any adverse impacts to the water quality have occurred during operations. Results of the water quality monitoring will be provided to MDEQ, who will determine whether down-sizing or cessation of the monitoring program is permissible. Provided that additional water quality monitoring is not warranted, the monitoring wells will be decommission by sealing the full length of the well with an inert cement grout and the casing will be cut off below ground level as per Montana well abandonment protocols and regulations.

12 – SUMMARY

A feasibility level design has been prepared for the Cemented Tailings Facility (CTF) at the Black Butte Copper Project. The feasibility design provides permanent and secure storage of cemented tailings for operations and closure.

The feasibility design is based on a projected 15 year mine life at a processing rate of 3,300 tonnes per day. A total of 13.2 million tonnes of ore will be processed over the life of the mine; 45% of the tailings produced will be used for underground backfill and the remaining 55% will be stored on surface in the CTF. The CTF has been designed to store 3.56 million m^3 of tailings at an averaged settled dry density of 2 t/m^3, 0.35 million m^3 of waste rock, with additional capacity for temporary storage of a Probable Maximum Flood event. A separate Process Water Pond (PWP) will store approximately 200,000 m^3 of process water recycled for use in the mill, with additional capacity for storm storage.

The main features of the waste and water management systems are as follows:

- Ultra-thickened (79% solids content) tailings, with 0.5-2% (by weight) cement, and fly ash or slag added, delivered by pipeline to the CTF, located south of the mill site. The cement and fly ash or slag additives will stiffen the tailings after deposition and create a non-flowable mass.
- Cemented tailings will be discharged using spigot offtakes at the south end of the impoundment. The offtakes will be repositioned as needed to ensure the development of northward sloping beaches. Bleed water and precipitation will be collected in a basin drain integrated with a wet well sump and pumped to the PWP for mill use. The tailings will be delivered to the CTF via insulated 8-inch diameter PN150 steel pipelines with an HDPE liner to provide corrosion protection. The tailings pipeline will be constructed with double containment between the mill and CTF to provide back-up protection in the event of a pipe leak. The pipelines will be flushed with water and drained when not in use.
- The CTF will be constructed with a single embankment to utilize the natural topographic containment located to the west. A cut-fill balance will be achieved through impoundment shaping to provide embankment fill material. The CTF will locally extend below the groundwater table elevation.
- The CTF will have a double liner system comprised of a 7.6 mm, high flow geonet layer sandwiched between layers of 100 mil HDPE geomembrane that encompasses the entire basin and on the upstream slope of the embankment. Potential seepage through defects in the upper geomembrane liner will be collected in the geonet and gravity-delivered to a sump and pump system to be pumped back into the CTF.
- Foundation drains will be constructed beneath the CTF to collect groundwater flow and seepage beneath the impoundments and deliver it to foundation drain collection ponds for pump back to the respective facilities.
- A basin drain will be constructed in the CTF using waste rock generated during the pre-production year. This basin drain will allow the collection of tailings bleed water and maintain a low hydraulic head on the geomembrane. It will convey any water that percolates through the tailings to the wet well sump and reclaim pump system.
- A reclaim water systems will be constructed at the CTF. The reclaim system will deliver water from the CTF to the PWP, and will be capable of removing water from a 1 in 100 year 24-hour storm event over a 10 day period.

- A water balance model developed for the facility indicates that the CTF and PWP will operate at a net water deficit during all years of operations, and only a portion of the process water requirements can be satisfied by water reclaim from the CTF. Additionally, precipitation and run-on into the CTF and PWP will be pumped directly to the WTP for treatment and release. Overall, approximately 163,000 m^3 of make-up water sourced from the underground mine is required annually to offset water losses to tailings voids, evaporation, and the diversion of precipitation and run-off.
- Instrumentation will be provided for all embankments, including vibrating wire piezometers, survey monuments, vibrating wire settlement gauges, and inclinometers. The instrumentation will be monitored as part of the detailed monitoring plans to be developed for the facility.
- The primary objective of reclamation and closure activities will be to ensure physical and chemical stability of the CTF, and ensure that acceptable downstream water quality is maintained. Closure and reclamation will focus on removal of surface infrastructure (except for the CTF and the CTF diversion channel) and exposed liner systems, and covering all exposed tailings surfaces. Additional closure work will involve progressive reclamation and revegetation of the embankments and any other disturbed surfaces.

13 – REFERENCES

Administrative Rules of Montana (ARM), Rule Chapter 36.14, Dam Safety. Available at: http://www.mtrules.org/gateway/ChapterHome.asp?Chapter=36%2E14 Accessed April 2015.

ADS, Inc., 2009. *Drainage Handbook – ADS N-12 ST IB Pipe (per ASTM F2648) Specification.* ADS, Inc., October 2009.

ADS, Inc., 2015. *Technical Note 1.01 – Dual Wall Perforation Patterns.* ADS, Inc., January 2015.

Bengston, H.H. 2014. *Spreadsheet Use for Partially Full Pipeline Calculations.* CED Engineering Professional Development Course.

Berena, M., Pazmino, L. & Stark, T.D., 2010. *Subgrade Requirements for Fabricated Geomembranes*. Fabricated Geomembrane Institute at the University of Illinois at Urbana-Champaign, June 2010.

Berglund, J., and McEldowney, R. 2008. *Montana Wetland Assessment Method*. Montana Department of Transportation, Environmental Services, Helena, Montana

Bray, J.D.& Travasarou, T., 2007, *Simplified Procedure for Estimating Earthquake-induced Deviatoric Slope Displacement*. doi 10.1061/(ASCE)1090-0241(2007)133:4(381).

"Cemented Tailings Paste Characterization and Laboratory Test Results – Appendix K-5 in the BBC MOP dated July 14, 2017). Original laboratory testing done by AMEC Foster Wheeler in 2015 in Hamilton, Ontario (Canada).

Duncan, J.M. et al, 2014. *Soil Strength and Slope Stability*.

Enviromin, Black Butte Copper Project – Final Baseline Environmental Geochemistry Evaluation of Waste Rock and Tailings – Revised Mine Operating Permit April 24, 2017, 28 p. with Appendices A through D. Presented as Appendix D in the Black Butte Copper Revised Mine Operating Permit Application (Revision 3) dated July 14, 2017 submitted to the Montana Dep.

Enviromin, 2012, Black Butte Copper Project – Final Baseline Environmental Geochemistry Evaluation: 2012 Johnny Lee Decline, 28 p. Included as sub-appendix A in Appendix D of the BBC MOP Application dated July 14, 2017.

Federal Emergency Management Agency (FEMA). 2004. *Federal Guidelines for Dam Safety*.

GEO-SLOPE International Ltd., Geostudio 2012 (Version 8.13). Calgary, Alberta.

Giroud, J.P., Bonaparte, R., 1988. *Leakage through Liners Constructed with Geomembranes – Part 2. Composite Liners*. Geotextiles and Geomembranes (1989) Pg. 71-111.

Giroud, J.P. & Bonaparte, R., 1989a. *Leakage Through Liners Constructed with Geomembranes – Part I – Geomembrane Liners.* Geotextiles and Geomembranes, Volume 8, pp. 27-67.

Giroud, J.P. & Bonaparte, R., 1989b. *Leakage Through Liners Constructed with Geomembranes – Part II – Composite Liners.* Geotextiles and Geomembranes, Volume 8, pp. 71-111.

Giroud, J.P., 1997. *Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects.* Geosynthetics International, Volume 4, Nos. 3-4, pp. 335-348.

GSE Environmental, 2014a. *GSE HD Textured Geomembrane Product Data Sheet*. Available at: http://www.gseworld.com/content/documents/datasheets/membranes/North_America/HD_Textured_Geomem_METRIC_DS.pdf. Accessed May 2015.

GSE Environmental, 2014b. GSE TRxNet Geonet Product Data Sheet. Available at: http://www.gseworld.com/content/documents/datasheets/Bi-Planar/TRxNet_Geonet_METRIC_DS.pdf. Accessed May 2015.

Hydrometrics, 2017, Appendix B: Baseline Water Resources Monitoring and Hydrogeologic Investigations Report, *in* Mine Operating Permit Application (Revision 1) submitted to the Montana Department of Environmental Quality on September 2016, Tintina Resources, Black Butte Project, August 2015, revised 2017, 58 pages.

International Commission on Large Dams (ICOLD). 1989. *Selecting Seismic Parameters for Large Dams: Guidelines.* Bulletin 72.

International Commission on Large Dams (ICOLD). 1989. *Tailings Dam Safety: Guidelines.* Bulletin 74.

International Commission on Large Dams (ICOLD). 1992. *Selection of Design Flood: Current Methods.* Bulletin 82.

International Commission on Large Dams (ICOLD). 1995. *Tailings Dams and Seismicity: Review and Recommendations.* Bulletin 98.

International Commission on Large Dams (ICOLD). 1996. *A Guide to Tailings Dams and Impoundments.* Bulletin 106.

International Commission on Large Dams (ICOLD). 2010. *Selecting Seismic Parameters for Large Dams: Guideline.* Bulletin 72, 2010 Revision. Bulletin 148.

International Metallurgical and Environmental Inc., 2015, Tailings gradation curve from average values from lab test results, October, 2015.

Jensen Control Engineering Systems, 2015. *Wet Well Design Guidelines.* Available at: http://www.jensenengineeredsystems.com/category/wet-wells. Accessed May 2015.

Knight Piésold Ltd., 2015a. *Black Butte Copper Project Meteorology Data Analysis Update.* KP Reference VA15-02445, Issued May 27, 2015.

Knight Piésold Ltd. (KP), 2015. *Tintina Resources Inc. Tailings Storage Facility: Ken Brouwer, P.E. Designation as Engineer of Record*. KP Reference VA15-03202, Issued October 2, 2015.

Knight Piésold Ltd., 2015b. *Life of Mine Water Balance.* KP Reference VA15-03200, Issued October 7, 2015.

Knight Piésold Ltd. (KP), 2017. *Black Butte Copper Project – 2015 Geotechnical Site Investigation Report*. Vancouver. Ref. No. VA101-460/3-1, Rev 4.

Knight Piésold Ltd. (KP), 2017. *Tailings Operations, Maintenance and Surveillance (TOMS) Manual*. Vancouver. Ref. No. VA101-460/3-4, Rev 0.

Knight Piésold Ltd. (KP), 2017. *Black Butte Copper Project – CTF Dam Breach Risk Assessment*. KP Reference VA17-01339, Issued August 11, 2017.

Knight Piésold Ltd. (KP), 2005*. Stillwater Mining Company Summary of Paste Tailings Trial Program and Precedent Practice Review*. Vancouver. Ref. No. VA101-110/2-2, Rev 0.

Leps, T.M,. 1970. *Review of Shearing Strength of Rockfill, Journal of the Soil Mechanics and Foundations Division.* Vol. 96, pp 1159-1170.

Makdisi, F.I., and Seed, B.H., 1977, *A Simplified Procedure for Estimating Earthquake-Induced Deformations in Dams and Embankments*. Earthquake Engineering Research Center Report No. UCB/EERC-77/19, University of California, Berkeley, California.

MG Engineering, 2016. *Black Butte Tailings Pipeline Feasibility Study.* MG Project No. 147315, Project Memorandum 001 Revision 01, February 23, 2016.

Newmark, N.M., 1965, *Effects of Earthquakes on Dams and Embankments*. Vol. 15 No. 2 pp 139 – 159.

Swaisgood, J.R., 2003, *Embankment Dam Deformations Caused by Earthquakes*. 2003 Pacific.

Stark, T.D & Villarreal, R., 2014. *Guidelines for Installation of Factory Fabricated Heavyweight Geomembranes*. Fabricated Geomembrane Institute at the University of Illinois at Urbana-Champaign, prepared for the International Association of Geosynthetic Installers (IAGI), March 2014.

Tintina Resource Inc., *Updated Technical Report and Preliminary Economic Assessment for the Black Butte Copper Project*, Montana Document No. 1391880100-REP-R0004-01.1, July 12 2013.

United States Army Core of Engineers, Regulation No. ER-1110-2-1806 "*Earthquake Design and Evaluation for Civil Works Projects"*, July 31, 1995.

US Dept. of Agriculture, 1994, *National Engineering Handbook: Chapter 26 – Gradation Design of Sand & Gravel Filters.* National Resources Conservation Centre, October 1994.

US EPA, 1992. *Action Leakage Rates for Leak Detection Systems.* United States Environmental Protection Agency, Office of Solid Waste, EPA 530-R-92-004, January 1992.

Westech Environmental Services, Inc., 2017, Updated Soil Salvage Volumes for the Black Butte Copper Project, Montana, internal table (7-2) completed for Tintina Resources, Inc. and incorporated into the Mine Operating Permit Application submitted to the Montana Department of Environmental Quality, March, 2017.

Whitehall Geogroup Inc., *Quaternary Faulting Potential,* June 22, 2017

14 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

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APPENDIX A

2015 GEOTECHNICAL SITE INVESTIGATION

(Pages A-1 to A-377)

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION REPORT

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BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION REPORT
VA101-460/3-1

Rev	Description	Date
0	Issued in Final	April 27, 2016
1	Minor Revisions	May 20, 2016
2	Updated Figures	May 24, 2016
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EXECUTIVE SUMMARY

Knight Piésold Ltd. (KP) was retained by Tintina Resources Inc. (TRI) to undertake geotechnical and hydrogeological site investigations for the Black Butte Copper Project (the Project) in 2015. This data report summarizes the work carried out and the observations made during the site investigation program. The key objectives of the site investigation were to:

- Collect geotechnical and hydrogeological information to support a feasibility level design for the construction of the Cemented Tailings Facility (CTF), Process Water Pond (PWP) and Non-Contact Water Reservoir (NCWR).
- To collect geotechnical and hydrogeological information for the conditions at the proposed plant site (to be designed by others).
- To complete test pit excavations over the project area to characterize soil depth to bedrock and suitability as potential for construction material borrow sources.

The site investigation program included the following work:

- Drilling with standard penetration testing (SPT) in overburden, Lugeon packer testing in bedrock, and detailed geotechnical logging of core or characterization of drill-cuttings.
- Installation of standpipe piezometers.
- Excavation of test pits through overburden until contact with (weathered) bedrock.
- Sample collection of soil for index testing and bedrock for strength testing.

The site investigation was conducted between March and May 2015, and included 24 drillholes and 44 test pits. It was split into two phases. Phase 1 was carried out in March 2015 and included 19 geotechnical drill holes; 4 holes had standpipe piezometers installed. The second phase was carried out in May 2015 and consisted of 5 geotechnical drillholes and 44 test pits. All Phase 1 holes were drilled with a Sandvik 710 track mounted mud rotary drill rig. Phase 2 drillholes were completed with an LF 70 track mounted mud rotary drill rig.

Results of the site investigation program indicate:

- The geology of the project area consists mainly of calcareous shale rocks of the Newland Formation (shales) and mostly low permeability rocks (diorites) of a local intrusive suite.
- Overburden typically consists of a compact, silty sand and clay matrix supporting fine gravel with rare cobbles. Overburden thickness ranges from 0.2 to 6.7 m, but is generally 1 m thick or less.
- Hydraulic conductivities for the bedrock units encountered throughout the project area ranged from 2 x 10^{-3} to 6 x 10^{-6} m/s. These values are based on passive response testing (falling head) in competent, fractured and/or weathered rock units.
- The groundwater levels in the drillholes varied from site to site but were generally in the range of 5 to 8 m below ground surface (mbgs) when observed under static conditions. One drillhole (SC15-184) exhibited artesian conditions due to its location at a topographic low on the property and with a significant thickness of confining, low permeability, till materials over the bedrock.
- Field estimates of UCS for weathered bedrock units encountered within the project area ranged from 5 to 25 MPa with competent bedrock ranging from 30 to 150 MPa. The RMR ranged from 38 to 62 indicating a rock mass designation of FAIR.

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APPENDICES

1 – INTRODUCTION

1.1 PROJECT DESCRIPTION AND BACKGROUND

The Black Butte Copper Project (the Project) is a proposed copper/cobalt mine in the Strawberry Butte area of Montana, located approximately 32 kilometres (km) north of White Sulphur Springs and 5 km off of U.S. Highway 89. Figure 1.1 shows the location of the Project site.

Knight Piésold Ltd. (KP) was retained to produce feasibility level designs for the waste and surface water management facilities at the Project. As part of the scope of work, KP completed a geotechnical Site Investigation (SI) to collect data for the design of the waste and water management facilities.

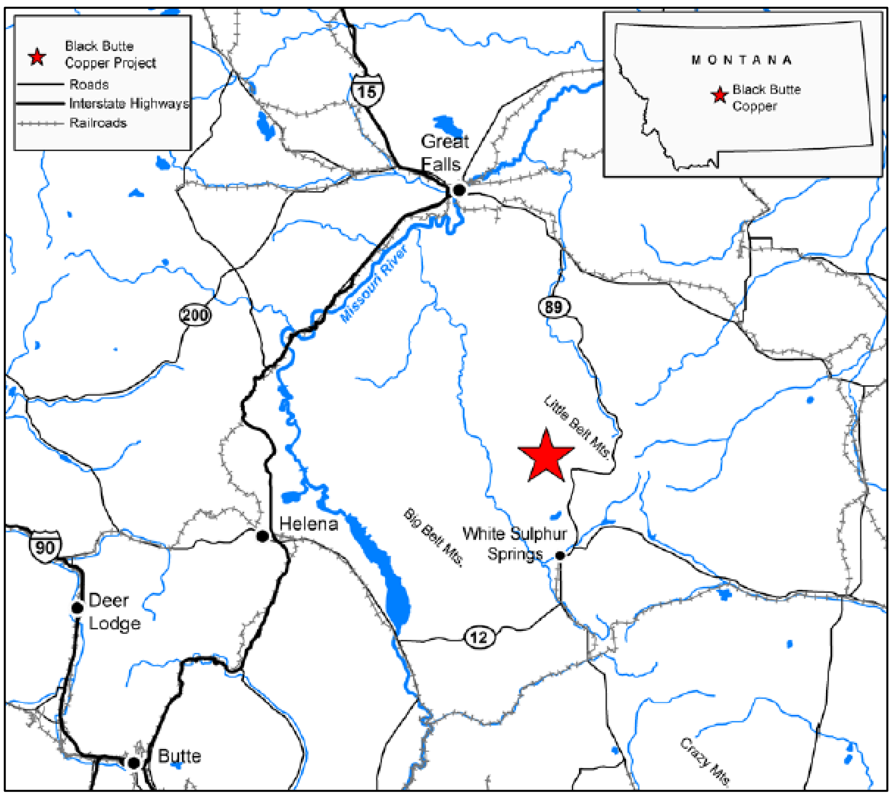


Figure 1.1 Project Location Map

1.2 SCOPE OF WORK

A geotechnical SI program was completed to collect the data required for the waste and water management systems design. The SI program scope included the following:

- Geotechnical investigation of the Cemented Tailings Facility (CTF), Process Water Pond (PWP), and Non-Contact Water Reservoir (NCWR), including previously identified alternative locations, and waste dump foundation conditions.
- Geotechnical investigation of the plant site foundations and provision of foundation design parameters to facilitate foundation designs by others.

- Identification of construction materials and borrow areas for the project facilities.
- Integration with the hydrogeological study to establish groundwater levels and hydraulic conductivity values, as appropriate.

The SI program was planned using the most current site layout available with the intent of gaining an understanding of the geology and geotechnical conditions of the project area as a whole.

The site investigation was completed in two phases. Phase 1 consisted of a geotechnical drilling program completed in March 2015. The Phase 2 program consisted of test pitting and additional geotechnical drill holes, and was conducted in May 2015 after the snowmelt and ground thaw had occurred. Figure 1.2 shows the distribution of drill holes and test pits across the Project area.

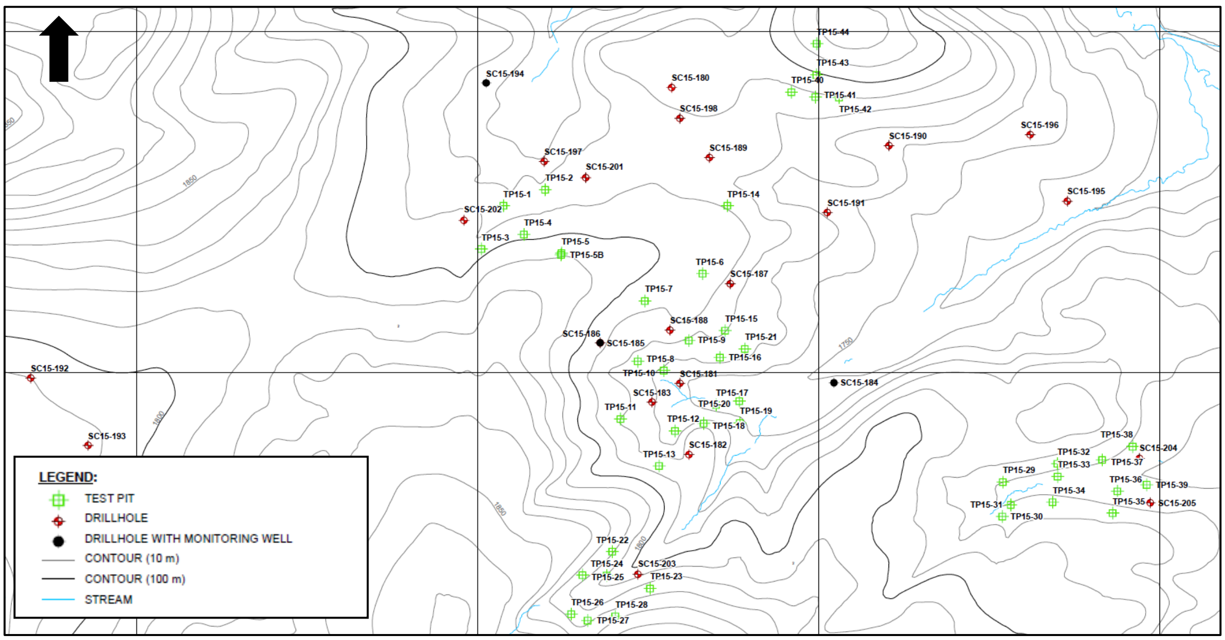


Figure 1.2 Overall Site Investigation Plan

2 – GENERAL SITE CHARACTERISTICS

2.1 PHYSIOGRAPHY AND CLIMATE

The climate is typical of uplands in central Montana with moderate summers and cold winters. The average daily minimum and maximum temperatures for White Sulphur Springs (elevation 1,609 masl) are -10°C during the winter months and up to 17°C in the summer. Temperature typically varies from -30°C in winter, up to 40°C in summer. The average annual precipitation and evaporation of the project area are approximately 416 mm and 514 mm respectively. The project lies between an elevation of 1,700 and 1,850 metres above sea level (masl), and is located in the Little Belt Mountains, resulting in cooler temperatures and higher precipitation than those recorded at White Sulphur Springs (Tintina, 2013).

2.2 REGIONAL GEOLOGY

The copper-cobalt deposits of Black Butte occur in middle Proterozoic sediments of the Belt Supergroup which are extensively exposed in an eastward protrusion of the Rocky Mountain chain called the Helena salient in central Montana (Zieg and Leitch 1993).

During formation of the Belt Basin, a deep water middle Proterozoic calcareous shale facies (Newland Formation) deposited in an embayment, known as the Helena embayment, which extended in trough-like fashion east into the craton through central Montana (Godlewski and Zieg 1984). The northern boundary of the deeper water portion of the Helena embayment lays along the southern flank of the Little Belt Mountains north of White Sulphur Springs. During the Cretaceous Laramide orogeny, renewed faulting along the ancestral northern margin of the Helena embayment formed the Volcano Valley thrust fault (Winston 1986). The bedded massive sulphides of the Black Butte are concentrated along the northern margin of the Helena embayment along the Volcano Valley Fault (VVF) zone.

2.3 SURFICIAL GEOLOGY

Newland Formation sedimentary rocks and diorite intrusive rocks occur as localized, weathered outcrops throughout the property. The overburden material varies in thickness over the property with the depth to weathered bedrock typically 1.0 m. The overburden material varies slightly around the property, but generally consists of a relatively thin cover of silty sand or sandy silt with clay and gravel (glacial till).

2.4 BEDROCK GEOLOGY

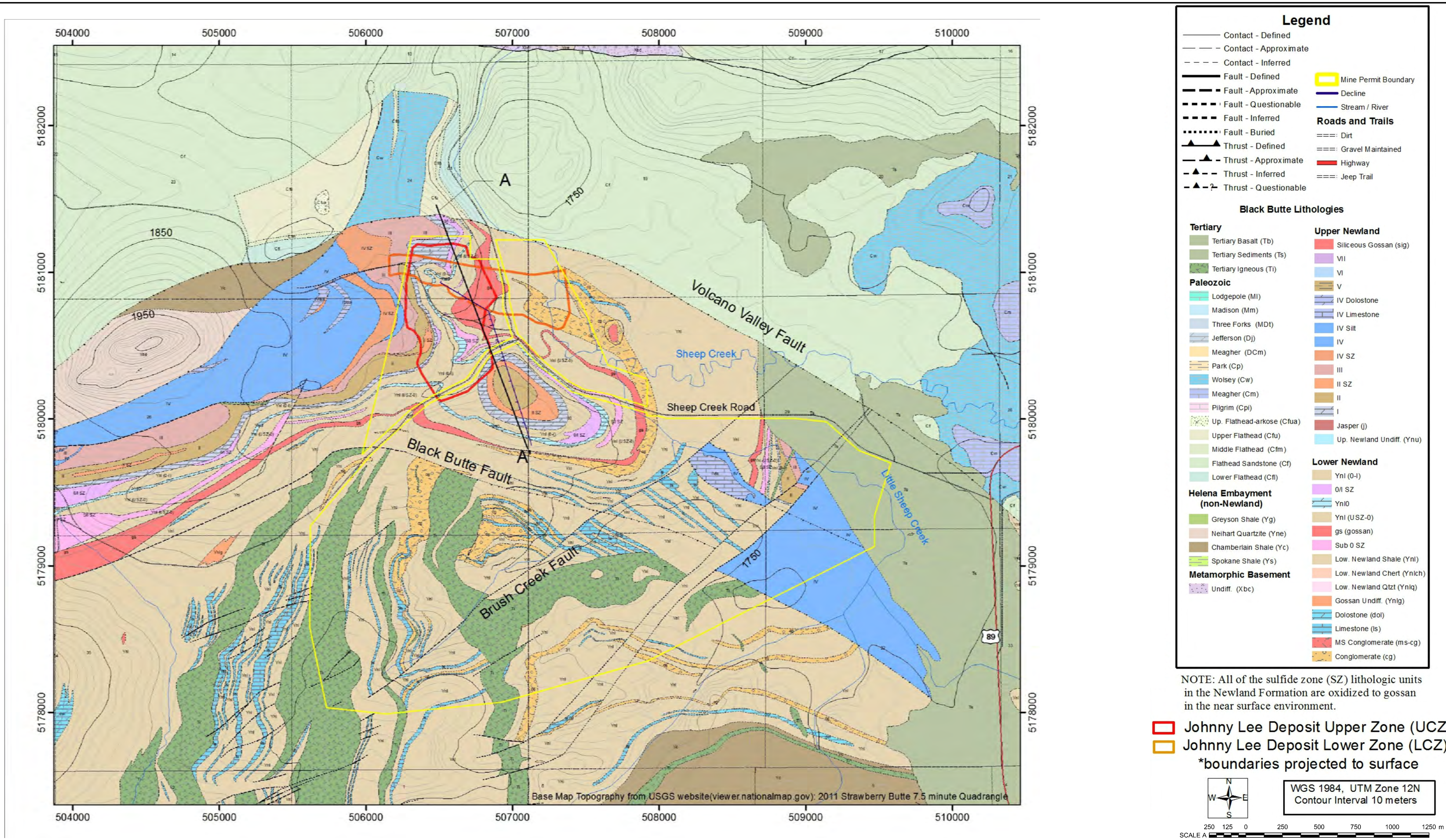
The Newland Shale consists of a lower shale-dominated part which measures approximately 760 m thick and an upper carbonate-dominated part which measures approximately 350 m thick. The shale was deposited as microturbidites in a sub-wavebase depositional setting. Debris flow conglomerates punctuate the section along the northern margin of the embayment.

Igneous rocks intrude the Newland Formation rocks throughout the property and are seen predominantly in the north and northwestern section of the property in the areas of the Process Water Pond and the south CTF impoundment. These igneous intrusive rocks consist of diorite and granodiorite and have been emplaced predominantly as sills and lesser dikes within the sedimentary package.

2.5 STRUCTURAL GEOLOGY

There are several major east trending fault systems in the region, as shown in Figure 2.1. Within the Project area the Copper Creek segment of the Volcano Valley fault (VVF) shows an orientation of roughly N80E. At Butte Creek, a N50E trending structure offsets the VVF in sinistral fashion to a point 1 km northeast of its previous location. From this point, the Black Butte segment of the VVF continues east north of Black Butte for approximately 2 km and gradually arcs toward the southeast for 7 km at a bearing of S45E toward Newlan Creek. From its entrance into the Newlan Creek valley, the Newlan Creek segment of the VVF continues with an easterly bearing for at least 16 km. The flexures in the VVF at Butte Creek and at Newlan Creek are joined by a S65E trending northeast directed reverse fault called the Black Butte Fault (BBF) which carries Chamberlain shale over Newland Shale. The area enclosed between the Black Butte segment of the VVF and the BBF contains all known copper resource at the Project (Tintina Resources Inc., 2013).

Based on the above, none of the proposed infrastructure for the project is impacted by the Volcano Valley or Black Butte fault systems. Smaller scale faults and shear zones have been observed in drill core, but were localized and over short intervals.



TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

REGIONAL GEOLOGY

Knight Piésold CONSULTING

P/A NO. VA101-460/3 | REF NO. 1

FIGURE 2.1 REV 2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
2	06SEP'16	ISSUED WITH REPORT	GIM	MJC	KDE

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3 – 2015 GEOTECHNICAL SITE INVESTIGATION PROGRAM

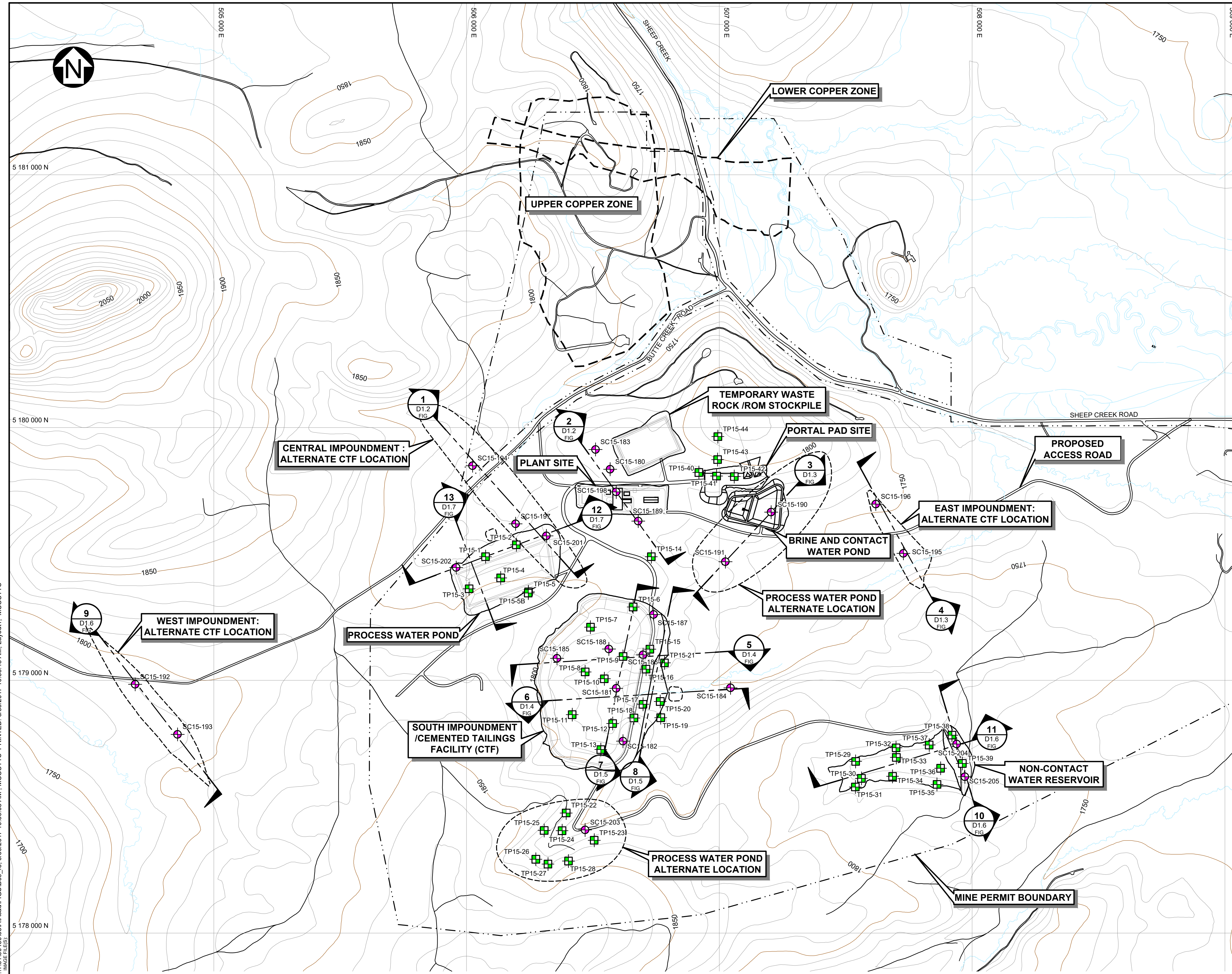
3.1 GENERAL

The 2015 geotechnical Site Investigation program was divided into two phases. Phase 1 started on March 3 and was completed on March 22, 2015. Phase 2 commenced on May 26 and completed on June 5, 2015. The primary objective of the SI program was to evaluate the geotechnical and hydrogeological conditions at the proposed Plant Site, Process Water Pond, and the proposed East, Central, West and South Tailings Impoundment locations. The data collected will support the feasibility level engineering design of the site facilities. Long-term groundwater monitoring wells were installed in order to support environmental baseline studies and ongoing groundwater monitoring.

The 2015 geotechnical SI program included the following activities:

- 724 metres drilled in 24 geotechnical drillholes using both tricone and mud rotary methods. In-situ packer testing was conducted during drilling to evaluate the hydraulic conductivity of the rock mass. The geotechnical holes were completed to assess the soil and rock foundation conditions of various proposed mine site facilities locations, primarily at the proposed CTF (the south tailings impoundment location). Geotechnical logging of drill core was carried out in all drillholes to characterize the rock mass.
- Long term monitoring wells were installed in 4 of the 24 geotechnical drillholes. Upon completion of well installations, well development and response testing was left to be carried out by Tintina Resources Inc.
- 44 test pits were excavated throughout the project area at the proposed facilities to determine overburden thickness and to characterize the overburden material.
- Drill core samples were collected for laboratory UCS testing. Laboratory testing of the rock samples was conducted by Mine Design Engineering in Kingston, Ontario, Canada.
- Samples of soil materials recovered from the geotechnical drillholes and test pits were taken for soil index testing. One triaxial test was performed on a soil sample collected downstream of the CTF embankment.

The SI plan is shown in Figure 3.1. The South Impoundment location was selected as the preferred location for the CTF prior to commencing the site investigation, and therefore has a higher density of drillhole coverage.



LEGEND:

# / ### / FIG	CROSS-SECTION REFERENCE
	DRILL HOLE
	TEST PIT
	ALTERNATE CTF AND PWP LOCATION
	MINE PERMIT BOUNDARY

NOTES:

1. TOPOGRAPHIC BASE MAP FROM 2011 AERIAL LIDAR SURVEY WITH MAP PROJECTION: UTM ZONE 12N AND MAP DATUM: NAD83.
2. CONTOUR INTERVAL IS 10 METERS.
3. ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

150 75 0 250 500 750 m
SCALE A

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

GENERAL ARRANGEMENT CTF OPTIONS AND SITE INVESTIGATION PLAN

Knight Piésold CONSULTING

P/A NO.	REF NO.	
VA101-460/3	1	
FIGURE 3.1		REV 3

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All drill collars were surveyed at the completion of drilling by KP staff using a handheld Garmin GPS Map62. All survey information uses the UTM-NAD 83 coordinate system.

Ruen Drilling Inc. completed all drilling using a Sandvik 710 drill rig capable of drilling PQ3 and HQ3 sized diamond drilling in overburden and bedrock. All drilling was completed under the supervision of KP field personnel. Detailed geotechnical logging of soil and drill core was conducted in all drillholes in order to evaluate and characterize the ground conditions. Drillholes were grouted to surface at completion by Ruen personnel, with the exception of the four monitoring well locations.

The Sandvik 710 drill rig was equipped with a hydraulic drop-hammer to perform Standard Penetration Tests (SPTs). SPT results and sample descriptions were recorded by KP field personnel. SPTs were conducted through overburden until contact with weathered bedrock and “refusal” of the sampler.

3.2 GEOTECHNICAL DRILLING

A total of 724 m of drilling was completed in 24 geotechnical drillholes during the 2015 SI program. The depth of drilling was to a minimum of 30 m with at least 6 m penetration into competent, unweathered bedrock. Geotechnical and hydrogeological data was collected for various mine facilities, primarily at the CTF and stockpile areas. Table 3.1 provides a summary of the geotechnical drillholes. The site general arrangement and SI plan are provided in Figure 3.1.

SPTs were conducted in holes SC15-181, SC15-184, SC15-192, SC15-193, SC15-195, SC15-198, and SC15-201 to SC15-205 at 1.5 m intervals. Monitoring wells were installed in holes SC15-184, SC15-185, SC15-194 and SC15-198. The monitoring well installations involved the use of 1.5-inch PVC standpipe piezometers installed at specified depths within bedrock contacts, fractured/fault zones, or highly permeable zones. The installations were conducted by Ruen Drilling Inc. under the direction and supervision of KP field personnel.

Table 3.1 Summary of Geotechnical Drillholes

Drillhole	Drillhole Location	Coordinates [1]			Total Depth	Depth to Bedrock
		Northing	Easting	Elevation		
		(m)	(m)	(m)	(m)	(m)
SC15-180	Plant Site	5,179,835	506,568	1,788	30.2	0.6
SC15-181	South Impoundment Embankment	5,178,968	506,592	1,770	30.1	6.7
SC15-182	South Impoundment Embankment	5,178,759	506,619	1,794	30.2	0.2
SC15-183	South Impoundment Embankment	5,178,913	506,510	1,779	30.2	0.6
SC15-184	Seepage Collection Pond	5,178,970	507,044	1,756	30.0	4.6
SC15-185	South Impoundment Embankment	5,179,087	506,358	1,806	30.2	0.3
SC15-186	South Impoundment Embankment	5,179,101	506,698	1,786	30.2	0.3
SC15-187	South Impoundment Embankment	5,179,260	506,740	1,786	30.2	0.3
SC15-188	South Impoundment Embankment	5,179,124	506,563	1,792	30.2	0.2
SC15-189	Plant Site	5,179,630	506,679	1,782	30.2	0.3
SC15-190	Process Water Storage Pond	5,179,665	507,205	1,761	30.2	0.5
SC15-191	Process Water Storage Pond	5,179,469	507,024	1,768	30.2	0.5
SC15-192	West Impoundment Embankment	5,178,984	504,689	1,792	30.5	2.1
SC15-193	West Impoundment Embankment	5,178,786	504,857	1,787	30.2	2.1
SC15-194	Central Impoundment Embankment	5,179,849	506,024	1,774	30.1	0.5
SC15-195	East Impoundment Embankment	5,179,502	507,728	1,736	30.1	0.2
SC15-196	East Impoundment Embankment	5,179,697	507,619	1,751	30.5	1.5
SC15-197	Central Impoundment Embankment	5,179,619	506,194	1,775	29.9	0.2
SC15-198	SAG Mill	5,179,745	506,592	1,787	30.0	1.4
SC15-201	Process Water Storage Pond	5,179,571	506,316	1,783	30.3	0.6
SC15-202	Process Water Storage Pond	5,179,446	505,959	1,795	29.8	1.4
SC15-203	Process Water Pond (Alternate)	5,178,408	506,469	1,794	30.2	1.2
SC15-204	Non-Contact Water Reservoir	5,178,748	507,939	1,761	30.2	0.3
SC15-205	Non-Contact Water Reservoir	5,178,618	507,971	1,773	29.9	0.7

NOTES:
1. Coordinates are based on final collar survey data using the NAD83 UTM Zone 12N coordinate system.

3.2.1 Overburden Drilling and Logging

Overburden drilling in the geotechnical drillholes was typically completed by Ruen Drilling Inc. using diamond drilling methods. A tricone drill bit was used on several occasions to advance the drill through unstable overburden materials or to assist with the advancement of the casing through the overburden.

SPTs were completed at selected overburden depth intervals in 11 drillholes. SPTs were not conducted where bedrock was encountered close to ground surface. SPTs were completed every 1.5 m (5 feet) and then terminated at refusal of the sampler, typically when bedrock was encountered. A 140-lb automatic hammer with a 30 inch drop setup, equipped with a 24 inch split spoon sampler was utilized for each test. Blow counts were recorded over four 15 cm (6 in) intervals for a total of 60 cm (24 in) of sampling length. The SPT ‘n’ value was determined by adding the blow counts from the second and third intervals of the test.

Soils were logged according to guidelines specified in the Canadian Foundation Engineering Manual and according to the Visual-Manual Procedure for Standard Practice for Description and Identification of Soils (ASTM D2488-06).

3.2.2 Bedrock Drilling and Logging

Bedrock coring involved the use of a diamond drill bit with a standard wireline barrel set-up and a 1.5 m core barrel. This coring method allowed for continuous core sampling as the drillhole was advanced. Twenty-one drillholes were drilled with HQ3 size equipment using a triple tube core barrel set up. Three drillholes were drilled using PQ3 size equipment.

All geotechnical drillholes were advanced using water as the main drilling fluid. Additives such as polymers and/or drill mud were used sparingly, and only as required to stabilize drillholes.

Detailed geotechnical logging of the drill core was carried out in all of the geotechnical drillholes in order to characterize the rock mass quality using Bieniawski’s Rock Mass Rating (Bieniawski, 1989) classification system. On a run-by-run basis, the following information was collected:

- Core run interval
- Core recovery
- Rock Quality Designation (RQD)
- Lithological Description
- Field estimated Unconfined Compressive Strength (UCS) of rock
- Number of discontinuities
- Discontinuity Types, and
- Joint Conditions of Discontinuities (i.e. roughness, infilling, weathering/alteration, aperture, etc.).

3.3 TEST PIT EXCAVATIONS

A total of 44 test pits were excavated in the project area during the 2015 Phase 2 Site Investigation program. Six test pits were completed in the proposed Process Water Pond area, sixteen in the South Tailings Impoundment and downstream embankment area, seven in the alternate Process Water Pond location, eleven in the Non-Contact Water Reservoir and four in the area of the Portal.

All test pits were excavated using a Komatsu 210 excavator. Test pit depths ranged from 0.2 to 3.9 m and were terminated when they could not be excavated further, typically in weathered bedrock. The test pit sites were accessed by walking the machine to each site, and care was taken to minimize environmental disturbance. Wherever possible, the surface organic material and vegetation was stripped prior to excavating the test pit and stockpiled separately. The exposed soils in the pit walls and spoil piles were logged for geotechnical characteristics and select samples were collected and sealed in heavy duty plastic sample bags for laboratory testing. All of the test pits were backfilled and the surface was re-contoured upon completion. The final activity at each site involved the replacement of the surface material and vegetation to recreate, as much as possible, the pre-investigation conditions.

A summary of the test pits, including their locations and depths, is presented in Table A1.2. The locations of the test pits for the 2015 Site Investigations are shown in Figure 3.1. Detailed logs of each test pit are presented in Appendix A4 which includes a photograph of the test pit excavation. The test pit soil results are summarized in Table C1.1 and the laboratory reports are included in Appendix C1.

3.4 ROCK MASS CLASSIFICATION

Bieniawski's Rock Mass Rating (RMR) classification system (1989) was used to describe the rock mass condition. The RMR system is based on determining values for the following five key rock mass parameters:

- Intact Rock Hardness and/or UCS – Estimated in the field and later verified with laboratory testing.
- RQD – The sum of the lengths of all intact core pieces greater than 10 cm in length, as a percentage of the drill run length.
- Fracture Spacing – The number of natural fractures encountered per drill run length.
- Fracture Condition – An evaluation of fracture persistence, roughness, infilling, aperture, and weathering determined by examination of the discontinuities. The persistence is conservatively assumed to have a rating of 0, consistent with high persistence, because delineating the actual persistence of a discontinuity is impossible due to the relatively small diameter of the drill core.
- Groundwater Condition – The groundwater rating is 15, which corresponds to dry conditions. This allows the RMR values to be consistent with geological strength index (GSI) values that can be used to estimate rock mass strength (Hoek et al. 1995).

The RMR rating and rock mass quality classification system is presented in Appendix F2. Table F2.1 shows the numerical values that were applied to each of the five parameters. The sum of these ratings defines the rock mass quality as an RMR value. This value can range from less than 20 and up to 100 and corresponds to the following rock mass quality descriptions:

- VERY GOOD: RMR 81 to 100
- GOOD: RMR 61 to 80
- FAIR: RMR 41 to 60
- POOR: RMR 21 to 40, and
- VERY POOR: RMR < 20.

Drillhole logs and detailed RMR logging spreadsheets are presented in Appendices A1 and A3, respectively. Drill core photographs are included in Appendix E1.

3.5 PACKER TESTING

Packer testing (Lugeon or Falling Head) was completed in the geotechnical drillholes to estimate the hydraulic conductivity of the rock mass. The packer testing was completed under the supervision and direction of KP field personnel using an HQ wireline nitrogen-inflated packer test assembly.

Packer tests were performed while the drillhole was being advanced and testing was conducted after encountering the first zone of bedrock that was suitable to seat the packer. The target interval for packer testing was every 7 m for tailings and water storage facility foundations, and 15 m for the plant site foundations. However, the bedrock to seat the packer requires suitable rock quality so that damage will not occur to the packer system during inflation and deflation. The packer test intervals were varied as needed based on the rock mass quality and assessment by KP field personnel.

General methodology for the packer tests included the following:

- Flushing the drillhole until the drill return was clear of cuttings.
- Calculating how many rods needed to pull out of the drillhole to expose the test zone and calculation of the required nitrogen inflation pressure and Lugeon test pressures for each packer test depth.
- Pulling the drill rods out of the hole to expose the desired test section.
- Lowering the packer equipment with a pressure transducer enclosed in a housing unit below the packer to the drill bit with the wireline and nitrogen line.
- Inflating the packer bladder with nitrogen to isolate the test interval.
- Establishing a stable water level in the drillhole.
- Completing the test. The following tests were conducted based on groundwater conditions:
    - Response testing was conducted in select intervals which involved filling up the rods with a known quantity of water after the packer was inflated and allowing the static groundwater level to recover. These tests were conducted in zones that were fully submerged beneath the groundwater level.
    - Lugeon testing which involved pumping water into the isolated test interval at three ascending and two descending water pressure stages and recording the flow rate of water into the rock mass. These tests were conducted in zones that were partially or fully above the groundwater level. Leakage was measured for each pressure stage and the values were recorded.
- Measurements were collected with a mechanical flowmeter measuring in gallons and a water pressure gauge in pounds per square inch (psi). The pressure transducer monitored the water pressures throughout the testing stages.
- Any observations about the testing were noted where appropriate.

Individual packer test analysis sheets are provided in Appendix B1. Hydraulic conductivity results based on the packer testing are summarized in Table A1.1 in Appendix A1.

3.6 MONITORING WELL INSTALLATION

Groundwater monitoring wells were installed in four of the completed geotechnical drillholes during the 2015 SI program. All monitoring wells were drilled and installed by Ruen Drilling Inc. with the supervision of KP field personnel.

The wells were installed at four of the proposed mine facilities, SAG Mill (Plant Site), Seepage Collection Pond (for the South Tailings Impoundment), Central Tailings Impoundment and South Tailings Impoundment, in order to monitor baseline groundwater quality conditions. A single well was installed at each location in bedrock below the water table. Table 3.2 provides a summary of the monitoring wells and their locations can be seen in Figure 1.2.

Table 3.2 Summary of Monitoring Well Installation and Hydrogeological Testing

Drillhole	Piezometer Information [1]				
	Completion Zone		Stick Up Height	Static Water Level	Hydraulic Conductivity (Falling Head) [2]
	From (m)	To (m)	(m)	(mbgs)	(m/sec)
SC15-184	14.9	27.5	1.60	Artesian flow ~10 gal/min	-
SC15-185	17.2	25.9	3.05	7.0	5×10^{-6}
SC15-194	21.6	28.8	0.6	N/A	6×10^{-6}
SC15-198	15.8	22.9	0.6	N/A	7×10^{-7}

NOTES:
1. All monitoring wells were installed with 1.5” diameter PVC.
2. Values reported are pre-installation over the same interval as completion zone.

The wells were installed at specified depths in areas of interest such as fractured/fault zones or highly permeable zones as identified by geotechnical logging and packer testing results. The purpose of the installation is to be able to measure the groundwater level, conduct falling/rising head response tests in the isolated completion zone and collect samples for environmental baseline water quality data.

The piezometers were constructed with 1.75-inch diameter, decontaminated, flush-threaded, Schedule 40 polyvinyl chloride (PVC) riser pipes. The screened completion zones are 1.75-inch Schedule 40, Slot 20 PVC threaded installed across the zone of interest, and 1.75-inch Schedule 40 PVC threaded blank pipe was installed to the surface. Bentonite pellets were used to backfill the drillhole, if it was not desirable to set the completion zone at the bottom of the hole. The annular space around the completion zone was backfilled with 10/20 silica filter sand. The completion zone was sealed at either end with hydrated bentonite chips or pellets. A cement/grout mix was used to backfill the drillhole to surface above the top bentonite seal. Monuments were installed to protect and prevent tampering to the PVC pipe, which extends above the ground surface. The monitoring well completion details are presented in Appendix A1.

3.7 LABORATORY TESTWORK

Selected bedrock and soil samples from the drillholes were collected for laboratory strength testing and material characterization. Detailed summaries of the results from all soil and rock laboratory testing are provided in Appendix C.

3.7.1 Soil Testing

SPT soil samples and grab samples from test pit excavations were selected for laboratory testing in order to characterize the types of materials found at the drillhole locations. Particle Size Analysis (PSA), moisture content and Atterberg limits testing were completed.

PSAs were conducted in accordance with ASTM D-422 procedures using both conventional screen and hydrometer methods, in order to assess the particle distribution and grading characteristics of the material deposits on site. A hydrometer analysis was used to determine the silt and clay fraction particle sizes for material with a fine fraction exceeding 15% of the total sample.

Soil testing results and PSA summaries for the various mine site facilities are presented in Appendix C1. Table 3.3 summarizes the number of tests and test types performed. A summary of the soil laboratory test results is presented in Appendix C1.

Table 3.3 Soil Laboratory Testing Summary

Test Type	Number of Tests
Particle Size Distribution	29
Moisture Content	16
Atterberg Limits	29
Multi-stage Triaxial	1

3.7.2 Rock Testing

Seventeen rock core samples were collected during Phase 1 of the 2015 SI program, of which twelve were subject to unconfined compressive strength (UCS) testing and five (being too short to test for UCS) were tested to point load failure. Testing was carried out at Mine Design Engineering in Kingston, Ontario, Canada. Representative samples of the rock types on site without pre-existing planes of weakness were collected when possible.

No additional rock core samples were collected for testing during the Phase 2 SI program.

A summary of the lab results is presented below in Table 3.4 with the complete results in Appendix C2.

Table 3.4 Summary of Rock Mass Strength Properties

Sample	Mean Rock Strength (MPa) UCS		Density (g/cm^3)	Young's Modulus (GPa) [2]	Poisson's Ratio [2]	Point Load Index (MPa)
	Foliation Break	Intact				
SC15-181-UCS#1	50.9 (pf)	---	2.68	11.560	0.14	---
SC15-182-UCS#1		170.6	2.66	24.173	0.30	---
SC15-183-UCS#1	---	---	---	---	---	0.21
SC15-183-UCS#2	2.2 (f)	---	2.30	0.179	---	---
SC15-187-UCS#1	---	124.3	2.60	19.273	0.15	---
SC15-187-UCS#2	---	56.8	2.67	20.782	0.22	---
SC15-188	---	76.3	2.59	10.025	0.37	---
SC15-189-UCS#1	---	---	---	---	---	0.32
SC15-190-UCS#1	---	---	---	---	---	1.38
SC15-191-UCS#1	36.1 (pf)	---	2.69	12.050	0.14	---
SC15-193-UCS#1	---	106.7	2.74	16.537	0.17	---
SC15-197-UCS#1	---	---	---	---	---	0.41
SC15-197-UCS#2	---	76.8	2.60	17.186	0.23	---
SC15-198-UCS#1	---	42.9	2.69	16.049	0.24	---
SC15-198-UCS#2	14.3 (f)	---	2.70	8.773	0.27	---
SC15-198-UCS#3	1.8 (f)	---	2.62	0.592	---	---
SC15-198-UCS#4	---	---	---	---	---	0.33

NOTES:

1. Data is based on 2015 geotechnical holes.
2. Sample failure occurring along pre-existing foliation surface denoted with (f).
3. Sample failure partially occurring along pre-existing failure surface denoted with (pf).

4 – MATERIAL CHARACTERIZATION

4.1 GENERAL

Three primary geotechnical units were observed during the 2015 SI program, overburden, weathered bedrock, and competent bedrock.

4.2 OVERBURDEN

Overburden ranges in thickness from 0 to 6.7 m in the project area with the thickest overburden cover observed in the proposed East and West Tailings Impoundment areas. Overburden mainly consists of sandy silt or silty sand and gravel, with trace to some cobbles and boulders, and trace clay. Moisture content ranged from 14% to 25%, with an average of 19%. The overburden is typically loose to compact, dry to moist, with sub-angular to sub-rounded particles. The gravel particles are typically sub-angular to sub-rounded and poorly graded. Localized variation in overburden composition is discussed in the following sub-sections.

A topsoil veneer covers the Black Butte project area, consisting of dry to moist, spongy, fibrous, dark brown silt and sand with organics. The topsoil layer typically ranges in thickness from 0.1 to 0.3 m.

4.3 WEATHERED BEDROCK

Two main rock types of bedrock were encountered during the 2015 SI; intrusive and sedimentary. The intrusive rocks predominantly comprise granodiorite whereas the sedimentary package consisted mostly of shale punctuated by localized intervals of related calcareous sediments and debris flow conglomerates.

Weathered bedrock is characterized by an orangey brown discoloration or staining of the rock mass, joints and fractures, by iron oxide. The rock typically has a high degree of fracturing and may be rubbleized or, in some cases, completely decomposed to a saprolitic material.

Weathered bedrock is between 0.2 and 6.7 mbgs with an average overburden / weathered bedrock contact at 1.1 mbgs. The weathered bedrock thickness varies between 0.3 to 17.5 m.

4.4 COMPETENT BEDROCK

Bedrock across the project site consists predominantly of rock of the Newland Formation; calcareous and dolomitic shales and debris flow conglomerates. In the areas of the Process Water Pond and the South Tailings Impoundment, intrusive diorite rocks were encountered in some drill core and test pit excavations. These rocks have likely been emplaced as sills and vary in thickness and occurrence throughout this area of the property.

4.5 ROCK MASS PERMEABILITY

Hydrogeological testing was conducted to assess the hydraulic conductivity of the rock mass at various intervals. Two testing methods were adopted: Lugeon (Single Packer) Permeability testing and Falling Head Response tests. A total of 59 Lugeon tests were conducted in all geotechnical drillholes of which 12 were completed in zones of weathered bedrock and the remaining 47 in unweathered bedrock.

The test results indicate that the weathered bedrock across the project area typically has a moderate permeability with hydraulic conductivities in the order of 2 x 10^{-9} to 1 x 10^{-5} m/sec. Competent bedrock across the project area typically has a low to moderate permeability with hydraulic conductivities in the order of 1 x 10^{-9} to 1 x 10^{-6} m/sec.

The individual packer hydraulic conductivity test sheets are presented in Appendix B1 and are summarized in Table A1.1 in Appendix A1.

5 – GEOTECHNICAL CONDITIONS

5.1 GENERAL

The geotechnical conditions of the overburden and bedrock for the proposed facility locations were assessed using the information collected during the 2015 SI program and previous exploration resource drilling. Geotechnical cross sections through the proposed infrastructure are provided in Appendix D.

5.2 TAILINGS IMPOUNDMENT AREAS

Four impoundment areas were initially proposed for the storage of tailings at the project site; identified as the Central, West, East and South Impoundments. Thirteen geotechnical drillholes were completed over these areas. An alternatives assessment of the impoundment options deemed the South Impoundment the preferred option for the CTF; however two drillholes were completed along the embankments for each of the Central, West and East Impoundments.

The geotechnical characteristics of the proposed impoundment areas are summarized as follows:

- **Central Impoundment:** 2 geotechnical holes (SC15-194 and SC15-197) were completed along the embankment centerline during the 2015 SI program. The overburden is characterized as loose, silty sand with clay with a thickness from 0.2 to 0.5 m. Bedrock underlying the overburden was identified as shale with weathering of this unit pervasive for 8 to 10 mbgs. The average field estimated UCS of the shale was approximately 50 MPa and the average RMR was 44 indicating a rock mass designation of FAIR (Bieniawski, 1989). Five falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 2.5 $x10^{-6}$ m/s. This is based on testing in all types of shale encountered during drilling, including competent and highly fractured and/or weathered sections.
- **West Impoundment:** 2 geotechnical holes (SC15-192 and SC15-193) were completed along the embankment centerline. The overburden is characterized as compact, silty sand and sandy clay with sub-angular to sub-rounded gravel (till). The overburden thickness was approximately 2.1 m. Bedrock underlying the overburden was predominantly shale with minor granodiorite intrusion near surface. Weathering of this unit was pervasive for 7 to 10 mbgs. The average field estimated UCS of the shale was approximately 40 MPa and the average RMR was 47 indicating a rock mass designation of FAIR (Bieniawski, 1989). Four falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 6 $x10^{-7}$ m/s. This is based on testing in all types of shale encountered during drilling, including competent and highly fractured and/or weathered sections.
- **East Impoundment:** 2 geotechnical holes (SC15-195 and SC15-196) were completed along the embankment centerline. The overburden is characterized as clayey sand with sub-angular to sub-rounded gravel (till). The overburden thickness varies in thickness from 0.2 to 1.5 m. Bedrock underlying the overburden was predominantly shale with associated sedimentary rocks. Weathering of this unit was pervasive for 2 to 7 mbgs. The average field estimated UCS of the shale was approximately 35 MPa and the average RMR was 42 indicating a rock mass designation of FAIR (Bieniawski, 1989). Four falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 1 $x10^{-6}$ m/s. This is based on testing in all types of shale encountered during drilling, including competent and highly fractured and/or weathered sections.

- **South Impoundment:** 7 geotechnical holes (SC15-181 to SC15-183 and SC15-185 to SC15-188) were completed along the embankment centerline and within the impoundment area. The overburden is characterized as compact, silty sand with sub-angular to sub-rounded gravel and some clay (till). The overburden thickness varies from 0.2 to 6.7 m. Bedrock underlying the overburden was predominantly granodiorite with shale, limestone and conglomerate. Weathering was evident for up to 13.4 mbgs although in the majority of the drillholes the weathering only persisted for 1 to 2 mbgs. The average field estimated UCS of the granodiorite and shale in the South Impoundment drillholes was approximately 100 MPa and 30 MPa, respectively. The average RMR across the embankment centreline was 55 indicating a rock mass designation of FAIR (Bieniawski, 1989). Thirteen falling head tests were completed for the 4 drillholes along the embankment centreline with an average hydraulic conductivity of 1 x10^{-6} m/s. This is based on testing in all types of granodiorite and shale encountered during drilling, including competent and highly fractured and/or weathered sections.

5.3 PROCESS WATER STORAGE POND

Two geotechnical drillholes (SC15-190 and SC15-191) were completed along the initially proposed embankment area of the Process Water Pond (PWP). The overburden mainly consists of dense, moist, sandy silt with clay and gravels. The gravel is sub-angular to sub-rounded and poorly graded. The overburden contains some roots and organics and is roughly 0.5 m thick. Bedrock underlying the overburden was predominantly shale and limestone. Weathering of this unit was pervasive up to 7 mbgs. The average field estimated UCS of the shale and limestone was approximately 35 MPa and the average RMR was 41 indicating a rock mass designation of FAIR (Bieniawski, 1989). Five falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 5 x10^{-6} m/s. This is based on testing in all types of shale and limestone encountered during drilling, including competent and highly fractured and/or weathered sections.

The PWP was relocated east of the plant site prior to the Phase 2 site investigation, and 2 geotechnical drillholes (SC15-201 and SC15-202) were completed along the main embankment of the new location. The overburden at the relocated PWP consists of compact to stiff, silty sand with trace clay and gravel. The gravel is composed of shale clasts and is sub-angular, poorly graded and up to 1.5 m thick. Bedrock underlying the overburden was predominantly shale with some granodiorite intrusive rocks (less than 3 m). Weathering of this unit continued for up to 13.4 mbgs in SC15-202. The average field estimated UCS of the shale was approximately 50 MPa and the average RMR was 48 indicating a rock mass designation of FAIR (Bieniawski, 1989). Seven falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 4 x10^{-6} m/s. The first falling head test for SC15-202 reported a hydraulic conductivity of 2 x 10^{-3} m/s through highly weathered granodiorite near surface.

An alternative PWP location was also identified south of the South Impoundment, and one geotechnical drillhole (SC15-203) was completed within that area. The overburden at the alternate Process Water Pond was similar to the primary PWP foundation area and consisted of a loose to compact silty sand with trace clay and fine gravel. The gravel component is sub-angular, poorly graded shale. The bedrock at this drillhole was shale with a field estimated UCS of approximately 60 MPa and an RMR of 54 indicating a rock mass designation of FAIR (Bieniawski, 1989). The average hydraulic conductivity from three falling head tests was 2 x 10^{-7} m/s through mostly competent shale.

5.4 PLANT SITE

Three geotechnical drillholes (SC15-180, SC15-189 and SC15-198) were completed within the proposed plant site area. The overburden consists mainly of firm to compact, moist, sandy silt and clayey sand with some gravel. The gravel is sub-angular to sub-rounded and poorly graded. The overburden contains some roots and organics and. The thickness varies from 0.3 to 1.4 m. Bedrock underlying the overburden was predominantly shale with associated sedimentary rocks. Weathering of this unit was pervasive for 16.5 mbgs in SC15-180 but significantly less in the other 2 drillholes The average field estimated UCS of the shale was approximately 35 MPa and the average RMR was 42 indicating a rock mass designation of FAIR (Bieniawski, 1989). Nine falling head tests were completed for the 3 drillholes with an average hydraulic conductivity of 3 x10^{-7} m/s.

5.5 NON-CONTACT WATER RESERVOIR

Two geotechnical drillholes (SC15-204 and SC15-205) were completed along the main embankment of the proposed Non-Contact Water Reservoir location during the Phase 2 SI. The overburden consists mainly of firm to compact, moist, sandy silt and clayey sand with some gravel. The gravel is sub-angular to sub-rounded and poorly graded. The overburden contains some roots and organics and. The thickness varies from 0.3 to 1.4 m. Bedrock underlying the overburden was predominantly shale and conglomerate. Weathering of this unit was pervasive for 4 to 8 mbgs. The average field estimated UCS of the shale was approximately 50 MPa and the average RMR was 53 indicating a rock mass designation of FAIR (Bieniawski, 1989). Six falling head tests were completed for the 2 drillholes with an average hydraulic conductivity of 2 x10^{-6} m/s. This is based on testing in all types of shale and conglomerate encountered during drilling, including competent and highly fractured and/or weathered sections.

7 – SUMMARY AND RECOMMENDATIONS

7.1 SUMMARY OF 2015 SI PROGRAM

The 2015 geotechnical and hydrogeological site investigation program was performed to support a feasibility level design of the site facilities. Twenty-four geotechnical drillholes were completed over the property at the proposed infrastructure sites with 4 piezometers installed, and 44 test pits were excavated.

Results of the investigation program indicate the following:

- The geology within the Project area is comprised of two major rock types; shales and associated sedimentary rocks of the Newland Formation and igneous intrusive rocks composed mainly of diorite.
- The South Impoundment centerline overlies both Newland Formation (shales) and granodiorite intrusive rocks.
- Hydraulic conductivities ranged from 1 x 10^{-4} to 1 x 10^{-9} m/s for the bedrock units encountered along the South Impoundment centerline. These values are based on Falling Head testing in competent, fractured and/or weathered rock units.
- The Process Water Pond also overlies Newland Formation (shales) and granodiorite intrusive rocks. Hydraulic conductivities ranged from 2 x 10^{-3} to 8 x 10^{-8} m/s for the bedrock units encountered along the Process Water Pond embankment. These values are based on Falling Head testing in competent, fractured and/or weathered rock units.
- The Non-Contact Water Reservoir overlies Newland Formation (shales and conglomerates) Hydraulic conductivities ranged from 9 x 10^{-6} to 8 x 10^{-8} m/s for the bedrock units encountered along the reservoir embankment centerline. These values are based on Falling Head testing in competent, fractured and/or weathered rock units.
- Test pit investigations in the overburden material throughout the project area have indicated that the material consists of silty sand or sandy silt with clay and gravel, covered by a thin topsoil veneer. Test pitting and sampling were conducted in shallow depths as the depth to weathered bedrock through the overburden was generally quite shallow (less than 1.5 metres), with a maximum depth of 7 m.
- Field estimates of UCS for weathered bedrock units encountered within the Project area ranged from 5 to 25 MPa, with competent bedrock ranging from 30 to 150 MPa The RMR ranged from 38 to 62 indicating a rock mass designation of FAIR within the Project area.
- The geology and geotechnical conditions for the proposed plant site / mill area have been forwarded to the designers for inclusion in their work on these facilities.

7.2 RECOMMENDATIONS FOR FUTURE WORK

As the Project moves onto the detailed design phase it is recommended that additional site work be conducted to build on the current geotechnical and hydrogeological database. The next phase of site investigations for detailed design will be developed based on comments and recommendations made by the Project Independent Review Panel, and will consider comments from the Project's Mine Operating Permit Application. This work may include:

- Additional geotechnical drilling and test pitting to better delineate overburden, weathered bedrock, and competent bedrock profiles.

- Installation of additional monitoring wells within the facility footprints more accurately define the groundwater table elevation.
- Additional rock and soil laboratory testing to establish suitability of available construction materials, including slake testing of bedrock to determine the potential of long term strength degradation, and testing for potential acid generation of the bedrock.

This data will be used to refine KP's understanding of the foundation conditions for the various facilities and better define construction material quantities.

8 – REFERENCES

Bieniawski, Z.T., 1989, Engineering Rock Mass Classifications, Wiley, New York.

Hoek, E., Kaiser, P.K. and Bawden, W.F., 1995, Support of Underground Excavations in Hard Rock, A.A. Balkema.

Tintina Resources Inc., 2013. Updated Technical Report and Preliminary Economic Assessment for the Black Butte Copper Project, Montana.

9 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Jesse Collison, GIT
Staff Engineer

Reviewed:

Greg Magoon, P.Eng.
Project Engineer

Reviewed:

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Approval that this document adheres to Knight Piésold Quality Systems:

APPENDIX A

GEOTECHNICAL DRILLHOLE DATA

Appendix A1	Geotechnical Drillhole and Test Pit Summary Tables
Appendix A2	Geotechnical Drillhole Logs
Appendix A3	Geotechnical Drillhole Logging Records
Appendix A4	Test Pit Logs

APPENDIX A1

GEOTECHNICAL DRILLHOLE AND TEST PIT SUMMARY TABLES

(Page A1-1 to A1-4)

TABLE A1.1

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION
DRILLHOLE SUMMMARY

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				NAD83 UTM Coordinates[1]									Packer Test Hydraulic Conductivity Testing				Installation Information						
Drillhole #	Pre-Drill Designation	Rig #	Drillhole Location	Easting	Northing	Elevation	Azimuth	Inclination	Hole Size	Total Depth	Depth to Weathered Bedrock	Depth to Competent Bedrock	Packer Test Zone		Constant Head Test Results	Falling Head Test Results	Completion Zone		Piezometer Diameter	Stickup Height	Static Water Level	Date and Time of Measurement	Drillhole Notes (artesian conditions, fault zones, zones with circulation loss, etc.)
				(m)	(m)	(m)	(˚)	(˚)	Nominal	(m)	(m)	(m)	From (m)	To (m)	(m/s)	(m/s)	From (m)	To (m)	(mm)	(m)	(mbgs)		
SC15-180	DH15-19	Sandvik 710	Plant Site	506,568	5,179,835	1,788	0	90	HQ3	30.2	0.6	16.5	8.1	19.5	n/a	6.E-07	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 1.52 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													18.7	30.2	n/a	1.E-08							
SC15-181	DH15-8	Sandvik 710	South Impoundment Embankment	506,592	5,178,968	1,770	0	90	HQ3	30.1	6.7	13.4	9.6	14.9	n/a	1.E-06	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 6.71 m and continued with HQ3 coring until end of hole 30.1 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													12.6	21.0	n/a	2.E-07							
													20.3	30.1	n/a	1.E-09							
SC15-182	DH15-7	Sandvik 710	South Impoundment Embankment	506,619	5,178,759	1,794	0	90	HQ3	30.2	0.2	1.2	2.0	7.3	1E-06	n/a	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.2 m. Loss of circulation at 6.8 m, drillers add shredded paper to improve circulation after packer test (#1). Loss of circulation observed at 8.2 to 9.4 m and then again at 11.5 to 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													6.6	13.4	1E-06	n/a							
													12.6	19.5	n/a	6.E-06							
													18.7	19.5	3E-07	n/a							
													24.8	30.2	n/a	3.E-06							
SC15-183	DH15-6	Sandvik 710	South Impoundment Embankment	506,510	5,178,913	1,779	0	90	HQ3	30.2	0.6	17.6	5.0	11.9	n/a	4.E-08	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 1.52 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Slight loss of circulation at about 28.2 m noted by the driller but regained it shortly.
													11.1	18.0	n/a	5.E-08							
													17.2	24.1	n/a	2.E-07							
													23.3	30.2	n/a	2.E-06							
SC15-184	DH15-11	Sandvik 710	Seepage Collection Pond	507,044	5,178,970	1,756	0	90	PQ3	30.0	4.6	5.9	6.6	13.4	n/a	3.E-06	14.9	27.5	44.45	1.60	Artesian flow at approx. 10 gal/min	10/03/2015 2:00	PWT casing advanced to 4.57 m and continued with PQ3 coring until end of hole 30.0 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Slight loss of circulation from 10.06 to 10.36 m. Artesian condition observed at around 69 ft (see packer testing results).
													14.2	21.0	n/a	4.E-06							
													20.3	30.0	Artesian (see test notes)								
SC15-185	DH15-5	Sandvik 710	South Impoundment Embankment	506,358	5,179,087	1,806	0	90	PQ3	30.2	0.3	1.1	5.6	11.9	n/a	1.E-07	17.2	25.9	44.45	3.05	7.0	11/03/2015 5:00	PWT casing advanced to 4.42 m and continued with PQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Loss of cirulation (remained 20 to 30 %) starting at 16.76 m until end of hole.
													12.6	18.0	n/a	1.E-05							
													17.2	24.1	n/a	5.E-06							
													23.3	30.2	n/a	1.E-05							
SC15-186	DH15-10	Sandvik 710	South Impoundment Embankment	506,698	5,179,101	1,786	0	90	HQ3	30.2	0.3	4.7	5.0	11.9	n/a	6.E-08	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													12.6	18.0	n/a	1.E-07							
													17.2	24.1	n/a	8.E-08							
													23.3	30.2	n/a	1.E-08							
SC15-187	DH15-13	Sandvik 710	South Impoundment Embankment	506,740	5,179,260	1,786	0	90	HQ3	30.2	0.3	6.1	2.7	8.8	n/a	2.E-06	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Lugeon test performed at 2.7 m, all other packing tests were falling head response tests.
													9.6	14.9	n/a	2.E-06							
													15.7	22.6	n/a	3.E-08							
													23.3	30.2	n/a	6.E-07							
SC15-188	DH15-9	Sandvik 710	South Impoundment Embankment	506,563	5,179,124	1,792	0	90	HQ3	30.2	0.2	10.4	3.5	8.8	n/a	2.E-07	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Artesian zone encounterd after 79ft to 84 ft drill run. Stopped flowing after approximately 3 minutes. Measured water flow of 3 L in 2.5 minutes before flow stopped.
													8.1	14.9	n/a	1.E-07							
													15.7	22.6	n/a	1.E-07							
													23.3	30.2	n/a	1.E-08							
SC15-189	DH15-17	Sandvik 710	Plant Site	506,679	5,179,630	1,782	0	90	HQ3	30.2	0.3	5.8	5.0	11.9	n/a	4.E-07	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													11.1	18.0	n/a	2.E-07							
													17.2	24.1	n/a	4.E-08							
													24.8	30.2	n/a	1.E-07							
SC15-190	DH15-14	Sandvik 710	Process Water Storage Pond	507,205	5,179,665	1,761	0	90	HQ3	30.2	0.5	7.5	8.1	14.8	n/a	3.E-07	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 2.13 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													15.7	22.1	n/a	3.E-07							
													21.8	30.2	n/a	2.E-06							
SC15-191	DH15-12	Sandvik 710	Process Water Storage Pond	507,024	5,179,469	1,768	0	90	HQ3	30.2	0.5	2.7	8.1	14.9	n/a	2.E-05	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 1.52 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Loss of circulation (90% loss) starting at 10.76 m to 12.01 m.
													15.7	22.6	n/a	3.E-07							
													21.8	30.2	n/a	1.E-07							
SC15-192	DH15-2	Sandvik 710	West Impoundment Embankment	504,689	5,178,984	1,792	0	90	HQ3	30.5	2.1	9.8	9.6	19.8	n/a	4.E-07	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 5.2 m and continued with HQ3 coring until end of hole 30.5 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													20.6	30.5	n/a	2.E-06							
SC15-193	DH15-1	Sandvik 710	West Impoundment Embankment	504,857	5,178,786	1,787	0	90	HQ3	30.2	2.1	7.5	8.1	18.0	n/a	1.E-07	No installation. Drillhole backfilled with grout to surface.						HWT casing advanced to 3.66 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													17.2	30.2	n/a	6.E-08							

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Drillhole #	Pre-Drill Designation	Rig #	Drillhole Location	NAD83 UTM Coordinates[1] Easting	NAD83 UTM Coordinates[1] Northing	NAD83 UTM Coordinates[1] Elevation	Azimuth	Inclination	Hole Size	Total Depth	Depth to Weathered Bedrock	Depth to Competent Bedrock	Packer Test Hydraulic Conductivity Testing: Packer Test Zone From (m)	Packer Test Zone To (m)	Constant Head Test Results	Falling Head Test Results	Installation Information: Completion Zone From (m)	Completion Zone To (m)	Piezometer Diameter	Stickup Height	Static Water Level	Date and Time of Measurement	Drillhole Notes (artesian conditions, fault zones, zones with circulation loss, etc.)
				(m)	(m)	(m)	(˚)	(˚)	Nominal	(m)	(m)	(m)	From (m)	To (m)	(m/s)	(m/s)	From (m)	To (m)	(mm)	(m)	(mbgs)		
SC15-194	DH15-3	Sandvik 710	Central Impoundment Embankment	506,024	5,179,849	1,774	0	90	PQ3	30.1	0.5	10.4	12.6	17.7	n/a	5.E-07	21.6	28.8	44.45	0.6	N/A	N/A	PWT casing advanced to 4.57 m and continued with PQ3 coring until end of hole 30.1 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. Water level meter was covered in grease, so did not measure static water level in well to avoid contamination.
													17.2	23.8	n/a	7.E-08							
													23.3	30.1	n/a	6.E-06							
SC15-195	DH15-15	Sandvik 710	East Impoundment Embankment	507,728	5,179,502	1,736	0	90	HQ3	30.1	0.2	2.0	9.6	19.5	n/a	5.E-06	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 30.1 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													18.7	30.1	n/a	1.E-08							
SC15-196	DH15-16	Sandvik 710	East Impoundment Embankment	507,619	5,179,697	1,751	0	90	HQ3	30.5	1.5	7.2	13.6	22.9	n/a	3.E-07	No installation. Drillhole backfilled with grout to surface.						Triconed to 2.43 m but no casing was advanced. Continued with HQ3 coring until end of hole 30.5 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													22.1	30.5	n/a	4.E-08							
SC15-197	DH15-4	Sandvik 710	Central Impoundment Embankment	506,194	5,179,619	1,775	0	90	HQ3	29.9	0.2	8.2	9.6	19.4	n/a	4.E-06	No installation. Drillhole backfilled with grout to surface.						No casing advanced as bedrock is near surface, HQ3 coring until end of hole 29.9 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													18.7	29.9	n/a	1.E-06							
SC15-198	DH15-18	Sandvik 710	SAG Mill	506,592	5,179,745	1,787	0	90	HQ3	30.0	1.4	1.4	9.6	16.3	n/a	2.E-07	15.8	22.9	44.45	0.6	N/A	N/A	No casing advanced as bedrock is near surface. HQ3 coring until end of hole 30.0 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water. A HWT casing advancer (tricone) was used to drill to 17.4 m to facilitate the installation of the monitoring well. Water level meter was covered with grease, so no water level measurement was made at the end of the well installation in order to avoid contamination.
													15.7	22.6	n/a	7.E-07							
													21.8	30.0	n/a	1.E-07							
SC15-201	DH15-21	LF 70	Process Water Storage Pond	506,316	5,179,571	1,783	0	90	HQ3	30.3	0.6	4.1	5.6	12.0	n/a	2.E-06	No installation. Drillhole backfilled with bentonite to surface.						HWT casing advanced to 3.0 m and continued with HQ3 coring until end of hole 30.3 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													11.4	24.2	n/a	2.E-07							
													22.1	30.3	n/a	8.E-08							
SC15-202	DH15-20	LF 70	Process Water Storage Pond	505,959	5,179,446	1,795	0	90	HQ3	29.8	1.5	13.4	2.4	10.4	n/a	2.E-03	No installation. Drillhole backfilled with bentonite to surface.						HWT casing advanced to 3.2 m and continued with HQ3 coring until end of hole 29.8 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													6.7	14.6	n/a	2.E-05							
													14.3	20.7	n/a	5.E-08							
													20.1	29.8	n/a	3.E-06							
SC15-203	DH15-22	LF 70	Process Water Pond (Alternate)	506,469	5,178,408	1,794	0	90	HQ3	30.2	1.2	8.2	8.5	14.9	n/a	6.E-07	No installation. Drillhole backfilled with bentonite to surface.						Casing advanced to 3.7 m. Lost return at 11.3 m.
													14.0	22.5	n/a	2.E-09							
													21.6	30.2	n/a	6.E-08							
SC15-204	DH15-23	LF 70	Non Contact Water Reservoir	507,939	5,178,748	1,761	0	90	HQ3	30.2	0.3	8.6	7.9	14.9	n/a	2.E-08	No installation. Drillhole backfilled with bentonite to surface.						HWT casing advanced to 3.0 m and continued with HQ3 coring until end of hole 30.2 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													12.5	22.6	n/a	8.E-08							
													21.6	30.2	n/a	2.E-06							
SC15-205	DH15-24	LF 70	Non Contact Water Reservoir	507,971	5,178,618	1,773	0	90	PQ3	29.9	0.7	8.5	4.6	11.6	n/a	5.E-07	No installation. Drillhole backfilled with bentonite to surface.						HWT casing advanced to 3.0 m and continued with HQ3 coring until end of hole 29.9 m. Drilled with a mixture of light polymer (Poly-Plus RD) and water.
													10.7	22.2	n/a	2.E-07							
													19.8	29.9	n/a	9.E-06							

\\KPL\VA-Prj$\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Rev 0\Appendices\A1 - Geotechnical Drillhole Summary Table\[Table A1.1 - Drillhole Summary.xlsx]Table 1 Drillhole Summary

NOTES:
1. COORDINATES ARE NAD83 UTM. COORDINATES WERE SURVEYED BY KP USING A HANDHELD GARMIN GPS MAP62 WITH AN ACCURACY OF ±3 METRES.

REV	DATE	DESCRIPTION	PREP'D	REV'D
0	26APR'16	ISSUED WITH REPORT VA101-460/3-1	JDC	GIM

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TABLE A1.2

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION
TEST PIT SUMMARY

Print Apr/26/16 16:23:41

Test Pit ID	Test Pit Location	GPS UTM Coordinates NAD 83 Easting (m)	Northing (m)	Elevation (m)	Depth of Excavation (m)	Ground-water (m)	Reason For Termination	Samples Collected	KP Field Description of Main Soil Type	Comments
TP15-1	Process Water Storage Pond	506,075	5,179,489	1780	1.1	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-2	Process Water Storage Pond	506,197	5,179,536	1785	1.0	-	Sufficient excavation into weathered bedrock	0.3 - 0.5 m	silty SAND	Easy excavation
TP15-3	Process Water Storage Pond	506,010	5,179,362	1797	0.6	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-4	Process Water Storage Pond	506,135	5,179,405	1796	0.8	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-5	Process Water Storage Pond	506,245	5,179,350	1804	0.6	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-5B	Process Water Storage Pond	506,244	5,179,345	1806	0.5		Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-6	South Impoundment	506,659	5,179,290	1794	0.2	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-7	South Impoundment	506,490	5,179,210	1795	0.7	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-8	South Impoundment	506,469	5,179,033	1778	1.7	-	Sufficient excavation into weathered bedrock	0.3 - 0.6 m	silty SAND	Easy excavation
TP15-9	South Impoundment	506,619	5,179,094	1781	1.7	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-10	South Impoundment	506,545	5,179,006	1770	0.6	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-11	South Impoundment	506,418	5,178,864	1782	1.6	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-12	South Impoundment	506,578	5,178,829	1767	1.8	-	Sufficient excavation into weathered bedrock	0.4 - 0.6 m	silty SAND	Easy excavation
TP15-13	South Impoundment	506,531	5,178,726	1782	1.4	-	Sufficient excavation into weathered bedrock	0.4 - 0.5 m	silty SAND	Easy excavation
TP15-14	South Impoundment	506,731	5,179,489	1782	1.4	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-15	South Impoundment	506,725	5,179,123	1782	1.5	-	Sufficient excavation into weathered bedrock	0.74 - 1.0 m	silty SAND	Easy excavation
TP15-16	South Impoundment	506,710	5,179,044	1773	0.8	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-17	South Impoundment	506,698	5,178,905	1757	3.9	-	Sufficient excavation into weathered bedrock	1.9 - 2.0 m	silty SAND	Easy excavation
TP15-18	South Impoundment	506,662	5,178,851	1764	0.9	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-19	South Impoundment	506,768	5,178,852	1762	0.8	-	Sufficient excavation into weathered bedrock	3.2 - 3.3 m	silty SAND	Easy excavation
TP15-20	South Impoundment	506,766	5,178,916	1756	2.6	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-21	South Impoundment	506,783	5,179,069	1775	0.6	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-22	Process Water Pond (Alternate)	506,394	5,178,475	1818	1.1	-	Sufficient excavation into weathered bedrock	3.6 - 3.7 m	sandy SILT	Easy excavation
TP15-23	Process Water Pond (Alternate)	506,505	5,178,367	1818	1.5	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-24	Process Water Pond (Alternate)	506,378	5,178,405	1809	2.1	-	Sufficient excavation into weathered bedrock	0.3 - 0.5 m	sandy SILT	Easy excavation
TP15-25	Process Water Pond (Alternate)	506,307	5,178,406	1821	2.1	-	Sufficient excavation into weathered bedrock	0.4 - 0.6 m	silty SAND	Easy excavation

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TABLE A1.2

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION
TEST PIT SUMMARY

Print Apr/26/16 16:23:41

Test Pit ID	Test Pit Location	GPS UTM Coordinates NAD 83 Easting (m)	Northing (m)	Elevation (m)	Depth of Excavation (m)	Ground-water (m)	Reason For Termination	Samples Collected	KP Field Description of Main Soil Type	Comments
TP15-26	Process Water Pond (Alternate)	506,274	5,178,292	1823	1.2	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-27	Process Water Pond (Alternate)	506,322	5,178,273	1822	1.3	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-28	Process Water Pond (Alternate)	506,403	5,178,285	1830	1.4	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-29	Non Contact Water Reservoir	507,539	5,178,679	1774	1.7	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-30	Non Contact Water Reservoir	507,562	5,178,612	1773	2.3	-	Sufficient excavation into weathered bedrock	0.2 - 0.3 m 0.3 - 0.6 m	silty SAND	Easy excavation
TP15-31	Non Contact Water Reservoir	507,538	5,178,578	1776	2.1	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-32	Non Contact Water Reservoir	507,699	5,178,733	1774	1.8	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-33	Non Contact Water Reservoir	507,700	5,178,695	1769	1.9	-	Sufficient excavation into weathered bedrock	-	sandy SILT	Easy excavation
TP15-34	Non Contact Water Reservoir	507,685	5,178,620	1772	1.2	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-35	Non Contact Water Reservoir	507,861	5,178,588	1773	1.1	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-36	Non Contact Water Reservoir	507,875	5,178,652	1764	1.0	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-37	Non Contact Water Reservoir	507,830	5,178,744	1775	1.0	-	Sufficient excavation into weathered bedrock	0.2 - 0.5 m	silty SAND	Easy excavation
TP15-38	Non Contact Water Reservoir	507,920	5,178,783	1768	0.8	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-39	Non Contact Water Reservoir	507,961	5,178,671	1760	1.2	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-40	Proposed Portal	506,919	5,179,822	1787	1.2	-	Sufficient excavation into weathered bedrock	0.1 - 0.2 m	silty SAND	Easy excavation
TP15-41	Proposed Portal	506,989	5,179,808	1790	2.4	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-42	Proposed Portal	507,059	5,179,806	1791	1.6	-	Sufficient excavation into weathered bedrock	0.45 - 0.65 m	silty SAND	Easy excavation
TP15-43	Proposed Portal	506,993	5,179,873	1797	1.9	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation
TP15-44	Proposed Portal	506,994	5,179,964	1785	0.8	-	Sufficient excavation into weathered bedrock	-	silty SAND	Easy excavation

\\KPL\VA-Prj$\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Rev 0\Appendices\A1 - Geotechnical Drillhole Summary Table\[Table A1.2 - Test Pit Summary Table.xlsx]Table A1.2 Test Pit Summary

REV	DATE	DESCRIPTION	PREP'D	REV'D
0	15JUN'15	ISSUED WITH REPORT VA101-460/3-1	JDC	GIM

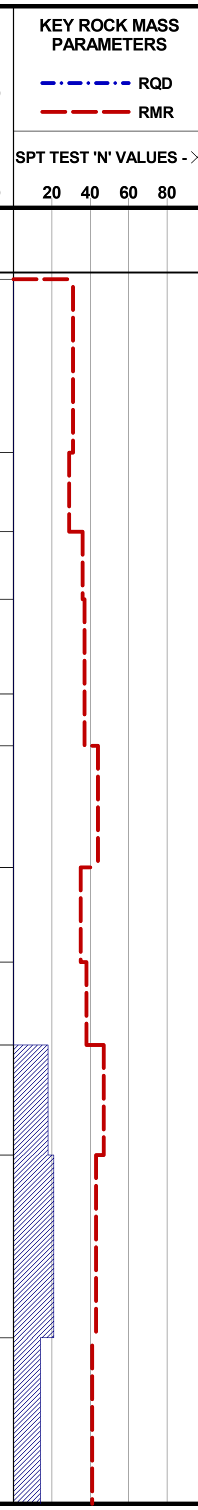
APPENDIX A2

GEOTECHNICAL DRILLHOLE LOGS

(Page A2-1 to A2-28)

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-180	**Page:** 1 of 4
Location: Plant Site	Drill Type: Sandvik 710	Date Started: Mar 4, 15
Coordinates: 506,568 E , 5,174,835 N	Total Length: 30.2m	Date Completed: Mar 5, 15
Coordinate System: NAD83	Elevation: 1788 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES
			SANDY SILT (0 to 0.6 m) Sandy SILT with trace clay; some coarse grained sand, low plasticity, brown, trace organics.									
1	1787		**SHALE** (0.6 to 1.9 m) Medium grey shale and rubble.	70				5				
2	1786		**WEATHERED SHALE** (1.9 to 16.5 m) Medium to dark grey, fine grained, very thinly laminated to very thinly bedded, weak, moderately weathered with FeO staining along joints; some calcite veinlets.	100				2.5				
				100				20				
3	1785			96				50				
4	1784			100				40				
				64				50				
5	1783			100				35				
6	1782			78				50				
7	1781			98				35				
8	1780			96				40				8.1 m to 19.5 m - Lugeon Packer Test #1 - k = 6E-07 m/s
9	1779			98				40				



GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-1

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-180	**Page:** 2 of 4
Location: Plant Site	Drill Type: Sandvik 710	Date Started: Mar 4, 15
Coordinates: 506,568 E , 5,174,835 N	Total Length: 30.2m	Date Completed: Mar 5, 15
Coordinate System: NAD83	Elevation: 1788 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS (RQD, RMR; SPT TEST 'N' VALUES - X; 20 40 60 80)	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES
			WEATHERED SHALE (1.9 to 16.5 m) Medium to dark grey, fine grained, very thinly laminated to very thinly bedded, weak, moderately weathered with FeO staining along joints; some calcite veinlets.	100				50				
11	1777			93				35				
12	1776			96				35				
13	1775			100				50				
14	1774			98				40				
15	1773											
16	1772			96				40				
17	1771		**SHALE** (16.5 to 30.2 m) Medium to light grey, fine grained, very thinly laminated to very thinly bedded, medium strong to strong with occasional rubbly zones, mostly fresh and unweathered with some clay infilling along joints; trace calcite veins and veinlets.	100				40				
18	1770			100				50				
19	1769											18.7 m to 30.2 m - Lugeon Packer Test #2 - k = 1E-08 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-1

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-180	Page: 3 of 4
Location: Plant Site	Drill Type: Sandvik 710	Date Started: Mar 4, 15
Coordinates: 506,568 E , 5,174,835 N	Total Length: 30.2m	Date Completed: Mar 5, 15
Coordinate System: NAD83	Elevation: 1788 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS (RQD, RMR; SPT TEST 'N' VALUES; 20 40 60 80)	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES
			SHALE (16.5 to 30.2 m) Medium to light grey, fine grained, very thinly laminated to very thinly bedded, medium strong to strong with occasional rubbly zones, mostly fresh and unweathered with some clay infilling along joints; trace calcite veins and veinlets.	100				50				
21	1767											
22	1766			100				50				
23	1765			100				40				
24	1764											
25	1763			97				50				
26	1762			100				50				
27	1761											
28	1760			100				50				
29	1759			100				50				

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-1

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-180	Page: 4 of 4
Location: Plant Site	Drill Type: Sandvik 710	Date Started: Mar 4, 15
Coordinates: 506,568 E , 5,174,835 N	Total Length: 30.2m	Date Completed: Mar 5, 15
Coordinate System: NAD83	Elevation: 1788 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS (RQD, RMR; SPT TEST 'N' VALUES; 20 40 60 80)	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES
			End of Drillhole: 30.2 m									
31	1757											
32	1756											
33	1755											
34	1754											
35	1753											
36	1752											
37	1751											
38	1750											
39	1749											

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-1

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.
Location: South Impoundment Embankment
Coordinates: 506,592 E , 5,178,968 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-181
Drill Type: Sandvik 710
Total Length: 30.1m
Elevation: 1770 m
Inclination: -90

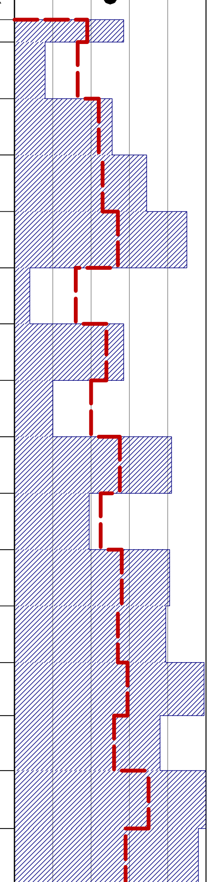
Page: 1 of 1
Date Started: Mar 5, 15
Date Completed: Mar 5, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 to 1.5		**SILTY SAND** (0 to 1.5 m) Silty SAND, subangular, fine to coarse grained, subangular, no plasticity, light brown, frozen with no visible ice; trace gravel; trace organics near surface.
1.5 to 3.1		**SAND WITH SILT AND GRAVEL** (1.5 to 3.1 m) SAND with trace silt and trace angular gravel, sand is medium to coarse grained, poorly graded, low plasticity, brown.
3.1 to 6.7 (5)	1765	**SAND WITH SILT** (3.1 to 6.7 m) SAND with trace silt, subangular, fine to medium grained, poorly graded, non-plastic, orange/brown, moist.
6.7 to 13.4 (10)	1760	**WEATHERED BEDROCK** (6.7 to 13.4 m) GRANODIORITE, fine to coarse grained, inequigranular, light grey to grey with orange oxide staining throughout, very weak to weak, highly weathered, massive.
13.4 to 21 (15, 20)	1755, 1750	**MUDSTONE/SHALE** (13.4 to 21 m) MUDSTONE/SHALE. fine grained, equigranular, grey to light grey, medium strong, highly fractured with some rubbleized sections, slightly to moderately weathered with FeO and calcite infilling along fractures and joints, thinly laminated, intermittent calcite veinlets throughout.
21 to 30.1 (25, 30)	1745, 1740	**SHALE** (21 to 30.1 m) SHALE, fine grained, equigranular, grey to light grey, medium strong, moderately fractured, fresh and unweathered, thinly laminated, occasional calcite veins and veinlets.
		End of Drillhole: 30.11 m

SAMPLE NO.	SAMPLE REC. (%)	BLOW COUNTS (PER 6")	SPT 'N' VALUE
SPT01	46	2/2/3	5
SPT02	42	3/4/7	11
SPT03	42	16/26/50+	R
~~SHELBY01~~	~~100~~		
SPT04	100	50+	R
UCS-01			

RUN RECOVERY (%)	UCS / BLOW COUNTS
100	10
91	5
82	20
93	20
100	40
72	10
100	50
100	40
100	50
98	40
100	50
88	40
100	50
100	40
100	40
99	40

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

9.6 m to 14.9 m - Lugeon Packer Test #1 - k = 1E-06 m/s

12.6 m to 21.0 m - Lugeon Packer Test #2 - k = 2E-07 m/s

20.3 m to 30.1 m - Lugeon Packer Test #3 - k = 1E-09 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-2

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.
Location: South Impoundment Embankment
Coordinates: 506,619 E , 5,178,759 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-182
Drill Type: Sandvik 710
Total Length: 30.2m
Elevation: 1794 m
Inclination: -90

Date Started: Mar 6, 15
Date Completed: Mar 7, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m) | ELEVATION - (m) | GRAPHIC LOG | MATERIAL DESCRIPTION | RUN RECOVERY (%) | SAMPLE NO. | SAMPLE REC. (%) | SAMPLE TYPE | UCS BLOW COUNTS (PER 6") | SPT 'N' VALUE | KEY ROCK MASS PARAMETERS (RQD, RMR; SPT TEST 'N' VALUES) | INSTRUMENTATION / WELL DETAILS | DRILLING NOTES

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.2 m)
Silty SAND, brown, dry with some organics.

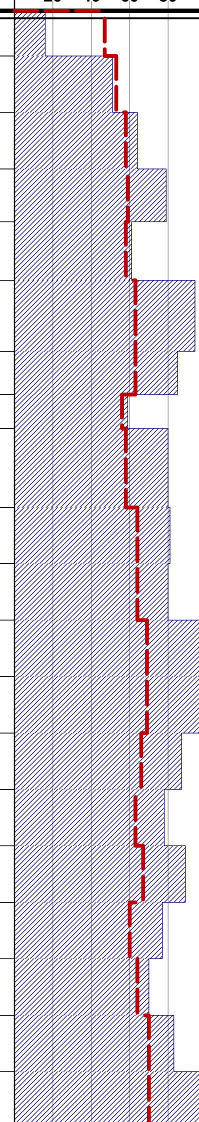
WEATHERED BEDROCK
(0.2 to 1.2 m)
GRANODIORITE, medium to coarse grained, inequigranular, light grey, strong, moderately weathered, some FeO staining throughout rock and along joints, some soil infilling along joints and fractures, massive.

GRANODIORITE
(1.2 to 30.2 m)
GRANODIORITE, medium to coarse grained, inequigranular, light grey, strong, slightly weathered to fresh, some calcite infilling along joints and fractures, minor clay alteration along some joint and fracture surfaces, massive.

End of Drillhole: 30.2 m

Run Recovery (%)	Sample No.	UCS
98		120
100		120
93		120
100	UCS-01	120
96		120
99		100
99		100
98		100
100		100
100		125
95		125
98		125
100		125
100		125
100		125
100		125
98		100
100		120
95		120
100		120

Depth scale (m): 5, 10, 15, 20, 25, 30
Elevation scale (m): 1790, 1785, 1780, 1775, 1770, 1765, 1760



DRILLING NOTES

2.0 m to 7.3 m - Lugeon Packer Test #1 - k = 1E-06 m/s

6.6 m to 13.4 m - Lugeon Packer Test #2 - k = 1E-04 m/s

12.6 m to 19.5 m - Lugeon Packer Test #3 - k = 6E-06 m/s

18.7 m to 25.6 m - Lugeon Packer Test #4 - k = 3E-07 m/s

24.8 m to 30.2 m - Lugeon Packer Test #5 - k = 3E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-3

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.
Location: South Impoundment Embankment
Coordinates: 506,510 E , 5,178,913 N
Coordinate System: NAD83
Hole Size HQ3

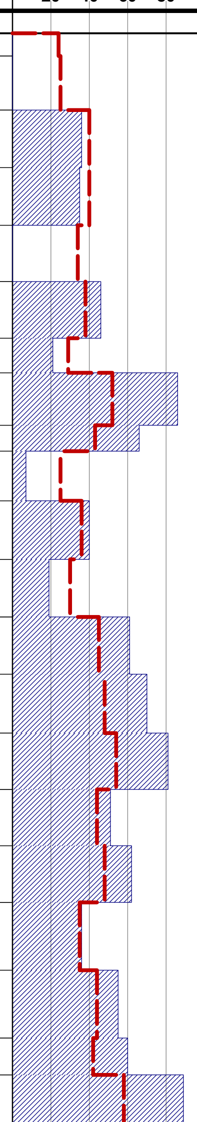
Drillhole No.: SC15-183
Drill Type: Sandvik 710
Total Length: 30.2m
Elevation: 1779 m
Inclination: -90

Page: 1 of 1
Date Started: Mar 7, 15
Date Completed: Mar 8, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 – 0.6		**SILTY SAND** (0 to 0.6 m) Silty SAND, fine grained, non plastic, brown, moist with some organics.
0.6 – 1.5		**WEATHERED BEDROCK** (0.6 to 1.5 m) GRANODIORITE, inequigranular, brownish orange, friable, completely weathered.
1.5 – 17.6	1775, 1770, 1765	**WEATHERED BEDROCK** (1.5 to 17.6 m) GRANODIORITE, medium grained, inequigranular, brownish grey, very weak to weak, highly weathered with localized intervals of complete weathering, massive.
9.2 – 9.9		**SHEAR ZONE** (9.2 to 9.9 m) Strong clay and yellow FeO staining with structural shear fabrics.
17.6 – 21.1	1760	**GRANODIORITE** (17.6 to 21.1 m) GRANODIORITE, medium grained, inequigranular, light grey to pale grey, medium strong to strong, slightly to moderately weathered with some FeO staining along joint surfaces and fractures, massive.
21.1 – 30.2	1755, 1750	**INTERBEDDED SHALE** (21.1 to 30.2 m) SILTY SHALE, fine grained, grey and light grey sub horizontal beds, weak with occasional fractured zones and claye rubble, slightly weathered becoming mostly fresh towards bottom of hole, very thin to thickly laminated, sporadic calcite veins and veinlets.
30.2	1745	End of Drillhole: 30.2 m

RUN RECOVERY (%)	SAMPLE NO.	BLOW COUNTS (PER 6") / UCS
66		0.5
96		1
94		5
100		10
100		5
100		7
95		1
100	UCS-02	10
100		15
92		1
95		5
100		1
98		10
100		20
100		50
98		10
98		25
88		1
100		25
99		10
100	UCS-01	50

KEY ROCK MASS PARAMETERS



DRILLING NOTES

5.0 m to 11.9 m - Lugeon Packer Test #1 - k = 4E-08 m/s

11.1 m to 18.0 m - Lugeon Packer Test #2 - k = 5E-08 m/s

17.2 m to 24.1 m - Lugeon Packer Test #3 - k = 2E-07 m/s

23.3 m to 30.2 m - Lugeon Packer Test #4 - k = 2E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-4

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-184	**Page:** 1 of 1
Location: Seepage Collection Pond	Drill Type: Sandvik 710	Date Started: Mar 8, 15
Coordinates: 507,044 E , 5,178,970 N	Total Length: 30.0m	Date Completed: Mar 9, 15
Coordinate System: NAD83	Elevation: 1756 m	Logged by: GM/JBC
Hole Size PQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 to 2.1		**SILTY SAND** (0 to 2.1 m) Silty SAND, angular to subangular, fine to coarse grained, porrly graded, low to no plasticity, dark brown, loose.
2.1 to 4.6		**SANDY, CLAYEY SILT** (2.1 to 4.6 m) Clayey SILT with sand, poorly graded, high plasticity, light brown, wet.
4.6 to 5.1		**WEATHERED BEDROCK** (4.6 to 5.1 m) Highly weathered silty and carboncaeous SHALE with FeO staining along fractures.
5.1 to 5.9		**WEATHERED BEDROCK** (5.1 to 5.9 m) SHALE, fine grained, grey to black, weak to very weak, highly fractured and oxidized, moderately to heavily weathered, discontinuous laminations.
5.9 to 15		**INTERBEDDED CONGLOMERATES AND SHALES** (5.9 to 15 m) Interbedded SHALES with heterolithic CONGLOMERATES, fine grained, light grey to black, weak with sections of highly fractured and rubbleized clayey rock (<5cm thick), moderately to slightly weathered with FeO along some joint surfaces, chaotic bedding.
15 to 19.9		**SHALE** (15 to 19.9 m) SHALE, fine grained, grey to black, weak to medium strong with several highly fractured/rubble zones throughout interval, slightly to moderately weathered, very thinly to thickly laminated with subhorizontal bedding; some calcite veins and veinlets.
19.9 to 24.4		**INTERBEDDED CONGLOMERATES AND SHALES** (19.9 to 24.4 m) Interbedded SHALES with heterolithic CONGLOMERATES, fine grained, light grey to black, weak with sections of highly fractured and rubbleized clayey rock (<5cm thick), moderately to slightly weathered with FeO along some joint surfaces, chaotic bedding.
24.4 to 30		**SHALE AND LIMESTONE** (24.4 to 30 m) Interbedded SHALE and LIMESTONE, fine grained, light to dark grey, strong, mostly fresh and unweathered with trace FeO infilling along some fractures and joints, thin laminations and bedding.
30		End of Drillhole: 30 m

Depth scale: 5, 10, 15, 20, 25, 30. Elevation scale: 1755, 1750, 1745, 1740, 1735, 1730, 1725.

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
	SPT01	75		2/2/3	5
	SPT02	29		1/1/3	4
	SHELBY01	31			
	SPT03	80		~~14/19/32~~	~~51~~
90				1	
93				10	
98				0 5	
100				5	
98				5	
100				15	
100				50	
100				20	
98				35	
100				40	
95				40	
100				75	
95				100	
100				70	
100				70	
100				50	
98				50	

KEY ROCK MASS PARAMETERS

RQD

RMR

SPT TEST 'N' VALUES - ×

20 40 60 80

INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

6.6 m to 13.4 m - Lugeon Packer Test #1 - k = 3E-06 m/s

14.2 m to 21.0 m - Lugeon Packer Test #2 - k = 4E-06 m/s

20.3 m to 30.0 m - Lugeon Packer Test #3 - Artesian conditions encountered

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-5

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Appendix: A2

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-185	**Page:** 1 of 1
Location: South Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 10, 15
Coordinates: 506,358 E , 5,179,087 N	Total Length: 30.2m	Date Completed: Mar 11, 15
Coordinate System: NAD83	Elevation: 1806 m	Logged by: GM/JBC
Hole Size PQ3	Inclination: -90	Reviewed by: GM

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.3 m)
Silty SAND, medium brown with some organics.

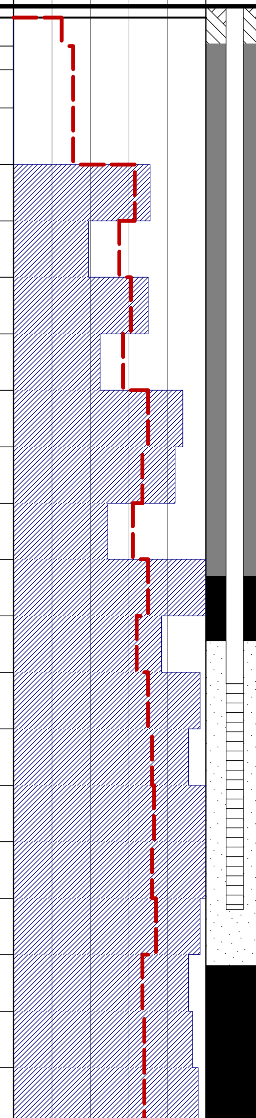
WEATHERED BEDROCK
(0.3 to 1.1 m)
Completely to highly weathered SHALE.

SHALE
(1.1 to 4.3 m)
SHALE, fine grained, medium to dark grey, very weak; highly fractured over entire interval with some rubble zones and clay infilling in some fractures, moderately weathered, very thin to thinly laminated.

GRANODIORITE
(4.3 to 30.2 m)
GRANODIORITE, medium grained, inequigranular with white feldspar phenocrysts (1-2 mm), light grey to grey, very strong, moderately fractured with some subvertical fracturing, slightly weathered to fresh and unweathered (at ~10.1 mbgs) with minor FeO staining along joints and fractures, massive.

End of Drillhole: 30.2 m

RUN RECOVERY (%)	UCS / BLOW COUNTS (PER 6")
45	1
94	10
100	10
79	10
100	120
89	120
100	120
100	120
100	120
97	120
100	120
100	120
97	120
97	120
98	150
100	150
100	150
97	150
97	150
100	150
97	150



DRILLING NOTES

5.6 m to 11.9 m - Lugeon Packer Test #1 - k = 1E-07 m/s

12.6 m to 18.0 m - Lugeon Packer Test #2 - k = 1E-05 m/s

17.2 m to 24.1 m - Lugeon Packer Test #3 - k = 5E-06 m/s

23.3 m to 30.2 m - Lugeon Packer Test #4 - k = 1E-05 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-6

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.
Location: South Impoundment Embankment
Coordinates: 506,698 E , 5,179,101 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-186
Drill Type: Sandvik 710
Total Length: 30.2m
Elevation: 1786 m
Inclination: -90

Page: 1 of 1
Date Started: Mar 11, 15
Date Completed: Mar 12, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m) | **ELEVATION - (m)** | **GRAPHIC LOG** | **MATERIAL DESCRIPTION** | **RUN RECOVERY (%)** | **SAMPLE NO.** | **SAMPLE REC. (%)** | **SAMPLE TYPE** | **UCS** / **BLOW COUNTS (PER 6")** | **SPT 'N' VALUE** | **KEY ROCK MASS PARAMETERS** | **INSTRUMENTATION / WELL DETAILS** | **DRILLING NOTES**

Depth scale: 5, 10, 15, 20, 25, 30. Elevation scale: 1785, 1780, 1775, 1770, 1765, 1760, 1755.

TOPSOIL
(0 to 0.3 m)
No recovery.

WEATHERED BEDROCK
(0.3 to 3.2 m)
SHALE, fine grained, equigranular with heterolithic angular to subangular CONGLOMERATE, medium grey, weak with several (up to 10cm) rubble zones, highly to completely weathered with FeO and clay infill along joints and fractures, thinly to thickly laminated with clasts.
Contact with intrusive unit at 3.2 mbgs.

WEATHERED BEDROCK
(3.2 to 4.7 m)
GRANODIORITE, medium grained with white feldspar phenocrysts, inequigranular, brownish grey, very weak to weak, completely to highly weathered with FeO staining along joints and fractures.

GRANODIORITE
(4.7 to 14.9 m)
GRANODIORITE, medium grained with white feldspar phenocrysts, inequigranular, grey to medium grey, strong to very strong with moderate fracturing, small, localized rubble zones throughout interval, moderately to slightly weathered with FeO staining along joints and fractures.

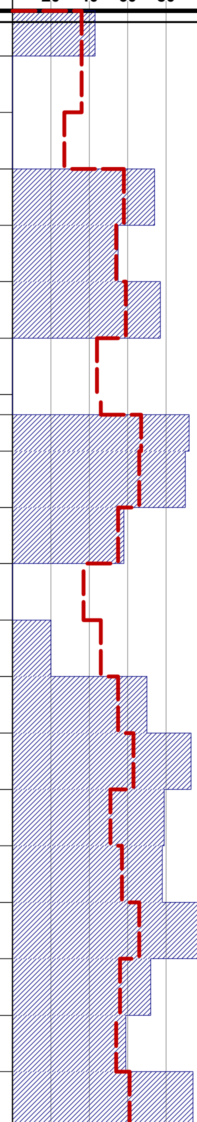
SHALE
(14.9 to 17.8 m)
SHALE, fine grained, black and dark blue, weak, highly fractured, moderately weathered with FeO infill along fractures and joints and FeO stained bedding, thickly laminated.

DEBRIS FLOW CONGLOMERATE
(17.8 to 26.9 m)
CONGLOMERATE, fine grained matrix with sub angular to angular heterolithic clasts, grey, medium strong with moderate fracturing becoming more intact downhole, moderately weathered, joints infilled with FeO, clay and calcite.

SHALE
(26.9 to 30.2 m)
SHALE, fine grained, light to dark grey, medium strong, moderately weathered with minor FeO infill along joints, very thinly to thinly laminated, calcite veins up to 1 mm thick throughout, calcite infilling along some joints.
DEBRIS FLOW CONGLOMERATE from 28.65 - 29.25 m.

End of Drillhole: 30.2 m

Run Recovery (%)	Blow Counts / UCS	Sample No.
88	10	
92	10	
66	3	
100	90	
100	90	
100	90	
0	90	
73	90	
92	90	
98	120	
98	120	
100	40	
100	50	
100	50	
98	50	
97	40	
98	50	
100	60	
100	50	
100	50	
100	50	UCS-01



DRILLING NOTES

5.0 m to 11.9 m - Lugeon Packer Test #1 - k = 6E-08 m/s

12.6 m to 18.0 m - Lugeon Packer Test #2 - k = 1E-07 m/s

17.2 m to 24.1 m - Lugeon Packer Test #3 - k = 8E-08 m/s

23.3 m to 30.2 m - Lugeon Packer Test #4 - k = 1E-08 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-7

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Ruen Drilling Inc.
Location: South Impoundment Embankment
Coordinates: 506,740 E , 5,179,260 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-187
Drill Type: Sandvik 710
Total Length: 30.2m
Elevation: 1786 m
Inclination: -90

Page: 1 of 1
Date Started: Mar 12, 15
Date Completed: Mar 12, 15
Logged by: GM/JBC
Reviewed by: GM

MATERIAL DESCRIPTION

TOSPOIL
(0 to 0.3 m)
No recovery.

WEATHERED BEDROCK
(0.3 to 6.1 m)
GRANODIORITE, medium grained, inequigranular, light grey to greenish grey, very strong to strong with moderate fracturing, slightly to moderately weathered; FeO staining along joints and fractures, massive.

SHEAR ZONE
(5 to 5.9 m)
SHALE, orangey brown, strongly weathered, FeO stained, sheared and disintegrated.

GRANODIORITE
(6.1 to 17.8 m)
GRANODIORITE, medium grained, inequigranular, light grey to greenish grey, very strong, slightly weathered; FeO staining along some joints and fractures with trace FeO stained blebs throughout interval, massive.

SHALEY LIMESTONE
(17.8 to 30.2 m)
SHALE, fine grained, medium grey, medium strong, slightly weathered, mostly massive except for 17.83 - 18.41 m interval which is thick to very thickly bedded (up to 1.2 cm).

CLAST SUPPORTED CONGLOMERATE
(18.4 to 20.4 m)
CONGLOMERATE, poorly sorted, heterolithic, clast supported, angular to subangular limestone clasts.

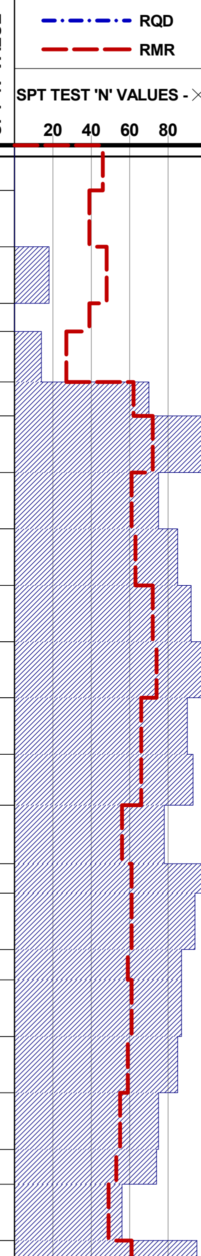
SHALEY LIMESTONE
(20.4 to 22.1 m)
SHALE with DEBRIS FLOW CONGLOMERATES, fine grained matrix, blue to blue grey, medium strong, slightly weathered, strongly deformed.

SHALEY LIMESTONE
(22.1 to 30.2 m)
SHALE, SHALEY LIMESTONE and DEBRIS FLOW CONGLOMERATES, strongly disrupted, moderately weathered with FeO staining along joints and fractures, mostly massive with thin bedding towards end of interval.

End of Drillhole: 30.2 m

RUN RECOVERY (%)	SAMPLE NO.	UCS / BLOW COUNTS (PER 6")
96		120
96		50
100		120
88		50
85		1
100	UCS-01	120
100		120
98		120
100		120
100		120
98		120
97		120
100		120
91	UCS-02	40
100		40
100		40
100		40
100		40
100		50
100		40
100		40
100		40
95		40

KEY ROCK MASS PARAMETERS



DRILLING NOTES

2.7 m to 8.8 m - Lugeon Packer Test #1 - k = 2E-06 m/s

9.6 m to 14.9 m - Lugeon Packer Test #2 - k = 2E-06 m/s

15.7 m to 22.6 m - Lugeon Packer Test #3 - k = 3E-08 m/s

23.3 m to 30.2 m - Lugeon Packer Test #4 - k = 6E-07 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-8

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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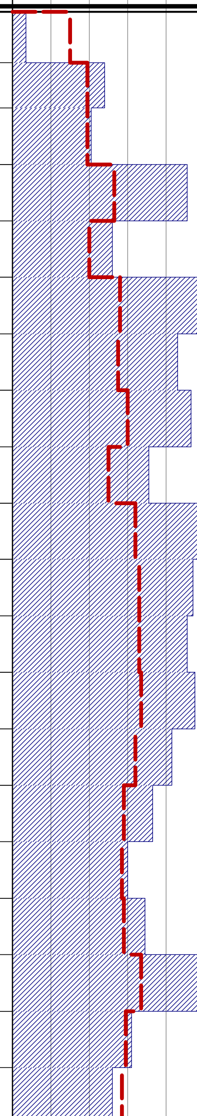
Appendix: A2

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-188	**Page:** 1 of 1
Location: South Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 12, 15
Coordinates: 506,563 E , 5,179,124 N	Total Length: 30.2m	Date Completed: Mar 13, 15
Coordinate System: NAD83	Elevation: 1792 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE	DRILLING NOTES
0 – 0.2		**SANDY SILT WITH CLAY** (0 to 0.2 m) Sandy SILT with some clay and trace organics.	100				1		
	1790	**WEATHERED BEDROCK** (0.2 to 1.5 m) GRANODIORITE, medium grained, inequigranular, light grey, highly weathered with lenses of extremely weak orangey brown soil material (up to 10 cm).	96				10		
			100				20		3.5 m to 8.8 m - Lugeon Packer Test #1 - k = 2E-07 m/s
5		**WEATHERED BEDROCK** (1.5 to 10.4 m) GRANODIORITE, medium grained, inequigranular, light grey / orangey grey, medium strong, moderately weathered with pervasive FeO staining throughout groundmass, FeO infilling along joints, massive.	98	UCS-01			30		
	1785		98				10		
			100				40		8.1 m to 14.9 m - Lugeon Packer Test #2 - k = 1E-07 m/s
10			100				50		
	1780	**GRANODIORITE** (10.4 to 30.2 m) GRANODIORITE, medium grained, inequigranular, light grey to grey, medium strong, slightly weathered with occasional locally oxidized zones, FeO infilling along many joints with a weak chlorite alteration observed along joints towards bottom of hole, massive.	100				75		
			100				75		
15			100				100		
	1775		100				120		15.7 m to 22.6 m - Lugeon Packer Test #3 - k =1E-07 m/s
			96				120		
20			100				120		
	1770		98				120		
			96				120		
			97				120		23.3 m to 30.2 m - Lugeon Packer Test #4 - k = 1E-08 m/s
25			100				120		
	1765		100				120		
			100				120		
30			100				120		
	1760	End of Drillhole: 30.2 m							



GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-9

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-189	**Page:** 1 of 1
Location: Plant Site	Drill Type: Sandvik 710	Date Started: Mar 13, 15
Coordinates: 506,679 E , 5,179,630 N	Total Length: 30.2m	Date Completed: Mar 14, 15
Coordinate System: NAD83	Elevation: 1782 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m) | ELEVATION - (m) | GRAPHIC LOG

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.3 m)
Brown silty SAND.

WEATHERED BEDROCK
(0.3 to 1.7 m)
SHALE, fine grained, grey, weak, highly to completely weathered with FeO staining throughout. Interval is highly fractured and mostly rubbleized.

WEATHERED BEDROCK
(1.7 to 5.8 m)
SHALE, fine grained, grey to dark grey, weak, highly fractured with multiple sections of rubbly oxidized material (up to 5 cm), moderately weathered with FeO staining along joints and fractures, very thin to thinly laminated. Numerous subvertical fractures parallel to deformed bedding throughout interval.

SILTY SHALE
(5.8 to 26.3 m)
SHALE, fine grained, grey to light grey, medium strong, moderately fractured with some sections of rubbly material, slightly weathered, some FeO and clay infill along joints and fractures, very thin to thinly laminated. Numerous subvertical fractures parallel to deformed bedding throughout interval.

SHALE / CONGLOMERATE
(21.1 to 22.7 m)
SHALE / CONGLOMERATE, grey, weak, slightly weathered, mostly shale clasts (up to 2 cm diameter), very fine grained matrix, trace calcite veinlets.

SHEAR ZONE
(23.8 to 24.2 m)
Highly fractured with fine gravel sized clasts and thick clay.

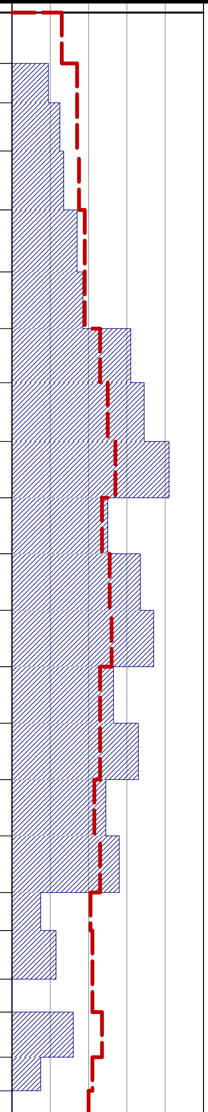
SHALE
(26.3 to 30.2 m)
SHALE, fine grained, grey to light grey, medium strong, mostly fresh and unweathered, moderately to highly fractured with occasional rubble zones (up to 10 cm) throughout interval, very thin laminations and bedding.

End of Drillhole: 30.2 m

Depth (m): 5, 10, 15, 20, 25, 30
Elevation (m): 1780, 1775, 1770, 1765, 1760, 1755, 1750

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE
100				1	
94				5	
99				5	
96				5	
95				15	
98				10	
100				25	
96				25	
98				40	
100				40	
100				40	
98				40	
100				25	
100				25	
100				25	
98				25	
100				25	
89				40	
100				50	
92	UCS-01			50	
98				50	
100				50	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

5.0 m to 11.9 m - Lugeon Packer Test #1 - k = 4E-07 m/s

11.1 m to 18.0 m - Lugeon Packer Test #2 - k = 2E-07 m/s

17.2 m to 24.1 m - Lugeon Packer Test #3 - k = 4E-08 m/s

24.8 m to 30.2 m - Lugeon Packer Test #4 - k = 1E-07 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-10

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-190	Page: 1 of 1
Location: Process Water Storage Pond	Drill Type: Sandvik 710	Date Started: Mar 14, 15
Coordinates: 507,205 E , 5,179,665 N	Total Length: 30.2m	Date Completed: Mar 15, 15
Coordinate System: NAD83	Elevation: 1761 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

MATERIAL DESCRIPTION

SILT
(0 to 0.5 m)
SILT with some clay, brown, some roots.

WEATHERED BEDROCK
(0.5 to 1.2 m)
SHALE, tan and grey, fine grained, highly to completely weathered.

WEATHERED BEDROCK
(1.2 to 3.6 m)
SHALE, fine grained, tan and medium grey, highly broken and rubbleized, completely weathered.

WEATHERED BEDROCK
(3.6 to 7.5 m)
SHALE, fine grained, medium grey and tan bedding, highly fractured with rubble and clay filled zones, medium strength for intact rock, moderately weathered, very thin laminations and bedding.

SHALE
(7.5 to 8.9 m)
SHALE, fine grained, grey to medium grey, highly fractured with rubble and clay filled zones, medium strength for intact rock, moderately weathered, very thin laminations and bedding.

SHEAR ZONE
(8.9 to 9.9 m)
Cohesive shear with large clay fraction.

SHALE
(9.9 to 30.2 m)
SHALE, fine grained, light to medium grey, moderately fractured with some rubble zones (up to 20cm), medium strength, moderately weathered to fresh and unweathered, very thin laminations and bedding.

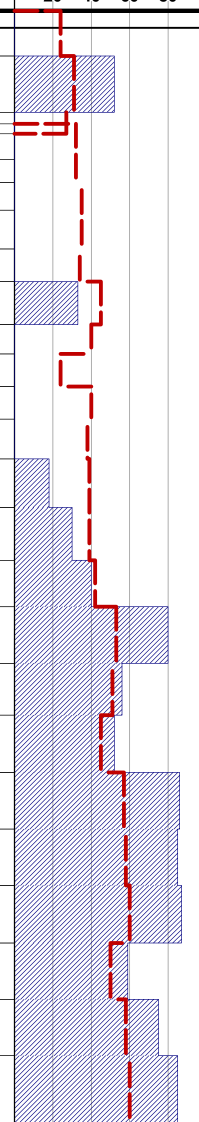
End of Drillhole: 30.2 m

Depth - (m): 5, 10, 15, 20, 25, 30
Elevation - (m): 1760, 1755, 1750, 1745, 1740, 1735, 1730

RUN RECOVERY (%)	SAMPLE NO.	UCS
80		0.5
52		0.5
86		0.5
62		30
90		30
92		30
94		30
85		30
101		35
98		30
94		0.5
100		30
100		30
92		30
96	UCS-01	30
100		30
98		30
100		30
98		30
100		40
100		50
100		50
100		40
100		50
100		50

Columns: SAMPLE REC. (%), SAMPLE TYPE, BLOW COUNTS (PER 6"), SPT 'N' VALUE, INSTRUMENTATION / WELL DETAILS

KEY ROCK MASS PARAMETERS



DRILLING NOTES

8.1 m to 14.8 m - Lugeon Packer Test #1 - k = 3E-07 m/s

15.7 m to 22.1 m - Lugeon Packer Test #2 - k = 2E-06 m/s

21.8 m to 30.2 m - Lugeon Packer Test #3 - k = 3E-07 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-11

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Ruen Drilling Inc.
Location: Process Water Storage Pond
Coordinates: 507,024 E , 5,179,469 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-191
Drill Type: Sandvik 710
Total Length: 30.2m
Elevation: 1768 m
Inclination: -90

Page: 1 of 1
Date Started: Mar 15, 15
Date Completed: Mar 15, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS (RQD, RMR; SPT TEST 'N' VALUES 20 40 60 80)	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES

SANDY SILT WITH CLAY
(0 to 0.5 m)
Sandy SILT with some clay, medium to light brown, trace roots and organics.

WEATHERED BEDROCK
(0.5 to 2.7 m)
Light brown / tan, highly weathered and disintegrated shale, some pebble sized fragments of shaley limestone, heavily infilled with clay, some FeO staining throughout interval.

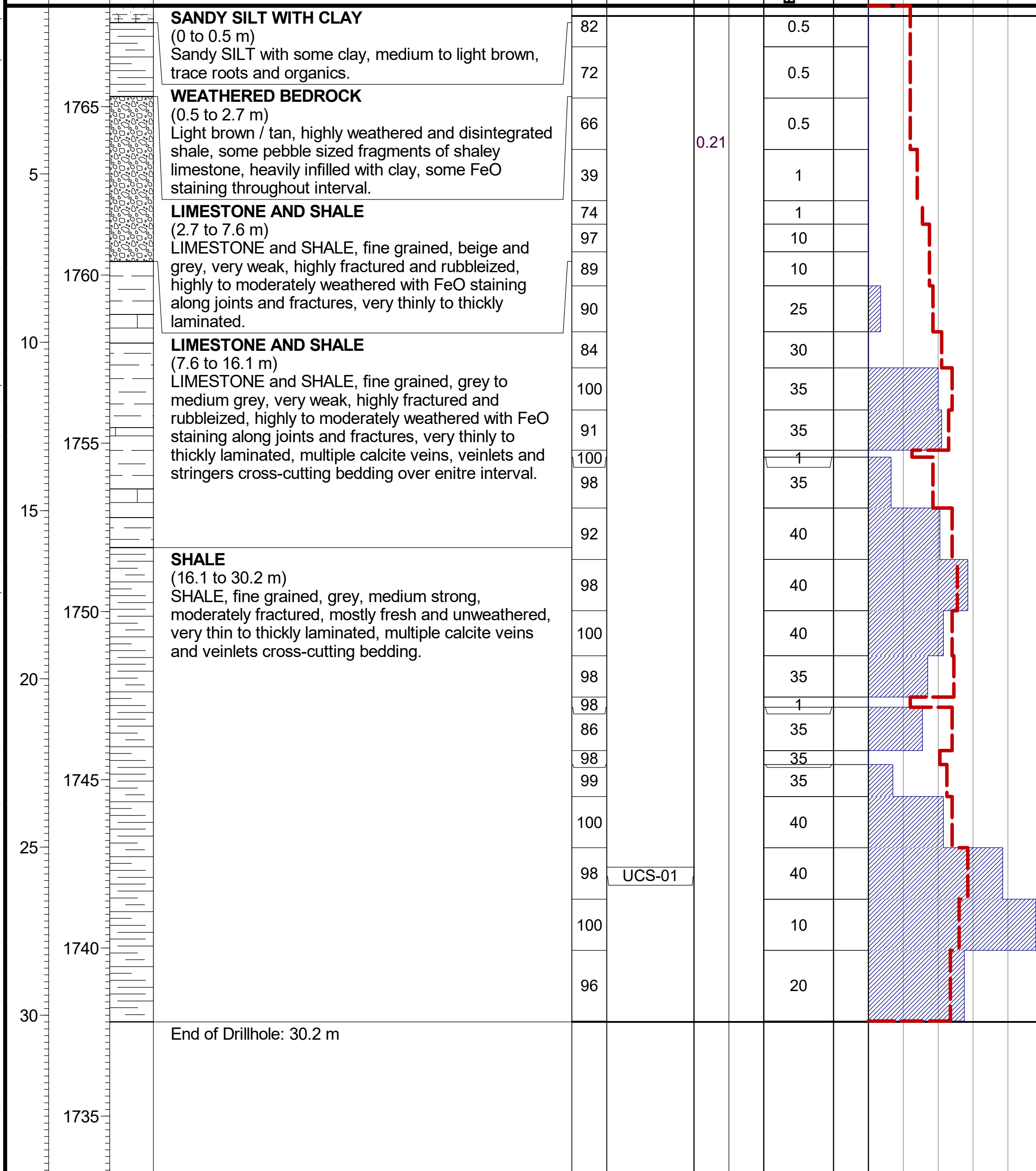
LIMESTONE AND SHALE
(2.7 to 7.6 m)
LIMESTONE and SHALE, fine grained, beige and grey, very weak, highly fractured and rubbleized, highly to moderately weathered with FeO staining along joints and fractures, very thinly to thickly laminated.

LIMESTONE AND SHALE
(7.6 to 16.1 m)
LIMESTONE and SHALE, fine grained, grey to medium grey, very weak, highly fractured and rubbleized, highly to moderately weathered with FeO staining along joints and fractures, very thinly to thickly laminated, multiple calcite veins, veinlets and stringers cross-cutting bedding over enitre interval.

SHALE
(16.1 to 30.2 m)
SHALE, fine grained, grey, medium strong, moderately fractured, mostly fresh and unweathered, very thin to thickly laminated, multiple calcite veins and veinlets cross-cutting bedding.

End of Drillhole: 30.2 m

Run Recovery (%)	Sample No.	Sample Rec. (%)	UCS / Blow Counts
82			0.5
72			0.5
66		0.21	0.5
39			1
74			1
97			10
89			10
90			25
84			30
100			35
91			35
100			1
98			35
92			40
98			40
100			40
98			35
98			1
86			35
98			35
99			35
100			40
98	UCS-01		40
100			10
96			20



Drilling notes:

8.1 m to 14.9 m - Lugeon Packer Test #1 - k = 2E-05 m/s

15.7 m to 22.6 m - Lugeon Packer Test #2 - k = 3E-07 m/s

21.8 m to 30.2 m - Lugeon Packer Test #4 - k = 1E-07 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-12

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Ruen Drilling Inc.
Location: West Impoundment Embankment
Coordinates: 504,689 E , 5,178,984 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-192
Drill Type: Sandvik 710
Total Length: 30.5m
Elevation: 1792 m
Inclination: -90

Date Started: Mar 15, 15
Date Completed: Mar 16, 15
Logged by: GM/JBC
Reviewed by: GM

DEPTH - (m) | ELEVATION - (m) | GRAPHIC LOG

MATERIAL DESCRIPTION

SILTY SAND
(0 to 1.5 m)
Silty SAND, subangular to subrounded, fine to coarse grained, some angular gravel, poorly graded, dry, trace clay.

SILTY CLAY
(1.5 to 2.1 m)
Silty CLAY, medium plasticity, brown to orangey brown, compact, massive, moist; some sand, coarse grained, some gravel, subangular to angular, fine to coarse grained, well graded.

WEATHERED BEDROCK
(2.1 to 3 m)
GRANODIORITE, completely weathered, fine to coarse grained, poorly graded, non plastic, greyish brown, moist to wet.

WEATHERED BEDROCK
(3 to 5.2 m)
SHALE, completely weathered, oxidized, some clay sections.

WEATHERED BEDROCK
(5.2 to 9.8 m)
SHALE, fine grained, medium grey, weak to medium strong, highly fractured and rubbleized in sections, moderately weathered with some FeO staining and some clayey gouge infilling along joints, very thinly laminated and bedded.

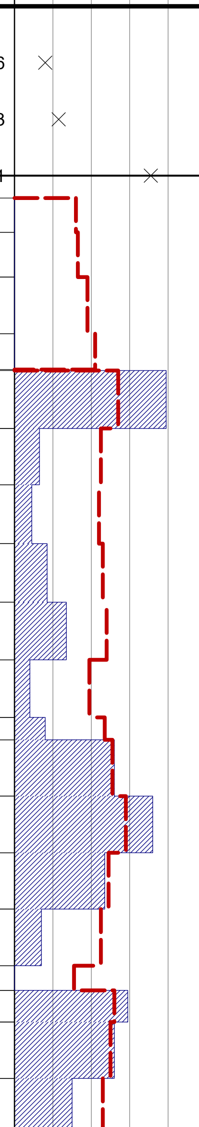
SHALE
(9.8 to 18.2 m)
SHALE, fine grained, grey to medium grey, medium strong, moderately fractured with some minor rubbleized sections (less than 10 cm), slightly weathered to fresh and unweathered,some clayey gouge infilling along joints, very thinly laminated and bedded.

SHALE
(18.2 to 30.5 m)
SHALE, fine grained, medium grey and light grey, medium strong, moderately to highly fractured, fresh to slightly weathered, very thinly to thickly laminated and very thinly bedded, calcite veins and veinlets throughout interval, minor FeO staining along some fractures.

End of Drillhole: 30.5 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
	SPT01	75		6/9/7	16
	SPT02	71		9/10/13	23
	SPT03	51		2/31/40	71
68				25	
86				25	
84				25	
90				35	
100				40	
102				40	
98				40	
95				40	
100				50	
98				40	
100				40	
100				40	
100				40	
100				40	
100				40	
75				1	
100				40	
98				40	
100				40	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

9.6 m to 19.8 m - Lugeon Packer Test #1 - k = 4E-07 m/s

20.6 to 30.5 m - Lugeon Packer Test #2 - k = 2E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-13

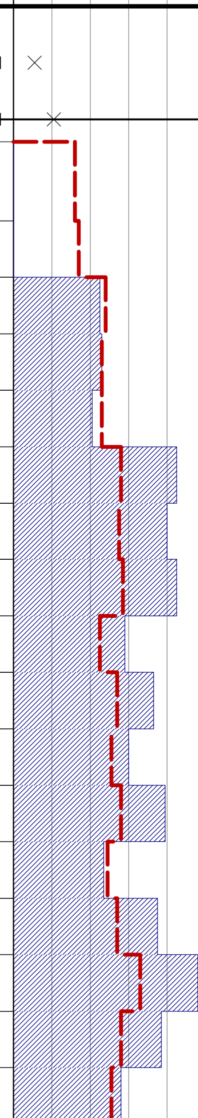
Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-193	**Page:** 1 of 1	
Location: West Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 16, 15	
Coordinates: 504,857 E , 5,178,786 N	Total Length: 30.2m	Date Completed: Mar 17, 15	
Coordinate System: NAD83	Elevation: 1787 m	Logged by: GM/JBC	
Hole Size HQ3	Inclination: -90	Reviewed by: GM	

MATERIAL DESCRIPTION
SILTY SAND (0 to 0.5 m) Topsoil - no recovery
SILTY SAND (0.5 to 1.1 m) Silty SAND with angular gravel, poorly sorted, , non plastic, moist to dry.
SAND AND COBBLES (1.1 to 1.5 m) SAND and COBBLES, trace silt and clay, some subangular gravel, low plasticity, moist to dry.
GRAVELLY CLAY (1.5 to 2.1 m) Gravelly CLAY with some silt and sand, medium to high plasticity, brown to greyish brown, massive, firm and compact, moist to wet; gravel is subangular to subrounded, fine to coarse grained; sand is fine to coarse grained, subangular to subrounded, well graded.
WEATHERED BEDROCK (2.1 to 3.7 m) SHALE, completely weathered, sections of oxidized clay, crumbles easily.
WEATHERED SHALE (3.7 to 7.5 m) SHALE, fine grained, grey to light grey, very weak, moderately weathered, very thinly laminated and bedded, highly fractured over entire interval with some FeO stained clay infilling.
SHALE (7.5 to 15.3 m) SHALE, fine grained, grey to light grey, medium strong, mostly fresh and unweathered, very thinly laminated and bedded, moderately fractured over entire interval, trace calcite veins.
SHALE WITH DEBRIS FLOW (15.3 to 17.7 m) SHALE with DEBRIS FLOW unit for first 21 cm of interval, fine grained, grey to light grey, medium strong, mostly fresh and unweathered, very thinly laminated and bedded, moderately fractured, multiple sub vertical calcite, quartz and dolomite veins.
SHALE (17.7 to 30.2 m) SHALE, fine grained, grey to light grey, medium strong, mostly fresh and unweathered, very thinly laminated and bedded, moderately fractured over entire interval, some calcite veins parallel to bedding towards end of interval.
End of Drillhole: 30.2 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
	SPT01	50	7/3/8	11
	~~SPT02~~	~~92~~	~~6/9/12~~	~~21~~
96			15	
100			25	
100			30	
100			30	
100			30	
100			35	
100			35	
100	UCS-01		40	
100			40	
100			40	
94			40	
100			40	
100			40	
100			40	
96			50	
100			50	
100			50	

KEY ROCK MASS PARAMETERS



DRILLING NOTES

8.1 m to 18.0 m - Lugeon Packer Test #1 - k = 1E-07 m/s

17.2 m to 30.2 m - Lugeon Packer Test #2 - k = 6E-08 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-14

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

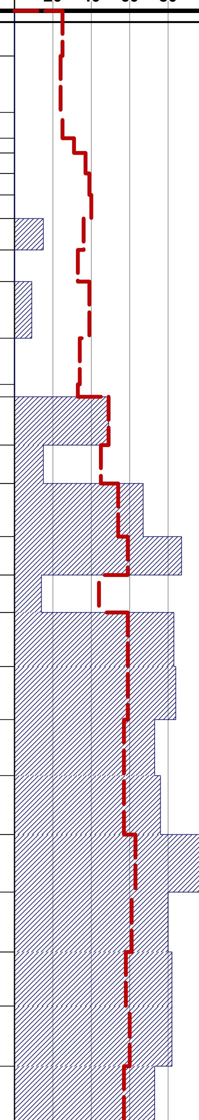
File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BLACK BUTTE COPPER PROJECT.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, GEOTECHNICAL DRILLHOLE LOG, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor:	Ruen Drilling Inc.	**Drillhole No.:**	SC15-194	**Page:**	1 of 1
Location:	Central Impoundment Embankment	Drill Type:	Sandvik 710	Date Started:	Mar 17, 15
Coordinates:	506,024 E , 5,179,849 N	Total Length:	30.1m	Date Completed:	Mar 18, 15
Coordinate System:	NAD83	Elevation:	1774 m	Logged by:	GM/JBC
Hole Size	PQ3	Inclination:	-90	Reviewed by:	GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 – 0.5		**CLAYEY SAND** (0 to 0.5 m) Clayey SAND, orangey brown with shale fragments.
0.5 – 2.8		**WEATHERED BEDROCK** (0.5 to 2.8 m) SHALE, grey-brown, completely weathered with shale fragments and clay.
2.8 – 10.4	1770	**WEATHERED BEDROCK** (2.8 to 10.4 m) SHALE, fine grained, medium grey, medium strong, moderately to strongly weathered with FeO staining along most fractures and joints, highly fractured and rubbleized in many sections along interval.
10.4 – 30.1	1765 / 1760 / 1755 / 1750 / 1745	**SHALE** (10.4 to 30.1 m) SHALE, fine grained, medium to dark grey, medium strong to strong, fresh and unweathered, thickly laminated to very thinly bedded with localized micro turbidites and pebble debris flow conglomerates, moderately fractured with occasional fractured/broken zones (up to 20 cm long) throughout interval, calcite veins and veinlets throughout.
30.1	1740	End of Drillhole: 30.1 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
90				0.5	
39				0.5	
57				0.5	
91				10	
91				35	
92				35	
100				35	
94				40	
70				35	
72				35	
72				35	
45				35	
88				50	
100				50	
95				50	
100				50	
86				50	
99				50	
99				50	
95				50	
97				50	
100				50	
98				60	
97				60	
100				60	
100				50	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

12.6 m to 17.7 m - Lugeon Packer Test #1 - k = 5E-07 m/s

17.2 m to 23.8 m - Lugeon Packer Test #2 - k = 7E-08 m/s

23.3 m to 30.1 m - Lugeon Packer Test #3 - k = 6E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-15

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-195	Page: 1 of 1
Location: East Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 18, 15
Coordinates: 507,728 E , 5,179,502 N	Total Length: 30.1m	Date Completed: Mar 19, 15
Coordinate System: NAD83	Elevation: 1736 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

MATERIAL DESCRIPTION

TOPSOIL
(0 to 0.2 m)
No recovery.

WEATHERED BEDROCK
(0.2 to 2 m)
SHALE, completely weathered, brown-grey silty clay with shale fragments, some relict bedding,

SHALE
(2 to 3.8 m)
SHALE, highly fractured, mainly rubble with angular fragments up to 4 cm in diameter.

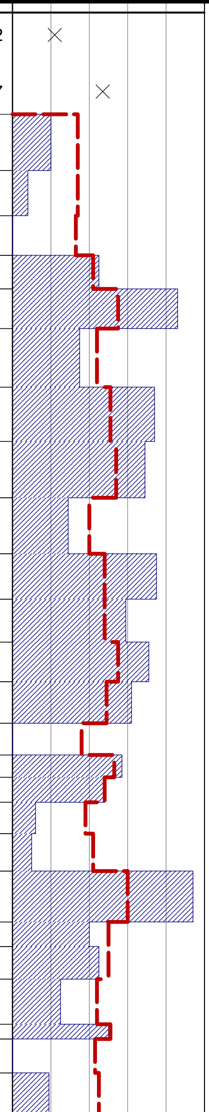
SHALE
(3.8 to 7.9 m)
SHALE, fine grained, grey to light grey, weak becoming medium strong as rock becomes more intact, highly to moderately fractured, thinly laminated and very thinly bedded with interbedded very thin to thin limestone beds every 1 - 2 m, calcite veins, veinlets and stringers throughout.

SHALE
(7.9 to 30.1 m)
SHALE, fine grained, grey to light grey, medium strong, moderately fractured, thinly laminated and very thinly bedded with interbedded very thin to thin limestone beds every 1 - 2 m, intermittent zones of gouge and rubble over entire interval, calcite veins, veinlets and stringers throughout.

End of Drillhole: 30.1 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
	SPT01	75		9/11/11	22
	SPT02	75		11/18/29	47
92				5	
90				10	
94				10	
100				20	
102				40	
88				40	
100				40	
90				40	
90				30	
100				30	
95				40	
94				40	
100				40	
68				35	
92				40	
84				35	
66				35	
79				35	
100				35	
82				35	
96				35	
94				35	
101				35	
98				35	
65				35	

KEY ROCK MASS PARAMETERS



DRILLING NOTES

9.6 m to 19.5 m - Lugeon Packer Test #1 - k = 5E-06 m/s

18.7 m to 30.1 m - Lugeon Packer Test #2 - k = 1E-08 m/s

Depth (m): 5, 10, 15, 20, 25, 30 — Elevation (m): 1735, 1730, 1725, 1720, 1715, 1710, 1705

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-196	Page: 1 of 1
Location: East Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 19, 15
Coordinates: 507,619 E , 5,179,697 N	Total Length: 30.5m	Date Completed: Mar 20, 15
Coordinate System: NAD83	Elevation: 1751 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

MATERIAL DESCRIPTION

TOPSOIL
(0 to 0.3 m)
No recovery.

CLAYEY SAND WITH GRAVEL
(0.3 to 0.6 m)
Clayey SAND with angular, poorly sorted gravel, reddish brown, medium plasticity, moist to dry.

GRAVELLY SAND
(0.6 to 1.5 m)
SAND with some gravel, dry. Relict texture may indicate completely weathered bedrock material.

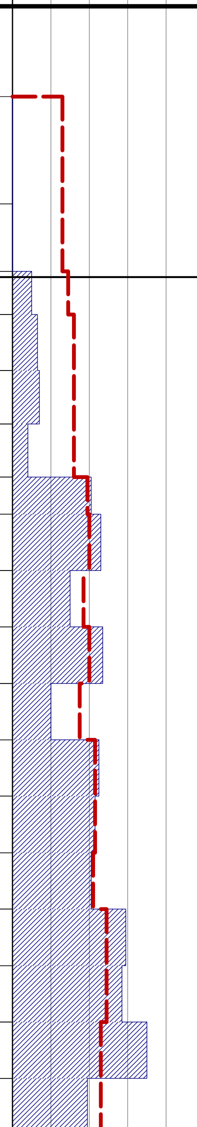
WEATHERED BEDROCK
(1.5 to 7.2 m)
Completely weathered bedrock, orangey brown to greyish brown, clay rich, highly oxidized, dense, moist; protolith most likely granodiorite, weathered shale and granodiorite clasts throughout.

DEBRIS FLOW CONGLOMERATE
(7.2 to 30.5 m)
Very poorly sorted, clast supported, heterolithic DEBRIS FLOW CONGLOMERATE, fine grained, grey with orangey brown FeO staining throughout, very weak, highly weathered, highly fractured becoming more competent by end of hole, massive.

End of Drillhole: 30.5 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
78				0.5	
77				0.5	
100				1	
89				1	
90				1	
61				10	
100				20	
100				20	
100				15	
100				20	
98				15	
100				25	
99				25	
100				25	
98				30	
100				30	
98				30	
100				30	

KEY ROCK MASS PARAMETERS



DRILLING NOTES

13.6 m to 22.9 m - Lugeon Packer Test #1 - k = 3E-07 m/s

22.1 m to 30.5 m - Lugeon Packer Test #2 - k - 4E-08 m/s

INSTRUMENTATION / WELL DETAILS

DEPTH - (m): 5, 10, 15, 20, 25, 30
ELEVATION - (m): 1750, 1745, 1740, 1735, 1730, 1725, 1720

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-17

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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Appendix: A2

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-197	**Page:** 1 of 2
Location: Central Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 20, 15
Coordinates: 506,194 E , 5,179,619 N	Total Length: 29.9m	Date Completed: Mar 21, 15
Coordinate System: NAD83	Elevation: 1775 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m) | ELEVATION - (m) | GRAPHIC LOG | MATERIAL DESCRIPTION | RUN RECOVERY (%) | SAMPLE NO. | SAMPLE REC. (%) | SAMPLE TYPE | UCS BLOW COUNTS (PER 6") | SPT 'N' VALUE | KEY ROCK MASS PARAMETERS | INSTRUMENTATION / WELL DETAILS | DRILLING NOTES

Depth (m)	Elevation (m)
5	1770
10	1765
15	1760
20	1755
25	1750
30	1745

TOPSOIL
(0 to 0.2 m)
Brownish grey silty SAND.

WEATHERED BEDROCK
(0.2 to 1.2 m)
SHALE, fine grained, grey to light grey, fractured and microfractured, very weak, highly weathered with some FeO infilling along joints, some rubbleized material at end of interval.

WEATHERED SHALE
(1.2 to 3.7 m)
SHALE, fine grained, grey, highly fractured and rubbleized, very weak, highly to moderately weathered with some FeO infilling along joints, some rubbleized material at end of interval, intact rock is very thinly to thickly laminated.

WEATHERED SHALE
(3.7 to 8.2 m)
SHALE, fine grained, grey, highly fractured and rubbleized, very weak to weak, moderately weathered with some FeO infilling along joints, some rubbleized material at end of interval, intact rock is very thinly to thickly laminated, some local shearing parallel to bedding.

SHALE
(8.2 to 12.1 m)
SHALE, fine grained, grey, moderately fractured, medium strong, moderately weathered with some minor rubble and clay infilling, very thickly to thinly laminated, calcite veins and veinlets throughout.

SHALE
(12.1 to 16.3 m)
SHALE, fine grained, grey to white, highly to moderately fractured, medium strong, moderately weathered with some rubbleized zones and minor gouge, very thickly to thinly laminated, thick quartz-dolomite vein with shale clasts for majority of this interval.

SHALE
(16.3 to 20.5 m)
SHALE, fine grained, grey, highly fractured with rubbleized zones throughout interval, medium strong, moderately weathered to unweathered, intact rock is very thinly to thickly laminated. some local shearing parallel to bedding, calcite veins and veinlets throughout.

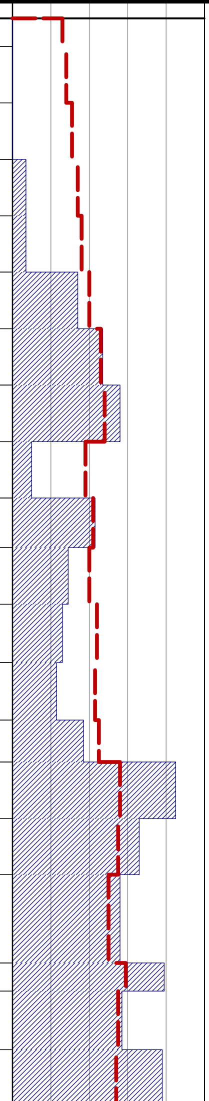
SHALE
(20.5 to 26.1 m)
SHALE, fine grained, grey, moderately fractured, medium strong, moderately weathered with some minor rubble and clay infilling, very thickly to thinly laminated, calcite veins and veinlets throughout, some dolomite-quartz veins with depth.

GRANODIORITE
(26.1 to 29.4 m)
GRANODIORITE, fine to coarse grained, inequigranular, light grey to grey with white phenocrysts, strong, fresh and unweathered with some hematite and calcite infilling along joints and fractures, massive.

DEBRIS FLOW CONGLOMERATE

Run Recovery (%)	Sample No.	Blow Counts
100		1
93		1
94		5
95		15
94		15
95		15
100		40
99		40
66		40
100		40
98		40
95		40
96	UCS-02	35
100		35
100		50
100	UCS-01	50
100		50
98		60
98		60
100		50

KEY ROCK MASS PARAMETERS



Drilling notes:

9.6 m to 19.4 m - Lugeon Packer Test #1 - k = 4E-06 m/s

18.7 m to 29.9 m - Lugeon Packer Test #2 - k = 1E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-18

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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Appendix: A2

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-197	**Page:** 2 of 2
Location: Central Impoundment Embankment	Drill Type: Sandvik 710	Date Started: Mar 20, 15
Coordinates: 506,194 E , 5,179,619 N	Total Length: 29.9m	Date Completed: Mar 21, 15
Coordinate System: NAD83	Elevation: 1775 m	Logged by: GM/JBC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	GRAPHIC LOG	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE	KEY ROCK MASS PARAMETERS (RQD, RMR) / SPT TEST 'N' VALUES - × (20 40 60 80)	INSTRUMENTATION / WELL DETAILS	DRILLING NOTES
			(29.4 to 29.9 m) DEBRIS FLOW CONGLOMERATE, heterolithic, clast supported with subangular pebble-cobble clasts, fine grained, medium grey, highly to moderately fractured, medium strong, unweathered with some rubbleized zones and minor gouge at the start of interval, massive, calcite veinlets throughout.									
			End of Drillhole: 29.9 m									
40	1735											
45	1730											
50	1725											
55	1720											
60	1715											
65	1710											

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-18

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-198
Location: SAG Mill	Drill Type: Sandvik 710
Coordinates: 506,592 E , 5,179,745 N	Total Length: 30.0m
Coordinate System: NAD83	Elevation: 1787 m
Hole Size HQ3	Inclination: -90

Date Started: Mar 21, 15
Date Completed: Mar 22, 15
Logged by: GM/JBC
Reviewed by: GM

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.6 m)
Silty SAND with trace gravel, brown, non plastic, some organics.

GRAVELLY SAND
(0.6 to 1.4 m)
SAND with shale fragments, fine to medium grained, non plastic, brown to grey.

SHALE
(1.4 to 22.9 m)
SHALE, fine grained, medium grey, medium strong, highly to moderately fractured with several rubbleized zones (up to 30 cm in length) over the interval with some clay gouge infill, moderately weathered with FeO staining along most joints and within fractures, very thinly to thickly laminated, trace calcite veins and veinlets.

SHEAR ZONE
(17.9 to 18.6 m)
Sheared / faulted; weakly cohesive silty clay gouge, FeO stained with shale fragments.

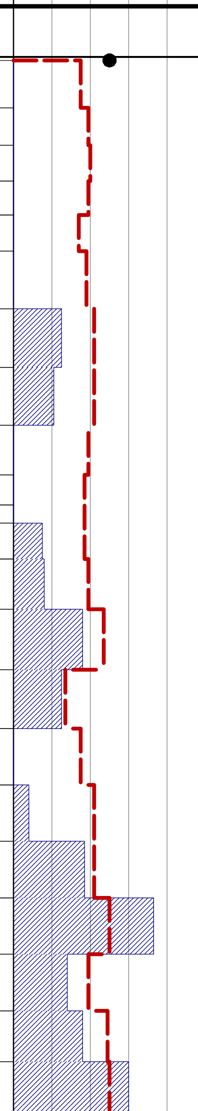
SHALE
(22.9 to 30 m)
SHALE, fine grained, medium grey, medium strong, moderately fractured with some small rubbleized zones (up to 15 cm in length), mostly unweathered with FeO staining along some joints and within fractures, very thinly to thickly laminated, calcite veins and veinlets throughout.

End of Drillhole: 30 m

Depth - (m): 5, 10, 15, 20, 25, 30
Elevation - (m): 1785, 1780, 1775, 1770, 1765, 1760, 1755

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
	Grab Sump SPT01	100		30/50+	R
55				35	
99				0 35	
92				35	
93				35	
100				35	
99				35	
97	UCS-04			35	
98				25	
100				25	
91				25	
94				25	
100				25	
97				35	
64	UCS-01			50	
98				0.5	
94				40	
98				40	
93	UCS-02			40	
100				50	
98				25	
98				40	
100	UCS-03			45	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

9.6 m to 16.3 m - Lugeon Packer Test #1 - k = 2E-07 m/s

15.7 m to 22.6 m - Lugeon Packer Test #2 - k = 7E-07 m/s

21.8 m to 30.0 m - Lugeon Packer Test #3 - k = 1E-07 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-19

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.
Location: Process Water Storage Pond
Coordinates: 506,316 E , 5,179,571 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-201
Drill Type: LF 70
Total Length: 30.3m
Elevation: 1783 m
Inclination: -90

Page: 1 of 1
Date Started: May 27, 15
Date Completed: May 30, 15
Logged by: JDC
Reviewed by: GM

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.6 m)
Silty SAND with trace gravel, medium brown, non plastic, some organics and roots.

WEATHERED BEDROCK
(0.6 to 1.4 m)
SHALE, dark grey, highly fractured and rubbleized with coarse silty sand infill.

WEATHERED BEDROCK
(1.4 to 4.1 m)
SHALE, fine grained, very thickly bedded, dark grey, highly fractured with several rubbleized zones over the interval, highly weathered with FeO staining along most joints and within fractures, weak.

DEBRIS FLOW CONGLOMERATE
(4.1 to 12.9 m)
DEBRIS FLOW CONGLOMERATE, fine grained matrix, very thickly bedded, heterolithic, clast supported, dark to medium grey, moderately fractured with some heavily fractured zones, moderately weathered with FeO staining along most joints and within fractures, some calcite infilling along joints, medium strong; microfractures throughout.

GRANODIORITE
(12.9 to 14.1 m)
GRANODIORITE, medium grained, inequigranular, grey to greenish grey, strong, slightly weathered with some FeO staining along joints, massive.

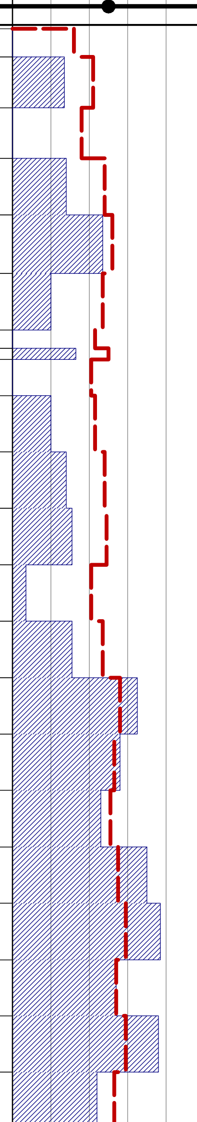
SHALE
(14.1 to 22.7 m)
SHALE, fine grained, very thickly bedded, dark to medium grey, moderately fractured, moderately weathered with FeO staining along joints only and within fractures, some calcite infilling along joints, medium strong; microfractures throughout.

SHALE
(22.7 to 30.3 m)
SHALE, fine grained, thinly bedded, dark grey, moderately fractured, unweathered, some calcite veinlets and infilling along joints, medium strong; trace localized sulphides.

End of Drillhole: 30.3 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
0	1	100		8/50+	R
59				5	
98				25	
62				15	
100				50	
96				60	
100				60	
68				40	
105				60	
100				40	
100				40	
100				40	
100				70	
100				35	
100				40	
100				50	
100				50	
100				50	
100				50	
100				60	
100				60	
100				70	
100				60	

KEY ROCK MASS PARAMETERS



DRILLING NOTES

5.49 m to 12.04 m - Lugeon Packer Test #1 - k = 2E-06 m/s

11.43 m to 24.23 m - Lugeon Packer Test #2 - k = 2E-07 m/s

22.10 m to 30.33 m - Lugeon Packer Test #3 - k = 8E-08 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-20

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.
Location: Process Water Storage Pond
Coordinates: 505,959 E , 5,179,446 N
Coordinate System: NAD83
Hole Size HQ3

Drillhole No.: SC15-202
Drill Type: LF 70
Total Length: 29.8m
Elevation: 1795 m
Inclination: -90

Date Started: May 30, 15
Date Completed: May 31, 15
Logged by: JDC
Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)
5	1790
10	1785
15	1780
20	1775
25	1770
30	1765

MATERIAL DESCRIPTION

SILTY SAND
(0 to 0.7 m)
Silty SAND, medium brown, fine to medium grained, trace roots, low plasticity, massive, compact to stiff, moist.

SANDY SILT
(0.7 to 1.5 m)
Sandy SILT, light brown, fine grained, no plasticity, massive, firm, dry.

WEATHERED BEDROCK
(1.4 to 13.4 m)
GRANODIORITE, medium grained, inequigranular, porphyritic, grey to greenish grey, medium strong, slightly to moderately weathered with some FeO staining along joints and fractures, some dissolution weathering towards end of interval, massive.

SHEAR ZONE
(7.7 to 8.8 m)
SHEAR ZONE, moderately fractured rock with silt/clay gouge infilling, FeO staining along fractures.

SHEAR ZONE
(13.3 to 13.7 m)
SHEAR ZONE, highly fractured rock with clay gouge infilling.

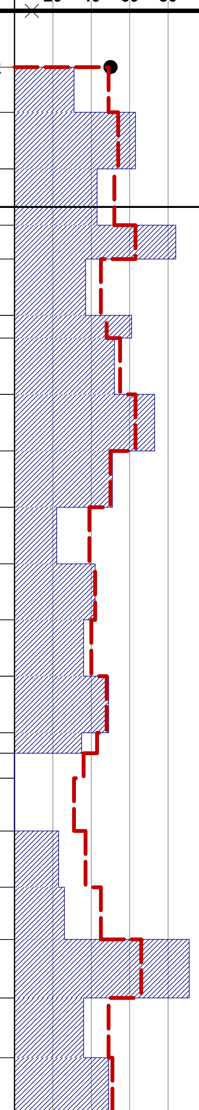
SHALE
(13.4 to 23.7 m)
SHALE, fine grained, thinly to thickly bedded, medium grey and tan, heavily fractured with some rubbleized zones, highly weathered with FeO staining throughout rock and along most joints and within fractures, some dissolution weathering in calcite veins, some calcite veinlets and infilling along healed fratures, weak rock.

SHALE
(23.7 to 29.8 m)
SHALE, fine grained, thinly to very thinly bedded, medium grey, moderately fractured, moderately weathered with FeO staining along joints and fractures, some microfractures, medium strong.

End of Drillhole: 29.8 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	UCS / BLOW COUNTS (PER 6")	SPT 'N' VALUE
0	1	100		2/3/6	9
	2	100		28/50+	R
84				75	
				31	
100				75	
100				70	
98				80	
100				60	
98				60	
100				75	
100				100	
100				70	
100				25	
100				30	
100				30	
100				30	
84				30	
98				25	
71				10	
100				40	
96				40	
96				50	
94				35	
100				45	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

2.44 m to 10.36 m - Lugeon Packer Test #1 - k = 2E-03 m/s

6.71 m to 14.94 m - Lugeon Packer Test #2 - k = 2E-05 m/s

14.33 m to 20.73 m - Lugeon Packer Test #3 - k = 5E-08 m/s

20.12 m to 29.81 m - Lugeon Packer Test #4 - k = 3E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-21

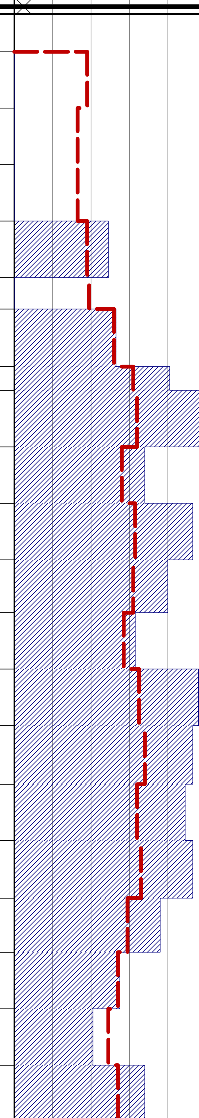
Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A2

Contractor: Ruen Drilling Inc.	**Drillhole No.:** SC15-203	**Page:** 1 of 1
Location: Process Water Pond (Alternate)	Drill Type: LF 70	Date Started: May 31, 15
Coordinates: 506,469 E , 5,178,408 N	Total Length: 30.2m	Date Completed: Jun 1, 15
Coordinate System: NAD83	Elevation: 1794 m	Logged by: JDC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION	RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE	DRILLING NOTES
0 – 1.2		**SILTY SAND** (0 to 1.2 m) Silty SAND, medium brown, fine grained with some fine shale gravel, trace clay, trace roots, low plasticity, massive, loose to compact, moist.	0	1	85		2/3/2	5	
			28				5		
1.2 – 8.2	1790	**WEATHERED BEDROCK** (1.2 to 8.2 m) SHALE, fine grained, thinly to very thinly bedded, medium to dark grey, weak, highly weathered, highly jointed and fractured with vertical and subvertical fracturing throughout with some FeO staining along joints, some localized rubble zones, some calcite veins and veinlets, trace dissolution weathering.	100				10		
5			100				15		
			49				10		
			95				25		
8.2 – 22.5	1785	**SHALE** (8.2 to 22.5 m) SHALE, fine grained, thinly bedded, light to medium grey, medium strong, moderately weathered to unweathered, mostly competent with some moderately fractured zones, some FeO staining along joints only, trace calcite veinlets and infilling along joints.	98				50		8.53 m to 14.94 m - Lugeon Packer Test #1 - k = 6E-07 m/s
10			100				50		
			100				60		
			100				60		
	1780		100				60		14.02 m to 22.52 m - Lugeon Packer Test #2 - k = 2E-09 m/s
15			98				70		
			100				50		
	1775		100				70		
20			96				70		
			100				70		21.64 m to 30.18 m - Lugeon Packer Test #3 - k = 6E-08 m/s
22.5 – 27.1	1770	**SHALE/LIMESTONE** (22.5 to 27.1 m) INTERBEDDED SHALE AND LIMESTONE, fine grained, thinly to very thinly bedded, medium to dark grey, strong, mostly fresh and unweathered, some calcite veinlets and infilling along joints, joint sets and conjugate joints oriented subvertically to core axis.	98				70		
25			100				70		
			100				60		
27.1 – 30.2	1765	**SHALE** (27.1 to 30.2 m) SHALE, fine grained, thinly to very thinly bedded, dark to medium grey, medium strong, moderately weathered to unweathered, moderately fractured, some FeO staining along joints, some calcite infilling along joints and healed fractures.	100				60		
30			96				60		
	1760	End of Drillhole: 30.2 m							

KEY ROCK MASS PARAMETERS



GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-22

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

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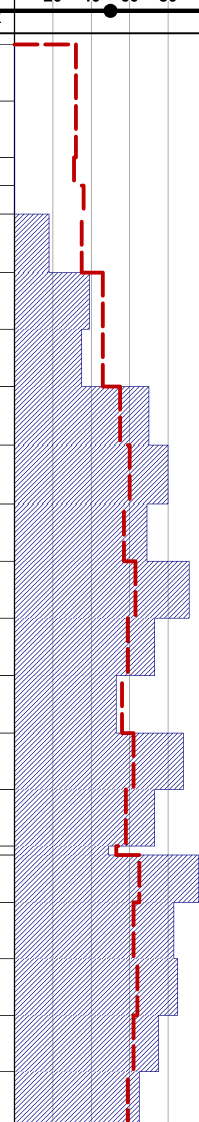
Contractor:	Ruen Drilling Inc.	**Drillhole No.:**	SC15-204	**Page:**	1 of 1
Location:	Non Contact Water Reservoir	Drill Type:	LF 70	Date Started:	Jun 1, 15
Coordinates:	507,939 E , 5,178,748 N	Total Length:	30.2m	Date Completed:	Jun 2, 15
Coordinate System:	NAD83	Elevation:	1761 m	Logged by:	JDC
Hole Size	HQ3	Inclination:	-90	Reviewed by:	GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 – 0.1		**TOPSOIL** (0 to 0.1 m) TOPSOIL, dark brown, organics and roots.
0.1 – 0.3	1760	**SILTY SAND** (0.1 to 0.3 m) Silty SAND, dark to medium brown with some FeO staining throughout, trace shale gravel, trace roots, low plasticity, massive, loose, moist.
0.3 – 4	1755	**WEATHERED BEDROCK** (0.3 to 4 m) SHALE, fine grained, very thinly bedded, medium to dark grey, weak, highly weathered, highly fractured, FeO staining throughout rock and along joints, some localized rubble zones, some calcite infilling along joints and fractures.
4 – 5.9		**SHALE** (4 to 5.9 m) SHALE, highly fractured and rubbleized, highly weathered, very weak.
5.9 – 8.6	1750	**WEATHERED BEDROCK** (5.9 to 8.6 m) SHALE, fine grained, very thinly bedded, medium to dark grey, weak, highly weathered, highly fractured, FeO staining throughout rock and along joints, some localized rubble zones, some calcite infilling along joints and fractures.
8.6 – 30.2	1745 – 1735	**SHALE** (8.6 to 30.2 m) SHALE, fine grained, thinly bedded, dark to medium grey, medium strong, mostly unweathered, moderately fractured with some subvertical fracturing, some calcite infilling along joints and poorly healed fractures, some localized stockwork calcite veining near the end of the interval.
30.2	1730	End of Drillhole: 30.2 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
35	1	100		2/3/23	R
62				10	
80				10	
59				10	
89				5	
76				20	
100				40	
98				40	
96				50	
96				50	
98				60	
100				70	
98				70	
98				65	
100				70	
100				60	
62				70	
102				70	
100				65	
100				65	
83				60	
82				60	

KEY ROCK MASS PARAMETERS



DRILLING NOTES

7.92 m to 13.32 m - Lugeon Packer Test #1 - k = 2E-08 m/s

12.5 m to 22.56 m - Lugeon Packer Test #2 - k = 8E-08 m/s

21.64 m to 30.21 m - Lugeon Packer Test #3 - k = 2E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-23

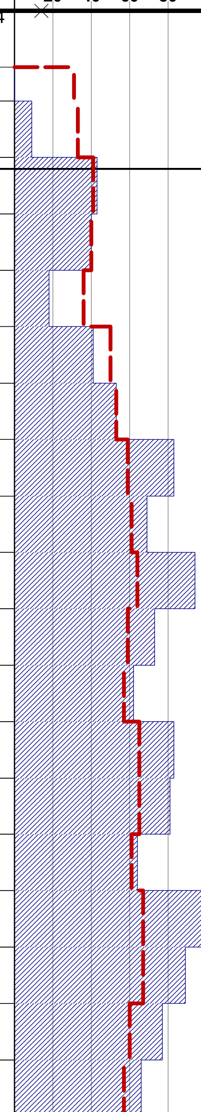
Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Ruen Drilling Inc.	Drillhole No.: SC15-205	Page: 1 of 1
Location: Non Contact Water Reservoir	Drill Type: LF 70	Date Started: Jun 3, 15
Coordinates: 507,971 E , 5,178,618 N	Total Length: 29.9m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1773 m	Logged by: JDC
Hole Size HQ3	Inclination: -90	Reviewed by: GM

DEPTH - (m)	ELEVATION - (m)	MATERIAL DESCRIPTION
0 to 0.1		**TOPSOIL** (0 to 0.1 m) TOPSOIL, dark brown, organics and roots.
0.1 to 0.7	1770	**SILTY SAND** (0.1 to 0.7 m) Silty SAND, medium brown, trace shale gravel, trace roots, low plasticity, massive, loose, moist.
0.7 to 8.5 (5)	1765	**WEATHERED BEDROCK** (0.7 to 8.5 m) SHALE, fine grained, thinly bedded, medium grey and tan, very weak to weak, highly weathered with FeO staining throughout rock and along joints, highly jointed and fractured with some calcite infilling and veinlets throughout.
8.5 to 16.7 (10, 15)	1760	**SHALE** (8.5 to 16.7 m) SHALE, fine grained, very thinly to thinly bedded, medium to dark grey, medium strong, moderately weathered, moderately fractured, some FeO staining along joints until ~25.6 mbgs becoming fresh and unweathered, some calcite infilling along joints and fractures, trace calcite veinlets and infilling cross-cutting bedding, jointing parallel with bedding.
16.7 to 26.5 (20, 25)	1755, 1750	**DEBRIS FLOW CONGLOMERATE** (16.7 to 26.5 m) DEBRIS FLOW CONGLOMERATE, fine grained matrix with shale clasts up to 30 mm, medium to dark grey, medium strong, mostly fresh and unweathered with localized dissolution weathering of calcite infill at beginning of interval, some deformed bedding throughout interval, occasional localized minor (< 5 cm) shear zones, trace calcite veins and veinlets throughout.
26.5 to 29.9 (30)	1745	**SHALE** (26.5 to 29.9 m) SHALE, fine grained, very thickly to thinly bedded, medium grey, medium strong, moderately fractured, fresh and unweathered, trace calcite veinlets and infilling along healed fractures and joints.
	1740	End of Drillhole: 29.9 m

RUN RECOVERY (%)	SAMPLE NO.	SAMPLE REC. (%)	SAMPLE TYPE	BLOW COUNTS (PER 6") / UCS	SPT 'N' VALUE
0	1	100		1/4/10	14
79				5	
100				10	
100				20	
100				20	
100				15	
100				40	
100				50	
100				60	
100				60	
100				65	
100				55	
100				40	
100				60	
100				60	
100				50	
100				70	
100				70	
100				60	
100				50	

KEY ROCK MASS PARAMETERS



INSTRUMENTATION / WELL DETAILS

DRILLING NOTES

4.57 m to 11.58 m - Lugeon Packer Test #1 - k = 5E-07 m/s

10.67 m to 22.25 m - Lugeon Packer Test #2 - k = 2E-07 m/s

19.81 m to 29.87 m - Lugeon Packer Test #3 - k = 9E-06 m/s

GENERAL REMARKS:

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-00460/03	1	0

FIGURE A2-24

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

APPENDIX A3

RMR LOGGING SHEETS

(Pages A3-1 to A3-43)

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-180

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.8	0.55	1.80												Brown, sandy silt with trace clay and some organics. Sand fraction is predominantly coarse (50+%), no medium grained sand visible, trace to some fine grained sand. Ground is frozen. Logged in sump.	OB													GIM							
1.8	0.55	6.20	1.89	4.40	0.94	70	0.00	0	max	5	5	R2	Med Grey	Very fine grained,		Shale, extremely weathered and rubbly, several zones of decomposed or ground core presents similar to clay. Intact rock fragments can be cipped easily with the point of a hammer.	Ynl	0	0	3	2	1	6	15			cc	ox		GIM	1.5	3.0	5.0	6.0	15	31	31
6.2	1.89	8.20	2.50	2.00	0.62	100	0.00	0	20	30	2.5	R1	Med Grey	Very fine grained.	Laminated with calcite veining at ~40-50° TCA.	Shale, very weathered with gouge zone at upper 10-15 cm of run. Rubble between joints, could scraped or peel with knife.	Ynl	0	0	1	2	1	4	15			cc	ox		GIM	1.3	3.0	5.4	4.0	15	29	29
8.2	2.50	9.90	3.02	1.70	0.53	100	0.00	0	20	25	20	R2	Med Grey	Very fine grained.	Laminated with carbonate veing 1-3 mm thick at ~40-50° TCA.	Shale, moderately weathered with carbonate veins 1-3 mm thick every 0.5-2 cm.	Ynl	0	4	1	2	3	10	15			cc	ox		GIM	3.0	3.0	5.3	10.0	15	36	36
9.9	3.02	12.30	3.75	2.40	0.70	96	0.00	0	14	47	50	R4	Med Grey	Very fine grained.	Laminated with carbonate veing 1-3 mm thick at ~40-50° TCA.	Shale, moderately weathered with carbonate veins 1-3 mm thick every 0.5-2 cm. 2-3 blows with a hammer to chip.	Ynl	0	1	1	2	4	8	15			cc	ox		GIM	5.7	3.0	5.6	8.0	15	37	37
12.3	3.75	13.60	4.15	1.30	0.58	100	0.00	0	9	58	40	R3	Med Grey	Very fine grained.	Laminated with carbonate veing 1-3 mm thick at ~40-50° TCA.	Shale, moderately weathered with carbonate veins 1-3 mm thick every 0.5-2 cm. 2-3 blows with a hammer to fracture.	Ynl	0	1	1	2	4	8	15			cc	ox		GIM	4.8	3.0	5.8	8.0	15	37	37
13.6	4.15	16.70	5.09	3.10	0.60	64	0.00	0	7	75	50	R4	Med Grey	Very fine grained.	Carbonate veinlets cross cut 5-10 mm thick carbonate veins at 40-50° TCA	Shale. Several blows to fracture sample with hammer. Carbonate infilling is beige/pale brown and "hard" infilling. Trace oxide on fracture surfaces.	Ynl	0	4	1	4	5	14	15			carb	ox		GIM	5.7	3.0	6.0	14.0	15	44	44
16.7	5.09	19.10	5.82	2.40	0.84	100	0.00	0	12	65	35	R3	Med Grey	Very fine grained.	Carbonate veinlets cross cut 5-10 mm thick carbonate veins at 40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Carbonate infilling is beige/pale brown and "hard" infilling. Trace oxide on fracture surfaces. Rubbly/clayey infilling in fractures near bottom of run, 1-6 mm thick.	Ynl	0	1	1	0	5	7	15			carb	ox		GIM	4.4	3.0	5.9	7.0	15	35	35
19.1	5.82	21.20	6.46	2.10	0.50	78	0.00	0	12	38	50	R4	Med Grey	Very fine grained.	Carbonate veinlets cross cut 5-10 mm thick carbonate veins at 40-50° TCA	Shale. Several firm blows to fracture sample with hammer. Carbonate infilling is beige/pale brown and "hard" infilling. Trace oxide on fracture surfaces. Rubbly/clayey infilling in fractures near top of run, 1-2 mm thick.	Ynl	0	1	1	2	5	9	15			carb	ox		GIM	5.7	3.0	5.5	9.0	15	38	38
21.2	6.46	24.00	7.31	2.80	0.84	98	0.15	18	9	84	35	R3	Med Grey	Very fine grained.	Carbonate veinlets cross cut 5-10 mm thick carbonate veins at 40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Carbonate infilling is beige/pale brown and "hard" infilling. Trace oxide on fracture surfaces. 5 cm rubble zone at top of run.	Ynl	0	4	3	4	5	16	15			carb	ox		GIM	4.4	5.1	6.1	16.0	15	47	47
24.0	7.31	28.60	8.72	4.60	1.34	96	0.29	21	18	71	40	R3	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Carbonate present as alteration halos around sealed fractures, and as vein filling. Trace oxide on fracture surfaces. Calcite veinlets present. Rubbly calcite vein ~1-2 mm thick 20 cm from bottom of run.	Ynl	0	2	3	2	5	12	15			cc	ox		GIM	4.8	5.5	6.0	12.0	15	43	43

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
28.6	8.72	33.40	10.18	4.80	1.44	98	0.20	14	17	80	40	R3	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Carbonate present as alteration halos around sealed fractures, and as vein filling. Trace oxide on fracture surfaces. Calcite veinlets present. 1 mm calcite veins appear periodically throughout run.	Ynl	0	1	3	2	5	11	15			cc	ox		GIM	4.8	4.6	6.1	11.0	15	41	41
33.4	10.18	36.30	11.06	2.90	0.94	100	0.00	0	13	67	50	R4	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Several firm blows to fracture sample with hammer. Carbonate present as alteration halos around sealed fractures, and as vein filling 1-7 mm thick. Trace oxide on fracture surfaces. Calcite veinlets and fracture coating present. 1 mm calcite veins appear periodically throughout run.	Ynl	0	1	3	2	5	11	15			cc	ox		GIM	5.7	3.0	5.9	11.0	15	41	41
36.3	11.06	40.20	12.25	3.90	1.10	93	0.00	0	16	65	35	R3	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Carbonate present as alteration halos around sealed fractures, and as vein filling. Trace oxide on fracture surfaces. Calcite veinlets present. 1 mm calcite veins appear periodically throughout run.	Ynl	0	4	2	2	5	13	15			cc	ox		GIM	4.4	3.0	5.9	13.0	15	41	41
40.2	12.25	43.60	13.29	3.40	1.00	96	0.14	14	16	59	35	R3	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Several firm blows to fracture sample with hammer. Beige carbonate present as alteration halos and veins 1-5 mm thick. Trace oxide on fracture surfaces. Calcite veinlets present. 1 mm calcite veins appear periodically throughout run.	Ynl	0	1	3	2	5	11	15			Rub	cc		GIM	4.4	4.6	5.8	11.0	15	41	41
43.6	13.29	46.40	14.14	2.80	0.90	100	0.00	0	15	56	50	R4	Med Grey	Very fine grained.	Calcite veinlets throughout run, Carbonate veins and alteration halos ~40-50° TCA	Shale. Single firm blow to fracture sample with hammer. Beige carbonate present as alteration halos and veins 1-5 mm thick. Trace oxide on fracture surfaces. Calcite veinlets present. 1 mm calcite veins appear periodically throughout run. Some rubbly infilling on fractures in upper 30 cm of run, 1-2 mm thick.	Ynl	0	4	1	2	5	12	15			cc	ox		GIM	5.7	3.0	5.8	12.0	15	41	41
46.40	14.14	51.60	15.73	5.20	1.56	98	0.20	13	19	78	40	R3	Med and Light grey	Very fine grained.	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present.	Ynl	0	4	1	2	5	12	15			cc			GIM	4.8	4.5	6.1	12.0	15	42	42
51.6	15.73	54.00	16.46	2.40	0.70	96	0.20	27	8	78	40	R3	Med and Light grey	Very fine grained.	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present.	Ynl	0	4	1	2	5	12	15			cc			GIM	4.8	6.4	6.1	12.0	15	44	44
54.0	16.46	59.00	17.98	5.00	1.52	100	0.56	37	12	117	40	R3	Med and Light grey	Very fine grained.	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present.	Ynl	0	1	1	2	6	10	15			cc			GIM	4.8	7.8	6.6	10.0	15	44	44
59.0	17.98	64.00	19.51	5.00	1.52	100	0.30	20	15	95	50	R4	Med and Light grey	Very fine grained.	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present.	Ynl	0	1	1	2	6	10	15						GIM	5.7	5.4	6.3	10.0	15	42	42
64.0	19.51	69.00	21.03	5.00	1.52	100	1.40	92	8	169	50	R4	Med grey to grey	Fine grained	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present. Fresh	Ynl	0	4	3	2	6	15	15			cly	cc		JBC	5.7	18.3	7.2	15.0	15	61	61
69.0	21.03	74.00	22.55	5.00	1.52	100	1.45	95	6	217	50	R4	Med grey to grey	Fine grained	Bedded at ~65-70° TCA, medium and light grey bands 2-5 mm thick.	Bedded shale. Some calcite veinlets present. Fresh	Ynl	0	4	1	2	6	13	15			cly			JBC	5.7	19.1	7.8	13.0	15	61	61
74.0	22.55	79.00	24.08	5.00	1.52	100	1.15	75	15	95	40	R3	Med grey to grey	Fine grained	Discontinuities occurring along bedding (40 to 50° TCA),	Bedded shale, medium strong to strong, slightly weathered to fresh, clay rich infilling, some rubble towards the end (~2 cm thick)	Ynl	0	1	3	0	5	9	15			cly	Rub		JBC	4.8	14.8	6.3	9.0	15	50	50
79.0	24.08	84.00	25.60	5.00	1.48	97	1.35	89	6	211	50	R4	Med grey to grey	Fine grained	Bedded at ~20 to 40 ° TCA, grey bands up to 5 mm	Medium strong to strong, slightly weathered to fresh, rubbly clay rich zone (~1 cm thick) at 81 ft.	Ynl	0	1	3	2	6	12	15			cly	Rub		JBC	5.7	17.6	7.7	12.0	15	58	58

DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
84.0	25.60	89.00	27.13	5.00	1.52	100	1.20	79	10	138	50	R4	Med grey to grey	Fine grained	Bedded at ~20 to 40 ° TCA, grey bands up to 5 mm	Medium strong, fresh to slightly weathered, trace calcite veinlets, subvertical discontinuities along bedding	Ynl
89.0	27.13	94.00	28.65	5.00	1.52	100	1.20	79	8	169	50	R4	Med grey to grey	Fine grained	Bedded at ~10 to 30 ° TCA, grey bands up to 5 mm	Medium strong, fresh to slightly weathered, some calcite veinlets, subvertical discontinuities along bedding	Ynl
94.0	28.65	99.00	30.17	5.00	1.52	100	1.12	73	15	95	50	R4	Med grey to grey	Fine grained	Bedded at ~40 to 60 ° TCA, grey bands up to 1 cm	Medium strong, clay infilling, trace calcite veinlets, slightly weathered to fresh	Ynl
																	EOH

	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition																			
Depth From (ft)	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
84.0	0	1	3	2	6	12	15			cly			JBC	5.7	15.5	6.8	12.0	15	**55**	**55**
89.0	0	4	3	2	6	15	15			cc			JBC	5.7	15.5	7.2	15.0	15	**58**	**58**
94.0	0	1	3	2	6	12	15			cly			JBC	5.7	14.4	6.3	12.0	15	**53**	**53**

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-181

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	17.5	5.33	17.50		0										Pale brown, sand, some silt, and trace organics. Logged in sump	OB													GIM							
17.5	5.33	22.00	6.71	4.50		0							Orange to brown	Coarse grained		Highly weathered bedrock	YnIII													JBC							
22.0	6.71	24.00	7.31	2.00	0.61	100	0.35	57	10	55	10	R2	Light grey to grey	Fine to coarse grained, inequigranular	Porphyrthic	Weak, some intact core pieces, easily crumbled by hand	YnIII	0	0	3	0	1	4	15			FeO	cly		JBC	2.0	11.3	5.8	4.0	15	38	38
24.0	7.31	29.00	8.84	5.00	1.38	91	0.25	16	22	60	5	R2	Light to orangey grey	Fine to coarse grained, inequigranular	Porphyrthic	Weak, highly oxidized	YnIII	0	0	3	0	3	6	15			FeO	cly		JBC	1.5	4.9	5.8	6.0	15	33	33
29.0	8.84	34.00	10.36	5.00	1.25	82	0.78	51	10	114	20	R2	Light to orangey grey	Fine to coarse grained, inequigranular	Porphyrthic	Weak, highly oxidized	YnIII	0	1	3	2	3	9	15			FeO	cly		JBC	3.0	10.2	6.5	9.0	15	44	44
34.0	10.36	39.00	11.89	5.00	1.42	93	1.05	69	20	68	20	R2	Grey to pale grey	Fine to medium grained, inequigranular	Porphyrthic, chert phenocrysts?up to 2 mm diameter	Highly weathered zone (~20 cm thick) at 37 ft, easily crumbled and weak	YnIII	0	1	3	2	3	9	15			FeO	cly		JBC	3.0	13.5	5.9	9.0	15	46	46
39.0	11.89	44.00	13.41	5.00	1.52	100	1.37	90	7	190	40	R3	Grey to pale grey	Fine to medium grained, inequigranular	Porphyrthic, chert phenocrysts?up to 2 mm diameter	Highly weathered section (~5 cm thick) at 40 ft.	YnIII	0	1	3	2	3	9	15			FeO	rub		JBC	4.8	17.9	7.5	9.0	15	54	54
44.0	13.41	49.00	14.93	5.00	1.10	72	0.12	8	Max	5	10	R2	Grey to light grey	Fine grained, equigranular	Highly fractured	Low recovery, weak, rubbly and highly oxidized	YnIII	0	0	3	0	3	6	15			rub	cly		JBC	2.0	3.9	5.0	6.0	15	32	32
49.0	14.93	54.00	16.46	5.00	1.52	100	0.87	57	9	152	50	R4	Grey to medium grey	Fine grained, equigranular	Bedded, 75 to 85 degree TCA	Shale, strong to medium strong, calcite veinlets, slightly to moderately weathered, iron oxide and calcite infilling	YnI	0	1	3	2	3	9	15			FeO	cc		JBC	5.7	11.3	7.0	9.0	15	48	48
54.0	16.46	59.00	17.98	5.00	1.52	100	0.30	20	15	95	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, 75 to 85 degree TCA	Shale, subvertical calcite veins, iron oxide and calcite infilling	YnI	0	1	3	2	3	9	15			cc	FeO		JBC	4.8	5.4	6.3	9.0	15	40	40
59.0	17.98	64.00	19.51	5.00	1.52	100	1.25	82	8	169	50	R4	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal	Shale, medium strong, chaotic calcite veinlets, slightly weathered to fresh, iron oxide and calcite infilling	YnI	0	1	3	2	5	11	15			FeO	cc		JBC	5.7	16.2	7.2	11.0	15	55	55
64.0	19.51	69.00	21.03	5.00	1.50	98	0.60	39	18	79	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal	Shale, medium strong, chaotic calcite veinlets, slightly weathered to fresh, iron oxide and calcite infilling	YnI	0	1	3	2	5	11	15			cc	FeO		JBC	4.8	8.2	6.1	11.0	15	45	45
69.0	21.03	74.00	22.55	5.00	1.52	100	1.23	81	7	190	50	R4	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 2-3 firms blows with hammer to fracture. Calcite veins 1-2 mm thick every 5-10 cm, calcite veinlets sporadically throughout.	YnI	0	1	3	2	6	12	15			cc			GIM	5.7	15.9	7.5	12.0	15	56	56
74.0	22.55	79.00	24.08	5.00	1.34	88	1.20	79	5	223	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 1-2 firms blows with hammer to fracture. Calcite veins 1-2 mm thick every 5-10 cm, calcite veinlets sporadically throughout.	YnI	0	1	3	2	5	11	15			cc	FeO		GIM	4.8	15.5	7.9	11.0	15	54	54
79.0	24.08	83.70	25.51	4.70	1.43	100	1.42	99	5	238	50	R4	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 2-3 firms blows with hammer to fracture. Irregular, discontinuous, calcite veinlets sporadically throughout.	YnI	0	1	1	2	6	10	15			cc			GIM	5.7	20.0	8.0	10.0	15	59	59
83.7	25.51	88.60	27.00	4.90	1.50	100	1.13	76	6	214	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 1-2 firms blows with hammer to fracture. Irregular, discontinuous, calcite veinlets sporadically throughout.	YnI	0	1	1	2	6	10	15			cc			GIM	4.8	14.8	7.8	10.0	15	52	52
88.60	27.00	93.70	28.56	5.10	1.55	100	1.55	100	1	775	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 1-2 firms blows with hammer to fracture. Irregular, discontinuous, calcite veinlets sporadically throughout.	YnI	0	4	1	6	6	17	15						GIM	4.8	20.1	13.1	17.0	15	70	70
93.7	28.56	98.80	30.11	5.10	1.54	99	1.49	96	4	308	40	R3	Grey to medium grey	Fine grained, equigranular	Bedded, horizontal to sub-horizontal, 1-10 mm beds.	Shale, 1-2 firms blows with hammer to fracture. Irregular, discontinuous, calcite veinlets sporadically throughout. 5 mm thick calcite veins spaced 0.7 m apart throughout run.	YnI	0	1	1	2	6	10	15			cc			GIM	4.8	19.2	8.8	10.0	15	58	58

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-182

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Joint Condition Apert- A	Joint Condition Rough R	Joint Condition Infill I	Joint Condition Weath W	Joint Condition TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger g.)	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	0.8	0.23	0.75		0											OB																				
0.0	0.00	4.00	1.22	4.00	1.20	98	0.20	16	12	92	120	R5	Grey	Inequigranular. Medium grained grey matrix with 1-2 mm white phenocrysts.	Massive	Granodiorite, trace amount of fine grained pyroxene. White phenocrysts make up ~20-30% of rock mass. Matrix is medium grained.	IG	0	1	4	2	3	10	15			soil				10.6	4.9	6.2	10.0	15	47	47
4.0	1.22	9.00	2.74	5.00	1.55	102	0.78	51	15	97	120	R5	Grey	Inequigranular. Medium grained grey matrix with 1-2 mm white phenocrysts.	Massive	Granodiorite, trace amount of fine grained pyroxene. White phenocrysts make up ~20-30% of rock mass. Matrix is medium grained. Some soil is present within fractures.	IG	0	1	3	2	5	11	15			soil				10.6	10.2	6.3	11.0	15	53	53
9.0	2.74	14.00	4.27	5.00	1.42	93	0.98	64	10	129	120	R5	Grey	Inequigranular. Medium grained grey matrix with 1-2 mm white phenocrysts.	Massive	Granodiorite, trace amount of fine grained pyroxene. White phenocrysts make up ~20-30% of rock mass. Matrix is medium grained. Calcite fracture filling and hematite coating on some fractures.	IG	0	1	3	4	5	13	15			Hem	cc			10.6	12.6	6.7	13.0	15	58	58
14.0	4.27	18.70	5.70	4.70	1.46	102	1.13	79	8	162	120	R5	Grey	Inequigranular. Medium grained grey matrix with 1-2 mm white phenocrysts.	Massive	Granodiorite, trace amount of fine grained pyroxene. White phenocrysts make up ~20-30% of rock mass. Matrix is medium grained. Calcite fracture filling on some fractures.	IG	0	1	3	2	5	11	15			cc				10.6	15.5	7.1	11.0	15	59	59
18.7	5.70	23.90	7.28	5.20	1.52	96	0.96	61	6	217	120	R5	Grey	Inequigranular. Medium grained grey matrix with 1-2 mm white phenocrysts.	Massive	Granodiorite, trace amount of fine grained pyroxene. White phenocrysts make up ~20-30% of rock mass. Matrix is medium grained. Hematite staining on some fractures. Low RQD due to high angled joints in run.	IG	0	1	3	4	5	13	15			Hem				10.6	11.9	7.8	13.0	15	58	58
23.9	7.28	30.20	9.20	6.30	1.90	99	1.80	94	7	238	100	R5	Grey to light grey	Medium grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	1	3	2	6	12	15			cc	hem		JBC	9.4	18.8	8.0	12.0	15	63	63
30.2	9.20	34.00	10.36	3.80	1.15	99	0.99	85	8	128	100	R5	Grey to light grey	Medium grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	4	3	2	6	15	15			cc	hem		JBC	9.4	16.9	6.7	15.0	15	63	63
34.0	10.36	37.00	11.28	3.00	0.90	98	0.54	59	8	100	100	R5	Grey to light grey	Medium grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	4	3	2	5	14	15			cc	hem		JBC	9.4	11.6	6.3	14.0	15	56	56
37.0	11.28	44.00	13.41	7.00	2.13	100	1.70	80	12	164	100	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	1	3	2	5	11	15			cc	hem		JBC	9.4	15.7	7.1	11.0	15	58	58
44.0	13.41	49.00	14.93	5.00	1.52	100	1.24	81	10	138	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	4	3	2	6	15	15			cc	hem		JBC	10.9	16.0	6.8	15.0	15	64	64
49.0	14.93	54.00	16.46	5.00	1.45	95	1.22	80	6	207	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface discoloration possible hematite?	IG	0	4	3	2	6	15	15			cc	hem		JBC	10.9	15.8	7.7	15.0	15	64	64
54.0	16.46	59.00	17.98	5.00	1.49	98	1.49	98	4	298	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface staining, calcite veinlets up to 1 mm thick,	IG	0	4	3	2	6	15	15			cc	hem		JBC	10.9	19.7	8.7	15.0	15	69	69
59.0	17.98	64.00	19.51	5.00	1.52	100	1.52	100	5	253	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface staining, calcite veinlets up to 1 mm thick,	IG	0	4	3	2	6	15	15			cc	hem		JBC	10.9	20.1	8.2	15.0	15	69	69

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DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
64.0	19.51	69.00	21.03	5.00	1.52	100	1.32	87	6	217	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface staining, calcite veinlets up to 1 mm thick,	IG
69.0	21.03	74.00	22.55	5.00	1.52	100	1.19	78	11	127	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slightly weathered to fresh, joint filled with calcite, joint surface staining, calcite veinlets up to 1 mm thick,	IG
74.00	22.55	79.00	24.08	5.00	1.52	100	1.35	89	5	253	125	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slighly weathered to fresh, calcite infilling and veinlets, competent	IG
79.0	24.08	84.00	25.60	5.00	1.50	98	1.18	77	13	107	100	R5	Grey to light grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, strong, slighly weathered to fresh, calcite infilling and veinlets, slight discoloration on joint surfaces	IG
84.0	25.60	89.00	27.13	5.00	1.55	102	1.07	70	9	155	120	R5	Grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, some (~10%)medium grained pyroxene, 25-35% 1-2 mm white phenocrysts. Some hematite staining on fractures.	IG
89.0	27.13	94.00	28.65	5.00	1.45	95	1.26	83	4	290	120	R5	Grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, some (~10%)medium grained pyroxene, 25-35% 1-2 mm white phenocrysts.	IG
94.0	28.65	99.00	30.17	5.00	1.55	102	1.51	99	3	388	120	R5	Grey	Medium grained, to coarse grained, inequigranular, porphyritic	Massive	Granodiorite, some (~10%)medium grained pyroxene, 25-35% 1-2 mm white phenocrysts. <1 mm calcite veins/fracture coating present.	IG
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	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition																			
Depth From (ft)	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
64.0	0	4	3	2	6	15	15			cc			JBC	10.9	17.2	7.8	15.0	15	**66**	**66**
69.0	0	4	3	2	6	15	15			cc			JBC	10.9	15.3	6.7	15.0	15	**63**	**63**
74.00	0	4	3	2	6	15	15			cc			JBC	10.9	17.6	8.2	15.0	15	**67**	**67**
79.0	0	4	3	2	5	14	15			cc	hem		JBC	9.4	15.2	6.4	14.0	15	**60**	**60**
84.0	0	4	3	6	5	18	15			hem			GIM	10.6	13.7	7.0	18.0	15	**64**	**64**
89.0	0	4	3	6	6	19	15						GIM	10.6	16.3	8.6	19.0	15	**70**	**70**
94.0	0	4	3	2	6	15	15						GIM	10.6	20.0	9.7	15.0	15	**70**	**70**

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-183

DRILL RUN DATA / GEOLOGY - COMMENTS

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	2.0	0.61	2.00		0										Topsoil. Brown, silty fine sand with some organics. Poorly graded, non-plastic.	OB
2.0	0.61	4.00	1.22	2.00	0.40	66	0.00	0	max	5	0.5	R0	Orange Brown	Inequigranular, medium grained	Massive	Extremely weathered granodiorite. Friable.	IG
4.0	1.22	8.80	2.68	4.80	1.40	96	0.00	0	max	5	1	R1	Brownish grey	Inequigranular, medium grained	Massive	Weathered granodiorite, slightly stronger than previous run, but can be pulled apart with some effort or peeled easily.	IG
8.8	2.68	13.90	4.24	5.10	1.46	94	0.56	36	6	209	5	R2	Brownish grey	Inequigranular, medium grained	Massive	Weathered granodiorite, slightly stronger than previous run, but can be peeled easily with knife. Extremely weathered joint at 0.5 m.	IG
13.9	4.24	19.00	5.79	5.10	1.56	100	0.55	35	9	156	10	R2	Grey	Inequigranular, medium grained	Massive	Weathered granodiorite, slightly stronger than previous run, but can be peeled with difficulty with knife. Extremely weathered joint at 0.7 m.	IG
19.0	5.79	24.00	7.31	5.00	1.53	100	0.00	0	11	128	5	R2	Brownish grey	Inequigranular, medium grained	Massive	Weathered granodiorite, 25-35% white phenocrysts, can be peeled with slight difficulty with knife. Weathering of rock is more intense around joints.	IG
24.0	7.31	29.00	8.84	5.00	1.52	100	0.70	46	9	152	7	R2	Brownish grey	Inequigranular, medium grained	Massive	Weathered granodiorite, 25-35% white phenocrysts, can be peeled with slight difficulty with knife. Weathering of rock is more intense around joints.	IG
29.0	8.84	32.10	9.78	3.10	0.90	95	0.20	21	4	180	1	R1	Orange/Umber	Inequigranular, medium grained	Massive	Upper 0.45 m is weathered granodiorite, as described above. Lower 0.45 m is extremely weathered/clayey, with relic texture remaining. Very friable.	IG
32.1	9.78	36.70	11.19	4.60	1.40	100	1.20	86	5	233	10	R2	Brownish orange	Inequigranular, medium grained	Massive	Weathered granodiorite, 25-35% white phenocrysts, can be peeled with difficulty with knife, with some localized weakened zones near fractures. Weathering of rock is more intense around joints.	IG
36.7	11.19	39.00	11.89	2.30	0.77	100	0.46	66	3	193	15	R2	Brownish orange	Inequigranular, medium grained	Massive	Weathered granodiorite, 25-35% white phenocrysts, can be dented with firm blow from hammer point, with some localized weakened zones near fractures. Weathering of rock is more intense around joints.	IG
39.0	11.89	43.40	13.23	4.40	1.23	92	0.10	7	max	5	1	R1	Brownish orange	Inequigranular, medium grained	Massive	Weathered granodiorite, 25-35% white phenocrysts. Upper 0.5 m can be scraped or penetrated with a knife. The rest of the run is completely weathered.	IG
43.4	13.23	48.60	14.81	5.20	1.51	95	0.64	40	8	168	5	R2	Brownish orange	Inequigranular, medium grained	Massive	Upper 1.04 m is weathered granodiorite, brownish orange and easily scraped with a knife. The rest of the run is moderately weathered granodiorite, greenish grey. 1-5 mm calcite veins are present throughout the run.	IG
48.6	14.81	53.70	16.37	5.10	1.56	100	0.30	19	max	5	1	R1	Brownish orange	Inequigranular, medium grained	Massive	Upper 0.3 m is moderately weathered)as described above). From 0.3 to 1.3 m the run is strongly weathered (can be easily scraped with knife. The lower 0.2 m is completely weathered to residual soil.	IG

DISCONTINUITY DATA - RATING SYSTEMS / ADDITIONAL DISCONTUITY DATA / RMR CALCULATIONS

Depth From (ft)	Joint Condition Persis- P	Joint Condition Apert- A	Joint Condition Rough R	Joint Condition Infill I	Joint Condition Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0													GIM							
2.0	0	0	0	0	0	0	15						GIM	1.1	3.0	5.0	0.0	15	24	24
4.0	0	0	0	0	1	1	15						GIM	1.1	3.0	5.0	1.0	15	25	25
8.8	0	1	4	2	1	8	15			FeO			GIM	1.5	7.7	7.7	8.0	15	40	40
13.9	0	1	3	2	2	8	15			FeO			GIM	2.0	7.6	7.0	8.0	15	40	40
19.0	0	1	3	2	2	8	15			FeO			GIM	1.5	3.0	6.7	8.0	15	34	34
24.0	0	1	1	2	1	5	15			FeO			GIM	1.7	9.3	7.0	5.0	15	38	38
29.0	0	0	0	0	0	0	15			FeO			GIM	1.1	5.6	7.3	0.0	15	29	29
32.1	0	4	3	2	1	10	15			FeO	cly		GIM	2.0	16.9	8.0	10.0	15	52	52
36.7	0	1	1	2	1	5	15			FeO	cly		GIM	2.5	12.8	7.5	5.0	15	43	43
39.0	0	0	0	0	0	0	15			FeO	cly		GIM	1.1	3.8	5.0	0.0	15	25	25
43.4	0	0	3	0	1	4	15			cc	FeO		GIM	1.5	8.4	7.2	4.0	15	36	36
48.6	0	0	3	0	1	4	15			cc	cly		GIM	1.1	5.3	5.0	4.0	15	30	30

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS							
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
53.7	16.37	58.80	17.92	5.10	1.53	98	0.95	61	8	170	10	R2	Brownish orange	Inequigranular, medium grained	Massive	10-20 cm interlayered sequences of moderately to strongly weathered granodiorite.	IG	0	1	3	2	3	9	15			cly	FeO		GIM	2.0	12.0	7.2	9.0	15	45	45
58.8	17.92	64.00	19.51	5.20	1.59	100	1.11	70	10	145	20	R2	Brownish orange, light grey to pale grey	Medium grained, inequigranular, porphyritic	Massive	Medium strong, rock looks altered/weathered - easily scratched, lots of calcite phenocrysts, oxidized joint surfaces, vuggy calcite veins, moderately weathered	IG	0	1	3	2	3	9	15			cc	FeO		JBC	3.0	13.7	6.9	9.0	15	48	48
64.0	19.51	69.00	21.03	5.00	1.52	100	1.24	81	11	127	50	R4	Light grey to pale grey	Medium grained, inequigranular, porphyritic	Massive	Calcite, hornblende and quartz phenocrysts (up to 1 mm), medium strong to strong, calcite infilling, oxidized joint surfaces, slightly to moderately weathered	IG	0	1	3	2	5	11	15			FeO	cc		JBC	5.7	16.0	6.7	11.0	15	54	54
69.0	21.03	74.00	22.55	5.00	1.50	98	0.78	51	16	88	10	R2	Light grey to grey	Fine grained	Bedded	Transition to interbedded shale, subhorizontal bedding, chaotic and sporadic calcite veinlets, weak, slightly weathered	Ynl	0	1	3	2	5	11	15			cc	cly		JBC	2.0	10.2	6.2	11.0	15	44	44
74.0	22.55	79.00	24.08	5.00	1.49	98	0.94	62	10	135	25	R3	Light grey to grey	Fine grained	Bedded	Interbedded shale, subhorizontal beds of grey to light grey (up to 1 cm), medium strong, calcite veinlets	Ynl	0	1	3	2	5	11	15			cc			JBC	3.4	12.1	6.8	11.0	15	48	48
79.0	24.08	85.00	25.91	6.00	1.61	88	0.66	36	max	5	1	R1	Light grey to grey	Fine grained	Bedded	Interbedded shale, subhorizontal beds of grey to light grey (up to 1 cm), medium strong, calcite veinlets. Highly fractured with 10 cm clayey rubble zone at the top of run. Very weak and can be dented with a fingernail.	Ynl	0	0	3	0	3	6	15			cly	rub		JBC	1.1	7.7	5.0	6.0	15	35	35
85.0	25.91	91.00	27.74	6.00	1.85	101	1.01	55	35	51	25	R3	Light grey to grey	Fine grained	Bedded	Interbedded shale, subhorizontal beds of grey to light grey (up to 1 cm), medium strong, calcite veinlets	Ynl	0	1	3	0	5	9	15			cly	cc	py	JBC	3.4	10.9	5.7	9.0	15	44	44
91.0	27.74	94.30	28.74	3.30	1.00	99	0.60	60	20	48	10	R2	Light grey to grey	Fine grained	Bedded	Interbedded shale, subhorizontal beds of grey to light grey (up to 1 cm), medium strong, calcite veinlets. 5 cm zones of clayey rubble present throughout run.	Ynl	0	0	3	0	5	8	15			rub	rub		JBC	2.0	11.7	5.7	8.0	15	42	42
94.3	28.74	99.00	30.17	4.70	1.43	100	1.27	89	8	159	50	R4	Light grey to grey	Fine grained	Bedded	Interbedded shale, subhorizontal beds of grey to light grey (up to 1 cm), strong, calcite veinlets.	Ynl	0	4	1	2	6	13	15			py	cc		JBC	5.7	17.6	7.1	13.0	15	58	58
EOH																																					

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-184

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	14.0	4.27	14.00		0										Dark to light brown sandy silt and clay	OB													GIM							
14.0	4.27	15.00	4.57	1.00		0										Weathered shale, oxidized, easily dented by fingernail, logged from SPT sample #3	Ynl						0	15						JBC							
15.0	4.57	19.00	5.79	4.00	1.10	90	0.00	0	Max	5	1	R1	Grey to black	Fine grained	Chaotic and microfractured	Shale, highly fractured and oxidized, very weak, moderately weathered to heavily weathered, easily crumbled	Ynl	0	0	1	0	1	2	15			hem	rub	cly	JBC	1.1	3.0	5.0	2.0	15	26	26
19.0	5.79	24.00	7.31	5.00	1.42	93	1.07	70	15	89	10	R2	Grey to light grey	Fine grained	Chaotic and microfractured	Shale, weak, moderately weathered	Ynl	0	0	3	0	3	6	15			cly	rub		JBC	2.0	13.7	6.2	6.0	15	43	43
24.0	7.31	29.00	8.84	5.00	1.50	98	0.20	13	Max	5	5	R2	Grey to light grey	Fine grained	Chaotic and microfractured	Shale, weak, moderately weathered, sections (5 to 10 cm thick) of highly fractured rubble, oxidized joint surfaces	Ynl	0	0	3	0	3	6	15			rub	cly		JBC	1.5	4.5	5.0	6.0	15	32	32
29.0	8.84	34.00	10.36	5.00	1.52	100	0.60	39	Max	5	5	R2	Grey to light grey	Fine grained	Chaotic and microfractured	Shale, sections fo competent and rubble/clay (up to 5 cm thick)	Ynl	0	0	3	0	3	6	15			rub	cly		JBC	1.5	8.2	5.0	6.0	15	36	36
34.0	10.36	39.00	11.89	5.00	1.50	98	0.62	41	30	48	5	R2	Grey to black	Fine grained	Microfractured, bedded, sub-horizontal	Shale, highly fractured sections (up to 5 cm thick) filled with rubble and clay, moderately weathered, oxidized joint surfaces	Ynl	0	0	3	0	3	6	15			rub	cly		JBC	1.5	8.5	5.7	6.0	15	37	37
39.0	11.89	44.00	13.41	5.00	1.54	101	0.90	59	15	96	15	R2	Grey to black	Fine grained	Microfractured, bedded, sub-horizontal	Shale, highly fractured sections (up to 2 cm thick) filled with rubble and clay, moderately weathered, oxidized joint surfaces	Ynl	0	0	3	0	3	6	15			rub	cly		JBC	2.5	11.6	6.3	6.0	15	41	41
44.0	13.41	49.00	14.93	5.00	1.52	100	1.35	89	9	152	50	R4	Grey to black	Fine grained	Bedded, sub-horizontal	Shale, mostly intact with a 10 cm rubble zone at 46 ft	Ynl	0	0	3	0	5	8	15			rub			JBC	5.7	17.6	7.0	8.0	15	53	53
49.0	14.93	55.50	16.92	6.50	1.99	100	0.53	27	Max	5	20	R2	Grey to black	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale, highly fractured and rubble rich throughout, oxidized joint surfaces	Ynl	0	0	3	0	3	6	15			rub	hem		JBC	3.0	6.3	5.0	6.0	15	35	35
55.5	16.92	59.00	17.98	3.50	1.05	98	0.00	0	10	95	35	R3	Medium grey	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale with calcite veinlets spaced ~10 cm apart. 1-2 firm blows with hammer to fracture.	Ynl	0	1	1	2	5	9	15			FeO	cc		GIM	4.4	3.0	6.3	9.0	15	38	38
59.0	17.98	64.00	19.51	5.00	1.52	100	0.18	12	13	109	40	R3	Medium grey	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale with calcite veinlets spaced ~10 cm apart. 2-3 firm blows with hammer to fracture. 6 cm thick strongly weathered joint (clayey infilling) at 0.3 m.	Ynl	0	1	1	2	5	9	15			FeO	cc		GIM	4.8	4.4	6.5	9.0	15	40	40
64.0	19.51	68.50	20.88	4.50	1.30	95	0.20	15	12	100	40	R3	Medium grey	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale with calcite veinlets spaced ~10 cm apart. 2-3 firm blows with hammer to fracture. 4 mm thixk calcite vein near lower 15 cm of run.	Ynl	0	1	1	2	5	9	15			cc	FeO		GIM	4.8	4.7	6.3	9.0	15	40	40
68.5	20.88	73.60	22.43	5.10	1.60	100	0.42	27	11	133	75	R4	Medium grey	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale. From 0.5 m to end of run the rock is strongly fractured and re-sealed with quartz and calcite. 2-3 cm thick gouge filled shear zones are at 0.6 m and 1.06 m.	Ynl	0	0	3	0	5	8	15			gg	FeO	cc	GIM	7.7	6.4	6.8	8.0	15	44	44
73.6	22.43	78.80	24.02	5.20	1.50	95	0.95	60	8	167	100	R5	Light to medium grey	Fine grained	Mottled and fractured	Upper 0.5 m is shale, as described above. From 0.6 to 0.6 is a rubbly gouge zone of angualr fractured rock and clay. From 0.6 to 1.1 the shale transitions to a conglomerate or breccia, with 1-4 cm rounded light grey clasts in a fine grained medium gray matrix.	Ynl	0	0	3	0	5	8	15			gg	FeO	cc	GIM	9.4	11.8	7.2	8.0	15	51	51
78.8	24.02	83.80	25.54	5.00	1.52	100	1.00	66	6	217	70	R4	Light to medium grey	Fine grained	Conglomerate	Upper o.4 m is a fractured and reselaed shale/conglomerate, terminating in a 3 cm rubble zone at 0.4 m (FeO staining on fracture). The next 30 cm of the run is light grey, fine grained with up to 10 cm rounded clasts. The rest f the run is light grey, massive textured with no visible clasts.	Ynl	0	1	1	6	6	14	15			rub			GIM	7.3	12.8	7.8	14.0	15	57	57

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DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
83.80	25.54	88.50	26.97	4.70	1.52	100	0.99	69	8	169	70	R4	Medium grey	Fine grained	Bedded, sub-horizontal (70 to 80 ° TCA)	Shale, calcite stringers/veinlets throughout run. A 6 cm rubble zone is at 0.7 m.	Ynl
88.5	26.97	93.50	28.50	5.00	1.55	102	1.25	82	8	172	50	R4	Light to medium grey	Fine grained	Conglomerate	Upper 0.4 m and lower 0.3 m are shale (medium grey, sub-horizontal bedding with cc veinlets). From 0.4 to 1.2 m is conglomerate (light grey, with 5-20 cm clasts, fine grained matrix)	Ynl
93.5	28.50	98.50	30.02	5.00	1.50	98	1.35	89	9	150	50	R4	Light to medium grey	Fine grained	Conglomerate	Veinlets throughout	Ynl
EOH																	

	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition																			
Depth From (ft)	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
83.80	0	4	3	6	6	19	15						GIM	7.3	13.5	7.2	19.0	15	**62**	**62**
88.5	0	4	1	6	6	17	15						GIM	5.7	16.2	7.2	17.0	15	**61**	**61**
93.5	0	4	1	4	5	14	15			FeO			GIM	5.7	17.6	7.0	14.0	15	**59**	**59**

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-185

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Joint Condition Apert- A	Joint Condition Rough R	Joint Condition Infill I	Joint Condition Weath W	Joint Condition TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.0	0.30	1.00												Topsoil. Brown silty sand with some organics, non-plastic, dry, poorly graded.	OB													GIM							
1.0	0.30	3.50	1.07	2.50	0.34	45	0.00	0	max	5	1	R1	Grey	Fine grained.	Fractured.	Upper 12 cm of run is topsoil. The rest of the run is strongly weathered shale, decomposed with fragments of intact rock.	Ynl	0	0	0	0	1	1	15						GIM	1.1	3.0	5.0	1.0	15	25	25
3.5	1.07	5.60	1.71	2.10	0.60	94	0.00	0	max	5	10	R2	Medium grey	Fine grained.	Fractured.	Shale, upper 0.4 m is rubbly and fractured, rest of run is cored but strongly fractured. Fines and clyaye material likely washed out during drilling.	Ynl	0	0	3	0	3	6	15			cly	FeO		GIM	2.0	3.0	5.0	6.0	15	31	31
5.6	1.71	9.00	2.74	3.40	1.05	101	0.00	0	max	5	10	R2	Medium grey	Fine grained.	Fractured.	Shale, extremely fractured with rubble and clay fracture infilling, up to 5-6 cm thick.	Ynl	0	0	3	0	3	6	15			cly	Rub		GIM	2.0	3.0	5.0	6.0	15	31	31
9.0	2.74	14.00	4.27	5.00	1.20	79	0.00	0	max	5	10	R2	Medium grey	Fine grained.	Fractured.	Shale, extremely fractured with rubble and clay fracture infilling, up to 5-6 cm thick.	Ynl	0	0	3	0	3	6	15			Rub	cly		GIM	2.0	3.0	5.0	6.0	15	31	31
14.0	4.27	19.00	5.79	5.00	1.52	100	1.08	71	9	152	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm white phenocrysts, trace fine grained biotite	IG	0	4	3	4	5	16	15			FeO			GIM	10.6	13.9	7.0	16.0	15	63	63
19.0	5.79	24.00	7.31	5.00	1.35	89	0.60	39	10	123	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm white phenocrysts, trace fine grained biotite	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	8.2	6.6	14.0	15	55	55
24.0	7.31	29.00	8.84	5.00	1.55	102	1.07	70	8	172	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm white phenocrysts, trace fine grained biotite	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	13.7	7.2	14.0	15	61	61
29.0	8.84	34.00	10.36	5.00	1.52	100	0.69	45	6	217	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm white phenocrysts, trace fine grained biotite. One low angle (20-30° TCA) running through run.	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	9.2	7.8	14.0	15	57	57
34.0	10.36	39.00	11.89	5.00	1.52	100	1.34	88	6	217	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics.	IG	0	4	3	6	6	19	15			FeO			GIM	10.6	17.5	7.8	19.0	15	70	70
39.0	11.89	44.00	13.41	5.00	1.48	97	1.28	84	4	296	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics.	IG	0	4	4	2	6	16	15			cc			GIM	10.6	16.6	8.7	16.0	15	67	67
44.0	13.41	49.00	14.93	5.00	1.52	100	0.75	49	2	507	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics. Low-angle (20-25° TCA) joint running through core from 0-0.7 m.	IG	0	4	4	2	6	16	15			cc			GIM	10.6	9.9	10.8	16.0	15	62	62
49.0	14.93	54.00	16.46	5.00	1.52	100	1.52	100	4	304	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics.	IG	0	4	3	2	6	15	15			cc			GIM	10.6	20.1	8.8	15.0	15	70	70
54.0	16.46	59.00	17.98	5.00	1.48	97	1.18	77	5	247	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics.	IG	0	4	3	2	6	15	15			cc			GIM	10.6	15.2	8.1	15.0	15	64	64
59.0	17.98	64.00	19.51	5.00	1.48	97	1.48	97	3	370	120	R5	Light grey	Medium grained, mottled, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics.	IG	0	4	3	2	6	15	15			cc			GIM	10.6	19.5	9.5	15.0	15	70	70
64.0	19.51	69.00	21.03	5.00	1.49	98	1.38	91	5	248	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, trace calcite on discontinuites	IG	0	4	3	6	6	19	15				cc		JBC	12.2	18.0	8.1	19.0	15	72	72
69.00	21.03	74.00	22.55	5.00	1.52	100	1.52	100	4	304	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, trace calcite on discontinuites, hard calcite vein (up to 1 mm) at 71 ft.	IG	0	4	3	4	6	17	15			cc			JBC	12.2	20.1	8.8	17.0	15	73	73

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS							
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
74.0	22.55	79.00	24.08	5.00	1.52	100	1.52	100	3	380	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, competent, joints filled with calcite and a slimy green mineral (posibble olivine?)	IG	0	4	3	2	6	15	15			cc		oliv	JBC	12.2	20.1	9.6	15.0	15	**72**	**72**
79.0	24.08	84.00	25.60	5.00	1.48	97	1.48	97	5	247	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, competent	IG	0	4	3	6	6	19	15						JBC	12.2	19.5	8.1	19.0	15	**74**	**74**
84.0	25.60	89.00	27.13	5.00	1.48	97	1.38	91	5	247	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, competent, surface staining	IG	0	4	3	2	5	14	15			cc	hem		JBC	12.2	18.0	8.1	14.0	15	**67**	**67**
89.0	27.13	94.00	28.65	5.00	1.52	100	1.42	93	5	253	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, competent, surface staining	IG	0	4	3	2	5	14	15			cc	hem		JBC	12.2	18.6	8.2	14.0	15	**68**	**68**
94.0	28.65	99.00	30.17	5.00	1.48	97	1.46	96	6	211	150	R5	Grey to light grey	Medium grained, porphyritic, inequigranular	Massive	Granodiorite, 25-35% 1-2 mm white phenocrysts, trace fine grained biotite and medium grained mafics, very strong, competent, surface staining	IG	0	4	3	2	5	14	15			cc	hem		JBC	12.2	19.2	7.7	14.0	15	**68**	**68**

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-186

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS							
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.0	0.30	1.00		0											OB													GIM							
0.0	0.00	4.00	1.22	4.00	1.07	88	0.52	43	11	89	10	R2	Medium Grey	Fine grained, equigranular.	Bedded	Shale, strongly weathered, 20 cm rubbly clayey zones at top and bottom of run.	Ynl	0	0	3	0	1	4	15			cly	FeO		GIM	2.0	8.8	6.2	4.0	15	36	36
4.0	1.22	9.00	2.74	5.00	1.40	92	0.00	0	15	88	10	R2	Medium Grey	Fine grained, equigranular.	Bedded	Shale, strongly weathered, heavy oxidation with some clay infilling on fractures. Rubbly at top and botom 10 cm.	Ynl	0	4	3	2	1	10	15			FeO	cly		GIM	2.0	3.0	6.2	10.0	15	36	36
9.0	2.74	14.00	4.27	5.00	1.00	66	0.00	0	max	5	3	R1	Pale Green/Brown	Medium grained, inequigranular	Massive	0-20 cm - Strongly weathered shale. 20-30 cm - Strongly weathered and oxidized transition zone, very soft. 30-60 cm - Completely weathered granodiorite, very soft, original texture intact. 60-150 cm - Strongly weathered granodiorite, easily fractured with point of hammer.	IG	0	0	3	0	0	3	15			FeO	cly		GIM	1.3	3.0	5.0	3.0	15	27	27
14.0	4.27	19.00	5.79	5.00	1.55	102	1.13	74	8	172	90	R4	Light Greenish Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained.	IG	0	4	3	2	3	12	15			cc	FeO		GIM	8.7	14.5	7.2	12.0	15	58	58
19.0	5.79	24.00	7.31	5.00	1.52	100	0.84	55	8	169	90	R4	Light Greenish Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained.	IG	0	4	3	2	3	12	15			FeO	cc		GIM	8.7	10.9	7.2	12.0	15	54	54
24.0	7.31	29.00	8.84	5.00	1.57	100	1.18	77	5	262	90	R4	Light Greenish Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained. Rubbly joint at 0.4 cm ~1 cm thick.	IG	0	4	3	2	3	12	15			cc	FeO		GIM	8.7	15.2	8.3	12.0	15	59	59
29.0	8.84	34.00	10.36	5.00		0		0	11	0	90	R4	Light Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained.	IG	0	4	3	2	3	12	15			FeO	cc		GIM	8.7	3.0	5.0	12.0	15	44	44
34.0	10.36	35.80	10.91	1.80	0.40	73	0.00	0	max	5	90	R4	Light Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained. Lower 0.2 m is completely crushed.	IG	0	4	3	2	5	14	15			FeO	cc		GIM	8.7	3.0	5.0	14.0	15	46	46
35.8	10.91	39.00	11.89	3.20	0.90	92	0.90	92	1	450	90	R4	Light Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. Caclite veinlets present intermitantly. Phenocrysts are FeO stained.	IG	0	1	5	4	5	15	15			FeO			GIM	8.7	18.4	10.3	15.0	15	67	67
39.0	11.89	44.00	13.41	5.00	1.50	98	1.37	90	4	300	120	R5	Light Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. 1-2 mm thick caclite veins and veinlets present intermitantly. Phenocrysts and calcite veins are FeO stained.	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	17.9	8.7	14.0	15	66	66
44.0	13.41	49.00	14.93	5.00	1.50	98	0.89	58	10	136	120	R5	Light Grey	Medium grained, inequigranular	Massive	Granodiorite, 20-30% 1-2 mm phenocrysts. 1-2 mm thick caclite veins and veinlets present intermitantly. Upper 0.5 m of run is fractured with rubbly joints. Lower 0.1 m of run is crushed/weak rock (transition zone).	IG	0	1	3	2	5	11	15			Rub	cc		GIM	10.6	11.5	6.8	11.0	15	55	55
49.0	14.93	54.00	16.46	5.00	1.55	102	0.00	0	28	53	40	R3	Medium Grey	Fine grained, equigranular.	Bedded, sub-horizontal (70-80°TCA)	Shale, moderately weathered, calcite veinlets throughout run, strongly FeO stained. Lower half of run is altered to a dark to medium tan colour.	Ynl	0	0	3	2	3	8	15			FeO	cc		GIM	4.8	3.0	5.7	8.0	15	37	37
54.0	16.46	59.00	17.98	5.00	1.52	100	0.31	20	22	66	50	R4	Medium Grey	Fine grained, equigranular.	Bedded, sub-horizontal (70-80°TCA)	Shale, FeO staining on fractures, but not staining calcite veins as with previous run. Rubbly zones at 0.8 and 1.3 m	Ynl	0	4	3	2	5	14	15			cc	FeO		GIM	5.7	5.5	5.9	14.0	15	46	46

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
59.0	17.98	64.00	19.51	5.00	1.53	100	1.06	70	9	153	50	R4	Grey to medium grey	Fine grained with some angular clasts	Bedded, sub-horizontal	Conglomerate/shale, some veinlets, medium strong, joints filled with calcite, clay and iron oxide	Ynl	0	4	3	2	5	14	15			cc	FeO		JBC	5.7	13.6	7.0	14.0	15	**55**	**55**
64.0	19.51	69.00	21.03	5.00	1.50	98	1.41	93	3	375	50	R4	Grey to medium grey	Fine grained with some angular clasts	Bedded, sub-horizontal	Conglomerate/shale, some veinlets, medium strong, joints filled with calcite, clay and iron oxide, more intact run	Ynl	0	4	3	2	5	14	15			cc			JBC	5.7	18.5	9.5	14.0	15	**63**	**63**
69.00	21.03	74.00	22.55	5.00	1.48	97	1.21	79	12	114	40	R3	Grey to medium grey	Fine grained with some angular clasts (up to 1 cm)	Bedded, sub-horizontal	Conglomerate/shale, a 5 cm rubble zone near the end of the run at 73 ft	Ynl	0	1	3	0	5	9	15			Rub	FeO		JBC	4.8	15.6	6.5	9.0	15	**51**	**51**
74.0	22.55	79.00	24.08	5.00	1.50	98	1.19	78	10	136	50	R4	Grey to medium grey	Fine grained with some angular clasts (up to 1 cm)	Bedded, sub-horizontal	Conglomerate/shale, some veinlets, medium strong	Ynl	0	4	3	2	5	14	15			cc	FeO		JBC	5.7	15.3	6.8	14.0	15	**57**	**57**
79.0	24.08	84.00	25.60	5.00	1.52	100	1.52	100	3	380	60	R4	Grey	Fine grained	Bedded, sub-horizontal, bands of light and dark grey (2 mm thick)	Shale, calcite veinlets along bedding	Ynl	0	4	3	2	6	15	15			cc			JBC	6.5	20.1	9.6	15.0	15	**66**	**66**
84.0	25.60	89.00	27.13	5.00	1.52	100	1.09	72	7	190	50	R4	Grey	Fine grained	Bedded, sub-horizontal, bands of light and dark grey (2 mm thick)	Shale, medium strong, calcite veinlets, some congromerate sections	Ynl	0	4	3	2	5	14	15			FeO	cc		JBC	5.7	14.0	7.5	14.0	15	**56**	**56**
89.0	27.13	94.00	28.65	5.00	1.52	100	0.90	59	15	95	50	R4	Grey	Fine grained	Bedded, sub-horizontal (75-85°TCA)	Shale, joints along bedding, calcite veinlets (up to a 1 mm thick)	Ynl	0	4	3	2	6	15	15			cly	cc		JBC	5.7	11.6	6.3	15.0	15	**54**	**54**
94.0	28.65	99.00	30.17	5.00	1.52	100	1.43	94	8	169	50	R4	Grey	Fine grained with some angular clasts (up to 1 cm)	Bedded, sub-horizontal (75-85°TCA)	Shale , slight surface staining, subhoriziontal bedding	Ynl	0	4	3	2	5	14	15			FeO	cc		JBC	5.7	18.8	7.2	14.0	15	**61**	**61**
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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-187

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.0	0.30	1.00		0											OB													GIM							
0.0	0.00	4.00	1.22	4.00	1.17	96	0.00	0	12	90	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite	IG	0	1	3	2	5	11	15		FeO	cly			GIM	10.6	3.0	6.2	11.0	15	**46**	**46**
4.0	1.22	9.00	2.74	5.00	1.46	96	0.00	0	20	70	50	R4	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. Zones of weathered, weakened rock throughout run.	IG	0	1	3	2	3	9	15		FeO	cly			GIM	5.7	3.0	5.9	9.0	15	**39**	**39**
9.0	2.74	14.00	4.27	5.00	1.53	100	0.27	18	25	59	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite.	IG	0	1	3	2	5	11	15		FeO	cly			GIM	10.6	5.1	5.8	11.0	15	**48**	**48**
14.0	4.27	16.50	5.03	2.50	0.67	88	0.00	0	9	67	50	R4	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. Lower 10 cm of run is clay.	IG	0	1	3	2	3	9	15		FeO	cly			GIM	5.7	3.0	5.9	9.0	15	**39**	**39**
16.5	5.03	21.00	6.40	4.50	1.17	85	0.19	14	Max	5	1	R1	Orange/brown	fine grained	bedded	Upper 0.7 m is extremely weathered shale with some decomposed zones near top fo run. Lower 0.37 m is slightly weathered granodiorite.	Ynl	0	0	0	0	1	1	15		cly	FeO			GIM	1.1	4.6	5.0	1.0	15	**27**	**27**
21.0	6.40	24.00	7.31	3.00	0.92	100	0.64	70	6	131	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite.	IG	0	4	3	4	5	16	15		FeO				GIM	10.6	13.7	6.7	16.0	15	**62**	**62**
24.0	7.31	29.00	8.84	5.00	1.52	100	1.52	100	3	380	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. ~5% FeO stained plagioclase grains.	IG	0	4	3	4	6	17	15		FeO				GIM	10.6	20.1	9.6	17.0	15	**72**	**72**
29.0	8.84	34.00	10.36	5.00	1.50	98	1.15	75	3	375	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. ~5% FeO stained plagioclase grains.	IG	0	1	3	2	5	11	15		FeO	cly			GIM	10.6	14.8	9.5	11.0	15	**61**	**61**
34.0	10.36	39.00	11.89	5.00	1.52	100	1.30	85	3	380	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. ~5% FeO stained plagioclase grains.	IG	0	1	3	2	5	11	15		FeO	cly			GIM	10.6	16.9	9.6	11.0	15	**63**	**63**
39.0	11.89	44.00	13.41	5.00	1.52	100	1.40	92	4	304	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite.	IG	0	4	3	6	6	19	15						GIM	10.6	18.3	8.8	19.0	15	**72**	**72**
44.0	13.41	49.00	14.93	5.00	1.49	98	1.49	98	3	373	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 25-35% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite.	IG	0	4	3	6	6	19	15						GIM	10.6	19.7	9.5	19.0	15	**74**	**74**
49.0	14.93	54.00	16.46	5.00	1.48	97	1.37	90	4	296	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 20-30% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite. ~5% FeO stained plagioclase grains and on calcite vein filling.	IG	0	4	3	2	5	14	15		cc	FeO			GIM	10.6	17.9	8.7	14.0	15	**66**	**66**
54.0	16.46	58.50	17.83	4.50	1.37	100	1.28	93	6	196	120	R5	Light Grey	Medium grained, inequigranular.	Massive	Granodiorite. 20-30% 1-2 mm white phenocrysts, trace amounts of fine to medium grained biotite.	IG	0	4	3	2	5	14	15		cc	FeO			GIM	10.6	18.7	7.5	14.0	15	**66**	**66**
58.5	17.83	63.70	19.41	5.20	1.45	91	1.23	78	7	181	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal (70-80° TCA)	Shale with trace calcite veinlets. Lower half of run is conglomerate with 1-10 cm clasts.	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	4.8	15.2	7.4	14.0	15	**56**	**56**
63.7	19.41	66.30	20.21	2.60	0.80	100	0.82	100	3	199	40	R3	Medium Grey	Fine grained	Massive	Conglomerate. 1-10 cm light grey clasts.	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	4.8	20.0	7.6	14.0	15	**61**	**61**
66.30	20.21	71.30	21.73	5.00	1.52	100	1.44	94	6	217	40	R3	Medium Grey	Fine grained	Massive	Inter-bedded conglomerate and shale (~30 cm zones throughout run)	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	4.8	18.9	7.8	14.0	15	**61**	**61**

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
71.3	21.73	74.00	22.55	2.70	0.82	100	0.72	87	3	205	40	R3	Medium Grey	Fine grained	Massive	Inter-bedded conglomerate and shale (~30 cm zones throughout run)	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	4.8	17.4	7.6	14.0	15	**59**	**59**
74.0	22.55	79.00	24.08	5.00	1.52	100	1.33	87	5	253	40	R3	Medium Grey	Fine grained	Massive	Conglomerate. 1-4 cm light grey clasts. Irregular calcite veining (<1-1 mm) throughout run.		0	4	5	2	5	16	15		cc	FeO			GIM	4.8	17.3	8.2	16.0	15	**61**	**61**
79.0	24.08	84.00	25.60	5.00	1.52	100	1.30	85	9	152	50	R4	Medium Grey	Fine grained	Massive	Shale with trace calcite veinlets. Upper 0.4 m of run transitions from conglomerate.	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	5.7	16.9	7.0	14.0	15	**59**	**59**
84.0	25.60	89.00	27.13	5.00	1.52	100	1.15	75	11	127	40	R3	Medium Grey	Fine grained	Bedded (40-60°TCA)	Shale with trace calcite veinlets.	Ynl	0	4	3	2	5	14	15		cc	FeO			GIM	4.8	14.8	6.7	14.0	15	**55**	**55**
89.0	27.13	92.10	28.07	3.10	0.95	100	0.70	74	4	189	40	R3	Medium Grey	Fine grained	Bedded (40-60°TCA)	Shale with trace calcite veinlets.	Ynl	0	1	3	2	5	11	15		Rub	cc			GIM	4.8	14.5	7.5	11.0	15	**53**	**53**
92.1	28.07	97.10	29.59	5.00	1.52	100	0.86	56	11	127	40	R3	Medium Grey	Fine grained	Bedded (horizontal)	Conglomerate with ~10% 1-4 cm clasts throughout run.	Ynl	0	1	3	2	5	11	15		FeO	cc			GIM	4.8	11.1	6.7	11.0	15	**49**	**49**
97.1	29.59	99.00	30.17	1.90	0.55	95	0.55	95	1	275	40	R3	Medium Grey	Fine grained	Bedded (horizontal)	Conglomerate with ~10% 1-4 cm clasts throughout run.	Ynl	0	4	3	2	5	14	15		FeO	cc			GIM	4.8	19.0	8.4	14.0	15	**61**	**61**
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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-188

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	0.5	0.15	0.50		0										Topsoil, mainly roots, silt with some clay and sand	OB													JBC							
0.5	0.15	5.00	1.52	4.50	1.37	100	0.10	7	15	86	1	R1	Grey, orangey brown weathering	Medium grained, porphyritic	Massive	Granodiorite, highly weathered lenses (up to 10 cm) of extremely weak material, easily indented by finger	IG	0	0	3	0	1	4	15			FeO	cly		JBC	1.1	3.8	6.2	4.0	15	30	30
5.0	1.52	9.00	2.74	4.00	1.17	96	0.59	48	12	90	10	R2	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, more intact than previous, 2 cm rubbly weak section, oxidized	IG	0	0	3	0	3	6	15			FeO	cly		JBC	2.0	9.7	6.2	6.0	15	39	39
9.0	2.74	14.00	4.27	5.00	1.52	100	0.62	41	18	80	20	R2	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, highly weathered, some sections easily crumbled by finger	IG	0	0	3	0	3	6	15			FeO	cly		JBC	3.0	8.5	6.1	6.0	15	39	39
14.0	4.27	19.00	5.79	5.00	1.49	98	1.38	91	8	166	30	R3	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, medium strong, oxidized joint surfaces	IG	0	1	3	2	3	9	15			FeO	cly		JBC	3.9	18.0	7.2	9.0	15	53	53
19.0	5.79	24.00	7.31	5.00	1.50	98	0.80	52	15	94	10	R2	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, medium strong, highly oxidized, orangey brown weak sections	IG	0	0	3	0	3	6	15			FeO	cly		JBC	2.0	10.4	6.3	6.0	15	40	40
24.0	7.31	29.00	8.84	5.00	1.52	100	1.48	97	6	217	40	R3	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, medium strong, oxidized joint surfaces	IG	0	1	3	2	3	9	15			FeO	cly		JBC	4.8	19.5	7.8	9.0	15	56	56
29.0	8.84	34.00	10.36	5.00	1.52	100	1.31	86	5	253	50	R4	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, 20% phenocrysts (up to 1 mm thickness), sections have been oxidized and weathered	IG	0	1	3	2	3	9	15			FeO	cly		JBC	5.7	17.0	8.2	9.0	15	55	55
34.0	10.36	39.00	11.89	5.00	1.52	100	1.41	93	7	190	75	R4	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, 20% phenocrysts (up to 1 mm thickness), slightly weathered run	IG	0	1	3	2	5	11	15			FeO			JBC	7.7	18.5	7.5	11.0	15	60	60
39.0	11.89	44.00	13.41	5.00	1.52	100	1.08	71	10	138	75	R4	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, 20% phenocrysts (up to 1 mm thickness), some oxidized sections up to 1 cm thick	IG	0	1	3	0	3	7	15			FeO	cly		JBC	7.7	13.9	6.8	7.0	15	50	50
44.0	13.41	49.00	14.93	5.00	1.52	100	1.52	100	4	304	100	R5	Light grey to grey	Medium grained, porphyritic	Massive	Granodiorite, 20% phenocrysts (up to 1 mm thickness), more competent run, slightly weathered to fresh	IG	0	1	3	2	5	11	15			FeO			JBC	9.4	20.1	8.8	11.0	15	64	64
49.0	14.93	54.00	16.46	5.00	1.52	100	1.43	94	4	304	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene)	IG	0	1	3	4	5	13	15			FeO			GIM	10.6	18.8	8.8	13.0	15	66	66
54.0	16.46	59.00	17.98	5.00	1.46	96	1.38	91	5	243	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene)	IG	0	4	3	2	5	14	15			FeO	cc		GIM	10.6	18.0	8.1	14.0	15	66	66
59.0	17.98	64.00	19.51	5.00	1.54	101	1.45	95	5	257	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene)	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	19.1	8.2	14.0	15	67	67
64.0	19.51	69.00	21.03	5.00	1.50	98	1.27	83	5	250	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene)	IG	0	4	3	2	5	14	15			FeO	cc		GIM	10.6	16.5	8.2	14.0	15	64	64
69.0	21.03	74.00	22.55	5.00	1.47	96	1.12	73	8	163	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). FeO staining/halos present around calcite veins and veinlets.	IG	0	1	3	2	5	11	15			FeO	cc		GIM	10.6	14.4	7.1	11.0	15	58	58
74.00	22.55	79.00	24.08	5.00	1.48	97	0.92	60	4	296	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). <1-2 mm calcite veins at low angles every 40-50 cm (~20-30°TCA). Upper 10 cm is strongly oxidized and moderately rubbly.	IG	0	1	3	2	5	11	15			cc	FeO		GIM	10.6	11.9	8.7	11.0	15	57	57
79.0	24.08	84.00	25.60	5.00	1.58	100	1.05	69	7	198	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). <1-2 mm calcite veins at low angles throughout run (~20-30°TCA).	IG	0	1	3	2	5	11	15			cc	FeO		GIM	10.6	13.5	7.6	11.0	15	58	58

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger g.)	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
84.0	25.60	89.00	27.13	5.00	1.56	100	1.48	97	5	260	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). <1-2 mm calcite veins at low angles throughout run (~20-30°TCA).	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	19.5	8.3	14.0	15	**67**	**67**
89.0	27.13	94.00	28.65	5.00	1.52	100	0.95	62	10	138	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). <1-2 mm calcite veins at low angles throughout run (~20-30°TCA).	IG	0	4	3	2	5	14	15			cc	FeO		GIM	10.6	12.2	6.8	14.0	15	**59**	**59**
94.0	28.65	99.00	30.17	5.00	1.55	102	0.80	52	9	155	120	R5	Light grey to grey	Medium grained, inequigranular, porphyritic	Massive	Granodioirte, 20-30% white phenocrysts. Trace amounts of fine to medium grained mafic mineral (biotite/pyroxene). <1-2 mm calcite veins throughout run.	IG	0	4	3	2	5	14	15			cc			GIM	10.6	10.4	7.0	14.0	15	**57**	**57**
EOH																																					

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ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-189

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
0.0	0.00	1.0	0.30	1.00		0										Topsoil	OB													JBC							
1.0	0.30	5.50	1.68	4.50	1.40	102	0.00	0	Max	5	1	R1	Grey, some brownish grey sections	Fine grained	Completely weathered, lenses of weak soil-like material	Shale, mostly rubble, highly oxidized	Ynl	0	0	1	0	1	2	15			Rub	cly		JBC	1.1	3.0	5.0	2.0	15	**26**	**26**
5.5	1.68	9.00	2.74	3.50	1.00	94	0.20	19	15	63	5	R2	Grey	Fine grained	Thinly bedded (1 mm)	Shale, highly fractured, sections (<5 cm) of rubble and oxidized material	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.5	5.3	5.9	6.0	15	**34**	**34**
9.0	2.74	13.30	4.05	4.30	1.30	99	0.33	25	20	62	5	R2	Grey	Fine grained	Thinly bedded (1 mm)	Shale, fractured, sections (<5 cm) of rubble and oxidized material	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.5	6.1	5.8	6.0	15	**34**	**34**
13.3	4.05	18.50	5.64	5.20	1.52	96	0.43	27	20	72	5	R2	Grey	Fine grained	Thinly bedded (1 mm)	Shale, fractured, sections (<5 cm) of rubble and oxidized material	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.5	6.4	6.0	6.0	15	**35**	**35**
18.5	5.64	24.00	7.31	5.50	1.60	95	0.57	34	14	107	15	R2	Grey	Fine grained	Thinly bedded (1 mm)	Shale, fractured, sections (<5 cm) of rubble and oxidized material	Ynl	0	1	3	0	3	7	15			cly	FeO		JBC	2.5	7.4	6.4	7.0	15	**38**	**38**
24.0	7.31	29.00	8.84	5.00	1.50	98	0.56	37	19	75	10	R2	Grey	Fine grained	Thinly bedded (1 mm)	Shale, fractured, sections (<5 cm) of rubble and oxidized material	Ynl	0	1	3	0	3	7	15			cly	FeO		JBC	2.0	7.8	6.0	7.0	15	**38**	**38**
29.0	8.84	33.80	10.30	4.80	1.47	100	0.90	62	15	92	25	R3	Grey	Fine grained	Thinly bedded (1 mm), subvertical	Shale, fractured, oxidized joint surfaces	Ynl	0	1	3	2	3	9	15			cly	FeO		JBC	3.4	12.1	6.2	9.0	15	**46**	**46**
33.8	10.30	39.00	11.89	5.20	1.52	96	1.10	69	12	117	25	R3	Grey	Fine grained	Thinly bedded (1 mm), subvertical	Shale, fractured, oxidized joint surfaces	Ynl	0	1	3	2	5	11	15			FeO	cly		JBC	3.4	13.6	6.6	11.0	15	**50**	**50**
39.0	11.89	44.00	13.41	5.00	1.50	98	1.25	82	10	136	40	R3	Grey to light grey	Fine grained	Bedded (up to 1 cm thick), sub-vertical	Shale, medium strong, some clay and iron oxide on joint surfaces, slightly weathered	Ynl	0	1	3	2	5	11	15			FeO	cly		JBC	4.8	16.2	6.8	11.0	15	**54**	**54**
44.0	13.41	49.00	14.93	5.00	1.52	100	0.76	50	15	95	40	R3	Grey to light grey	Fine grained	Bedded (up to 1 cm thick), sub-vertical	Shale, medium strong, some clay and iron oxide on joint surfaces, slightly weathered, trace calcite veinlets	Ynl	0	1	3	2	5	11	15			FeO	cly		JBC	4.8	10.0	6.3	11.0	15	**47**	**47**
49.0	14.93	54.00	16.46	5.00	1.52	100	1.02	67	10	138	40	R3	Grey to light grey	Fine grained	Bedded (up to 1 cm thick), sub-vertical	Shale, disturbed bedding, possible conglomerate with shale clasts, fine matrix, cannibalized?	Ynl	0	1	3	2	5	11	15			cly			JBC	4.8	13.1	6.8	11.0	15	**51**	**51**
54.0	16.46	59.00	17.98	5.00	1.49	98	1.13	74	10	135	40	R3	Grey to light grey	Fine grained	Bedded (up to 1 cm thick), sub-vertical	Shale, disturbed bedding, possible conglomerate with shale clasts, fine matrix, cannibalized?	Ynl	0	1	3	2	5	11	15			cc	cly		JBC	4.8	14.5	6.8	11.0	15	**52**	**52**
59.0	17.98	64.00	19.51	5.00	1.52	100	0.81	53	15	95	25	R3	Grey to light grey	Fine grained	Bedded, cannibalized texture?	Shale, disturbed bedding, calcite veinlets, medium strong to weak, easily fractured and crumbled	Ynl	0	1	3	2	5	11	15			cly	cc		JBC	3.4	10.6	6.3	11.0	15	**46**	**46**
64.0	19.51	69.00	21.03	5.00	1.52	100	1.01	66	9	152	25	R3	Grey to light grey	Fine grained	Bedded, cannibalized texture?	Shale, rubble and clay section (about 2 m thick) at 68 ft	Ynl	0	0	3	0	5	8	15			Rub	cly		JBC	3.4	13.0	7.0	8.0	15	**46**	**46**
69.0	21.03	74.00	22.55	5.00	1.52	100	0.75	49	12	117	25	R3	Grey to light grey	Fine grained	Thinly bedded shale, conglomerate sections	Shale/conglomerate, very fine grained matrix with clasts up to 2 cm diameter (mostly shale clasts) , rubble zone at 71 ft (about 10 cm thick), trace calcite veinlets, weak, slightly weathered	Ynl	0	0	3	0	5	8	15			Rub	cly		JBC	3.4	9.9	6.6	8.0	15	**43**	**43**
74.00	22.55	79.00	24.08	5.00	1.50	98	0.85	56	20	71	25	R3	Grey to light grey	Fine grained	Thinly bedded shale, conglomerate sections	Shale/conglomerate, very fine grained matrix with clasts up to 2 cm diameter (mostly shale clasts) , trace calcite veinlets, weak and easily fractured, slightly weathered	Ynl	0	1	3	2	5	11	15			cly			JBC	3.4	11.0	6.0	11.0	15	**46**	**46**
79.0	24.08	82.40	25.11	3.40	1.06	102	0.16	15	14	71	25	R3	Medium grey	Fine grained	Thinly bedded shale, conglomerate sections	Shale/conglomerate, very fine grained matrix with angular clasts up to 2 cm diameter (mostly shale clasts) , trace calcite veinlets, weak and easily fractured, slightly weathered.	Ynl	0	4	1	2	5	12	15			cc				3.4	4.8	6.0	12.0	15	**41**	**41**
82.4	25.11	86.70	26.42	4.30	1.17	89	0.30	23	10	106	40	R3	Medium grey	Fine grained	Thinly bedded shale, conglomerate sections	Shale/conglomerate, very fine grained matrix with angular clasts up to 2 cm diameter (mostly shale clasts) , trace calcite veinlets.	Ynl	0	1	1	2	6	10	15			cc				4.8	5.8	6.4	10.0	15	**42**	**42**
86.7	26.42	89.60	27.31	2.90	0.90	102	0.00	0	17	50	50	R4	Medium grey	Fine grained	Bedded, sub-horizontal (70-80° TCA)	Shale. Trace calcite veinlets throughout run. Upper 10 cm is rubble/gouge (shear zone).	Ynl	0	4	1	2	6	13	15			cc	rub			5.7	3.0	5.7	13.0	15	**42**	**42**

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DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
89.6	27.31	93.60	28.53	4.00	1.12	92	0.39	32	12	86	50	R4	Medium grey	Fine grained	Bedded, sub-horizontal (70-80° TCA)	Shale. Trace calcite veinlets throughout run.	Ynl
93.6	28.53	96.60	29.44	3.00	0.90	98	0.14	15	10	82	50	R4	Medium grey	Fine grained	Bedded, sub-horizontal (70-80° TCA)	Shale. Calcite veinlets and 1mm veins throughout run. Center 10 cm is rubble/gouge (shear zone).	Ynl
96.6	29.44	99.00	30.17	2.40	0.74	101	0.00	0	10	67	50	R4	Medium grey	Fine grained	Bedded 40-50° TCA	Shale. Calcite veinlets and 1mm veins throughout run.	Ynl

EOH

Depth From (ft)	DISCONTINUITY DATA - RATING SYSTEMS Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	ADDITIONAL DISCONTUITY DATA Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR CALCULATIONS RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
89.6	0	4	1	2	6	13	15			cc				5.7	7.1	6.2	13.0	15	**47**	**47**
93.6	0	1	1	2	6	10	15			cc	rub			5.7	4.8	6.1	10.0	15	**42**	**42**
96.6	0	1	1	2	6	10	15			cc				5.7	3.0	5.9	10.0	15	**40**	**40**

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-190

DRILL RUN DATA / GEOLOGY - COMMENTS

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	1.0	0.30	1.00		0											OB
0.0	0.00	4.00	1.22	4.00	0.97	80	0.00	0	max	5	0.5	R0	Beige/brown			Completely weathered shale, very soft, can be penetrated with finger easily. Lower 0.17 m has intact fragemtns of moderately weathered shale.	Ynl
4.0	1.22	9.00	2.74	5.00	0.80	52	0.80	52	max	5	0.5	R0	Beige/brown	Fine grained	Bedded	Interbedded beige and medium grey shale fragments intermixed with completely weathered shale.	Ynl
9.0	2.74	10.90	3.32	1.90	0.50	86	0.00	0	max	5	0.5	R0	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Interbedded beige and medium grey shale fragments intermixed with completely weathered shale. Run is predominantly rock fragments over weathered clay.	Ynl
10.0	3.05	13.20	4.02	3.20	0.60	62	0.00	0	8	67	30	R3	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Shale, 0.5-1 cm thick clay and rubble infilling on some fractures.	Ynl
13.2	4.02	15.20	4.63	2.00	0.55	90	0.00	0	10	50	30	R3	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Shale, 0.5-1 cm thick clay and rubble infilling on some fractures.	Ynl
15.2	4.63	17.70	5.39	2.50	0.70	92	0.00	0	14	47	30	R3	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Shale, <0.5 cm thick clay and rubble infilling on some fractures.	Ynl
17.7	5.39	21.10	6.43	3.40	0.97	94	0.00	0	20	46	30	R3	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Shale, <0.5 cm thick clay and rubble infilling on some fractures. Calcite veining visible throughout run.	Ynl
21.1	6.43	24.00	7.31	2.90	0.75	85	0.00	0	30	24	30	R3	Beige/brown	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~30-40° TCA.	Shale, <0.5 cm thick clay and rubble infilling on some fractures. Calcite veining visible throughout run.	Ynl
24.0	7.31	27.80	8.47	3.80	1.17	101	0.38	33	16	69	35	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Upper 0.2 m is weathered shale as described above, terminating in a rubbly clayey fracture. Rest of run is unweathered shale, with some calcite veinings.	Ynl
27.8	8.47	30.40	9.27	2.60	0.78	98	0.00	0	11	65	30	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, with some calcite veining. Extrememly fractured and lower 10 cm is weak and friable.	Ynl
30.4	9.27	33.30	10.15	2.90	0.83	94	0.00	0	max	5	0.5	R0	Medium Grey	Fine grained	Fault zone	Fault zone, grey gouge, can easily penetrate with knife. Lower 0.3 m is fractured but unfaulted shale.	flt
33.3	10.15	36.20	11.03	2.90	0.88	100	0.00	0	20	42	30	R3	Medium Grey	Fine grained	Bedded, layers up to 2 cm thick of medium grey and light beige rock. ~40-50° TCA.	Shale, calcite veinlets present throughout run, very fractured. Fractured with single firm blow from hammer.	Ynl
36.2	11.03	39.70	12.10	3.50	1.07	100	0.00	0	15	67	30	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, calcite veinlets present throughout run, very fractured. Fractured with single firm blow from hammer. <1 cm rubble and clayey fractures throughout run.	Ynl

DISCONTINUITY DATA - RATING SYSTEMS / ADDITIONAL DISCONTUITY DATA / RMR CALCULATIONS

Depth From (ft)	Depth To (ft)	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	1.0													GIM							
0.0	4.00	0	0	0	0	0	0	15			cly			GIM	1.1	3.0	5.0	0.0	15	24	24
4.0	9.00	0	0	0	0	0	0	15			cly			GIM	1.1	10.4	5.0	0.0	15	31	31
9.0	10.90	0	0	3	0	0	3	15			cly			GIM	1.1	3.0	5.0	3.0	15	27	27
10.0	13.20	0	0	1	0	3	4	15			cly	rub		GIM	3.9	3.0	5.9	4.0	15	32	32
13.2	15.20	0	0	1	0	3	4	15			rub	cly		GIM	3.9	3.0	5.7	4.0	15	32	32
15.2	17.70	0	1	1	2	3	7	15			cly	rub		GIM	3.9	3.0	5.6	7.0	15	35	35
17.7	21.10	0	1	1	2	3	7	15			cc	rub		GIM	3.9	3.0	5.6	7.0	15	35	35
21.1	24.00	0	1	1	2	3	7	15			rub	cly		GIM	3.9	3.0	5.3	7.0	15	34	34
24.0	27.80	0	4	1	2	5	12	15			cc			GIM	4.4	7.2	5.9	12.0	15	45	45
27.8	30.40	0	4	1	2	5	12	15			cc			GIM	3.9	3.0	5.9	12.0	15	40	40
30.4	33.30	0	0	0	0	0	0	15			gg			GIM	1.1	3.0	5.0	0.0	15	24	24
33.3	36.20	0	4	1	2	6	13	15			cc			GIM	3.9	3.0	5.6	13.0	15	40	40
36.2	39.70	0	1	1	2	6	10	15			rub	cly		GIM	3.9	3.0	5.9	10.0	15	38	38

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
39.7	12.10	44.00	13.41	4.30	1.20	92	0.24	18	14	80	30	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, calcite veinlets present throughout run, very fractured. Fractured with single firm blow from hammer. 10 cm rubble zone at .5 m, and 5 cm rubble zone at 0.7 m.	Ynl	0	0	1	2	6	9	15			rub			GIM	3.9	5.2	6.1	9.0	15	**39**	**39**
44.0	13.41	48.70	14.84	4.70	1.37	96	0.43	30	21	62	30	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, calcite veinlets present throughout run, very fractured. Fractured with single firm blow from hammer. From 0.8 to 1.1 m there is a zone of medium grey and beige interbedded shale (as decribed at top of hole, with 2-4 cm fault gouge at contacts.	Ynl	0	0	1	0	6	7	15			gg	rub		GIM	3.9	6.8	5.8	7.0	15	**39**	**39**
48.70	14.84	52.80	16.09	4.10	1.25	100	0.50	40	15	78	30	R3	Medium to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, sections (up to 1 cm thick) of clayey rubble present throughout run, slightly weathered, weak	Ynl	0	1	3	0	5	9	15			rub	cly		JBC	3.9	8.3	6.1	9.0	15	**42**	**42**
52.8	16.09	57.80	17.62	5.00	1.49	98	1.22	80	13	106	30	R3	Grey to light grey	Fine grained	Bedded, layers up to 1 cm thick, sub-vertical	Shale, weak to medium strength, slightly weathered to fresh, joints filled with clay	Ynl	0	1	3	2	6	12	15			cly			JBC	3.9	15.8	6.4	12.0	15	**53**	**53**
57.8	17.62	62.40	19.02	4.60	1.40	100	0.79	56	15	88	30	R3	Grey to light grey	Fine grained	Bedded, layers up to 1 cm thick, 45 to 50 degree TCA	Shale, weak to medium strength, slightly weathered to fresh, joints filled with clay	Ynl	0	4	3	2	6	15	15			cly	cc		JBC	3.9	11.1	6.2	15.0	15	**51**	**51**
62.4	19.02	67.50	20.57	5.10	1.52	98	0.81	52	20	72	30	R3	Grey to light grey	Fine grained	Bedded, layers up to 1 cm thick, 45 to 50 degree TCA	Shale, weak to medium strength, slightly weathered to fresh, a 2 cm thick rubble section at 66 ft	Ynl	0	1	3	0	6	10	15			rub			JBC	3.9	10.4	6.0	10.0	15	**45**	**45**
67.5	20.57	72.50	22.10	5.00	1.52	100	1.31	86	10	138	40	R3	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 50 degree TCA	Shale, medium strong, calcite infilling	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	17.0	6.8	13.0	15	**57**	**57**
72.5	22.10	77.50	23.62	5.00	1.52	100	1.30	85	8	169	50	R4	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 50 degree TCA	Shale, medium strong, calcite infilling	Ynl	0	4	1	2	6	13	15			cc			JBC	5.7	16.9	7.2	13.0	15	**58**	**58**
77.5	23.62	82.60	25.18	5.10	1.55	100	1.35	87	7	194	50	R4	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 50 degree TCA	Shale, medium strong, calcite infilling	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	17.2	7.5	15.0	15	**60**	**60**
82.6	25.18	87.60	26.70	5.00	1.52	100	0.90	59	15	95	40	R3	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 50 degree TCA	Shale, medium strong to weak, calcite veinlets throughout	Ynl	0	1	3	2	6	12	15			cc	cly		JBC	4.8	11.6	6.3	12.0	15	**50**	**50**
87.6	26.70	92.60	28.22	5.00	1.52	100	1.14	75	8	169	50	R4	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 50 degree TCA	Shale, medium strong to weak, calcite veinlets throughout	Ynl	0	4	3	2	6	15	15			cly			JBC	5.7	14.7	7.2	15.0	15	**58**	**58**
92.6	28.22	99.00	30.17	6.40	1.96	100	1.66	85	10	178	50	R4	Grey to light grey	Fine grained	Bedded, layers up to 2 cm thick, 45 to 55 degree TCA	Shale, medium strong, calcite veinlets throughout	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	16.8	7.3	15.0	15	**60**	**60**

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-191

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger g.)	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.0	0.30	1.00		0											OB													GIM							
0.0	0.00	4.00	1.22	4.00	1.00	82	0.00	0	max	5	0.5	R0	Beige brown	Fine grained	Decomposed bedrock	Upper 0.3 m is topsoil, transitioning into completely decomposed bedrock, can be penetrated with hammer point easily. Lower 0.2 m shows fragments of medium grey shale.	Ynl	0	0	0	0	0	0	15			cly			GIM	1.1	3.0	5.0	0.0	15	24	24
4.0	1.22	9.00	2.74	5.00	1.10	72	0.00	0	max	5	0.5	R0	Beige brown	Fine grained	Decomposed bedrock	Fragments, 1-4 cm, of beige and medium grey shale held together by decomposed rock.	Ynl	0	0	0	0	0	0	15			cly	Rub		GIM	1.1	3.0	5.0	0.0	15	24	24
9.0	2.74	14.00	4.27	5.00	1.00	66	0.00	0	max	5	0.5	R0	Beige brown	Fine grained	Decomposed bedrock	Fragments, 1-4 cm, of beige and medium grey shale held together by decomposed rock.	Ynl	0	0	0	0	0	0	15			cly	Rub		GIM	1.1	3.0	5.0	0.0	15	24	24
14.0	4.27	19.00	5.79	5.00	0.60	39	0.00	0	max	5	1	R1	Beige brown & medium grey	Fine grained	Fragmented bedrock	Extremely fractured beige and medium grey shale with ~40% of run as decomposed bedrock and rubble.	Ynl	0	0	3	0	1	4	15			cly	Rub		GIM	1.1	3.0	5.0	4.0	15	28	28
19.0	5.79	21.30	6.49	2.30	0.52	74	0.00	0	max	5	1	R1	Beige brown & medium grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Extremely fractured shale with rubble, clay, and FeO infilling on fractures. Rock fragments are held together enough to show bedding orientation.		0	1	3	2	1	7	15			Rub	cly	FeO	GIM	1.1	3.0	5.0	7.0	15	31	31
21.3	6.49	24.00	7.31	2.70	0.80	97	0.00	0	12	62	10	R2	Beige brown & medium grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Fractured shale with rubble, clay, and FeO infilling on fractures. Core is more competent than previous run.		0	1	3	2	3	9	15			Rub	cly	FeO	GIM	2.0	3.0	5.8	9.0	15	35	35
24.0	7.31	27.30	8.32	3.30	0.90	89	0.00	0	14	60	10	R2	Beige brown & medium grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Upper 0.4 m is beige and medium grey shale with rubbly fractures. Rest of run is medium grey, unweathered shale with calcite veins and veinlets throughout run.	Ynl	0	1	3	2	3	9	15			Rub	cc		GIM	2.0	3.0	5.8	9.0	15	35	35
27.3	8.32	31.80	9.69	4.50	1.24	90	0.10	7	19	62	25	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale with calcite veins ~1 mm thick throughout run. Zone of weathered shale (beige) at 0.7-0.9 m.	Ynl	0	1	3	2	3	9	15			cc	Rub		GIM	3.4	3.8	5.8	9.0	15	37	37
31.8	9.69	35.30	10.76	3.50	0.90	84	0.00	0	12	69	30	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale. Discontinuous calcite veinlets throughout run.	Ynl	0	4	3	2	5	14	15			cc	FeO		GIM	3.9	3.0	5.9	14.0	15	42	42
35.3	10.76	39.40	12.01	4.10	1.25	100	0.50	40	13	89	35	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale. Discontinuous calcite veinlets throughout run. Lower half of run features 1-3 cm thick light grey beds spaced 10 cm apart. Lost 90% of water return during this run.	Ynl	0	4	3	2	5	14	15			cc	FeO		GIM	4.4	8.3	6.2	14.0	15	48	48
39.4	12.01	43.35	13.21	3.95	1.10	91	0.50	42	8	122	35	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale. Discontinuous calcite veinlets throughout run.	Ynl	0	1	3	2	5	11	15			cc	Rub		GIM	4.4	8.6	6.6	11.0	15	46	46
43.4	13.21	44.00	13.41	0.65	0.20	100	0.00	0	max	5	1	R1	Beige	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Very soft, strongly weathered shale. Can be dented or penetrated with firm blow of hammer. Friable.	Ynl	0	0	0	0	1	1	15			gg			GIM	1.1	3.0	5.0	1.0	15	25	25
44.0	13.41	49.00	14.93	5.00	1.50	98	0.20	13	max	5	35	R3	Medium Grey	Fine grained	Disturbed bedding, 40-50° TCA, 1-10 mm thick layers	Shale. Bedding is discontinuous/disturbed with fragments of light grey layers throughout run. Discontinuous calcite veinlets throughout run. Old fault structure indicated by disturbed bedding.	Ynl	0	0	3	0	5	8	15			Rub	cc		GIM	4.4	4.5	5.0	8.0	15	37	37
49.0	14.93	54.00	16.46	5.00	1.40	92	0.63	41	12	108	40	R3	Medium Grey	Fine grained	Disturbed bedding, 40-50° TCA, 1-10 mm thick layers	Shale. Bedding is discontinuous/disturbed with fragments of light grey layers throughout run. Discontinuous calcite veinlets throughout run. Old fault structure indicated by disturbed bedding	Ynl	0	4	1	2	6	13	15			cc			GIM	4.8	8.6	6.4	13.0	15	48	48

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
54.0	16.46	59.00	17.98	5.00	1.50	98	0.87	57	12	115	40	R3	Medium Grey	Fine grained	Disturbed bedding, 40-50° TCA, 1-10 mm thick layers	Shale. Bedding is discontinuous/disturbed with fragments of light grey layers throughout run. Discontinuous calcite veinlets throughout run. Old fault structure indicated by disturbed bedding	Ynl	0	4	1	2	6	13	15			cc			GIM	4.8	11.3	6.5	13.0	15	51	51
59.00	17.98	63.40	19.32	4.40	1.34	100	0.58	43	13	96	40	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale with dsicontinuous calcite veinlets and veins (1-2 mm) throughout run. Bedding is mostly intact, with minor localized disturbance.	Ynl	0	4	1	2	6	13	15			cc			GIM	4.8	8.9	6.3	13.0	15	48	48
63.4	19.32	67.40	20.54	4.00	1.19	98	0.42	34	8	132	35	R3	Medium Grey	Fine grained	Bedded, 40-50° TCA, 1-10 mm thick layers	Shale with dsicontinuous calcite veinlets and veins (1-2 mm) throughout run. Bedding is mostly intact, with minor localized disturbance.	Ynl	0	4	3	2	6	15	15			cc			GIM	4.4	7.5	6.8	15.0	15	49	49
67.4	20.54	68.40	20.85	1.00	0.30	98	0.00	0	max	5	1	R1	Medium Grey	Fine grained	Fault zone	Fractured with intense calcite veining. Gouge ~1-2 cm thick at ~45° TCA.	flt	0	0	0	0	0	0	15			gg			GIM	1.1	3.0	5.0	0.0	15	24	24
68.4	20.85	72.60	22.13	4.20	1.10	86	0.40	31	9	110	35	R3	Medium Grey	Fine grained	Bedded, Sub-horizontal at 70-80° TCA, 1-10 mm thick layers	Shale with dsicontinuous calcite veinlets and veins (1-2 mm) throughout run. Bedding is mostly intact, with minor localized disturbance.	Ynl	0	4	3	2	6	15	15			cc			GIM	4.4	7.0	6.5	15.0	15	48	48
72.6	22.13	74.00	22.55	1.40	0.42	98	0.00	0	6	60	35	R3	Medium Grey	Fine grained	Bedded, Sub-horizontal at 70-80° TCA, 1-10 mm thick layers	Shale with dsicontinuous calcite veinlets and veins (1-2 mm) throughout run. Bedding is mostly intact, with minor localized disturbance.	Ynl	0	4	1	2	6	13	15			cc			GIM	4.4	3.0	5.8	13.0	15	41	41
74.0	22.55	77.10	23.50	3.10	0.94	99	0.13	14	14	63	35	R3	Medium Grey	Fine grained	Bedded, Sub-horizontal at 70-80° TCA, 1-10 mm thick layers	Shale. Irregular/discontinuous calcite veinlets and 1-2 mm veins.	Ynl	0	4	3	2	6	15	15			cc			GIM	4.4	4.6	5.9	15.0	15	45	45
77.1	23.50	82.10	25.02	5.00	1.52	100	0.66	43	20	72	40	R3	Medium Grey	Fine grained	Bedded, Sub-horizontal at 70-80° TCA, 1-10 mm thick layers	Shale. Irregular/discontinuous calcite veinlets and 1-2 mm veins.	Ynl	0	4	1	2	6	13	15			cc			GIM	4.8	8.9	6.0	13.0	15	48	48
82.1	25.02	87.10	26.55	5.00	1.49	98	1.18	77	10	135	40	R3	Grey to medium grey	Fine grained	Bedded, up to 10 mm thick beds, various orientations	Shale, calcite veinlets, fresh, medium strong, calcite infilling	Ynl	0	4	3	2	6	15	15			cc			JBC	4.8	15.2	6.8	15.0	15	57	57
87.1	26.55	92.10	28.07	5.00	1.52	100	1.46	96	8	169	10	R2	Grey to medium grey	Fine grained	Bedded, up to 10 mm thick beds, various orientations	Shale, discontinuous and chaotic calcite veinlets, a 3 cm thick gougey clay zone with angular fragments (up to 2 cm diameter) at 92 ft	Ynl	0	1	3	0	5	9	15			gg	cly		JBC	2.0	19.2	7.2	9.0	15	52	52
92.1	28.07	99.00	30.17	6.90	2.02	96	1.15	55	32	61	20	R2	Grey to medium grey	Fine grained	Bedded, up to 1 cm thick beds, various orientations	Shale, discontinuous and chaotic calcite veinlets, run is more fractured	Ynl	0	1	3	2	6	12	15			cc	cly		JBC	3.0	10.8	5.8	12.0	15	47	47

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-192

DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	15.0	4.57	15.00		0											OB
17.0	5.18	20.00	6.10	3.00	0.62	68	0.00	0	max	5	25	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale, calcite veinlets throughout intact rock fragements. Fractured with rubble and clay zones.	Ynl
20.0	6.10	24.00	7.31	4.00	1.05	86	0.00	0	21	48	25	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale, calcite veinlets throughout intact rock fragements. Fractured with rubble and clay zones near top and bottom of run. Some bedding layers are brown/beige in colour.	Ynl
24.0	7.31	29.00	8.84	5.00	1.28	84	0.00	0	27	46	25	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale. Calcite veinlets throughout run. Fractured with rubble and clay ~1 cm thick near top and bottom of run.	Ynl
29.0	8.84	32.20	9.81	3.20	0.88	90	0.00	0	20	42	35	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale. Calcite veinlets throughout run. Very fractured with minimal occurances of rubble and clay in some fractures.	Ynl
32.3	9.84	37.40	11.40	5.10	1.52	98	1.23	79	25	58	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale. 1-2 mm calcite veins and veinlets throughout run. Some ~5 mm rubbly fractures present every 0.4-0.6 m.	Ynl
37.4	11.40	42.40	12.92	5.00	1.55	102	0.20	13	21	70	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale. 1-2 mm calcite veins and veinlets throughout run. Upper 0.2 m is rubbly with some clay gouge. 5 cm rubble joint at 1.0 m. Pyrite in bedding in lower 0.3 m.	Ynl
42.4	12.92	47.60	14.51	5.20	1.55	98	0.14	9	18	82	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale. Calcite veinlets throughout run. Pyrite in bedding in upper 0.3 m.	Ynl
47.6	14.51	52.80	16.09	5.20	1.50	95	0.27	17	14	100	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale. 1-2 mm calcite veins and veinlets throughout run.	Ynl
52.8	16.09	57.90	17.65	5.10	1.55	100	0.42	27	29	52	50	R4	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale. 1-2 mm calcite veins and veinlets throughout run. 1 cm thick gouge zone at 1.35 m, followed by heavily fractured rock.	Ynl
57.9	17.65	63.00	19.20	5.10	1.53	98	0.12	8	22	67	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale, upper 0.6 is weathered/altered to a beige and grey colour, strongly fractured. Rest of run is shale as described above.	Ynl
63.0	19.20	65.00	19.81	2.00	0.63	100	0.10	16	8	70	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale, trace calcite veinlets throughout run	Ynl
65.0	19.81	70.00	21.33	5.00	1.53	100	0.80	52	9	153	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale, trace calcite veinlets throughout run	Ynl
70.0	21.33	75.00	22.86	5.00	1.54	100	1.09	72	10	140	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale, trace calcite veinlets present.	Ynl
75.0	22.86	80.00	24.38	5.00	1.57	100	0.72	47	14	105	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale, with light grey beds throughout. Trace calcite veinlets present and 2-3 mm thick calcite vein runs sub-parallel to core axis.	Ynl
80.0	24.38	85.00	25.91	5.00	1.55	100	0.22	14	16	91	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shale, with light grey beds throughout. Discontinuous calcite veinlets present as well as 1-3 mm thick calcite veins.	Ynl
85.00	25.91	87.20	26.58	2.20	0.50	75	0.00	0	8	56	1	R1	Medium Grey	Fine grained	Bedded, sub-horizontal, 60-75° TCA	Shear zone. Upper half of run is rubbly shale. Lower half of run features a 1-2 cm beige clay gouge shear at ~20-30° TCA with rubble below.	FLT

	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition																			
Depth From (ft)	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0													JBC							
17.0	0	0	3	0	3	6	15			Rub	cly		GIM	3.4	3.0	5.0	6.0	15	32	32
20.0	0	0	3	0	3	6	15			Rub	cly		GIM	3.4	3.0	5.7	6.0	15	33	33
24.0	0	1	3	2	5	11	15			Rub	cly	FeO	GIM	3.4	3.0	5.6	11.0	15	38	38
29.0	0	4	3	2	5	14	15			cc	FeO		GIM	4.4	3.0	5.6	14.0	15	42	42
32.3	0	4	1	2	6	13	15			cc	Rub		GIM	4.8	15.6	5.8	13.0	15	54	54
37.4	0	4	3	2	6	15	15			cc			GIM	4.8	4.5	6.0	15.0	15	45	45
42.4	0	4	3	2	5	14	15			cc	FeO		GIM	4.8	4.0	6.1	14.0	15	44	44
47.6	0	4	3	2	6	15	15			cc			GIM	4.8	5.0	6.3	15.0	15	46	46
52.8	0	4	3	2	6	15	15			cc	gg		GIM	5.7	6.4	5.7	15.0	15	48	48
57.9	0	1	3	2	3	9	15			cc	Rub		GIM	4.8	3.9	5.9	9.0	15	39	39
63.0	0	4	3	4	5	16	15			FeO			GIM	4.8	4.9	6.0	16.0	15	47	47
65.0	0	4	3	2	5	14	15			cc	FeO		GIM	4.8	10.4	7.0	14.0	15	51	51
70.0	0	4	1	6	6	17	15						GIM	4.8	14.0	6.9	17.0	15	58	58
75.0	0	4	1	2	6	13	15			cc			GIM	4.8	9.5	6.4	13.0	15	49	49
80.0	0	4	3	2	5	14	15			cc	FeO		GIM	4.8	4.7	6.2	14.0	15	45	45
85.00	0	0	1	0	5	6	15			gg	Rub		GIM	1.1	3.0	5.8	6.0	15	31	31

DRILL RUN DATA: Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	GEOLOGY - COMMENTS: Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
87.2	26.58	90.00	27.43	2.80	0.86	100	0.50	59	2	287	40	R3	Medium Grey	Fine grained	Disturbed bedding	Shale. Upper 0.15 m is continuation of shear. Rest of run is disturbed shale with discontinuous bedding and calcite veins and veinlets.	Ynl
90.0	27.43	95.00	28.95	5.00	1.50	98	0.79	52	12	115	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale with trace calcite and quartz veinlets throughout the run. Some minor rubbly fractures in upper half of run.	Ynl
95.0	28.95	100.00	30.48	5.00	1.53	100	0.46	30	15	96	40	R3	Medium Grey	Fine grained	Bedded, sub-horizontal, 70-80° TCA	Shale with trace calcite and quartz veinlets throughout the run. Some minor rubbly fractures at 0.7 to 0.9 m. Pyrite present in bedding in upp34 0.3 m of run.	Ynl
EOH																	

Depth From (ft)	DISCONTINUITY DATA - RATING SYSTEMS: Joint Condition: Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	ADDITIONAL DISCONTUITY DATA: Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR CALCULATIONS: RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
87.2	0	4	1	2	5	12	15			cc	FeO		GIM	4.8	11.5	8.6	12.0	15	**52**	**52**
90.0	0	4	1	2	6	13	15			cc	qtz		GIM	4.8	10.3	6.5	13.0	15	**50**	**50**
95.0	0	4	1	2	6	13	15			Rub	gg		GIM	4.8	6.8	6.3	13.0	15	**46**	**46**

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-193

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
0.0	0.00	10.0	3.05	10.00													OB	0												JBC							
10.0	3.05	12.00	3.66	2.00												Completely weathered Shale	Ynl	0					0	15						JBC	1.0	3.0	5.0	0.0	15	**24**	**24**
12.0	3.66	19.00	5.79	7.00	2.04	96	0.00	0	Max	5	15	R2	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal (75 to 85 degrees TCA)	Shale, very weak and easily crumbled, joints along bedding, orangey brown oxidized and clayey sections (up to 2 cm thick)	Ynl	0	1	3	0	3	7	15			cly	FeO		JBC	2.5	3.0	5.0	7.0	15	**32**	**32**
19.0	5.79	24.00	7.31	5.00	1.52	100	0.00	0	50	30	25	R3	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal (75 to 85 degrees TCA)	Shale, very weak and easily crumbled, joints along bedding	Ynl	0	1	3	0	3	7	15			cly			JBC	3.4	3.0	5.4	7.0	15	**34**	**34**
24.0	7.31	29.00	8.84	5.00	1.57	100	0.68	45	18	83	30	R3	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal	Shale, weak, clay and calcite infilling	Ynl	0	4	3	2	5	14	15			cc	cly		JBC	3.9	9.1	6.1	14.0	15	**48**	**48**
29.0	8.84	34.00	10.36	5.00	1.52	100	0.70	46	20	72	30	R3	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal	Shale, weak, clay and calcite infilling	Ynl	0	4	1	2	5	12	15			cc	cly		JBC	3.9	9.3	6.0	12.0	15	**46**	**46**
34.0	10.36	39.00	11.89	5.00	1.52	100	0.62	41	21	69	30	R3	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal	Shale, weak, joints along bedding, fresh	Ynl	0	4	1	2	6	13	15			cc	cly		JBC	3.9	8.5	5.9	13.0	15	**46**	**46**
39.0	11.89	44.00	13.41	5.00	1.54	100	1.30	85	12	118	35	R3	Grey to light grey	Fine grained	Bedded, beds up to 5 mm, sub-horizontal	Shale, weak, joints along bedding, fresh, some calcite veinlets	Ynl	0	4	1	2	6	13	15			cc			JBC	4.4	16.9	6.6	13.0	15	**56**	**56**
44.0	13.41	49.00	14.93	5.00	1.55	100	1.22	80	12	119	35	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh	Ynl	0	4	1	2	6	13	15			cc			JBC	4.4	15.8	6.6	13.0	15	**55**	**55**
49.0	14.93	54.00	16.46	5.00	1.58	100	1.30	85	8	176	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh, calcite veinlets throughout	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	16.9	7.3	13.0	15	**57**	**57**
54.0	16.46	59.00	17.98	5.00	1.60	100	0.88	58	16	94	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh, calcite veinlets throughout (up to 3 cm thick), an 8 cm thick gougey clay section with angular fragments (up to 0.5 cm diameter) at 55 ft	Ynl	0	0	3	0	5	8	15			Rub	gg	cly	JBC	4.8	11.4	6.3	8.0	15	**45**	**45**
59.0	17.98	64.00	19.51	5.00	1.57	100	1.12	73	10	143	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh, calcite veinlets throughout	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	14.4	6.9	13.0	15	**54**	**54**
64.0	19.51	69.00	21.03	5.00	1.43	94	0.92	60	13	102	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh, calcite veinlets throughout	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	11.9	6.4	13.0	15	**51**	**51**
69.0	21.03	74.00	22.55	5.00	1.52	100	1.20	79	7	190	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (75 to 85 degrees TCA)	Shale, medium strong, fresh, calcite veinlets throughout	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	15.5	7.5	13.0	15	**56**	**56**
74.0	22.55	79.00	24.08	5.00	1.52	100	0.72	47	12	117	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (65 to 75 degrees TCA)	Shale, medium strong, fresh, calcite infilling, joints along bedding	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	9.5	6.6	13.0	15	**49**	**49**
79.0	24.08	84.00	25.60	5.00	1.52	100	1.14	75	10	138	40	R3	Grey to light grey	Fine grained	Bedded, beds up to 1 cm, sub-horizontal (65 to 75 degrees TCA)	Shale, medium strong, fresh, calcite infilling, joints along bedding	Ynl	0	4	1	2	6	13	15			cc			JBC	4.8	14.7	6.8	13.0	15	**54**	**54**
84.0	25.60	89.00	27.13	5.00	1.46	96	1.46	96	4	292	50	R4	Grey to light grey	Fine grained	Bedded, beds up to 2cm, sub-horizontal (65 to 75 degrees TCA)	Shale, strong to medium strong, fresh, no infilling	Ynl	0	4	1	6	6	17	15						JBC	5.7	19.2	8.6	17.0	15	**66**	**66**

DRILL RUN DATA

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.
89.0	27.13	94.00	28.65	5.00	1.52	100	1.18	77	11	127	50	R4
94.0	28.65	99.00	30.17	5.00	1.52	100	0.85	56	13	109	50	R4

GEOLOGY - COMMENTS / **DISCONTINUITY DATA - RATING SYSTEMS**

Depth From (ft)	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating
89.0	Grey to light grey	Fine grained	Bedded, beds up to 2cm, sub-horizontal (65 to 75 degrees TCA)	Shale, strong to medium strong, fresh, calcite veins throughout (up to 2 cm thick)	Ynl	0	4	1	2	6	13	15
94.0	Grey to light grey	Fine grained	Bedded, beds up to 2cm, sub-horizontal (65 to 75 degrees TCA)	Shale, strong to medium strong, fresh, sporadic calcite veinlets thorughout	Ynl	0	4	1	2	6	13	15

ADDITIONAL DISCONTUITY DATA / **RMR CALCULATIONS**

Depth From (ft)	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
89.0			cc			JBC	5.7	15.2	6.7	13.0	15	**56**	**56**
94.0			cc			JBC	5.7	11.0	6.5	13.0	15	**51**	**51**

EOH

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-194

DRILL RUN DATA / GEOLOGY - COMMENTS

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	1.0	0.30	1.00		0											OB
0.0	0.00	4.00	1.22	4.00	1.10	90	0.00	0	max	5	0.5	R0	Brown and grey	Fine grained	Bedded	Upper 0.3 m is topsoil plug. Rest of run is completely weathered shale, grey and brown, with structure intact. Very soft (easily penetrated with hammer point).	Ynl
4.0	1.22	9.00	2.74	5.00	0.60	39	0.00	0	max	5	0.5	R0	Beige	Fine grained	None	Completely weathered shale, some relic structure visible.	Ynl
9.0	2.74	11.30	3.44	2.30	0.40	57	0.00	0	max	5	0.5	R0	Beige and medium grey	Fine grained	None	Medium grey and beige shale rubble with clay (Weathered bedorck washed out during drilling).	Ynl
11.3	3.44	12.60	3.84	1.30	0.36	91	0.00	0	max	5	10	R2	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~70-50° TCA	Medium grey and beige shale, completely fractured but intact with visible bedding, some trace weathered rock..	Ynl
12.6	3.84	14.40	4.39	1.80	0.50	91	0.00	0	max	5	35	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~70-80° TCA	Medium grey and beige shale, strongly fractured with trace clay and rubble on fractures.	Ynl
14.4	4.39	16.30	4.97	1.90	0.53	92	0.00	0	10	48	35	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~70-80° TCA	Medium grey and beige shale, strongly fractured with trace clay and rubble on fractures.	Ynl
16.3	4.97	18.40	5.61	2.10	0.67	100	0.00	0	5	112	35	R3	Beige and medium grey	Fine grained	Discontinous	Disturbed shale or conglomerate, discontinuous structure with 5-10 mm clasts.	Ynl
18.4	5.61	21.20	6.46	2.80	0.80	94	0.13	15	12	62	40	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~80-90° TCA	Shale, moderately weathered. Strongly fractured and resealed with discontinuous calcite veinlets. 0.15 m rubble and gouge zone at 0.4 m.	Ynl
21.2	6.46	24.00	7.31	2.80	0.60	70	0.00	0	max	5	35	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~80-90° TCA	Shale, moderately weathered. Strongly fractured and resealed with discontinuous calcite veinlets.	Ynl
24.0	7.31	29.00	8.84	5.00	1.10	72	0.14	9	12	85	35	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~80-90° TCA	Shale, several calcite veinlets throughout run. Bedding is partially disturbed and clasts (0.5-1 cm) present throughout run.	Ynl
29.0	8.84	33.10	10.09	4.10	0.90	72	0.00	0	22	39	35	R3	Beige and medium grey	Fine grained	Sub-vertical bedding @ ~80-90° TCA	Shale, moderately weathered. Strongly fractured. 3-8 cm rubble zone at 0.35 m.	Ynl
33.1	10.09	34.20	10.42	1.10	0.15	45	0.00	0	max	5	35	R3	Beige and medium grey	Fine grained	Rubble	Shale rubble	Ynl
34.2	10.42	38.50	11.73	4.30	1.15	88	0.64	49	15	72	50	R4	Medium grey	Fine grained	Bedded, ~60-70° TCA	Unweathered shale, calcite veinlets crosscut bedding, and bedding is partially offset on some veins.	Ynl
38.5	11.73	41.90	12.77	3.40	1.05	100	0.16	15	8	117	50	R4	Medium grey	Fine grained	Bedded, ~60-70° TCA	Shale, calcite veinlets crosscut bedding, and bedding is partially offset on some veins.	Ynl
41.9	12.77	46.60	14.20	4.70	1.36	95	0.96	67	7	170	50	R4	Medium grey	Fine grained	Bedded, ~60-70° TCA	Shale, calcite veinlets crosscut bedding, and bedding is partially offset on some veins.	Ynl
46.60	14.20	50.00	15.24	3.40	1.09	100	0.90	87	3	273	50	R4	Medium grey	Fine grained	Bedded, ~60-70° TCA	Shale, calcite veinlets crosscut bedding, and bedding is partially offset on some veins.	Ynl
50.0	15.24	53.30	16.25	3.30	0.86	86	0.14	14	10	78	50	R4	Medium grey	Fine grained	Bedded, ~60-70° TCA	Shale, calcite veinlets crosscut bedding, and bedding is partially offset on some veins. Upper 0.15 m is rubble.	Ynl
53.3	16.25	58.10	17.71	4.80	1.45	99	1.21	83	8	161	50	R4	Grey to light grey	Fine grained	Bedded, beds up to 0.5 cm, sub-vertical ~65-85° TCA	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl
58.1	17.71	62.80	19.14	4.70	1.42	99	1.20	84	10	129	50	R4	Grey to light grey	Fine grained	Bedded, beds up to 0.5 cm, sub-vertical ~65-85° TCA	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl

DISCONTINUITY DATA - RATING SYSTEMS / ADDITIONAL DISCONTUITY DATA / RMR CALCULATIONS

Depth From (ft)	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0													GIM							
0.0	0	0	0	0	1	1	15			cly			GIM	1.1	3.0	5.0	1.0	15	25	25
4.0	0	0	0	0	0	0	15			cly			GIM	1.1	3.0	5.0	0.0	15	24	24
9.0	0	0	0	0	1	1	15			cly	Rub		GIM	1.1	3.0	5.0	1.0	15	25	25
11.3	0	0	3	0	3	6	15			Rub	cly		GIM	2.0	3.0	5.0	6.0	15	31	31
12.6	0	4	1	2	3	10	15			cly	Rub		GIM	4.4	3.0	5.0	10.0	15	37	37
14.4	0	4	1	2	4	11	15			cly	FeO	Rub	GIM	4.4	3.0	5.7	11.0	15	39	39
16.3	0	4	1	2	4	11	15			FeO	cc		GIM	4.4	3.0	6.5	11.0	15	40	40
18.4	0	0	1	2	3	6	15			Rub	FeO		GIM	4.8	4.8	5.8	6.0	15	36	36
21.2	0	0	1	2	3	6	15			FeO	cc		GIM	4.4	3.0	5.0	6.0	15	33	33
24.0	0	1	3	2	3	9	15			cc	FeO		GIM	4.4	4.0	6.1	9.0	15	39	39
29.0	0	0	1	2	3	6	15			FeO	cc		GIM	4.4	3.0	5.5	6.0	15	34	34
33.1	0	0	1	2	3	6	15			FeO			GIM	4.4	3.0	5.0	6.0	15	33	33
34.2	0	4	1	2	6	13	15			cc			GIM	5.7	9.8	6.0	13.0	15	49	49
38.5	0	4	1	2	6	13	15			cc			GIM	5.7	4.8	6.6	13.0	15	45	45
41.9	0	4	1	2	6	13	15			cc			GIM	5.7	13.1	7.2	13.0	15	54	54
46.60	0	4	1	2	6	13	15			cc			GIM	5.7	17.2	8.4	13.0	15	59	59
50.0	0	4	1	2	6	13	15			cc			GIM	5.7	4.6	6.1	13.0	15	44	44
53.3	0	4	3	2	6	15	15			cc			JBC	5.7	16.3	7.1	15.0	15	59	59
58.1	0	4	3	2	6	15	15			cc			JBC	5.7	16.5	6.7	15.0	15	59	59

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
62.8	19.14	67.80	20.66	5.00	1.45	95	1.12	73	9	145	50	R4	Grey to light grey	Fine grained	Bedded, beds up to 0.5 cm, sub-vertical ~65-85° TCA	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	14.4	6.9	15.0	15	**57**	**57**
67.8	20.66	73.00	22.25	5.20	1.54	97	1.20	76	11	128	50	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	14.9	6.7	15.0	15	**57**	**57**
73.0	22.25	78.10	23.80	5.10	1.60	100	1.52	98	8	178	50	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	19.7	7.3	15.0	15	**63**	**63**
78.1	23.80	83.40	25.42	5.30	1.58	98	1.30	80	5	263	60	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	3	2	6	15	15			cc			JBC	6.5	15.8	8.3	15.0	15	**61**	**61**
83.4	25.42	88.20	26.88	4.80	1.42	97	1.20	82	7	178	60	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick, some clastic sections with clasts up to 1 cm diameter	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	1	2	6	13	15			cc			JBC	6.5	16.2	7.3	13.0	15	**58**	**58**
88.2	26.88	93.50	28.50	5.30	1.61	100	1.33	82	4	322	60	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	1	2	6	13	15			cc			JBC	6.5	16.2	9.0	13.0	15	**60**	**60**
93.5	28.50	98.70	30.08	5.20	1.59	100	1.15	73	11	133	50	R4	Grey to light grey	Fine grained	Bedded, subvertical, beds up to 2 cm thick, 60 to 70 degrees TCA	Shale, calcite veinlets cross-cutting bedding, fresh, strong	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	14.2	6.8	15.0	15	**57**	**57**
EOH																																					

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-195

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	0.8	0.23	0.75		0										Topsoil	OB													JBC							
0.8	0.23	6.50	1.98	5.75	1.28	73	0.00	0	Max	5	0.5	R0	Orangey brown to brown	Fine grained	Completely weathered	Shale, completely weathered, mostly silty clay with some shale fragments, bedding @45 degrees, calcite veining, poor recovery	Ynl	0	0	3	0	1	4	15			cly	Rub		JBC	1.1	3.0	5.0	4.0	15	**28**	**28**
6.5	1.98	9.00	2.74	2.50	0.65	85	0.00	0	Max	5	1	R1	Grey to light grey	Fine grained	Bedded	Shale, highly fractured, mainly rubble, fragments are angular (up to 4 cm diameter)	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.1	3.0	5.0	6.0	15	**30**	**30**
9.0	2.74	15.00	4.57	6.00	1.68	92	0.37	20	30	54	5	R2	Grey to light grey	Fine grained	Bedded, subvertical bedding, up to 1 mm thick	Shale, angular fragments, last 90 cm is intact	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.5	5.4	5.7	6.0	15	**34**	**34**
15.0	4.57	19.00	5.79	4.00	1.10	90	0.10	8	25	42	10	R2	Grey to light grey	Fine grained	Bedded, (45 to 60 degrees TCA), up to 1 mm thick	Shale, angular fragments, last 90 cm is intact	Ynl	0	1	3	0	3	7	15			FeO	cly		JBC	2.0	3.9	5.6	7.0	15	**34**	**34**
19.0	5.79	22.50	6.86	3.50	1.00	94	0.00	0	22	43	10	R2	Grey to light grey	Fine grained	Bedded (45 to 65 degrees TCA)	Shale, calcite veining (up to 2 mm thick) throughout, highly fractured, oxidized joint surfaces	Ynl	0	1	3	0	3	7	15			cly	FeO		JBC	2.0	3.0	5.6	7.0	15	**33**	**33**
22.5	6.86	25.50	7.77	3.00	1.15	100	0.41	45	25	44	20	R2	Grey to light grey	Fine grained	Bedded (45 to 65 degrees TCA)	Shale, calcite veining (up to 2 mm thick) throughout, highly fractured, oxidized joint surfaces	Ynl	0	1	3	0	5	9	15			cly	FeO		JBC	3.0	9.1	5.6	9.0	15	**42**	**42**
25.5	7.77	29.00	8.84	3.50	1.09	102	0.92	86	10	99	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA)	Shale, fresh, calcite infilling	Ynl	0	4	1	2	5	12	15			cc	cly		JBC	4.8	17.1	6.3	12.0	15	**55**	**55**
29.0	8.84	34.20	10.42	5.20	1.40	88	0.56	35	32	42	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA)	Shale, fresh, calcite infilling, run is more fractured than last, calcite veinlets throughout	Ynl	0	1	3	2	5	11	15			cc	cly		JBC	4.8	7.6	5.6	11.0	15	**44**	**44**
34.2	10.42	39.00	11.89	4.80	1.50	100	1.08	74	18	79	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA), beds up to 5 mm thick	Shale, calcite veinlets throughout, slightly weathered, oxidized joint surfaces	Ynl	0	1	3	2	5	11	15			FeO	cc	cly	JBC	4.8	14.5	6.1	11.0	15	**51**	**51**
39.0	11.89	44.00	13.41	5.00	1.37	90	1.05	69	14	91	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA), beds up to 5 mm thick	Shale, calcite veinlets throughout, slightly weathered, oxidized joint surfaces	Ynl	0	4	3	2	5	14	15			cc	cly	FeO	JBC	4.8	13.5	6.2	14.0	15	**54**	**54**
44.0	13.41	49.00	14.93	5.00	1.37	90	0.44	29	30	44	30	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA), beds up to 5 mm thick	Shale, calcite veinlets throughout, slightly weathered, oxidized joint surfaces, sections of rubble and clay (about 2 cm thick)	Ynl	0	1	3	0	5	9	15			Rub	cly		JBC	3.9	6.7	5.6	9.0	15	**40**	**40**
49.0	14.93	53.00	16.15	4.00	1.30	100	0.91	75	22	57	30	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA)	Shale, calcite veinlets throughout, slightly weathered, oxidized joint surfaces	Ynl	0	1	3	0	5	9	15			cly	Rub		JBC	3.9	14.6	5.8	9.0	15	**48**	**48**
53.0	16.15	56.80	17.31	3.80	1.10	95	0.68	59	10	100	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA)	Shale, clay and calcite infilling, fresh, sections of rubble	Ynl	0	1	3	0	6	10	15			cly	Rub		JBC	4.8	11.6	6.3	10.0	15	**48**	**48**
56.8	17.31	60.30	18.38	3.50	1.00	94	0.76	71	11	83	40	R3	Grey to light grey	Fine grained	Bedded (45 to 55 degrees TCA)	Shale, clay and calcite infilling, fresh	Ynl	0	4	3	2	6	15	15			cly	cc		JBC	4.8	13.9	6.1	15.0	15	**55**	**55**
60.3	18.38	64.00	19.51	3.70	1.16	100	0.70	62	8	129	40	R3	Grey to light grey	Fine grained	Bedded, subvertical (30 to 40 degrees TCA)	Shale, sections (up to 2cm thick), of rubble and clay, calcite infilling	Ynl	0	1	3	0	6	10	15			Rub	cly		GM	4.8	12.2	6.7	10.0	15	**49**	**49**
64.0	19.51	66.80	20.36	2.80	0.58	68	0.00	0	5	97	35	R3	Medium grey	Fine grained	Bedded, subvertical (20 to 30° TCA)	Shale, fault gouge from 0.06-0.13 m. 1-3 mm thick calcite veins throughout run.	Ynl	0	0	1	0	6	7	15			gg	cc		GM	4.4	3.0	6.3	7.0	15	**36**	**36**
66.8	20.36	68.80	20.97	2.00	0.56	92	0.35	57	4	112	40	R3	Medium grey	Fine grained	Bedded, subvertical (20 to 30° TCA)	Shale, lower 5-8 cm is rubble and gouge. Calcite veinlets present throughout run.	Ynl	0	4	3	2	6	15	15			cc	gg		GM	4.8	11.3	6.5	15.0	15	**53**	**53**
68.8	20.97	71.00	21.64	2.20	0.56	84	0.32	48	5	93	35	R3	Medium grey	Fine grained	Bedded, subvertical (20 to 30° TCA)	Shale. Trace amounts of calcite veinlets present throughout run.	Ynl	0	4	1	2	6	13	15			cc			GM	4.4	9.6	6.3	13.0	15	**48**	**48**
71.0	21.64	73.80	22.49	2.80	0.56	66	0.10	12	5	93	35	R3	Medium grey	Fine grained	Bedded, (40 to 50° TCA)	Shale. Trace amounts of calcite veinlets present throughout run. Upper 7 cm is clay gouge.	Ynl	0	1	1	0	6	8	15			gg	cc		GM	4.4	4.4	6.3	8.0	15	**38**	**38**
73.8	22.49	77.10	23.50	3.30	0.79	79	0.10	10	10	72	35	R3	Medium grey	Fine grained	Bedded, (40 to 50° TCA)	Shale. Trace amounts of calcite veinlets present throughout run.	Ynl	0	4	1	2	6	13	15			cc			GM	4.4	4.1	6.0	13.0	15	**42**	**42**
77.1	23.50	81.60	24.87	4.50	1.40	100	1.29	94	4	280	35	R3	Medium grey	Fine grained	Bedded, (40 to 50° TCA)	Shale. Trace amounts of calcite veinlets present throughout run.	Ynl	0	4	1	2	6	13	15			cc			GM	4.4	18.8	8.5	13.0	15	**60**	**60**
81.6	24.87	83.80	25.54	2.20	0.55	82	0.27	40	3	138	35	R3	Medium grey	Fine grained	Bedded, (40 to 50° TCA)	Shale. Trace amounts of calcite veinlets present throughout run.	Ynl	0	4	3	2	6	15	15			cc			GM	4.4	8.4	6.8	15.0	15	**50**	**50**

DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
83.8	25.54	86.70	26.42	2.90	0.85	96	0.40	45	7	106	35	R3	Medium grey	Fine grained	Bedded, (40 to 50° TCA)	Shale. Frequent discontinuous calcite veinlets throughout run.	Ynl
86.7	26.42	90.70	27.64	4.00	1.15	94	0.30	25	7	144	35	R3	Medium grey	Fine grained	Bedded, sub-vertically (10 to 250° TCA)	Shale, frequent discontinuous calcite veinlets. Bedding is offset ~1 mm along some calcite veinlets.	Ynl
90.7	27.64	92.00	28.04	1.30	0.40	101	0.20	50	4	80	35	R3	Medium grey	Fine grained	Bedded, sub-vertically (10 to 250° TCA)	Shale, frequent discontinuous calcite veinlets. Bedding is offset ~1 mm along some calcite veinlets.	Ynl
92.0	28.04	95.00	28.95	3.00	0.90	98	0.00	0	12	69	35	R3	Medium grey	Fine grained	Bedded, sub-vertically (10 to 250° TCA)	Shale, frequent discontinuous calcite veinlets. Bedding is offset ~1 mm along some calcite veinlets.	Ynl
95.0	28.95	98.80	30.11	3.80	0.75	65	0.22	19	11	63	35	R3	Medium grey	Fine grained	Bedded, sub-vertically (10 to 250° TCA)	Shale, frequent discontinuous calcite veinlets. Bedding is offset ~1 mm along some calcite veinlets.	Ynl

Depth From (ft)	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition						Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)														
83.8	0	4	3	2	6	15	15			cc			GM	4.4	9.2	6.4	15.0	15	**50**	**50**
86.7	0	1	3	2	6	12	15			cc	gg		GM	4.4	6.0	6.9	12.0	15	**44**	**44**
90.7	0	4	3	2	6	15	15			cc			GM	4.4	10.1	6.1	15.0	15	**51**	**51**
92.0	0	4	3	2	6	15	15			cc			GM	4.4	3.0	5.9	15.0	15	**43**	**43**
95.0	0	4	3	2	6	15	15			cc			GM	4.4	5.3	5.9	15.0	15	**45**	**45**

EOH

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-196

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	**RMR-89 Total** Min. Joint	**RMR-89 Total** Run Average
0.0	0.00	8.0	2.44	8.00		0											OB													JBC							
8.0	2.44	17.50	5.33	9.50	2.25	78	0.00	0	Max	5	0.5	R0	Grey to orangey brown, multicolored	Completely weathered, soil-like	Highly fractured and oxidized	Completely weathered bedrock, clay rich, fragments consists of granodiorite and shale (up to 3 cm diameter)	OB	0	0	1	0	1	2	15			Rub	FeO	cly	JBC	1.1	3.0	5.0	2.0	15	**26**	**26**
17.5	5.33	23.50	7.16	6.00	1.40	77	0.00	0	Max	5	0.5	R0	Orangey brown to orange	Completely weathered, soil-like	Highly fractured and oxidized	Completely weathered bedrock, angular fragments shale, some granodiorite, clay rich	OB	0	0	1	0	1	2	15			Rub	FeO	cly	JBC	1.1	3.0	5.0	2.0	15	**26**	**26**
23.5	7.16	27.30	8.32	3.80	1.17	100	0.12	10	Max	5	1	R1	Brownish grey to orangey brown	Fine grained	Highly fractured and oxidized	Weathered bedrock, some intact pieces - mostly shale	Ynl	0	0	3	0	1	4	15			Rub	FeO	cly	JBC	1.1	4.2	5.0	4.0	15	**29**	**29**
27.3	8.32	32.30	9.84	5.00	1.35	89	0.20	13	Max	5	1	R1	Grey to bluish grey	Fine grained	Highly fractured and oxidized	Shale?, highly weathered, seams of iron oxide and clay, solid pieces can be penetrated by knife	Ynl	0	0	3	0	3	6	15			Rub	FeO	cly	JBC	1.1	4.5	5.0	6.0	15	**32**	**32**
32.3	9.84	37.00	11.28	4.70	1.29	90	0.20	14	Max	5	1	R1	Grey to bluish grey	Fine grained	Highly fractured and oxidized	Shale?, highly weathered, sections (about 20 cm) of oxidized clay reddish orange material	Ynl	0	0	3	0	3	6	15			FeO	cly	Rub	JBC	1.1	4.6	5.0	6.0	15	**32**	**32**
37.0	11.28	41.70	12.71	4.70	0.88	61	0.11	8	Max	5	10	R2	Brownish grey to orangey brown	Fine grained	Highly fractured and oxidized	Shale?, mostly rubble and oxidized material	Ynl	0	0	3	0	3	6	15			Rub	cly	FeO	JBC	2.0	3.9	5.0	6.0	15	**32**	**32**
41.7	12.71	45.00	13.72	3.30	1.02	101	0.41	41	15	64	20	R2	Bluish grey to medium grey	Fine grained	Microfratured, massive, some bedding	Shale?, some clasts up to 2 cm diameter, oxidized joint surfaces	Ynl	0	1	3	0	3	7	15			FeO	cly		JBC	3.0	8.5	5.9	7.0	15	**39**	**39**
45.0	13.72	50.00	15.24	5.00	1.52	100	0.70	46	25	58	20	R2	Bluish grey to medium grey	Fine grained	Microfratured, massive, some bedding	Shale?, some clasts up to 2 cm diameter, oxidized joint surfaces	Ynl	0	1	3	0	3	7	15			Rub	FeO	cly	JBC	3.0	9.3	5.8	7.0	15	**40**	**40**
50.0	15.24	55.00	16.76	5.00	1.52	100	0.46	30	35	42	15	R2	Bluish grey to medium grey	Fine grained	Microfratured, massive, some bedding	Shale?, highly oxidized, sections (up to 5 cm thick), of clayey oxidized rubble	Ynl	0	1	3	0	3	7	15			FeO	cly		JBC	2.5	6.8	5.6	7.0	15	**37**	**37**
55.0	16.76	60.00	18.29	5.00	1.52	100	0.71	47	20	72	20	R2	Grey to light grey	Fine grained	Microfratured, massive, some bedding	Shale?, some clasts up to 2 cm diameter, oxidized joint surfaces	Ynl	0	1	3	0	3	7	15			FeO	cly		JBC	3.0	9.4	6.0	7.0	15	**40**	**40**
60.0	18.29	65.00	19.81	5.00	1.50	98	0.30	20	30	48	15	R2	Grey to light grey	Fine grained	Microfratured, massive, some bedding	Shale, pockets of highly oxidized material, sections (up to 20 cm) of rubble and clay	Ynl	0	0	3	0	3	6	15			Rub	FeO	cly	JBC	2.5	5.4	5.7	6.0	15	**35**	**35**
65.0	19.81	70.00	21.33	5.00	1.52	100	0.69	45	14	101	25	R3	Pale grey to grey	Fine grained	Microfratured, massive, some bedding	Shale?, microfractured, oxidized joint surfaces	Ynl	0	1	3	2	3	9	15			FeO	cly		JBC	3.4	9.2	6.4	9.0	15	**43**	**43**
70.0	21.33	75.00	22.86	5.00	1.51	99	0.66	43	15	94	25	R3	Pale grey to grey	Fine grained	Microfratured, massive, some bedding	Shale?, microfractured, oxidized joint surfaces	Ynl	0	1	3	2	3	9	15			FeO	cly		JBC	3.4	8.9	6.3	9.0	15	**43**	**43**
75.0	22.86	80.00	24.38	5.00	1.52	100	0.62	41	25	58	25	R3	Grey to light grey	Fine grained	Microfratured, massive	Shale, oxidized patches throughout and on joint surfaces, highly fractured,	Ynl	0	1	3	2	3	9	15			FeO	cly		JBC	3.4	8.5	5.8	9.0	15	**42**	**42**
80.0	24.38	85.00	25.91	5.00	1.50	98	0.90	59	10	136	30	R3	Beige-grey	Fine grained	Microfratured, massive	Shale, oxidized zones throughout run. Trace calcite veinlets (oxide stained).	Ynl	0	4	3	2	3	12	15			FeO	cc			3.9	11.6	6.8	12.0	15	**49**	**49**
85.00	25.91	90.00	27.43	5.00	1.54	101	0.87	57	11	128	30	R3	Medium grey	Fine grained	Bedded, ~40-50° TCA	Shale, oxidized zones throughout run. Trace calcite veinlets (oxide stained).	Ynl	0	4	3	2	3	12	15			FeO	cc			3.9	11.3	6.7	12.0	15	**49**	**49**
90.0	27.43	95.00	28.95	5.00	1.50	98	1.06	70	7	188	30	R3	Medium grey	Fine grained	Bedded, ~40-50° TCA	Shale, oxidized zones throughout run. Trace calcite veinlets (oxide stained). 2-3 cm rubble and clay joint at 1.3 m.	Ynl	0	0	3	0	3	6	15			Rub	FeO	cly		3.9	13.6	7.4	6.0	15	**46**	**46**
95.0	28.95	100.00	30.48	5.00	1.53	100	0.59	39	12	118	30	R3	Medium grey	Fine grained	Bedded, ~40-50° TCA	Shale, oxidized zones throughout run. Trace clay infilling on joint.	Ynl	0	4	3	2	3	12	15			FeO	cly			3.9	8.1	6.6	12.0	15	**46**	**46**
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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-197

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Joint Condition Apert- A	Joint Condition Rough R	Joint Condition Infill I	Joint Condition Weath W	Joint Condition TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	1.5	0.46	1.50		0										Topsoil	OB													JBC							
1.5	0.46	4.00	1.22	2.50	0.80	100	0.00	0	Max	5	1	R1	Grey to light grey	Fine grained	Microfractured	Shale, highly oxidized and completely weathered	Ynl	0	0	1	0	1	2	15			cly	FeO		JBC	1.1	3.0	5.0	2.0	15	26	26
4.0	1.22	9.00	2.74	5.00	1.42	93	0.00	0	Max	5	1	R1	Grey to light grey	Fine grained	Microfractured	Shale, highly oxidized and completely weathered, clay rich, some rubble	Ynl	0	0	3	0	1	4	15			Rub	FeO	cly	JBC	1.1	3.0	5.0	4.0	15	28	28
9.0	2.74	14.00	4.27	5.00	1.43	94	0.00	0	Max	5	5	R2	Grey to light grey	Fine grained	Bedded, sub-horizontal, 70 to 80 degrees TCA	Shale, highly fractured run with sections (up to 5 cm) of clay and rubble, moderately weathered	Ynl	0	0	3	0	3	6	15			Rub	cly		JBC	1.5	3.0	5.0	6.0	15	31	31
14.0	4.27	19.00	5.79	5.00	1.45	95	0.10	7	35	40	15	R2	Grey to light grey	Fine grained	Bedded, sub-horizontal, 70 to 80 degrees TCA	Shale, highly fractured run with sections (up to 5 cm) of clay and rubble, moderately weathered, joints along bedding	Ynl	0	1	3	0	3	7	15			cly	FeO		JBC	2.5	3.7	5.6	7.0	15	34	34
19.0	5.79	24.00	7.31	5.00	1.44	94	0.10	7	35	40	15	R2	Grey to light grey	Fine grained	Bedded, sub-horizontal, 70 to 80 degrees TCA	Shale, microfractured, some sections (up to 3 cm) of clayey rubble	Ynl	0	1	3	0	5	9	15			cly	FeO		JBC	2.5	3.7	5.5	9.0	15	36	36
24.0	7.31	29.00	8.84	5.00	1.45	95	0.52	34	30	47	15	R2	Grey to light grey	Fine grained	Bedded, sub-horizontal, 70 to 80 degrees TCA	Shale, microfractured, some sections (up to 3 cm) of clayey rubble, some calcite veinlets, last 60 cm is more intact	Ynl	0	1	3	0	5	9	15			cly	FeO		JBC	2.5	7.4	5.6	9.0	15	40	40
29.0	8.84	34.00	10.36	5.00	1.52	100	0.72	47	20	72	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, lots of discontinuous calcite veinlets, few sections (up to 1 cm) of rubble and clay	Ynl	0	1	3	2	5	11	15			cly	cc	Rub	JBC	4.8	9.5	6.0	11.0	15	46	46
34.0	10.36	39.00	11.89	5.00	1.51	99	0.85	56	13	108	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, lots of discontinuous calcite veinlets, more competent than last run, no rubble sections	Ynl	0	1	3	2	5	11	15			cc	cly		JBC	4.8	11.0	6.4	11.0	15	48	48
39.0	11.89	44.00	13.41	5.00	1.00	66	0.15	10	30	32	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, lots of discontinuous calcite veinlets, low recovery run - possible washout but no evidence of clay	Ynl	0	1	3	0	5	9	15			Rub			JBC	4.8	4.1	5.4	9.0	15	38	38
44.0	13.41	48.40	14.75	4.40	1.57	100	0.58	43	40	38	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, first 30 cm is mainly rubble, large calcite vein at the end of the run, expanded across core diameter	Ynl	0	0	3	0	5	8	15			Rub			JBC	4.8	8.9	5.5	8.0	15	42	42
48.4	14.75	53.40	16.28	5.00	1.50	98	0.44	29	25	58	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, first 1 m of run is the calcite vein - angular fragments of shale (up to 2 cm diameter) are within the vein, sections of rubble	Ynl	0	0	3	0	5	8	15			Rub			JBC	4.8	6.7	5.8	8.0	15	40	40
53.4	16.28	58.60	17.86	5.20	1.51	95	0.42	26	25	58	40	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 60 to 70 degrees TCA	Shale, calcite veinlets throughout, some sections (up to 1 cm) of rubble, highly fractured run, fresh	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	4.8	6.3	5.8	12.0	15	44	44
58.6	17.86	63.70	19.41	5.10	1.50	96	0.35	23	32	45	35	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 60 to 70 degrees TCA	Shale, calcite veinlets throughout, highly fractured run	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	4.4	5.8	5.6	12.0	15	43	43
63.7	19.41	67.40	20.54	3.70	1.20	100	0.42	37	23	50	35	R3	Grey to light grey	Fine grained	Bedded, sub-horizontal, 60 to 70 degrees TCA	Shale, first 30 cm is mainly rubble, large calcite veinlets throughout	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	4.4	7.9	5.7	12.0	15	45	45
67.4	20.54	72.40	22.07	5.00	1.55	100	1.29	85	14	103	50	R4	Grey to light grey	Fine grained	Bedded, sub-horizontal, 60 to 70 degrees TCA	Shale, more competent than before, one section (up to 2 cm) of rubble, calcite veinlets throughout	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	5.7	16.7	6.4	12.0	15	56	56
72.4	22.07	77.40	23.59	5.00	1.54	100	1.00	66	15	96	50	R4	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA	Shale, calcite veinlets throughout	Ynl	0	4	3	2	6	15	15			cc			JBC	5.7	12.8	6.3	15.0	15	55	55
77.4	23.59	85.20	25.97	7.80	2.41	100	1.33	56	35	67	50	R4	Grey to light grey	Fine grained	Bedded, sub-horizontal, 65 to 75 degrees TCA, beds up to 5 mm	Shale, one section (up to 1 cm) of rubble	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	5.7	11.0	5.9	12.0	15	50	50
85.2	25.97	87.70	26.73	2.50	0.75	98	0.60	79	4	150	60	R4	Light grey to pale grey	Fine to coarse grained, porphyritic	Massive, phenocrysts (up to 5 mm)	Intrusive dyke, sharp contact, calcite phenocrysts, fresh, strong	IG	0	4	3	2	6	15	15			cc			JBC	6.5	15.5	7.0	15.0	15	59	59

DRILL RUN DATA

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.
87.7	26.73	92.90	28.31	5.20	1.56	98	0.90	57	8	173	60	R4
92.9	28.31	98.00	29.87	5.10	1.55	100	1.22	78	5	258	50	R4
EOH												

GEOLOGY - COMMENTS / **DISCONTINUITY DATA - RATING SYSTEMS**

Depth From (ft)	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating
87.7	Light grey to pale grey	Fine to coarse grained, porphyritic	Massive, phenocrysts (up to 5 mm)	Intrusive dyke (granodiorite?), joints filled with hematite and calcite	IG	0	4	3	2	6	15	15
92.9	Light grey to pale grey	Fine to coarse grained, porphyritic	Massive, phenocrysts (up to 5 mm), , bedded shale	Intrusive dyke, calcite phenocrysts, fresh, strong - contact with Shale at 96.5 ft, contact is rubble and clay zone (3 cm thick)	IG/Ynl	0	1	3	0	6	10	15

ADDITIONAL DISCONTUITY DATA / **RMR CALCULATIONS**

Depth From (ft)	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
87.7			hem	cc		JBC	6.5	11.2	7.3	15.0	15	**55**	**55**
92.9			Rub	cc		JBC	5.7	15.4	8.3	10.0	15	**54**	**54**

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-198

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
																		Joint Condition																			
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	4.8	1.46	4.80	1.2	0	0									Overburden. Upper 0.5 m is topsoil. 0.5-1.0 m is fine to medium sand, the rest of the run is fractured shale.	OB													GIM							
4.8	1.46	9.00	2.74	4.20	0.70	55	0.00	0	max	5	35	R3	Medium grey	Fine grained	Bedded	Shale, run is completely rubble with soem clay/overburden in residual fractures.	Ynl	0	0	3	0	5	8	15			FeO	cly		GIM	4.4	3.0	5.0	8.0	15	35	35
9.0	2.74	12.30	3.75	3.30	1.00	99	0.00	0	16	59	35	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA), dark grey laminations 1-5 mm thick.	Shale, calcite veins 1-2 mm thick throughout run. Some fractured surfaces are rubbly with trace clay. FeO staining on fractures	Ynl	0	1	3	2	5	11	15			Rub	cc	FeO	GIM	4.4	3.0	5.8	11.0	15	39	39
12.3	3.75	15.50	4.72	3.20	0.90	92	0.00	0	15	56	35	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA), dark grey laminations 1-5 mm thick.	Shale, calcite veins 1-2 mm thick throughout run. FeO staining on fractures	Ynl	0	4	1	2	5	12	15			FeO	cc		GIM	4.4	3.0	5.8	12.0	15	40	40
15.5	4.72	18.50	5.64	3.00	0.85	93	0.00	0	max	5	35	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA), dark grey laminations 1-5 mm thick.	Shale, calcite veins 1-2 mm thick throughout run. FeO staining on fractures. Cuttings at upper 0.2 m from redrilling.	Ynl	0	4	1	2	5	12	15			FeO	cc		GIM	4.4	3.0	5.0	12.0	15	39	39
18.5	5.64	21.70	6.61	3.20	0.98	100	0.00	0	max	5	35	R3	Medium grey	Fine grained	Fractured and rehealed with calcite, structure obscured	Shale, strongly fratured, calcite veins throughout run. Rubbly/clayey fractures 0.5-2 cm thick throughout run.	Ynl	0	1	1	2	3	7	15			Rub	FeO	cly	GIM	4.4	3.0	5.0	7.0	15	34	34
21.7	6.61	26.80	8.17	5.10	1.54	99	0.00	0	30	50	35	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Upper 0.2 m is rubble.	Ynl	0	4	1	2	3	10	15			cc	FeO	Rub	GIM	4.4	3.0	5.7	10.0	15	38	38
26.8	8.17	32.00	9.75	5.20	1.53	97	0.40	25	19	77	35	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins.	Ynl	0	4	1	2	3	10	15			cc	FeO		GIM	4.4	6.1	6.0	10.0	15	42	42
32.0	9.75	37.10	11.31	5.10	1.53	98	0.32	21	17	85	25	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins. Calcite veining itself is discontinuous.	Ynl	0	4	3	2	3	12	15			cc	FeO		GIM	3.4	5.5	6.1	12.0	15	42	42
37.1	11.31	41.50	12.65	4.40	1.35	100	0.00	0	22	59	25	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins. Calcite veining itself is discontinuous.	Ynl	0	4	3	2	3	12	15			cc	FeO		GIM	3.4	3.0	5.8	12.0	15	39	39
41.5	12.65	44.20	13.47	2.70	0.75	91	0.00	0	20	36	25	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1 cm thick sporadically throughout run.	Ynl	0	4	1	2	3	10	15			cc	FeO		GIM	3.4	3.0	5.5	10.0	15	37	37
44.2	13.47	45.80	13.96	1.60	0.46	94	0.00	0	15	29	25	R3	Beige and grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1 cm thick sporadically throughout run.	Ynl	0	4	1	2	3	10	15			cly	FeO	cc	GIM	3.4	3.0	5.4	10.0	15	37	37
45.8	13.96	49.00	14.93	3.20	1.00	100	0.15	15	22	43	25	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, strongly oxidized on fractures. Rubbly joints, <1 cm thick, throughout run with some clay.	Ynl	0	1	1	2	4	8	15			Rub	FeO	cc	GIM	3.4	4.8	5.6	8.0	15	37	37
49.0	14.93	53.40	16.28	4.40	1.30	97	0.22	16	20	62	35	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, strongly oxidized on fractures.	Ynl	0	1	1	2	5	9	15			cc	FeO		GIM	4.4	4.9	5.8	9.0	15	39	39
53.4	16.28	58.80	17.92	5.40	1.06	64	0.60	36	8	118	50	R4	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, trace calcite veinlets throughout run and oxidation onfractures.	Ynl	0	4	1	2	5	12	15			cc	FeO		GIM	5.7	7.8	6.6	12.0	15	47	47
58.8	17.92	64.00	19.51	5.20	1.56	98	0.40	25	max	5	0.5	R0	Beige	Fine grained	massive	Upper 0.35 m is completely weathered to fine sand. 0.35-0.6 m is strongly weathered shale with strong oxidation staining and calcite veining. The rest of the run is unweathered shale.	Fault	0	0	0	0	0	0	15			gg	FeO		GIM	1.1	6.1	5.0	0.0	15	27	27
64.00	19.51	69.00	21.03	5.00	1.44	94	0.00	0	19	72	40	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, 2-10 cm rubble clayey fractures and trace calcite veinlets throughout run.	Ynl	0	0	1	0	5	6	15			Rub	cly		GIM	4.8	3.0	6.0	6.0	15	35	35
69.0	21.03	74.00	22.55	5.00	1.50	98	0.12	8	22	65	40	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, trace calcite veinlets throughout run. Some minor <1 cm rubbly fractures.	Ynl	0	4	1	2	5	12	15			FeO	cc		GIM	4.8	3.9	5.9	12.0	15	42	42

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS							
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
74.0	22.55	79.00	24.08	5.00	1.42	93	0.57	37	22	62	40	R3	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, medium strong, some oxidation on joint surfaces, calcite veinlets throughout	Ynl	0	0	3	0	5	8	15			FeO	cly		JBC	4.8	7.9	5.8	8.0	15	42	42
79.0	24.08	84.00	25.60	5.00	1.52	100	1.12	73	15	95	50	R4	Medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, medium strong, calcite veinlets, more competent than previous but one section (1 cm) of rubble and clay at 80.5 ft	Ynl	0	1	3	0	5	9	15			Rub	cly		JBC	5.7	14.4	6.3	9.0	15	50	50
84.0	25.60	89.00	27.13	5.00	1.50	98	0.43	28	30	48	25	R3	Medium grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout - chaotic, a 17 cm thick section of soil-like (silty clay rich) with angular fragments (up to 1 cm diameter) at 87 ft	Ynl	0	0	3	0	5	8	15			Rub	cly		JBC	3.4	6.6	5.7	8.0	15	39	39
89.0	27.13	93.50	28.50	4.50	1.34	98	0.50	36	18	71	40	R3	Medium grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout, medium strong	Ynl	0	4	3	2	6	15	15			cc	cly		JBC	4.8	7.8	6.0	15.0	15	49	49
93.5	28.50	98.50	30.02	5.00	1.55	100	0.91	60	16	91	45	R3	Medium grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout, medium strong	Ynl	0	1	3	2	6	12	15			cc	Rub		JBC	5.2	11.7	6.2	12.0	15	50	50
EOH																																					

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-201

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	2.0	0.61	2.00	0.1	0	0									Overburden. Upper 0.13m is topsoil. 0.13-0.60 m is fractured shale rubble with silty clay infill	OB													JDC							
2.0	0.61	4.50	1.37	2.50	0.45	59	0.00	0	max	5	5	R2	Dark grey	Fine grained	Bedded	Shale, run is completely rubble with some clay/overburden in residual fractures.	Ynl	0	0	6	0	1	7	15			Rub	FeO		JDC	1.5	3.0	5.0	7.0	15	32	32
4.5	1.37	9.00	2.74	4.50	1.35	98	0.37	27	16	79	25	R3	Dark grey	Fine grained	Very thickly bedded with no discernible bedding.	Shale, fractured surfaces are rubbly with FeO staining on fractures and along joints.	Ynl	0	1	3	2	5	11	15			Rub	cc	FeO	JDC	3.4	6.4	6.1	11.0	15	42	42
9.0	2.74	13.50	4.11	4.50	0.85	62	0.00	0	5	142	15	R2	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA), dark grey laminations 1-5 mm thick.	Shale, calcite veins 1-2 mm thick throughout run. FeO staining on fractures	Ynl	0	1	5	2	1	9	15			FeO	cc		JDC	2.5	3.0	6.9	9.0	15	36	36
13.5	4.11	18.50	5.64	5.00	1.52	100	0.42	28	9	152	50	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA), dark grey laminations 1-5 mm thick.	Shale, calcite veins 1-2 mm thick throughout run. FeO staining on fractures. Cuttings at upper 0.2 m from redrilling.	Ynl	0	4	3	2	5	14	15			FeO	cc		JDC	5.7	6.5	7.0	14.0	15	48	48
18.5	5.64	23.70	7.22	5.20	1.52	96	0.75	47	8	169	60	R4	Dark grey	Fine grained	Fractured and rehealed with calcite, structure obscured	Shale, strongly fratured, calcite veins throughout run. Rubbly/clayey fractures 0.5-2 cm thick throughout run.	Ynl	0	4	3	2	5	14	15			Rub	FeO	cly	JDC	6.5	9.5	7.2	14.0	15	52	52
23.7	7.22	28.70	8.75	5.00	1.52	100	0.31	20	13	109	60	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Upper 0.2 m is rubble.	Ynl	0	4	3	2	5	14	15			cc	FeO	Rub	JDC	6.5	5.5	6.5	14.0	15	47	47
28.7	8.75	30.30	9.23	1.60	0.33	68	0.00	0	0	330	40	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins.	Ynl	0	1	3	2	5	11	15			cc	FeO		JDC	4.8	3.0	9.1	11.0	15	43	43
30.3	9.23	31.30	9.54	1.00	0.32	105	0.10	33	1	160	60	R4	medium grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins. Calcite veining itself is discontinuous.	Ynl	0	4	3	2	5	14	15			cc	FeO		JDC	6.5	7.2	7.1	14.0	15	50	50
31.3	9.54	34.50	10.52	3.20	0.97	100	0.00	0	5	162	40	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1-2 cm thick throughout run. Bedding is offset ~1-3 mm by crosscutting calcite veins. Calcite veining itself is discontinuous.	Ynl	0	1	3	2	5	11	15			cc	FeO		JDC	4.8	3.0	7.1	11.0	15	41	41
34.5	10.52	39.50	12.04	5.00	1.52	100	0.31	20	11	127	40	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1 cm thick sporadically throughout run.	Ynl	0	1	3	2	5	11	15			cc	FeO		JDC	4.8	5.5	6.7	11.0	15	43	43
39.5	12.04	44.50	13.56	5.00	1.52	100	0.42	28	6	217	40	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, beige layers 1 cm thick sporadically throughout run.	Ynl	0	4	3	2	5	14	15			cly	FeO	cc	JDC	4.8	6.5	7.8	14.0	15	48	48
44.5	13.56	49.50	15.09	5.00	1.52	100	0.48	31	6	217	80	R4	Light grey	Medium grained	Massive	Granodiorite	Sill	0	1	3	2	5	11	15			Rub	FeO	cc	JDC	8.0	7.0	7.8	11.0	15	49	49
49.5	15.09	54.50	16.61	5.00	1.52	100	0.11	7	10	138	35	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, strongly oxidized on fractures.	Ynl	0	1	3	2	5	11	15			cc	FeO		JDC	4.4	3.8	6.8	11.0	15	41	41
54.5	16.61	59.50	18.13	5.00	1.52	100	0.48	31	12	117	40	R3	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, trace calcite veinlets throughout run and oxidation onfractures.	Ynl	0	4	3	2	5	14	15			cc	FeO		JDC	4.8	7.0	6.6	14.0	15	47	47
59.5	18.13	64.50	19.66	5.00	1.52	100	0.99	65	4	304	50	R4	Dark grey	Fine grained	massive	Upper 0.35 m is completely weathered to fine sand. 0.35-0.6 m is strongly weathered shale with strong oxidation staining and calcite veining. The rest of the run is unweathered shale.	Ynl	0	4	3	2	5	14	15			gg	FeO		JDC	5.7	12.7	8.8	14.0	15	56	56
64.50	19.66	69.50	21.18	5.00	1.52	100	0.86	56	8	169	50	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, 2-10 cm rubble clayey fractures and trace calcite veinlets throughout run.	Ynl	0	4	3	2	5	14	15			Rub	cly		JDC	5.7	11.1	7.2	14.0	15	53	53
69.5	21.18	74.50	22.71	5.00	1.52	100	0.70	46	11	127	50	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, trace calcite veinlets throughout run. Some minor <1 cm rubbly fractures.	Ynl	0	4	3	2	5	14	15			FeO	cc		JDC	5.7	9.3	6.7	14.0	15	51	51
74.5	22.71	79.50	24.23	5.00	1.52	100	1.07	70	7	190	50	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, medium strong, some oxidation on joint surfaces, calcite veinlets throughout	Ynl	0	4	3	0	6	13	15			FeO	cly		JDC	5.7	13.7	7.5	13.0	15	55	55

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DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS							
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
79.5	24.23	84.50	25.75	5.00	1.52	100	1.17	77	7	190	60	R4	Dark grey	Fine grained	Bedded sub-vertically (~20-30° TCA)	Shale, medium strong, calcite veinlets, more competent than previous but one section (1 cm) of rubble and clay at 80.5 ft	Ynl	0	4	3	2	6	15	15			Rub	cly		JDC	6.5	15.1	7.5	15.0	15	**59**	**59**
84.5	25.75	89.50	27.28	5.00	1.52	100	0.83	54	8	169	60	R4	Dark grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout - chaotic, a 17 cm thick section of soil-like (silty clay rich) with angular fragments (up to 1 cm diameter) at 87 ft	Ynl	0	4	3	2	6	15	15			Rub	cly		JDC	6.5	10.8	7.2	15.0	15	**54**	**54**
89.5	27.28	94.50	28.80	5.00	1.52	100	1.16	76	9	152	70	R4	Dark grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout, medium strong	Ynl	0	4	3	2	6	15	15			cc	cly		JDC	7.3	14.9	7.0	15.0	15	**59**	**59**
94.5	28.80	99.50	30.33	5.00	1.52	100	0.67	44	8	169	60	R4	Dark grey	Fine grained	Bedded sub-vertically (~10-20° TCA)	Shale, calcite veinlets throughout, medium strong	Ynl	0	1	3	2	6	12	15			cc	Rub		JDC	6.5	9.0	7.2	12.0	15	**50**	**50**
EOH																																					

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-202

DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	5.0	1.52	5.00	0.0	0	0										OB
5.0	1.52	9.00	2.74	4.00	1.03	84	0.38	31	6	147	75	R4	Grey to green-grey	Medium grained, inequigranular.			IG
9.0	2.74	14.00	4.27	5.00	1.52	100	0.96	63	7	190	75	R4	Grey to green-grey	Medium grained, inequigranular.			IG
14.0	4.27	19.00	5.79	5.00	1.52	100	0.66	43	8	169	70	R4	Grey to green-grey	Medium grained, inequigranular.			IG
19.0	5.79	22.00	6.71	3.00	0.90	98	0.77	84	3	225	80	R4	Grey to green-grey	Medium grained, inequigranular.			IG
22.0	6.71	27.00	8.23	5.00	1.52	100	0.56	37	10	138	60	R4	Grey to green-grey	Medium grained, inequigranular.			IG
27.0	8.23	29.00	8.84	2.00	0.60	98	0.37	61	12	46	60	R4	Grey to green-grey	Medium grained, inequigranular.			IG
29.0	8.84	34.00	10.36	5.00	1.52	100	0.79	52	5	253	75	R4	Grey to green-grey	Medium grained, inequigranular.			IG
34.0	10.36	39.00	11.89	5.00	1.52	100	1.12	73	3	380	100	R5	Grey to green-grey	Medium grained, inequigranular.			IG
39.0	11.89	44.00	13.41	5.00	1.52	100	0.77	51	7	190	70	R4	Grey to green-grey	Medium grained, inequigranular.			IG
44.0	13.41	49.00	14.93	5.00	1.52	100	0.33	22	18	80	25	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
49.0	14.93	54.00	16.46	5.00	1.52	100	0.64	42	9	152	30	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
54.0	16.46	59.00	17.98	5.00	1.52	100	0.55	36	12	117	30	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
59.0	17.98	64.00	19.51	5.00	1.52	100	0.74	49	9	152	30	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
64.0	19.51	65.80	20.05	1.80	0.46	84	0.19	35	20	22	30	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
65.8	20.05	68.00	20.73	2.20	0.66	98	0.00	0	16	39	25	R3	Medium grey and tan	Fine grained	Thinly bedded		Ynl
68.00	20.73	72.70	22.16	4.70	1.02	71	0.00	0	11	85	10	R2	Medium grey and tan	Fine grained	Thinly bedded		Ynl
72.7	22.16	77.70	23.68	5.00	1.52	100	0.35	23	16	89	40	R3	Medium grey	Fine grained	Thinly bedded		Ynl
77.7	23.68	82.30	25.08	4.60	1.34	96	0.37	26	7	168	40	R3	Medium grey	Fine grained	Thinly bedded		Ynl
82.3	25.08	87.50	26.67	5.20	1.52	96	1.45	91	2	507	50	R4	Medium grey	Fine grained	Thinly bedded		Ynl
87.5	26.67	92.80	28.28	5.30	1.52	94	0.58	36	6	217	35	R3	Medium grey	Fine grained	Thinly bedded		Ynl
92.8	28.28	97.80	29.81	5.00	1.52	100	0.75	49	10	138	45	R3	Medium grey	Fine grained	Thinly bedded		Ynl
EOH																	

Depth From (ft)	DISCONTINUITY DATA - RATING SYSTEMS: Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	ADDITIONAL DISCONTUITY DATA: Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR CALCULATIONS: RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0																				
5.0	0	4	3	2	3	12	15						JDC	7.7	7.0	6.9	12.0	15	49	49
9.0	0	4	3	2	3	12	15						JDC	7.7	12.3	7.5	12.0	15	54	54
14.0	0	4	3	2	5	14	15						JDC	7.3	8.9	7.2	14.0	15	52	52
19.0	0	5	3	2	5	15	15						JDC	8.0	16.6	7.9	15.0	15	63	63
22.0	0	1	3	2	3	9	15						JDC	6.5	7.8	6.8	9.0	15	45	45
27.0	0	1	3	2	3	9	15						JDC	6.5	11.9	5.6	9.0	15	48	48
29.0	0	4	3	2	5	14	15						JDC	7.7	10.3	8.2	14.0	15	55	55
34.0	0	5	3	2	5	15	15						JDC	9.4	14.4	9.6	15.0	15	63	63
39.0	0	4	3	0	3	10	15						JDC	7.3	10.1	7.5	10.0	15	50	50
44.0	0	1	1	2	5	9	15						JDC	3.4	5.6	6.1	9.0	15	39	39
49.0	0	1	1	2	3	7	15						JDC	3.9	8.7	7.0	7.0	15	42	42
54.0	0	1	1	2	3	7	15						JDC	3.9	7.7	6.6	7.0	15	40	40
59.0	0	4	1	2	5	12	15						JDC	3.9	9.8	7.0	12.0	15	48	48
64.0	0	1	3	2	5	11	15						JDC	3.9	7.5	5.3	11.0	15	43	43
65.8	0	1	3	2	3	9	15						JDC	3.4	3.0	5.5	9.0	15	36	36
68.00	0	1	1	0	3	5	15						JDC	2.0	3.0	6.1	5.0	15	31	31
72.7	0	1	1	0	3	5	15						JDC	4.8	5.8	6.2	5.0	15	37	37
77.7	0	4	1	2	5	12	15						JDC	4.8	6.3	7.2	12.0	15	45	45
82.3	0	5	3	2	6	16	15						JDC	5.7	18.2	10.8	16.0	15	66	66
87.5	0	4	3	2	5	14	15						JDC	4.4	7.7	7.8	14.0	15	49	49
92.8	0	4	3	2	5	14	15						JDC	5.2	9.9	6.8	14.0	15	51	51

Print: 2/26/2016 10:51 AM

GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-203

DRILL RUN DATA													GEOLOGY - COMMENTS					DISCONTINUITY DATA - RATING SYSTEMS								ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.	Joint Condition Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	0.00	4.0	1.22	4.00	0.0	0	0										OB													JDC							
4.0	1.22	9.00	2.74	5.00	0.43	28	0.00	0	0	430	5	R2	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	0	5	1	2	8	15						JDC	1.5	3.0	10.1	8.0	15	38	38
9.0	2.74	14.00	4.27	5.00	1.52	100	0.00	0	30	49	10	R2	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	1	3	2	1	7	15						JDC	2.0	3.0	5.7	7.0	15	33	33
14.0	4.27	19.00	5.79	5.00	1.52	100	0.00	0	50	30	15	R2	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	1	3	2	1	7	15						JDC	2.5	3.0	5.4	7.0	15	33	33
19.0	5.79	24.00	7.31	5.00	0.75	49	0.75	49	16	44	10	R2	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	0	3	2	1	6	15						JDC	2.0	9.9	5.6	6.0	15	38	38
24.0	7.31	26.80	8.17	2.80	0.81	95	0.00	0	11	68	25	R3	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	3	2	3	12	15						JDC	3.4	3.0	5.9	12.0	15	39	39
26.8	8.17	31.90	9.72	5.10	1.52	98	0.83	53	14	101	50	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	3	2	5	14	15						JDC	5.7	10.6	6.4	14.0	15	52	52
31.9	9.72	34.00	10.36	2.10	0.64	100	0.52	81	1	320	50	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	3	2	6	16	15						JDC	5.7	16.0	8.9	16.0	15	62	62
34.0	10.36	39.00	11.89	5.00	1.52	100	1.50	98	3	380	60	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	1	2	5	13	15						JDC	6.5	19.8	9.6	13.0	15	64	64
39.0	11.89	44.00	13.41	5.00	1.52	100	1.03	68	5	253	60	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	1	2	5	13	15						JDC	6.5	13.2	8.2	13.0	15	56	56
44.0	13.41	49.00	14.93	5.00	1.52	100	1.42	93	3	380	60	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	1	2	5	13	15						JDC	6.5	18.6	9.6	13.0	15	63	63
49.0	14.93	53.70	16.37	4.70	1.40	98	1.15	80	2	467	70	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	1	2	5	13	15						JDC	7.3	15.8	10.4	13.0	15	62	62
53.7	16.37	58.70	17.89	5.00	1.52	100	0.96	63	6	217	50	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	5	3	2	6	16	15						JDC	5.7	12.3	7.8	16.0	15	57	57
58.7	17.89	63.70	19.41	5.00	1.52	100	1.47	96	5	253	70	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	3	2	6	15	15						JDC	7.3	19.4	8.2	15.0	15	65	65
63.7	19.41	68.90	21.00	5.20	1.52	96	1.47	93	1	760	70	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	3	2	5	14	15						JDC	7.3	18.5	12.9	14.0	15	68	68
68.9	21.00	73.90	22.52	5.00	1.52	100	1.36	89	5	253	70	R4	Medium to dark grey	Fine grained	thinly bedded	Interbedded shale and limestone	Ynl	0	5	3	2	6	16	15						JDC	7.3	17.7	8.2	16.0	15	64	64
73.90	22.52	79.00	24.08	5.10	1.52	98	1.44	93	2	507	70	R4	Medium to dark grey	Fine grained	thinly bedded	Interbedded shale and limestone	Ynl	0	5	1	2	6	14	15						JDC	7.3	18.5	10.8	14.0	15	66	66
79.0	24.08	83.80	25.54	4.80	1.46	100	1.11	76	6	209	70	R4	Medium to dark grey	Fine grained	thinly bedded	Interbedded shale and limestone	Ynl	0	5	1	2	6	14	15						JDC	7.3	14.9	7.7	14.0	15	59	59
83.8	25.54	88.80	27.06	5.00	1.52	100	0.84	55	7	190	60	R4	Medium to dark grey	Fine grained	thinly bedded	Interbedded shale and limestone	Ynl	0	5	1	2	6	14	15						JDC	6.5	10.9	7.5	14.0	15	54	54
88.8	27.06	93.80	28.59	5.00	1.52	100	0.63	41	8	169	60	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	1	2	5	12	15						JDC	6.5	8.6	7.2	12.0	15	49	49
93.8	28.59	99.00	30.17	5.20	1.52	96	1.08	68	8	169	60	R4	Medium to dark grey	Fine grained	thinly bedded	Shale	Ynl	0	4	1	2	5	12	15						JDC	6.5	13.3	7.2	12.0	15	54	54

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-204

DRILL RUN DATA / GEOLOGY - COMMENTS

Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	3.0	0.91	3.00	0.3	0	0		0								OB
3.0	0.91	8.00	2.44	5.00	0.94	62	0.00	0	20	45	10	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
8.0	2.44	13.00	3.96	5.00	1.22	80	0.00	0	12	94	10	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
13.0	3.96	15.50	4.72	2.50	0.45	59	0.00	0	20	21	10	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
15.5	4.72	18.00	5.49	2.50	0.68	89	0.00	0	20	32	5	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
18.0	5.49	23.20	7.07	5.20	1.21	76	0.28	18	15	76	20	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
23.2	7.07	28.20	8.59	5.00	1.52	100	0.59	39	10	138	40	R3	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
28.2	8.59	33.30	10.15	5.10	1.52	98	0.54	35	11	127	40	R3	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
33.3	10.15	38.50	11.73	5.20	1.52	96	1.11	70	6	217	50	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
38.5	11.73	43.70	13.32	5.20	1.52	96	1.27	80	3	380	50	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
43.7	13.32	48.80	14.87	5.10	1.52	98	1.07	69	6	217	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
48.8	14.87	53.80	16.40	5.00	1.52	100	1.39	91	5	253	70	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
53.8	16.40	58.90	17.95	5.10	1.52	98	1.13	73	4	304	70	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
58.9	17.95	64.00	19.51	5.10	1.52	98	0.83	53	3	380	65	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
64.0	19.51	69.00	21.03	5.00	1.52	100	1.34	88	4	304	70	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
69.0	21.03	74.00	22.55	5.00	1.52	100	1.12	73	5	253	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
74.00	22.55	74.80	22.80	0.80	0.15	62	0.12	49	0	150	70	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
74.8	22.80	79.00	24.08	4.20	1.31	102	1.23	96	3	328	70	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
79.0	24.08	84.00	25.60	5.00	1.52	100	1.27	83	3	380	65	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
84.0	25.60	89.00	27.13	5.00	1.52	100	1.30	85	4	304	65	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
89.0	27.13	94.00	28.65	5.00	1.26	83	1.15	75	2	420	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
94.0	28.65	99.10	30.20	5.10	1.28	82	1.01	65	3	320	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl

DISCONTINUITY DATA - RATING SYSTEMS / ADDITIONAL DISCONTUITY DATA / RMR CALCULATIONS

Depth From (ft)	Depth To (ft)	Joint Condition Persis- P	Joint Condition Apert- A	Joint Condition Rough R	Joint Condition Infill I	Joint Condition Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0	3.0													JDC							
3.0	8.00	0	0	3	2	1	6	15						JDC	2.0	3.0	5.6	6.0	15	32	32
8.0	13.00	0	0	3	2	1	6	15						JDC	2.0	3.0	6.3	6.0	15	32	32
13.0	15.50	0	0	3	2	1	6	15						JDC	2.0	3.0	5.3	6.0	15	31	31
15.5	18.00	0	0	5	5	1	11	15						JDC	1.5	3.0	5.4	11.0	15	36	36
18.0	23.20	0	0	3	2	1	6	15						JDC	3.0	5.1	6.0	6.0	15	35	35
23.2	28.20	0	1	3	2	5	11	15						JDC	4.8	8.1	6.8	11.0	15	46	46
28.2	33.30	0	1	3	2	6	12	15						JDC	4.8	7.5	6.7	12.0	15	46	46
33.3	38.50	0	4	1	2	6	13	15						JDC	5.7	13.7	7.8	13.0	15	55	55
38.5	43.70	0	5	1	2	6	14	15						JDC	5.7	15.8	9.6	14.0	15	60	60
43.7	48.80	0	5	1	2	6	14	15						JDC	6.5	13.5	7.8	14.0	15	57	57
48.8	53.80	0	5	1	2	6	14	15						JDC	7.3	18.2	8.2	14.0	15	63	63
53.8	58.90	0	5	1	2	6	14	15						JDC	7.3	14.2	8.8	14.0	15	59	59
58.9	64.00	0	5	1	2	6	14	15						JDC	6.9	10.6	9.6	14.0	15	56	56
64.0	69.00	0	5	1	2	6	14	15						JDC	7.3	17.5	8.8	14.0	15	62	62
69.0	74.00	0	5	1	2	6	14	15						JDC	6.5	14.4	8.2	14.0	15	58	58
74.00	74.80	0	5	1	2	6	14	15						JDC	7.3	9.9	7.0	14.0	15	53	53
74.8	79.00	0	5	1	2	6	14	15						JDC	7.3	19.3	9.0	14.0	15	65	65
79.0	84.00	0	5	1	2	6	14	15						JDC	6.9	16.5	9.6	14.0	15	62	62
84.0	89.00	0	5	3	2	6	16	15						JDC	6.9	16.9	8.8	16.0	15	64	64
89.0	94.00	0	5	3	2	6	16	15						JDC	6.5	14.8	10.0	16.0	15	62	62
94.0	99.10	0	5	3	2	6	16	15						JDC	6.5	12.7	8.9	16.0	15	59	59

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GEOTECHNICAL DRILLHOLE LOGGING DATA SHEET
ROCK MASS CLASSIFICATION - RMR 1989
DRILLHOLE I.D. SC15-205

DRILL RUN DATA													GEOLOGY - COMMENTS				
Depth From (ft)	Depth From (m)	Depth To (ft)	Depth To (m)	Run Length (ft)	Recov. Length (m)	Recov. (%)	RQD Length (m)	RQD (%)	# of Fractures	Average Fracture Spac. (mm)	UCS (Est.) (MPa)	ROCK CLASS.	Rock Colour	Rock Grain Size / Texture	Structure	Other Notes	Field Rock Interp.
0.0	0.00	5.0	1.52	5.00		0											OB
5.0	1.52	8.00	2.44	3.00	0.72	79	0.00	0	15	45	5	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
8.0	2.44	13.00	3.96	5.00	1.52	100	0.13	9	30	49	10	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
13.0	3.96	18.00	5.49	5.00	1.52	100	0.66	43	11	127	20	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
18.0	5.49	23.00	7.01	5.00	1.52	100	0.61	40	13	109	20	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
23.0	7.01	28.00	8.53	5.00	1.52	100	0.27	18	20	72	15	R2	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
28.0	8.53	33.00	10.06	5.00	1.52	100	0.63	41	6	217	40	R3	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
33.0	10.06	38.00	11.58	5.00	1.52	100	0.81	53	6	217	50	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
38.0	11.58	43.00	13.11	5.00	1.52	100	1.27	83	8	169	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
43.0	13.11	48.00	14.63	5.00	1.52	100	1.05	69	3	380	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
48.0	14.63	53.00	16.15	5.00	1.52	100	1.44	94	8	169	65	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
53.0	16.15	58.00	17.68	5.00	1.52	100	1.12	73	6	217	55	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
58.0	17.68	63.00	19.20	5.00	1.52	100	0.95	62	10	138	40	R3	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
63.0	19.20	68.00	20.73	5.00	1.52	100	1.26	83	4	304	60	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
68.0	20.73	73.00	22.25	5.00	1.52	100	1.24	81	3	380	60	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
73.0	22.25	78.00	23.77	5.00	1.52	100	0.98	64	3	380	50	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
78.00	23.77	83.00	25.30	5.00	1.52	100	1.52	100	4	304	70	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
83.0	25.30	88.00	26.82	5.00	1.52	100	1.35	89	2	507	70	R4	Dark grey	Fine grained with clasts		Debris flow conglomerate	Ynl
88.0	26.82	93.00	28.35	5.00	1.52	100	1.17	77	8	169	60	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl
93.0	28.35	98.00	29.87	5.00	1.52	100	1.01	66	9	152	50	R4	Medium to dark grey	Fine grained	Thinly bedded	Shale	Ynl

	DISCONTINUITY DATA - RATING SYSTEMS							ADDITIONAL DISCONTUITY DATA						RMR CALCULATIONS						
	Joint Condition																			
Depth From (ft)	Persis- P	Apert- A	Rough R	Infill I	Weath W	TOTAL (RMR)	Water Rating	Disc. Type	Aper. (mm)	Fill. Type 1 (see Leg)	Fill. Type 2 (see Leg)	Fill. Type 3 (see Leg)	Logger	RMR-89 UCS Rating	RMR-89 RQD Rating	RMR-89 Joint Spac. Rating	RMR-89 Joint Condition Rating	RMR-89 Water Rating	RMR-89 Total Min. Joint	RMR-89 Total Run Average
0.0													JDC							
5.0	0	0	3	2	1	6	15						JDC	1.5	3.0	5.6	6.0	15	31	31
8.0	0	0	3	2	1	6	15						JDC	2.0	4.0	5.7	6.0	15	33	33
13.0	0	1	3	2	1	7	15						JDC	3.0	8.9	6.7	7.0	15	41	41
18.0	0	1	3	2	1	7	15						JDC	3.0	8.4	6.5	7.0	15	40	40
23.0	0	1	3	2	1	7	15						JDC	2.5	5.1	6.0	7.0	15	36	36
28.0	0	4	3	2	5	14	15						JDC	4.8	8.6	7.8	14.0	15	50	50
33.0	0	5	1	2	6	14	15						JDC	5.7	10.6	7.8	14.0	15	53	53
38.0	0	5	1	2	6	14	15						JDC	6.5	16.5	7.2	14.0	15	59	59
43.0	0	5	3	2	6	16	15						JDC	6.5	13.5	9.6	16.0	15	61	61
48.0	0	5	3	2	6	16	15						JDC	6.9	18.9	7.2	16.0	15	64	64
53.0	0	5	3	2	6	16	15						JDC	6.1	14.4	7.8	16.0	15	59	59
58.0	0	5	5	2	6	18	15						JDC	4.8	12.2	6.8	18.0	15	57	57
63.0	0	5	5	2	6	18	15						JDC	6.5	16.3	8.8	18.0	15	65	65
68.0	0	5	5	2	6	18	15						JDC	6.5	16.0	9.6	18.0	15	65	65
73.0	0	5	5	2	6	18	15						JDC	5.7	12.6	9.6	18.0	15	61	61
78.00	0	5	3	2	6	16	15						JDC	7.3	20.1	8.8	16.0	15	67	67
83.0	0	5	3	2	6	16	15						JDC	7.3	17.6	10.8	16.0	15	67	67
88.0	0	5	3	2	6	16	15						JDC	6.5	15.1	7.2	16.0	15	60	60
93.0	0	5	3	2	6	16	15						JDC	5.7	13.0	7.0	16.0	15	57	57

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APPENDIX A4

GEOTECHNICAL TEST PIT LOGS

(Pages A4-1 to A4-45)

Contractor: Brian Zimmerman	Test Pit No.: TP15-01	Page: 1 of 1
Location: Process Water Storage Pond	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,075 E , 5,179,489 N	Total Depth: 1.1 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1780 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.2) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.2 m to 0.5) m Sandy SILT; medium to dark brown, fine grained, trace clay, low plasticity, massive, compact to dense, moist; trace roots.	
1	1779					**SILTY SAND** (0.5 m to 0.7) m Silty SAND; light brown, fine to medium grained, medium plasticity, trace fine shale gravel, massive, dense, moist.	
						WEATHERED BEDROCK (0.7 m to 1.1) m SHALE; highly weathered, highly fractured, some silty sand throughout.	
						End of Test Pit: 1.1 m Sufficient excavation into weathered bedrock	
2	1778						
3	1777						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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VA101-460/03	1	0

FIGURE A4-1

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
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Contractor: Brian Zimmerman	**Test Pit No.:** TP15-02	**Page:** 1 of 1
Location: Process Water Storage Pond	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,197 E , 5,179,536 N	Total Depth: 1 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1785 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.7) m Silty SAND; medium brown, fine to medium grained, trace clay, low plasticity, massive, dense, moist.	
1	1784					**WEATHERED BEDROCK** (0.7 m to 1) m SHALE; light grey / brown, fine grained, highly fractured, highly weathered.	
						End of Test Pit: 1 m Sufficient excavation into weathered bedrock	
2	1783						
3	1782						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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Black Butte Copper Project

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FIGURE A4-2

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-03	Page: 1 of 1
Location: Process Water Storage Pond	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,010 E , 5,179,362 N	Total Depth: 0.6 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1797 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.3) m Sandy SILT; medium brown, fine grained, moist, massive, low plasticity, firm; some organics, trace roots.	
						SANDY SILT (0.3 m to 0.5) m Sandy SILT with gravel; light brown, fine grained, moist massive, low plasticity, firm; well sorted, fine, subangular shale gravel.	
						WEATHERED BEDROCK (0.5 m to 0.6) m SHALE; light grey / brown, fine grained, highly fractured, highly weathered.	
						End of Test Pit: 0.6 m Sufficient excavation into weathered bedrock	
1	1796						
2	1795						
3	1794						

GENERAL REMARKS:

Easy excavation

SAMPLING SYMBOLS:

G B GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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VA101-460/03	1	0

FIGURE A4-3

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A4

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-04	**Page:** 1 of 1
Location: Process Water Storage Pond		Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,135 E , 5,179,405 N		Total Depth: 0.8 m	Date Completed: May 26, 15
Coordinate System: NAD83		Elevation: 1796 m	Logged by: JDC
			Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; dark brown, some roots, loose, moist, no plasticity.	
1	1795					**SANDY SILT** (0.2 m to 0.6) m Sandy SILT; light brown, some woody material, trace clay, low plasticity, massive, firm to compact, moist.	
						(0.6 m to 0.8) m SHALE; light grey, highly fratured, highly weathered, oxidized silty/clayey sand throughout.	
						End of Test Pit: 0.8 m Sufficient excavation into weathered bedrock	
2	1794						
3	1793						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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VA101-460/03	1	0

FIGURE A4-4

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman
Location: Process Water Storage Pond
Coordinates: 506,245 E , 5,179,350 N
Coordinate System: NAD83

Test Pit No.: TP15-05
Equipment Used: Komatsu 210
Total Depth: 0.6 m
Elevation: 1804 m

Page: 1 of 1
Date Started: May 26, 15
Date Completed: May 26, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.3) m Silty SAND, light brown, low plasticity, massive, moist, compact.	
						WEATHERED BEDROCK (0.3 m to 0.6) m SHALE; medium grey, highly weathered, fractured, some silty sand throughout.	
						End of Test Pit: 0.6 m Sufficient excavation into weathered bedrock	
1	1803						
2	1802						
3	1801						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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Black Butte Copper Project

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VA101-460/03	1	0

FIGURE A4-5

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-05B	**Page:** 1 of 1
Location: Process Water Storage Pond		Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,244 E , 5,179,345 N		Total Depth: 0.5 m	Date Completed: May 26, 15
Coordinate System: NAD83		Elevation: 1806 m	Logged by: JDC
			Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.4) m Silty SAND; light brown, some roots, moist, loose to compact, no plasticity, massive.	
						WEATHERED BEDROCK (0.4 m to 0.5) m SHALE; medium grey, highly fractured, highly weathered.	
1	1805					End of Test Pit: 0.5 m Sufficient excavation into weathered bedrock	
2	1804						
3	1803						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

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FIGURE A4-6

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-06	**Page:** 1 of 1	
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15	
Coordinates: 506,659 E , 5,179,290 N	Total Depth: 0.2 m	Date Completed: May 26, 15	
Coordinate System: NAD83	Elevation: 1794 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						SILTY SAND (0 m to 0.2) m Silty SAND; medium brown, some roots, trace organics; topsoil.	
						WEATHERED BEDROCK (0.2 m to 0.4) m GRANODIORITE; orange/brown, highly fractured, highly weathered.	
						End of Test Pit: 0.2 m Sufficient excavation into weathered bedrock	
1	1793						
2	1792						
3	1791						

GENERAL REMARKS:

Easy excavation

SAMPLING SYMBOLS:

GB GRAB

BLOCK

Tintina Resources Inc.
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FIGURE A4-7

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-07	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,490 E , 5,179,210 N	Total Depth: 0.7 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1795 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; medium brown, fine to medium grained, massive, moist, trace roots, slightly oxidized; some relict diorite textures at end of interval.	
1	1794					**WEATHERED BEDROCK** (0.5 m to 0.7) m GRANODIORITE; dark grey with white phenocrysts, highly weathered.	
						End of Test Pit: 0.7 m Sufficient excavation into weathered bedrock	
2	1793						
3	1792						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB ■ BLOCK

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FIGURE A4-8

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-08	**Page:** 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,469 E , 5,179,033 N	Total Depth: 1.7 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1778 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.4) m Silty SAND; dark brown, fine grained, low to no plasticity, trace roots, massive, moist, compact.	
1	1777					**WEATHERED BEDROCK** (0.4 m to 1.7) m SHALE; medium grey and tan, highly weathered, fractured, light brown clayey sand throughout.	
						End of Test Pit: 1.7 m Sufficient excavation into weathered bedrock	
2	1776						
3	1775						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

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FIGURE A4-9

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-09	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,619 E , 5,179,094 N	Total Depth: 1.7 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1781 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.4) m Sandy SILT; dark brown, fine grained, no plasticity, trace roots, massive, moist, compact.	
1	1780					**SILTY SAND** (0.4 m to 1) m Silty SAND; medium brown and orange, highly weathered and oxidized, no plasticity, subangular diorite cobbles, moist.	
						WEATHERED BEDROCK (1 m to 1.7) m GRANODIORITE; highly weathered, highly fractured with orangey/brown sand throughout.	
						End of Test Pit: 1.7 m Sufficient excavation into weathered bedrock	
2	1779						
3	1778						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

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VA101-460/03	1	0

FIGURE A4-10

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-10	**Page:** 1 of 1
Location: South Impoundment		Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,545 E , 5,179,006 N		Total Depth: 0.6 m	Date Completed: May 26, 15
Coordinate System: NAD83		Elevation: 1770 m	Logged by: JDC
			Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; dark brown, fine grained, low plasticity, some roots, massive, moist, compact.	
						WEATHERED BEDROCK (0.2 m to 0.6) m GRANODIORITE; medium grey, highly weathered and fractured, medium brown, medium grained FeO stained silty sand throughout.	
1	1769					End of Test Pit: 0.6 m Sufficient excavation into weathered bedrock	
2	1768						
3	1767						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB   BLOCK

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FIGURE A4-11

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	Test Pit No.: TP15-11	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,418 E , 5,178,864 N	Total Depth: 1.6 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1782 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.3) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.3 m to 1.4) m Silty SAND; medium brown, fine to medium grained, poorly graded shale gravel, no plasticity, massive, moist, compact.	
1	1781						
						WEATHERED BEDROCK (1.4 m to 1.6) m SHALE; dark grey and tan, highly weathered, highly fractured.	
						End of Test Pit: 1.6 m Sufficient excavation into weathered bedrock	
2	1780						
3	1779						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB   BLOCK

Tintina Resources Inc.
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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-12

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-12	**Page:** 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,578 E , 5,178,829 N	Total Depth: 1.8 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1767 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; dark brown, fine to medium grained, poorly graded shale gravel, no plasticity, massive, moist, loose.	
1	1766					**SILTY SAND** (0.2 m to 1.4) m Silty SAND; light brown, fine to medium grained, trace clay, some diorite cobbles and boulders, no plasticity, massive, dry, dense.	
						WEATHERED BEDROCK (1.4 m to 1.8) m GRANODIORITE; highly weathered, highly fractured, orange/brown coarse grained sand throughout.	
2	1765					End of Test Pit: 1.8 m Sufficient excavation into weathered bedrock	
3	1764						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-13

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-13	**Page:** 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,531 E , 5,178,726 N	Total Depth: 1.4 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1782 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.7) m Silty SAND; medium brown, fine to medium grained, trace clay, poorly graded shale gravel, low plasticity, massive, moist, dense.	
1	1781					**WEATHERED BEDROCK** (0.7 m to 1.4) m SHALE; highly fractured, highly weathered, orange/brown FeO staining throughout bedded rock.	
						End of Test Pit: 1.4 m Sufficient excavation into weathered bedrock	
2	1780						
3	1779						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-14

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Appendix: A4

Contractor: Brian Zimmerman	Test Pit No.: TP15-14	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,731 E , 5,179,489 N	Total Depth: 1.4 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1782 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.3) m Silty SAND; dark brown, fine to medium grained, trace roots, low plasticity, massive, moist, loose.	
1	1781					**SILTY SAND** (0.3 m to 0.6) m Silty SAND; light brown, medium grained, trace clay, low plasticity, massive, moist, dense.	
						WEATHERED BEDROCK (0.6 m to 1.4) m GRANODIORITE; highly weathered, relic textures with some diorite clasts, more intatc diorite cobbles at bottom.	
2	1780					End of Test Pit: 1.4 m Sufficient excavation into weathered bedrock	
3	1779						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB   BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-15

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-15	**Page:** 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,725 E , 5,179,123 N	Total Depth: 1.5 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1782 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.7) m Silty SAND; dark brown, fine grained, trace roots, no plasticity, massive, moist, compact.	
1	1781					**SAND WITH SILT** (0.7 m to 1.4) m SAND with silt; light brown, fine to coarse grained, trace clay, no plasticity, trace diorite clasts	
						WEATHERED BEDROCK (1.4 m to 1.5) m GRANODIORITE; weathered and fractured, fairly competent.	
						End of Test Pit: 1.5 m Sufficient excavation into weathered bedrock	
2	1780						
3	1779						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-16	**Page:** 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 26, 15
Coordinates: 506,710 E , 5,179,044 N	Total Depth: 0.8 m	Date Completed: May 26, 15
Coordinate System: NAD83	Elevation: 1773 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.2) m Sandy SILT; dark brown, fine grained, trace roots, no plasticity, massive, moist, firm.	
						WEATHERED BEDROCK (0.2 m to 0.8) m DEBRIS FLOW CONGLOMERATE; highly fractured, highly weathered, oxidized, silty sand with clay throughout.	
1	1772					End of Test Pit: 0.8 m Sufficient excavation into weathered bedrock	
2	1771						
3	1770						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

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Black Butte Copper Project

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Project No.	Ref. No.	Rev.
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FIGURE A4-17

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A4

Contractor: Brian Zimmerman
Location: South Impoundment
Coordinates: 506,698 E , 5,178,905 N
Coordinate System: NAD83

Test Pit No.: TP15-17
Equipment Used: Komatsu 210
Total Depth: 3.9 m
Elevation: 1757 m

Page: 1 of 1
Date Started: May 27, 15
Date Completed: May 27, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.6) m Silty SAND; dark brown, fine grained, trace roots, no plasticity, massive, moist, loose.	
1	1756					**SILTY SAND** (0.6 m to 1.6) m Silty SAND; light grey/brown, fine to coarse grained, no plasticity, dense, massive.	
2	1755					**SAND** (1.6 m to 2.6) m SAND; orange, medium to coarse grained, highly oxidized; water seepage at ~2.5mbgs.	
3	1754					**WEATHERED BEDROCK** (2.6 m to 3.9) m GRANODIORITE; highly fractured, highly weathered, orange/brown, highly oxidized, wet.	

End of Test Pit: 3.9 m
Sufficient excavati

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB
BLOCK

Tintina Resources Inc.
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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-18

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	Test Pit No.: TP15-18	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 27, 15
Coordinates: 506,662 E , 5,178,851 N	Total Depth: 0.9 m	Date Completed: May 27, 15
Coordinate System: NAD83	Elevation: 1764 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.2) m TOPSOIL; dark brown, organics, roots, needles.	
						SANDY SILT (0.2 m to 0.6) m Sandy SILT; light brown, fine to medium grained, trace roots, no plasticity, massive, dry, firm, slightly oxidized (orange/brown) at bedrock contact.	
1	1763					**WEATHERED BEDROCK** (0.6 m to 0.9) m GRANODIORITE; fractured, weathered, slightly oxidized.	
						End of Test Pit: 0.9 m Sufficient excavation into weathered bedrock	
2	1762						
3	1761						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

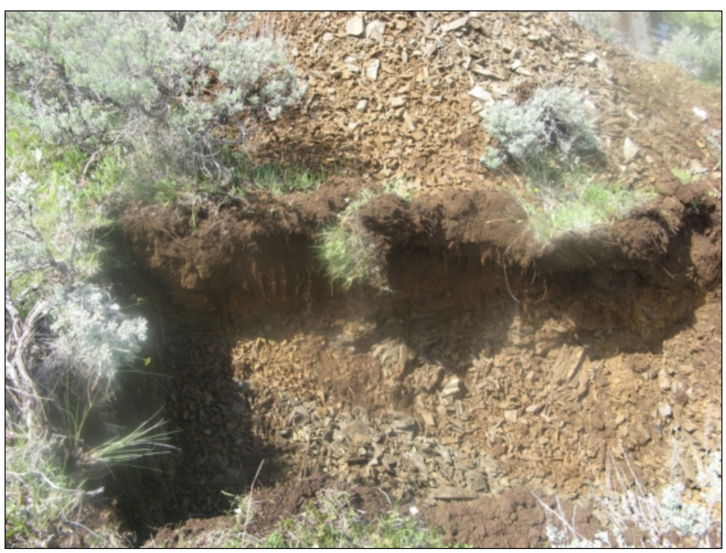
FIGURE A4-19

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-19	Page: 1 of 1	
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 27, 15	
Coordinates: 506,768 E , 5,178,852 N	Total Depth: 0.8 m	Date Completed: May 27, 15	
Coordinate System: NAD83	Elevation: 1762 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.3) m Sandy SILT; dark brown, fine to medium grained, trace roots, no plasticity, massive, compact, moist.	
						WEATHERED BEDROCK (0.3 m to 0.8) m SHALE; light grey/brown, highly weathered, highly fractured, oxidized.	
						End of Test Pit: 0.8 m Sufficient excavation into weathered bedrock	
1	1761						
2	1760						
3	1759						



GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-20

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-20	**Page:** 1 of 1	
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 27, 15	
Coordinates: 506,766 E , 5,178,916 N	Total Depth: 2.6 m	Date Completed: May 27, 15	
Coordinate System: NAD83	Elevation: 1756 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
1	1755					**SILTY SAND** (0.1 m to 1.4) m Sandy SILT; dark brown, fine to medium grained, trace roots, no plasticity, moist, dense; some subangular, well sorted shale gravel.	
2	1754					**WEATHERED BEDROCK** (1.4 m to 2.6) m SHALE; light grey/brown, highly weathered, highly fractured.	
3	1753					End of Test Pit: 2.6 m Sufficient excavation into weathered bedrock	

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-21

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Appendix: A4

Contractor: Brian Zimmerman	Test Pit No.: TP15-21	Page: 1 of 1
Location: South Impoundment	Equipment Used: Komatsu 210	Date Started: May 27, 15
Coordinates: 506,783 E , 5,179,069 N	Total Depth: 0.6 m	Date Completed: May 27, 15
Coordinate System: NAD83	Elevation: 1775 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Sandy SILT; dark brown, fine grained, trace roots, no plasticity, moist, loose.	
						WEATHERED BEDROCK (0.2 m to 0.6) m SHALE; medium grey, highly weathered, highly fractured, oxidized.	
						End of Test Pit: 0.6 m Sufficient excavation into weathered bedrock	
1	1774						
2	1773						
3	1772						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-22

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-22	**Page:** 1 of 1
Location: Process Water Pond (Alternate)	Equipment Used: Komatsu 210	Date Started: May 27, 15
Coordinates: 506,394 E , 5,178,475 N	Total Depth: 1.1 m	Date Completed: May 27, 15
Coordinate System: NAD83	Elevation: 1818 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.2) m Sandy SILT; medium brown, fine to medium grained, trace clay, trace roots, low plasticity, massive, moist, firm.	
1	1817					**WEATHERED BEDROCK** (0.2 m to 1.1) m SHALEY LIMESTONE; orangey brown, highly weathered, highly fractured, oxide staining throughout rock, decomposed to dense silty clay in parts with limestone clasts.	
						End of Test Pit: 1.1 m Sufficient excavation into weathered bedrock	
2	1816						
3	1815						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-23

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-23	**Page:** 1 of 1	
Location: Process Water Pond (Alternate)	Equipment Used: Komatsu 210	Date Started: May 27, 15	
Coordinates: 506,505 E , 5,178,367 N	Total Depth: 1.5 m	Date Completed: May 27, 15	
Coordinate System: NAD83	Elevation: 1818 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.4) m Sandy SILT; light brown, fine to medium grained, trace clay, some roots, low plasticity, massive, moist, firm; some poorly graded, subangular, shale gravel.	
1	1817					**WEATHERED BEDROCK** (0.4 m to 0.9) m SHALE; light orange/brown, highly fractured, highly weathered, oxidized, silty clay infilling.	
						WEATHERED BEDROCK (0.9 m to 1.5) m SHALE; medium grey / brown, highly fractured, highly weathered, oxidized.	
						End of Test Pit: 1.5 m Sufficient excavation into weathered bedrock	
2	1816						
3	1815						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-24

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-24	Page: 1 of 1
Location: Process Water Pond (Alternate)	Equipment Used: Komatsu 210	Date Started: May 27, 15
Coordinates: 506,378 E , 5,178,405 N	Total Depth: 2.1 m	Date Completed: May 27, 15
Coordinate System: NAD83	Elevation: 1809 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 1.1) m Sandy SILT; medium brown, fine to medium grained, trace clay, some roots, low plasticity, massive, moist, firm; some poorly graded, subangular, shale gravel.	
1	1808					**WEATHERED BEDROCK** (1.1 m to 2.1) m SHALE; light brown/grey, highly fractured, highly weathered, some FeO staining, silty clay infilling.	
2	1807					End of Test Pit: 2.1 m Sufficient excavation into weathered bedrock	
3	1806						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB   BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-25

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman
Location: Process Water Pond (Alternate)
Coordinates: 506,307 E , 5,178,406 N
Coordinate System: NAD83

Test Pit No.: TP15-25
Equipment Used: Komatsu 210
Total Depth: 2.1 m
Elevation: 1821 m

Page: 1 of 1
Date Started: May 27, 15
Date Completed: May 27, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 1.8) m Silty SAND; medium brown, fine to medium grained, trace clay, low plasticity, massive, moist, firm.	
1	1820						
						WEATHERED BEDROCK (1.8 m to 2.1) m SHALE; light brown/grey, highly fractured, highly weathered, FeO staining throughout.	
2	1819					End of Test Pit: 2.1 m Sufficient excavation into weathered bedrock	
3	1818						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-26

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman
Location: Process Water Pond (Alternate)
Coordinates: 506,274 E , 5,178,292 N
Coordinate System: NAD83

Test Pit No.: TP15-26
Equipment Used: Komatsu 210
Total Depth: 1.2 m
Elevation: 1823 m

Page: 1 of 1
Date Started: May 27, 15
Date Completed: May 27, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 1) m Sandy SILT; light brown, fine to medium grained, some roots, no plasticity, massive, dry, firm; poorly graded, some subangular, shale gravel.	
1	1822					**WEATHERED BEDROCK** (1 m to 1.2) m SHALE; light brown/grey, highly fractured, highly weathered, some FeO staining.	
						End of Test Pit: 1.2 m Sufficient excavation into weathered bedrock	
2	1821						
3	1820						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-27

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-27		**Page:** 1 of 1	
Location: Process Water Pond (Alternate)		Equipment Used: Komatsu 210		Date Started: May 27, 15	
Coordinates: 506,322 E , 5,178,273 N		Total Depth: 1.3 m		Date Completed: May 27, 15	
Coordinate System: NAD83		Elevation: 1822 m		Logged by: JDC	
				Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.2) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.2 m to 0.7) m Sandy SILT; light brown, fine to medium grained, some roots, no plasticity, massive, dry, firm; some poorly graded, subangular, shale gravel.	
1	1821					**WEATHERED BEDROCK** (0.7 m to 1.2) m SHALE; light brown/grey, highly fractured, highly weathered, FeO staining throughout, silty clay infilling.	
						WEATHERED BEDROCK (1.2 m to 1.3) m SHALE; light grey/brown, fractured, highly weathered, bedded.	
						End of Test Pit: 1.3 m Sufficient excavation into weathered bedrock	
2	1820						
3	1819						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-28

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-28	**Page:** 1 of 1
Location: Process Water Pond (Alternate)	Equipment Used: Komatsu 210	Date Started: May 27, 15
Coordinates: 506,403 E , 5,178,285 N	Total Depth: 1.4 m	Date Completed: May 27, 15
Coordinate System: NAD83	Elevation: 1830 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.2) m Sandy SILT; dark brown, fine to medium grained, some roots, trace clay, low plasticity, massive, moist, firm; some poorly graded, subangular, shale gravel.	
1	1829					**WEATHERED BEDROCK** (0.2 m to 1) m SHALE; light brown/grey, highly fractured, highly weathered, some FeO staining, silty clay infilling throughout.	
						WEATHERED BEDROCK (1 m to 1.4) m SHALE; light grey/brown, fractured, highly weathered, bedded, some silty clay infilling.	
						End of Test Pit: 1.4 m Sufficient excavation into weathered bedrock	
2	1828						
3	1827						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-29

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A4

Contractor: Brian Zimmerman	Test Pit No.: TP15-29	Page: 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,539 E , 5,178,679 N	Total Depth: 1.7 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1774 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.3) m Sandy SILT; dark brown, fine to medium grained, trace roots, trace clay, no plasticity, massive, moist, firm; trace poorly graded, subangular, shale gravel.	
1	1773					**SANDY SILT** (0.3 m to 1) m Sandy SILT; light brown, fine to medium grained, trace roots, no plasticity, massive, dry, firm; trace poorly graded, subangular, shale gravel.	
						WEATHERED BEDROCK (1 m to 1.5) m SHALE; light brown/grey, highly fractured, highly weathered, silty sand infilling throughout.	
2	1772					**WEATHERED BEDROCK** (1.5 m to 1.7) m SHALE; highly weathered, highly fractured, FeO stained.	
						End of Test Pit: 1.7 m Sufficient excavation into weathered bedrock	
3	1771						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB ■ BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-30

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-30	**Page:** 1 of 1	
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15	
Coordinates: 507,562 E , 5,178,612 N	Total Depth: 2.3 m	Date Completed: Jun 4, 15	
Coordinate System: NAD83	Elevation: 1773 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.4) m Silty SAND; dark brown, fine to medium grained, low plasticity, massive, moist, compact.	
1	1772					**SILTY SAND** (0.4 m to 1.7) m Silty SAND; medium brown, fine to medium grained, low plasticity, massive, moist, compact to dense.	
2	1771					**WEATHERED BEDROCK** (1.7 m to 2.3) m SHALE; grey/brown, highly weathered, highly fractured, some FeO staining.	
						End of Test Pit: 2.3 m Sufficient excavation into weathered bedrock	
3	1770						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-31

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	Test Pit No.: TP15-31	Page: 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,538 E , 5,178,578 N	Total Depth: 2.1 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1776 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.4) m Silty SAND; medium brown, fine to medium grained, low plasticity, massive, moist, loose, trace roots; some poorly graded, subangular shale gravel.	
1	1775					**SILTY SAND** (0.4 m to 0.8) m Silty SAND; brown/orange, fine to medium grained, low plasticity, massive, moist, compact; some poorly graded, subangular shale gravel.	
						WEATHERED BEDROCK (0.8 m to 2.1) m SHALE; orange/grey, highly weathered, highly fractured, FeO stained.	
2	1774						
						End of Test Pit: 2.1 m Sufficient excavation into weathered bedrock	
3	1773						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

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Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-32

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-32	**Page:** 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,699 E , 5,178,733 N	Total Depth: 1.8 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1774 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; dark brown, trace roots, fine to medium grained, low plasticity, massive, moist, compact.	
1	1773					**SILTY SAND** (0.5 m to 1.3) m Silty SAND; light brown, fine to medium grained, no plasticity, massive, dry, compact.	
						WEATHERED BEDROCK (1.3 m to 1.8) m SHALE; brown, highly weathered, highly fractured, silty sand infilling.	
						End of Test Pit: 1.8 m Sufficient excavation into weathered bedrock	
2	1772						
3	1771						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-33

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman
Location: Non Contact Water Reservoir
Coordinates: 507,700 E , 5,178,695 N
Coordinate System: NAD83

Test Pit No.: TP15-33
Equipment Used: Komatsu 210
Total Depth: 1.9 m
Elevation: 1769 m

Page: 1 of 1
Date Started: Jun 4, 15
Date Completed: Jun 4, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SANDY SILT (0.1 m to 0.7) m Sandy SILT; dark brown, trace roots, fine to medium grained, low plasticity, massive, moist, compact.	
1	1768					**SANDY SILT** (0.7 m to 1.8) m Sandy SILT; light brown, fine to medium grained, no plasticity, massive, dry, compact.	
2	1767					**WEATHERED BEDROCK** (1.8 m to 1.9) m SHALE; medium brown, weathered, highly fractured.	
						End of Test Pit: 1.9 m Sufficient excavation into weathered bedrock	
3	1766						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
G B GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-34

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-34	**Page:** 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,685 E , 5,178,620 N	Total Depth: 1.2 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1772 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.3) m Silty SAND; medium brown, trace roots, trace clay, fine to medium grained, low plasticity, massive, moist, compact, some poorly graded, subangular shale gravel.	
1	1771					**WEATHERED BEDROCK** (0.3 m to 1.2) m SHALE; brown/grey, highly weathered, highly fractured.	
						End of Test Pit: 1.2 m Sufficient excavation into weathered bedrock	
2	1770						
3	1769						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-35

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A4

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-35	**Page:** 1 of 1
Location: Non Contact Water Reservoir		Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,861 E , 5,178,588 N		Total Depth: 1.1 m	Date Completed: Jun 4, 15
Coordinate System: NAD83		Elevation: 1773 m	Logged by: JDC
			Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; medium brown, trace roots, fine to medium grained, no plasticity, massive, moist, loose; some poorly graded, subangular shale gravel.	
1	1772					**WEATHERED BEDROCK** (0.2 m to 1.1) m SHALE; brown/grey, highly weathered, highly fractured.	
						End of Test Pit: 1.1 m Sufficient excavation into weathered bedrock	
2	1771						
3	1770						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-36

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-36	**Page:** 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,875 E , 5,178,652 N	Total Depth: 1 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1764 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; dark brown, some roots, fine to medium grained, no plasticity, massive, moist, loose; some poorly graded, subangular shale gravel.	
1	1763					**WEATHERED BEDROCK** (0.2 m to 1) m SHALE; brown/grey, highly weathered, highly fractured, some FeO staining.	
						End of Test Pit: 1 m Sufficient excavation into weathered bedrock	
2	1762						
3	1761						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB   BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-37

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-37	**Page:** 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 2, 15
Coordinates: 507,830 E , 5,178,744 N	Total Depth: 1 m	Date Completed: Jun 2, 15
Coordinate System: NAD83	Elevation: 1775 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots.	
						SILTY SAND (0.1 m to 0.2) m Silty SAND; dark brown, some roots, fine to medium grained, no plasticity, massive, moist, loose; some poorly graded, subangular shale gravel.	
1	1774					**WEATHERED BEDROCK** (0.2 m to 1) m SHALE; brown/grey, highly weathered, highly fractured, some FeO staining.	
						End of Test Pit: 1 m Sufficient excavation into weathered bedrock	
2	1773						
3	1772						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-38

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-38	**Page:** 1 of 1
Location: Non Contact Water Reservoir	Equipment Used: Komatsu 210	Date Started: Jun 2, 15
Coordinates: 507,920 E , 5,178,783 N	Total Depth: 0.8 m	Date Completed: Jun 2, 15
Coordinate System: NAD83	Elevation: 1768 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.2) m Silty SAND; dark brown, organics, roots; some poorly graded, subangular shale gravel.	
						WEATHERED BEDROCK (0.2 m to 0.8) m SHALE; grey/brown, highly weathered, highly fractured, some FeO staining throughout, silty sand infilling.	
1	1767					End of Test Pit: 0.8 m Sufficient excavation into weathered bedrock	
2	1766						
3	1765						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-39

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman		**Test Pit No.:** TP15-39	**Page:** 1 of 1
Location: Non Contact Water Reservoir		Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 507,961 E , 5,178,671 N		Total Depth: 1.2 m	Date Completed: Jun 4, 15
Coordinate System: NAD83		Elevation: 1760 m	Logged by: JDC
			Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; medium brown, trace roots, fine to medium grained, trace clay, medium plasticity, massive, moist, compact.	
1	1759					**WEATHERED BEDROCK** (0.5 m to 1.2) m SHALE; brown/grey, highly weathered, highly fractured, some FeO staining.	
						End of Test Pit: 1.2 m Sufficient excavation into weathered bedrock	
2	1758						
3	1757						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB ■ BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-40

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-40	**Page:** 1 of 1
Location: Proposed Portal	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 506,919 E , 5,179,822 N	Total Depth: 1.2 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1787 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.3) m Silty SAND; medium brown, fine to medium grained, trace clay, medium plasticity, massive, moist, compact; trace poorly graded, subangular shale gravel.	
1	1786					**WEATHERED BEDROCK** (0.3 m to 1.2) m SHALE; brown/grey, highly weathered, highly fractured, FeO staining throughout, silty sand infilling.	
						End of Test Pit: 1.2 m Sufficient excavation into weathered bedrock	
2	1785						
3	1784						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-41

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Appendix: A4

Contractor: Brian Zimmerman
Location: Proposed Portal
Coordinates: 506,989 E , 5,179,808 N
Coordinate System: NAD83

Test Pit No.: TP15-41
Equipment Used: Komatsu 210
Total Depth: 2.4 m
Elevation: 1790 m

Page: 1 of 1
Date Started: Jun 4, 15
Date Completed: Jun 4, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.9) m Silty SAND; medium brown, trace roots, fine to medium grained, low plasticity, massive, moist, compact.	
1	1789					**SILTY SAND** (0.9 m to 1.5) m Silty SAND; brown, medium grained, no plasticity, massive, moist, dense.	
2	1788					**WEATHERED BEDROCK** (1.5 m to 2.4) m SHALE; orange/brown, highly weathered, highly fractured, FeO staining throughout, silty sand infilling.	
3	1787					End of Test Pit: 2.4 m Sufficient excavation into weathered bedrock	

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-42

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-42	**Page:** 1 of 1	
Location: Proposed Portal	Equipment Used: Komatsu 210	Date Started: Jun 4, 15	
Coordinates: 507,059 E , 5,179,806 N	Total Depth: 1.6 m	Date Completed: Jun 4, 15	
Coordinate System: NAD83	Elevation: 1791 m	Logged by: JDC	
		Reviewed by: GIM	

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; medium brown, trace roots, fine to medium grained, no plasticity, massive, dry, compact.	
1	1790					**WEATHERED BEDROCK** (0.5 m to 1.6) m SHALE; highly weathered, highly fractured, silty sand infilling.	
						End of Test Pit: 1.6 m Sufficient excavation into weathered bedrock	
2	1789						
3	1788						

GENERAL REMARKS:

Easy excavation

SAMPLING SYMBOLS:

GB GRAB   BLOCK

Tintina Resources Inc.
Black Butte Copper Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-43

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

Contractor: Brian Zimmerman
Location: Proposed Portal
Coordinates: 506,993 E , 5,179,873 N
Coordinate System: NAD83

Test Pit No.: TP15-43
Equipment Used: Komatsu 210
Total Depth: 1.9 m
Elevation: 1797 m

Page: 1 of 1
Date Started: Jun 4, 15
Date Completed: Jun 4, 15
Logged by: JDC
Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; medium brown, trace roots, fine to medium grained, trace clay, low plasticity, massive, moist, compact.	
1	1796					**WEATHERED BEDROCK** (0.5 m to 1.1) m SHALE; highly weathered, highly fractured, silty sand infilling.	
						WEATHERED BEDROCK (1.1 m to 1.9) m GRANODIORITE regolith; completely weathered, light brown, trace shale clasts throughout.	
2	1795					End of Test Pit: 1.9 m Sufficient excavation into weathered bedrock	
3	1794						

GENERAL REMARKS:
Easy excavation

SAMPLING SYMBOLS:
GB GRAB
BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-44

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

Contractor: Brian Zimmerman	**Test Pit No.:** TP15-44	**Page:** 1 of 1
Location: Proposed Portal	Equipment Used: Komatsu 210	Date Started: Jun 4, 15
Coordinates: 506,994 E , 5,179,964 N	Total Depth: 0.8 m	Date Completed: Jun 4, 15
Coordinate System: NAD83	Elevation: 1785 m	Logged by: JDC
		Reviewed by: GIM

DEPTH - (m)	ELEVATION - (m)	SAMPLES	SAMPLE NO.	GRAPHIC LOG	WATER LEVEL	MATERIAL DESCRIPTION	COMMENTS
						TOPSOIL (0 m to 0.1) m TOPSOIL; dark brown, organics, roots, silty sand.	
						SILTY SAND (0.1 m to 0.5) m Silty SAND; medium brown, fine to medium grained, no plasticity, massive, moist, compact.	
1	1784					**WEATHERED BEDROCK** (0.5 m to 0.8) m SHALE; slightly weathered, highly fractured, silty sand infilling.	
						End of Test Pit: 0.8 m Sufficient excavation into weathered bedrock	
2	1783						
3	1782						

GENERAL REMARKS:

Easy excavation

SAMPLING SYMBOLS:

GB GRAB ■ BLOCK

Tintina Resources Inc.
Black Butte Copper Project

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Project No.	Ref. No.	Rev.
VA101-460/03	1	0

FIGURE A4-45

Logging conducted according to the ASTM 2488 standard and the Canadian Foundation Engineering Manual, 4th Edition, 2006.

File:M:\1\01\00460\03\A\DATA\GINT\PROJECTS\BBCP TEST PITS.GPJ
Library: M:\1\01\00093\07\A\DATA\TASK 600 - SITE INVESTIGATIONS\GINT\LIBRARY\2015 KP CANADA GINT LIBRARY - REV A.GLB, TEST PIT LOG WITH PHOTO - PORTRAIT, 2015 KP CANADA GINT DATA TEMPLATE - REV A.GDT, Mar 3, 16

APPENDIX B

HYDROGEOLOGICAL DRILLHOLE DATA

(Pages B-1 to B-72)

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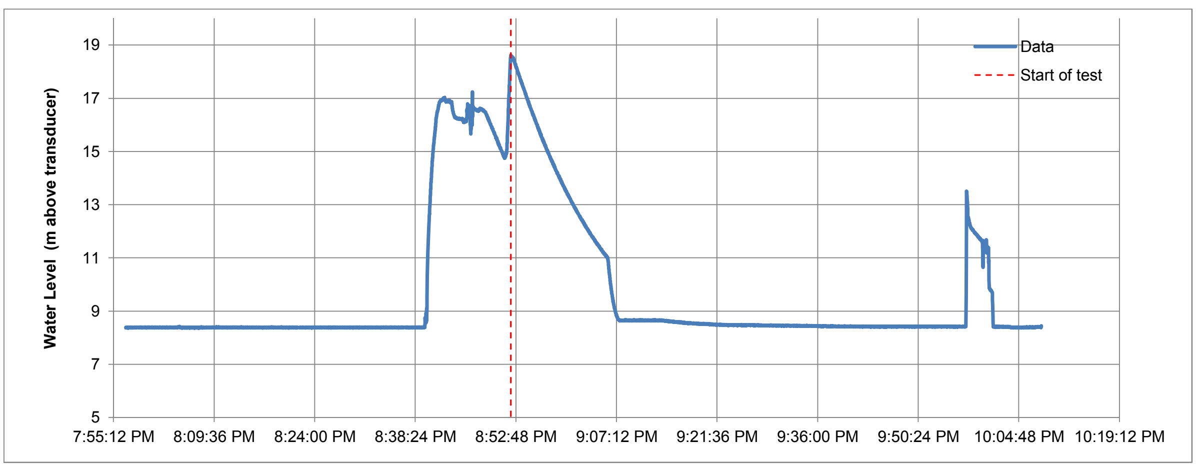
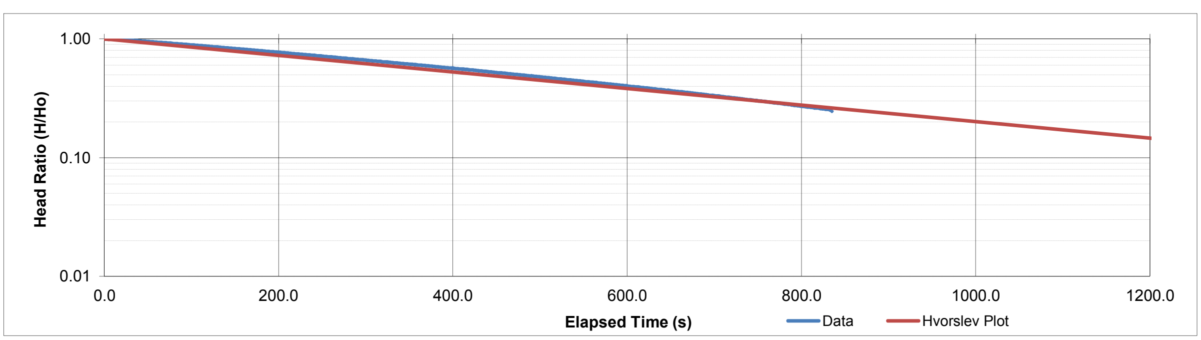
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 12:53

Project No.	VA101-460/03		**Drillhole**	**SC15-180**	
Field Technician	JBC		**Test No.**	1	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	19	L of water	**Packer Inflation Time**	5:51:46 PM	
Test Date	4-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	8:52:05 PM	
Top of test interval	8.1	**m along hole**	**Initial water level**	8.40	**m above transducer**
Bottom of test interval	19.5	**m along hole**	**Water level after slug**	18.61	**m above transducer**
Test length, L	11.4	**m along hole**	**Change in Water Level, H_o**	10.21	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	4	**m**
Transmissivity, T	7E-06	**m^2/s**			
Hydraulic Conductivity, K	6E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	4MAR'15	ISSUED WITH REPORT	JBC	GIM

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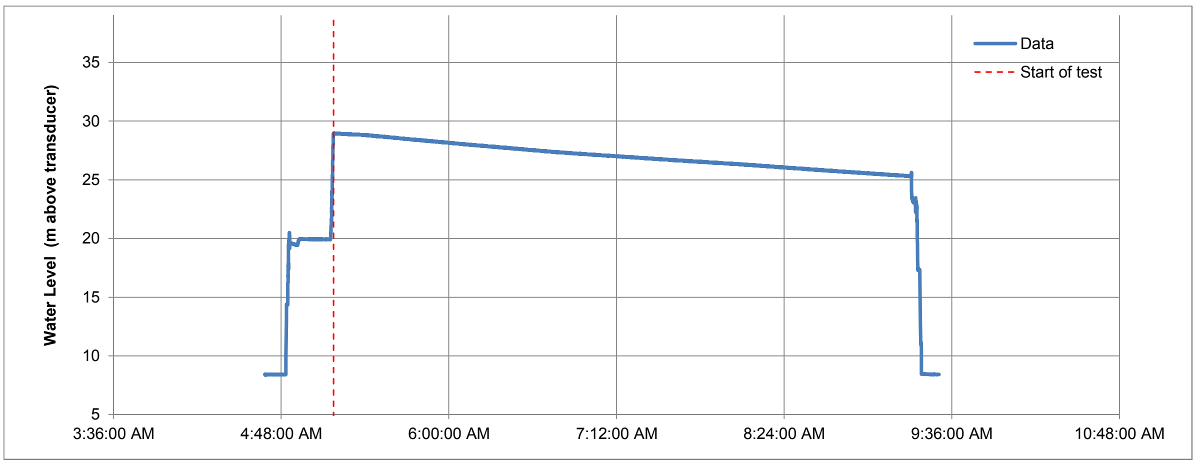
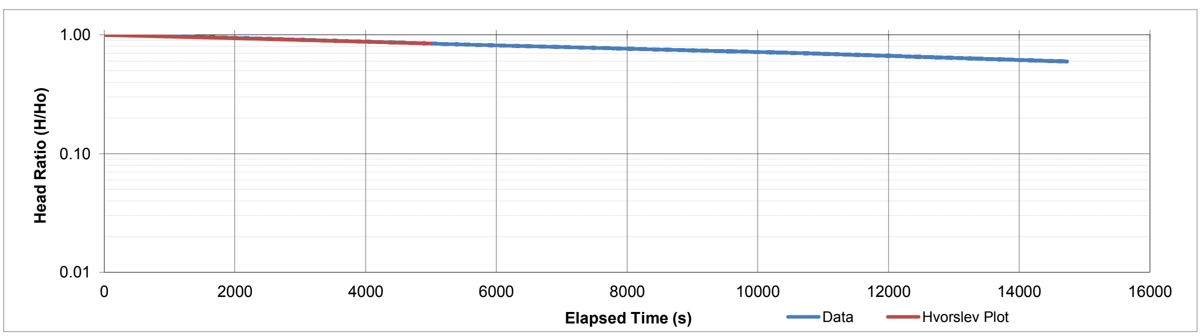
TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 12:53

Project No.	VA101-460/03			**Drillhole**	**SC15-180**	
Field Technician	JBC			**Test No.**	2	
Analyst	GIM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	38	L of water		**Packer Inflation Time**	4:51:33 AM	
Test Date	5-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	5:10:27 AM	
Top of test interval	18.7	**m along hole**		**Initial water level**	20.00	**m above transducer**
Bottom of test interval	30.2	**m along hole**		**Water level after slug**	28.94	**m above transducer**
Test length, L	11.4	**m along hole**		**Change in Water Level, H_o**	8.94	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	8	**m**
Transmissivity, T	1E-07	**m^2/s**				
Hydraulic Conductivity, K	1E-08	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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BLACK BUTTE COPPER PROJECT

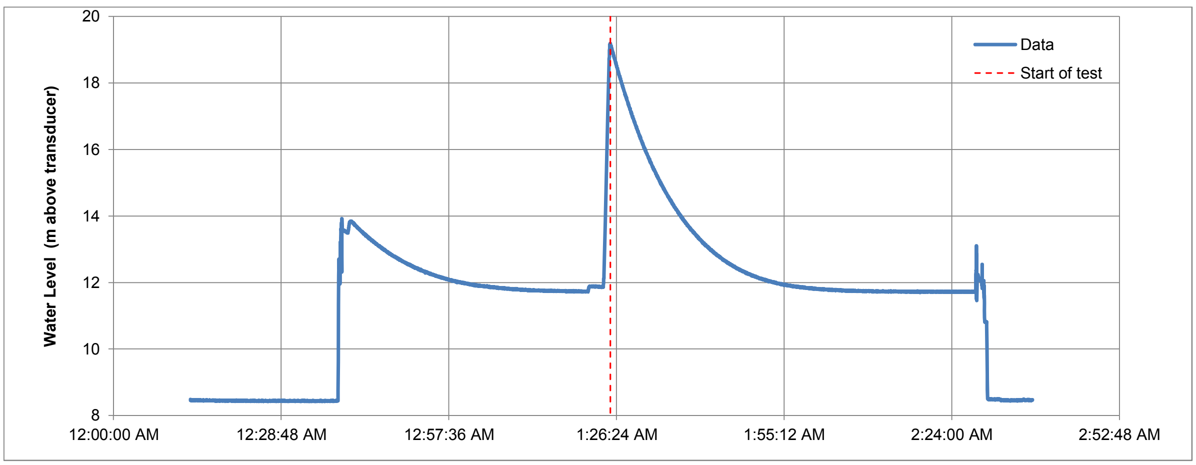
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

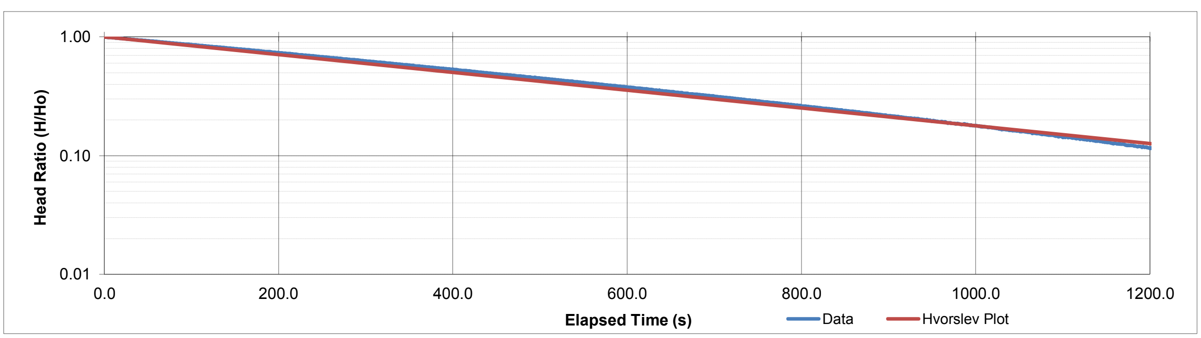
Print 02/26/16 12:55

Project No.	VA101-460/03		Drillhole	SC15-181
Field Technician	JBC		Test No.	1
Analyst	JBC			
Monitoring Instrument Type	Transducer		Packer Type	HQ Nitrogen
Slug Type	40	L of water	Packer Inflation Time	12:38:35 AM
Test Date	6-Mar-15			

Drillhole diameter, D	HQ3	0.096 m				
Drill rod diameter, d	HQ3	0.078 m		Slug Injected, Time = 0	1:25:22 AM	
Top of test interval	9.6	m along hole		Initial water level	11.75	m above transducer
Bottom of test interval	14.9	m along hole		Water level after slug	19.18	m above transducer
Test length, L	5.3	m along hole		Change in Water Level, H_o	7.43	m
Drillhole angle	90	degrees		Expected Change in Water Level, H_o	8	m

Transmissivity, T	6E-06	m^2/s		
Hydraulic Conductivity, K	1E-06	m/s	Intercept	1.0





TEST COMMENTS:

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A	6MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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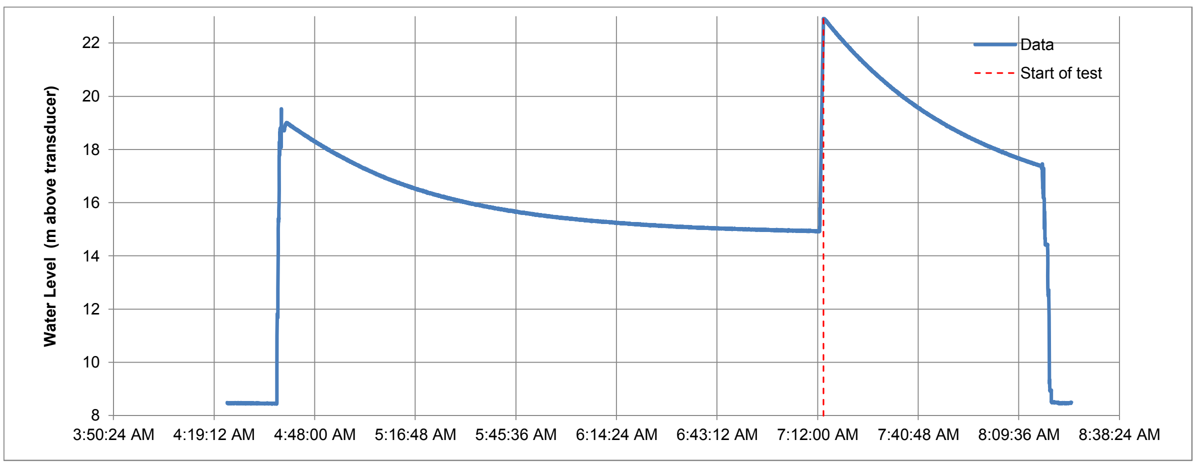
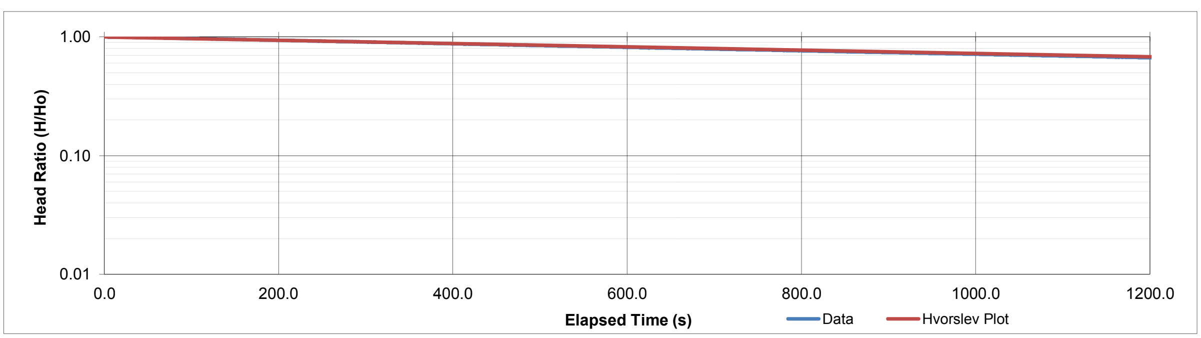
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 12:55

Project No.	VA101-460/03			**Drillhole**	**SC15-181**	
Field Technician	GM			**Test No.**	2	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	40	L of water		**Packer Inflation Time**	4:42:00 AM	
Test Date	6-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	7:13:42 AM	
Top of test interval	12.6	**m along hole**		**Initial water level**	14.92	**m above transducer**
Bottom of test interval	21.0	**m along hole**		**Water level after slug**	22.92	**m above transducer**
Test length, L	8.4	**m along hole**		**Change in Water Level, H_o**	7.99	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	8	**m**
Transmissivity, T	1E-06	**m^2/s**				
Hydraulic Conductivity, K	2E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	6MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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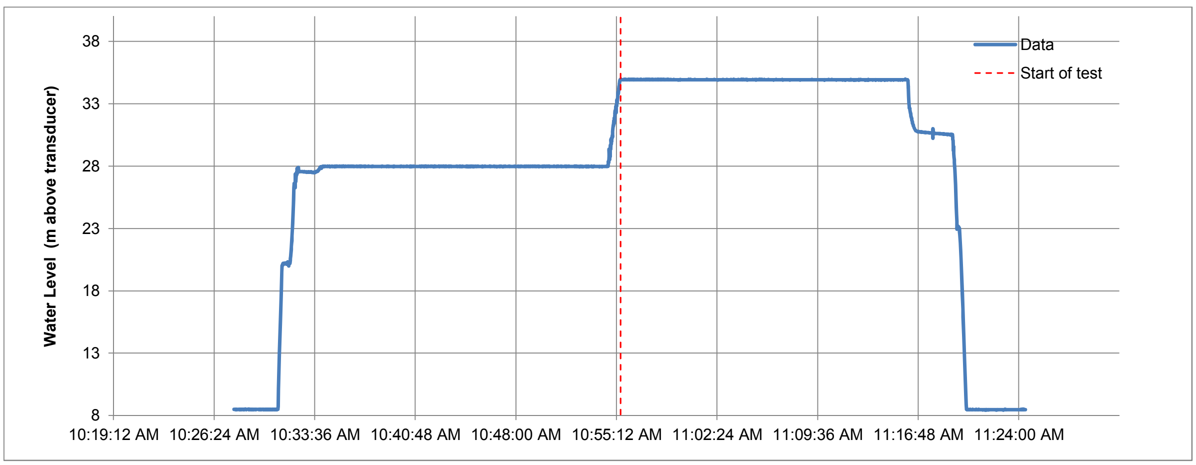
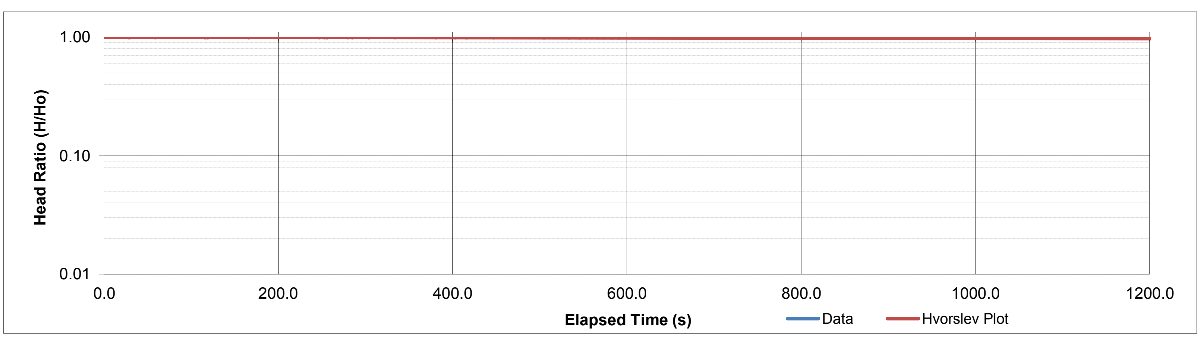
TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 12:55

Project No.	VA101-460/03		**Drillhole**	**SC15-181**	
Field Technician	GM		**Test No.**	3	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	40	L of water	**Packer Inflation Time**		
Test Date	6-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	10:55:30 AM	
Top of test interval	20.3	**m along hole**	**Initial water level**	27.99	**m above transducer**
Bottom of test interval	30.1	**m along hole**	**Water level after slug**	34.97	**m above transducer**
Test length, L	9.8	**m along hole**	**Change in Water Level, H_o**	6.99	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	8	**m**
Transmissivity, T	1E-07	**m^2/s**			
Hydraulic Conductivity, K	1E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

Driller bailed water out of hole with core tube before inserting packer.
After inflation and start of test, water level dropped 1.5 cm after 20 minutes. The test was ended. The packer was checked for blockages on surface and none were found. Core showed the rock to be very competent so a low permeability is not unusual.

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A	6MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION USING CONSTANT HEAD METHOD

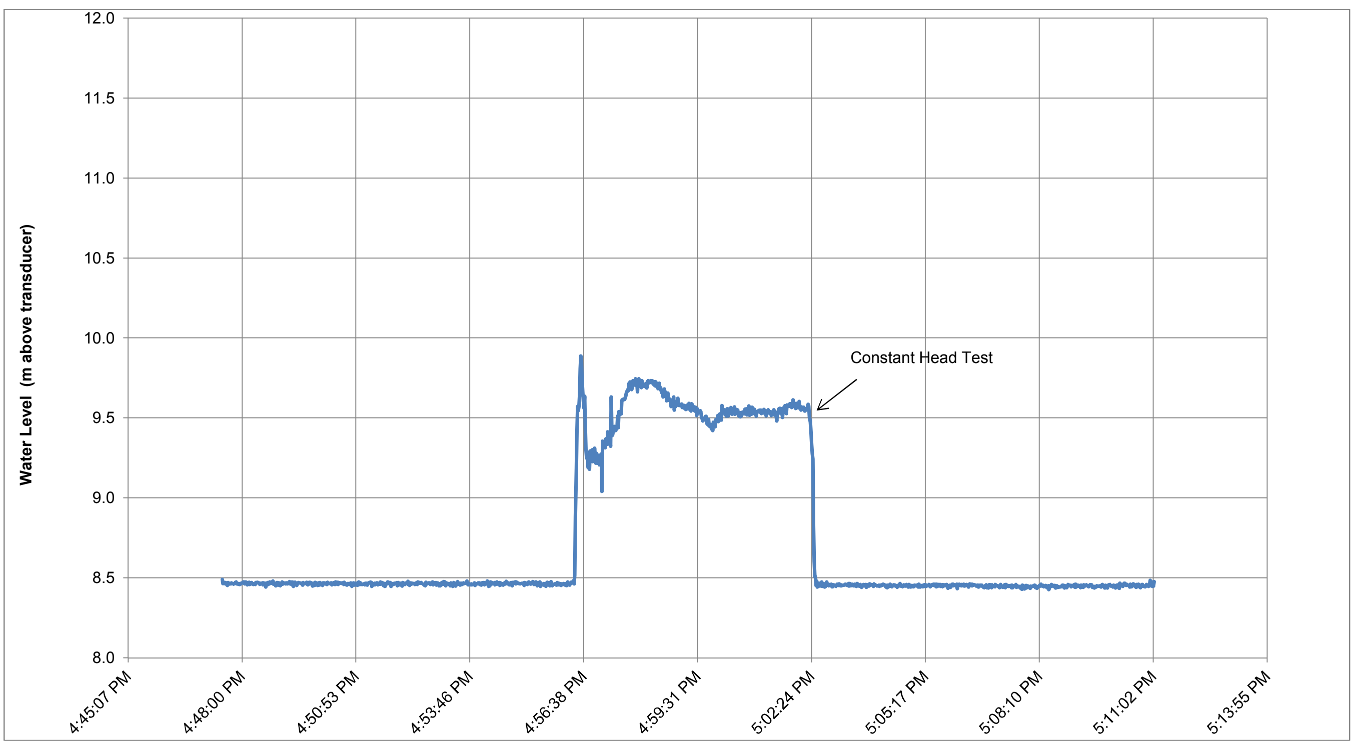
Print 02/26/16 13:18

Project No.	VA101-460/3		**Drillhole**	**SC15-182**	
Field Technician	JBC		**Test No.**	1	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Transducer Position:**	2.2	**m (Downhole from top of rods)**
Test Date	6-Mar-15				
Drill-hole diameter, D	HQ3	0.096 m			
Diameter of drill pipe, d	HQ3	0.078 m	**Test Start Time**	4:56 PM	
Top of test interval	2.0	**m along hole**	**Initial Water Level**	8.5	**m above transducer**
Bottom of test interval	7.3	**m along hole**	**Water Level During Testing**	9.5	**m above transducer**
Test length, L	5.3	**m along hole**	**Head Maintained above Initial , Hc**	1.1	**m**
Drill-hole angle		90 **degrees**			

$$K = \frac{Q}{FH_C}$$

$$F = \frac{2\pi L}{\ln(2L/D)}, \quad for\ L > 4D$$

Hydraulic Conductivity, K	2E-04	**m/s**	**Shape Factor, F**	7.1	
Transmissivity, T	8E-04	**m^2/s**	**Q**	1.2E-03	**m^3/s**



References:
Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50
Hoek, E., Bray, J., 1981. Rock Slope Engineering, CRC Press, pp 368

TEST COMMENTS:

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A	7MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING CONSTANT HEAD METHOD

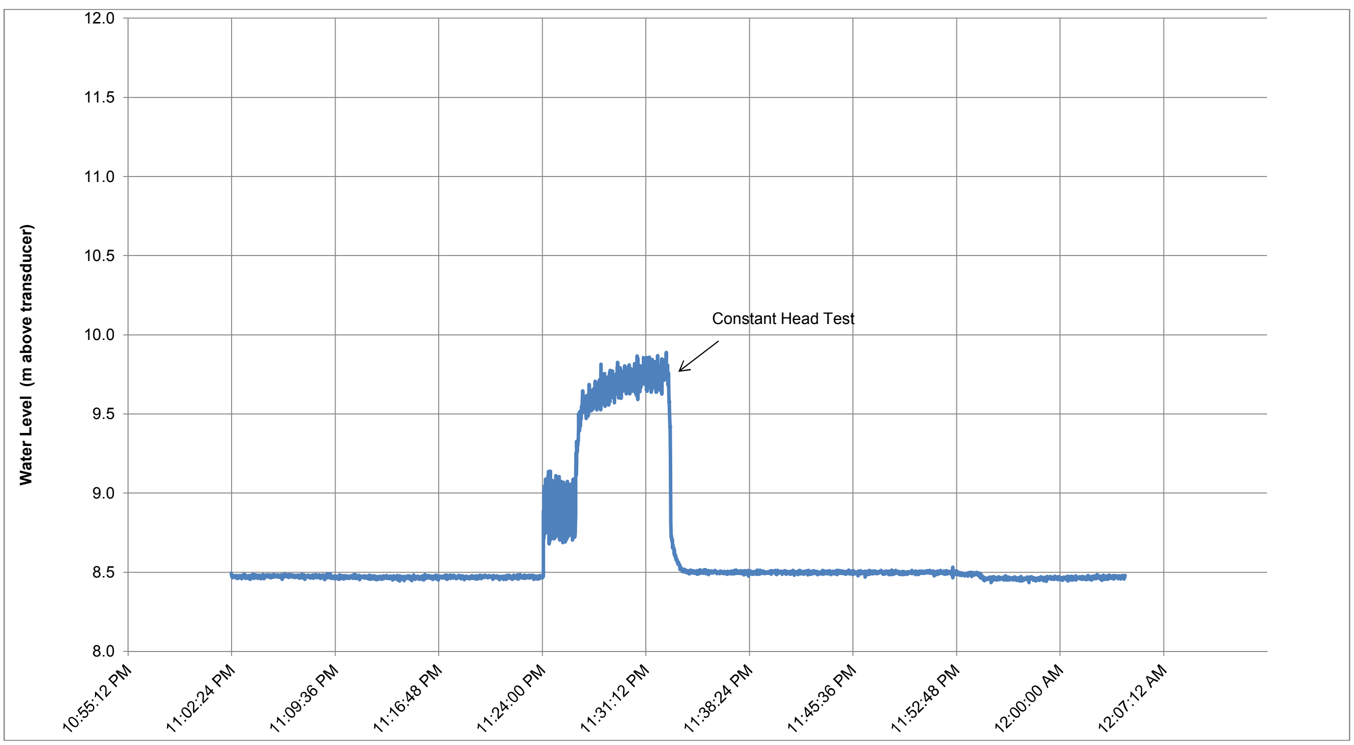
Print 02/26/16 13:18

Project No.	VA101-460/3		**Drillhole**	**SC15-182**	
Field Technician	JBC		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Transducer Position:**	6.8	**m (Downhole from top of rods)**
Test Date	6-Mar-15				
Drill-hole diameter, D	HQ3	0.096 m			
Diameter of drill pipe, d	HQ3	0.078 m	**Test Start Time**	11:26 PM	
Top of test interval	6.6	**m along hole**	**Initial Water Level**	8.5	**m above transducer**
Bottom of test interval	13.4	**m along hole**	**Water Level During Testing**	9.7	**m above transducer**
Test length, L	6.9	**m along hole**	**Head Maintained above Initial , Hc**	1.2	**m**
Drill-hole angle	90	**degrees**			

$$K = \frac{Q}{FH_c}$$

$$F = \frac{2\pi L}{\ln(2L/D)}, \quad for\ L > 4D$$

Hydraulic Conductivity, K	1E-04	**m/s**	**Shape Factor, F**	8.7	
Transmissivity, T	8E-04	**m^2/s**	**Q**	1.2E-03	**m^3/s**



References:
Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50
Hoek, E., Bray, J., 1981. Rock Slope Engineering, CRC Press, pp 368

TEST COMMENTS:

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A	7MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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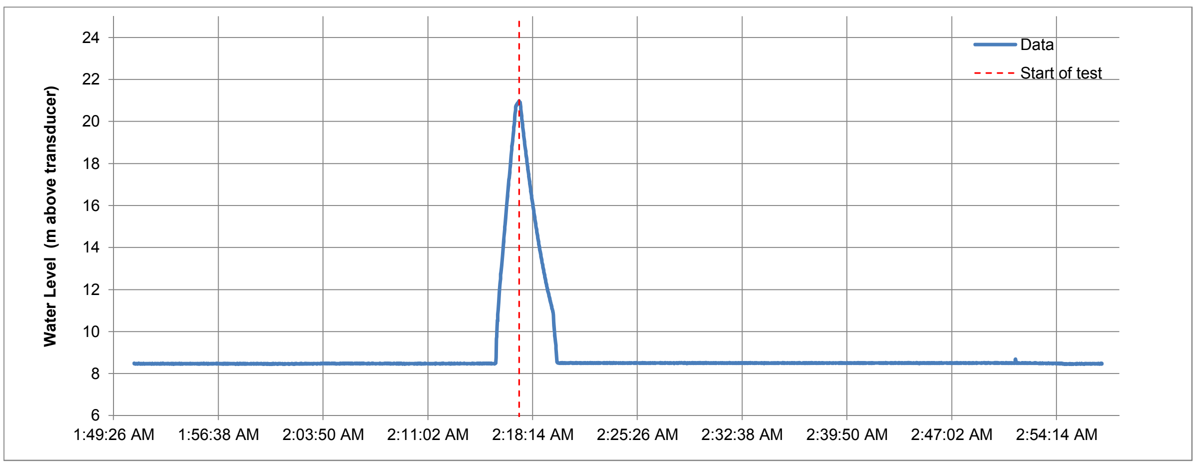
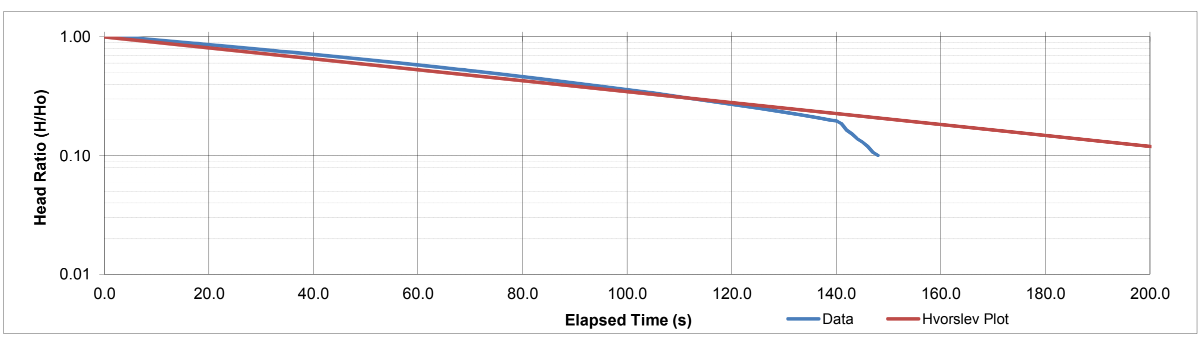
TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:18

Project No.	VA101-460/03		**Drillhole**	**SC15-182**	
Field Technician	JBC		**Test No.**	3	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	76	L of water	**Packer Inflation Time**	2:02:00 AM	
Test Date	7-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	2:17:19 AM	
Top of test interval	12.6	**m along hole**	**Initial water level**	8.46	**m above transducer**
Bottom of test interval	19.5	**m along hole**	**Water level after slug**	20.98	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	12.52	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	16	**m**
Transmissivity, T	4E-05	**m^2/s**			
Hydraulic Conductivity, K	6E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

Drill lost water return at 38.5' and have not regained circulation.

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-182 Hvorslev_Packer Drillhole.xlsx]SC15-182 Hvorslev Packer #3

A	7MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

Knight Piésold CONSULTING

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING CONSTANT HEAD METHOD

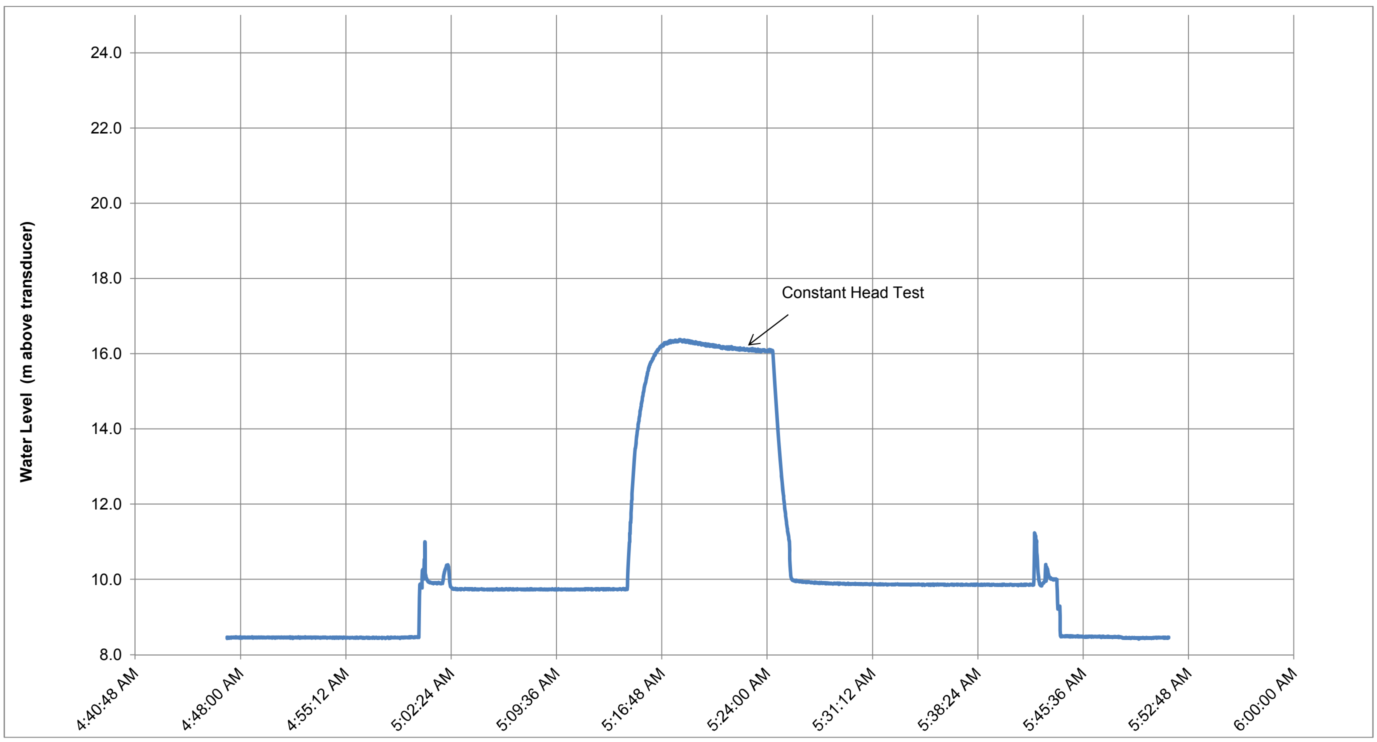
Print 02/26/16 13:18

Project No.	VA101-460/3		**Drillhole**	**SC15-182**	
Field Technician	JBC		**Test No.**	4	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Transducer Position:**	19.0	**m (Downhole from top of rods)**
Test Date	7-Mar-15				
Drill-hole diameter, D	HQ3	0.096 m			
Diameter of drill pipe, d	HQ3	0.078 m	**Test Start Time**	5:14 AM	
Top of test interval	18.7	**m along hole**	**Initial Water Level**	9.7	**m above transducer**
Bottom of test interval	25.6	**m along hole**	**Water Level During Testing**	16.2	**m above transducer**
Test length, L	6.9	**m along hole**	**Head Maintained above Initial , Hc**	6.4	**m**
Drill-hole angle	90	**degrees**			

$$K = \frac{Q}{FH_C}$$

$$F = \frac{2\pi L}{\ln(2L/D)}, \quad \text{for } L > 4D$$

Hydraulic Conductivity, K	1E-05	**m/s**	**Shape Factor, F**	8.7	
Transmissivity, T	8E-05	**m^2/s**	**Q**	6.2E-04	**m^3/s**



References:

Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50

Hoek, E., Bray, J., 1981. Rock Slope Engineering, CRC Press, pp 368

TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-182 Hvorslev_Packer Drillhole.xlsx]SC15-182 Constant Head Test #4

A	7MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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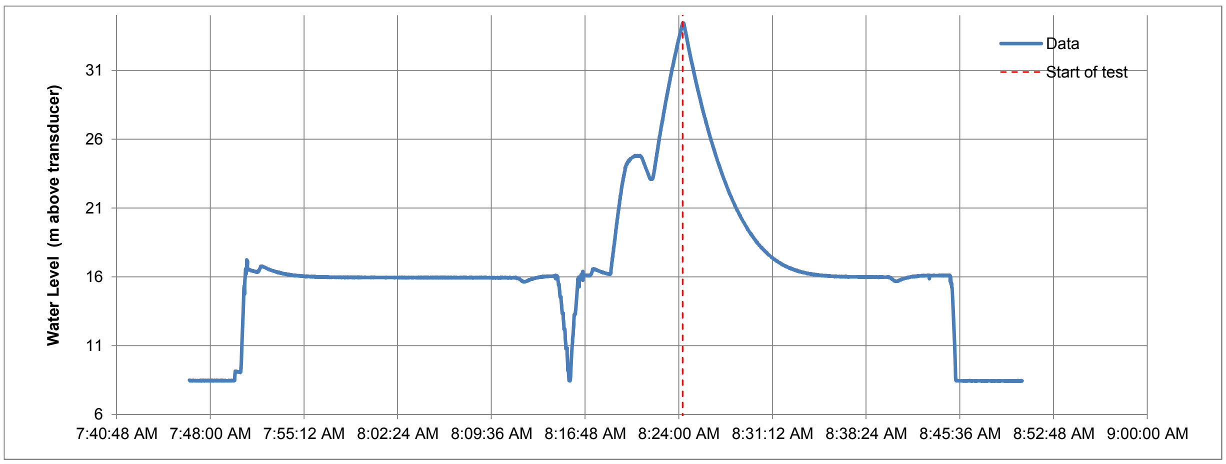
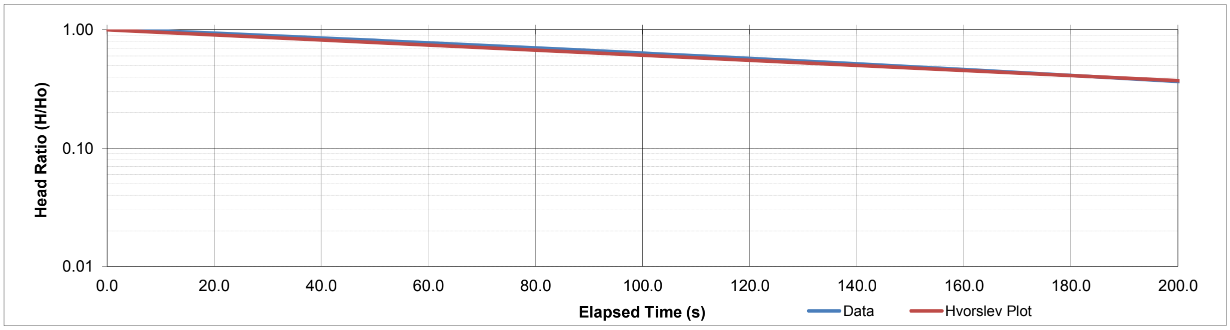
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:18

Project No.	VA101-460/03		**Drillhole**	**SC15-182**	
Field Technician	GM		**Test No.**	5	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	50	Gallons Water	**Packer Inflation Time**	8:15:00 AM	
Test Date	7-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	8:24:18 AM	
Top of test interval	24.8	m along hole	**Initial water level**	15.96	m above transducer
Bottom of test interval	30.2	m along hole	**Water level after slug**	34.42	m above transducer
Test length, L	5.3	m along hole	**Change in Water Level, H_o**	18.46	m
Drillhole angle	90	degrees	**Expected Change in Water Level, H_o**	11	m
Transmissivity, T	2E-05	m^2/s			
Hydraulic Conductivity, K	3E-06	m/s	Intercept	1.0	





TEST COMMENTS:

Filled rods with approximately 50 gallons of water (see notes for flow meter measurements). Stopped filling for ~30 seconds) at 2.5 minutes into test to switch water tanks.

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A	7MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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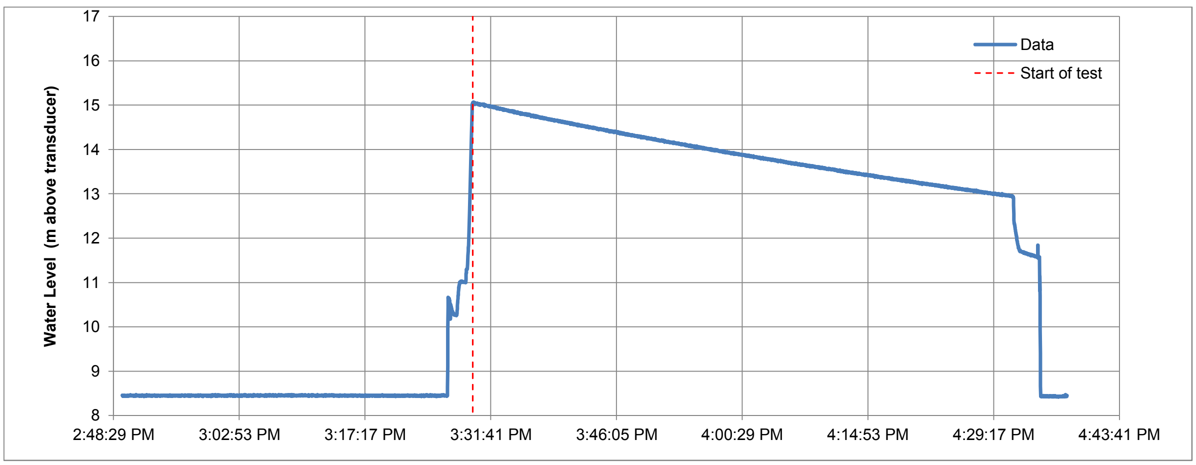
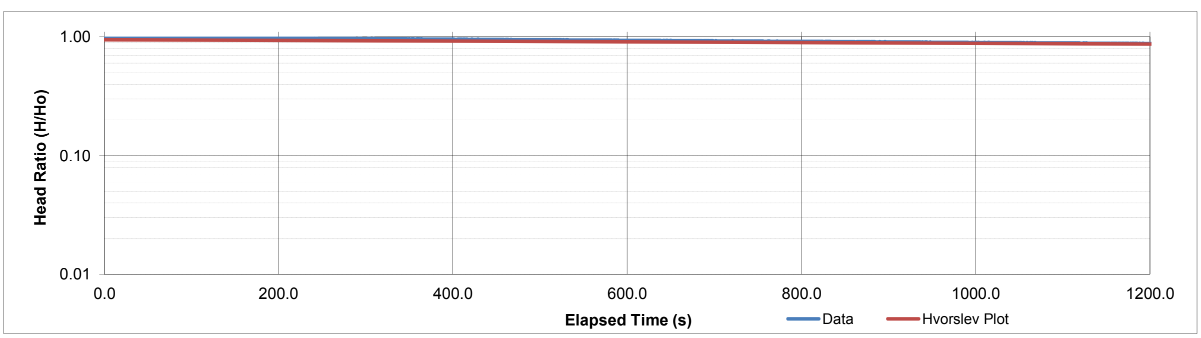
Project No.	VA101-460/03			**Drillhole**	**SC15-183**	
Field Technician	GM			**Test No.**	1	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type		Gal of water		**Packer Inflation Time**	5:51:46 PM	
Test Date	7-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	3:29:38 PM	
Top of test interval	5.0	**m along hole**		**Initial water level**	8.43	**m above transducer**
Bottom of test interval	11.9	**m along hole**		**Water level after slug**	15.05	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	6.62	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	0	**m**
Transmissivity, T	3E-07	**m^2/s**				
Hydraulic Conductivity, K	4E-08	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	8MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

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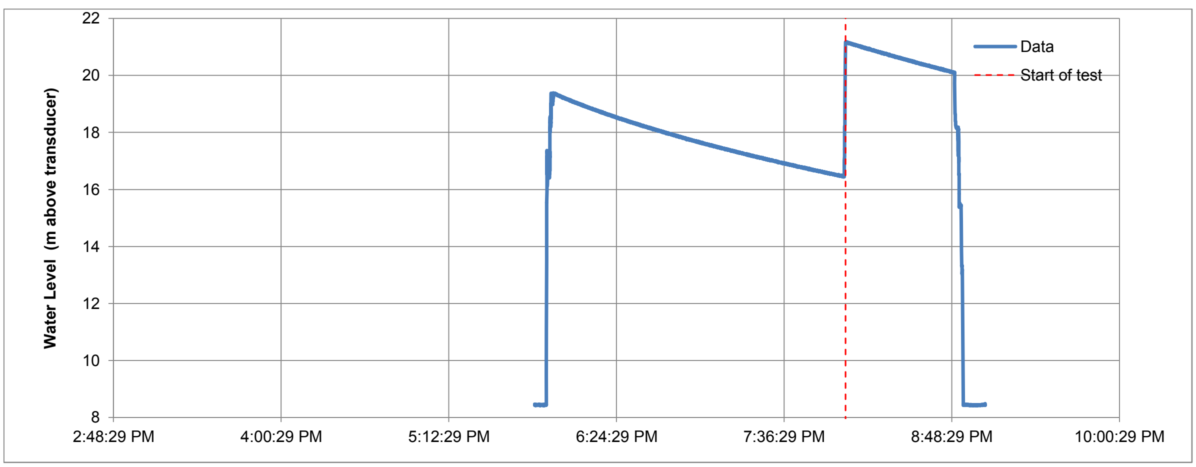
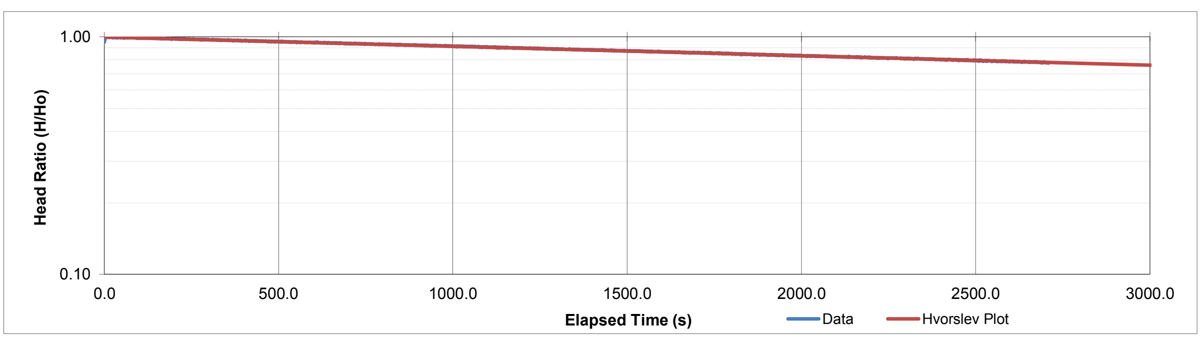
Project No.	VA101-460/03		Drillhole	SC15-183	
Field Technician	JBC		Test No.	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		Packer Type	HQ Nitrogen	
Slug Type	26.5	Lof water	Packer Inflation Time	5:51:46 PM	
Test Date	7-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	Slug Injected, Time = 0	8:02:50 PM	
Top of test interval	11.1	m along hole	Initial water level	16.45	m above transducer
Bottom of test interval	18.0	m along hole	Water level after slug	21.18	m above transducer
Test length, L	6.9	m along hole	Change in Water Level, H_o	4.7	m
Drillhole angle	90	degrees	Expected Change in Water Level, H_o	5.6	m
Transmissivity, T	3E-07	m^2/s			
Hydraulic Conductivity, K	5E-08	m/s	Intercept	1.0	





TEST COMMENTS:

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A	8MAR'15	ISSUED WITH REPORT	JBC	GIM
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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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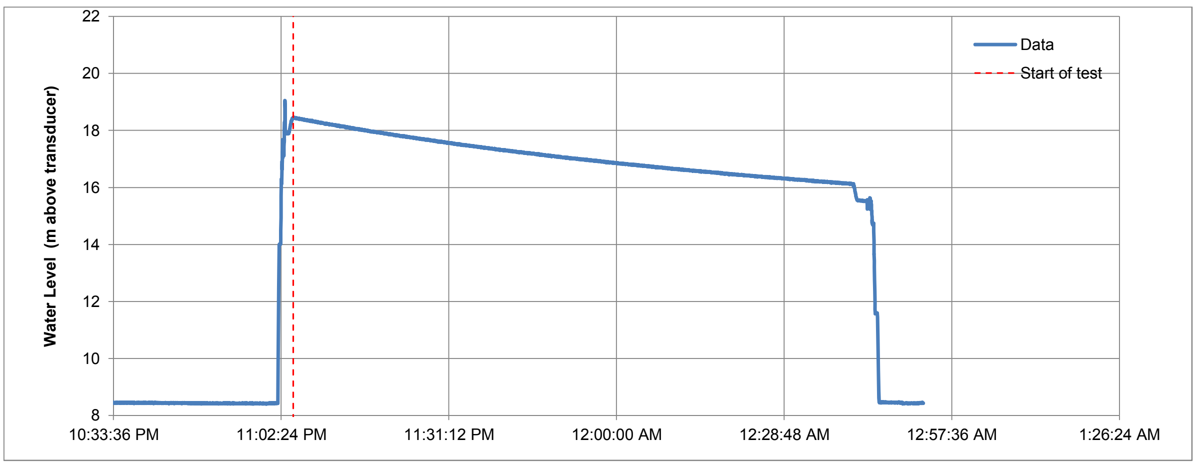
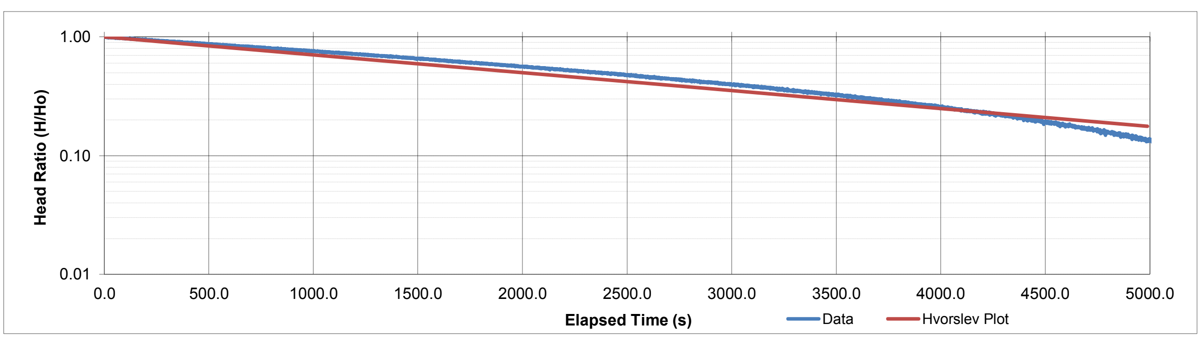
Project No.	VA101-460/03		**Drillhole**	**SC15-183**	
Field Technician	JBC		**Test No.**	3	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	n/a	Lof water	**Packer Inflation Time**	11:03:00 AM	
Test Date	7-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	11:04:29 PM	
Top of test interval	17.2	**m along hole**	**Initial water level**	16.00	**m above transducer**
Bottom of test interval	24.1	**m along hole**	**Water level after slug**	18.46	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	2.5	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	n/a	**m**
Transmissivity, T	1E-06	**m^2/s**			
Hydraulic Conductivity, K	2E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

No slug inserted as the initial water level recovery was relatively linear based on manual water level measurements for 1.5 hour. Transducer data indicate a slight curve towards a water level of 16 m above transducer. The initial water level recovery curve was used for the K value estimation since there was no slug insertion for the actual falling head test.

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A	8MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

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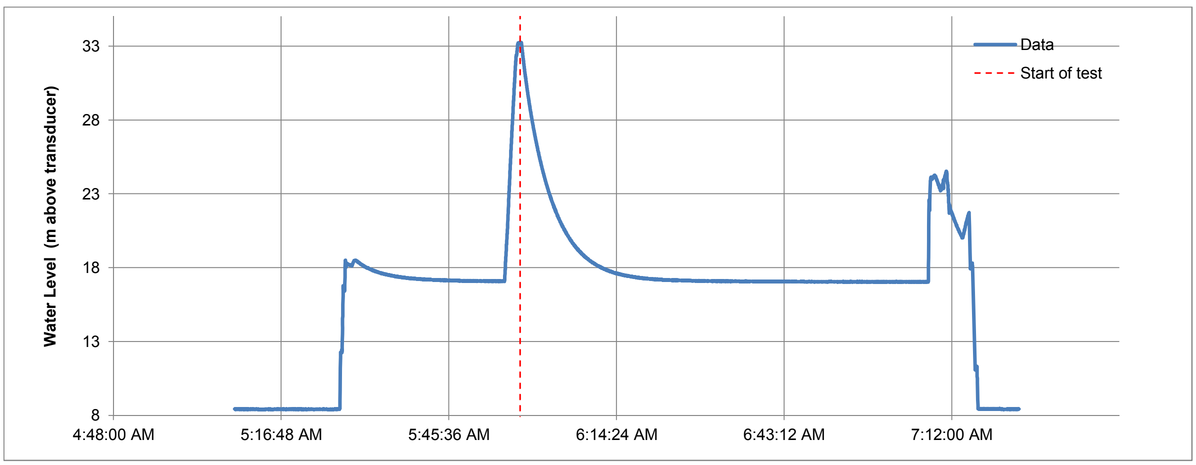
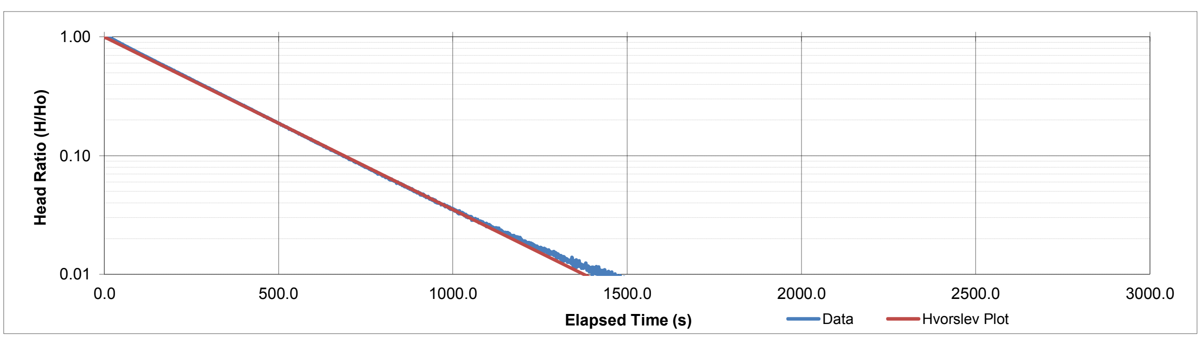
Project No.	VA101-460/03		**Drillhole**	**SC15-183**	
Field Technician	JBC/GIM		**Test No.**	4	
Analyst	GIM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	79.5	L of water		5:29:00 AM	
Test Date	8-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:57:51 AM	
Top of test interval	23.3	**m along hole**	**Initial water level**	17.04	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	33.24	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	16.2	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	16.7	**m**
Transmissivity, T	1E-05	**m^2/s**			
Hydraulic Conductivity, K	2E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	8MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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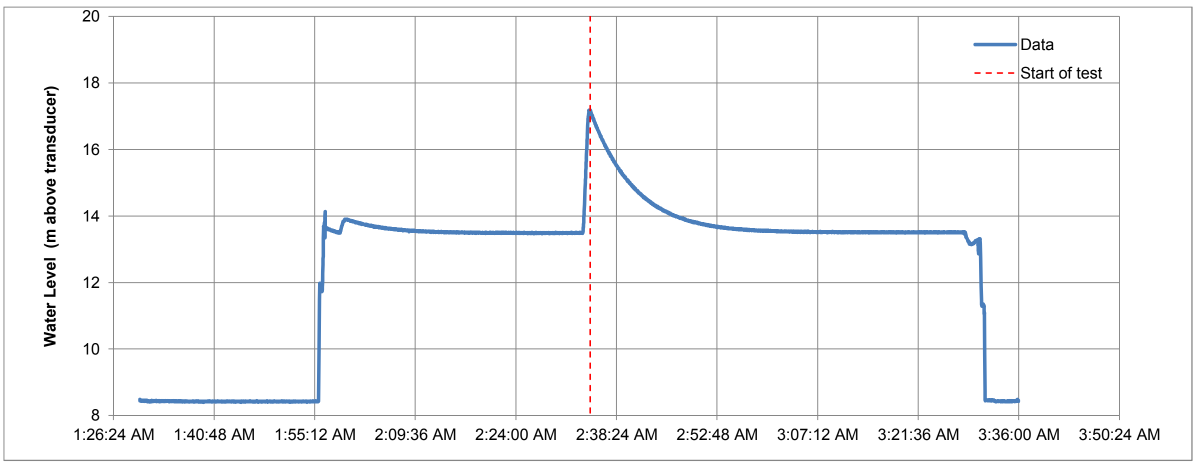
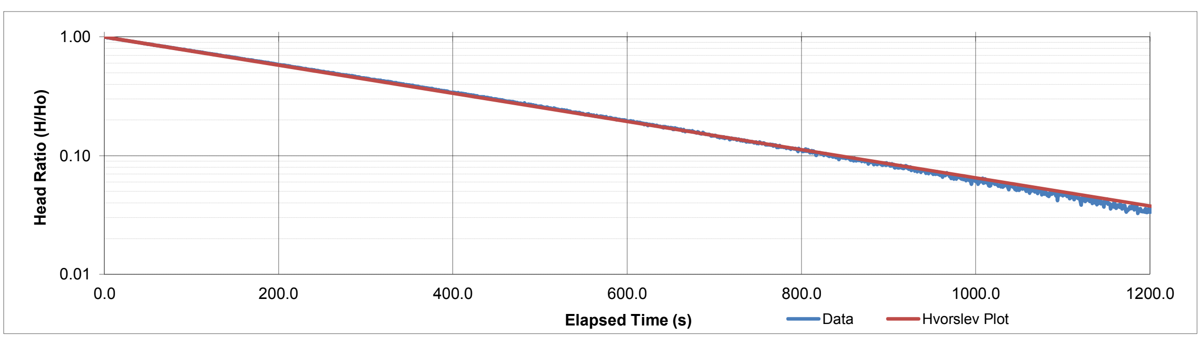
Project No.	VA101-460/03			**Drillhole**	**SC15-184**	
Field Technician	JBC			**Test No.**	1	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	PQ Nitrogen	
Slug Type	40	L of water		**Packer Inflation Time**	1:58:00 AM	
Test Date	9-Mar-15					
Drillhole diameter, D	PQ3	0.123	m			
Drill rod diameter, d	PQ3	0.103	m	**Slug Injected, Time = 0**	2:34:39 AM	
Top of test interval	6.6	**m along hole**		**Initial water level**	13.50	**m above transducer**
Bottom of test interval	13.4	**m along hole**		**Water level after slug**	17.19	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	3.68	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	5	**m**
Transmissivity, T	2E-05	**m^2/s**				
Hydraulic Conductivity, K	3E-06	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	9MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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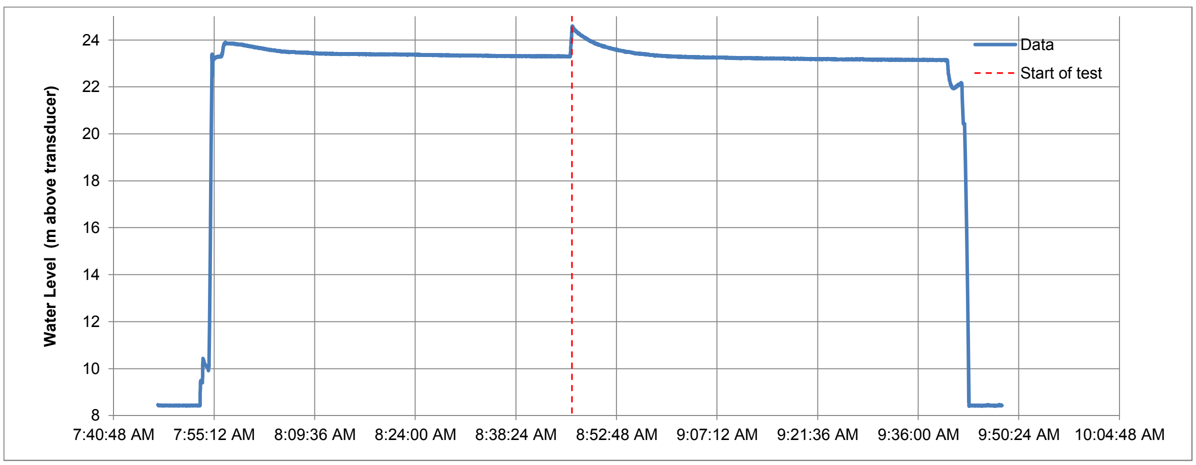
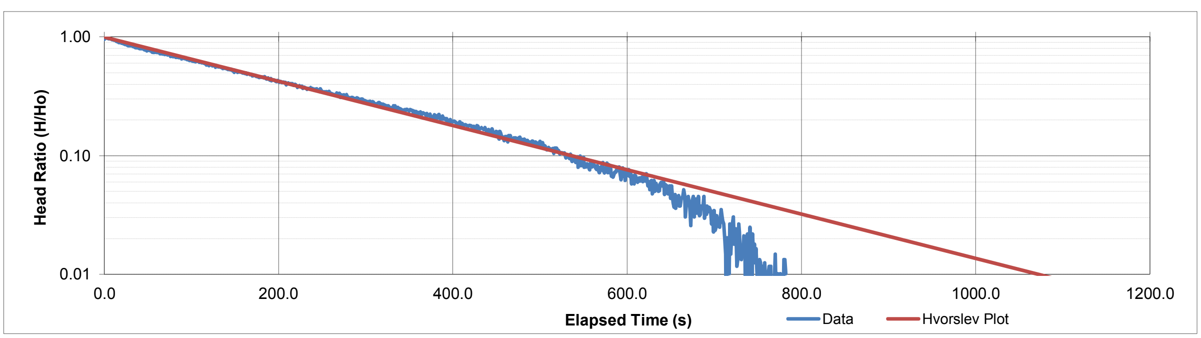
Project No.	VA101-460/03		**Drillhole**	**SC15-184**	
Field Technician	GM		**Test No.**	2	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	PQ Nitrogen	
Slug Type	19	L of water (approx.)	**Packer Inflation Time**	7:57:00 AM	
Test Date	9-Mar-15				
Drillhole diameter, D	PQ3	0.123 m			
Drill rod diameter, d	PQ3	0.103 m	**Slug Injected, Time = 0**	8:46:27 AM	
Top of test interval	14.2	**m along hole**	**Initial water level**	23.31	**m above transducer**
Bottom of test interval	20.9	**m along hole**	**Water level after slug**	24.59	**m above transducer**
Test length, L	6.7	**m along hole**	**Change in Water Level, H_o**	1.28	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	2	**m**
Transmissivity, T	3E-05	**m^2/s**			
Hydraulic Conductivity, K	4E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

Water level is higher than in previous test

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A	9MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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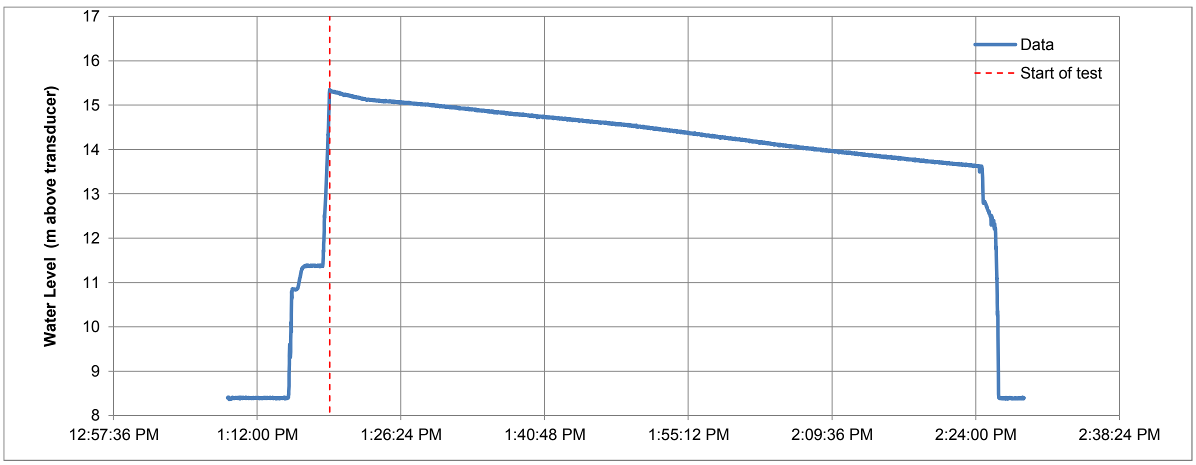
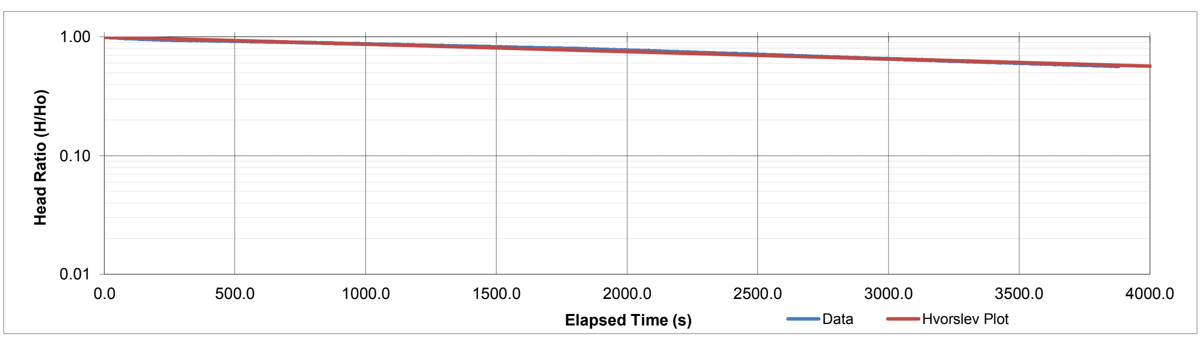
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:48

Project No.	VA101-460/03		**Drillhole**	**SC15-185**	
Field Technician	GIM		**Test No.**	1	
Analyst	GIM				
Monitoring Instrument Type	Transducer		**Packer Type**	PQ Nitrogen	
Slug Type		L of water	**Packer Inflation Time**		
Test Date	10-Mar-15				
Drillhole diameter, D	PQ3	0.123 m			
Drill rod diameter, d	PQ3	0.103 m	**Slug Injected, Time = 0**	1:19:16 PM	
Top of test interval	5.6	m along hole	**Initial water level**	11.38	m above transducer
Bottom of test interval	11.9	m along hole	**Water level after slug**	15.35	m above transducer
Test length, L	6.2	m along hole	**Change in Water Level, H_o**	3.97	m
Drillhole angle	90	degrees	**Expected Change in Water Level, H_o**	0	m
Transmissivity, T	9E-07	m^2/s			
Hydraulic Conductivity, K	1E-07	m/s	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-185 Hvorslev_Packer Drillhole.xlsx]SC15-185 Hvorslev Packer #1

A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

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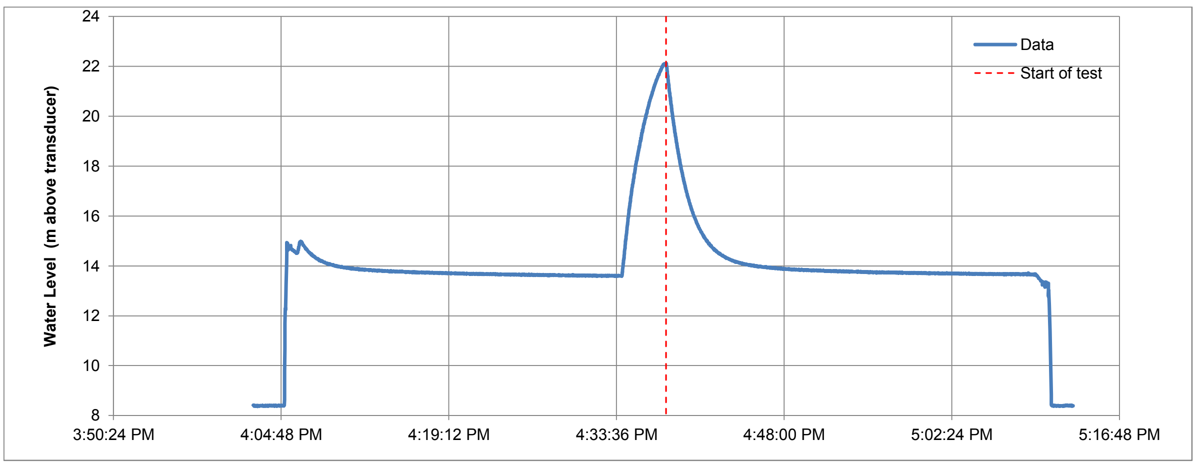
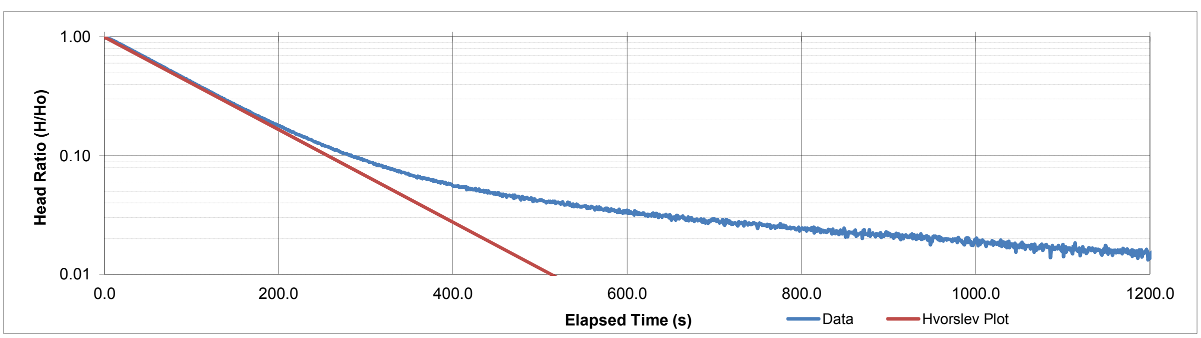
Project No.	VA101-460/03			Drillhole	SC15-185	
Field Technician	GIM			Test No.	2	
Analyst	GIM					
Monitoring Instrument Type	Transducer			Packer Type	PQ Nitrogen	
Slug Type	193	L of water over 3:35		Packer Inflation Time	4:05:00 PM	
Test Date	10-Mar-15					
Drillhole diameter, D	PQ3	0.123	m			
Drill rod diameter, d	PQ3	0.103	m	Slug Injected, Time = 0	4:37:51 PM	
Top of test interval	12.6	m along hole		Initial water level	13.60	m above transducer
Bottom of test interval	18.0	m along hole		Water level after slug	22.11	m above transducer
Test length, L	5.3	m along hole		Change in Water Level, H_o	8.51	m
Drillhole angle	90	degrees		Expected Change in Water Level, H_o	23	m
Transmissivity, T	5E-05	m^2/s				
Hydraulic Conductivity, K	1E-05	m/s		Intercept	1.0	





TEST COMMENTS:

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A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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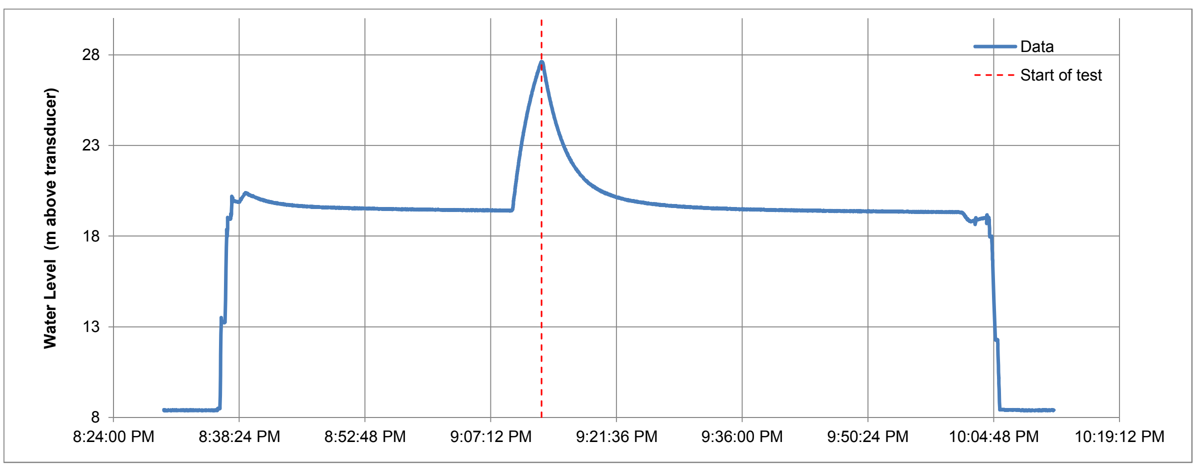
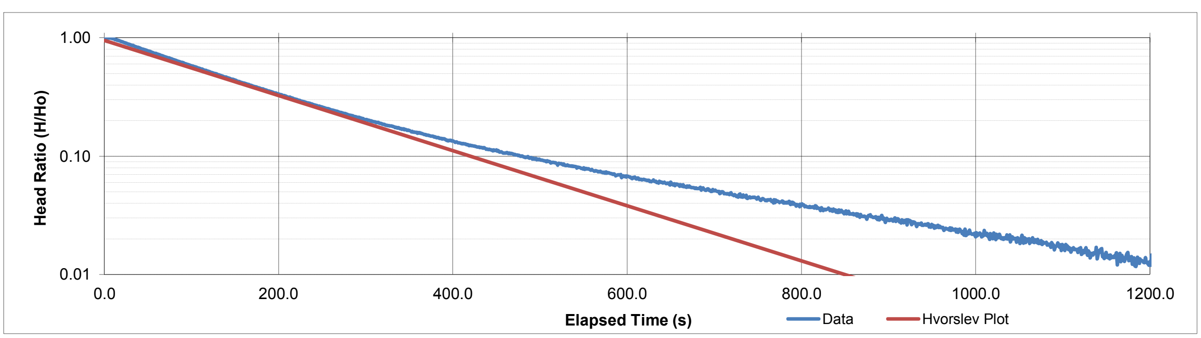
Project No.	VA101-460/03		**Drillhole**	**SC15-185**	
Field Technician	JBC		**Test No.**	3	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	PQ Nitrogen	
Slug Type	140	L of water	**Packer Inflation Time**	8:38:00 PM	
Test Date	10-Mar-15				
Drillhole diameter, D	PQ3	0.123 m			
Drill rod diameter, d	PQ3	0.103 m	**Slug Injected, Time = 0**	9:13:02 PM	
Top of test interval	17.2	**m along hole**	**Initial water level**	19.43	**m above transducer**
Bottom of test interval	24.1	**m along hole**	**Water level after slug**	27.62	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	8.19	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	17	**m**
Transmissivity, T	3E-05	**m^2/s**			
Hydraulic Conductivity, K	5E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	4MAR'15	ISSUED WITH REPORT	JBC	GIM

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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Project No. VA101-460/03
Field Technician JBC
Analyst JBC

Drillhole SC15-185
Test No. 4

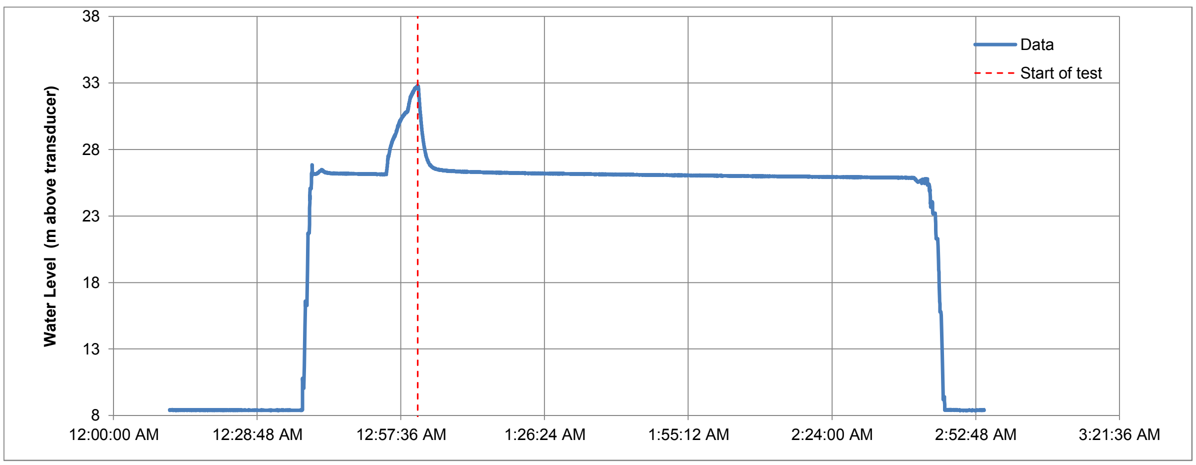
Monitoring Instrument Type Transducer
Slug Type 341 L of water
Test Date 11-Mar-15

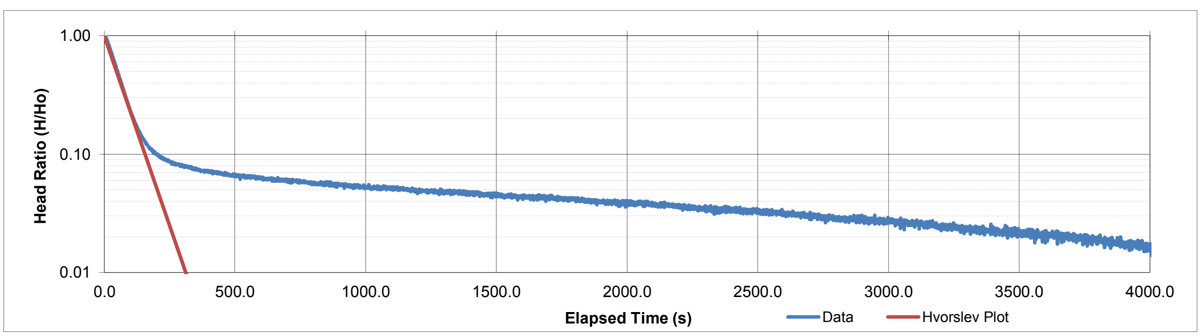
Packer Type PQ Nitrogen
Packer Inflation Time 12:45:00 AM

Drillhole diameter, D	PQ3	0.123	m
Drill rod diameter, d	PQ3	0.103	m
Top of test interval	23.3	**m along hole**	
Bottom of test interval	30.2	**m along hole**	
Test length, L	6.9	**m along hole**	
Drillhole angle	90	**degrees**	

Slug Injected, Time = 0	1:01:00 AM	
Initial water level	25.89	**m above transducer**
Water level after slug	32.80	**m above transducer**
Change in Water Level, H_o	6.91	**m**
Expected Change in Water Level, H_o	41	**m**

Transmissivity, T 9E-05 **m^2/s**
Hydraulic Conductivity, K 1E-05 **m/s**
Intercept 1.0





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-185 Hvorslev_Packer Drillhole.xlsx]SC15-185 Hvorslev Packer #4

A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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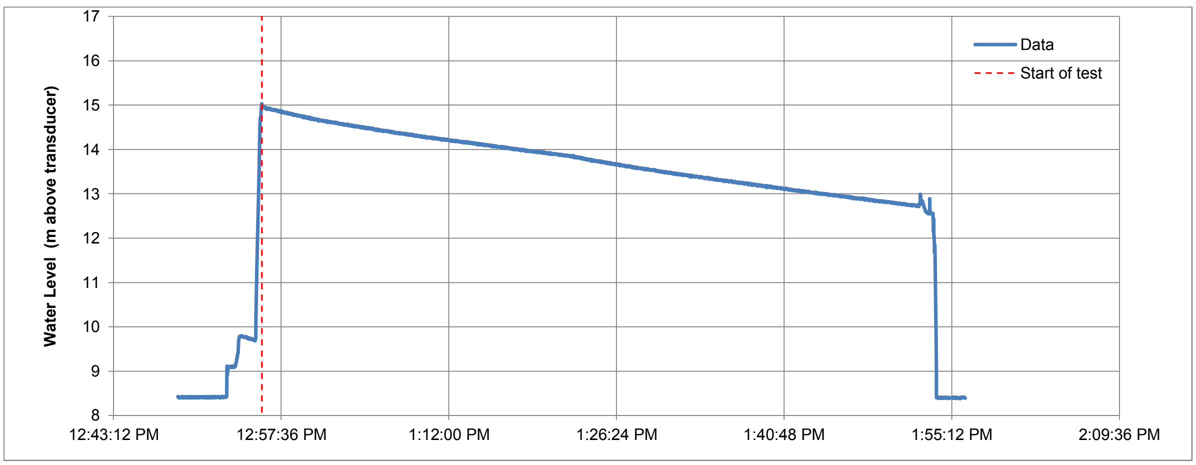
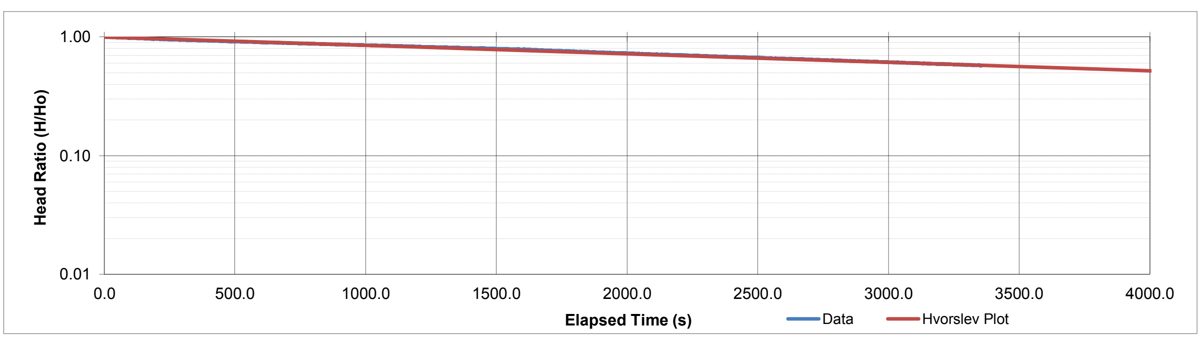
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:50

Project No.	VA101-460/03		**Drillhole**	**SC15-186**	
Field Technician	GM		**Test No.**	1	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	12:52:56 PM	
Test Date	11-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	12:55:57 PM	
Top of test interval	5.0	**m along hole**	**Initial water level**	9.73	**m above transducer**
Bottom of test interval	11.9	**m along hole**	**Water level after slug**	14.96	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	5.23	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	6E-07	**m^2/s**			
Hydraulic Conductivity, K	9E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-186 Hvorslev_Packer Drillhole.xlsx]SC15-186 Hvorslev Packer #1

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

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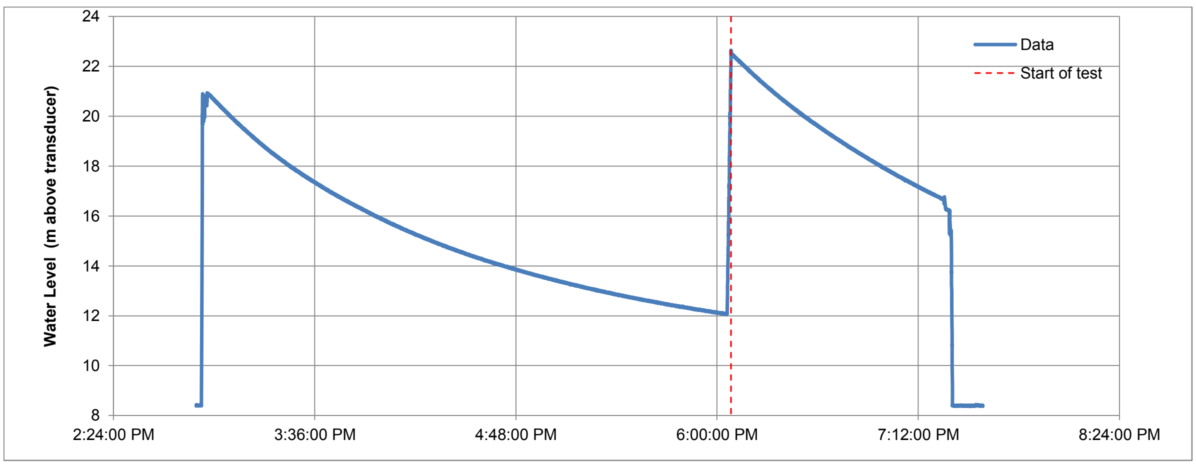
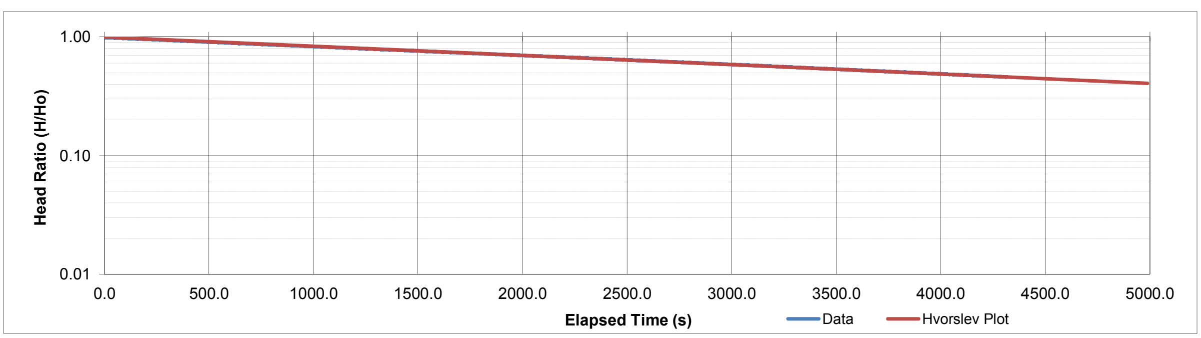
Project No.	VA101-460/03		**Drillhole**	**SC15-186**	
Field Technician	GM		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	12:52:56 PM	
Test Date	11-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	6:05:02 PM	
Top of test interval	12.6	m along hole	**Initial water level**	12.00	m above transducer
Bottom of test interval	18.0	m along hole	**Water level after slug**	22.64	m above transducer
Test length, L	5.3	m along hole	**Change in Water Level, H_o**	10.64	m
Drillhole angle	90	degrees	**Expected Change in Water Level, H_o**	#VALUE!	m
Transmissivity, T	6E-07	m^2/s			
Hydraulic Conductivity, K	1E-07	m/s	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-186 Hvorslev_Packer Drillhole.xlsx]SC15-186 Hvorslev Packer #2

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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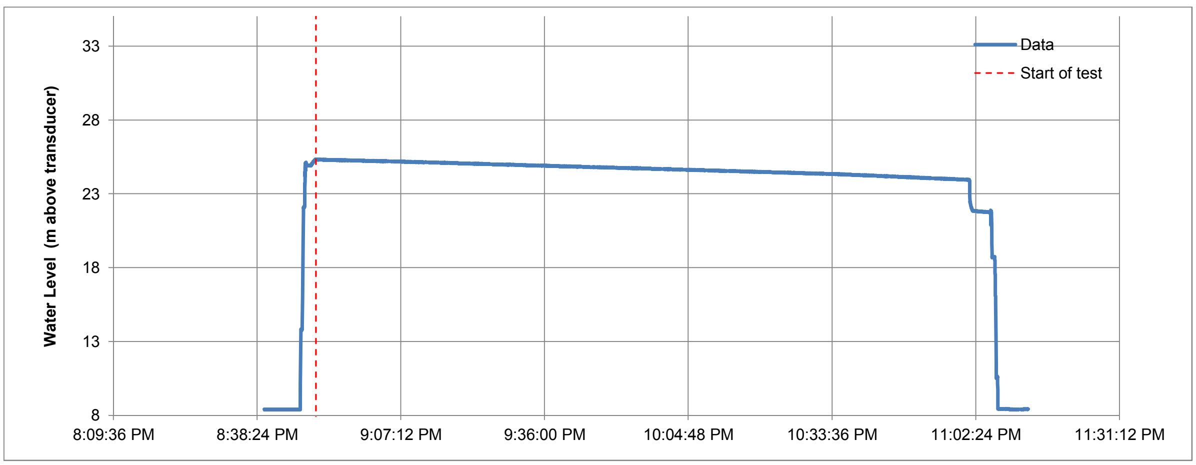
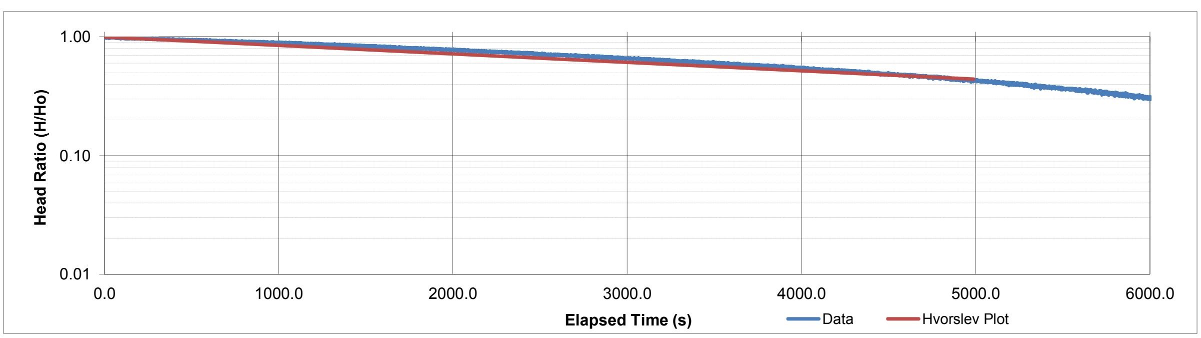
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 13:50

Project No.	VA101-460/03			Drillhole	SC15-186	
Field Technician	JBC			Test No.	3	
Analyst	JBC					
Monitoring Instrument Type	Transducer			Packer Type	HQ Nitrogen	
Slug Type	n/a	L of water		Packer Inflation Time	8:47:00 PM	
Test Date	11-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	Slug Injected, Time = 0	8:50:12 PM	
Top of test interval	17.2	m along hole		Initial water level	23.95	m above transducer
Bottom of test interval	24.1	m along hole		Water level after slug	25.33	m above transducer
Test length, L	6.9	m along hole		Change in Water Level, H_o	1.38	m
Drillhole angle	90	degrees		Expected Change in Water Level, H_o	#VALUE!	m
Transmissivity, T	6E-07	m^2/s				
Hydraulic Conductivity, K	9E-08	m/s		Intercept	1.0	





TEST COMMENTS:

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A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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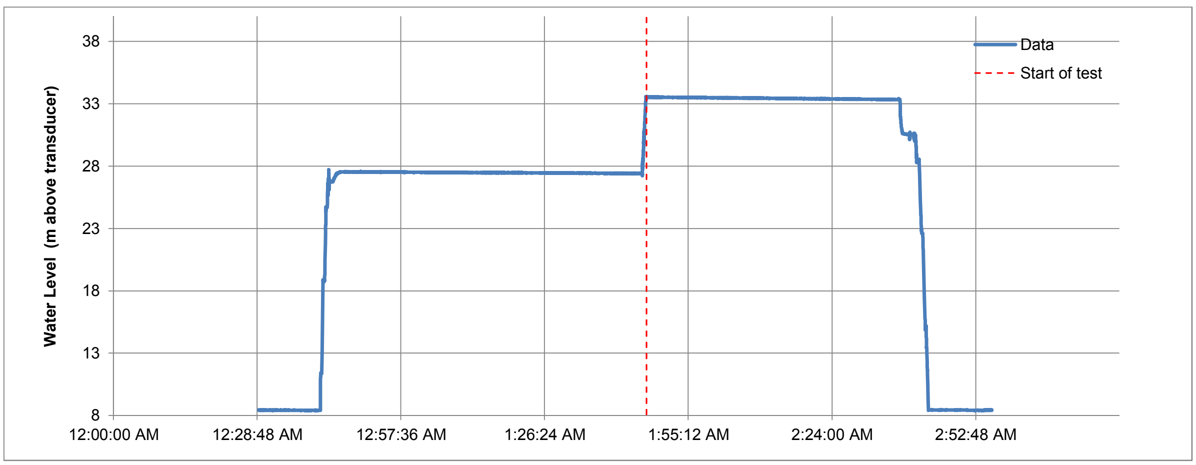
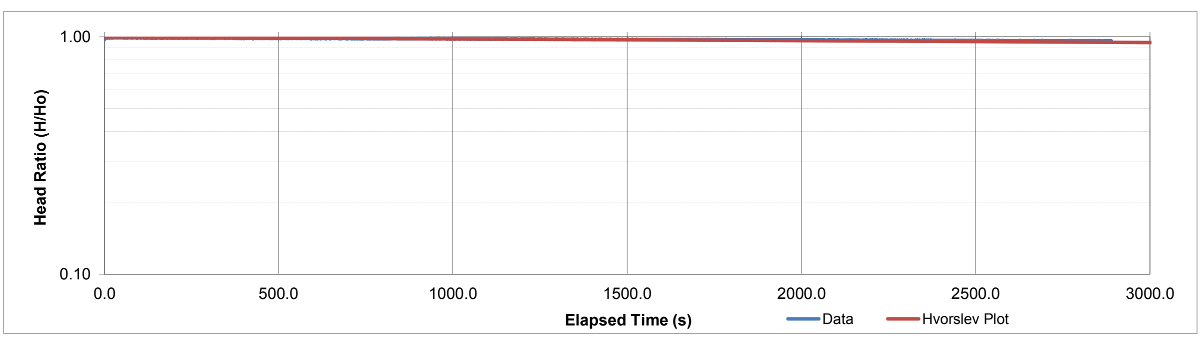
Project No.	VA101-460/03			**Drillhole**	**SC15-186**	
Field Technician	JBC			**Test No.**	4	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	40	L of water		**Packer Inflation Time**	12:44:00 AM	
Test Date	12-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	1:46:51 AM	
Top of test interval	23.3	**m along hole**		**Initial water level**	27.43	**m above transducer**
Bottom of test interval	30.2	**m along hole**		**Water level after slug**	33.58	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	6.15	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	8	**m**
Transmissivity, T	7E-08	**m^2/s**				
Hydraulic Conductivity, K	1E-08	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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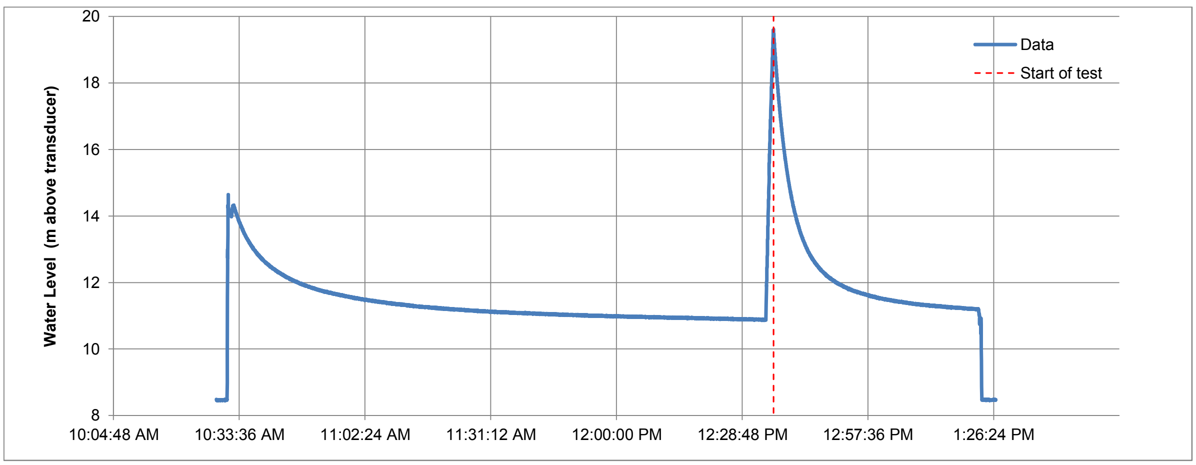
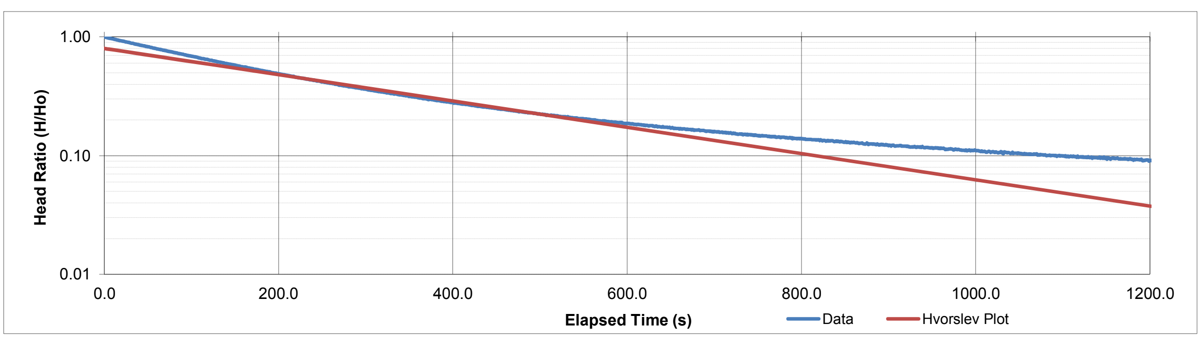
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:56

Project No.	VA101-460/03			**Drillhole**	**SC15-187**	
Field Technician	GM			**Test No.**	1	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water		**Packer Inflation Time**	10:31:00 AM	
Test Date	12-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	12:35:58 PM	
Top of test interval	3.5	**m along hole**		**Initial water level**	10.89	**m above transducer**
Bottom of test interval	8.8	**m along hole**		**Water level after slug**	19.61	**m above transducer**
Test length, L	5.3	**m along hole**		**Change in Water Level, H_o**	8.72	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	9E-06	**m^2/s**				
Hydraulic Conductivity, K	2E-06	**m/s**		Intercept	0.8	





TEST COMMENTS:

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A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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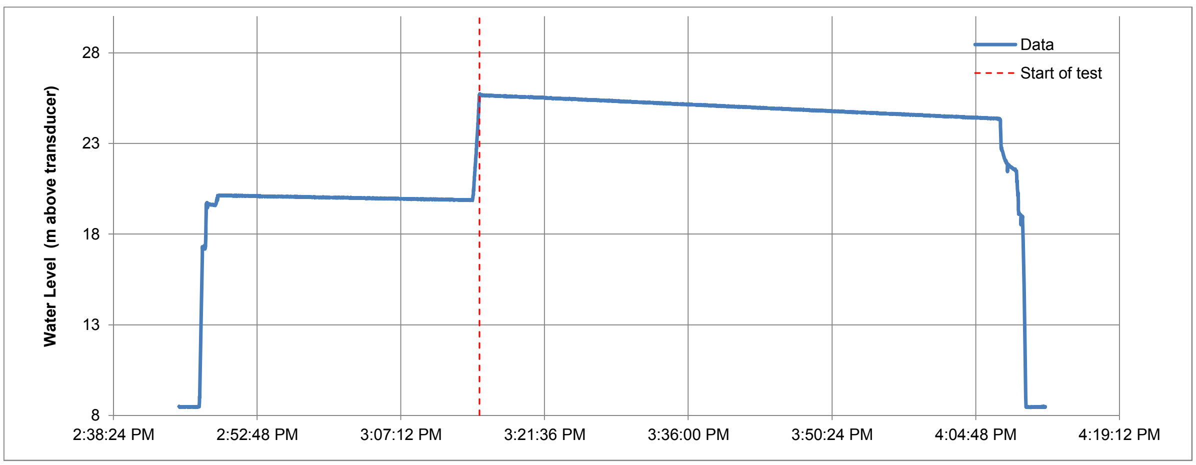
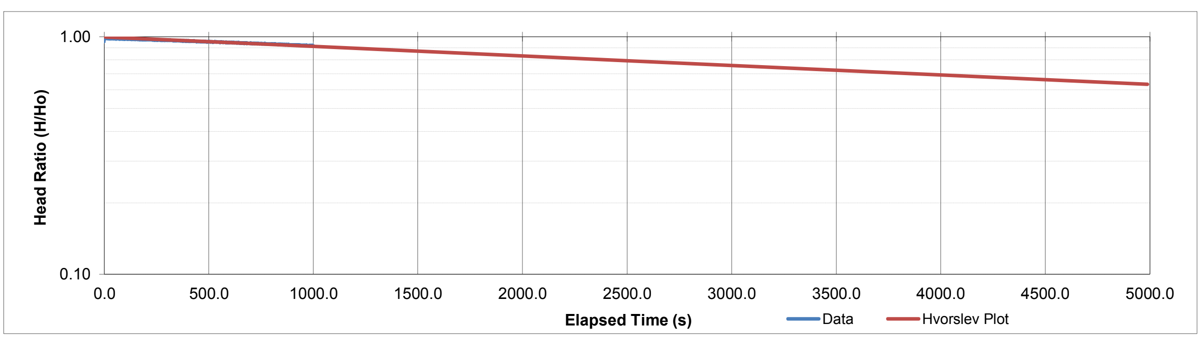
Project No.	VA101-460/03		**Drillhole**	**SC15-187**	
Field Technician	GM		**Test No.**	2	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	2:48:00 PM	
Test Date	12-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	3:15:05 PM	
Top of test interval	9.6	m along hole	**Initial water level**	19.87	m above transducer
Bottom of test interval	22.6	m along hole	**Water level after slug**	25.74	m above transducer
Test length, L	13.0	m along hole	**Change in Water Level, H_o**	5.86	m
Drillhole angle	90	degrees	**Expected Change in Water Level, H_o**	#VALUE!	m
Transmissivity, T	4E-07	m^2/s			
Hydraulic Conductivity, K	3E-08	m/s	Intercept	1.0	





TEST COMMENTS:

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A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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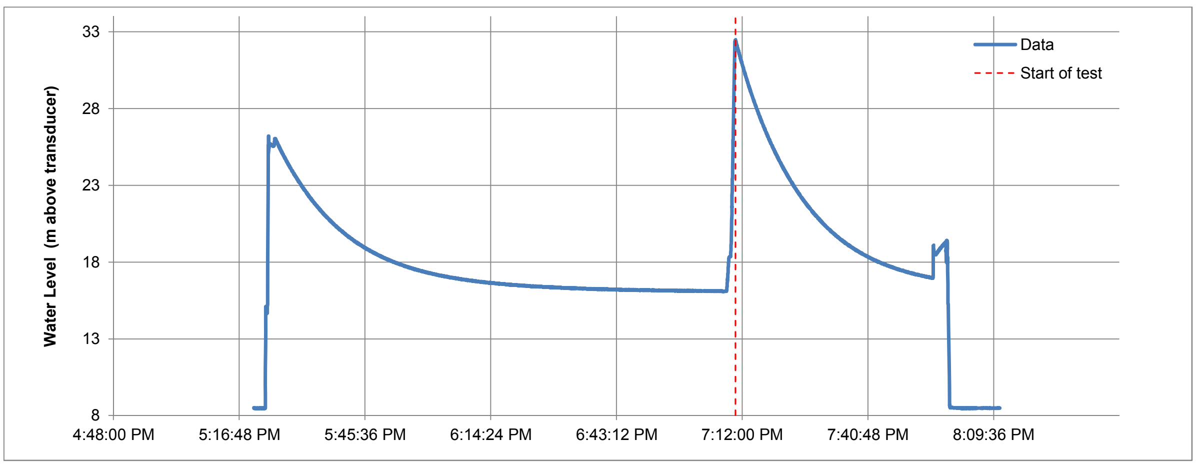
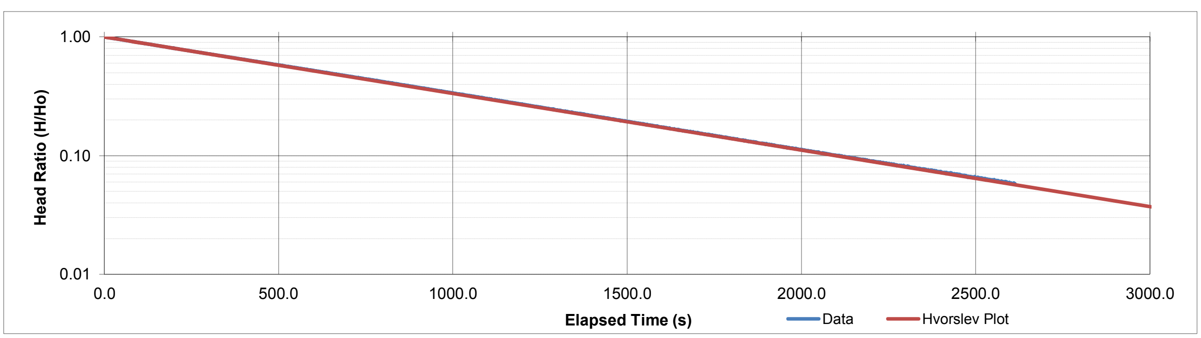
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 13:56

Project No.	VA101-460/03			**Drillhole**	**SC15-187**	
Field Technician	GM/JBC			**Test No.**	3	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	72	L of water		**Packer Inflation Time**	5:21:00 PM	
Test Date	12-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	7:10:27 PM	
Top of test interval	23.3	**m along hole**		**Initial water level**	16.11	**m above transducer**
Bottom of test interval	30.2	**m along hole**		**Water level after slug**	32.47	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	16.37	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	15	**m**
Transmissivity, T	4E-06	**m^2/s**				
Hydraulic Conductivity, K	6E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	4MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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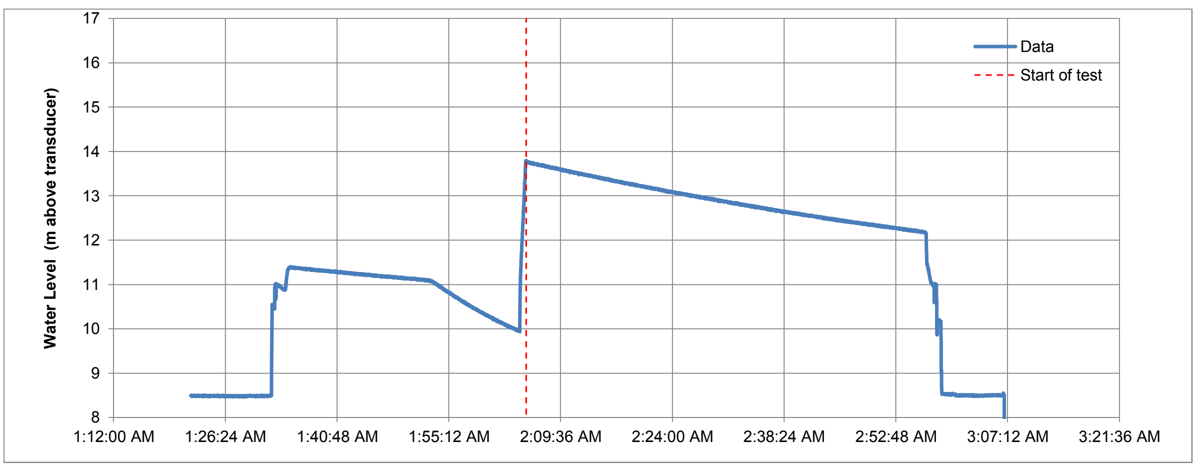
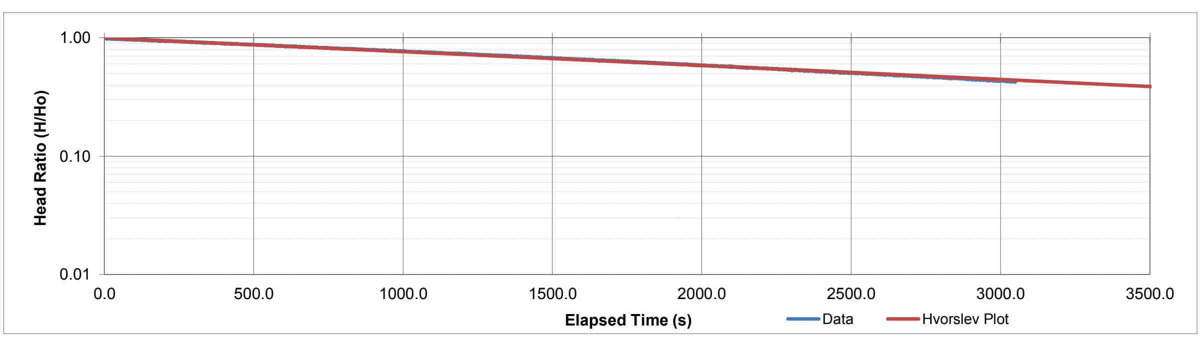
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:17

Project No.	VA101-460/03	**Drillhole**	**SC15-188**
Field Technician	JBC	**Test No.**	1
Analyst	JBC		
Monitoring Instrument Type	Transducer	**Packer Type**	HQ Nitrogen
Slug Type	15 L of water	**Packer Inflation Time**	1:35:00 AM
Test Date	13-Mar-15		
Drillhole diameter, D	HQ3 0.096 m		
Drill rod diameter, d	HQ3 0.078 m	**Slug Injected, Time = 0**	2:05:10 AM
Top of test interval	3.5 m along hole	**Initial water level**	11.00 m above transducer
Bottom of test interval	8.8 m along hole	**Water level after slug**	13.80 m above transducer
Test length, L	5.3 m along hole	**Change in Water Level, H_o**	2.80 m
Drillhole angle	90 degrees	**Expected Change in Water Level, H_o**	3 m
Transmissivity, T	1E-06 m^2/s		
Hydraulic Conductivity, K	2E-07 m/s	Intercept	1.0





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	13MAR'15	ISSUED WITH REPORT	JBC	GIM

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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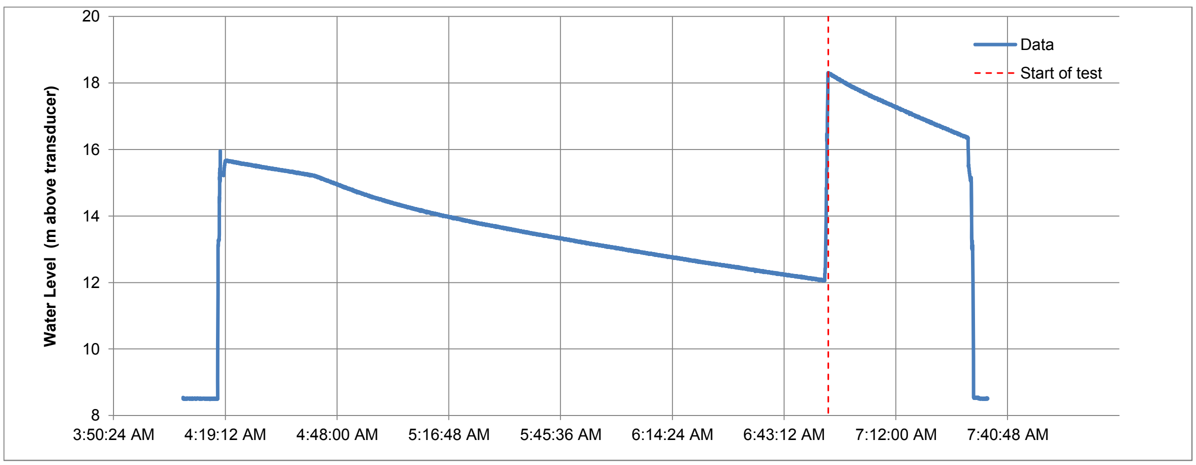
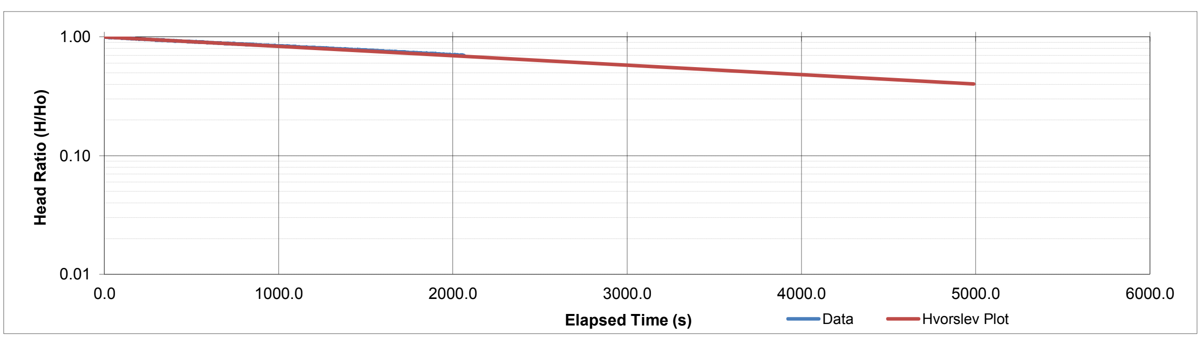
Project No.	VA101-460/03			**Drillhole**	**SC15-188**	
Field Technician	JBC			**Test No.**	2	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water		**Packer Inflation Time**	4:20:00 AM	
Test Date	13-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	6:54:36 AM	
Top of test interval	8.1	**m along hole**		**Initial water level**	12.05	**m above transducer**
Bottom of test interval	14.9	**m along hole**		**Water level after slug**	18.31	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	6.26	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	7E-07	**m^2/s**				
Hydraulic Conductivity, K	1E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	13MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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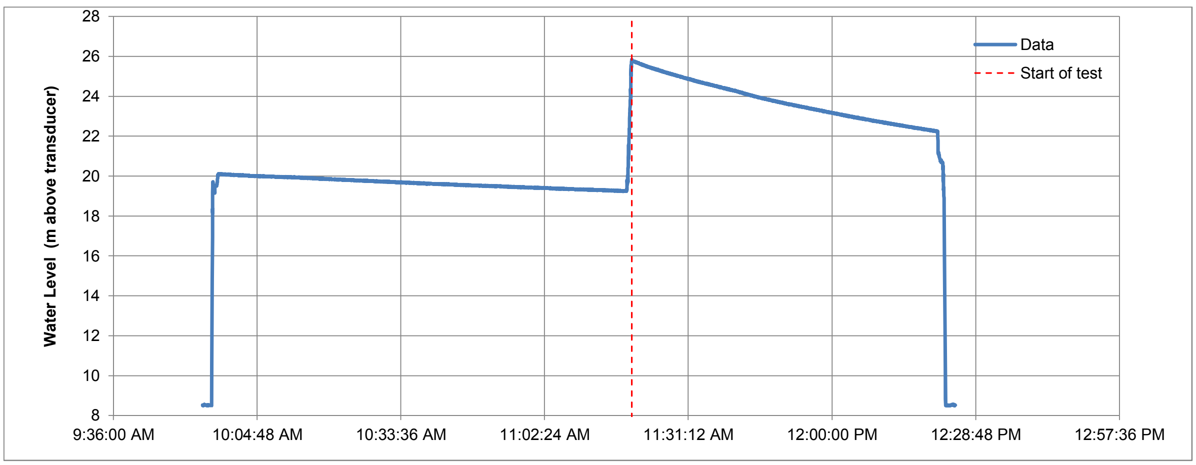
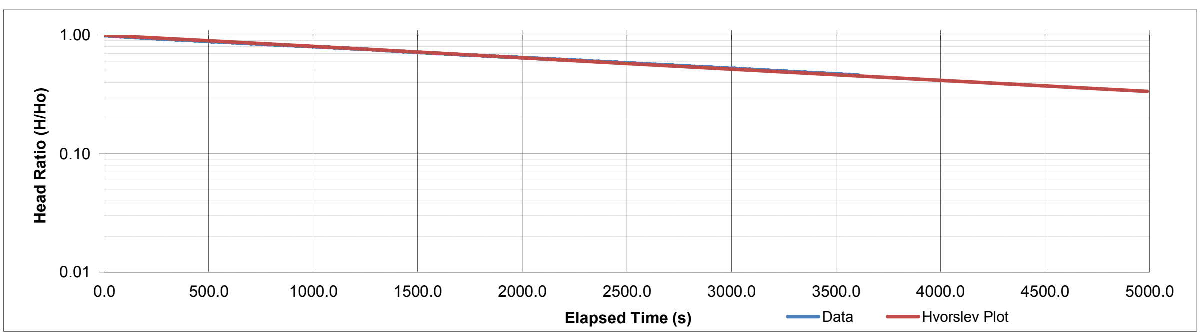
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:17

Project No.	VA101-460/03			**Drillhole**	**SC15-188**	
Field Technician	GM			**Test No.**	3	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water		**Packer Inflation Time**	9:56:00 AM	
Test Date	13-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	11:19:53 AM	
Top of test interval	15.7	**m along hole**		**Initial water level**	19.28	**m above transducer**
Bottom of test interval	22.6	**m along hole**		**Water level after slug**	25.83	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	6.56	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	8E-07	**m^2/s**				
Hydraulic Conductivity, K	1E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

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A	13MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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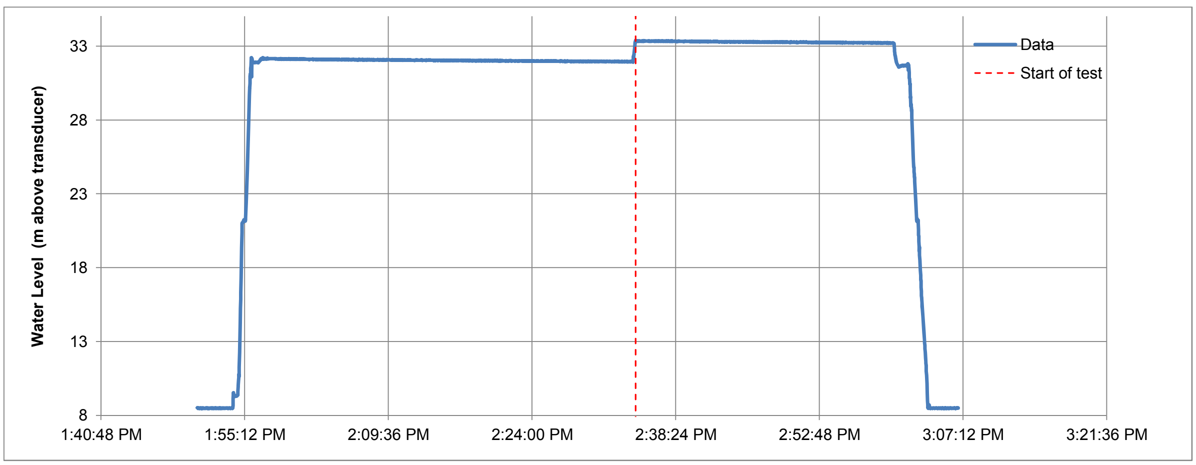
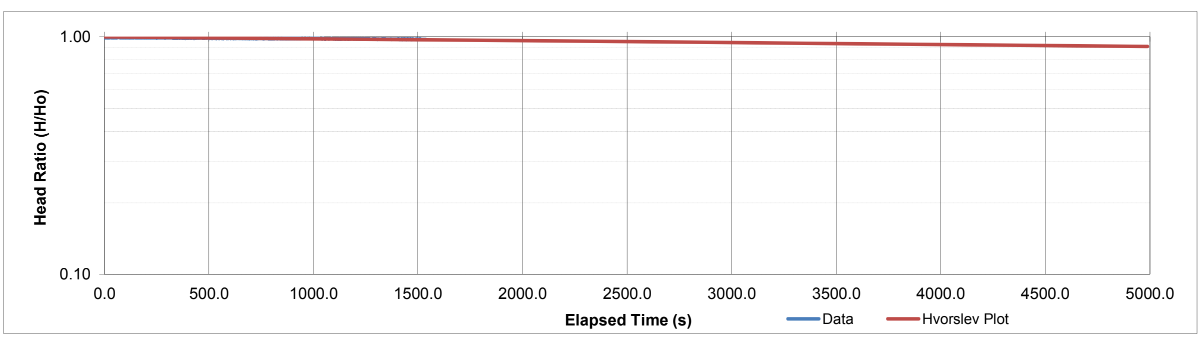
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:17

Project No.	VA101-460/03			**Drillhole**	**SC15-188**	
Field Technician	GM			**Test No.**	4	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water		**Packer Inflation Time**	1:56:00 PM	
Test Date	13-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	2:34:23 PM	
Top of test interval	23.3	**m along hole**		**Initial water level**	25.83	**m above transducer**
Bottom of test interval	30.2	**m along hole**		**Water level after slug**	33.38	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	7.55	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	7E-08	**m^2/s**				
Hydraulic Conductivity, K	1E-08	**m/s**		Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-188 Hvorslev_Packer Drillhole.xlsx]SC15-188 Hvorslev Packer #4

A	13MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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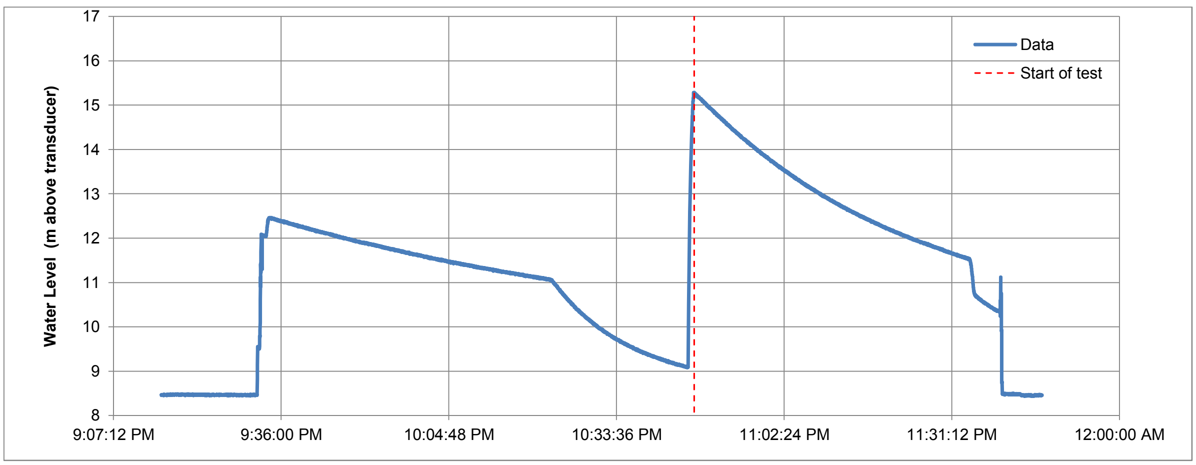
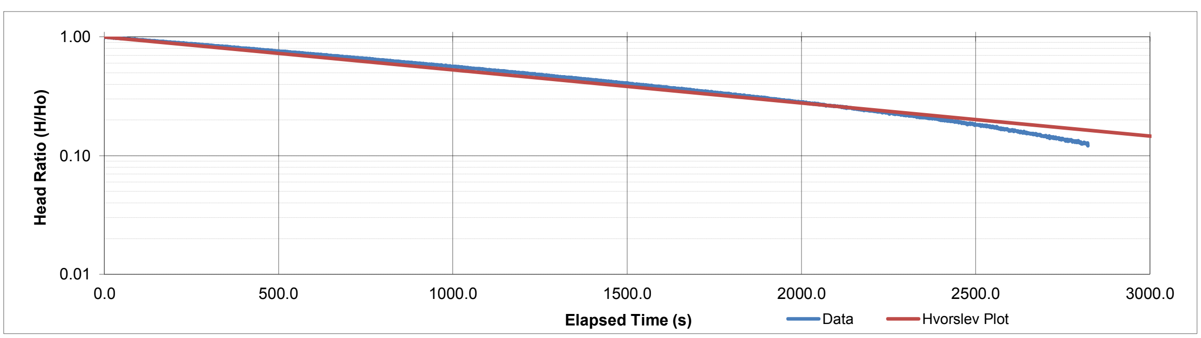
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:31

Project No.	VA101-460/03			**Drillhole**	**SC15-189**	
Field Technician	JBC			**Test No.**	1	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	21	L of water		**Packer Inflation Time**	9:32:00 PM	
Test Date	13-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	10:46:58 PM	
Top of test interval	5.0	**m along hole**		**Initial water level**	11.00	**m above transducer**
Bottom of test interval	11.9	**m along hole**		**Water level after slug**	15.29	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	4.29	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	4	**m**
Transmissivity, T	2E-06	**m^2/s**				
Hydraulic Conductivity, K	4E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

Saw bubbles from the top of the rods during the falling head test. Suspected leak from the bladder. Observed that the inflation pressure of 100 psi had decreased at the end of the test to approximately 75 psi. This gradual decrease in inflation pressure could explain the two slope patterns observed during the initial water level recovery. Informed drillers to inspect the nitrogen line connection for the next test. The first slope pattern was taken into the analysis of the K value as it has a more comparable slope to the falling head test recovery.

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-189 Hvorslev_Packer Drillhole.xlsx]SC15-189 Hvorslev Packer #1

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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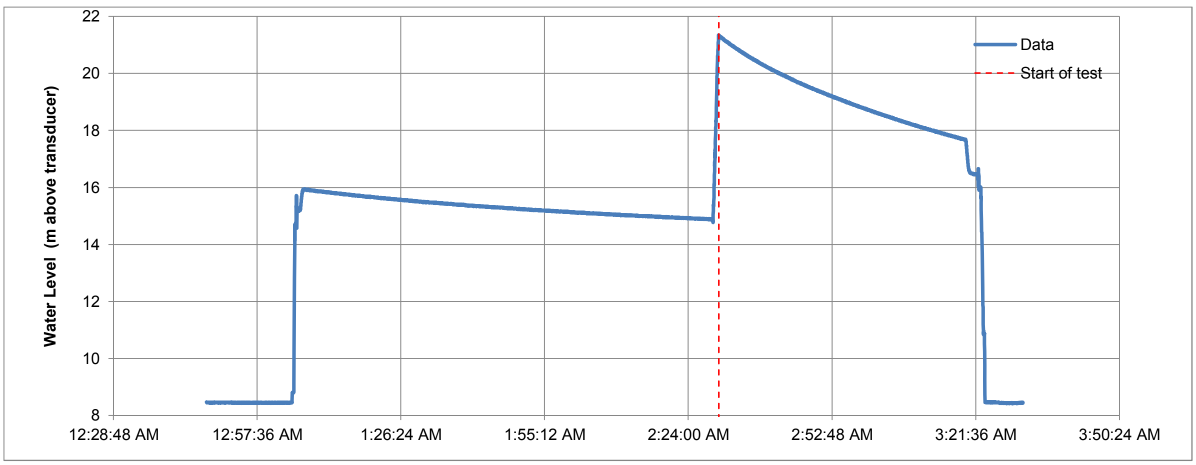
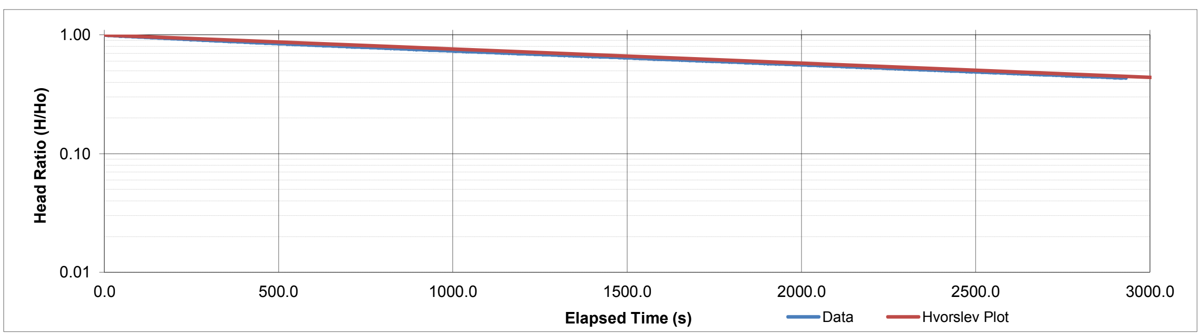
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:31

Project No.	VA101-460/03			**Drillhole**	**SC15-189**	
Field Technician	JBC			**Test No.**	2	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	43	L of water		**Packer Inflation Time**	1:05:00 AM	
Test Date	14-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	2:30:09 AM	
Top of test interval	11.1	**m along hole**		**Initial water level**	14.91	**m above transducer**
Bottom of test interval	18.0	**m along hole**		**Water level after slug**	21.35	**m above transducer**
Test length, L	6.9	**m along hole**		**Change in Water Level, H_o**	6.44	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	9	**m**
Transmissivity, T	1E-06	**m^2/s**				
Hydraulic Conductivity, K	2E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-189 Hvorslev_Packer Drillhole.xlsx]SC15-189 Hvorslev Packer #2

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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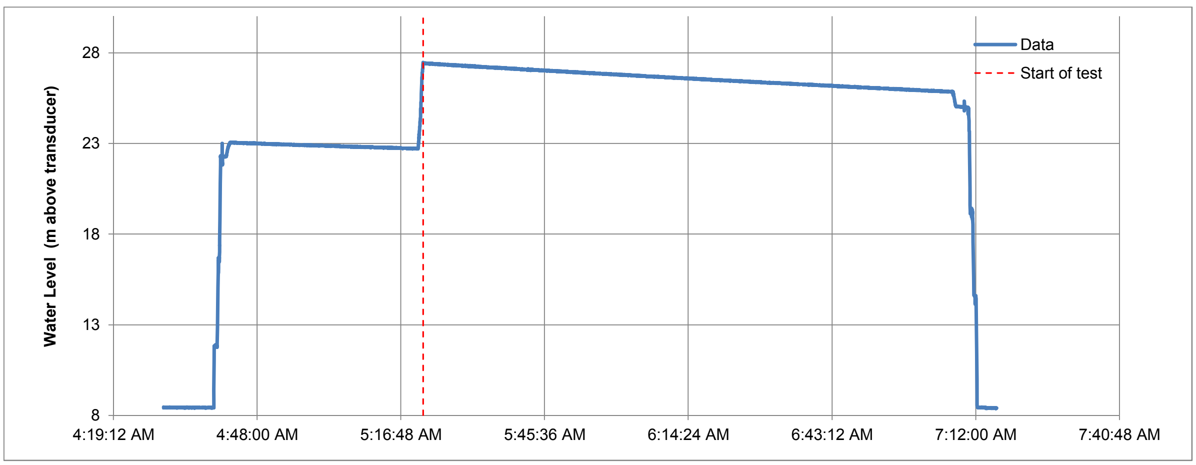
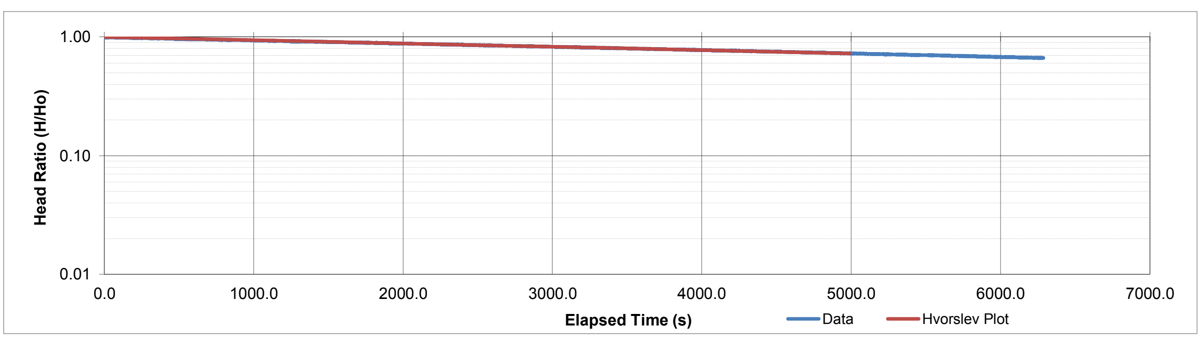
Project No.	VA101-460/03		**Drillhole**	**SC15-189**	
Field Technician	JBC		**Test No.**	3	
Analyst	GIM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	4:42:00 AM	
Test Date	14-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:21:14 AM	
Top of test interval	17.2	**m along hole**	**Initial water level**	22.71	**m above transducer**
Bottom of test interval	24.1	**m along hole**	**Water level after slug**	27.45	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	4.74	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	2E-07	**m^2/s**			
Hydraulic Conductivity, K	4E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-189 Hvorslev_Packer Drillhole.xlsx]SC15-189 Hvorslev Packer #3

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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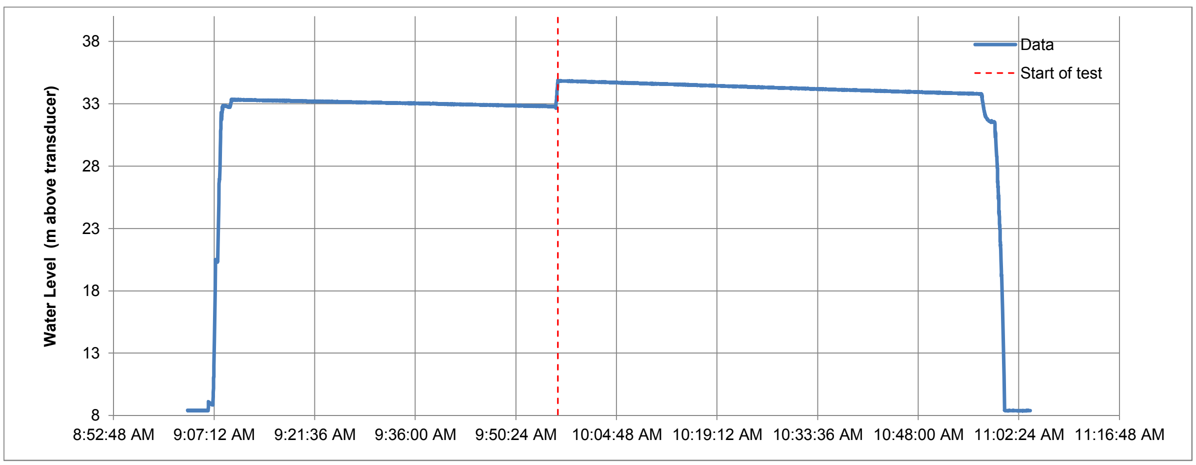
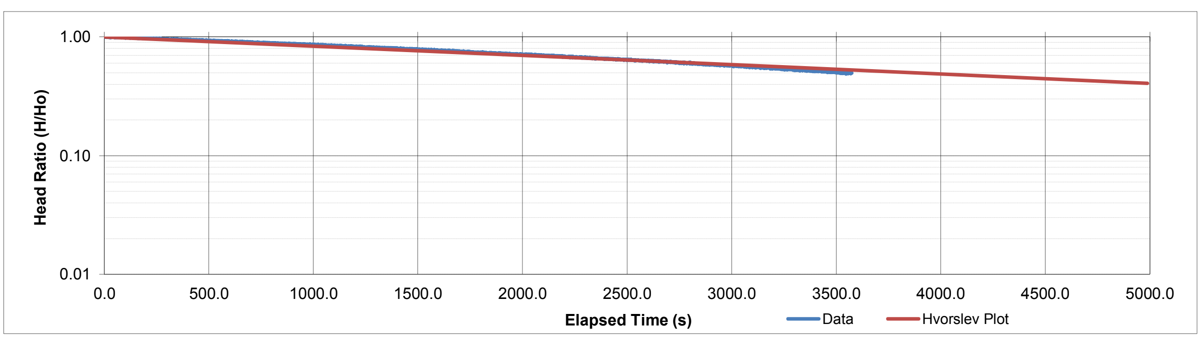
Project No.	VA101-460/03		**Drillhole**	**SC15-189**	
Field Technician	GM		**Test No.**	4	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	9:09:00 AM	
Test Date	14-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	9:56:26 AM	
Top of test interval	24.8	**m along hole**	**Initial water level**	32.79	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	34.84	**m above transducer**
Test length, L	5.3	**m along hole**	**Change in Water Level, H_o**	2.05	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	6E-07	**m^2/s**			
Hydraulic Conductivity, K	1E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

Water level dropping very slowly at a linear rate. Did not wait for static water level and ran test for 60 minutes.

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-189 Hvorslev_Packer Drillhole.xlsx]SC15-189 Hvorslev Packer #4

A	11MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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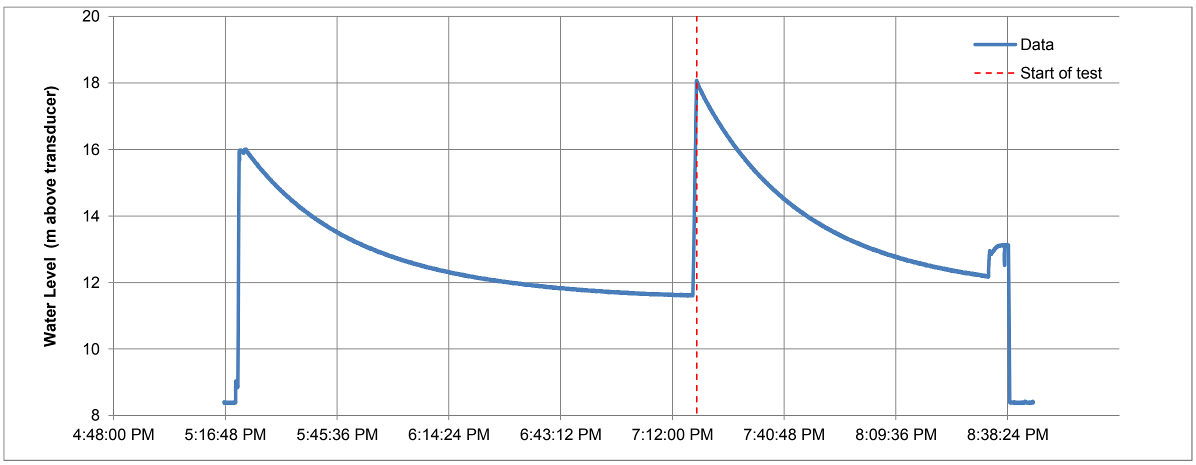
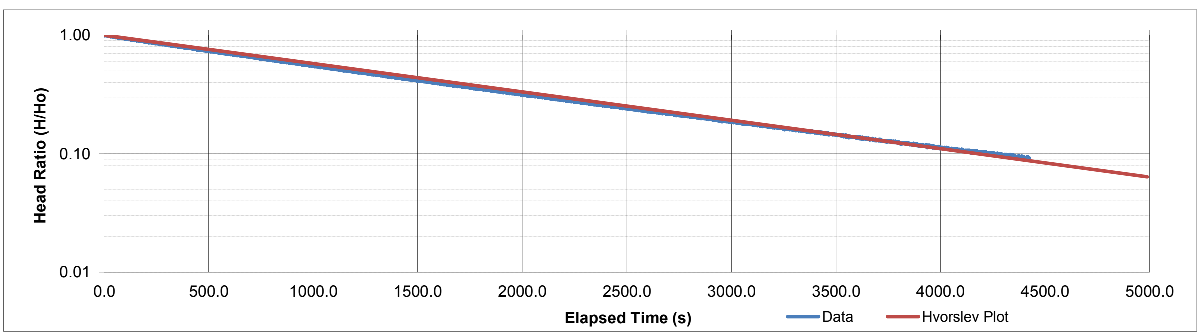
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 14:34

Project No.	VA101-460/03	**Drillhole**	**SC15-190**
Field Technician	GM/JBC	**Test No.**	1
Analyst	JBC		
Monitoring Instrument Type	Transducer	**Packer Type**	HQ Nitrogen
Slug Type	36 L of water	**Packer Inflation Time**	5:20:00 PM
Test Date	14-Mar-15		
Drillhole diameter, D	HQ3 0.096 m		
Drill rod diameter, d	HQ3 0.078 m	**Slug Injected, Time = 0**	7:18:16 PM
Top of test interval	8.1 **m along hole**	**Initial water level**	11.62 **m above transducer**
Bottom of test interval	14.8 **m along hole**	**Water level after slug**	18.08 **m above transducer**
Test length, L	6.8 **m along hole**	**Change in Water Level, H_o**	6.5 **m**
Drillhole angle	90 **degrees**	**Expected Change in Water Level, H_o**	7.6 **m**
Transmissivity, T	2E-06 **m^2/s**		
Hydraulic Conductivity, K	3E-07 **m/s**	Intercept	1.0





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-190 Hvorslev_Packer Drillhole.xlsx]SC15-190 Hvorslev Packer #1

REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	14MAR'15	ISSUED WITH REPORT	JBC	GIM

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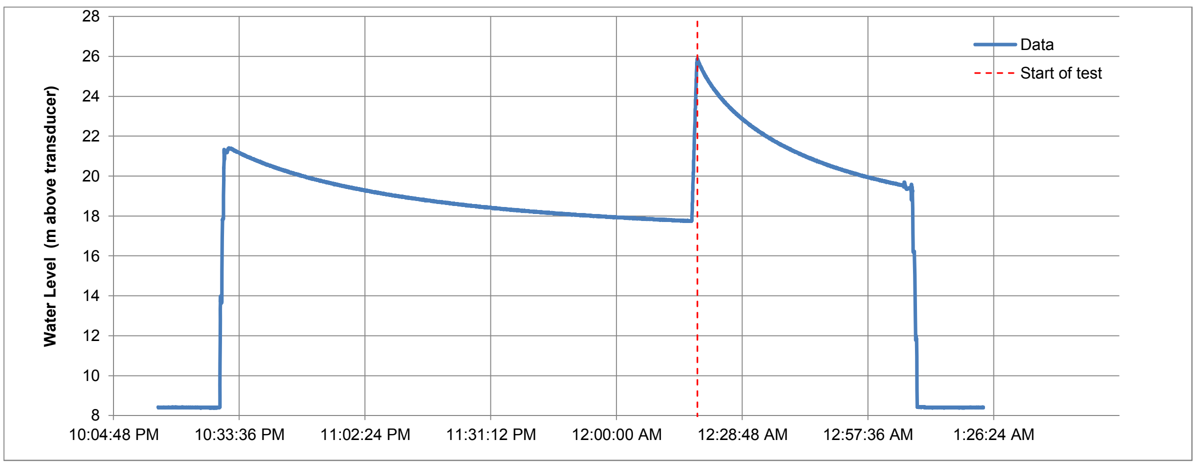
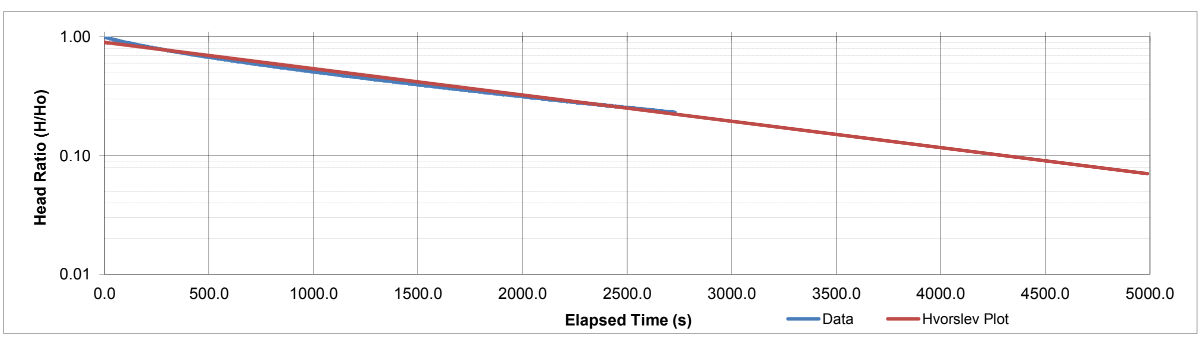
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 14:34

Project No.	VA101-460/03			**Drillhole**	**SC15-190**	
Field Technician	JBC			**Test No.**	2	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	45	L of water		**Packer Inflation Time**	10:30:00 PM	
Test Date	15-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	12:18:31 AM	
Top of test interval	15.7	**m along hole**		**Initial water level**	17.73	**m above transducer**
Bottom of test interval	22.1	**m along hole**		**Water level after slug**	25.89	**m above transducer**
Test length, L	6.4	**m along hole**		**Change in Water Level, H_o**	8.2	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	9.6	**m**
Transmissivity, T	2E-06	**m^2/s**				
Hydraulic Conductivity, K	3E-07	**m/s**		Intercept	0.9	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-190 Hvorslev_Packer Drillhole.xlsx]SC15-190 Hvorslev Packer #2

A	14MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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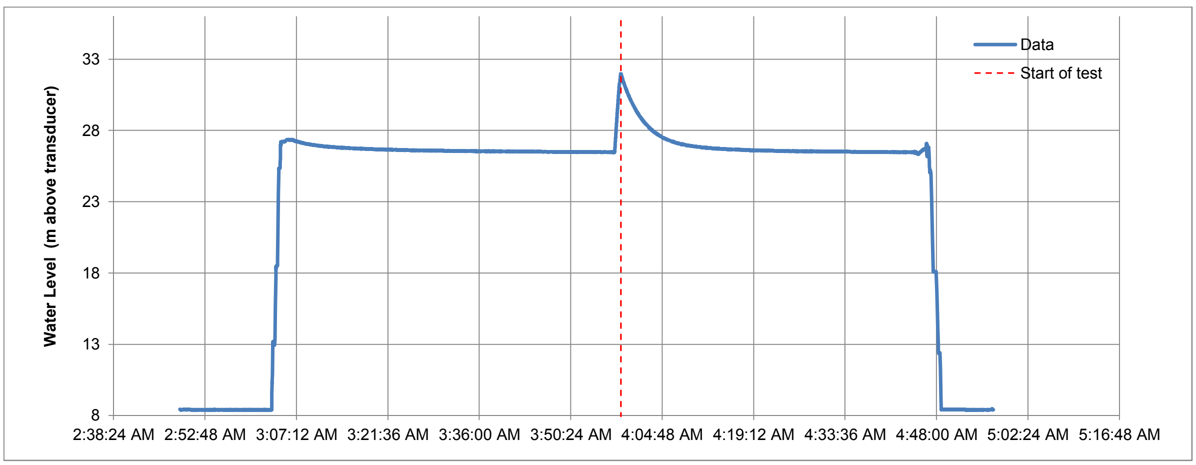
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

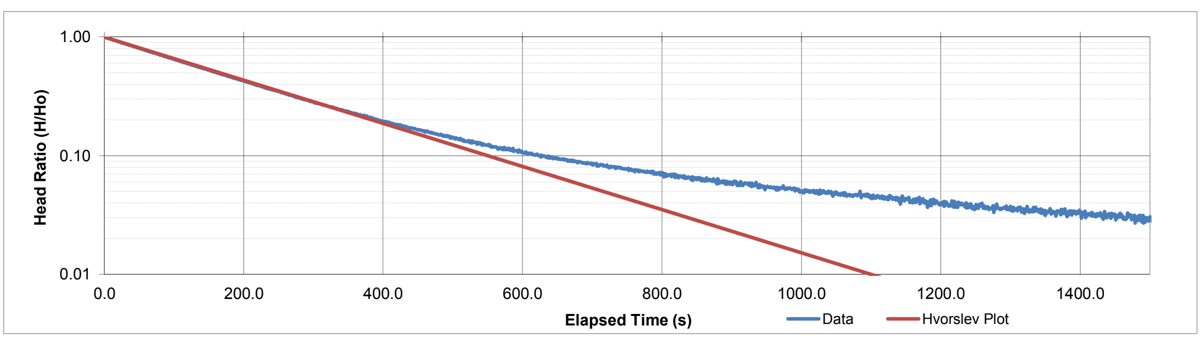
Print 02/26/16 14:34

Project No.	VA101-460/03		**Drillhole**	**SC15-190**	
Field Technician	JBC		**Test No.**	3	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	34	L of water	**Packer Inflation Time**	3:05:00 AM	
Test Date	15-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	3:58:19 AM	
Top of test interval	21.8	**m along hole**	**Initial water level**	26.40	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	31.97	**m above transducer**
Test length, L	8.4	**m along hole**	**Change in Water Level, H_o**	5.6	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	7.2	**m**

Transmissivity, T 2E-05 **m^2/s**

Hydraulic Conductivity, K 2E-06 **m/s** Intercept 1.0





TEST COMMENTS:

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A	14MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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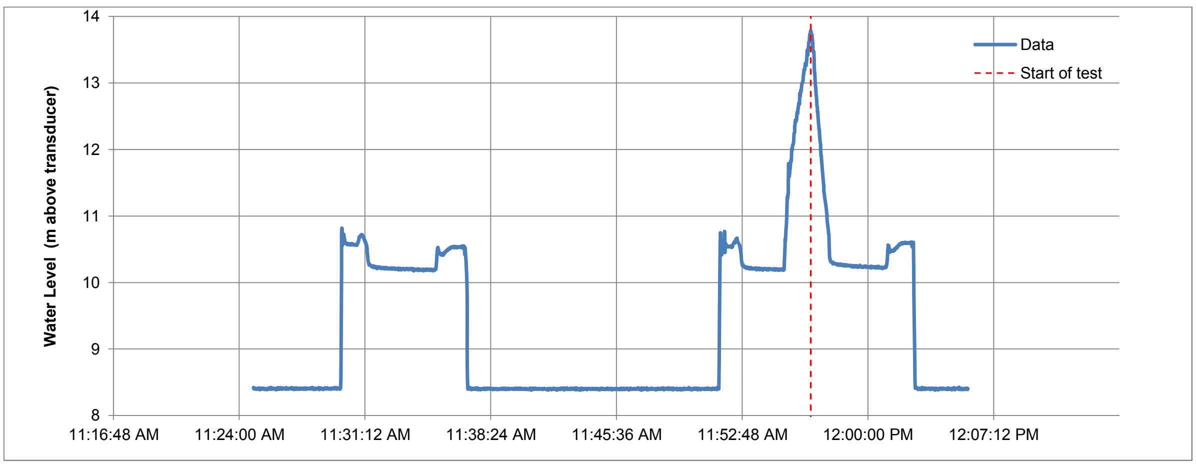
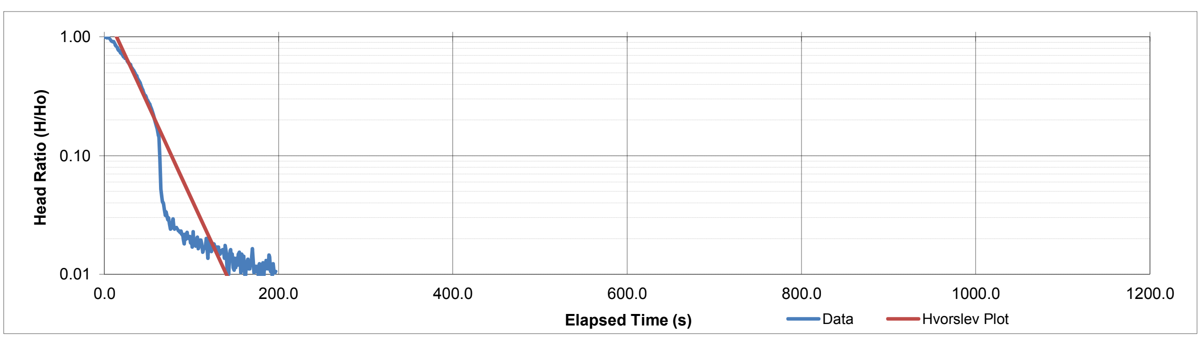
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:02

Project No.	VA101-460/03		**Drillhole**	**SC15-191**	
Field Technician	GM		**Test No.**	1	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	102	L of water over 2 minutes	**Packer Inflation Time**	11:30:00 AM	
Test Date	15-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	11:56:43 AM	
Top of test interval	8.1	**m along hole**	**Initial water level**	10.20	**m above transducer**
Bottom of test interval	14.9	**m along hole**	**Water level after slug**	13.78	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	3.59	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	21	**m**
Transmissivity, T	1E-04	**m^2/s**			
Hydraulic Conductivity, K	2E-05	**m/s**	Intercept	1.7	





TEST COMMENTS:

Put packer down hole, but could not measure static water level because it was below the packer. Pulled packer to measure open hole WL, and measured it at 8.62 mbsu (~24 ft), which was still above the packer level, meaning the zone was saturated. Proceeded to put packer back down and run falling head test.
Pumped water down hole at 19 gal /minute but couldn't fill rods. Drillers lost return from 35-39 ft.

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-191 Hvorslev_Packer Drillhole.xlsx]SC15-191 Hvorslev Packer #1

A	15MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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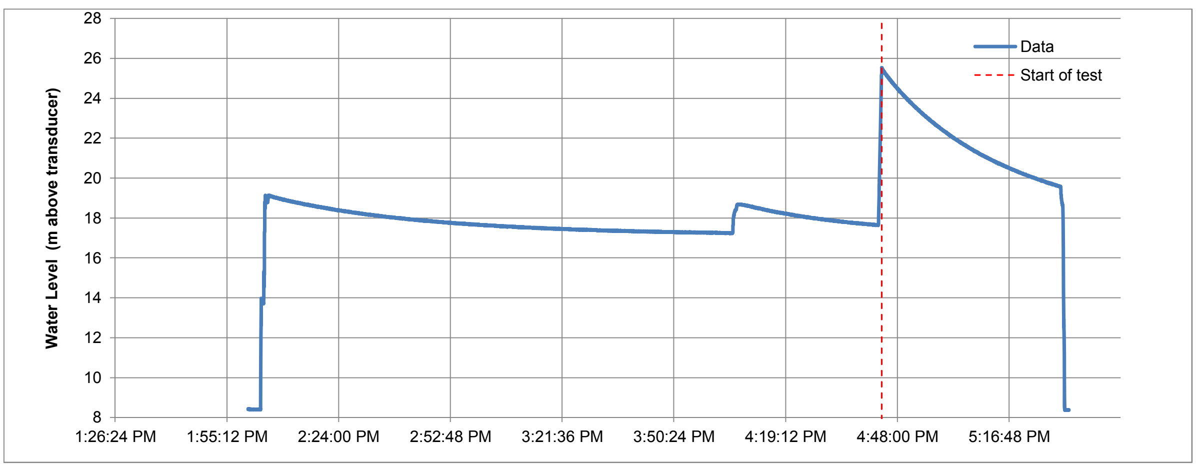
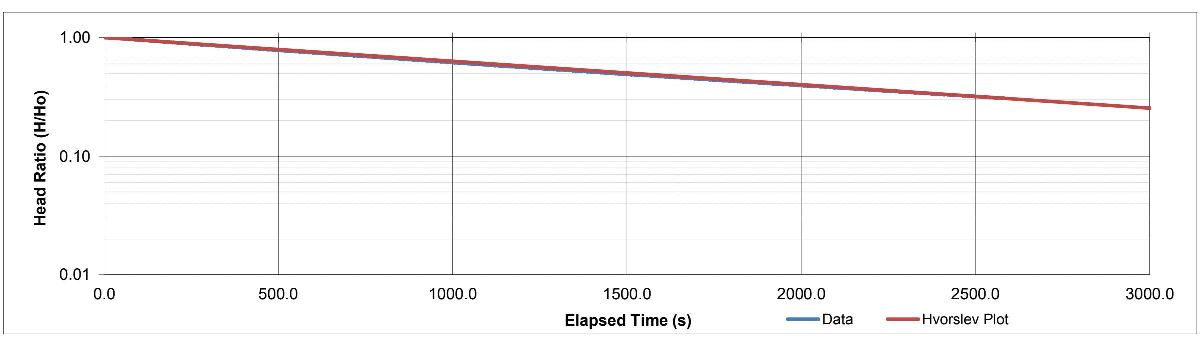
Project No.	VA101-460/03		**Drillhole**	**SC15-191**	
Field Technician	GM		**Test No.**	2	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	2:03:00 PM	
Test Date	15-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	4:43:57 PM	
Top of test interval	15.7	**m along hole**	**Initial water level**	17.24	**m above transducer**
Bottom of test interval	22.6	**m along hole**	**Water level after slug**	25.40	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	8.16	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	2E-06	**m^2/s**			
Hydraulic Conductivity, K	3E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	15MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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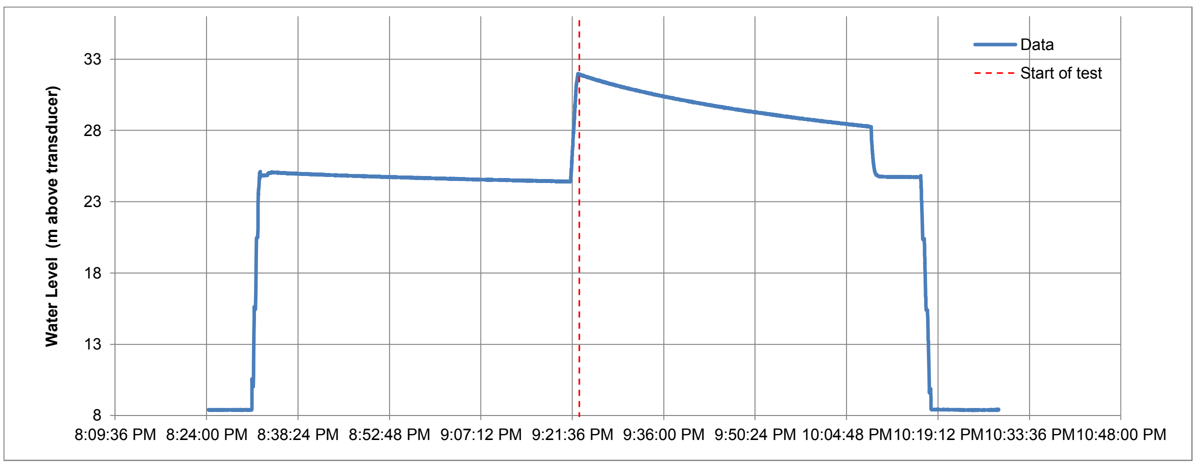
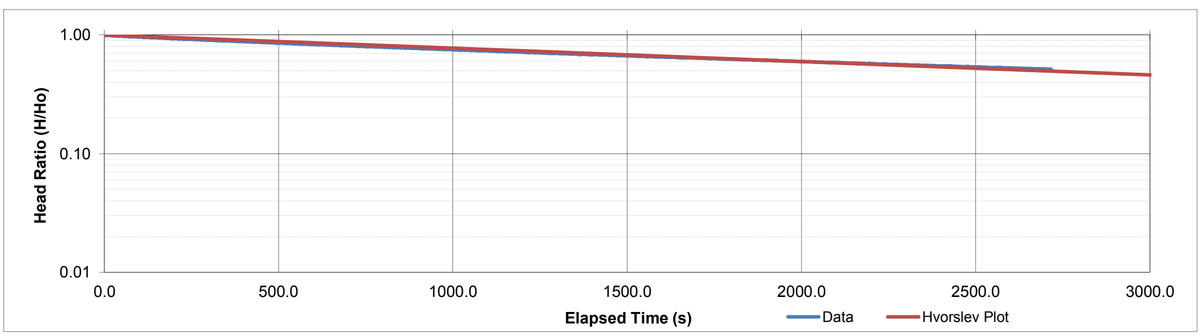
Project No.	VA101-460/03		**Drillhole**	**SC15-191**	
Field Technician	JBC		**Test No.**	3	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	42	L of water	**Packer Inflation Time**	8:33:00 PM	
Test Date	15-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	9:22:43 PM	
Top of test interval	21.8	**m along hole**	**Initial water level**	24.40	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	31.99	**m above transducer**
Test length, L	8.4	**m along hole**	**Change in Water Level, H_o**	7.59	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	9	**m**
Transmissivity, T	1E-06	**m^2/s**			
Hydraulic Conductivity, K	1E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-191 Hvorslev_Packer Drillhole.xlsx]SC15-191 Hvorslev Packer #3

A	15MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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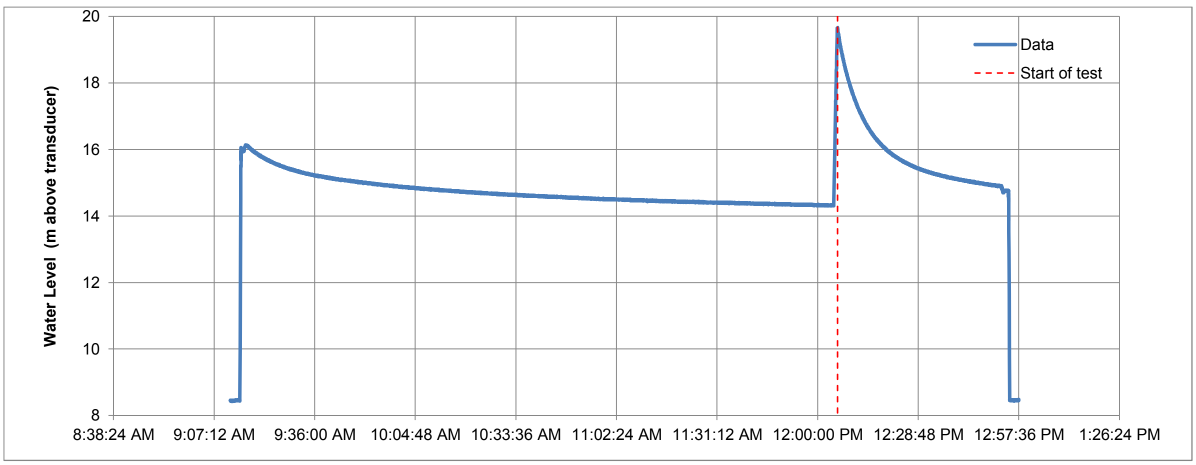
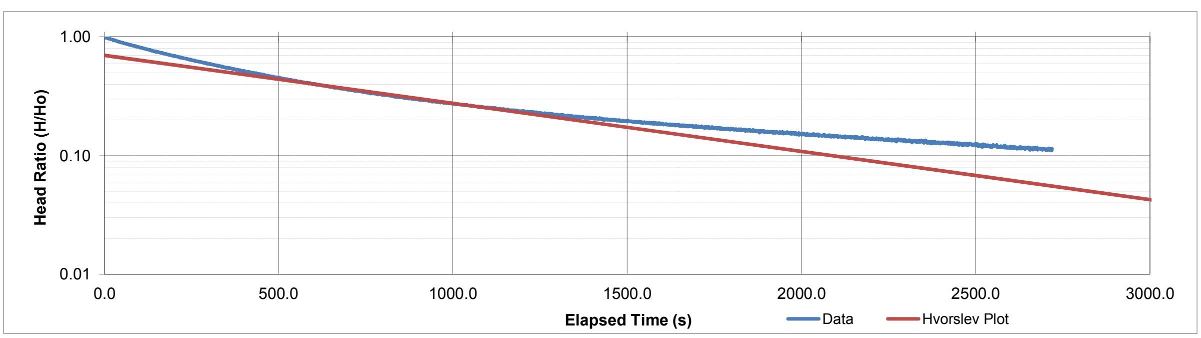
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:04

Project No.	VA101-460/03		Drillhole	SC15-192	
Field Technician	GM		Test No.	1	
Analyst	GM				
Monitoring Instrument Type	Transducer		Packer Type	HQ Nitrogen	
Slug Type	30	L of water	Packer Inflation Time	9:12:00 AM	
Test Date	16-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	Slug Injected, Time = 0	12:05:41 PM	
Top of test interval	9.6	m along hole	Initial water level	14.31	m above transducer
Bottom of test interval	19.8	m along hole	Water level after slug	19.67	m above transducer
Test length, L	10.2	m along hole	Change in Water Level, H_o	5.36	m
Drillhole angle	90	degrees	Expected Change in Water Level, H_o	6	m
Transmissivity, T	4E-06	m^2/s			
Hydraulic Conductivity, K	4E-07	m/s	Intercept	0.7	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-192 Hvorslev_Packer Drillhole.xlsx]SC15-192 Hvorslev Packer #1

REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	16MAR'15	ISSUED WITH REPORT	JBC	GIM

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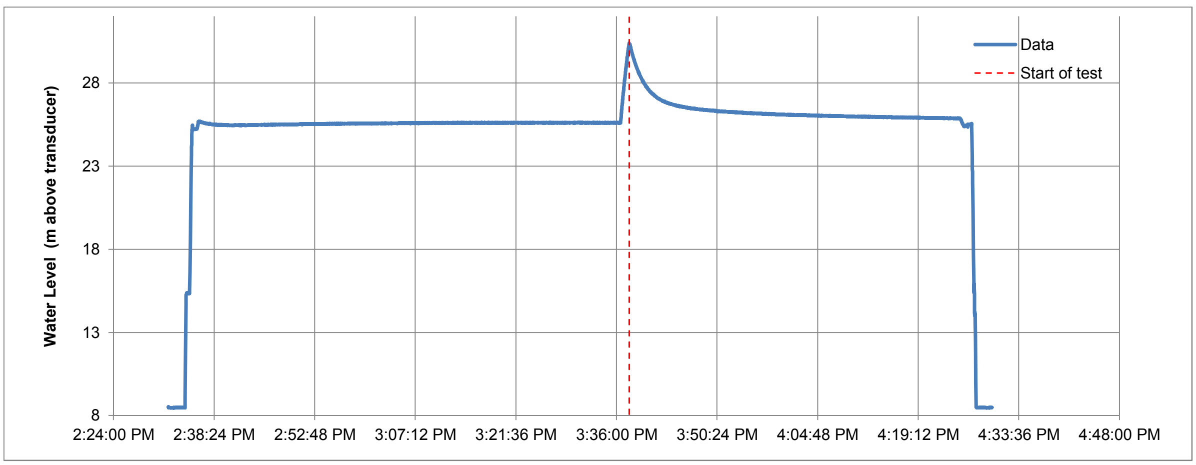
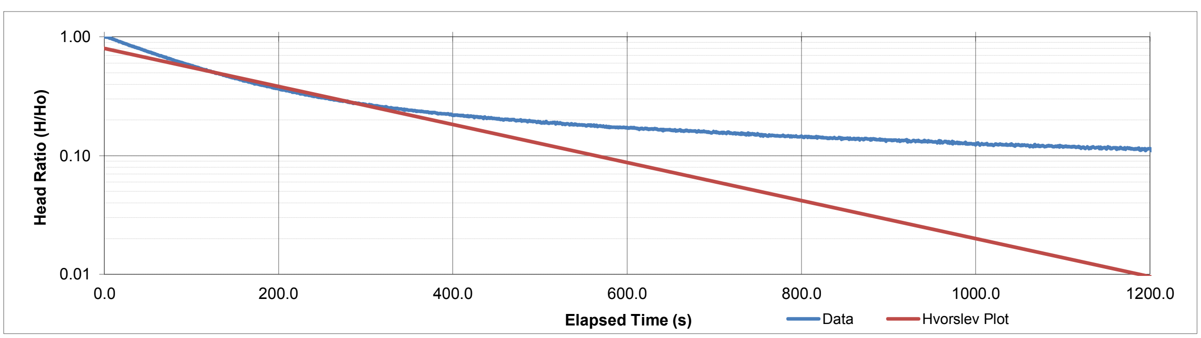
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:04

Project No.	VA101-460/03			**Drillhole**	**SC15-192**	
Field Technician	GM			**Test No.**	2	
Analyst	GM					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	32	L of water		**Packer Inflation Time**	2:30:00 PM	
Test Date	16-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	3:37:50 PM	
Top of test interval	20.6	m along hole		**Initial water level**	25.59	m above transducer
Bottom of test interval	30.5	m along hole		**Water level after slug**	30.39	m above transducer
Test length, L	9.9	m along hole		**Change in Water Level, H_o**	4.79	m
Drillhole angle	90	degrees		**Expected Change in Water Level, H_o**	7	m
Transmissivity, T	1E-05	m^2/s				
Hydraulic Conductivity, K	2E-06	m/s		Intercept	0.8	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-192 Hvorslev_Packer Drillhole.xlsx]SC15-192 Hvorslev Packer #2

A	16MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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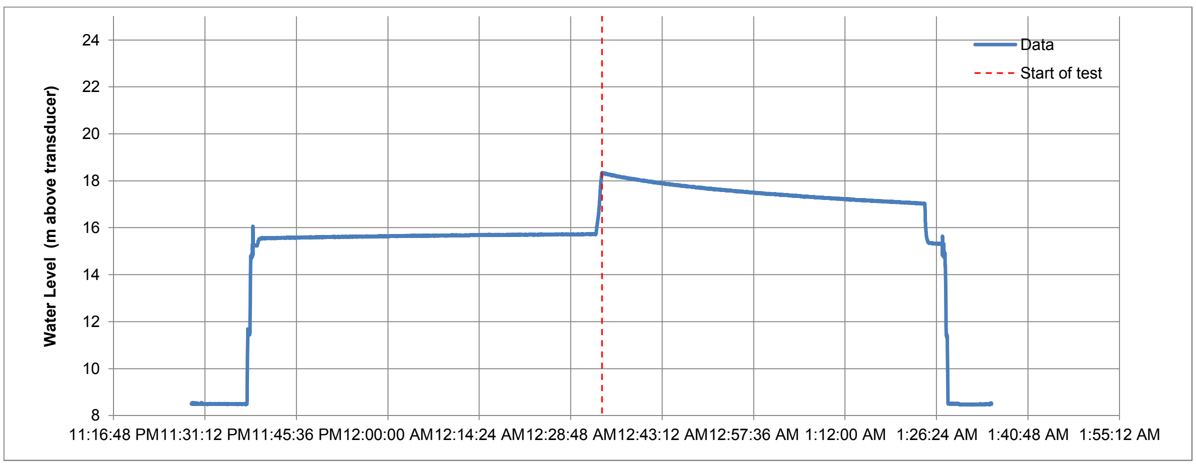
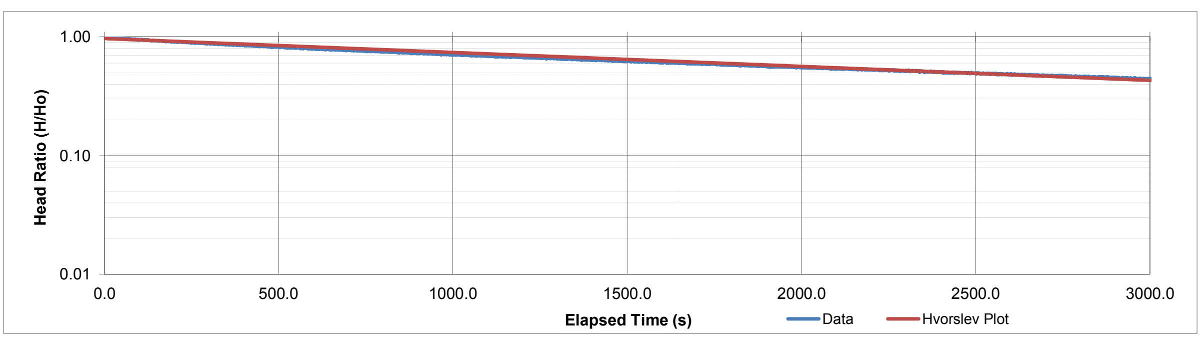
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:06

Project No.	VA101-460/03		**Drillhole**	**SC15-193**	
Field Technician	JBC		**Test No.**	1	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	15	L of water	**Packer Inflation Time**	11:39:00 PM	
Test Date	17-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	12:33:45 AM	
Top of test interval	8.1	**m along hole**	**Initial water level**	16.00	**m above transducer**
Bottom of test interval	18.0	**m along hole**	**Water level after slug**	18.35	**m above transducer**
Test length, L	9.9	**m along hole**	**Change in Water Level, H_o**	2.35	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	3	**m**
Transmissivity, T	1E-06	**m^2/s**			
Hydraulic Conductivity, K	1E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-193 Hvorslev_Packer Drillhole.xlsx]SC15-193 Hvorslev Packer #1

A	17MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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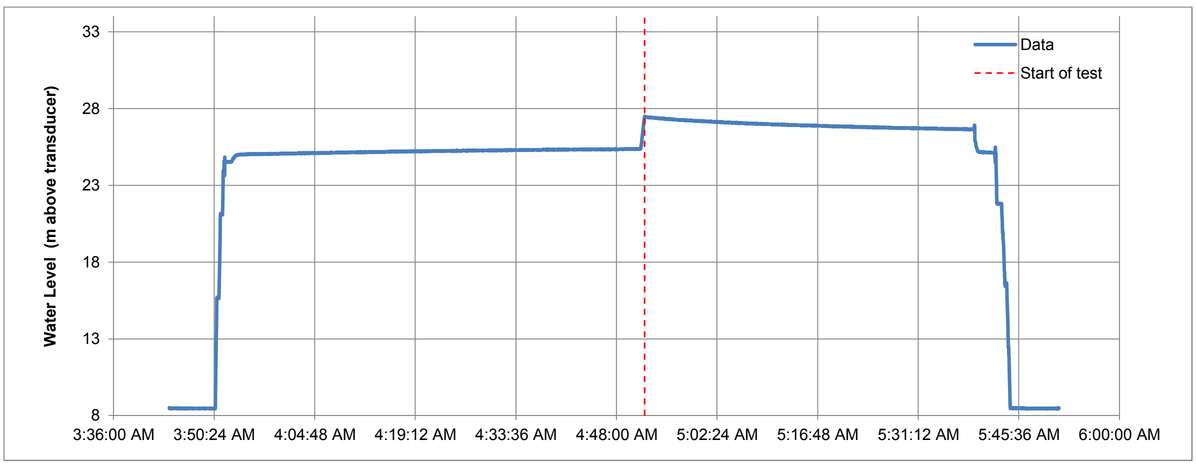
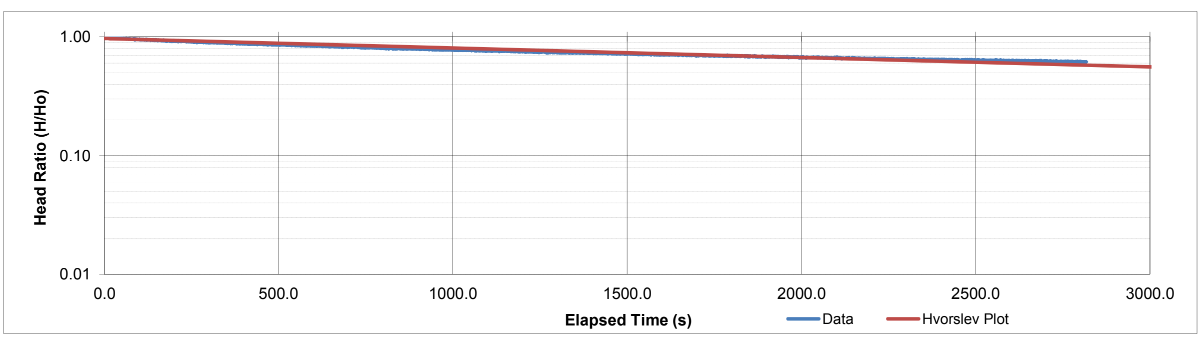
Project No.	VA101-460/03		**Drillhole**	**SC15-193**	
Field Technician	JBC		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	15	L of water	**Packer Inflation Time**	3:53:00 AM	
Test Date	17-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	4:52:03 AM	
Top of test interval	17.2	**m along hole**	**Initial water level**	25.30	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	27.48	**m above transducer**
Test length, L	13.0	**m along hole**	**Change in Water Level, H_o**	2.18	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	3	**m**
Transmissivity, T	8E-07	**m^2/s**			
Hydraulic Conductivity, K	6E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	17MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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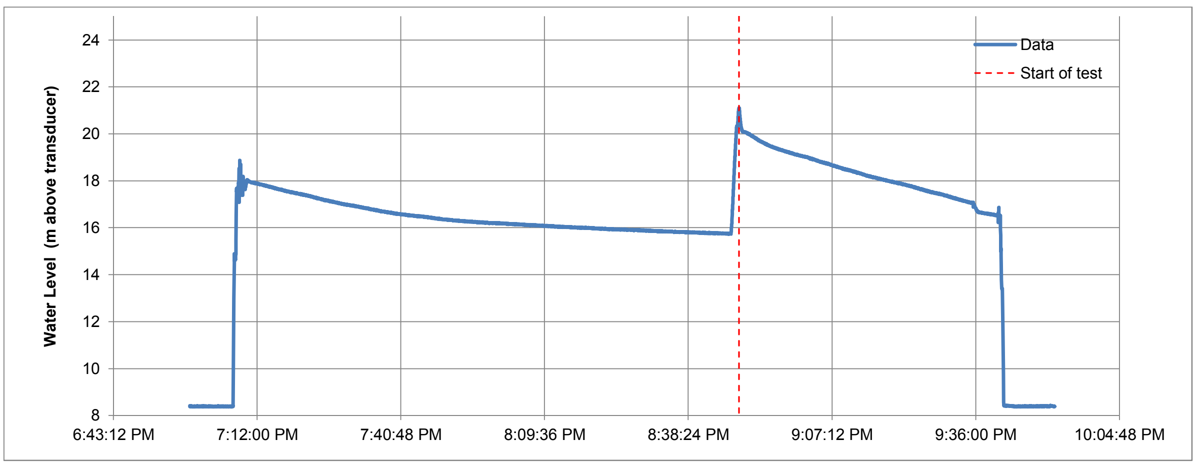
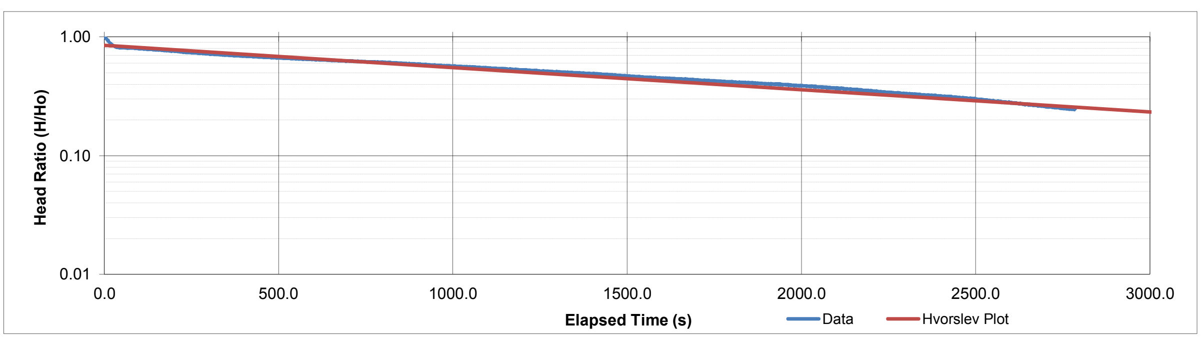
Project No.	VA101-460/03			**Drillhole**	**SC15-194**	
Field Technician	JBC			**Test No.**	1	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	PQ Nitrogen	
Slug Type	102	L of water		**Packer Inflation Time**	7:07:00 PM	
Test Date	17-Mar-15					
Drillhole diameter, D	PQ3	0.123	m			
Drill rod diameter, d	PQ3	0.103	m	**Slug Injected, Time = 0**	8:48:35 PM	
Top of test interval	12.6	**m along hole**		**Initial water level**	15.76	**m above transducer**
Bottom of test interval	17.7	**m along hole**		**Water level after slug**	21.10	**m above transducer**
Test length, L	5.1	**m along hole**		**Change in Water Level, H_o**	5.34	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	12	**m**
Transmissivity, T	3E-06	**m^2/s**				
Hydraulic Conductivity, K	5E-07	**m/s**		Intercept	0.9	





TEST COMMENTS:

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A	17MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

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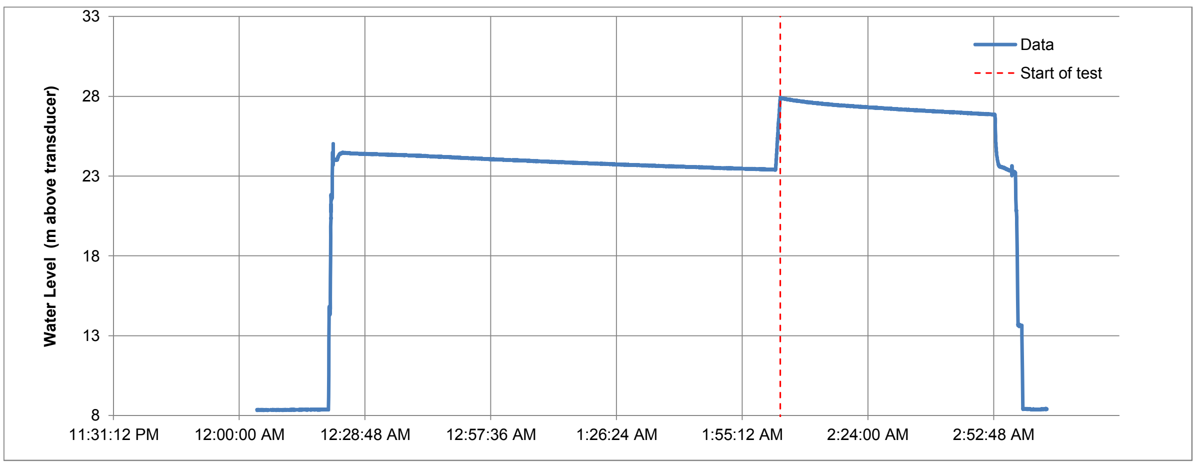
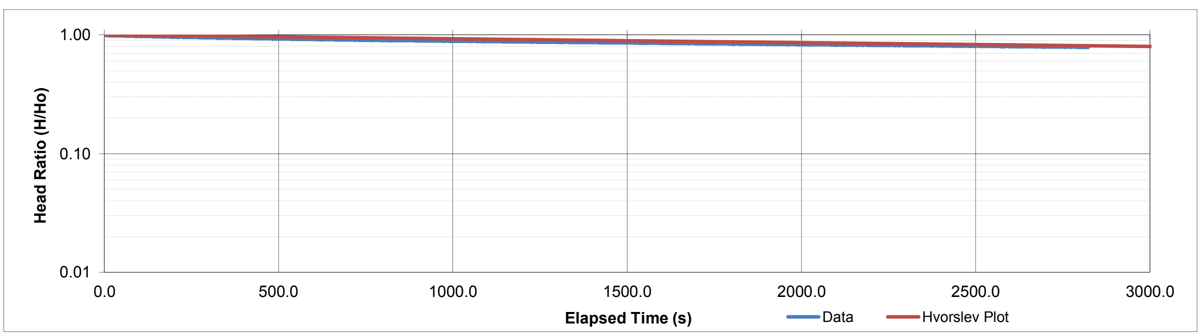
Project No.	VA101-460/03		**Drillhole**	**SC15-194**	
Field Technician	JBC		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	PQ Nitrogen	
Slug Type	42	L of water	**Packer Inflation Time**	12:23:00 AM	
Test Date	18-Mar-15				
Drillhole diameter, D	PQ3	0.123 m			
Drill rod diameter, d	PQ3	0.103 m	**Slug Injected, Time = 0**	2:03:57 AM	
Top of test interval	17.2	**m along hole**	**Initial water level**	23.00	**m above transducer**
Bottom of test interval	23.8	**m along hole**	**Water level after slug**	27.93	**m above transducer**
Test length, L	6.6	**m along hole**	**Change in Water Level, H_o**	4.93	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	5	**m**
Transmissivity, T	5E-07	**m^2/s**			
Hydraulic Conductivity, K	7E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	17MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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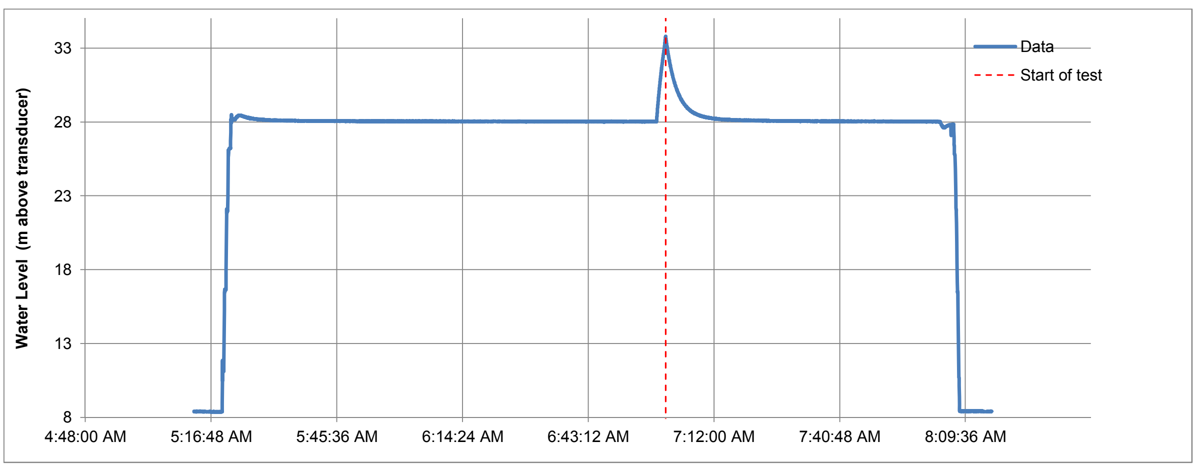
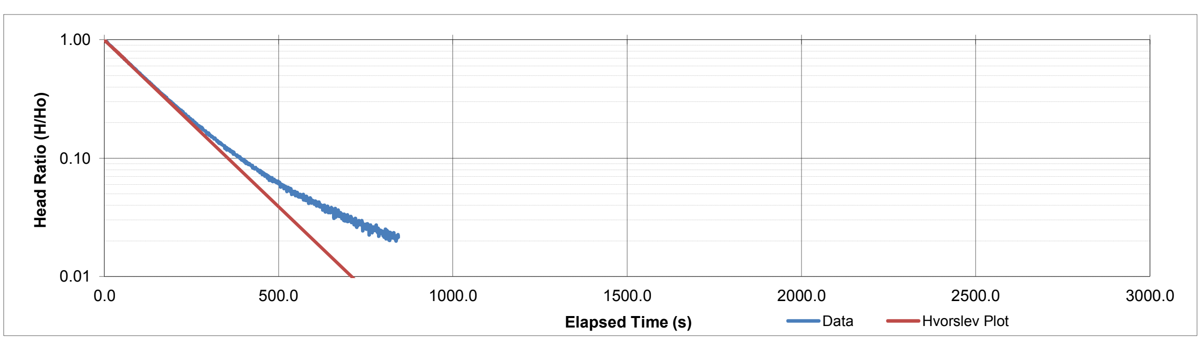
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:08

Project No.	VA101-460/03		**Drillhole**	**SC15-194**	
Field Technician	JBC/GM		**Test No.**	3	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	PQ Nitrogen	
Slug Type	87	L of water	**Packer Inflation Time**		
Test Date	18-Mar-15				
Drillhole diameter, D	PQ3	0.123 m			
Drill rod diameter, d	PQ3	0.103 m	**Slug Injected, Time = 0**	7:00:56 AM	
Top of test interval	23.3	**m along hole**	**Initial water level**	28.03	**m above transducer**
Bottom of test interval	30.1	**m along hole**	**Water level after slug**	33.74	**m above transducer**
Test length, L	6.8	**m along hole**	**Change in Water Level, H_o**	5.71	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	10	**m**
Transmissivity, T	4E-05	**m^2/s**			
Hydraulic Conductivity, K	6E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	17MAR'15	ISSUED WITH REPORT	JBC	GIM

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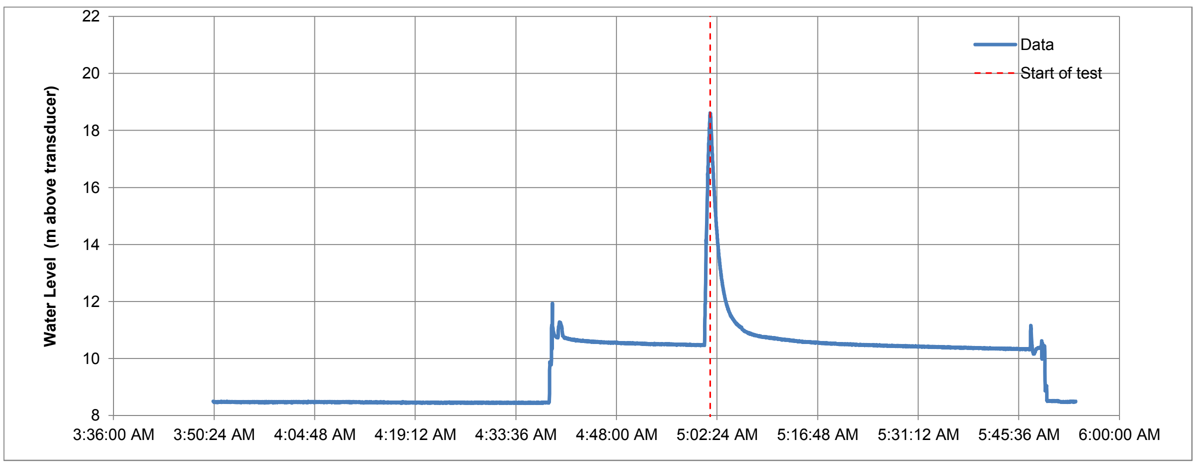
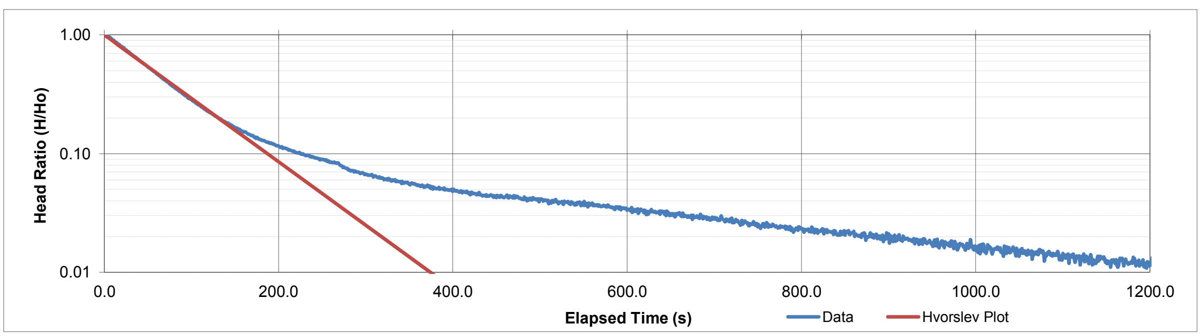
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:09

Project No.	VA101-460/03		**Drillhole**	**SC15-195**	
Field Technician	JBC		**Test No.**	1	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	60.56018168	L of water	**Packer Inflation Time**	4:40:00 AM	
Test Date	19-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:01:26 AM	
Top of test interval	9.6	**m along hole**	**Initial water level**	10.40	**m above transducer**
Bottom of test interval	19.5	**m along hole**	**Water level after slug**	18.61	**m above transducer**
Test length, L	9.9	**m along hole**	**Change in Water Level, H_o**	8.21	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	13	**m**
Transmissivity, T	5E-05	**m^2/s**			
Hydraulic Conductivity, K	5E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	19MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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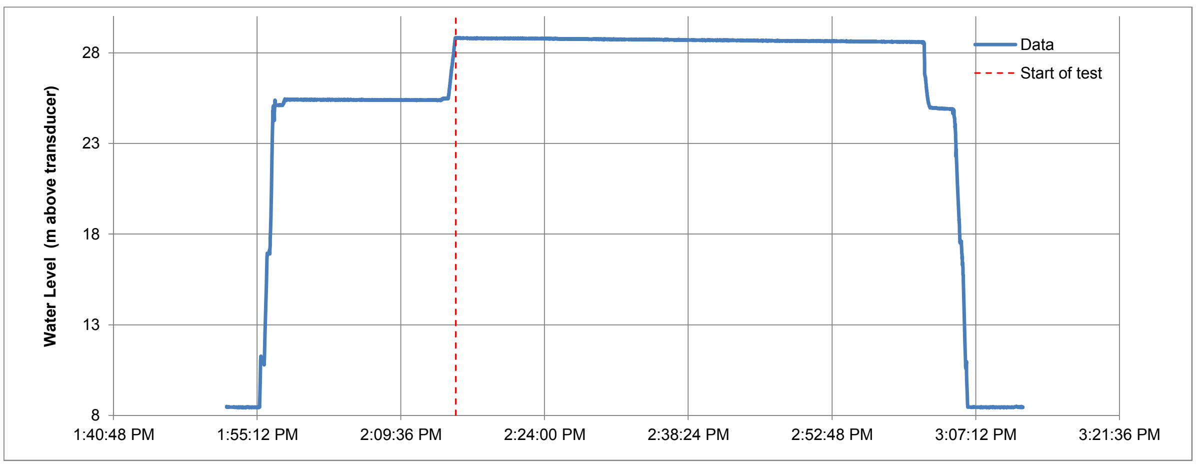
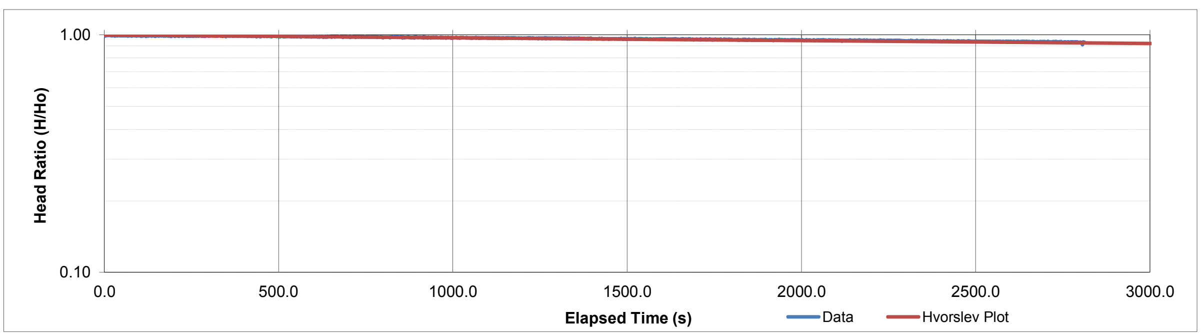
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:09

Project No.	VA101-460/03		**Drillhole**	**SC15-195**	
Field Technician	GM		**Test No.**	2	
Analyst	GM/JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	19	L of water	**Packer Inflation Time**	1:57:00 PM	
Test Date	19-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	2:15:07 PM	
Top of test interval	18.7	**m along hole**	**Initial water level**	25.37	**m above transducer**
Bottom of test interval	30.1	**m along hole**	**Water level after slug**	28.83	**m above transducer**
Test length, L	11.4	**m along hole**	**Change in Water Level, H_o**	3.46	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	4	**m**
Transmissivity, T	1E-07	**m^2/s**			
Hydraulic Conductivity, K	1E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	19MAR'15	ISSUED WITH REPORT	JBC	GIM

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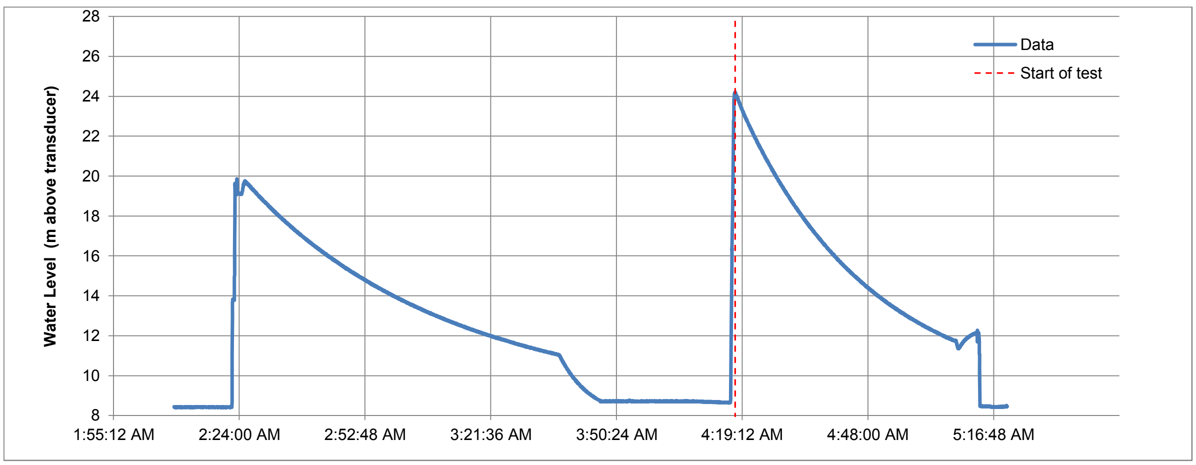
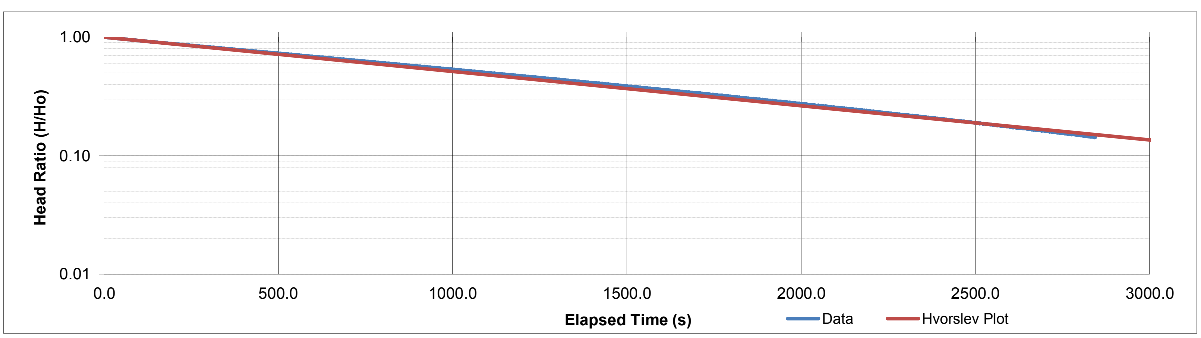
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:11

Project No.	VA101-460/03		**Drillhole**	**SC15-196**	
Field Technician	JBC		**Test No.**	1	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	64	L of water	**Packer Inflation Time**	2:25:00 AM	
Test Date	20-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	4:17:36 AM	
Top of test interval	13.6	**m along hole**	**Initial water level**	10.00	**m above transducer**
Bottom of test interval	22.9	**m along hole**	**Water level after slug**	24.20	**m above transducer**
Test length, L	9.3	**m along hole**	**Change in Water Level, H_o**	14.20	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	14	**m**
Transmissivity, T	3E-06	**m^2/s**			
Hydraulic Conductivity, K	3E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	19MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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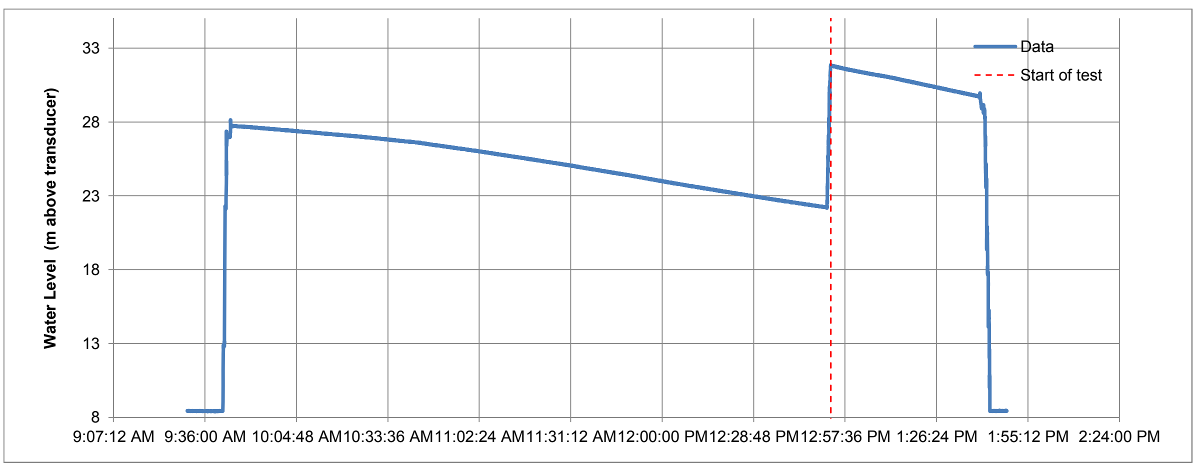
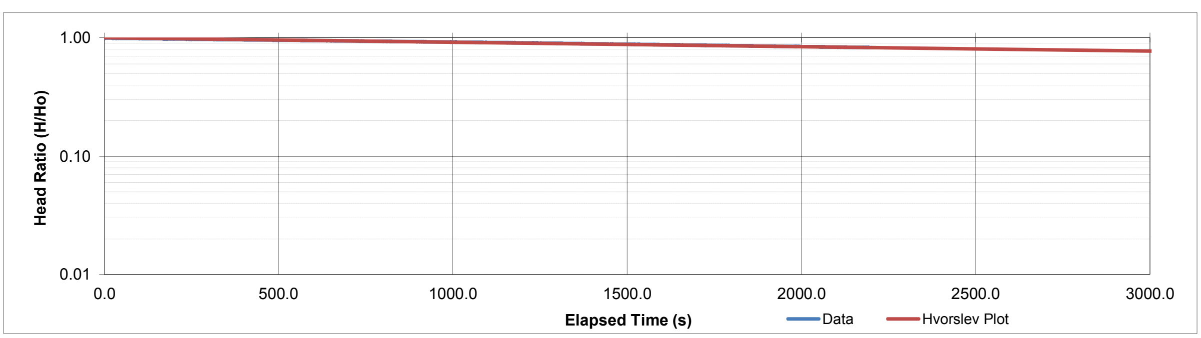
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:11

Project No.	VA101-460/03		**Drillhole**	**SC15-196**	
Field Technician	GM		**Test No.**	2	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	45	L of water	**Packer Inflation Time**		
Test Date	20-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	12:53:06 PM	
Top of test interval	22.1	**m along hole**	**Initial water level**	22.17	**m above transducer**
Bottom of test interval	30.5	**m along hole**	**Water level after slug**	31.86	**m above transducer**
Test length, L	8.4	**m along hole**	**Change in Water Level, H_o**	9.69	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	10	**m**
Transmissivity, T	3E-07	**m^2/s**			
Hydraulic Conductivity, K	4E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	19MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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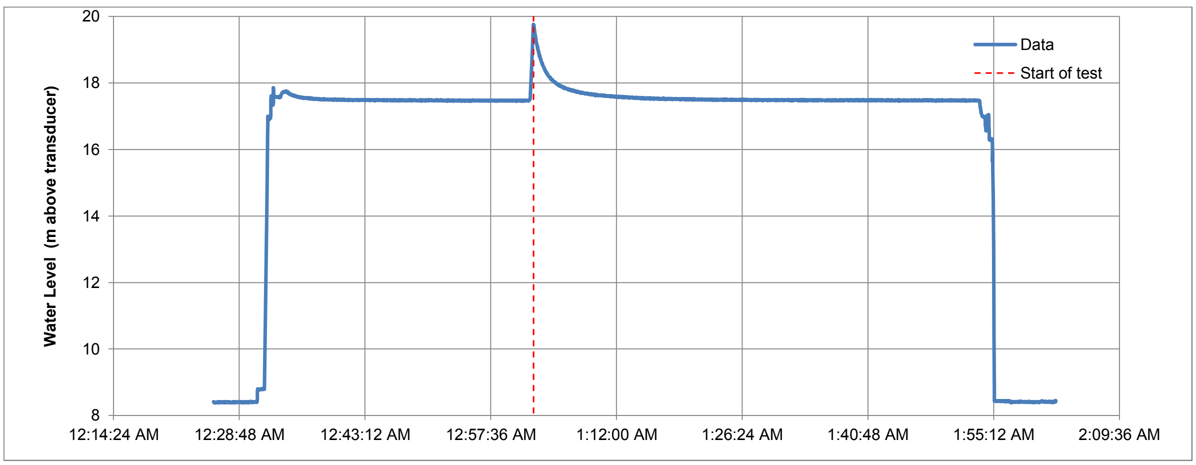
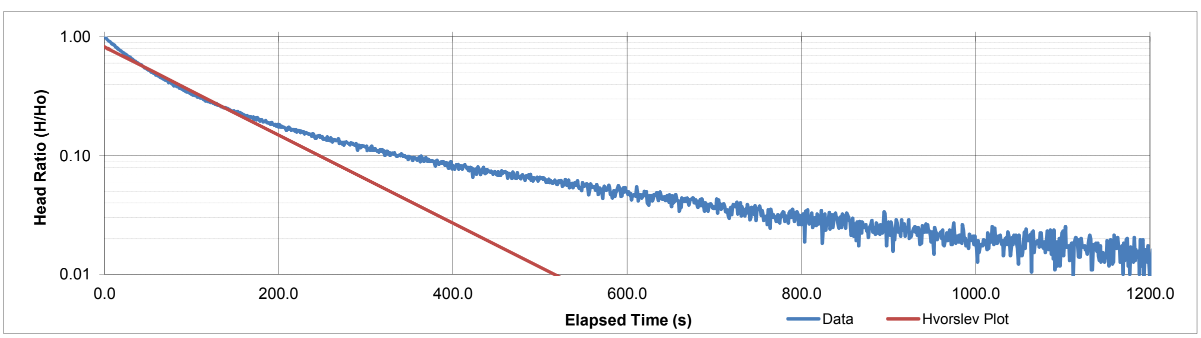
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:14

Project No.	VA101-460/03			**Drillhole**	**SC15-197**	
Field Technician	JBC			**Test No.**	1	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	13	L of water		**Packer Inflation Time**	12:33:00 AM	
Test Date	21-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	1:02:31 AM	
Top of test interval	9.6	**m along hole**		**Initial water level**	17.47	**m above transducer**
Bottom of test interval	19.4	**m along hole**		**Water level after slug**	19.76	**m above transducer**
Test length, L	9.8	**m along hole**		**Change in Water Level, H_o**	2.29	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	3	**m**
Transmissivity, T	3E-05	**m^2/s**				
Hydraulic Conductivity, K	4E-06	**m/s**		Intercept	0.8	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-197 Hvorslev_Packer Drillhole.xlsx]SC15-197 Hvorslev Packer #1

A	21MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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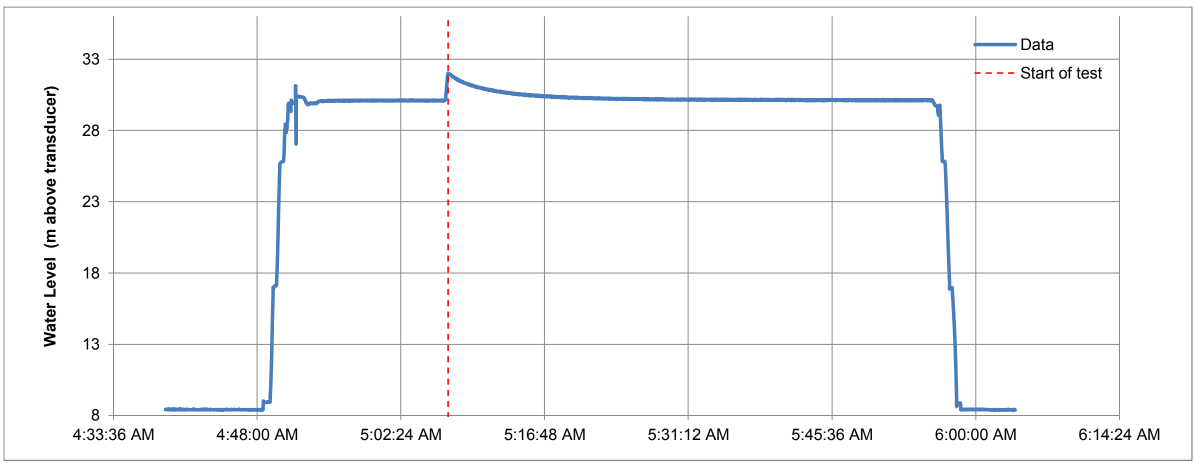
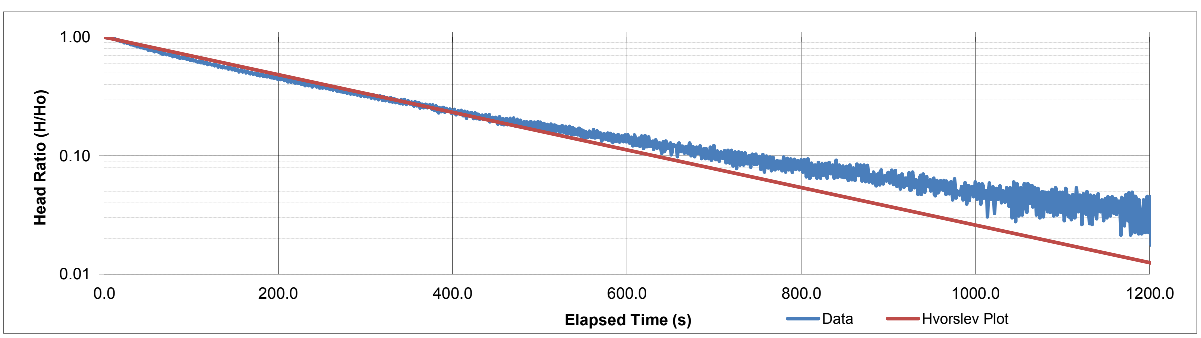
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:14

Project No.	VA101-460/03		**Drillhole**	**SC15-197**	
Field Technician	JBC		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	13	L of water	**Packer Inflation Time**	4:50:00 AM	
Test Date	21-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:07:08 AM	
Top of test interval	18.7	**m along hole**	**Initial water level**	30.13	**m above transducer**
Bottom of test interval	29.9	**m along hole**	**Water level after slug**	32.00	**m above transducer**
Test length, L	11.1	**m along hole**	**Change in Water Level, H_o**	1.87	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	3	**m**
Transmissivity, T	2E-05	**m^2/s**			
Hydraulic Conductivity, K	1E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-197 Hvorslev_Packer Drillhole.xlsx]SC15-197 Hvorslev Packer #2

A	21MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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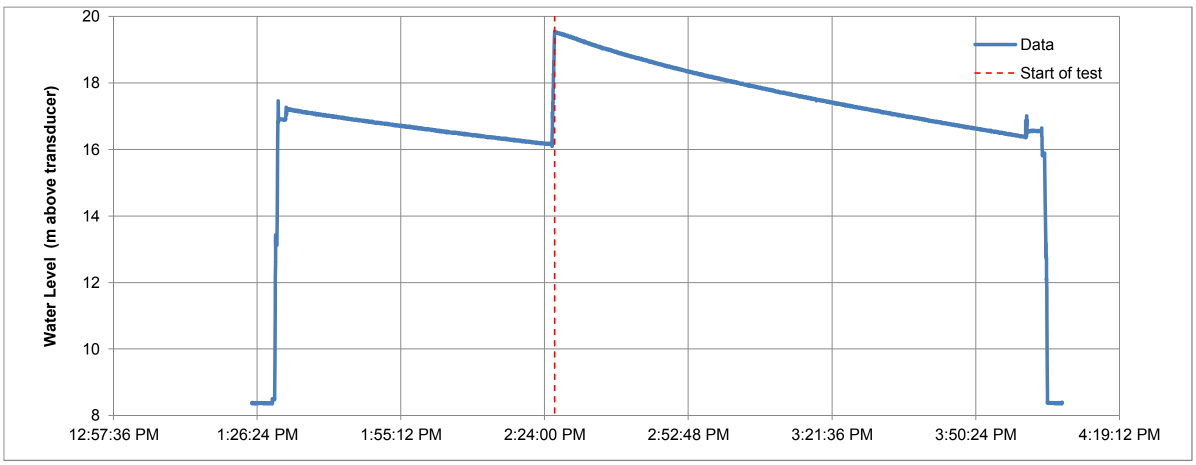
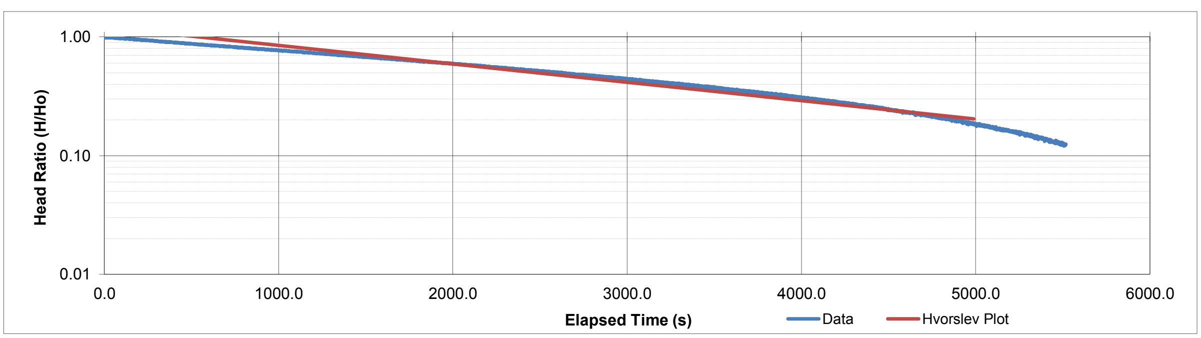
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:30

Project No.	VA101-460/03		**Drillhole**	**SC15-198**	
Field Technician	GM		**Test No.**	1	
Analyst	GM				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	unknown	L of water	**Packer Inflation Time**	1:32:00 PM	
Test Date	21-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	2:26:02 PM	
Top of test interval	9.6	**m along hole**	**Initial water level**	16.00	**m above transducer**
Bottom of test interval	16.3	**m along hole**	**Water level after slug**	19.56	**m above transducer**
Test length, L	6.7	**m along hole**	**Change in Water Level, H_o**	3.56	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	#VALUE!	**m**
Transmissivity, T	1E-06	**m^2/s**			
Hydraulic Conductivity, K	2E-07	**m/s**	Intercept	1.2	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-198 Hvorslev_Packer Drillhole.xlsx]SC15-198 Hvorslev Packer #1

A	22MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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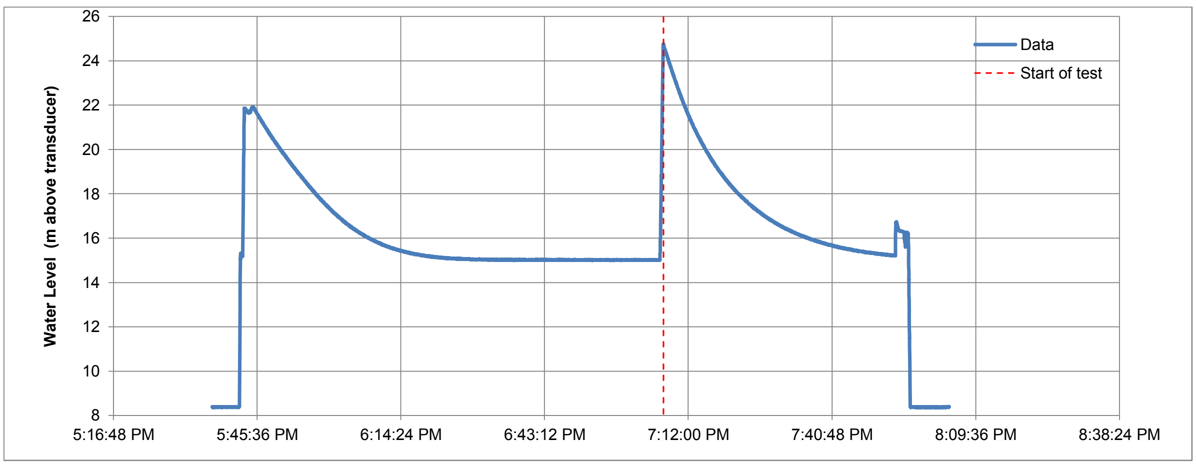
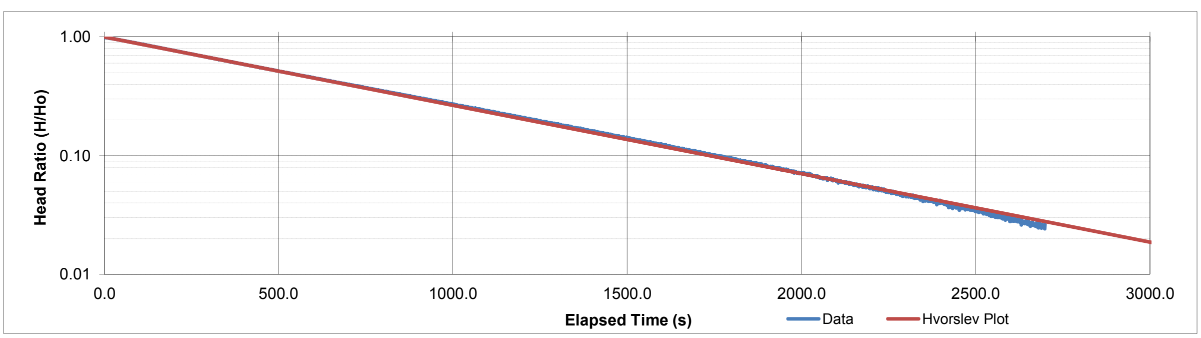
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:30

Project No.	VA101-460/03		**Drillhole**	**SC15-198**	
Field Technician	GM/JBC		**Test No.**	2	
Analyst	JBC				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	61	L of water	**Packer Inflation Time**	5:45:00 PM	
Test Date	21-Mar-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	7:07:01 PM	
Top of test interval	15.7	**m along hole**	**Initial water level**	15.00	**m above transducer**
Bottom of test interval	22.6	**m along hole**	**Water level after slug**	24.77	**m above transducer**
Test length, L	6.9	**m along hole**	**Change in Water Level, H_o**	9.77	**m**
Drillhole angle	90	**degrees**	**Expected Change in Water Level, H_o**	13	**m**
Transmissivity, T	5E-06	**m^2/s**			
Hydraulic Conductivity, K	7E-07	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	22MAR'15	ISSUED WITH REPORT	JBC	GIM
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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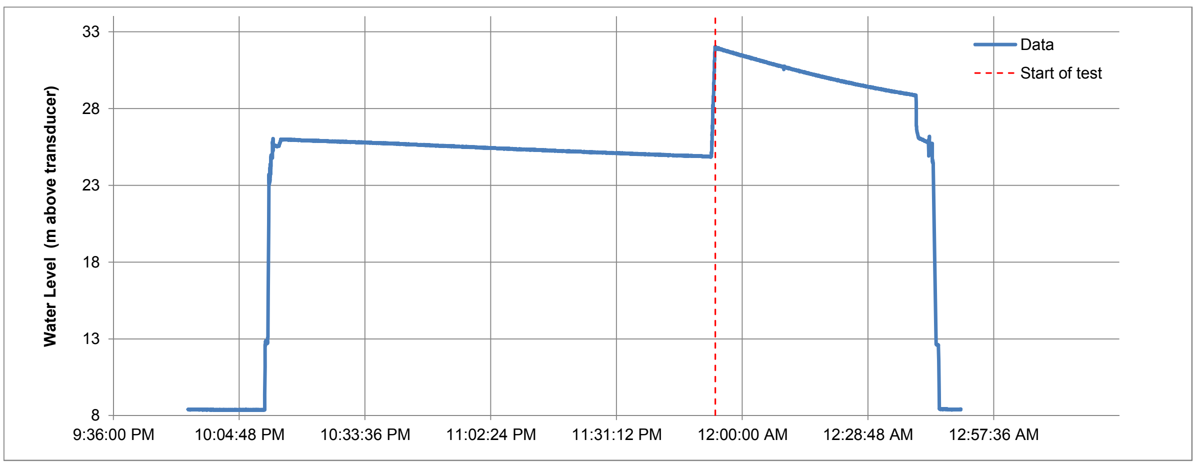
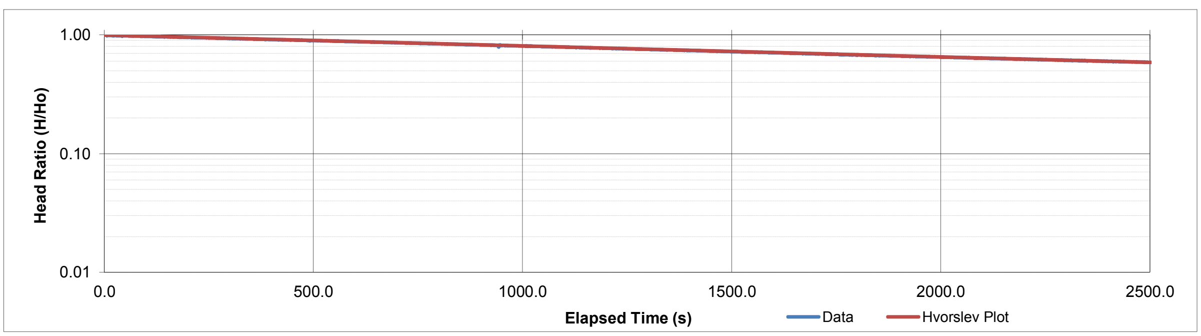
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:30

Project No.	VA101-460/03			**Drillhole**	**SC15-198**	
Field Technician	JBC			**Test No.**	3	
Analyst	JBC					
Monitoring Instrument Type	Transducer			**Packer Type**	HQ Nitrogen	
Slug Type	38	L of water		**Packer Inflation Time**	10:13:00 PM	
Test Date	21-Mar-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	11:53:51 PM	
Top of test interval	21.8	**m along hole**		**Initial water level**	24.86	**m above transducer**
Bottom of test interval	30.0	**m along hole**		**Water level after slug**	32.02	**m above transducer**
Test length, L	8.2	**m along hole**		**Change in Water Level, H_o**	7.16	**m**
Drillhole angle	90	**degrees**		**Expected Change in Water Level, H_o**	8	**m**
Transmissivity, T	8E-07	**m^2/s**				
Hydraulic Conductivity, K	1E-07	**m/s**		Intercept	1.0	





TEST COMMENTS:

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REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	22MAR'15	ISSUED WITH REPORT	JBC	GIM

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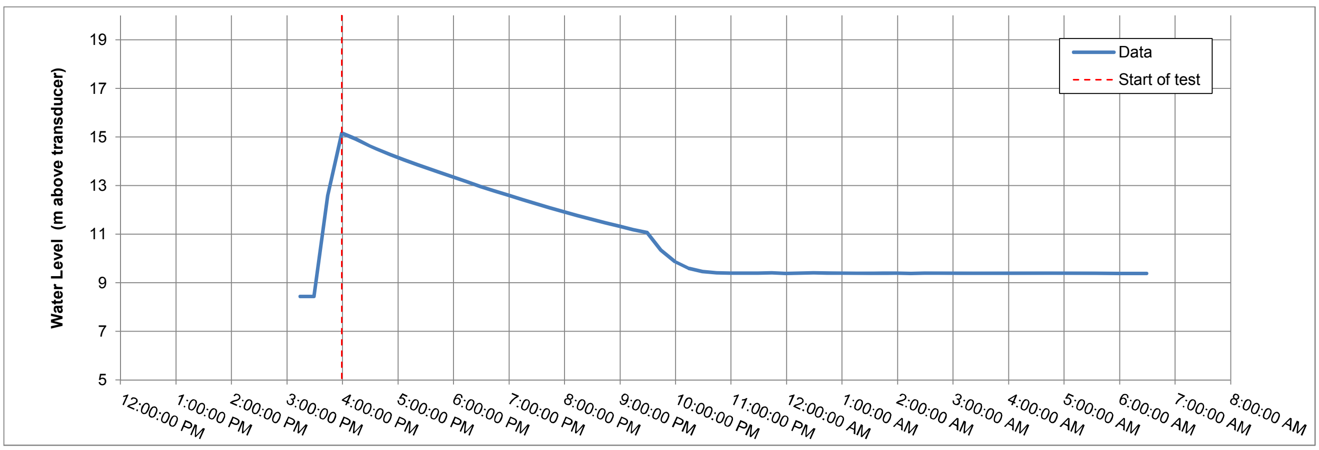
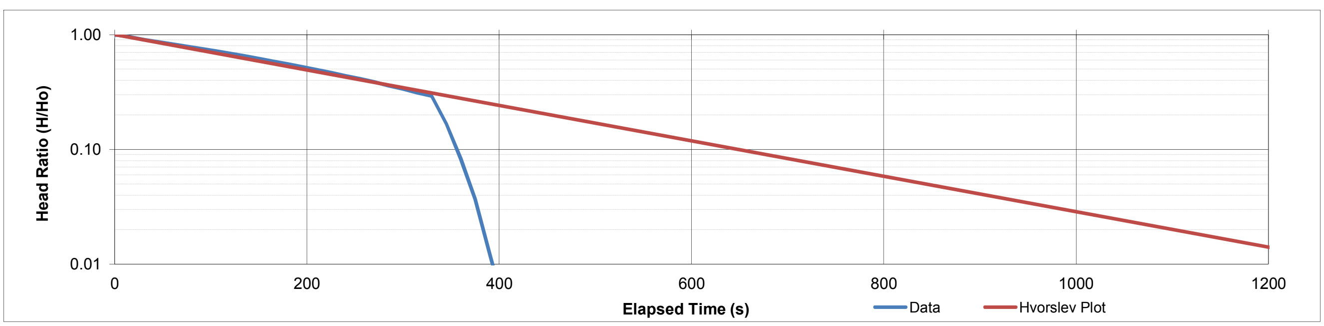
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:34

Project No.	VA101-460/03		**Drillhole**	**SC15-201**	
Field Technician	JBC		**Test No.**	1	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	13	L of water	**Packer Inflation Time**	-	
Test Date	28-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	3:59:09 PM	
Top of test interval	5.6	**m along hole**	**Initial water level**	9.38	**m above transducer**
Bottom of test interval	12.0	**m along hole**	**Water level after slug**	15.17	**m above transducer**
Test length, L	6.4	**m along hole**	**Change In Water Level, H_o**	5.78	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	3	**m**
Transmissivity, T	1E-05	**m^2/s**			
Hydraulic Conductivity, K	2E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM STABLE WATER LEVEL RECORDED AFTER RECOVERY TEST AT 14:29 (9.38 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-201 Hvorslev_Packer Drillhole.xlsx]SC15-201 Hvorslev Packer #1

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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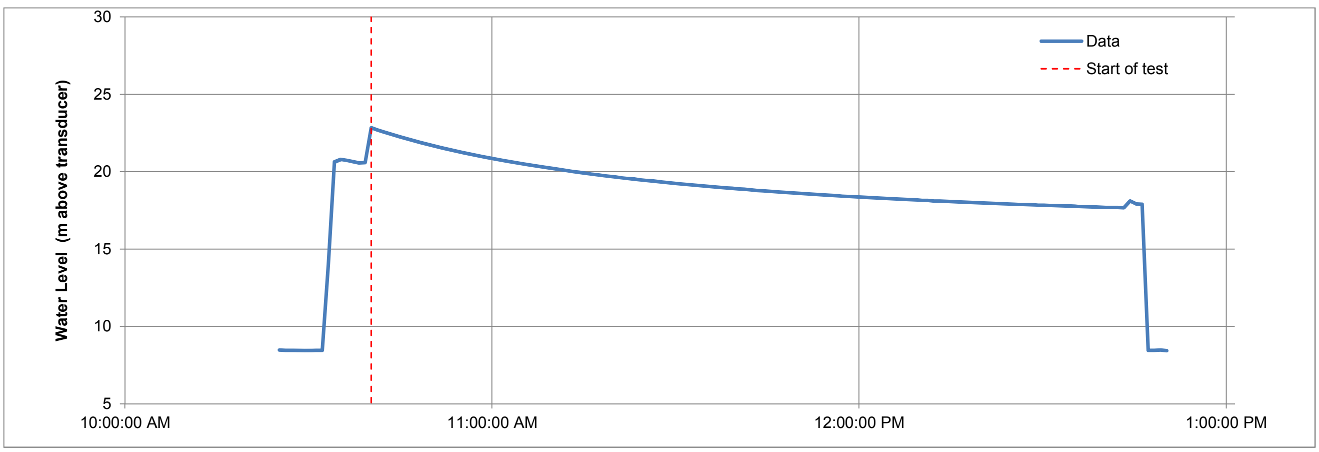
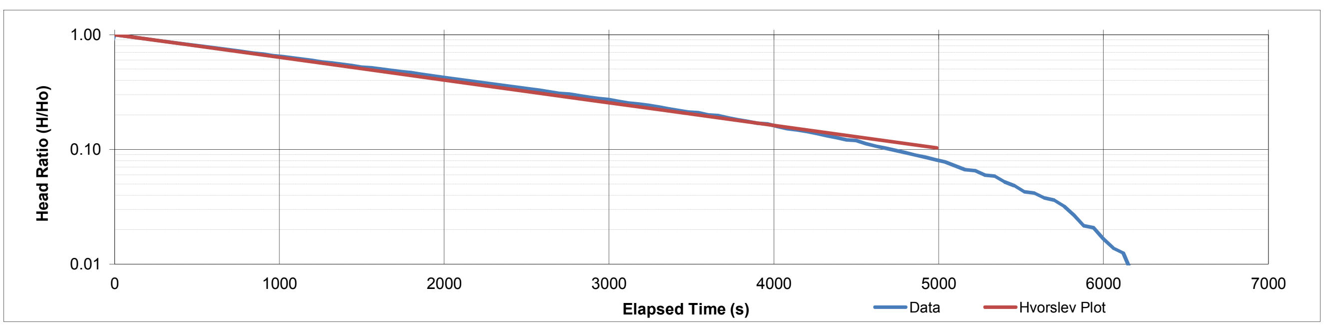
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:34

Project No.	VA101-460/03		**Drillhole**	**SC15-201**	
Field Technician	JBC		**Test No.**	2	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	16	L of water	**Packer Inflation Time**	-	
Test Date	29-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	10:40:17 AM	
Top of test interval	11.4	m along hole	**Initial water level**	17.89	m above transducer
Bottom of test interval	24.2	m along hole	**Water level after slug**	22.83	m above transducer
Test length, L	12.8	m along hole	**Change In Water Level, H_o**	4.94	m
Drillhole angle	90	degrees	**Expected Change In Water Level, H_o**	3	m
Transmissivity, T	2E-06	m^2/s			
Hydraulic Conductivity, K	2E-07	m/s	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM STABLE WATER LEVEL RECORDED AFTER RECOVERY TEST AT 12:50 (17.89 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-201 Hvorslev_Packer Drillhole.xlsx]SC15-201 Hvorslev Packer #2

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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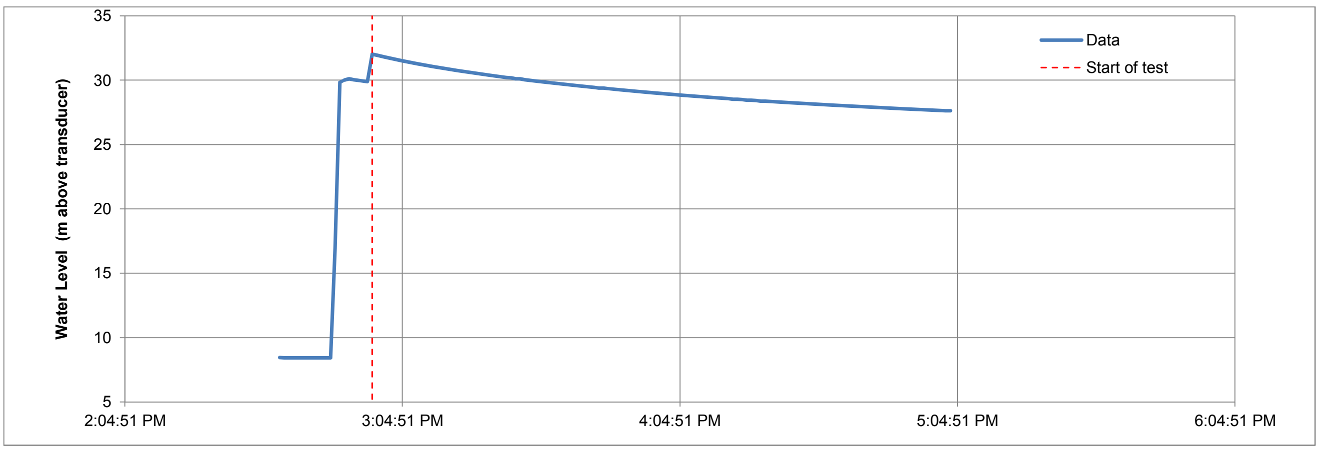
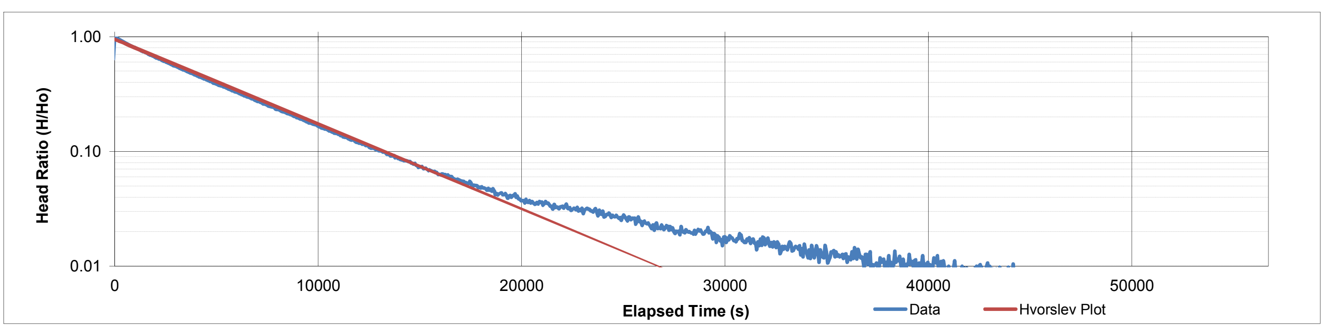
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:34

Project No.	VA101-460/03		**Drillhole**	**SC15-201**	
Field Technician	JBC		**Test No.**	3	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	10	L of water	**Packer Inflation Time**	-	
Test Date	29-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	2:58:20 PM	
Top of test interval	22.1	m along hole	**Initial water level**	26.13	m above transducer
Bottom of test interval	30.3	m along hole	**Water level after slug**	32.03	m above transducer
Test length, L	8.2	m along hole	**Change In Water Level, H_o**	5.90	m
Drillhole angle	90	degrees	**Expected Change In Water Level, H_o**	2	m
Transmissivity, T	7E-07	m^2/s			
Hydraulic Conductivity, K	8E-08	m/s	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM STABLE WATER LEVEL RECORDED AFTER RECOVERY TEST AT 18:30 (26.13 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-201 Hvorslev_Packer Drillhole.xlsx]SC15-201 Hvorslev Packer #3

REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	10JUN'15	ISSUED WITH REPORT	KTD	MBG

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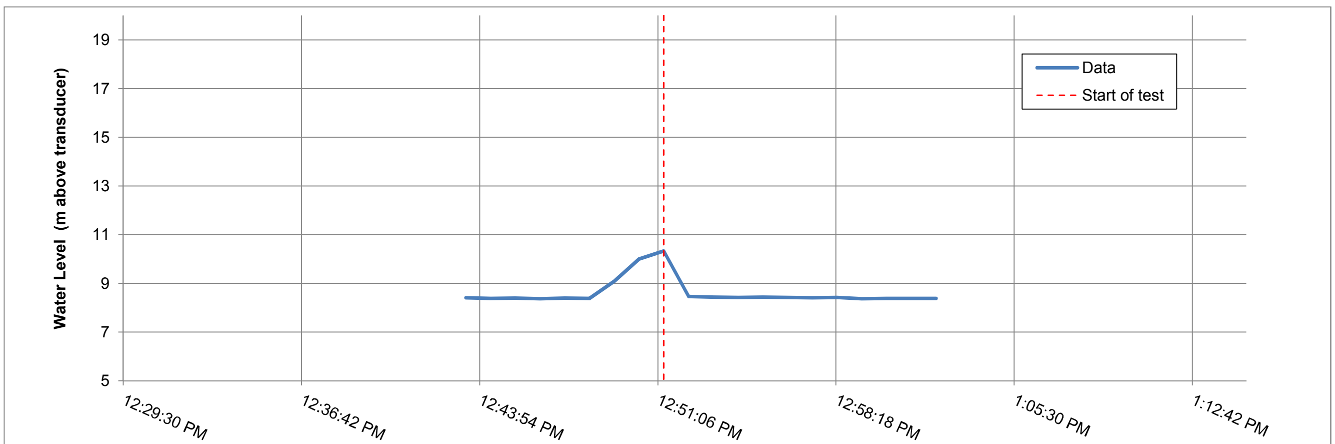
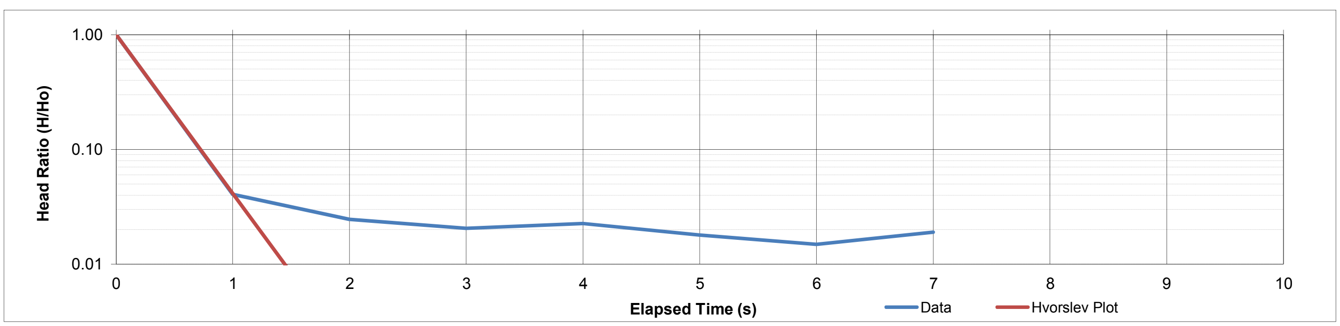
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:38

Project No.	VA101-460/03		**Drillhole**	**SC15-202**	
Field Technician	JBC		**Test No.**	1	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	8	L of water	**Packer Inflation Time**	-	
Test Date	30-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	12:51:21 PM	
Top of test interval	2.4	m along hole	**Initial water level**	8.38	m above transducer
Bottom of test interval	10.4	m along hole	**Water level after slug**	10.33	m above transducer
Test length, L	7.9	m along hole	**Change In Water Level, H_o**	1.95	m
Drillhole angle	90	degrees	**Expected Change In Water Level, H_o**	2	m
Transmissivity, T	1E-02	m^2/s			
Hydraulic Conductivity, K	2E-03	m/s	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-202 Hvorslev_Packer Drillhole.xlsx]SC15-202 Hvorslev Packer #1

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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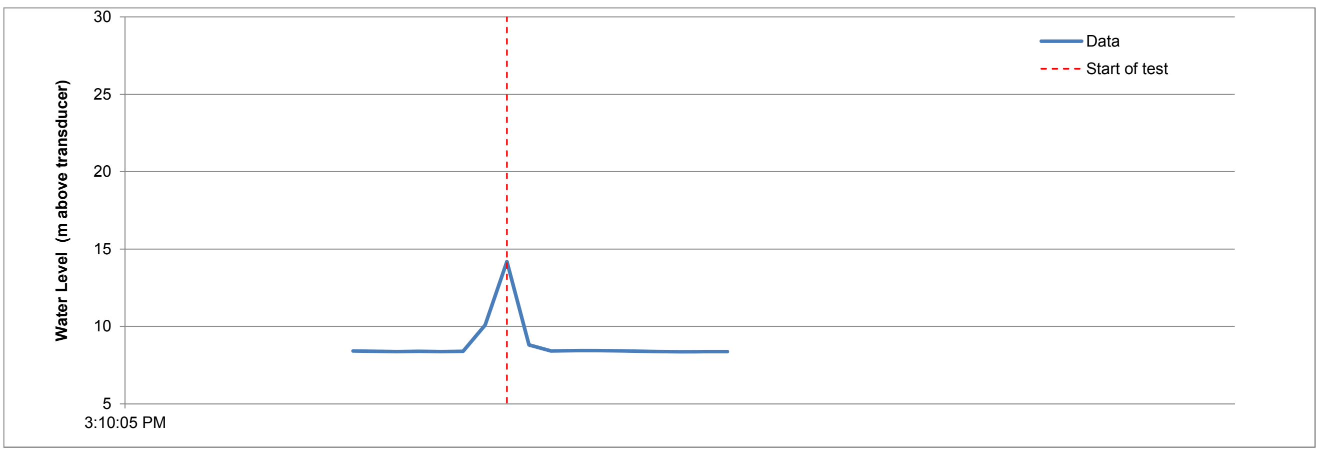
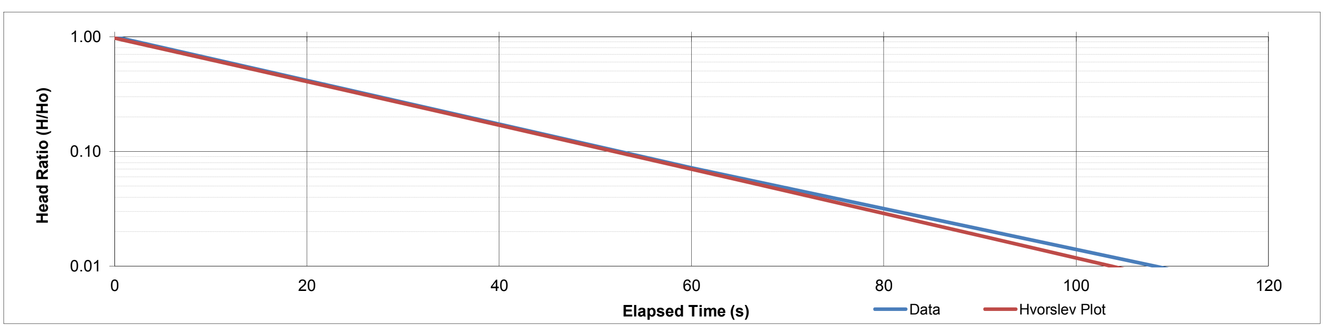
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:38

Project No.	VA101-460/03		**Drillhole**	**SC15-202**	
Field Technician	JBC		**Test No.**	2	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	49	L of water	**Packer Inflation Time**	-	
Test Date	29-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	3:27:26 PM	
Top of test interval	6.7	**m along hole**	**Initial water level**	8.38	**m above transducer**
Bottom of test interval	14.9	**m along hole**	**Water level after slug**	14.19	**m above transducer**
Test length, L	8.2	**m along hole**	**Change In Water Level, H_o**	5.81	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	10	**m**
Transmissivity, T	2E-04	**m^2/s**			
Hydraulic Conductivity, K	2E-05	**m/s**	Intercept	1.0	





TEST COMMENTS:

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A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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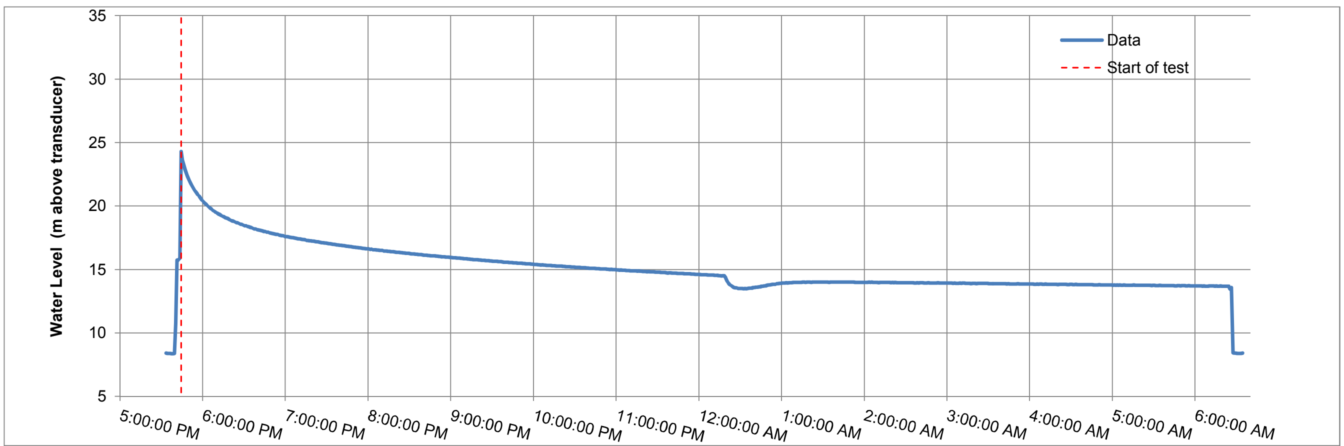
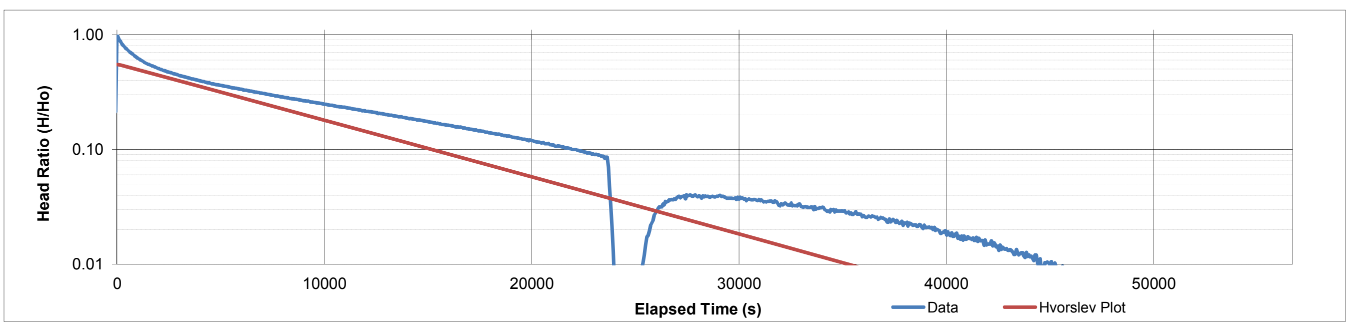
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:38

Project No.	VA101-460/03			**Drillhole**	**SC15-202**	
Field Technician	JBC			**Test No.**	3	
Analyst	KTD					
Monitoring Instrument Type	Transducer			**Packer Type**	-	
Slug Type	Unknown Water Vol.	L of water		**Packer Inflation Time**	-	
Test Date	30-May-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	5:44:28 PM	
Top of test interval	14.3	**m along hole**		**Initial water level**	13.58	**m above transducer**
Bottom of test interval	20.7	**m along hole**		**Water level after slug**	24.29	**m above transducer**
Test length, L	6.4	**m along hole**		**Change In Water Level, H_o**	10.71	**m**
Drillhole angle	90	**degrees**		**Expected Change In Water Level, H_o**	-	**m**
Transmissivity, T	3E-07	**m^2/s**				
Hydraulic Conductivity, K	5E-08	**m/s**		Intercept	0.6	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM WATER LEVEL RECORDED AFTER RECOVERY TEST AT 18:26 (13.58 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-202 Hvorslev_Packer Drillhole.xlsx]SC15-202 Hvorslev Packer #3

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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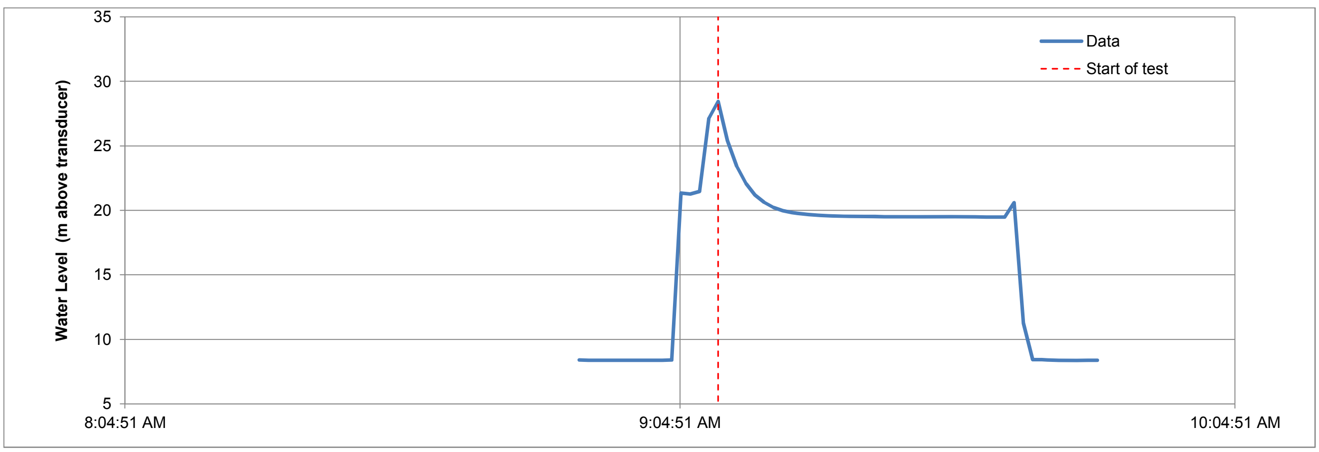
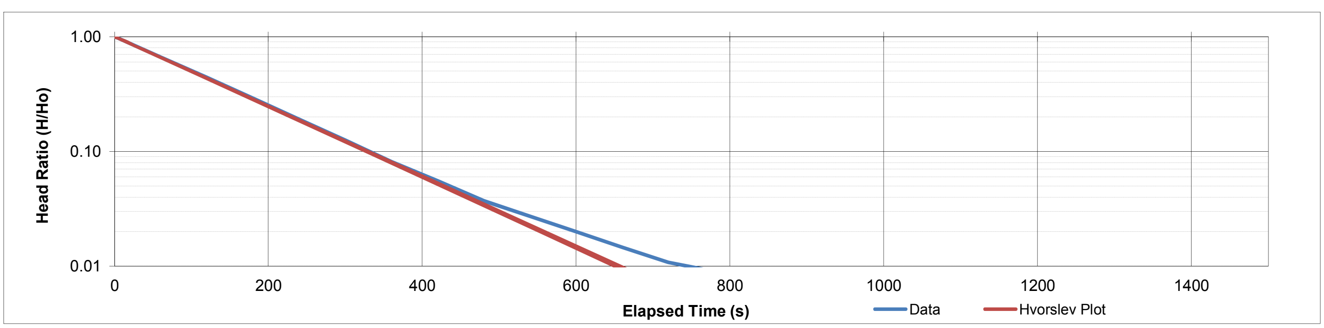
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:38

Project No.	VA101-460/03		**Drillhole**	**SC15-202**	
Field Technician	JBC		**Test No.**	4	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	44	L of water	**Packer Inflation Time**	-	
Test Date	31-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	9:08:59 AM	
Top of test interval	20.1	m along hole	**Initial water level**	19.48	m above transducer
Bottom of test interval	29.8	m along hole	**Water level after slug**	28.45	m above transducer
Test length, L	9.7	m along hole	**Change In Water Level, H_o**	8.97	m
Drillhole Angle	90	degrees	**Expected Change In Water Level, H_o**	9	m
Transmissivity, T	3E-05	m^2/s			
Hydraulic Conductivity, K	3E-06	m/s	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM WATER LEVEL RECORDED AFTER RECOVERY TEST AT 21:37 (19.38 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-202 Hvorslev_Packer Drillhole.xlsx]SC15-202 Hvorslev Packer #4

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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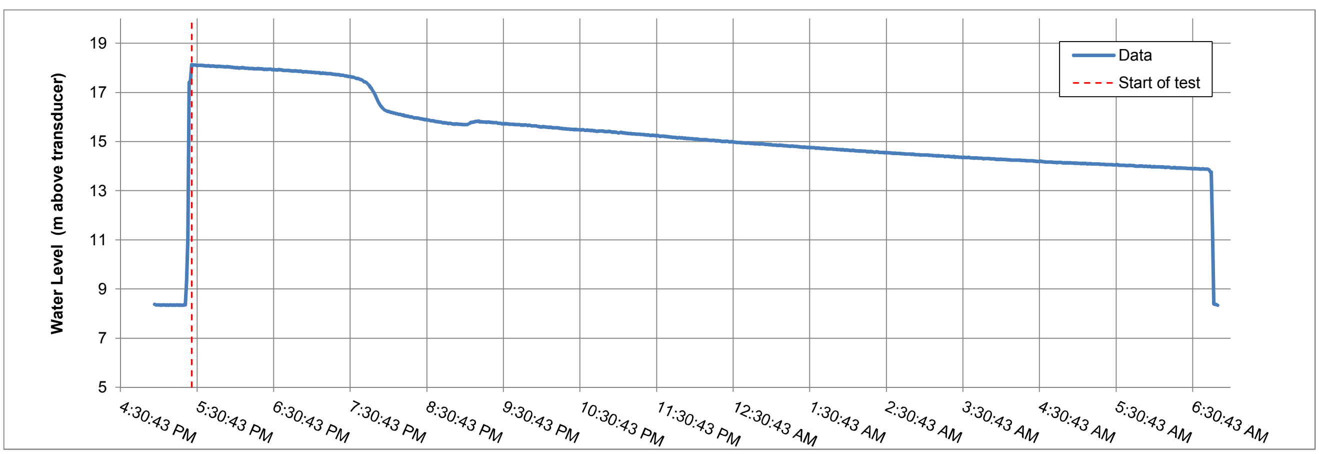
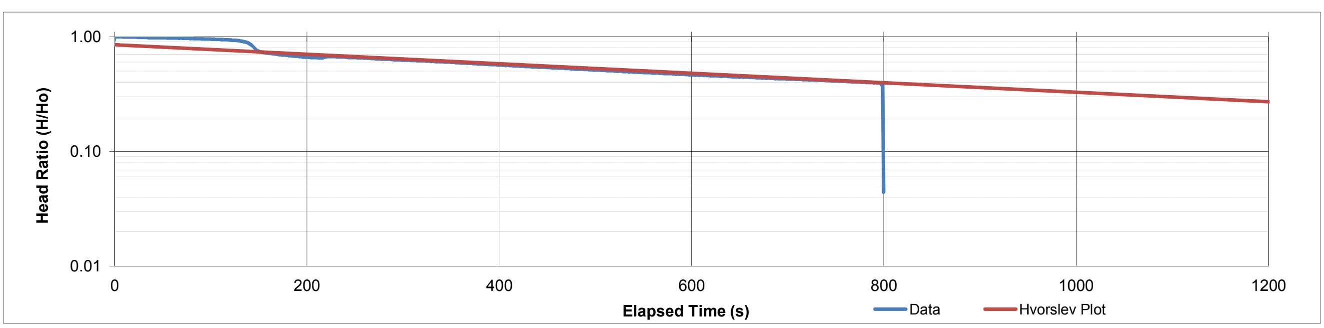
BLACK BUTTE COPPER PROJECT

HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:41

Project No.	VA101-460/03		**Drillhole**	**SC15-203**	
Field Technician	JBC		**Test No.**	1	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	5	L of water	**Packer Inflation Time**	-	
Test Date	28-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:26:26 PM	
Top of test interval	8.5	**m along hole**	**Initial water level**	11.09	**m above transducer**
Bottom of test interval	14.9	**m along hole**	**Water level after slug**	18.13	**m above transducer**
Test length, L	6.4	**m along hole**	**Change In Water Level, H_o**	7.04	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	1	**m**
Transmissivity, T	4E-06	**m^2/s**			
Hydraulic Conductivity, K	6E-07	**m/s**	Intercept	0.9	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-203 Hvorslev_Packer Drillhole.xlsx]SC15-203 Hvorslev Packer #1

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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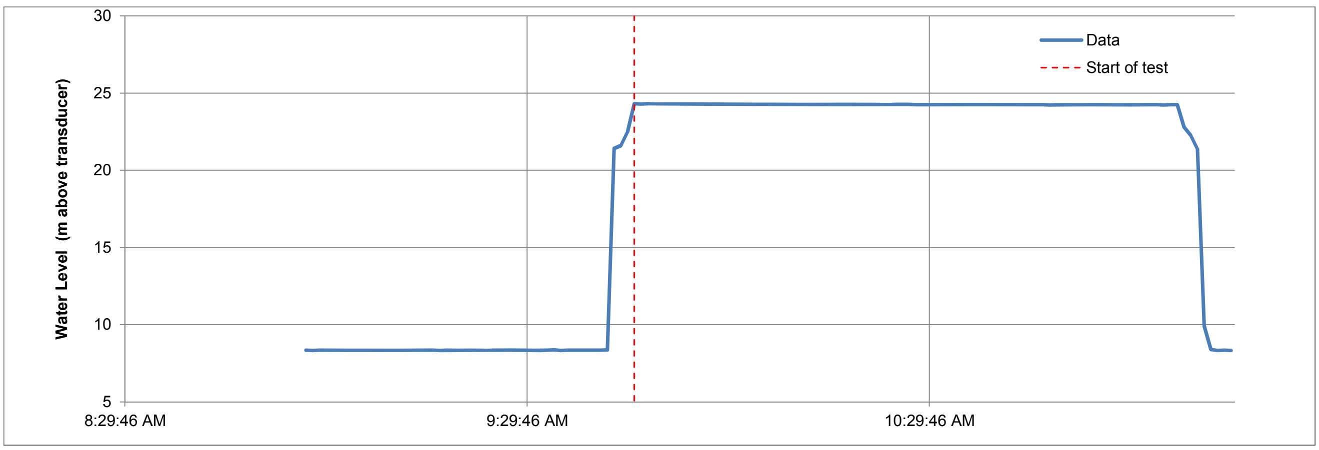
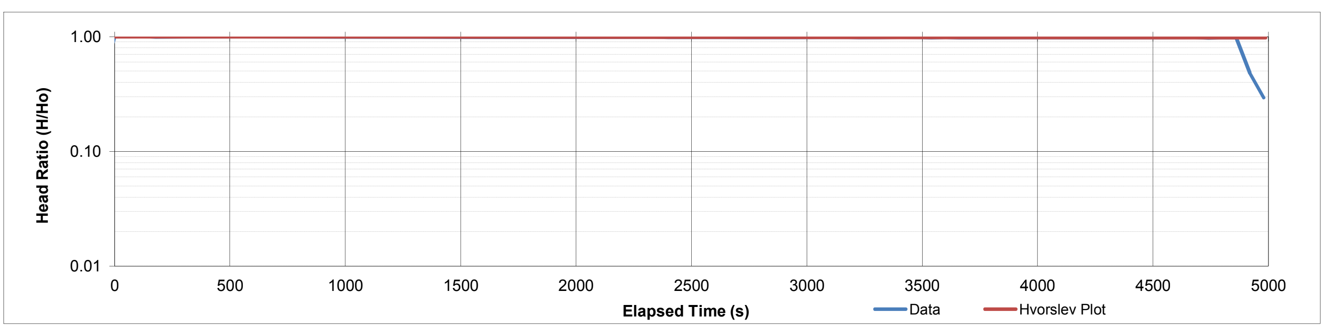
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:41

Project No.	VA101-460/03		Drillhole	SC15-203	
Field Technician	JBC		Test No.	2	
Analyst	KTD				
Monitoring Instrument Type	Transducer		Packer Type	HQ Nitrogen	
Slug Type	11	L of water	Packer Inflation Time	-	
Test Date	29-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	Slug Injected, Time = 0	9:45:46 AM	
Top of test interval	14.0	m along hole	Initial water level	21.41	m above transducer
Bottom of test interval	22.5	m along hole	Water level after slug	24.30	m above transducer
Test length, L	8.5	m along hole	Change In Water Level, H_o	2.89	m
Drillhole angle	90	degrees	Expected Change In Water Level, H_o	2	m
Transmissivity, T	2E-08	m^2/s			
Hydraulic Conductivity, K	2E-09	m/s	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-203 Hvorslev_Packer Drillhole.xlsx]SC15-203 Hvorslev Packer #2

REV	DATE	DESCRIPTION	PREP'D	CHK'D
A	10JUN'15	ISSUED WITH REPORT	KTD	MBG

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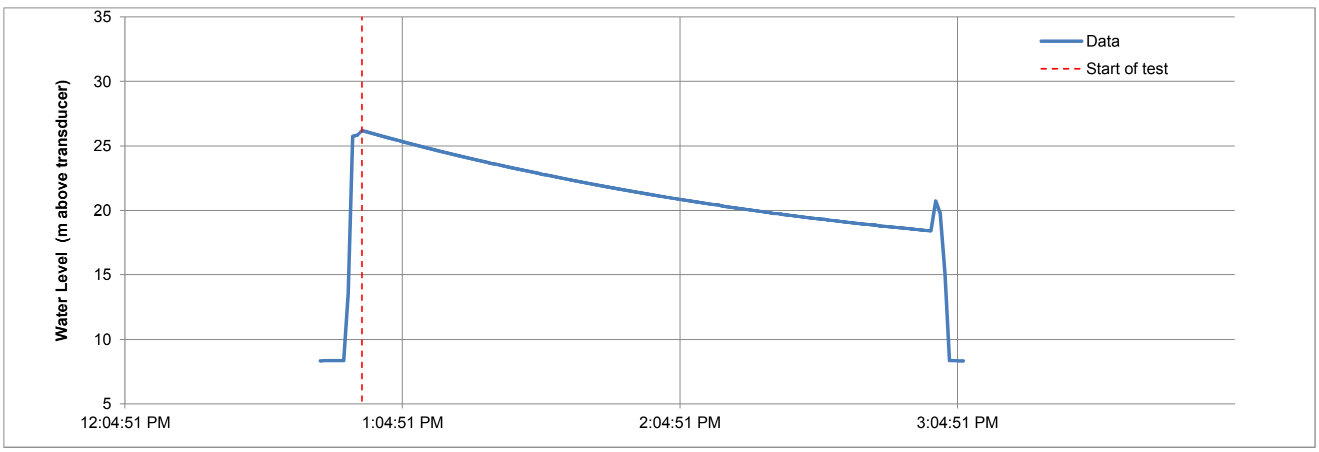
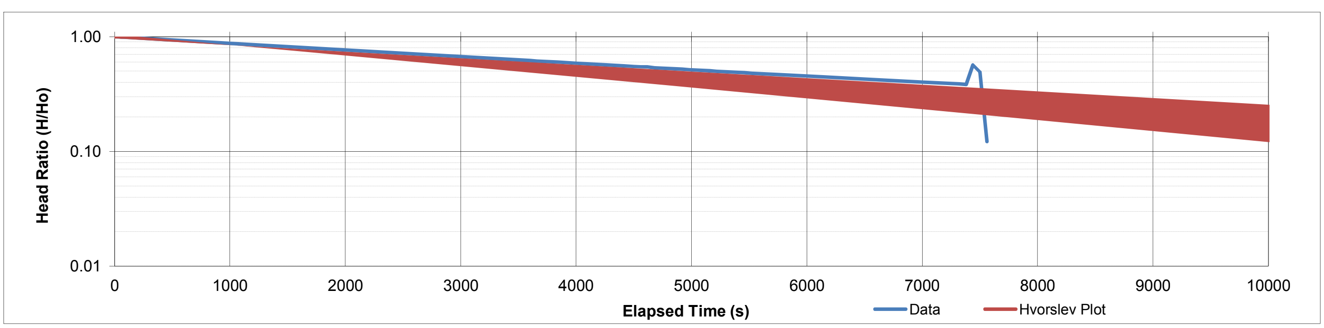
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:41

Project No.	VA101-460/03		**Drillhole**	**SC15-203**	
Field Technician	JBC		**Test No.**	3	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	HQ Nitrogen	
Slug Type	10	L of water	**Packer Inflation Time**	-	
Test Date	29-May-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	12:56:09 PM	
Top of test interval	21.6	**m along hole**	**Initial water level**	13.54	**m above transducer**
Bottom of test interval	30.2	**m along hole**	**Water level after slug**	26.20	**m above transducer**
Test length, L	8.5	**m along hole**	**Change In Water Level, H_o**	12.65	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	2	**m**
Transmissivity, T	5E-07	**m^2/s**			
Hydraulic Conductivity, K	6E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-203 Hvorslev_Packer Drillhole.xlsx]SC15-203 Hvorslev Packer #3

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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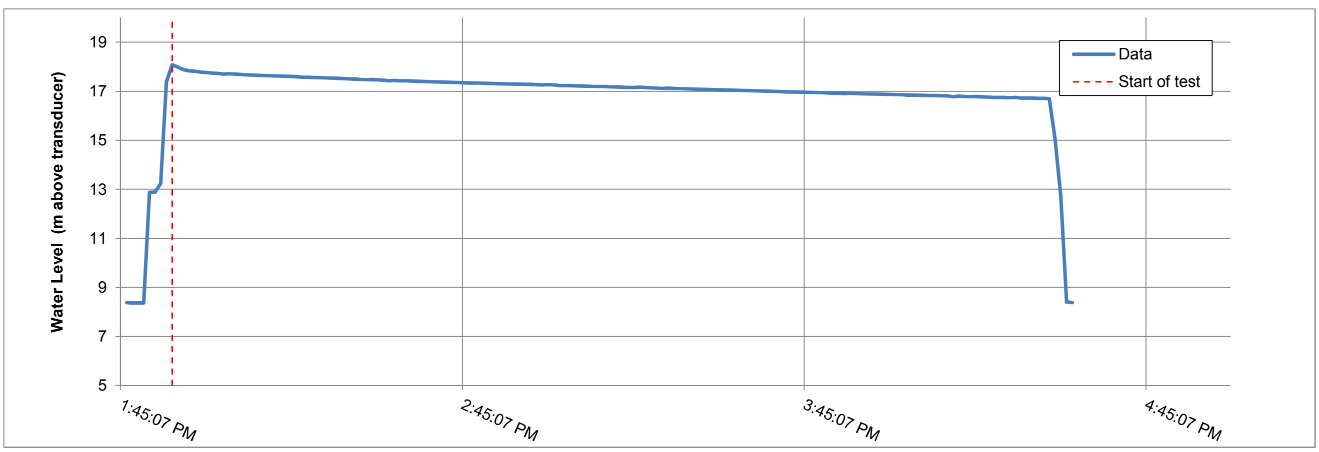
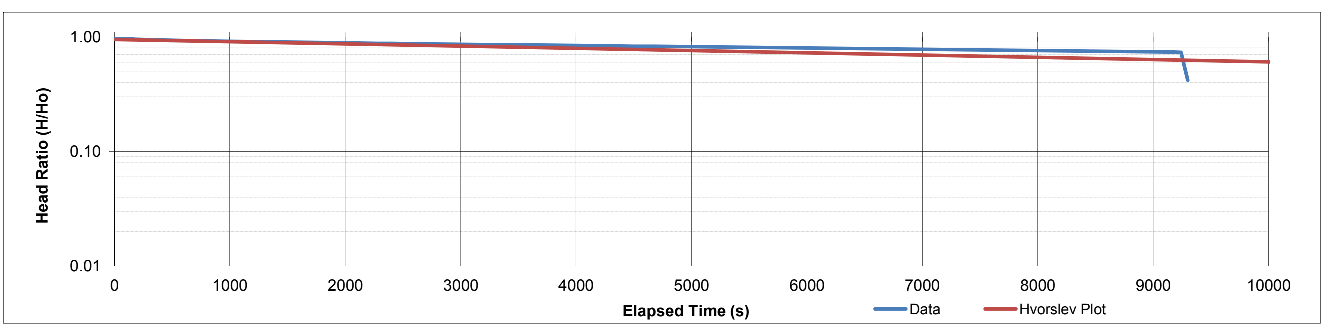
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:42

Project No.	VA101-460/03			**Drillhole**	**SC15-204**	
Field Technician	JBC			**Test No.**	1	
Analyst	KTD					
Monitoring Instrument Type	Transducer			**Packer Type**	-	
Slug Type	24	L of water		**Packer Inflation Time**	-	
Test Date	28-May-15					
Drillhole diameter, D	HQ3	0.096	m			
Drill rod diameter, d	HQ3	0.078	m	**Slug Injected, Time = 0**	1:54:12 PM	
Top of test interval	7.9	**m along hole**		**Initial water level**	12.87	**m above transducer**
Bottom of test interval	14.9	**m along hole**		**Water level after slug**	18.08	**m above transducer**
Test length, L	6.9	**m along hole**		**Change In Water Level, H_o**	5.20	**m**
Drillhole angle	90	**degrees**		**Expected Change In Water Level, H_o**	5	**m**
Transmissivity, T	1E-07	**m^2/s**				
Hydraulic Conductivity, K	2E-08	**m/s**		Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-204 Hvorslev_Packer Drillhole.xlsx]SC15-204 Hvorslev Packer #1

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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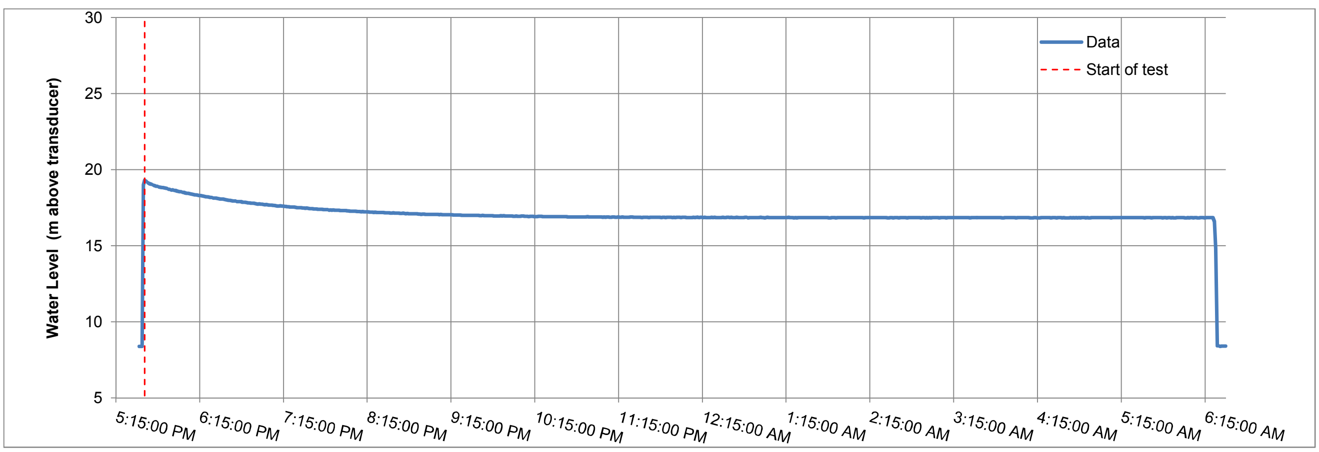
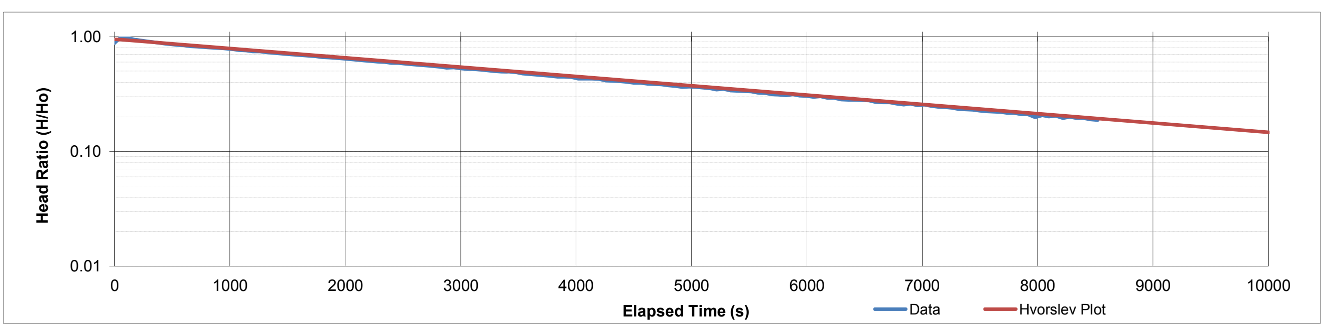
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:42

Project No.	VA101-460/03		**Drillhole**	**SC15-204**	
Field Technician	JBC		**Test No.**	2	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	18	L of water	**Packer Inflation Time**	-	
Test Date	2-Jun-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:35:42 PM	
Top of test interval	12.5	**m along hole**	**Initial water level**	16.86	**m above transducer**
Bottom of test interval	22.6	**m along hole**	**Water level after slug**	19.31	**m above transducer**
Test length, L	10.1	**m along hole**	**Change In Water Level, H_o**	2.45	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	4	**m**
Transmissivity, T	8E-07	**m^2/s**			
Hydraulic Conductivity, K	8E-08	**m/s**	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM STABLE WATER LEVEL RECORDED AFTER RECOVERY TEST AT 18:20 (16.86 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-204 Hvorslev_Packer Drillhole.xlsx]SC15-204 Hvorslev Packer #2

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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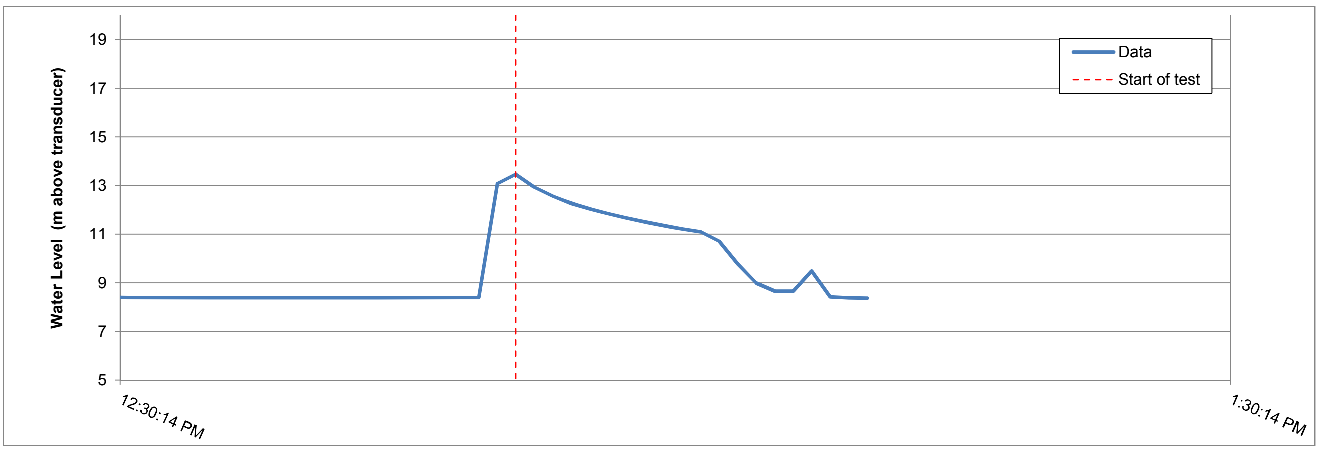
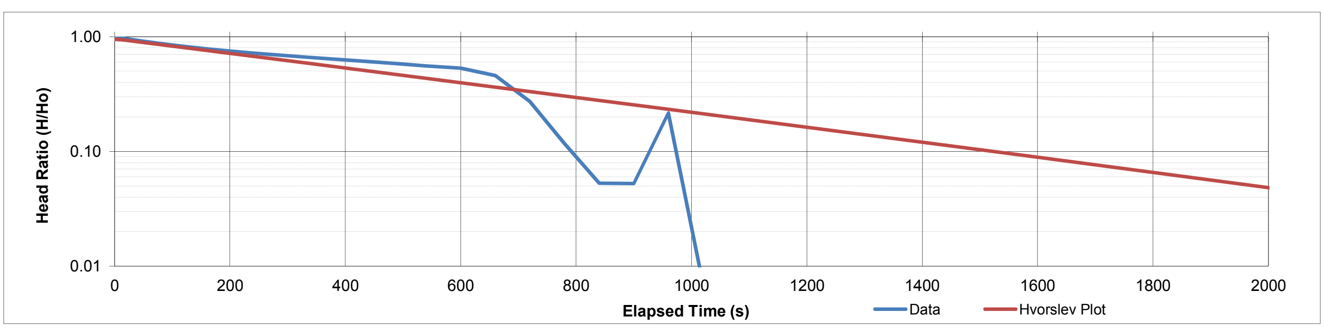
HYDRAULIC CONDUCTIVITY CALCULATION USING HVORSLEV (1951) METHOD

Print 02/26/16 15:44

Project No.	VA101-460/03		Drillhole	SC15-205	
Field Technician	JBC		Test No.	1	
Analyst	KTD				
Monitoring Instrument Type	Transducer		Packer Type	-	
Slug Type	33	L of water	Packer Inflation Time	-	
Test Date	3-Jun-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	Slug Injected, Time = 0	12:51:37 PM	
Top of test interval	4.6	m along hole	Initial water level	8.39	m above transducer
Bottom of test interval	11.6	m along hole	Water level after slug	13.46	m above transducer
Test length, L	7.0	m along hole	Change In Water Level, H_o	5.07	m
Drillhole angle	90	degrees	Expected Change In Water Level, H_o	7	m
Transmissivity, T	4E-06	m^2/s			
Hydraulic Conductivity, K	5E-07	m/s	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-205 Hvorslev_Packer Drillhole.xlsx]SC15-204 Hvorslev Packer #1

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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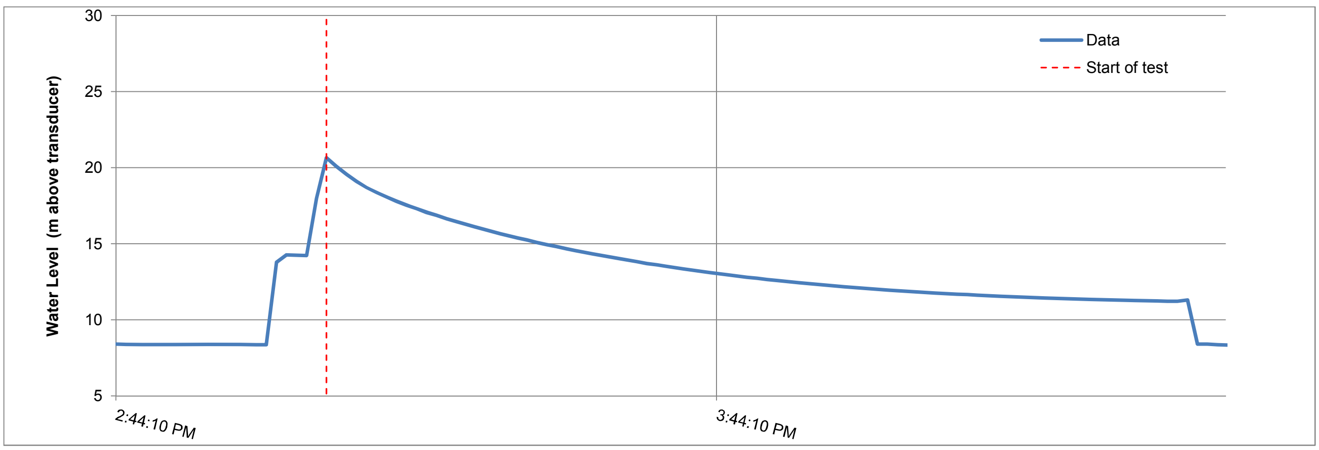
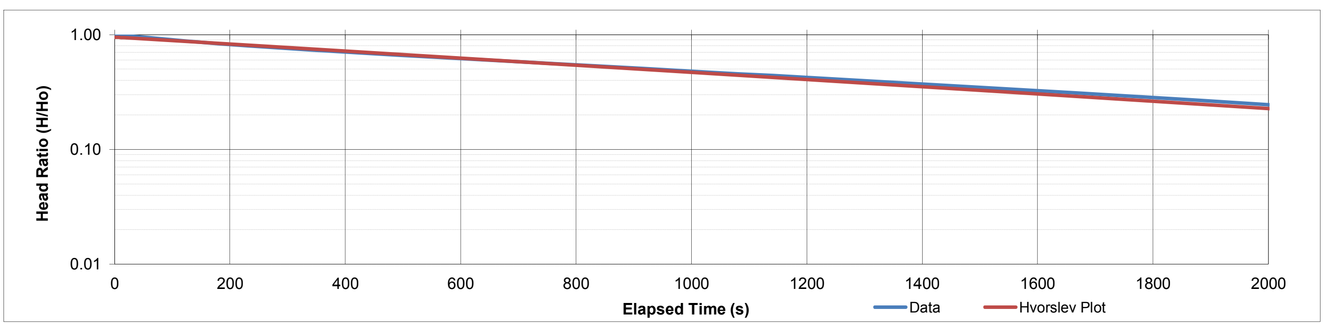
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:44

Project No.	VA101-460/03		**Drillhole**	**SC15-205**	
Field Technician	JBC		**Test No.**	2	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	37	L of water	**Packer Inflation Time**	-	
Test Date	3-Jun-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	3:05:12 PM	
Top of test interval	10.7	m along hole	**Initial water level**	11.28	m above transducer
Bottom of test interval	22.2	m along hole	**Water level after slug**	20.66	m above transducer
Test length, L	11.6	m along hole	**Change In Water Level, H_o**	9.39	m
Drillhole angle	90	degrees	**Expected Change In Water Level, H_o**	8	m
Transmissivity, T	3E-06	m^2/s			
Hydraulic Conductivity, K	2E-07	m/s	Intercept	1.0	





TEST COMMENTS:

1. INITIAL WATER LEVEL AT THE START OF THE TEST WAS NOT FULLY RECOVERED. FOR THE ANALYSIS THE INITIAL WATER LEVEL PRIOR TO SLUG INSERTION WAS INFERRED FROM WATER LEVEL RECORDED AFTER RECOVERY TEST AT 16:25 (11.28 meters above transducer)

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-205 Hvorslev_Packer Drillhole.xlsx]SC15-204 Hvorslev Packer #2

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

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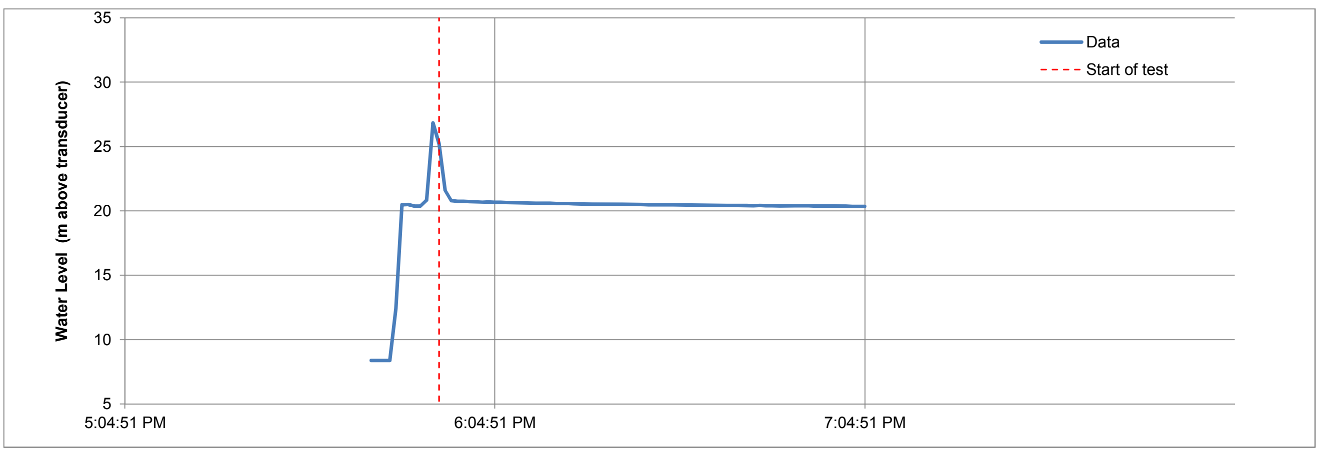
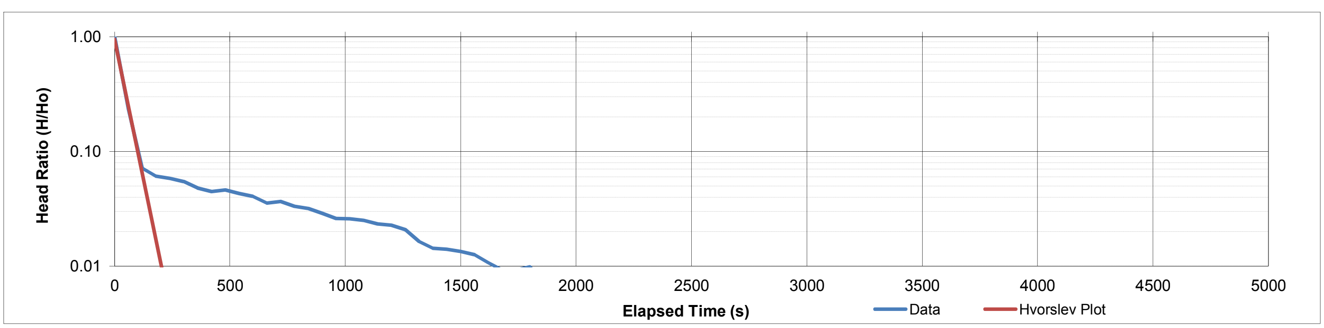
HYDRAULIC CONDUCTIVITY CALCULATION
USING HVORSLEV (1951) METHOD

Print 02/26/16 15:44

Project No.	VA101-460/03		**Drillhole**	**SC15-205**	
Field Technician	JBC		**Test No.**	3	
Analyst	KTD				
Monitoring Instrument Type	Transducer		**Packer Type**	-	
Slug Type	48	L of water	**Packer Inflation Time**	-	
Test Date	3-Jun-15				
Drillhole diameter, D	HQ3	0.096 m			
Drill rod diameter, d	HQ3	0.078 m	**Slug Injected, Time = 0**	5:55:48 PM	
Top of test interval	19.8	**m along hole**	**Initial water level**	20.47	**m above transducer**
Bottom of test interval	29.9	**m along hole**	**Water level after slug**	25.21	**m above transducer**
Test length, L	10.1	**m along hole**	**Change In Water Level, H_o**	4.75	**m**
Drillhole angle	90	**degrees**	**Expected Change In Water Level, H_o**	10	**m**
Transmissivity, T	9E-05	**m^2/s**			
Hydraulic Conductivity, K	9E-06	**m/s**	Intercept	1.0	





TEST COMMENTS:

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\B1 - Hydraulic Conductivity Testing Sheets\[SC15-205 Hvorslev_Packer Drillhole.xlsx]SC15-204 Hvorslev Packer #3

A	10JUN'15	ISSUED WITH REPORT	KTD	MBG
REV	DATE	DESCRIPTION	PREP'D	CHK'D

APPENDIX C

LABORATORY TEST RESULTS

Appendix C1 Soil Laboratory Testing Results
Appendix C2 Rock Laboratory Testing Results

APPENDIX C1

SOIL LABORATORY TESTING RESULTS

(Pages C1-1 to C1-43)

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TABLE C1.1

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2015 GEOTECHNICAL SITE INVESTIGATION
SUMMARY OF 2015 SOIL LABORATORY TEST RESULTS

Print Feb/29/16 10:02:59

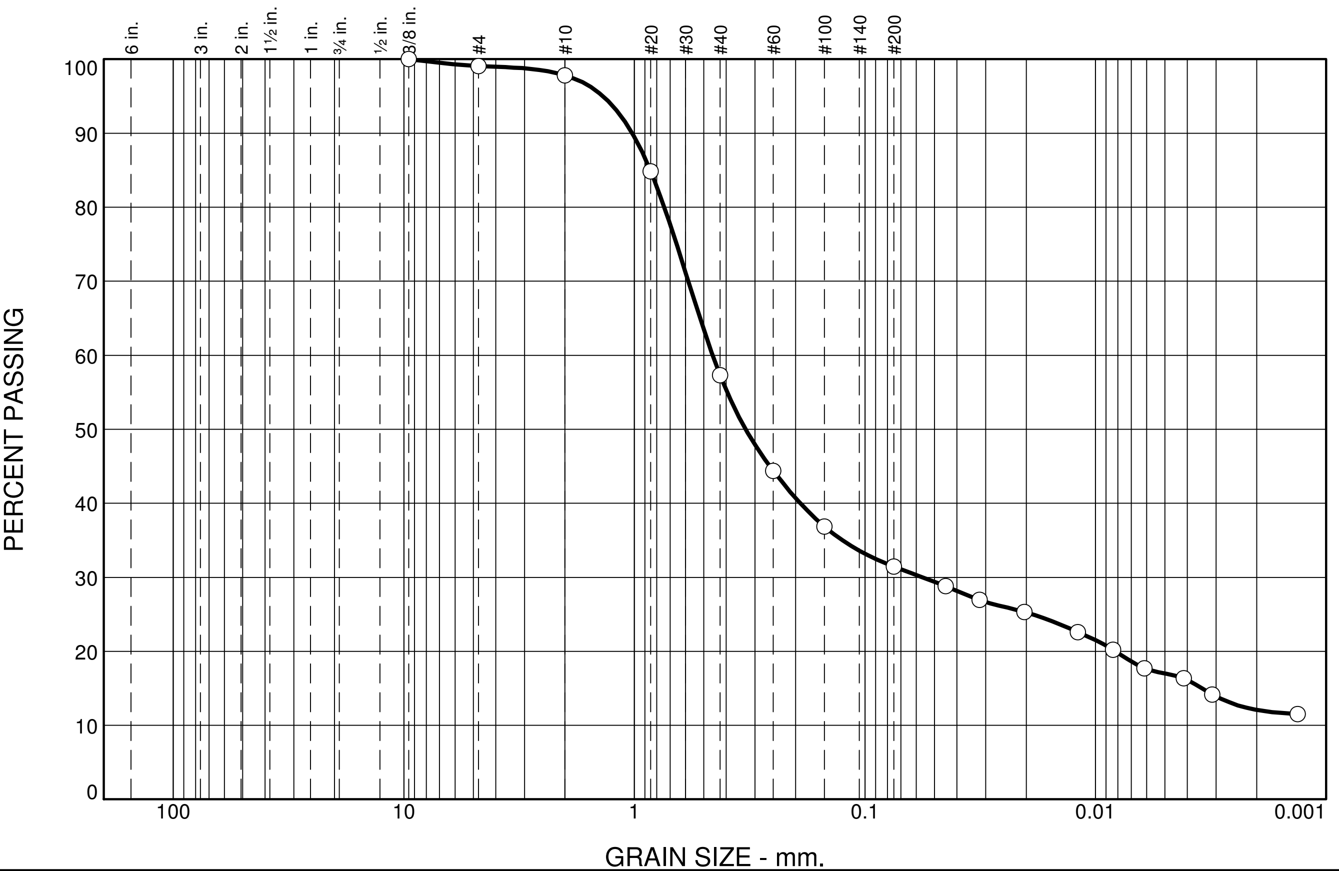
Sample Location	Sample I.D.	Sample General Area	Coordinates (Easting, Northing)		Depth (ft)		Depth (m)		Natural Moisture Content	Percent Passing 3/8"	Percent Passing #200	Atterberg Limits[1]			Particle Size Distribution				USCS	Triaxial Testing				Description
												P.L. %	L.L. %	P.I. %	Gravel %	Sand %	Silt %	Clay %		Total		Effective		
					From	To	From	To	(%)	Sieve	Sieve				+ 5 mm	5 to 0.074 mm	0.074 to 0.002 mm	- 0.002 mm		φ` (deg)	c (kpa)	φ` (deg)	c (kpa)	
SC15-181	SPT01	South Impoundment Embankment	506,592	5,178,968	5	7	1.5	2.1	20.0	98.2	32.9	19	30	11	6.4	60.7	22.9	10.0	SC					clayey SAND
	SPT02				10	12	3.0	3.7	19.4	83.0	20.0	24	33	9	24.9	55.1	13.7	6.3	SC					clayey SAND with gravel
	SPT03				15	17	4.6	5.2	16.9	92.3	25.0	28	33	5	9.0	66.0	18.2	6.8	SM					silty SAND
	SPT04				20	20.3	6.1	6.2	19.3	100.0	23.0	NP	NP	NP	0.0	77.0	15.5	7.5	SM					silty SAND
	SHELBY01				17.5	18	5.3	5.5	23.2	100.0	26.2	31	33	2	0.2	73.6	20.8	5.4	SM					silty SAND
SC15-184	SPT01	Seepage Collection Pond	507,044	5,178,970	5	7	1.5	2.1	23.0	96.0	12.7	29	30	1	14.9	72.4	7.7	5.0	SM					silty SAND
	SPT02				10	12	3.0	3.7	25.3	96.1	41.4	19	34	15	13.0	45.6	28.0	13.4	SC					clayey SAND
	SHELBY01				12	13	3.7	4.0												37.6	0	47.0	64.8	
SC15-191	Weathered Rock	Process Water Pond	507,024	5,179,469	13.3	14	4.1	4.3	14.2	63.3	9.9	21	27	6	56.1	34.0	9.9	-	GP-GC					poorly graded GRAVEL with siltyclay and sand
SC15-192	SPT01	West Impoundment Embankment	504,689	5,178,984	5	7	1.5	2.1	20.9	79.4	40.1	18	31	13	31.6	28.3	28.6	11.5	GC					clayey GRAVEL with sand
	SPT02				10	12	3.0	3.7	21.1	100.0	13.1	NP	NP	NP	0.4	86.5	9.6	3.5	SM					silty SAND
	SPT03				15	17	4.6	5.2	11.1	81.6	12.1	24	32	8	39.1	48.8	12.1	-	SM					silty SAND with gravel
SC15-193	SPT01	West Impoundment Embankment	504,857	5,178,786	5	7	1.5	2.1	18.7	76.5	24.9	18	28	10	34.0	41.1	18.3	6.6	SC					clayey SAND with gravel
	SPT02				10	12	3.0	3.7	25.0	82.0	12.3	24	38	14	48.9	38.8	12.3	-	GC					clayey GRAVEL with sand
SC15-196	SPT01	East Impoundment Embankment	507,619	5,179,697	3	5	0.9	1.5	24.5	90.6	32.8	23	58	35	29.0	38.2	15.3	17.5	SC					clayey SAND with gravel
	SPT02				8	10	2.4	3.0	19.8	98.0	36.6	23	47	24	4.7	58.7	19.5	17.1	SC					clayey SAND
SC15-198	Grab Sump	SAG Mill	506,592	5,179,745	4	n/a	1.2	n/a	14.1	100.0	31.4	22	36	14	0.9	67.7	19.3	12.1	SC					clayey SAND
TP15-02	Grab Sample	Process Water Storage Pond	506,197	5,179,536	1.0	1.6	0.3	0.5	n/a	98.9	32.7	22	33	11	4.8	62.5	20.3	12.4	SC					clayey SAND
TP15-08	Grab Sample	South Impoundment Area	506,469	5,179,033	1.0	2.0	0.3	0.6	n/a	91.1	31.1	20	39	19	18.2	50.7	18	13.1	SC					clayey SAND with gravel
TP15-12	Grab Sample	South Impoundment Area	506,578	5,178,829	1.3	2.0	0.4	0.6	n/a	95.3	39.2	18	33	15	11.6	49.2	25.9	13.3	SC					clayey SAND
TP15-13	Grab Sample	South Impoundment Area	506,531	5,178,726	1.3	1.6	0.4	0.5	n/a	98.9	37.7	19	35	16	7.1	55.2	22.5	15.2	SC					clayey SAND
TP15-15	Grab Sample	South Impoundment Embankment	506,725	5,179,123	2.4	3.3	0.7	1.0	n/a	100.0	18.6	21	29	8	3.4	78	10.8	7.8	SC					clayey SAND
TP15-24	Grab Sample	Process Water Pond (Alternate)	506,378	5,178,405	1.0	1.6	0.3	0.5	n/a	97.0	38.3	18	29	11	11.5	50.2	26.2	12.1	SC					clayey SAND
TP15-25	Grab Sample	Process Water Pond (Alternate)	506,307	5,178,406	1.3	2.0	0.4	0.6	n/a	99.2	32.9	19	28	9	6.3	60.8	21.7	11.2	SC					clayey SAND
TP15-30	Grab Sample	Non Contact Water Reservoir	507,562	5,178,612	0.7	1.0	0.2	0.3	n/a	98.0	38.7	25	40	15	7.9	53.4	26.1	12.6	SC					clayey SAND
TP15-30	Grab Sample	Non Contact Water Reservoir	507,562	5,178,612	1.0	2.0	0.3	0.6	n/a	86.1	15.8	19	34	15	38.9	45.3	8.7	7.1	SC					clayey SAND with gravel
TP15-37	Grab Sample	Non Contact Water Reservoir	507,830	5,178,744	0.7	1.6	0.2	0.5	n/a	100.0	50.7	20	32	12	5.2	44.1	33.6	17.1	CL					sandy lean CLAY
TP15-40	Grab Sample	Proposed Portal	506,919	5,179,822	0.3	0.7	0.1	0.2	n/a	95.7	62	23	45	22	10.9	27.1	40.5	21.5	CL					sandy lean CLAY
TP15-42	Grab Sample	Proposed Portal	507,059	5,179,806	1.5	2.1	0.5	0.7	n/a	84.3	34.9	21	39	18	34.3	30.8	19.5	15.4	GC					clayey gravel with SAND
SC15-205	Grab Sump	Non Contact Water Reservoir	507,971	5,178,618	1.6	2.3	0.5	0.7	n/a	99.5	37.3	24	36	12	3.6	59.1	26	11.3	SC					clayey SAND

M:\1\01\00460\03\A\Report\1 - 2015 Geotech SI Report\Appendices\C1 - Soil Laboratory Testing Results\[Summary Tables_June26.xlsx]Table 4 Soil Lab Results

NOTES:
1. NP = NON-PLASTIC
2. SAMPLE "SC15-184 - SHELBY01' SENT FOR MULTISTAGE TRIAXIAL TEST

A	22MAR'15	ISSUED WITH REPORT	JDC	GM
REV	DATE	DESCRIPTION	PREP'D	REV'D

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	1.3	40.5	25.9	19.3	12.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.1		
#10	97.8		
#20	84.9		
#40	57.3		
#60	44.4		
#100	36.9		
#200	31.4		
0.0446 mm.	28.8		
0.0319 mm.	26.9		
0.0204 mm.	25.3		
0.0119 mm.	22.6		
0.0084 mm.	20.2		
0.0061 mm.	17.7		
0.0041 mm.	16.4		
0.0031 mm.	14.2		
0.0013 mm.	11.5		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 22 LL= 36 PI= 14

Coefficients

D_{90}= 1.0227 D_{85}= 0.8536 D_{60}= 0.4578
D_{50}= 0.3294 D_{30}= 0.0563 D_{15}= 0.0034
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

Sample No.: Grab Sump **Source of Sample:** **Date:** 3/30/15
Location: SC15-198 **Elev./Depth:** @4'

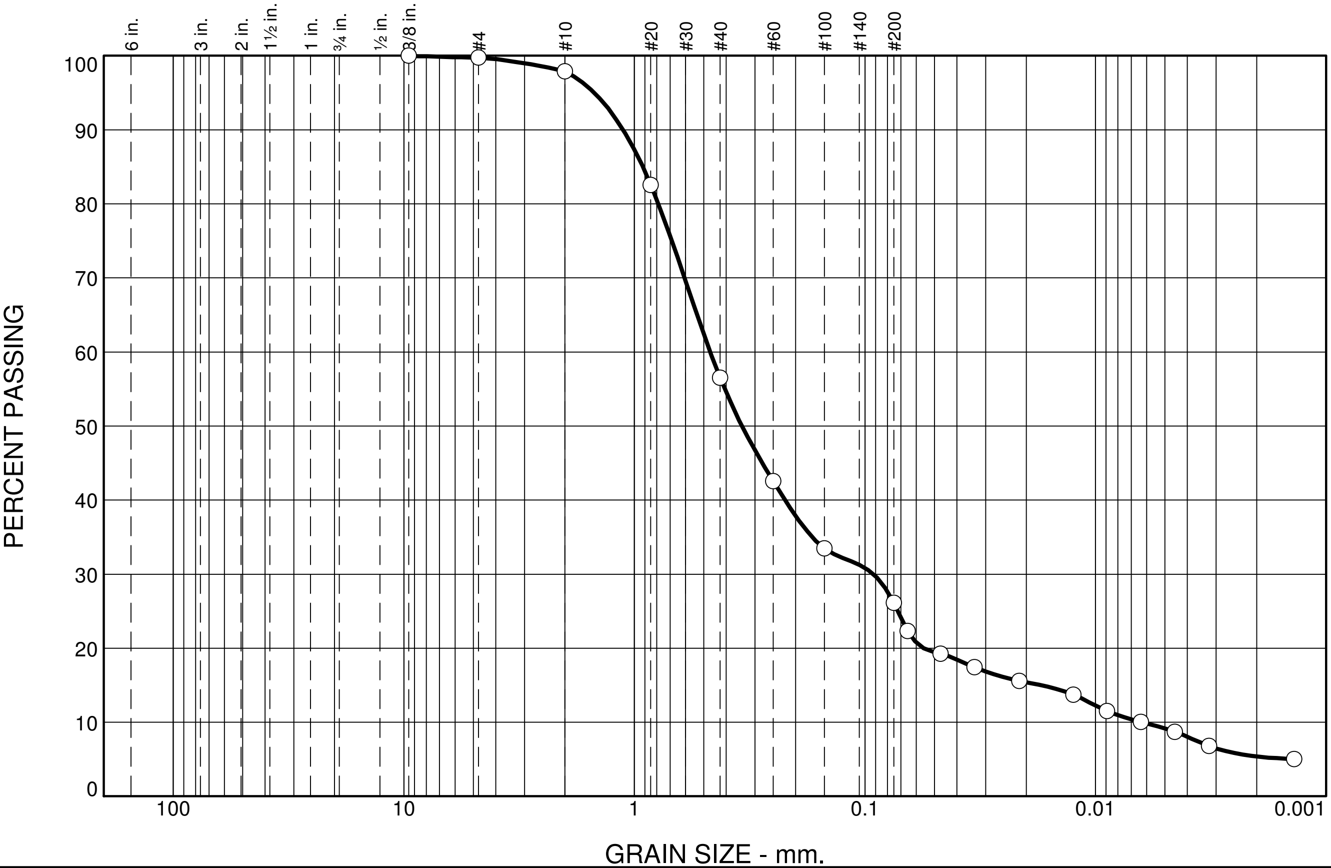
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	1.9	41.4	30.3	20.8	5.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.8		
#10	97.9		
#20	82.6		
#40	56.5		
#60	42.6		
#100	33.5		
#200	26.2		
0.0653 mm.	22.3		
0.0470 mm.	19.3		
0.0335 mm.	17.4		
0.0214 mm.	15.6		
0.0125 mm.	13.7		
0.0089 mm.	11.5		
0.0064 mm.	10.1		
0.0045 mm.	8.7		
0.0032 mm.	6.8		
0.0014 mm.	5.0		

* (no specification provided)

Soil Description

silty SAND

Atterberg Limits

PL= 31 LL= 33 PI= 2

Coefficients

D_{90}= 1.1204 D_{85}= 0.9201 D_{60}= 0.4691
D_{50}= 0.3415 D_{30}= 0.0921 D_{15}= 0.0172
D_{10}= 0.0063 C_u= 74.98 C_c= 2.89

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample No.: SHELBY01 **Source of Sample:** **Date:**
Location: SC15-181 **Elev./Depth:** 17.5'-18'

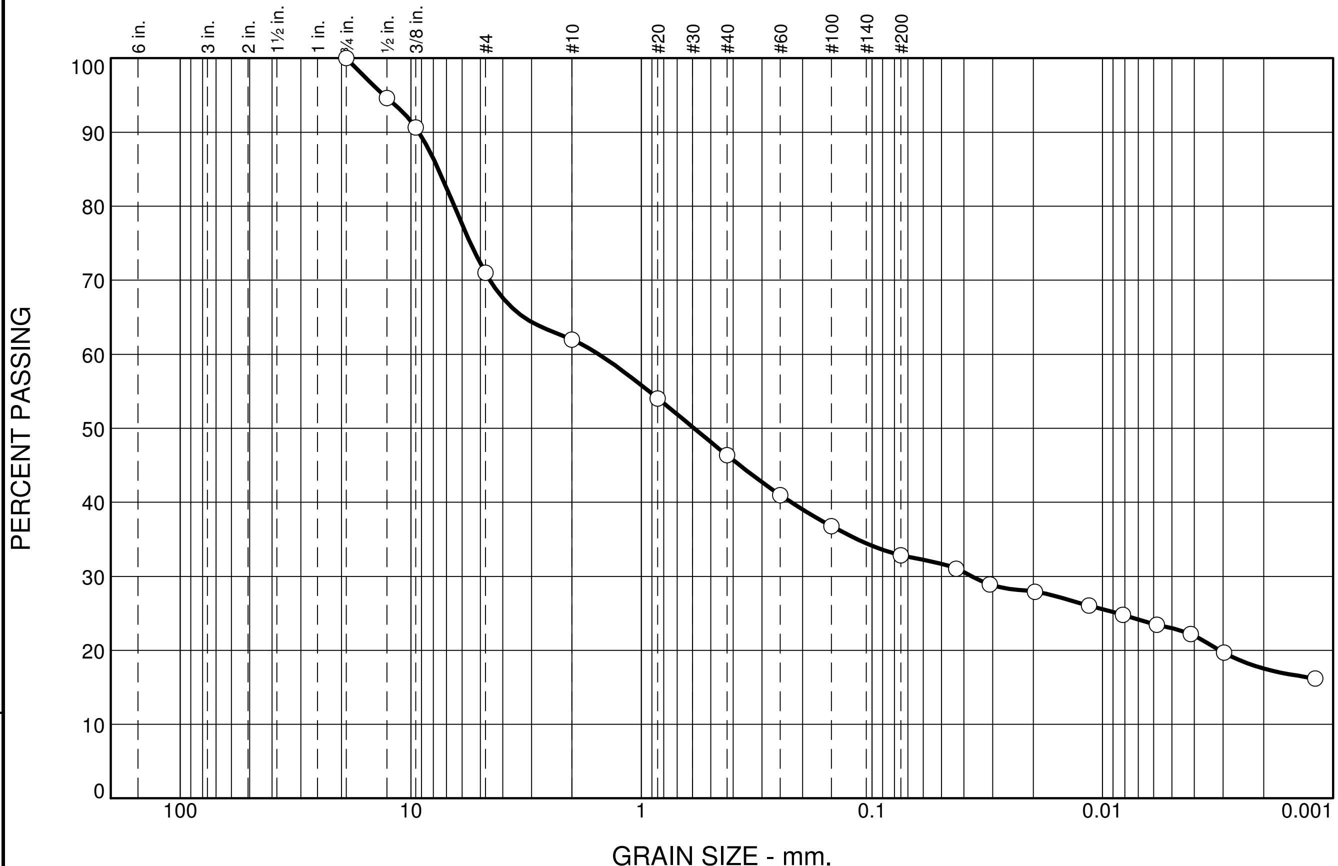
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	29.0	9.0	15.6	13.6	15.3	17.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	94.6		
0.375	90.6		
#4	71.0		
#10	62.0		
#20	54.0		
#40	46.4		
#60	41.0		
#100	36.8		
#200	32.8		
0.0431 mm.	31.0		
0.0309 mm.	28.9		
0.0196 mm.	27.9		
0.0115 mm.	26.0		
0.0082 mm.	24.8		
0.0058 mm.	23.5		
0.0041 mm.	22.2		
0.0030 mm.	19.7		
0.0012 mm.	16.2		

* (no specification provided)

Soil Description

clayey SAND with gravel

Atterberg Limits

PL= 23 LL= 58 PI= 35

Coefficients

D_{90}= 9.2286 D_{85}= 7.6121 D_{60}= 1.5328
D_{50}= 0.5916 D_{30}= 0.0369 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-7(4)

Remarks

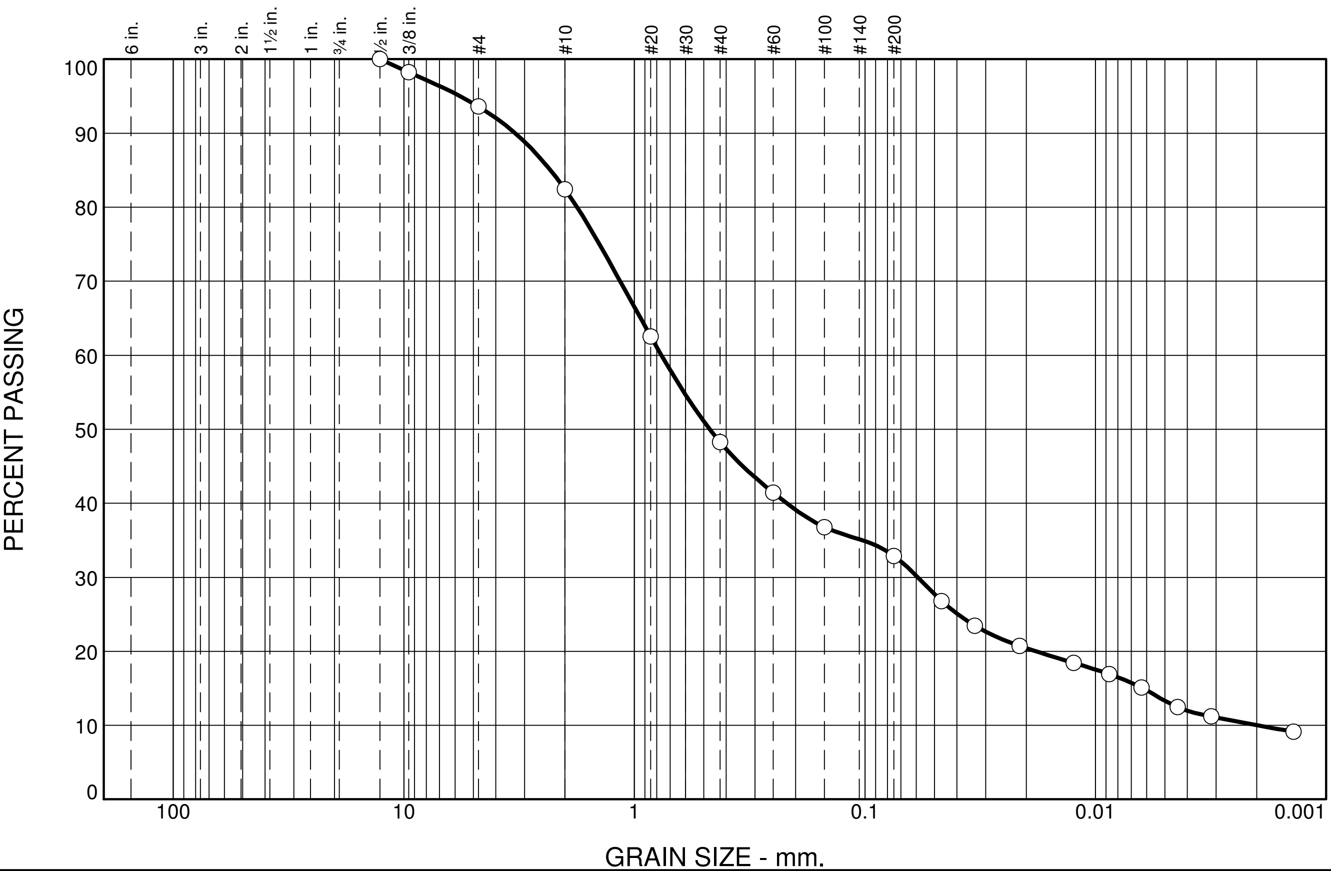
Sample No.: SPT01 **Source of Sample:** **Date:** 3/30/15
Location: SC15-196 **Elev./Depth:** 3'-5'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	11.2	34.1	15.4	22.9	10.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
0.375	98.2		
#4	93.6		
#10	82.4		
#20	62.5		
#40	48.3		
#60	41.4		
#100	36.8		
#200	32.9		
0.0465 mm.	26.8		
0.0334 mm.	23.5		
0.0214 mm.	20.7		
0.0124 mm.	18.5		
0.0087 mm.	16.9		
0.0063 mm.	15.1		
0.0044 mm.	12.5		
0.0031 mm.	11.2		
0.0014 mm.	9.1		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 19 LL= 30 PI= 11

Coefficients

D_{90}= 3.2950 D_{85}= 2.3119 D_{60}= 0.7637
D_{50}= 0.4714 D_{30}= 0.0591 D_{15}= 0.0062
D_{10}= 0.0020 C_u= 385.93 C_c= 2.31

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Sample No.: SPT01 **Source of Sample:** **Date:** 3/30/15
Location: SC15-181 **Elev./Depth:** 5'-7'

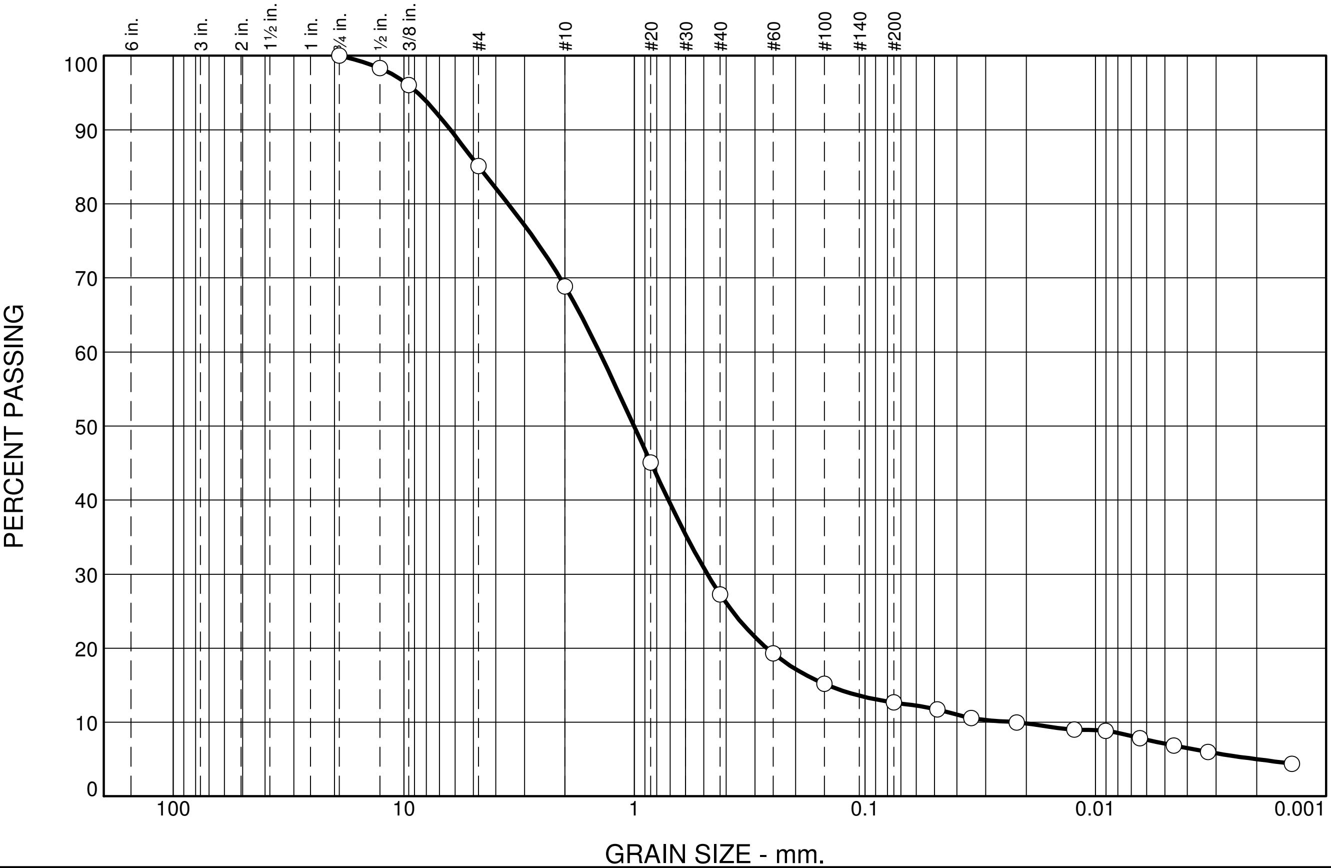
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.9	16.2	41.6	14.6	7.7	5.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.3		
0.375	96.0		
#4	85.1		
#10	68.9		
#20	45.1		
#40	27.3		
#60	19.3		
#100	15.2		
#200	12.7		
0.0486 mm.	11.7		
0.0346 mm.	10.6		
0.0220 mm.	10.0		
0.0123 mm.	9.0		
0.0090 mm.	8.8		
0.0064 mm.	7.9		
0.0046 mm.	6.9		
0.0032 mm.	6.0		
0.0014 mm.	4.4		

* (no specification provided)

Soil Description

silty SAND

Atterberg Limits

PL= 29 LL= 30 PI= 1

Coefficients

D_{90}= 6.2846 D_{85}= 4.7245 D_{60}= 1.4200
D_{50}= 1.0054 D_{30}= 0.4826 D_{15}= 0.1451
D_{10}= 0.0222 C_u= 63.89 C_c= 7.38

Classification

USCS= SM AASHTO= A-1-b

Remarks

Sample No.: SPT01 **Source of Sample:** **Date:** 3/30/15
Location: SC15-184 **Elev./Depth:** 5'-7'

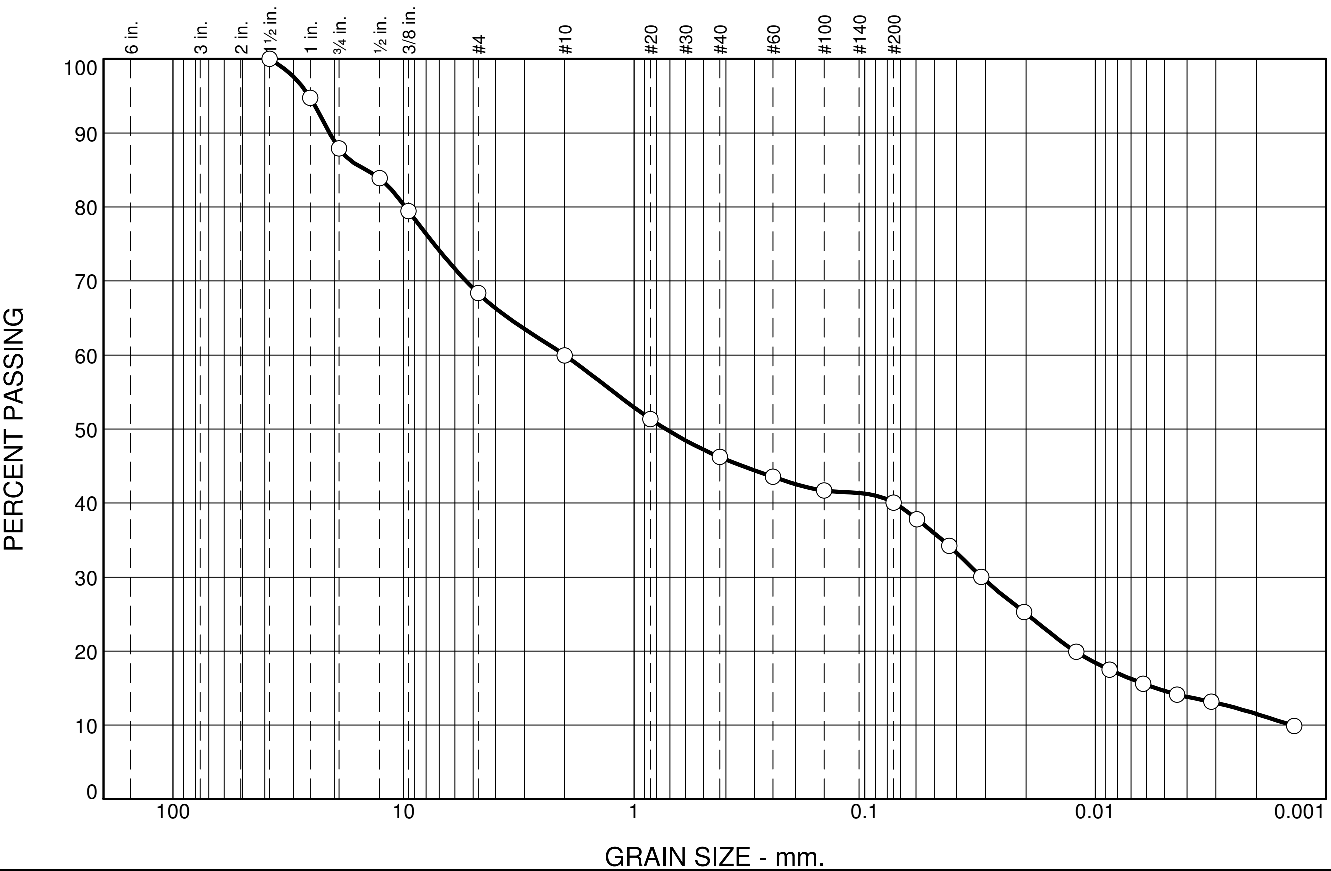
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.1	19.5	8.4	13.8	6.1	28.6	11.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.8		
.75	87.9		
.5	83.9		
0.375	79.4		
#4	68.4		
#10	60.0		
#20	51.4		
#40	46.2		
#60	43.5		
#100	41.7		
#200	40.1		
0.0594 mm.	37.8		
0.0430 mm.	34.2		
0.0312 mm.	30.0		
0.0203 mm.	25.3		
0.0121 mm.	19.9		
0.0087 mm.	17.5		
0.0062 mm.	15.6		
0.0044 mm.	14.1		
0.0031 mm.	13.1		
0.0014 mm.	9.9		

* (no specification provided)

Soil Description

clayey GRAVEL with sand

Atterberg Limits

PL= 18 LL= 31 PI= 13

Coefficients

D_{90}= 20.9536 D_{85}= 14.5035 D_{60}= 2.0079
D_{50}= 0.7285 D_{30}= 0.0311 D_{15}= 0.0055
D_{10}= 0.0014 C_u= 1420.19 C_c= 0.34

Classification

USCS= GC AASHTO= A-6(2)

Remarks

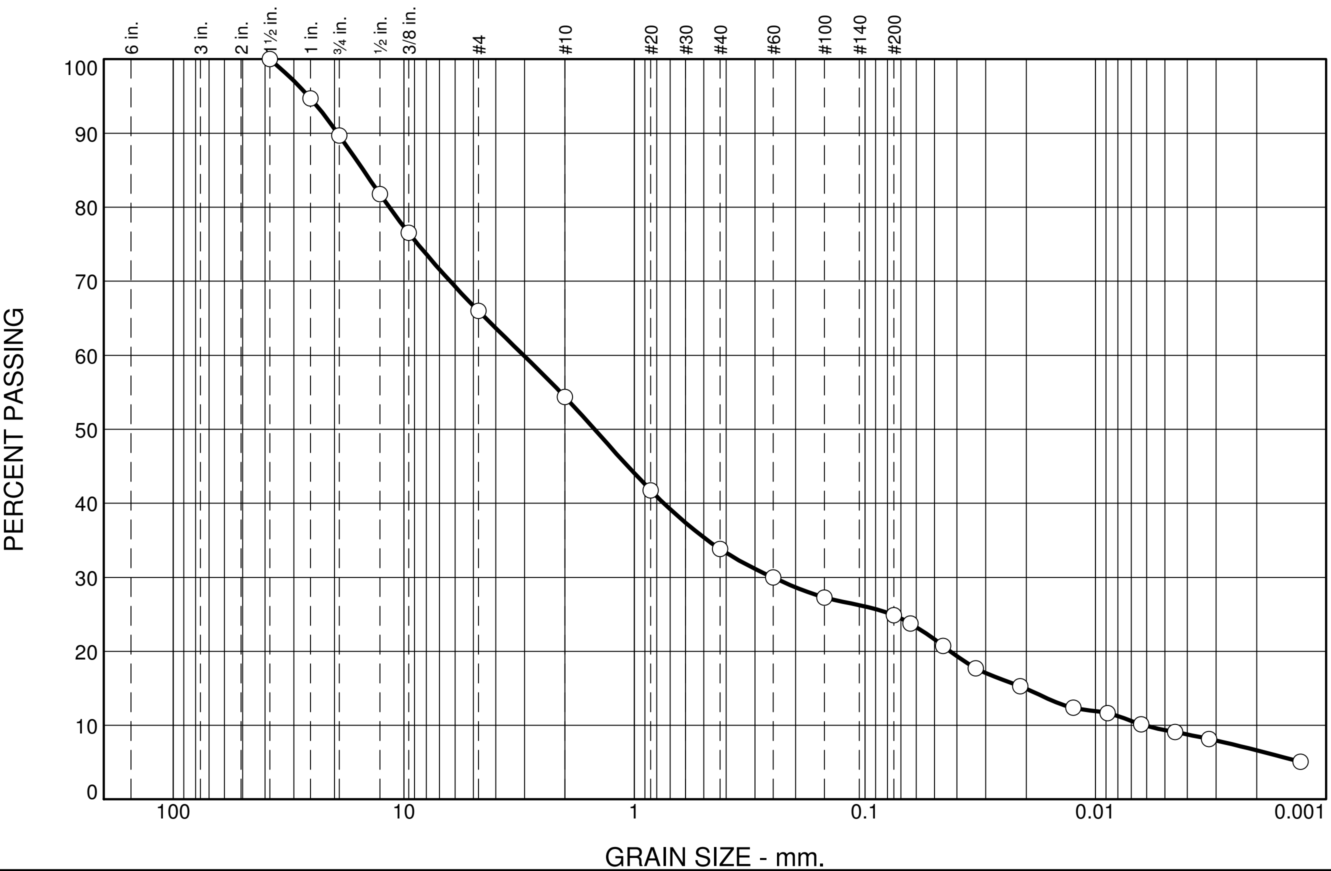
Sample No.: SPT01 **Source of Sample:** **Date:** 3/30/15
Location: SC15-192 **Elev./Depth:** 5'-7'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.3	23.7	11.6	20.6	8.9	18.3	6.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	94.7		
.75	89.7		
.5	81.8		
0.375	76.5		
#4	66.0		
#10	54.4		
#20	41.8		
#40	33.8		
#60	30.0		
#100	27.3		
#200	24.9		
0.0634 mm.	23.7		
0.0458 mm.	20.7		
0.0331 mm.	17.7		
0.0212 mm.	15.3		
0.0125 mm.	12.4		
0.0089 mm.	11.6		
0.0063 mm.	10.1		
0.0045 mm.	9.1		
0.0032 mm.	8.2		
0.0013 mm.	5.1		

* (no specification provided)

Soil Description

clayey SAND with gravel

Atterberg Limits

PL= 18 LL= 28 PI= 10

Coefficients

D_{90}= 19.3705 D_{85}= 14.9916 D_{60}= 3.0243
D_{50}= 1.4899 D_{30}= 0.2510 D_{15}= 0.0202
D_{10}= 0.0061 C_u= 492.69 C_c= 3.39

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

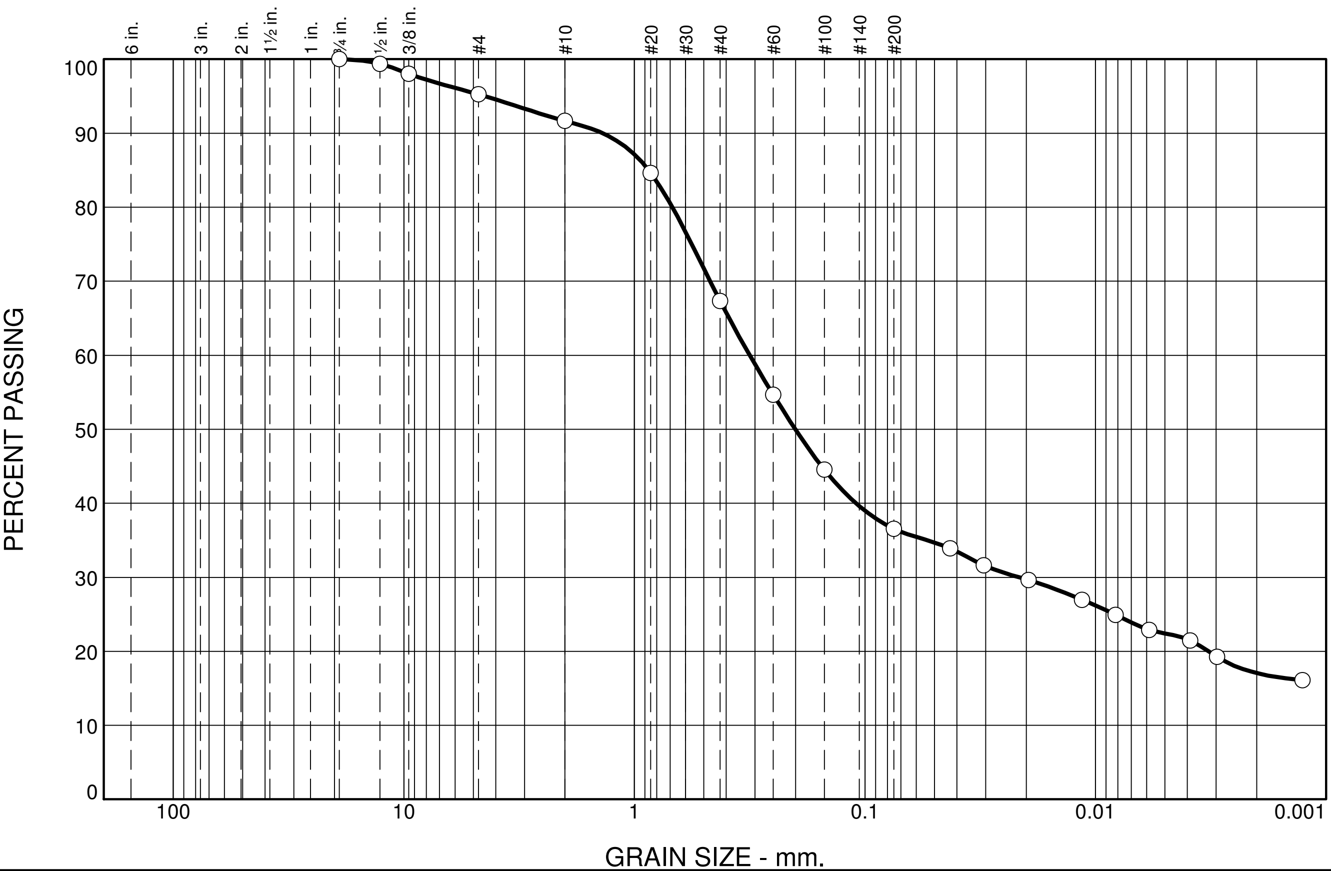
Sample No.: SPT01 **Source of Sample:** **Date:** 3/30/15
Location: SC15-193 **Elev./Depth:** 5'-7'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.7	3.6	24.4	30.7	19.5	17.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.4		
0.375	98.0		
#4	95.3		
#10	91.7		
#20	84.6		
#40	67.3		
#60	54.7		
#100	44.5		
#200	36.6		
0.0427 mm.	33.9		
0.0306 mm.	31.6		
0.0195 mm.	29.6		
0.0114 mm.	27.0		
0.0082 mm.	24.9		
0.0058 mm.	22.9		
0.0039 mm.	21.4		
0.0030 mm.	19.2		
0.0013 mm.	16.1		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 23 LL= 47 PI= 24

Coefficients

D_{90}= 1.3722 D_{85}= 0.8680 D_{60}= 0.3163
D_{50}= 0.2007 D_{30}= 0.0214 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(4)

Remarks

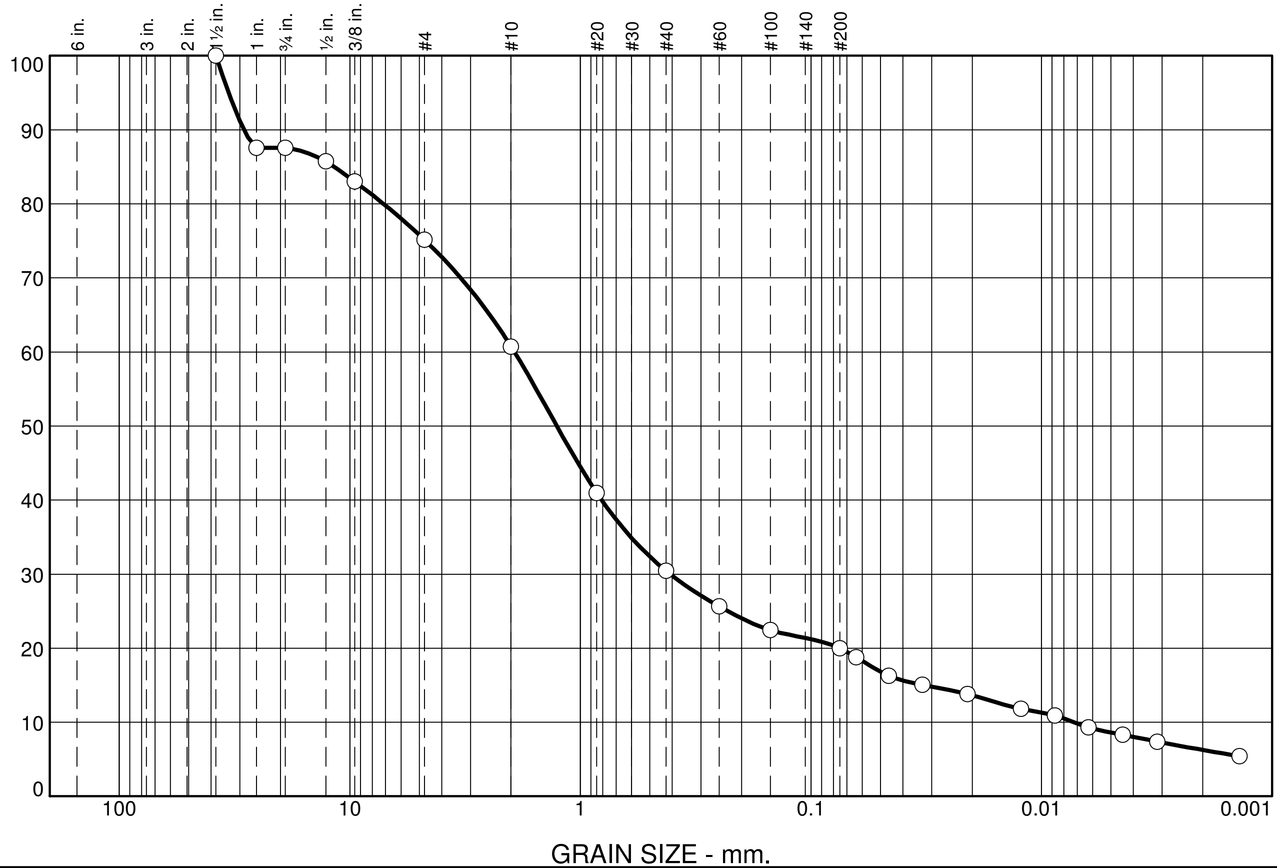
Sample No.: SPT02 **Source of Sample:** **Date:** 3/30/15
Location: SC15-196 **Elev./Depth:** 8'-10'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	12.5	14.4	30.3	10.4	13.7	6.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	87.6		
.75	87.6		
.5	85.7		
0.375	83.0		
#4	75.1		
#10	60.7		
#20	41.0		
#40	30.4		
#60	25.7		
#100	22.4		
#200	20.0		
0.0636 mm.	18.8		
0.0460 mm.	16.3		
0.0328 mm.	15.0		
0.0210 mm.	13.8		
0.0123 mm.	11.8		
0.0088 mm.	10.9		
0.0063 mm.	9.3		
0.0044 mm.	8.3		
0.0031 mm.	7.4		
0.0014 mm.	5.4		

* (no specification provided)

Soil Description

clayey SAND with gravel

Atterberg Limits

PL= 24 LL= 33 PI= 9

Coefficients

D_{90}= 28.8034 D_{85}= 11.6925 D_{60}= 1.9330
D_{50}= 1.2657 D_{30}= 0.4078 D_{15}= 0.0322
D_{10}= 0.0072 C_u= 267.72 C_c= 11.91

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Sample No.: SPT02 **Source of Sample:** **Date:** 3/30/15
Location: SC15-181 **Elev./Depth:** 10'-12'

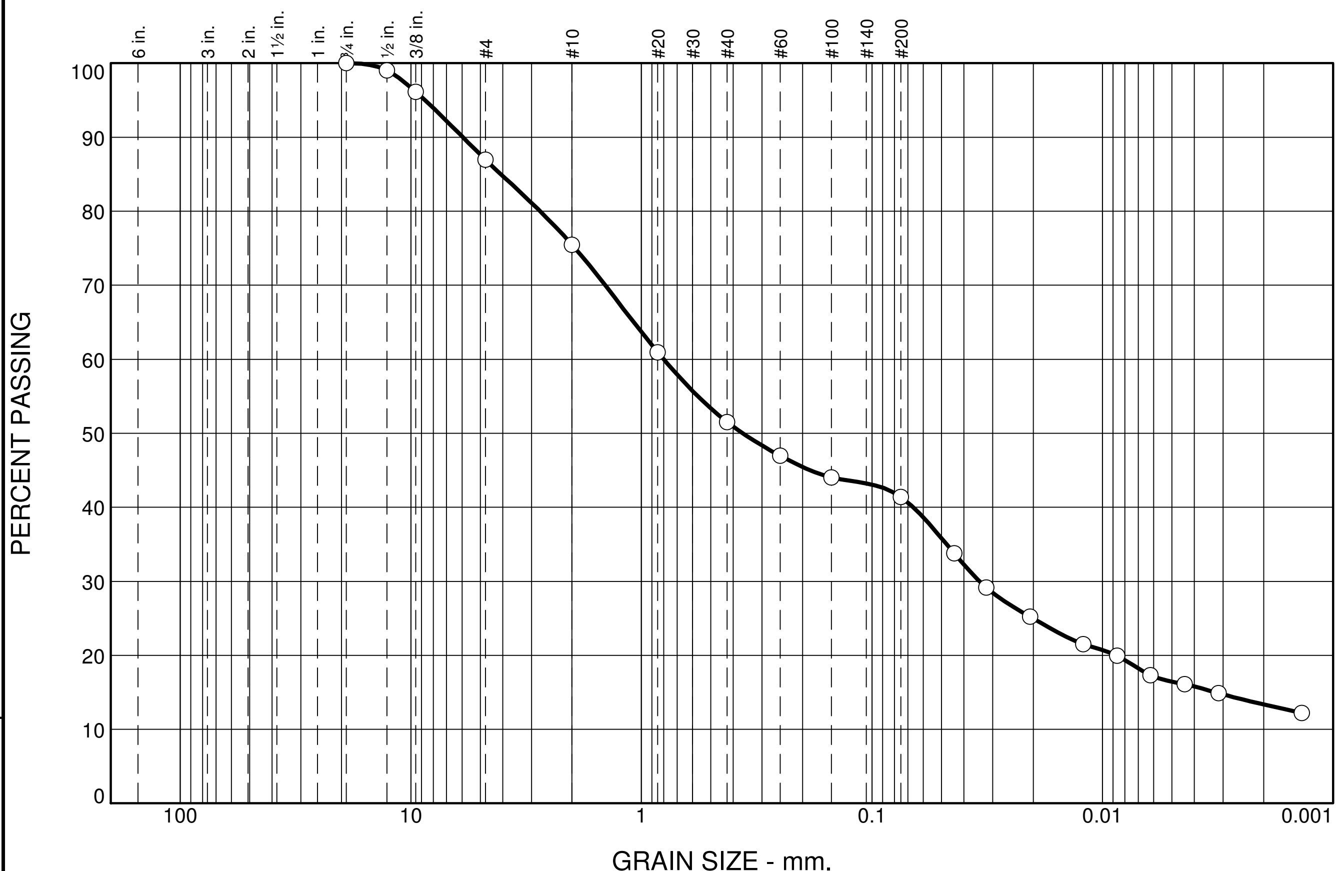
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.0	11.5	24.0	10.1	28.0	13.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.0		
0.375	96.1		
#4	87.0		
#10	75.5		
#20	61.0		
#40	51.5		
#60	47.0		
#100	44.1		
#200	41.4		
0.0440 mm.	33.8		
0.0319 mm.	29.2		
0.0206 mm.	25.2		
0.0121 mm.	21.5		
0.0086 mm.	19.9		
0.0062 mm.	17.3		
0.0044 mm.	16.1		
0.0031 mm.	14.9		
0.0014 mm.	12.2		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 19 LL= 34 PI= 15

Coefficients

D_{90}= 5.9544 D_{85}= 4.0694 D_{60}= 0.8008
D_{50}= 0.3638 D_{30}= 0.0341 D_{15}= 0.0032
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Sample No.: SPT02 **Source of Sample:** **Date:** 3/30/15
Location: SC15-184 **Elev./Depth:** 10'-12'

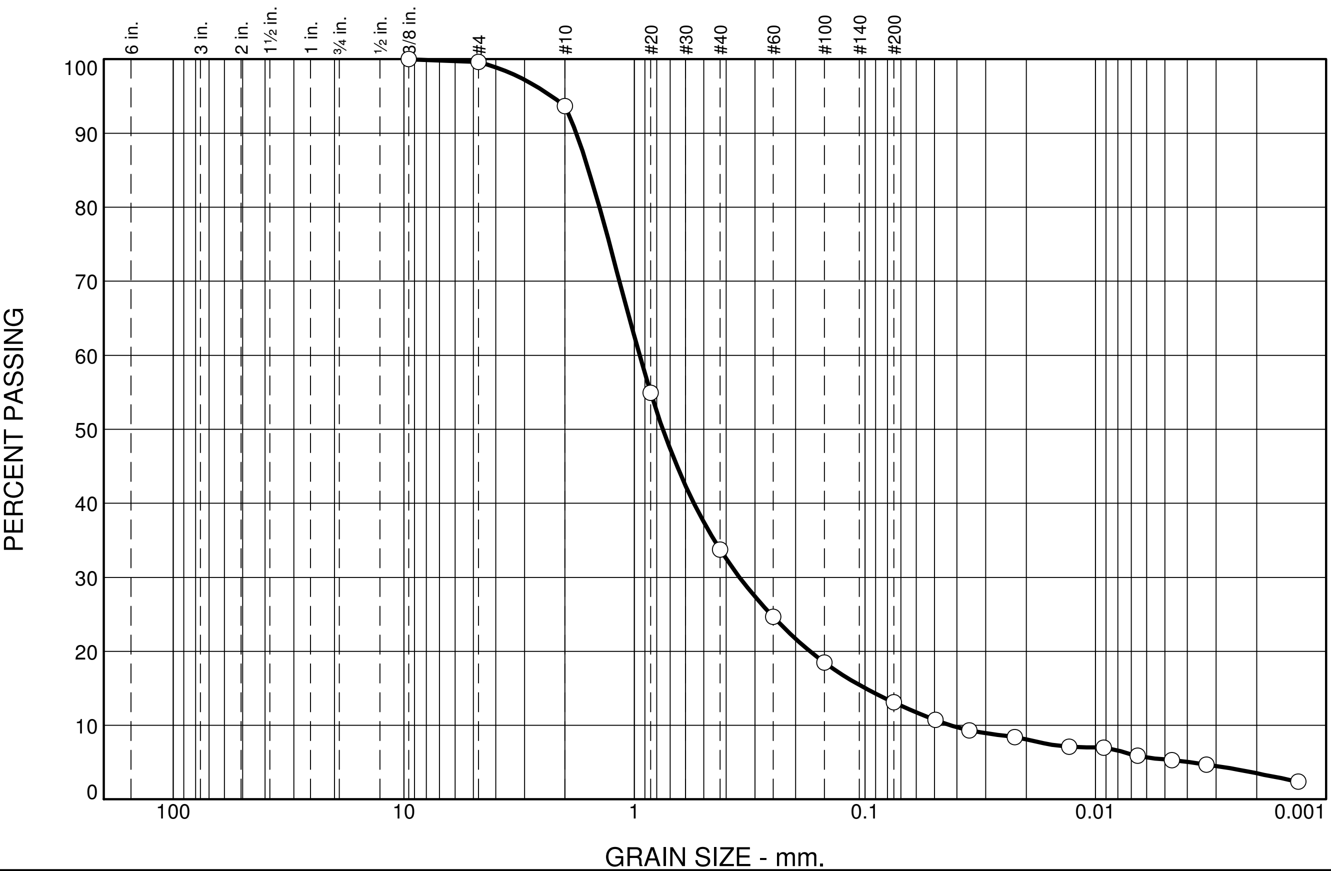
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	5.9	59.9	20.7	9.6	3.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	99.6		
#10	93.7		
#20	54.9		
#40	33.8		
#60	24.7		
#100	18.5		
#200	13.1		
0.0495 mm.	10.7		
0.0353 mm.	9.3		
0.0224 mm.	8.4		
0.0130 mm.	7.1		
0.0092 mm.	7.0		
0.0066 mm.	5.9		
0.0047 mm.	5.3		
0.0033 mm.	4.7		
0.0013 mm.	2.4		

* (no specification provided)

Soil Description

silty SAND

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.7894 D_{85}= 1.5818 D_{60}= 0.9497
D_{50}= 0.7531 D_{30}= 0.3500 D_{15}= 0.0994
D_{10}= 0.0424 C_u= 22.37 C_c= 3.04

Classification

USCS= SM AASHTO= A-1-b

Remarks

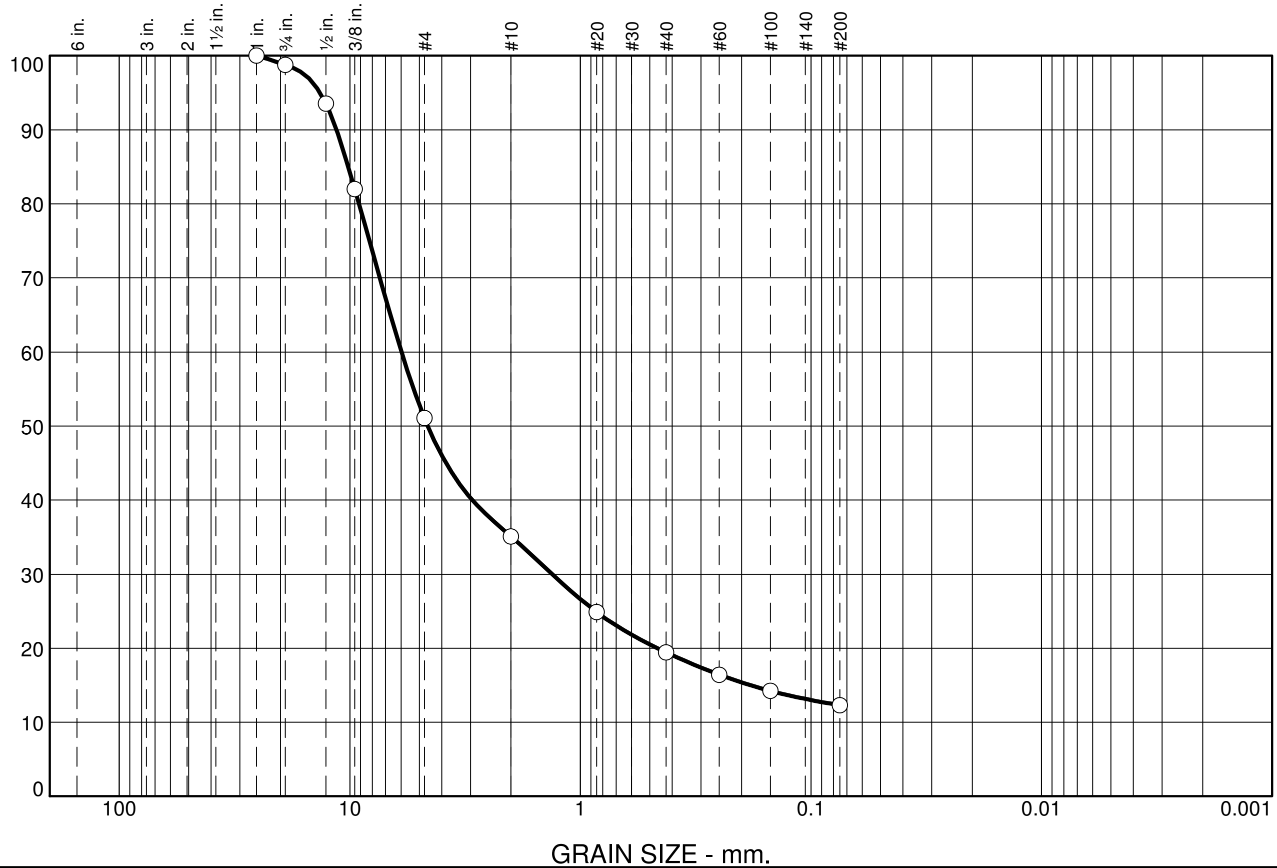
Sample No.: SPT02 **Source of Sample:** **Date:** 3/30/15
Location: SC15-192 **Elev./Depth:** 10'-12'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.2	47.7	16.0	15.7	7.1	12.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	98.8		
.5	93.5		
0.375	82.0		
#4	51.1		
#10	35.1		
#20	24.9		
#40	19.4		
#60	16.4		
#100	14.2		
#200	12.3		

* (no specification provided)

Soil Description

clayey GRAVEL with sand

Atterberg Limits

PL= 24 LL= 38 PI= 14

Coefficients

D_{90}= 11.4408 D_{85}= 10.1627 D_{60}= 5.9702
D_{50}= 4.5957 D_{30}= 1.3258 D_{15}= 0.1835
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(0)

Remarks

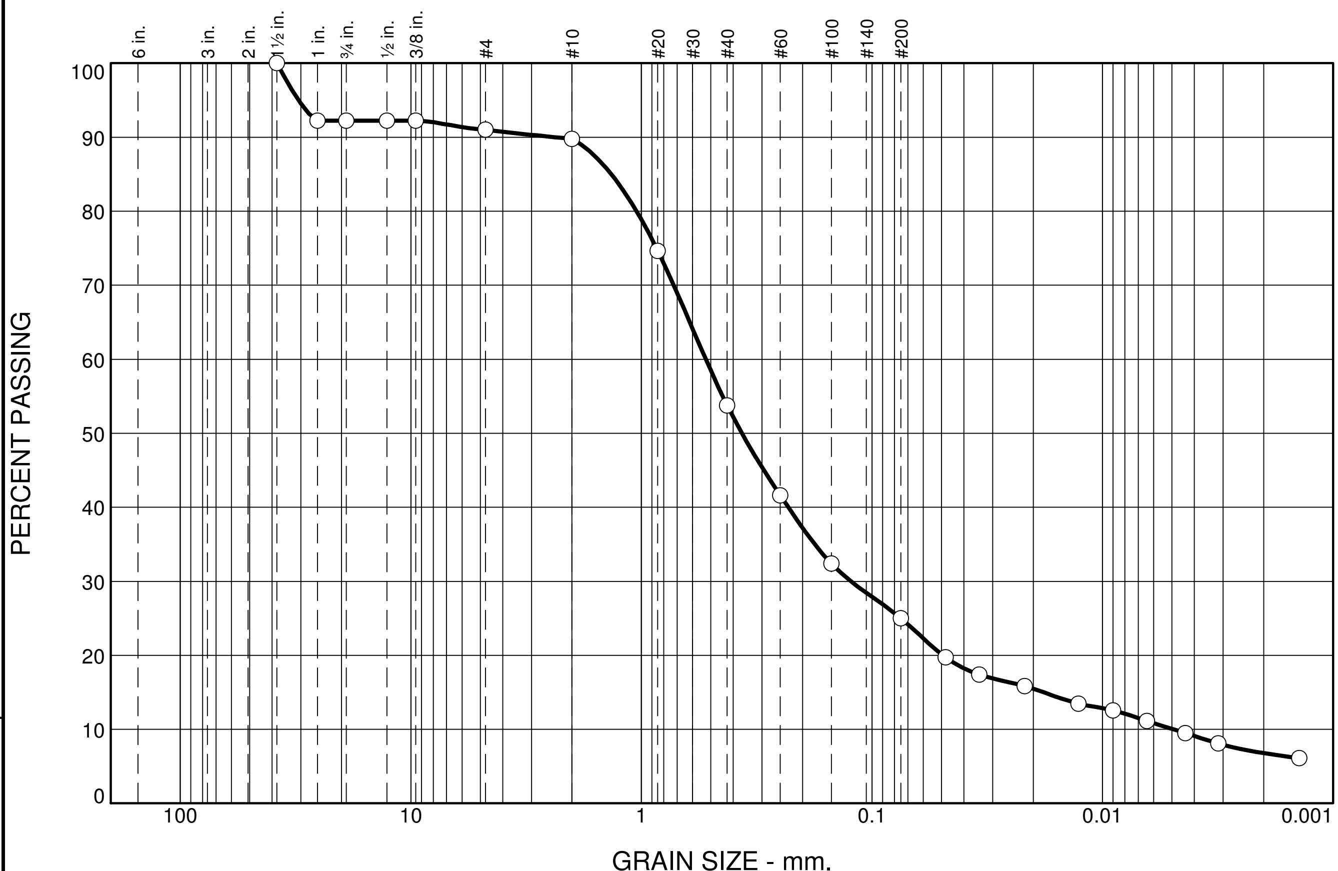
Sample No.: SPT02 **Source of Sample:** **Date:** 3/30/15
Location: SC15-193 **Elev./Depth:** 10'-12'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.7	1.3	1.2	36.0	28.8	18.2	6.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	92.3		
.75	92.3		
.5	92.3		
0.375	92.3		
#4	91.0		
#10	89.8		
#20	74.7		
#40	53.8		
#60	41.6		
#100	32.4		
#200	25.0		
0.0480 mm.	19.7		
0.0343 mm.	17.4		
0.0218 mm.	15.8		
0.0127 mm.	13.5		
0.0090 mm.	12.6		
0.0064 mm.	11.1		
0.0044 mm.	9.5		
0.0032 mm.	8.1		
0.0014 mm.	6.1		

* (no specification provided)

Soil Description

silty SAND

Atterberg Limits

PL= 28 LL= 33 PI= 5

Coefficients

D_{90}= 2.3629 D_{85}= 1.3500 D_{60}= 0.5256
D_{50}= 0.3669 D_{30}= 0.1235 D_{15}= 0.0180
D_{10}= 0.0049 C_u= 106.45 C_c= 5.88

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

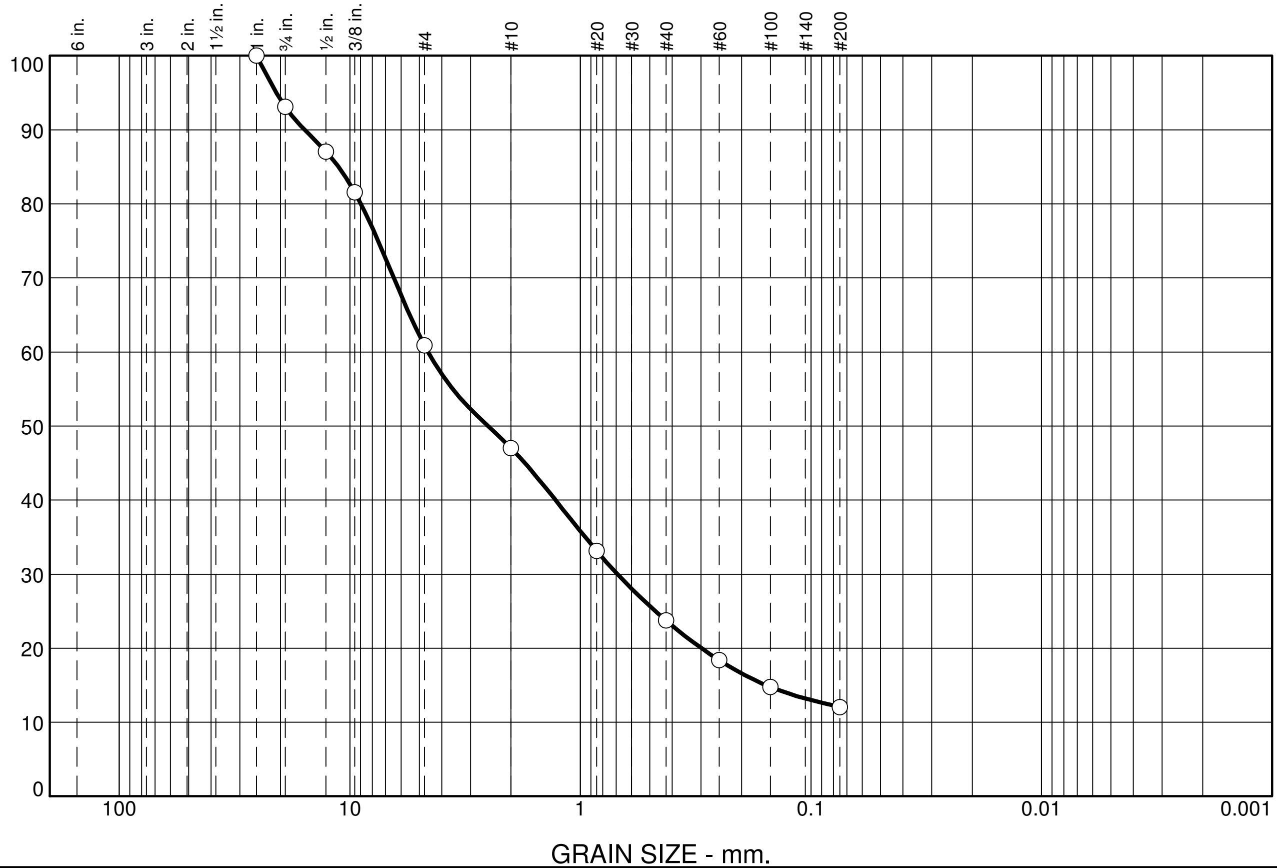
Sample No.: SPT03 **Source of Sample:** **Date:** 3/30/15
Location: SC15-181 **Elev./Depth:** 15'-17'

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	32.2	13.9	23.3	11.6	12.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	93.1		
.5	87.1		
0.375	81.6		
#4	60.9		
#10	47.0		
#20	33.1		
#40	23.7		
#60	18.4		
#100	14.8		
#200	12.1		

* (no specification provided)

Soil Description

silty SAND with gravel

Atterberg Limits

PL= 24 LL= 32 PI= 8

Coefficients

D_{90}= 15.7289 D_{85}= 11.2092 D_{60}= 4.5819
D_{50}= 2.5180 D_{30}= 0.6908 D_{15}= 0.1563
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample No.: SPT03 **Source of Sample:** **Date:** 3/30/15
Location: SC15-192 **Elev./Depth:** 15'-17'

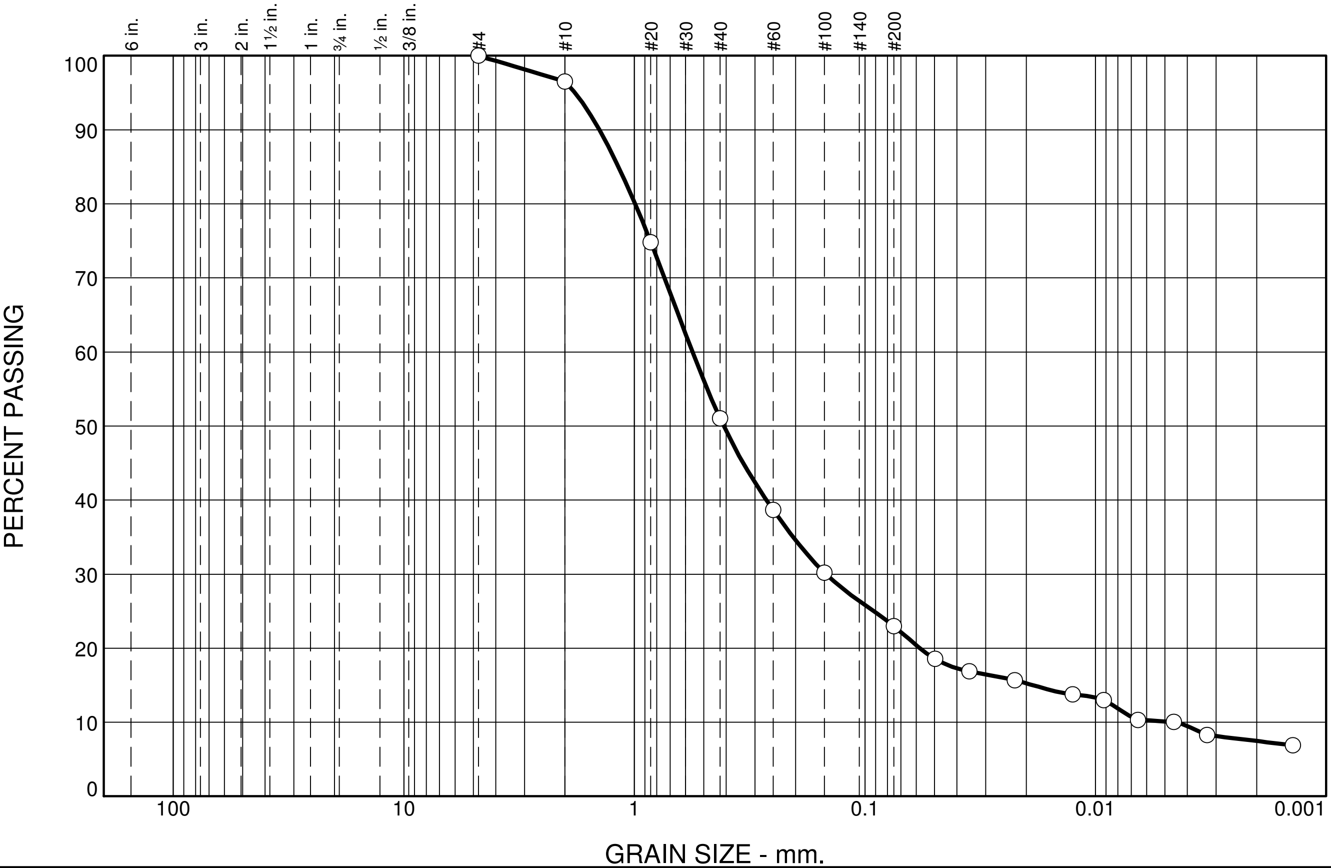
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	3.5	45.4	28.1	15.5	7.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	96.5		
#20	74.8		
#40	51.1		
#60	38.7		
#100	30.2		
#200	23.0		
0.0497 mm.	18.6		
0.0353 mm.	16.9		
0.0224 mm.	15.7		
0.0126 mm.	13.7		
0.0092 mm.	13.0		
0.0066 mm.	10.3		
0.0046 mm.	10.0		
0.0033 mm.	8.3		
0.0014 mm.	6.9		

* (no specification provided)

Soil Description

silty SAND

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.4194 D_{85}= 1.1733 D_{60}= 0.5599
D_{50}= 0.4096 D_{30}= 0.1476 D_{15}= 0.0186
D_{10}= 0.0045 C_u= 123.98 C_c= 8.62

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Sample No.: SPT04 **Source of Sample:** **Date:** 3/30/15
Location: SC15-181 **Elev./Depth:** 20'-20.25'

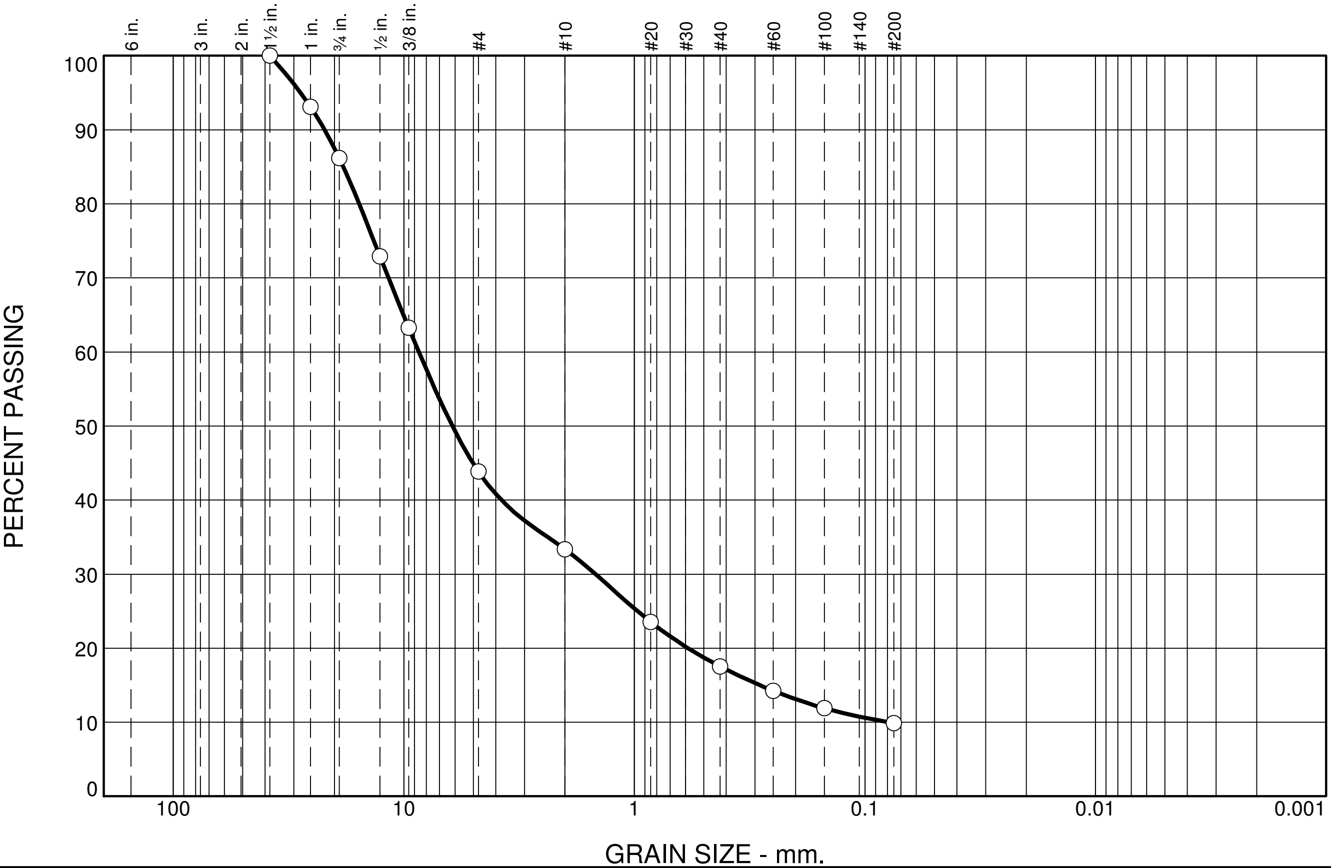
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.8	42.3	10.5	15.9	7.6	9.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	93.1		
.75	86.2		
.5	72.9		
0.375	63.3		
#4	43.9		
#10	33.4		
#20	23.5		
#40	17.5		
#60	14.3		
#100	11.9		
#200	9.9		

* (no specification provided)

Soil Description

poorly graded GRAVEL with siltyclay and sand

Atterberg Limits

PL= 21 LL= 27 PI= 6

Coefficients

D_{90}= 22.0514 D_{85}= 18.2964 D_{60}= 8.6092
D_{50}= 6.1588 D_{30}= 1.4755 D_{15}= 0.2854
D_{10}= 0.0786 C_u= 109.54 C_c= 3.22

Classification

USCS= GP-GC AASHTO= A-1-a

Remarks

Sample No.: Weathered Rock **Source of Sample:** **Date:** 3/30/15
Location: SC15-191 **Elev./Depth:** 13.3'-14'

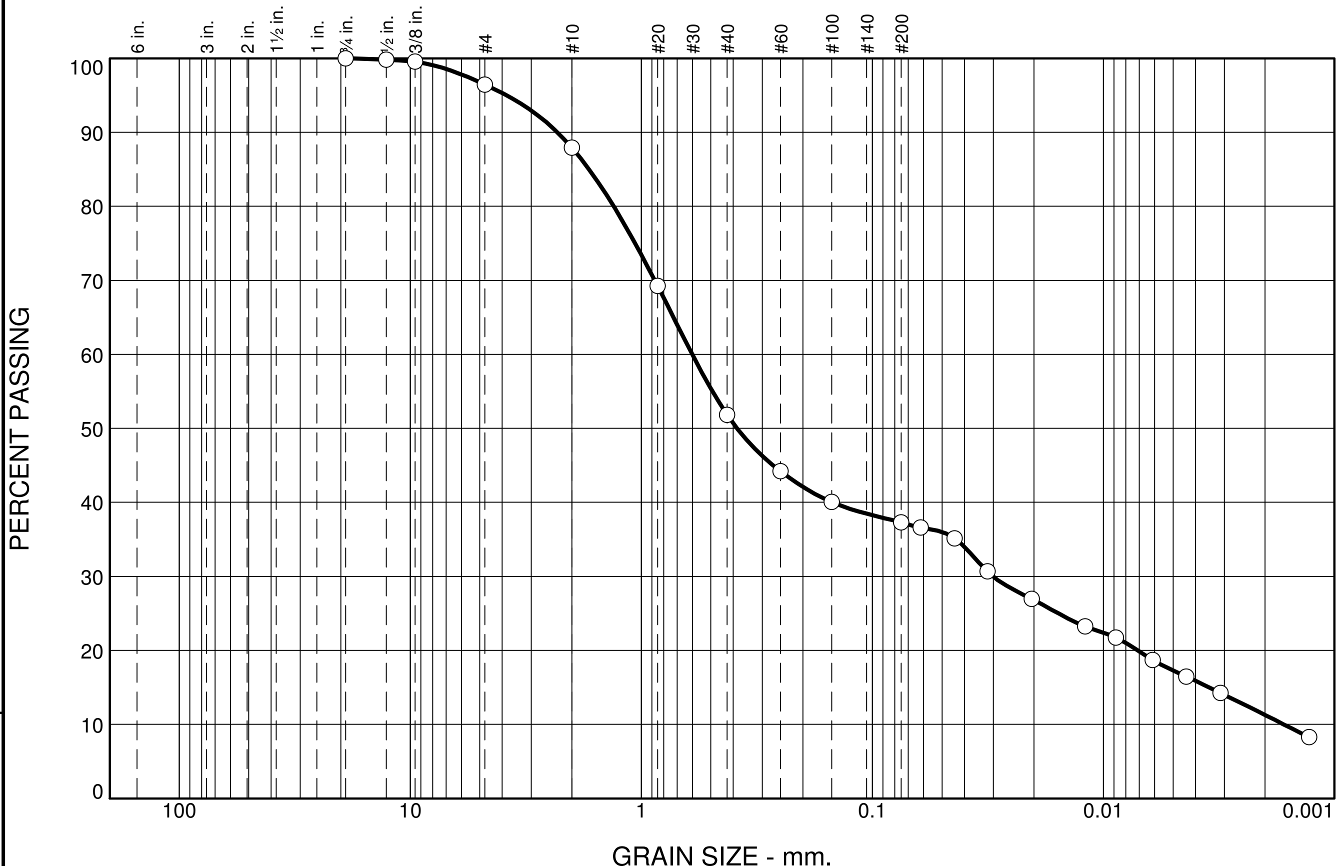
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	8.5	36.1	14.5	26.0	11.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.8		
0.375	99.5		
#4	96.4		
#10	87.9		
#20	69.2		
#40	51.8		
#60	44.2		
#100	40.0		
#200	37.3		
0.0618 mm.	36.6		
0.0440 mm.	35.1		
0.0318 mm.	30.7		
0.0204 mm.	27.0		
0.0120 mm.	23.3		
0.0088 mm.	21.7		
0.0061 mm.	18.7		
0.0044 mm.	16.5		
0.0031 mm.	14.3		
0.0013 mm.	8.3		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 24 LL= 36 PI= 12

Coefficients

D_{90}= 2.3110 D_{85}= 1.6852 D_{60}= 0.6022
D_{50}= 0.3851 D_{30}= 0.0300 D_{15}= 0.0035
D_{10}= 0.0017 C_u= 363.53 C_c= 0.91

Classification

USCS= SC AASHTO= A-6(1)

Remarks

Location: DH15-24
Sample Number: Sump Sample **Depth:** 0.5-0.7m **Date:** 6/12/15

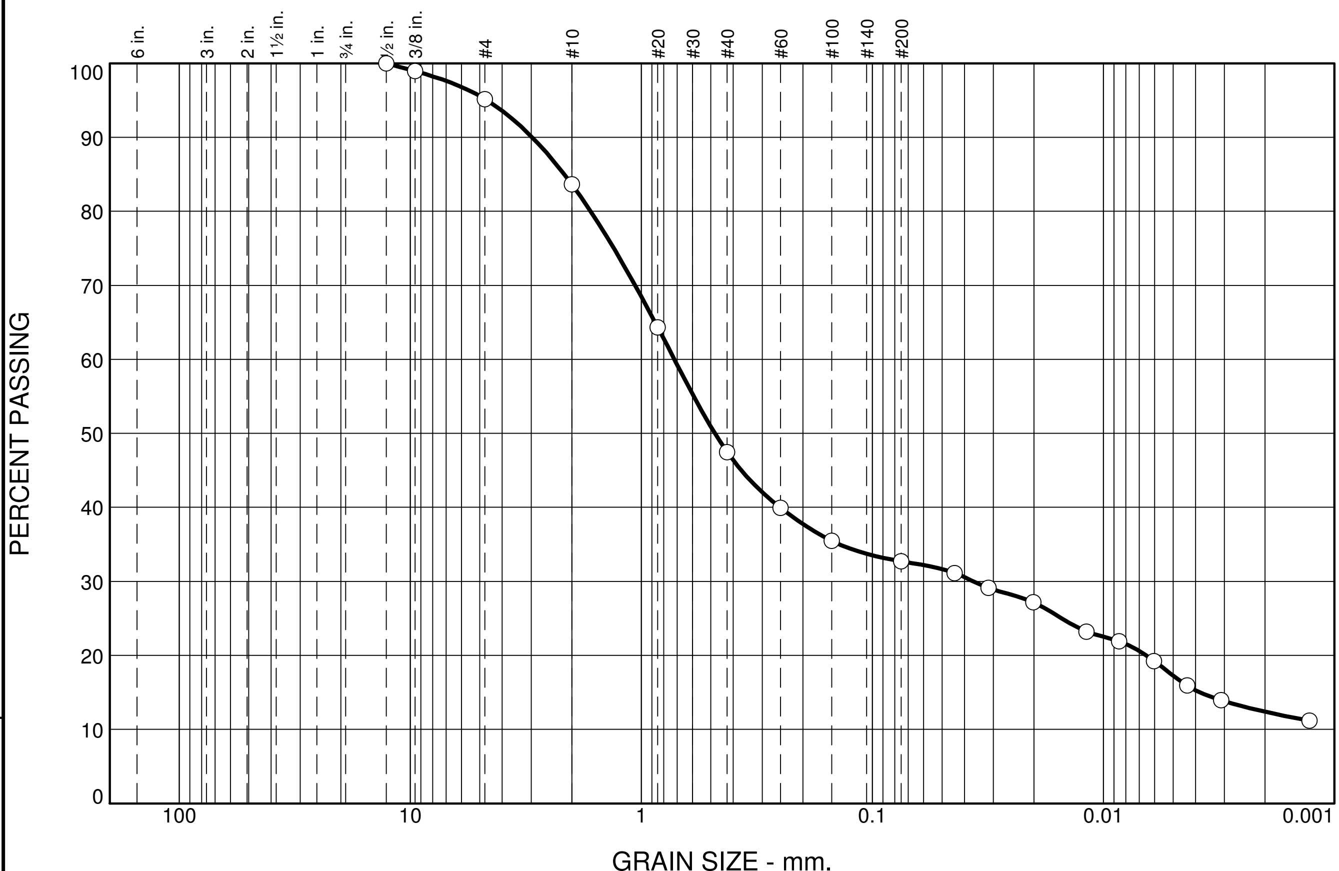
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	11.6	36.1	14.8	20.3	12.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
0.375	98.9		
#4	95.2		
#10	83.6		
#20	64.3		
#40	47.5		
#60	40.0		
#100	35.5		
#200	32.7		
0.0440 mm.	31.1		
0.0315 mm.	29.1		
0.0201 mm.	27.2		
0.0118 mm.	23.2		
0.0086 mm.	21.9		
0.0060 mm.	19.2		
0.0043 mm.	15.9		
0.0031 mm.	14.0		
0.0013 mm.	11.2		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 22 LL= 33 PI= 11

Coefficients

D_{90}= 2.9726 D_{85}= 2.1580 D_{60}= 0.7204
D_{50}= 0.4805 D_{30}= 0.0365 D_{15}= 0.0038
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: TP15-2
Depth: 0.3-0.5m

Date: 6/12/15

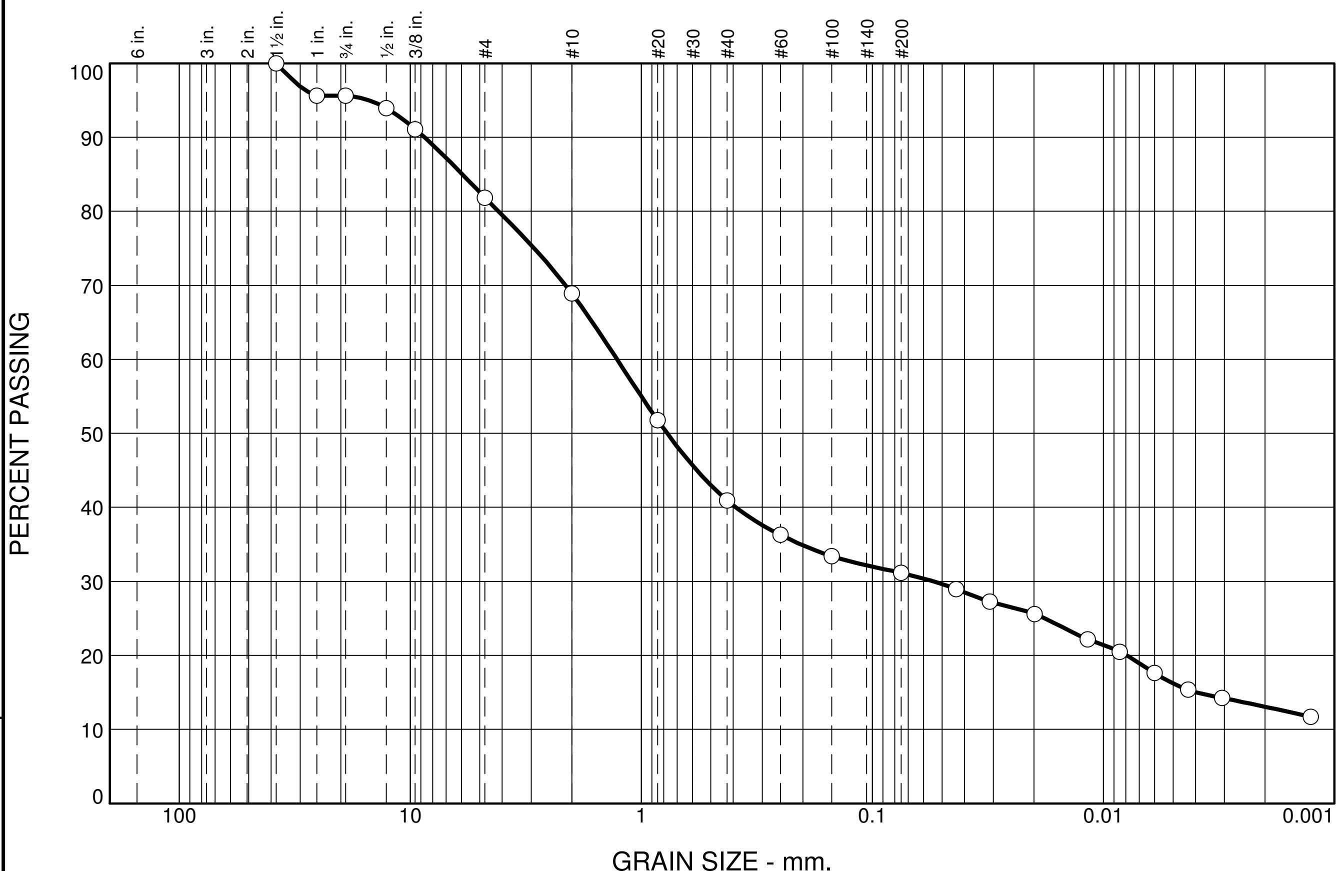
The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.4	13.8	12.9	28.0	9.8	18.0	13.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.6		
.75	95.6		
.5	93.9		
0.375	91.1		
#4	81.8		
#10	68.9		
#20	51.8		
#40	40.9		
#60	36.3		
#100	33.4		
#200	31.1		
0.0434 mm.	29.0		
0.0311 mm.	27.3		
0.0198 mm.	25.6		
0.0117 mm.	22.2		
0.0085 mm.	20.5		
0.0060 mm.	17.6		
0.0043 mm.	15.4		
0.0031 mm.	14.2		
0.0013 mm.	11.7		

* (no specification provided)

Soil Description

clayey SAND with gravel

Atterberg Limits

PL= 20 LL= 39 PI= 19

Coefficients

D_{90}= 8.6935 D_{85}= 5.9578 D_{60}= 1.2754
D_{50}= 0.7736 D_{30}= 0.0546 D_{15}= 0.0039
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-2-6(1)

Remarks

Location: TP15-8
Depth: 0.3-0.6m

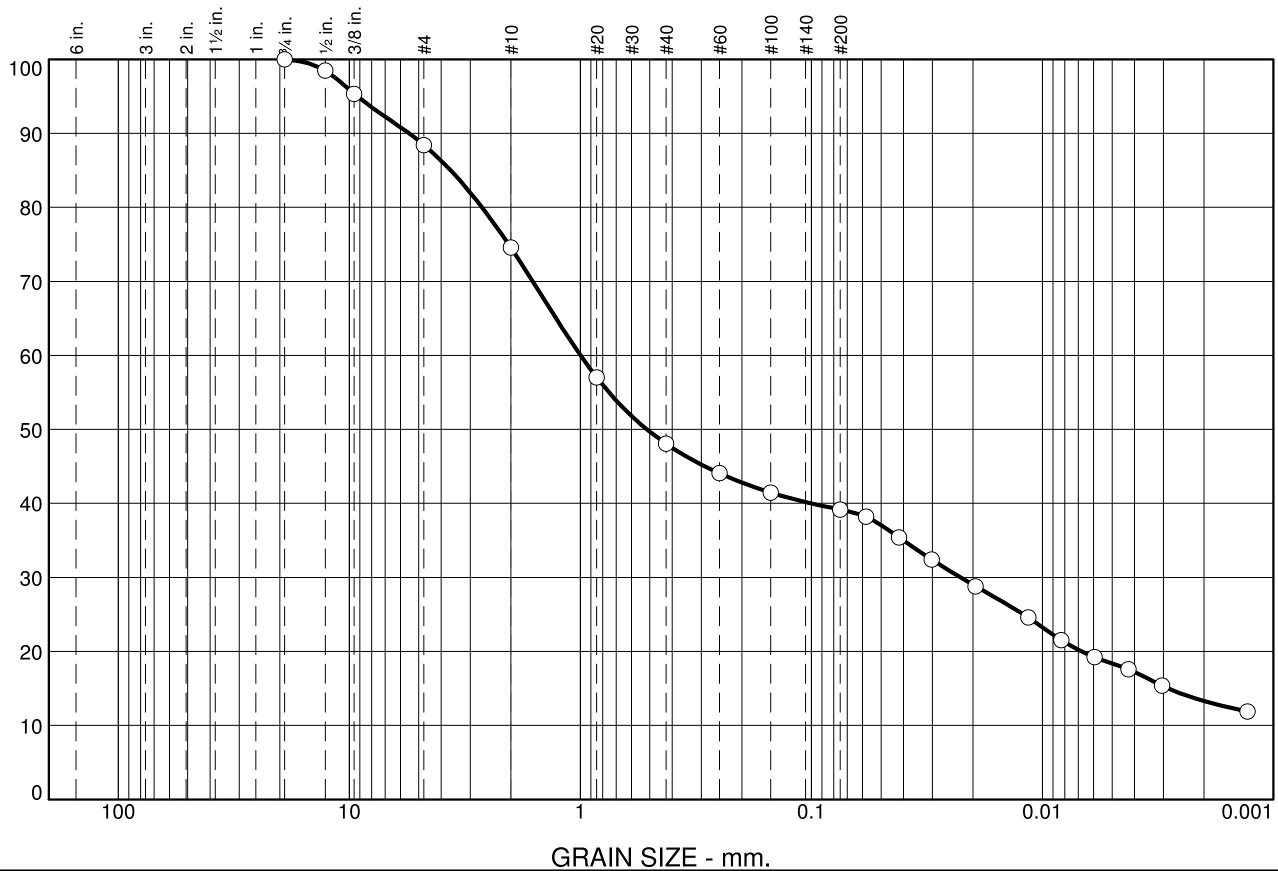
Date: 6/12/15

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.6	13.9	26.5	8.8	25.9	13.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.5		
0.375	95.3		
#4	88.4		
#10	74.5		
#20	57.0		
#40	48.0		
#60	44.1		
#100	41.4		
#200	39.2		
0.0581 mm.	38.2		
0.0418 mm.	35.4		
0.0301 mm.	32.4		
0.0195 mm.	28.8		
0.0115 mm.	24.6		
0.0083 mm.	21.5		
0.0059 mm.	19.2		
0.0042 mm.	17.6		
0.0030 mm.	15.4		
0.0013 mm.	11.9		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 18 LL= 33 PI= 15

Coefficients

D_{90}= 5.5246 D_{85}= 3.6480 D_{60}= 0.9987
D_{50}= 0.5153 D_{30}= 0.0227 D_{15}= 0.0029
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Location: TP15-12
Depth: 0.4-0.6m

Date: 6/15/15

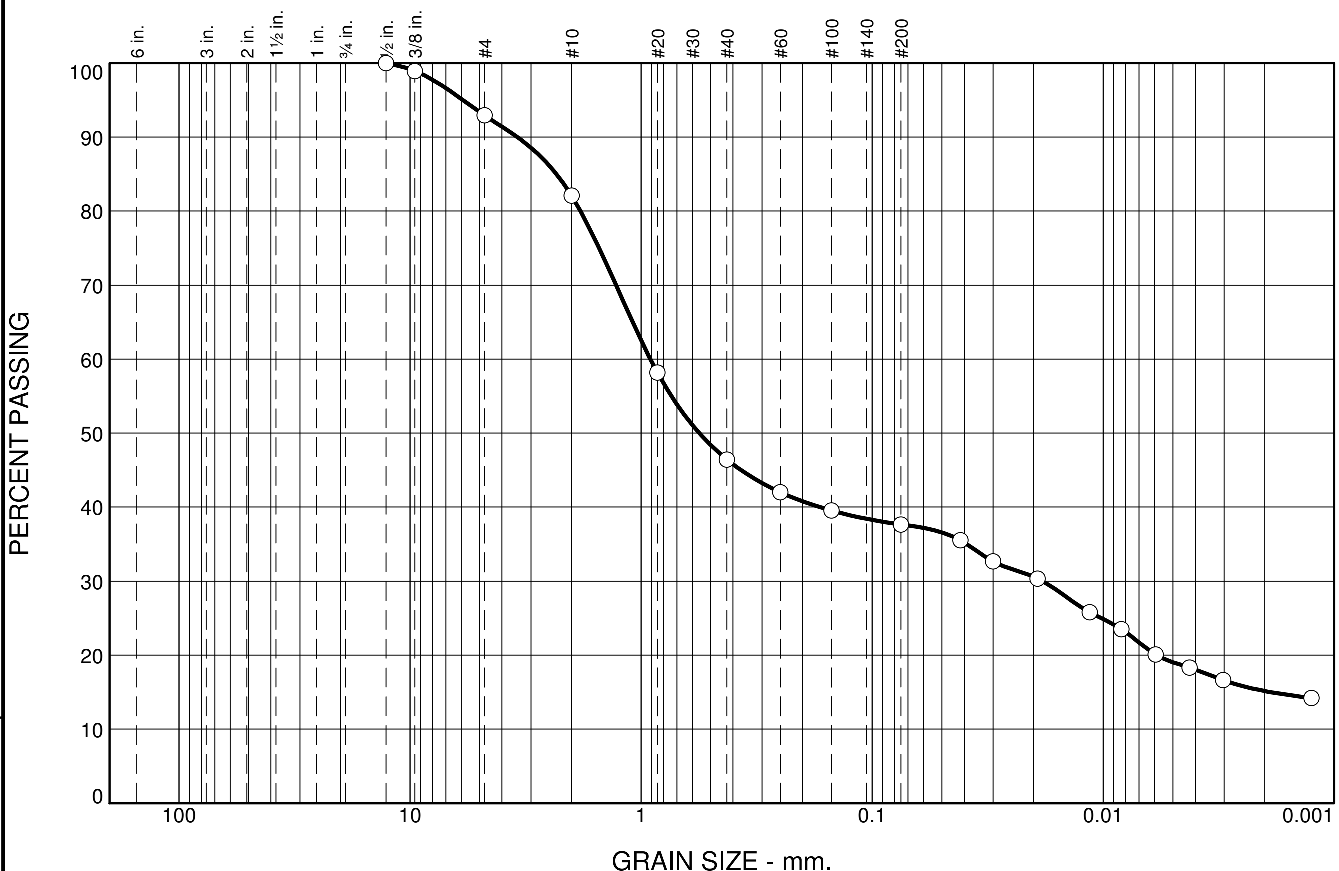
The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.1	10.8	35.7	8.7	22.5	15.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
0.375	98.9		
#4	92.9		
#10	82.1		
#20	58.2		
#40	46.4		
#60	42.0		
#100	39.5		
#200	37.7		
0.0416 mm.	35.5		
0.0300 mm.	32.7		
0.0193 mm.	30.4		
0.0114 mm.	25.8		
0.0083 mm.	23.5		
0.0059 mm.	20.1		
0.0042 mm.	18.3		
0.0030 mm.	16.6		
0.0013 mm.	14.2		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 19 LL= 35 PI= 16

Coefficients

D_{90}= 3.4363 D_{85}= 2.3269 D_{60}= 0.9118
D_{50}= 0.5603 D_{30}= 0.0183 D_{15}= 0.0019
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Location: TP15-13
Depth: 0.4-0.5m

Date: 6/12/15

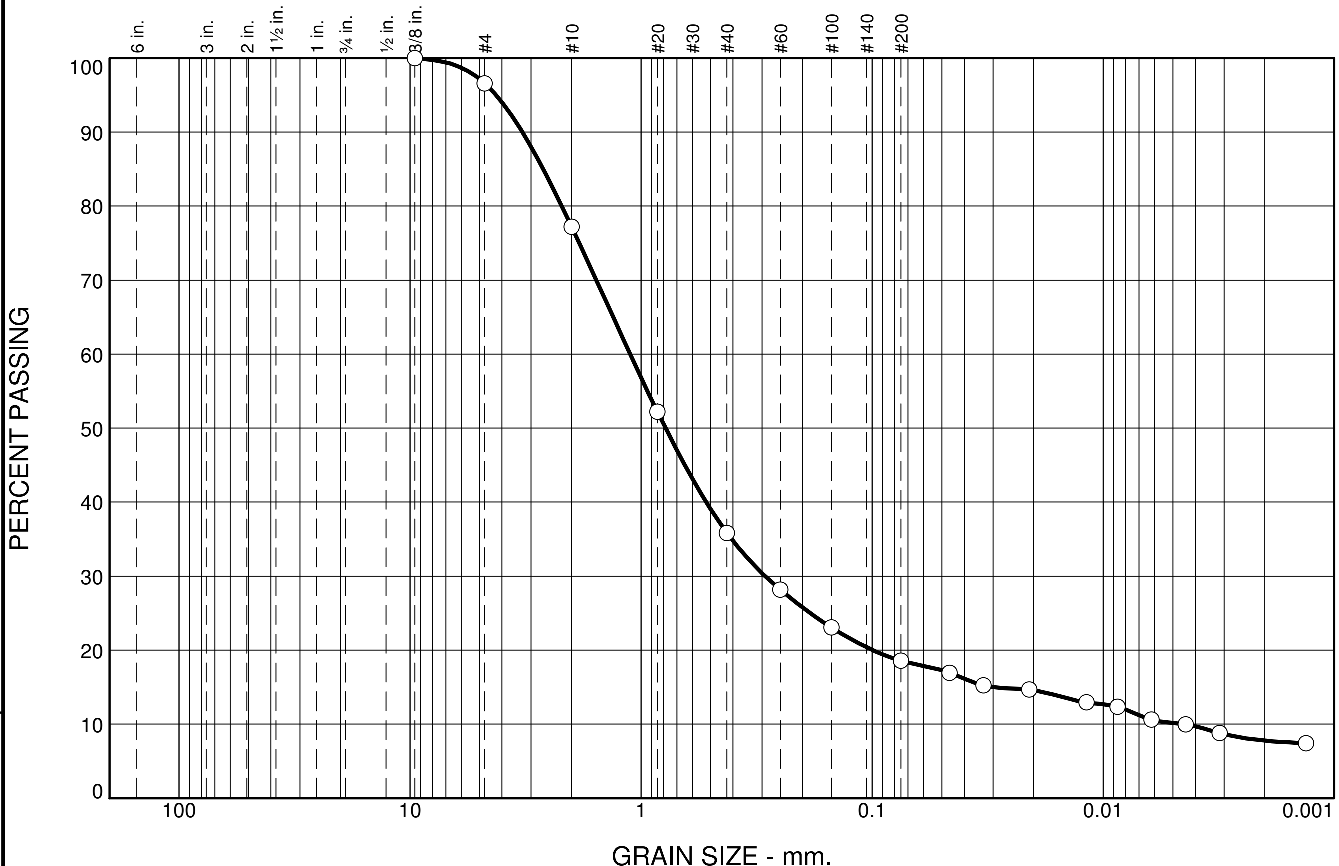
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.4	19.4	41.4	17.2	10.8	7.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	96.6		
#10	77.2		
#20	52.2		
#40	35.8		
#60	28.2		
#100	23.1		
#200	18.6		
0.0462 mm.	16.9		
0.0330 mm.	15.2		
0.0209 mm.	14.7		
0.0118 mm.	12.9		
0.0087 mm.	12.3		
0.0062 mm.	10.6		
0.0044 mm.	10.0		
0.0031 mm.	8.8		
0.0013 mm.	7.4		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 21 LL= 29 PI= 8

Coefficients

D_{90}= 3.2687 D_{85}= 2.6561 D_{60}= 1.1162
D_{50}= 0.7842 D_{30}= 0.2903 D_{15}= 0.0299
D_{10}= 0.0044 C_u= 250.84 C_c= 16.97

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Location: TP15-15
Depth: 0.74-1.0m

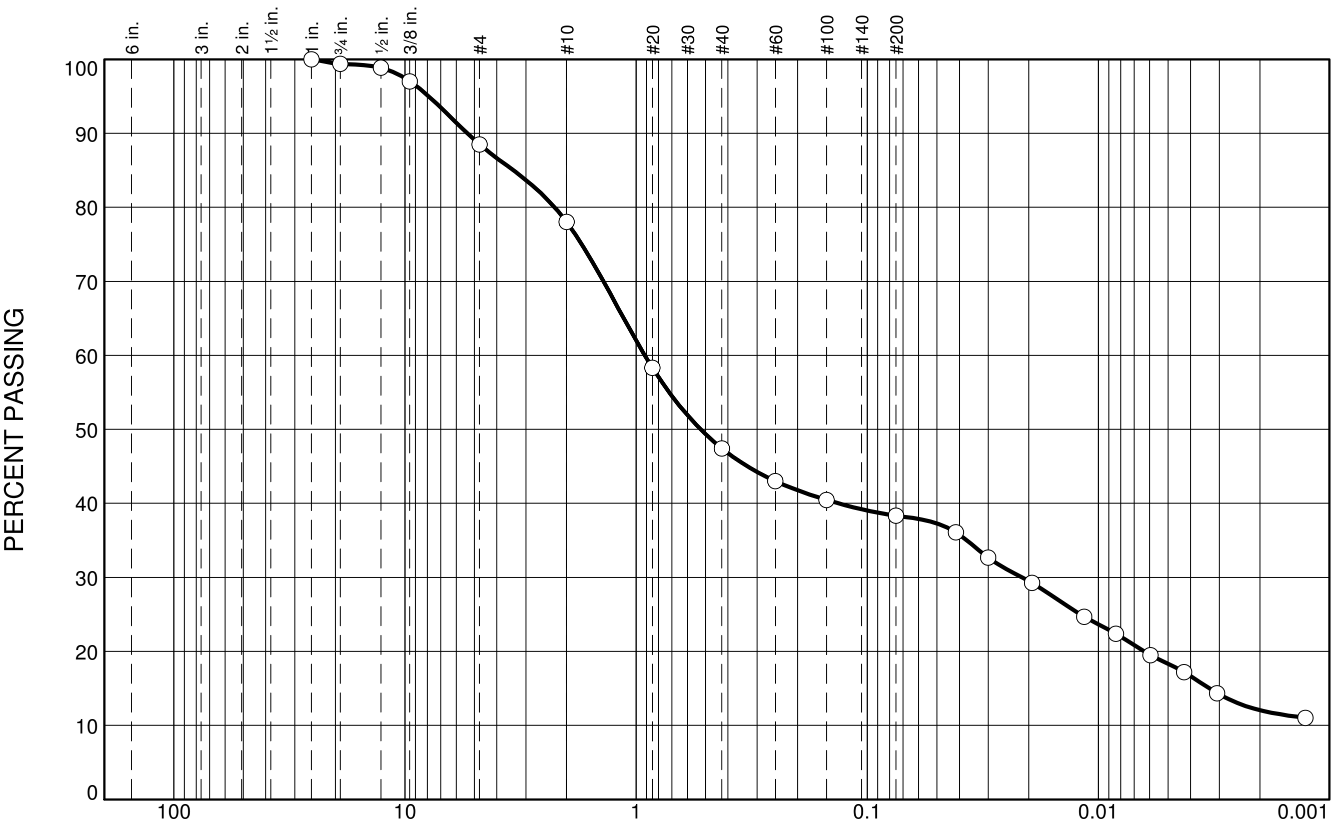
Date: 6/15/15

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.6	10.9	10.5	30.6	9.1	26.2	12.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	99.4		
.5	98.8		
0.375	97.0		
#4	88.5		
#10	78.0		
#20	58.3		
#40	47.4		
#60	43.0		
#100	40.5		
#200	38.3		
0.0414 mm.	36.1		
0.0300 mm.	32.7		
0.0194 mm.	29.2		
0.0115 mm.	24.7		
0.0084 mm.	22.4		
0.0059 mm.	19.5		
0.0043 mm.	17.2		
0.0031 mm.	14.4		
0.0013 mm.	11.0		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 18 LL= 29 PI= 11

Coefficients

D_{90}= 5.3686 D_{85}= 3.4043 D_{60}= 0.9177
D_{50}= 0.5255 D_{30}= 0.0214 D_{15}= 0.0033
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(1)

Remarks

Location: TP15-24
Depth: 0.3-0.5m

Date: 6/12/15

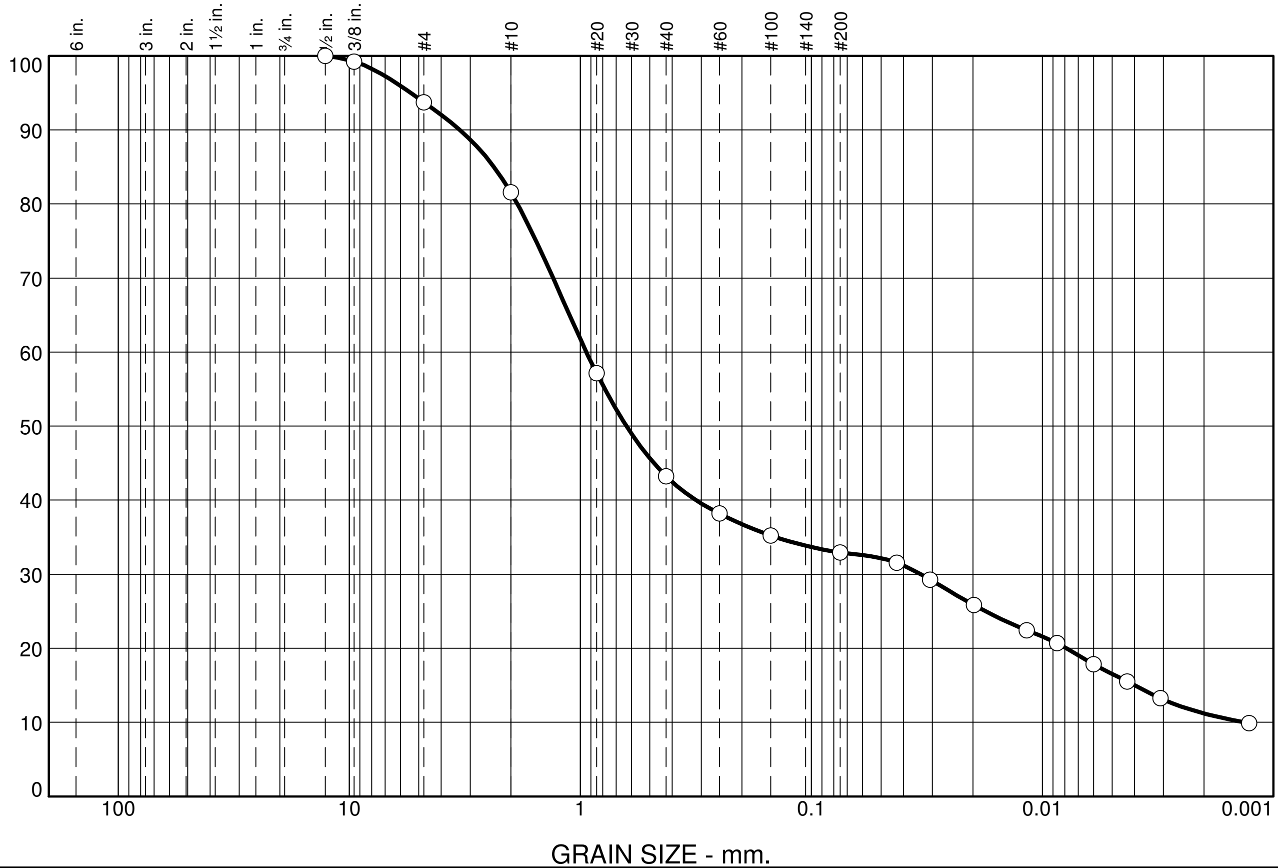
The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.3	12.2	38.3	10.3	21.7	11.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.5	100.0		
0.375	99.2		
#4	93.7		
#10	81.5		
#20	57.1		
#40	43.2		
#60	38.2		
#100	35.2		
#200	32.9		
0.0428 mm.	31.5		
0.0307 mm.	29.3		
0.0198 mm.	25.8		
0.0117 mm.	22.4		
0.0086 mm.	20.7		
0.0060 mm.	17.8		
0.0043 mm.	15.5		
0.0031 mm.	13.2		
0.0013 mm.	9.9		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 19 LL= 28 PI= 9

Coefficients

D_{90}= 3.3303 D_{85}= 2.3690 D_{60}= 0.9422
D_{50}= 0.6318 D_{30}= 0.0337 D_{15}= 0.0040
D_{10}= 0.0013 C_u= 704.70 C_c= 0.90

Classification

USCS= SC AASHTO= A-2-4(0)

Remarks

Location: TP15-25
Depth: 0.4-0.6m

Date: 6/12/15

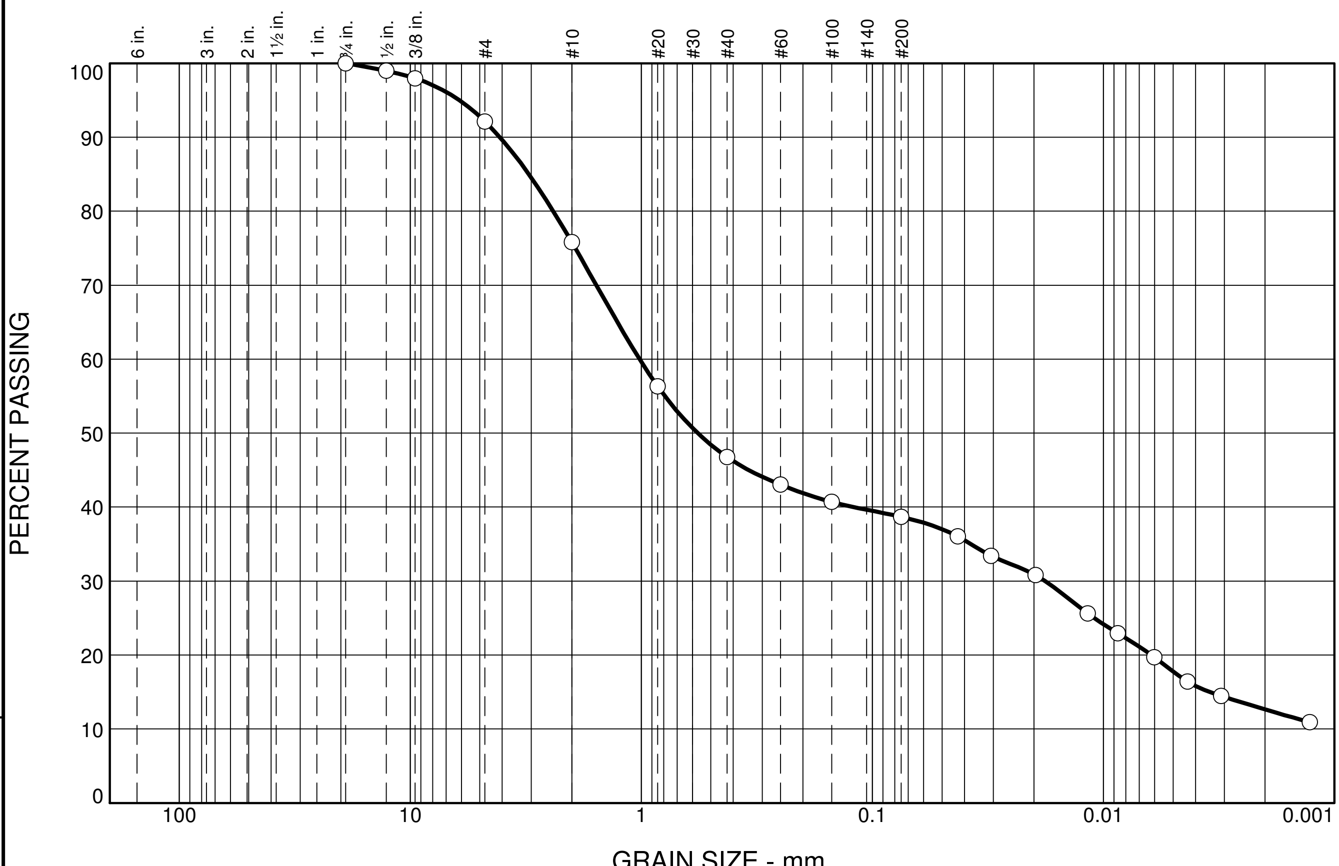
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.9	16.3	29.0	8.1	26.1	12.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	99.0		
0.375	98.0		
#4	92.1		
#10	75.8		
#20	56.3		
#40	46.8		
#60	43.0		
#100	40.7		
#200	38.7		
0.0428 mm.	36.0		
0.0307 mm.	33.4		
0.0197 mm.	30.8		
0.0117 mm.	25.6		
0.0087 mm.	23.0		
0.0060 mm.	19.7		
0.0043 mm.	16.4		
0.0031 mm.	14.5		
0.0013 mm.	10.9		

* (no specification provided)

Soil Description

clayey SAND

Atterberg Limits

PL= 25 LL= 40 PI= 15

Coefficients

D_{90}= 4.0964 D_{85}= 3.0743 D_{60}= 1.0187
D_{50}= 0.5701 D_{30}= 0.0179 D_{15}= 0.0035
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-6(2)

Remarks

Location: TP15-30
Depth: 0.2-0.3m

Date: 6/12/15

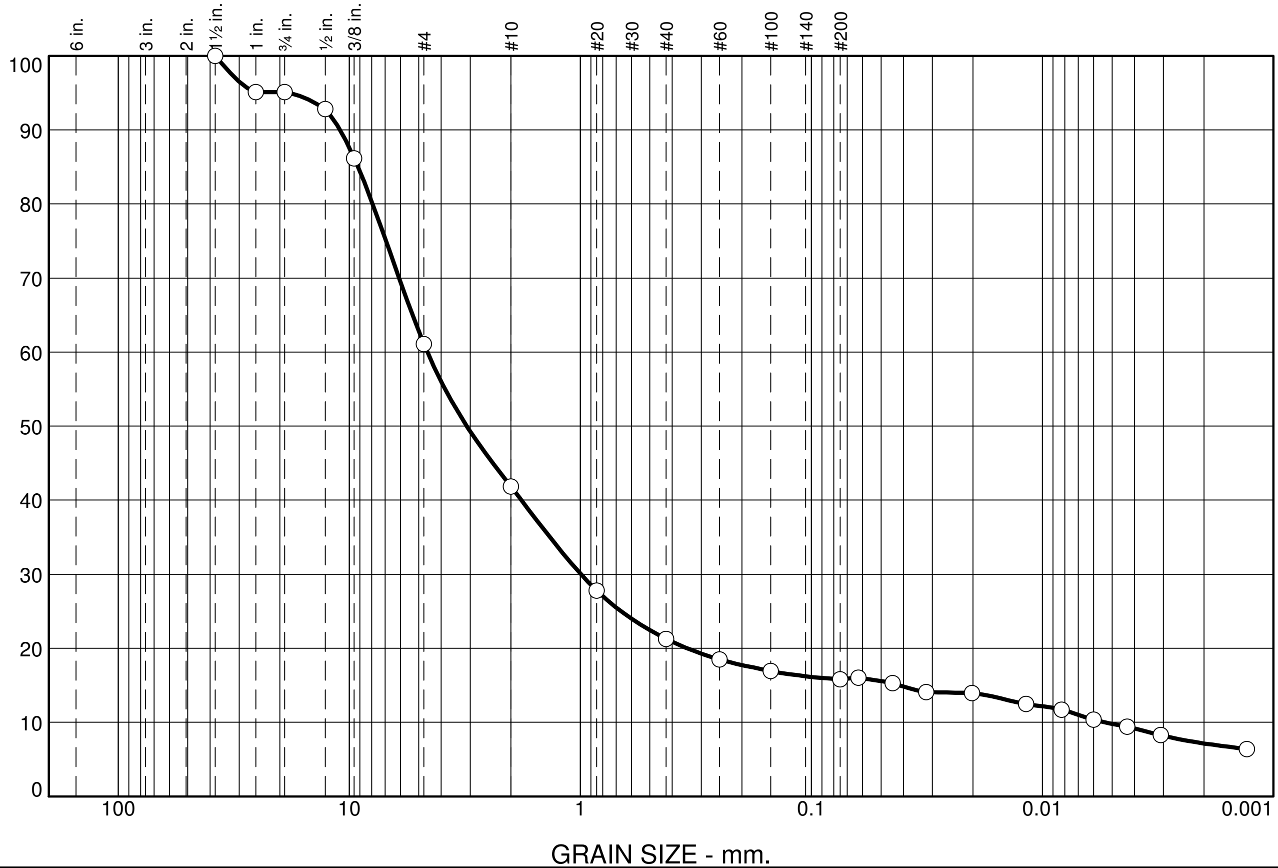
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.9	34.0	19.2	20.6	5.5	8.7	7.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	95.1		
.75	95.1		
.5	92.8		
0.375	86.1		
#4	61.1		
#10	41.9		
#20	27.8		
#40	21.3		
#60	18.5		
#100	16.9		
#200	15.8		
0.0625 mm.	16.0		
0.0445 mm.	15.3		
0.0318 mm.	14.1		
0.0202 mm.	14.0		
0.0118 mm.	12.5		
0.0083 mm.	11.7		
0.0060 mm.	10.4		
0.0043 mm.	9.4		
0.0031 mm.	8.3		
0.0013 mm.	6.4		

* (no specification provided)

Soil Description

clayey SAND with gravel

Atterberg Limits

PL= 19 LL= 34 PI= 15

Coefficients

D_{90}= 10.9882 D_{85}= 9.1790 D_{60}= 4.5918
D_{50}= 3.1039 D_{30}= 0.9945 D_{15}= 0.0415
D_{10}= 0.0054 C_u= 855.72 C_c= 40.14

Classification

USCS= SC AASHTO= A-2-6(0)

Remarks

Location: TP15-30
Depth: 0.3-0.6m

Date: 6/15/15

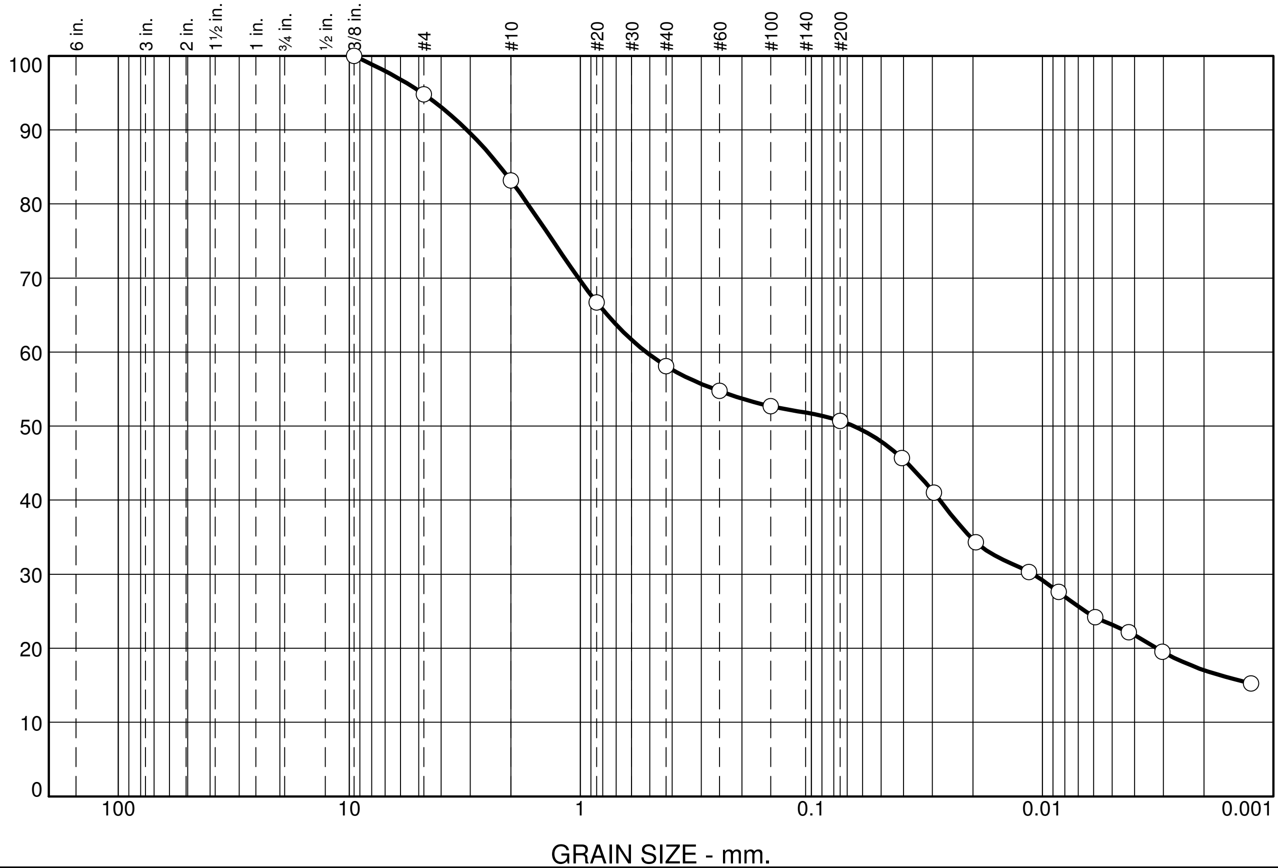
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.2	11.6	25.1	7.4	33.6	17.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	94.8		
#10	83.2		
#20	66.7		
#40	58.1		
#60	54.7		
#100	52.7		
#200	50.7		
0.0406 mm.	45.7		
0.0295 mm.	41.0		
0.0194 mm.	34.3		
0.0114 mm.	30.3		
0.0085 mm.	27.6		
0.0059 mm.	24.2		
0.0042 mm.	22.2		
0.0030 mm.	19.5		
0.0013 mm.	15.3		

* (no specification provided)

Soil Description

sandy lean CLAY

Atterberg Limits

PL= 20 LL= 32 PI= 12

Coefficients

D_{90}= 3.1048 D_{85}= 2.2231 D_{60}= 0.5195
D_{50}= 0.0656 D_{30}= 0.0110 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(3)

Remarks

Location: TP15-37
Depth: 0.2-0.5m

Date: 6/12/15

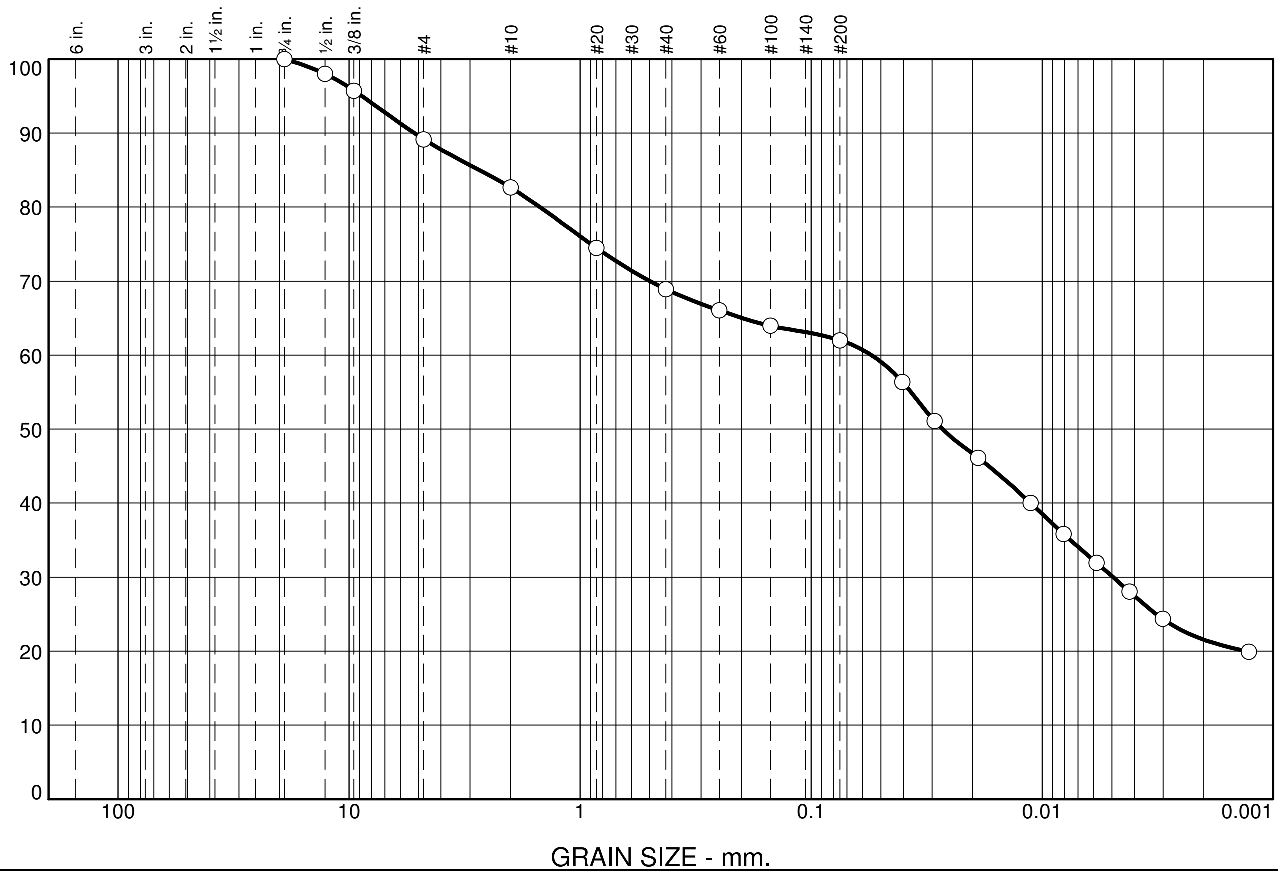
Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Tested By: JHK **Checked By:** JDB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.9	6.5	13.7	6.9	40.5	21.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	98.0		
0.375	95.7		
#4	89.1		
#10	82.6		
#20	74.5		
#40	68.9		
#60	66.0		
#100	64.0		
#200	62.0		
0.0403 mm.	56.4		
0.0292 mm.	51.1		
0.0189 mm.	46.1		
0.0112 mm.	40.0		
0.0081 mm.	35.8		
0.0058 mm.	31.9		
0.0042 mm.	28.0		
0.0030 mm.	24.4		
0.0013 mm.	19.9		

* (no specification provided)

Soil Description

sandy lean CLAY

Atterberg Limits

PL= 23 LL= 45 PI= 22

Coefficients

D_{90}= 5.2331 D_{85}= 2.7297 D_{60}= 0.0548
D_{50}= 0.0271 D_{30}= 0.0049 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(12)

Remarks

Location: TP15-40
Depth: 0.1-0.2m

Date: 6/15/15

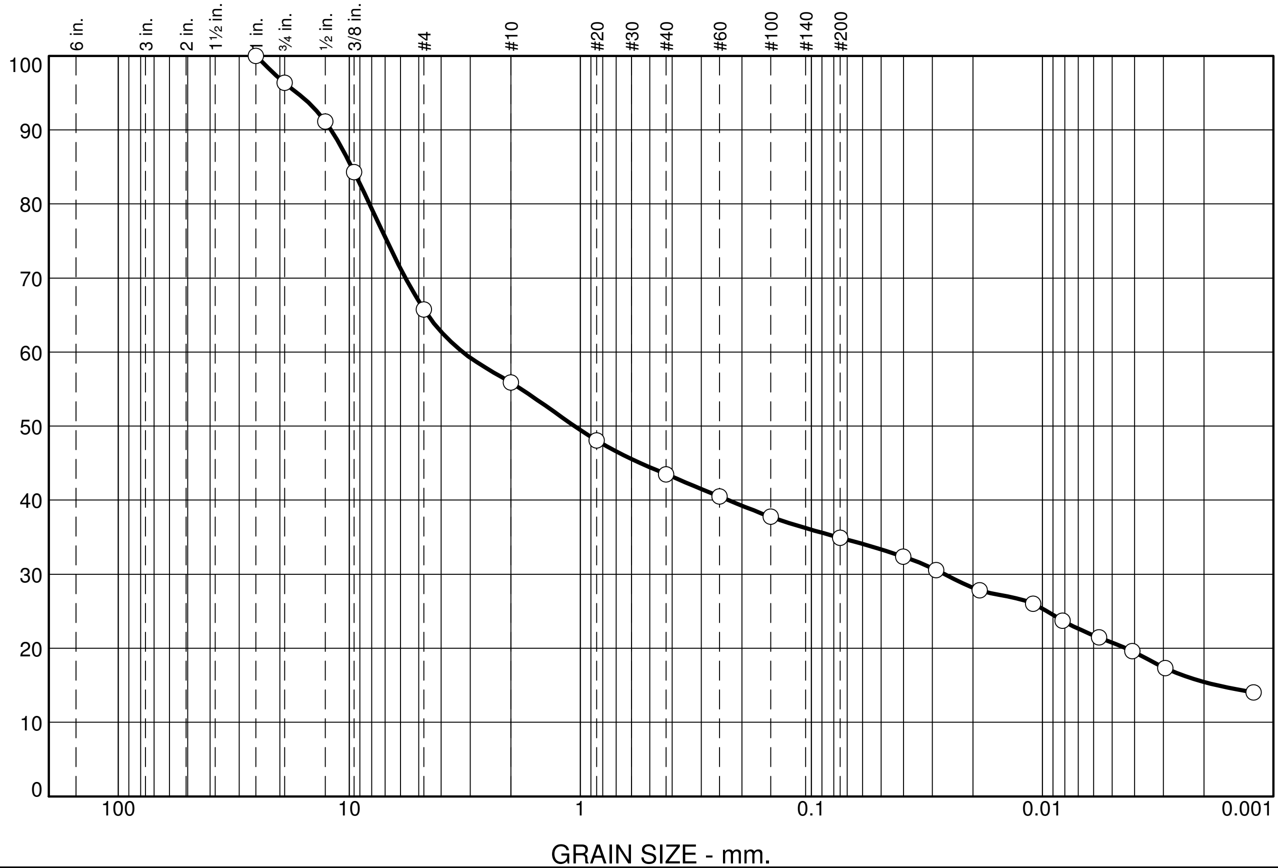
The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: STT **Checked By:** JDB

Particle Size Distribution Report



The USCS classification pertains only to the portion of sample that passes the 3" sieve as per ASTM D2487.

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.7	30.6	9.8	12.4	8.6	19.5	15.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
.75	96.3		
.5	91.1		
0.375	84.3		
#4	65.7		
#10	55.9		
#20	48.1		
#40	43.5		
#60	40.5		
#100	37.8		
#200	34.9		
0.0401 mm.	32.4		
0.0288 mm.	30.6		
0.0187 mm.	27.8		
0.0110 mm.	26.0		
0.0082 mm.	23.7		
0.0057 mm.	21.5		
0.0041 mm.	19.6		
0.0029 mm.	17.3		
0.0012 mm.	14.0		

* (no specification provided)

Soil Description

clayey GRAVEL with sand

Atterberg Limits

PL= 21 LL= 39 PI= 18

Coefficients

D_{90}= 11.9986 D_{85}= 9.7835 D_{60}= 3.2298
D_{50}= 1.0600 D_{30}= 0.0265 D_{15}= 0.0018
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-6(2)

Remarks

Location: TP15-42
Depth: 0.45-0.65m

Date: 6/12/15

Knight Piésold CONSULTING

Client:
Project: Black Butte Copper Project
Project No: VA101-00460/03 **Figure**

Tested By: JHK **Checked By:** JDB

Knight Piésold CONSULTING

Moisture Content
ASTM D 2216

Project	Black Butte Copper	Project No.	VA101-00460/03
Lab No.	L2015-032	Date of Test	3/30-4/8/15
Tested By	JHK	Checked By	JDB

Drying Conditions: 105 deg C Method: Oven

Sample No.		SPT # 01	SPT # 02	SPT # 03	SPT # 04	Shelby # 1
Sample ID		SC15-181	SC15-181	SC15-181	SC15-181	SC15-181
Depth (ft)		5-7'	10-12'	15-17'	20-20.25'	17.5-18'
Tare No.		L28	L35	L12	L18	C53
Tare + Wet Soil	A	219.5	223.3	216.4	155.1	536.1
Tare + Dry Soil	B	202.8	206.5	201.8	149.6	457.5
Tare	C	119.3	119.7	115.3	121.1	118.7
Wt. of Water	D , A-B	16.7	16.8	14.6	5.5	78.6
Dry Soil, Ws	E , B-C	83.5	86.8	86.5	28.5	338.8
Moisture Content, (%)	(D / E) x100	20.0	19.4	16.9	19.3	23.2

Sample No.		SPT # 01	SPT # 02	Weathered Rock	SPT # 02	SPT # 01
Sample ID		SC15-184	SC15-184	SC15-191	SC15-192	SC15-192
Depth (m)		5-7'	10-12'	13.3-14'	10-12'	5-7'
Tare No.		L20	L37	P59	C51	C52
Tare + Wet Soil	A	230.4	223.7	374.8	350.6	242.2
Tare + Dry Soil	B	209.9	202.7	346.4	310.0	220.7
Tare	C	120.7	119.8	146.9	118.0	117.9
Wt. of Water	A-B, D	20.5	21.0	28.4	40.6	21.5
Dry Soil, Ws	B-C, E	89.2	82.9	199.5	192.0	102.8
Moisture Content, (%)	(D / E) x100	23.0	25.3	14.2	21.1	20.9

Sample No.		SPT # 03	SPT # 01	SPT # 02	SPT # 01	SPT # 02
Sample ID		SC15-192	SC15-193	SC15-193	SC15-196	SC15-196
Depth (m)		15-17'	5-7'	10-12'	3-5'	8-10'
Tare No.		P76	L36	C78	C60	DB
Tare + Wet Soil	A	332.2	229.9	324.0	294.4	343.4
Tare + Dry Soil	B	313.8	212.7	282.7	262.3	311.8
Tare	C	148.5	120.8	117.8	131.4	151.8
Wt. of Water	A-B, D	18.4	17.2	41.3	32.1	31.6
Dry Soil, Ws	B-C, E	165.3	91.9	164.9	130.9	160.0
Moisture Content, (%)	(D / E) x100	11.1	18.7	25.0	24.5	19.8

Knight Piésold CONSULTING

Moisture Content
ASTM D 2216

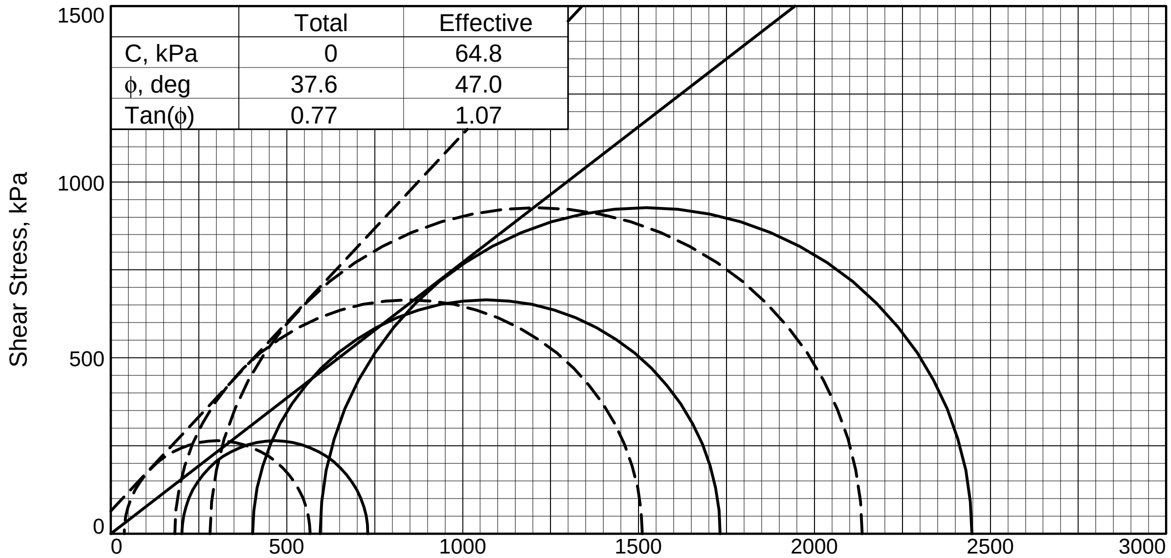
Project	Black Butte Copper	Project No.	VA101-00460/03
Lab No.	L2015-032	Date of Test	3/30-4/8/15
Tested By	JHK	Checked By	JDB

Drying Conditions: 105 deg C   Method: Oven

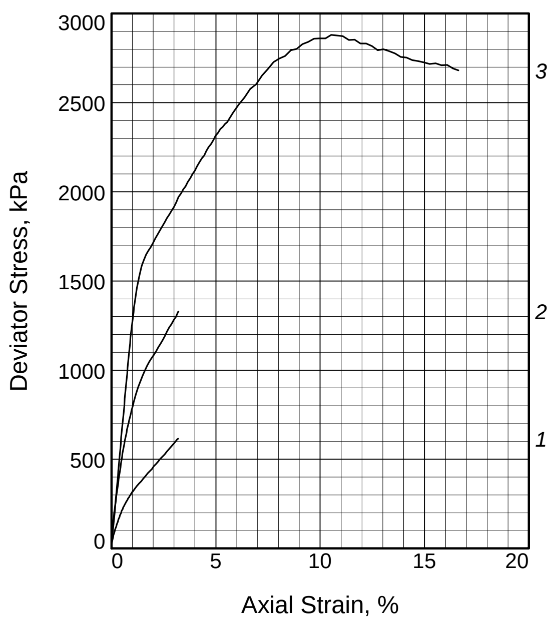
Sample No.		Grab Sump				
Sample ID		SC15-198				
Depth (ft)		4'				
Tare No.		P67				
Tare + Wet Soil	A	410.8				
Tare + Dry Soil	B	378.4				
Tare	C	148.9				
Wt. of Water	D , A-B	32.4				
Dry Soil, Ws	E , B-C	229.5				
Moisture Content, (%)	(D / E) x100	14.1				

Sample No.						
Sample ID						
Depth (m)						
Tare No.						
Tare + Wet Soil	A					
Tare + Dry Soil	B					
Tare	C					
Wt. of Water	A-B, D					
Dry Soil, Ws	B-C, E					
Moisture Content, (%)	(D / E) x100					

Sample No.						
Sample ID						
Depth (m)						
Tare No.						
Tare + Wet Soil	A					
Tare + Dry Soil	B					
Tare	C					
Wt. of Water	A-B, D					
Dry Soil, Ws	B-C, E					
Moisture Content, (%)	(D / E) x100					



	Total	Effective
C, kPa	0	64.8
ϕ, deg	37.6	47.0
Tan(ϕ)	0.77	1.07



Specimen No.		1	2	3
Initial	Water Content, %	16.1	16.1	16.1
	Dry Density, pcf	118.8	118.8	118.8
	Saturation, %	103.6	103.6	103.6
	Void Ratio	0.4186	0.4186	0.4186
	Diameter, in.	2.81	2.81	2.81
	Height, in.	5.40	5.40	5.40
At Test	Water Content, %	13.0	10.9	9.9
	Dry Density, pcf	124.9	130.3	133.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.3500	0.2940	0.2664
	Diameter, in.	2.77	2.77	2.80
	Height, in.	5.31	5.07	4.87
Strain rate, %/min.		0.03	0.03	0.03
Eff. Cell Pressure, kPa		202	403	595
Fail. Stress, kPa		529	1329	1853
Excess Pore Pr., kPa		164	221	313
Strain, %		2.5	3.2	2.7
Ult. Stress, kPa				
Excess Pore Pr., kPa				
Strain, %				
$\overline{\sigma}_1$ Failure, kPa		566	1511	2135
$\overline{\sigma}_3$ Failure, kPa		38	182	282

Type of Test:
CU with Pore Pressures

Sample Type: Trimmed from Shelby tube

Description:

Assumed Specific Gravity= 2.7

Remarks: Failure tangents drawn at peak principle stress ratio. Single specimen multistage test.

Figure _______

Client:

Project: Black Butte Copper Project

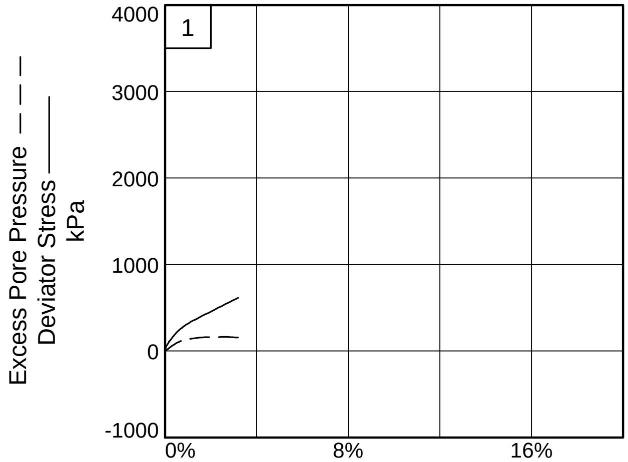
Location: SC15-184

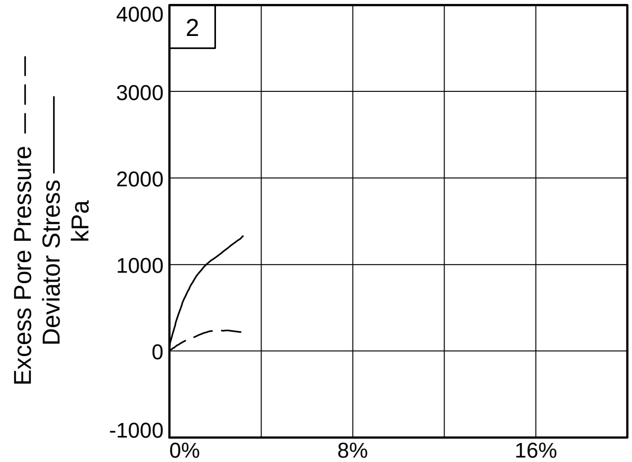
Sample Number: SHELBY01 **Depth:** 12'-13'

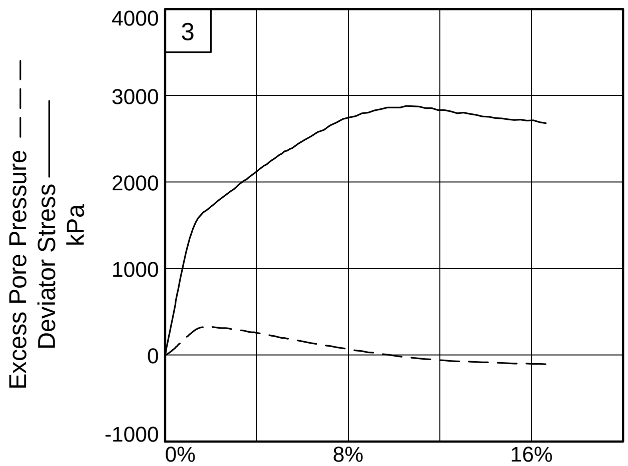
Proj. No.: VA101-00460/03 **Date Sampled:** 4/8/15

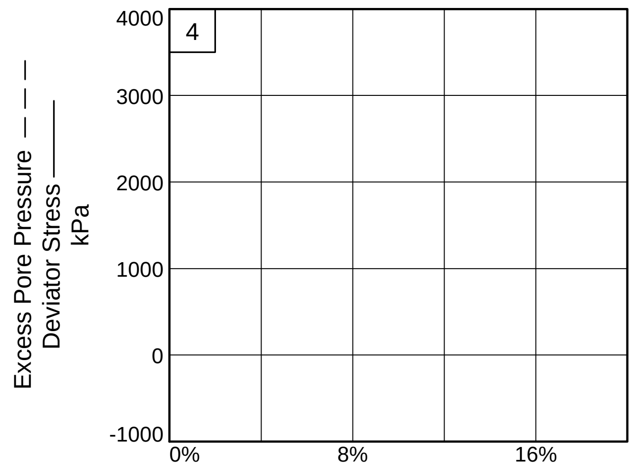
Knight Piésold CONSULTING

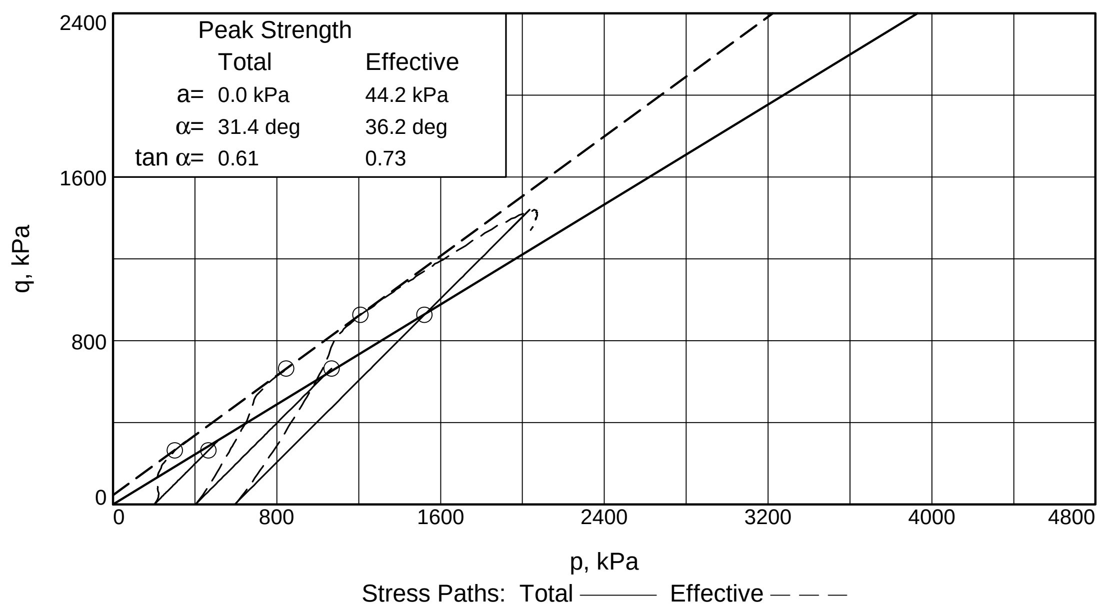
Tested By: JHK **Checked By:** JDB











Client:

Project: Black Butte Copper Project

Location: SC15-184 **Depth:** 12'-13' **Sample Number:** SHELBY01

Project No.: VA101-00460/03 **Figure** _______

Knight Piesold Geotechnical Lab.

Tested By: JHK **Checked By:** JDB

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

4/17/2015
11:55 AM

Date: 4/8/15
Client:
Project: Black Butte Copper Project
Project No.: VA101-00460/03
Location: SC15-184
Depth: 12'-13' **Sample Number:** SHELBY01
Description:
Remarks: Failure tangents drawn at peak principle stress ratio. Single specimen multistage test.
Type of Sample: Trimmed from Shelby tube
Assumed Specific Gravity=2.7 **LL=** **PL=** **PI=**
Test Method: COE uniform strain (staged method triaxial test)

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1214.000			1328.200
Moisture content: Dry soil+tare, gms.	1046.000			1163.800
Moisture content: Tare, gms.	0.000			117.770
Moisture, %	16.1	15.5	13.0	15.7
Moist specimen weight, gms.	1214.0			
Diameter, in.	2.81	2.81	2.77	
Area, in.²	6.21	6.21	6.01	
Height, in.	5.40	5.40	5.31	
Net decrease in height, in.		0.00	0.09	
Wet density, pcf	137.9	137.2	141.0	
Dry density, pcf	118.8	118.8	124.9	
Void ratio	0.4186	0.4186	0.3500	
Saturation, %	103.6	100.0	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.064 cm
Consolidation cell pressure = 59.43 psi (409.8 kPa)
Consolidation back pressure = 30.14 psi (207.8 kPa)
Consolidation effective confining stress = 201.9 kPa
Strain rate, %/min. = 0.03
Fail. Stress = 528.5 kPa **at reading no.** 55

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
0	0.0091	1.942	0.0	0.0	0.0	202.0	202.0	1.00	30.14	202.0	0.0
1	0.0105	32.652	30.7	0.0	35.2	196.6	231.8	1.18	30.92	214.2	17.6
2	0.0118	45.129	43.2	0.1	49.5	192.4	241.9	1.26	31.53	217.1	24.8
3	0.0132	56.977	55.0	0.1	63.1	188.2	251.3	1.34	32.13	219.8	31.6
4	0.0146	67.549	65.6	0.1	75.2	183.7	258.9	1.41	32.78	221.3	37.6
5	0.0159	76.403	74.5	0.1	85.3	178.9	264.2	1.48	33.49	221.5	42.7
6	0.0173	86.803	84.9	0.2	97.2	174.1	271.3	1.56	34.18	222.7	48.6
7	0.0186	95.238	93.3	0.2	106.9	169.3	276.2	1.63	34.87	222.8	53.4
8	0.0200	103.125	101.2	0.2	115.9	164.0	279.8	1.71	35.65	221.9	57.9
9	0.0213	110.533	108.6	0.2	124.3	157.3	281.6	1.79	36.62	219.4	62.2
10	0.0227	117.745	115.8	0.3	132.6	151.6	284.2	1.87	37.44	217.9	66.3
11	0.0240	126.521	124.6	0.3	142.6	146.7	289.3	1.97	38.15	218.0	71.3
12	0.0254	133.881	131.9	0.3	150.9	142.1	293.0	2.06	38.83	217.5	75.5
13	0.0268	142.209	140.3	0.3	160.4	137.6	298.1	2.17	39.47	217.9	80.2
14	0.0281	149.712	147.8	0.4	169.0	133.5	302.5	2.27	40.06	218.0	84.5
15	0.0295	156.154	154.2	0.4	176.3	129.6	305.9	2.36	40.63	217.7	88.1
16	0.0308	163.525	161.6	0.4	184.7	125.4	310.1	2.47	41.24	217.7	92.3
17	0.0322	169.963	168.0	0.4	192.0	121.1	313.0	2.59	41.87	217.0	96.0
18	0.0335	176.950	175.0	0.5	199.9	117.2	317.1	2.71	42.43	217.2	100.0
19	0.0349	183.839	181.9	0.5	207.7	113.5	321.2	2.83	42.97	217.3	103.9
20	0.0362	190.321	188.4	0.5	215.1	109.6	324.7	2.96	43.54	217.1	107.5
21	0.0376	195.677	193.7	0.5	221.1	106.1	327.2	3.08	44.04	216.7	110.6
22	0.0390	202.134	200.2	0.6	228.4	103.0	331.4	3.22	44.50	217.2	114.2
23	0.0403	207.811	205.9	0.6	234.9	99.9	334.8	3.35	44.94	217.4	117.4
24	0.0417	212.952	211.0	0.6	240.7	96.8	337.5	3.49	45.39	217.1	120.3
25	0.0430	217.470	215.5	0.6	245.8	93.7	339.4	3.62	45.85	216.5	122.9
26	0.0444	222.538	220.6	0.7	251.5	90.8	342.3	3.77	46.26	216.5	125.7
27	0.0457	228.619	226.7	0.7	258.3	88.2	346.5	3.93	46.64	217.4	129.2
28	0.0471	232.897	231.0	0.7	263.1	85.5	348.7	4.08	47.02	217.1	131.6
29	0.0484	237.158	235.2	0.7	267.9	82.9	350.8	4.23	47.41	216.9	134.0
30	0.0498	242.383	240.4	0.8	273.8	80.8	354.6	4.39	47.71	217.7	136.9
31	0.0512	246.940	245.0	0.8	278.9	78.6	357.5	4.55	48.03	218.1	139.5
32	0.0525	251.460	249.5	0.8	284.0	76.6	360.6	4.71	48.32	218.6	142.0
33	0.0539	255.282	253.3	0.8	288.3	74.8	363.1	4.85	48.58	218.9	144.1
34	0.0552	259.330	257.4	0.9	292.8	73.0	365.8	5.01	48.84	219.4	146.4
35	0.0566	264.452	262.5	0.9	298.6	71.6	370.1	5.17	49.05	220.8	149.3
36	0.0579	268.091	266.1	0.9	302.6	69.9	372.5	5.33	49.30	221.2	151.3
37	0.0593	271.786	269.8	0.9	306.7	68.6	375.3	5.47	49.49	221.9	153.4
38	0.0606	275.660	273.7	1.0	311.1	67.2	378.3	5.63	49.68	222.8	155.5
39	0.0620	279.952	278.0	1.0	315.9	66.1	381.9	5.78	49.85	224.0	157.9
40	0.0633	282.320	280.4	1.0	318.5	64.8	383.3	5.91	50.03	224.1	159.2
41	0.0688	298.203	296.3	1.1	336.2	61.2	397.4	6.49	50.55	229.3	168.1
42	0.0742	311.660	309.7	1.2	351.1	58.0	409.0	7.06	51.02	233.5	175.5
43	0.0796	324.063	322.1	1.3	364.8	52.9	417.7	7.89	51.76	235.3	182.4
44	0.0850	335.239	333.3	1.4	377.0	49.0	426.0	8.69	52.32	237.5	188.5
45	0.0904	348.005	346.1	1.5	391.1	47.2	438.2	9.29	52.59	242.7	195.5
46	0.0958	362.030	360.1	1.6	406.5	45.4	451.9	9.95	52.84	248.7	203.2

Knight Piesold Geotechnical Lab.

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
47	0.1012	375.489	373.5	1.7	421.3	43.9	465.1	10.60	53.07	254.5	210.6
48	0.1066	386.497	384.6	1.8	433.2	42.7	475.9	11.16	53.24	259.3	216.6
49	0.1120	398.328	396.4	1.9	446.1	41.8	487.8	11.68	53.37	264.8	223.0
50	0.1174	411.761	409.8	2.0	460.7	41.3	502.0	12.16	53.44	271.6	230.4
51	0.1228	423.605	421.7	2.1	473.5	41.3	514.9	12.46	53.44	278.1	236.8
52	0.1282	436.652	434.7	2.2	487.7	41.1	528.8	12.86	53.46	285.0	243.8
53	0.1336	451.003	449.1	2.3	503.3	41.1	544.3	13.26	53.48	292.7	251.6
54	0.1390	462.036	460.1	2.4	515.1	39.2	554.3	14.13	53.74	296.8	257.5
55	0.1444	474.517	472.6	2.5	528.5	37.7	566.2	15.02	53.96	302.0	264.3
56	0.1498	487.360	485.4	2.6	542.3	39.2	581.5	14.84	53.75	310.3	271.2
57	0.1552	499.998	498.1	2.8	555.8	40.2	596.1	14.81	53.59	318.2	277.9
58	0.1606	514.670	512.7	2.9	571.6	41.6	613.3	14.73	53.39	327.4	285.8
59	0.1660	526.173	524.2	3.0	583.8	43.1	627.0	14.54	53.18	335.0	291.9
60	0.1714	538.964	537.0	3.1	597.5	44.9	642.4	14.31	52.92	343.6	298.7
61	0.1768	552.491	550.5	3.2	611.9	46.7	658.6	14.10	52.66	352.6	305.9
62	0.1786	556.090	554.1	3.2	615.6	47.3	663.0	14.01	52.57	355.1	307.8

Knight Piesold Geotechnical Lab.

Parameters for Specimen No. 2

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1214.000			1328.200
Moisture content: Dry soil+tare, gms.	1046.000			1163.800
Moisture content: Tare, gms.	0.000			117.770
Moisture, %	16.1		10.9	15.7
Moist specimen weight, gms.	1214.0			
Diameter, in.	2.81		2.77	
Area, in.²	6.21		6.03	
Height, in.	5.40		5.07	
Net decrease in height, in.		0.26	0.07	
Wet density, pcf	137.9		144.4	
Dry density, pcf	118.8		130.3	
Void ratio	0.4186		0.2940	
Saturation, %	103.6		100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.064 cm
Consolidation cell pressure = 88.47 psi (610.0 kPa)
Consolidation back pressure = 30.03 psi (207.0 kPa)
Consolidation effective confining stress = 402.9 kPa
Strain rate, %/min. = 0.03
Fail. Stress = 1328.9 kPa **at reading no.** 61

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
0	0.0198	1.903	0.0	0.0	0.0	402.9	402.9	1.00	30.03	402.9	0.0
1	0.0212	82.059	80.2	0.0	91.6	392.4	484.0	1.23	31.55	438.2	45.8
2	0.0226	104.979	103.1	0.1	117.8	387.6	505.4	1.30	32.25	446.5	58.9
3	0.0239	128.794	126.9	0.1	144.9	383.4	528.3	1.38	32.87	455.8	72.5
4	0.0253	152.227	150.3	0.1	171.6	378.9	550.5	1.45	33.52	464.7	85.8
5	0.0266	176.116	174.2	0.1	198.9	374.1	573.0	1.53	34.21	473.5	99.4
6	0.0280	197.579	195.7	0.2	223.3	369.5	592.8	1.60	34.87	481.2	111.6
7	0.0293	220.053	218.2	0.2	248.9	364.9	613.7	1.68	35.55	489.3	124.4
8	0.0307	240.862	239.0	0.2	272.5	360.0	632.6	1.76	36.25	496.3	136.3
9	0.0320	261.622	259.7	0.2	296.1	355.1	651.2	1.83	36.97	503.2	148.1
10	0.0334	281.430	279.5	0.3	318.6	350.4	669.0	1.91	37.66	509.7	159.3
11	0.0348	303.307	301.4	0.3	343.5	345.7	689.2	1.99	38.33	517.5	171.7
12	0.0361	322.802	320.9	0.3	365.6	340.9	706.5	2.07	39.02	523.7	182.8
13	0.0375	342.807	340.9	0.3	388.3	336.2	724.5	2.16	39.71	530.3	194.1
14	0.0388	361.466	359.6	0.4	409.4	331.5	741.0	2.24	40.39	536.2	204.7
15	0.0402	380.878	379.0	0.4	431.4	327.2	758.6	2.32	41.01	542.9	215.7
16	0.0415	399.028	397.1	0.4	452.0	322.8	774.7	2.40	41.66	548.8	226.0
17	0.0429	417.502	415.6	0.5	472.9	318.3	791.2	2.49	42.30	554.7	236.4
18	0.0442	435.206	433.3	0.5	492.9	314.2	807.1	2.57	42.89	560.7	246.4
19	0.0456	452.945	451.0	0.5	512.9	310.2	823.1	2.65	43.49	566.6	256.5
20	0.0469	470.260	468.4	0.5	532.5	305.8	838.2	2.74	44.12	572.0	266.2
21	0.0483	486.388	484.5	0.6	550.7	301.9	852.6	2.82	44.68	577.2	275.3
22	0.0496	502.486	500.6	0.6	568.8	298.2	867.0	2.91	45.22	582.6	284.4
23	0.0510	518.321	516.4	0.6	586.6	294.5	881.1	2.99	45.76	587.8	293.3
24	0.0524	531.819	529.9	0.6	601.8	290.9	892.7	3.07	46.28	591.8	300.9

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
25	0.0537	545.463	543.6	0.7	617.1	287.6	904.7	3.15	46.76	596.2	308.6
26	0.0551	560.333	558.4	0.7	633.8	284.3	918.1	3.23	47.24	601.2	316.9
27	0.0564	574.105	572.2	0.7	649.3	281.2	930.5	3.31	47.69	605.8	324.7
28	0.0578	588.609	586.7	0.7	665.6	278.1	943.7	3.39	48.13	610.9	332.8
29	0.0591	601.482	599.6	0.8	680.0	275.5	955.5	3.47	48.51	615.5	340.0
30	0.0605	613.967	612.1	0.8	694.0	272.8	966.7	3.54	48.91	619.7	347.0
31	0.0618	626.846	624.9	0.8	708.4	270.0	978.4	3.62	49.31	624.2	354.2
32	0.0632	637.456	635.6	0.9	720.2	265.2	985.5	3.72	50.00	625.3	360.1
33	0.0646	648.848	646.9	0.9	732.9	261.9	994.9	3.80	50.48	628.4	366.5
34	0.0659	660.874	659.0	0.9	746.4	259.4	1005.7	3.88	50.85	632.5	373.2
35	0.0673	673.553	671.6	0.9	760.5	257.0	1017.5	3.96	51.20	637.2	380.3
36	0.0686	684.005	682.1	1.0	772.1	254.5	1026.6	4.03	51.56	640.5	386.1
37	0.0700	694.825	692.9	1.0	784.2	251.8	1036.0	4.11	51.94	643.9	392.1
38	0.0713	705.546	703.6	1.0	796.1	249.3	1045.4	4.19	52.31	647.4	398.0
39	0.0727	717.597	715.7	1.0	809.5	246.6	1056.1	4.28	52.70	651.4	404.8
40	0.0740	727.641	725.7	1.1	820.6	243.7	1064.3	4.37	53.12	654.0	410.3
41	0.0795	766.866	765.0	1.2	864.1	231.1	1095.2	4.74	54.95	663.2	432.0
42	0.0849	803.190	801.3	1.3	904.1	218.9	1123.0	5.13	56.72	671.0	452.1
43	0.0903	833.296	831.4	1.4	937.1	207.0	1144.1	5.53	58.44	675.6	468.5
44	0.0957	862.468	860.6	1.5	968.9	196.8	1165.7	5.92	59.93	681.2	484.5
45	0.1011	888.097	886.2	1.6	996.7	188.1	1184.7	6.30	61.19	686.4	498.3
46	0.1065	914.306	912.4	1.7	1025.0	176.0	1201.1	6.82	62.94	688.5	512.5
47	0.1119	935.427	933.5	1.8	1047.6	171.2	1218.8	7.12	63.64	695.0	523.8
48	0.1173	953.585	951.7	1.9	1066.9	168.3	1235.2	7.34	64.06	701.7	533.4
49	0.1227	970.569	968.7	2.0	1084.7	167.0	1251.7	7.49	64.24	709.4	542.4
50	0.1281	990.500	988.6	2.1	1105.8	166.8	1272.7	7.63	64.27	719.8	552.9
51	0.1335	1011.635	1009.7	2.2	1128.2	166.9	1295.1	7.76	64.26	731.0	564.1
52	0.1389	1031.281	1029.4	2.3	1148.9	167.9	1316.9	7.84	64.12	742.4	574.5
53	0.1443	1051.669	1049.8	2.5	1170.4	164.2	1334.7	8.13	64.65	749.5	585.2
54	0.1497	1072.675	1070.8	2.6	1192.5	166.3	1358.8	8.17	64.35	762.6	596.3
55	0.1551	1095.571	1093.7	2.7	1216.7	168.3	1385.1	8.23	64.05	776.7	608.4
56	0.1605	1117.335	1115.4	2.8	1239.6	171.5	1411.0	8.23	63.60	791.2	619.8
57	0.1659	1134.530	1132.6	2.9	1257.3	175.2	1432.5	8.18	63.06	803.8	628.6
58	0.1713	1156.543	1154.6	3.0	1280.3	178.6	1458.9	8.17	62.57	818.8	640.2
59	0.1767	1174.902	1173.0	3.1	1299.2	182.7	1482.0	8.11	61.97	832.4	649.6
60	0.1821	1201.977	1200.1	3.2	1327.8	181.3	1509.1	8.32	62.17	845.2	663.9
61	0.1826	1203.133	1201.2	3.2	1328.9	181.7	1510.6	8.32	62.12	846.1	664.5

Parameters for Specimen No. 3

Specimen Parameter	Initial	Cum. for Test	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1214.000			1328.200
Moisture content: Dry soil+tare, gms.	1046.000			1163.800
Moisture content: Tare, gms.	0.000			117.770
Moisture, %	16.1		9.9	15.7
Moist specimen weight, gms.	1214.0			
Diameter, in.	2.81		2.80	
Area, in.²	6.21		6.14	
Height, in.	5.40		4.87	
Net decrease in height, in.		0.49	0.04	
Wet density, pcf	137.9		146.2	
Dry density, pcf	118.8		133.1	
Void ratio	0.4186		0.2664	
Saturation, %	103.6		100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.064 cm
Consolidation cell pressure = 116.42 psi (802.7 kPa)
Consolidation back pressure = 30.18 psi (208.1 kPa)
Consolidation effective confining stress = 594.6 kPa
Strain rate, %/min. = 0.03
Fail. Stress = 1853.3 kPa **at reading no.** 54

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
0	0.0133	1.877	0.0	0.0	0.0	594.6	594.6	1.00	30.18	594.6	0.0
1	0.0146	28.203	26.3	0.0	29.5	594.5	624.1	1.05	30.19	609.3	14.8
2	0.0160	72.329	70.5	0.1	79.0	589.0	668.0	1.13	30.99	628.5	39.5
3	0.0173	103.814	101.9	0.1	114.3	584.6	699.0	1.20	31.62	641.8	57.2
4	0.0187	135.324	133.4	0.1	149.6	579.9	729.6	1.26	32.31	654.7	74.8
5	0.0200	166.454	164.6	0.1	184.5	575.1	759.6	1.32	33.01	667.3	92.2
6	0.0214	199.353	197.5	0.2	221.3	570.0	791.3	1.39	33.75	680.7	110.6
7	0.0228	231.162	229.3	0.2	256.9	564.4	821.2	1.46	34.57	692.8	128.4
8	0.0241	262.203	260.3	0.2	291.5	558.8	850.4	1.52	35.37	704.6	145.8
9	0.0255	296.007	294.1	0.3	329.3	553.0	882.3	1.60	36.21	717.7	164.7
10	0.0268	330.159	328.3	0.3	367.4	547.4	914.8	1.67	37.03	731.1	183.7
11	0.0282	359.438	357.6	0.3	400.1	541.4	941.5	1.74	37.90	741.5	200.1
12	0.0295	392.353	390.5	0.3	436.8	535.3	972.2	1.82	38.77	753.8	218.4
13	0.0309	424.523	422.6	0.4	472.7	529.4	1002.1	1.89	39.63	765.8	236.3
14	0.0322	460.430	458.6	0.4	512.7	523.4	1036.1	1.98	40.51	779.7	256.3
15	0.0336	493.368	491.5	0.4	549.4	517.1	1066.4	2.06	41.43	791.7	274.7
16	0.0349	526.628	524.8	0.4	586.4	511.1	1097.4	2.15	42.30	804.3	293.2
17	0.0363	560.261	558.4	0.5	623.8	504.8	1128.6	2.24	43.20	816.7	311.9
18	0.0377	592.848	591.0	0.5	660.0	498.4	1158.4	2.32	44.13	828.4	330.0
19	0.0390	624.398	622.5	0.5	695.0	491.9	1186.9	2.41	45.08	839.4	347.5
20	0.0404	655.098	653.2	0.6	729.1	483.6	1212.7	2.51	46.28	848.1	364.6
21	0.0417	685.739	683.9	0.6	763.1	475.9	1239.0	2.60	47.40	857.5	381.6
22	0.0431	719.208	717.3	0.6	800.2	469.4	1269.6	2.70	48.34	869.5	400.1
23	0.0444	755.640	753.8	0.6	840.6	462.7	1303.3	2.82	49.31	883.0	420.3
24	0.0458	787.988	786.1	0.7	876.5	455.8	1332.3	2.92	50.31	894.0	438.2

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
25	0.0471	820.315	818.4	0.7	912.3	449.0	1361.3	3.03	51.29	905.2	456.1
26	0.0485	852.128	850.3	0.7	947.4	442.5	1389.9	3.14	52.24	916.2	473.7
27	0.0499	880.541	878.7	0.8	978.8	435.4	1414.3	3.25	53.27	924.8	489.4
28	0.0512	911.602	909.7	0.8	1013.1	428.5	1441.7	3.36	54.27	935.1	506.6
29	0.0526	944.441	942.6	0.8	1049.4	421.8	1471.2	3.49	55.25	946.5	524.7
30	0.0539	976.421	974.5	0.8	1084.7	414.9	1499.6	3.61	56.25	957.2	542.4
31	0.0553	1007.397	1005.5	0.9	1118.9	407.8	1526.6	3.74	57.28	967.2	559.4
32	0.0566	1035.915	1034.0	0.9	1150.3	400.8	1551.1	3.87	58.29	976.0	575.2
33	0.0580	1067.226	1065.3	0.9	1184.8	393.9	1578.7	4.01	59.28	986.3	592.4
34	0.0593	1093.385	1091.5	0.9	1213.6	387.2	1600.7	4.13	60.27	993.9	606.8
35	0.0607	1118.632	1116.8	1.0	1241.3	380.2	1621.5	4.26	61.27	1000.9	620.6
36	0.0620	1144.778	1142.9	1.0	1270.0	373.6	1643.6	4.40	62.23	1008.6	635.0
37	0.0634	1169.159	1167.3	1.0	1296.7	366.9	1663.6	4.53	63.20	1015.3	648.4
38	0.0648	1195.673	1193.8	1.1	1325.8	360.6	1686.4	4.68	64.12	1023.5	662.9
39	0.0661	1219.388	1217.5	1.1	1351.7	354.2	1706.0	4.82	65.05	1030.1	675.9
40	0.0675	1239.307	1237.4	1.1	1373.5	348.0	1721.5	4.95	65.95	1034.7	686.7
41	0.0729	1318.641	1316.8	1.2	1459.9	323.5	1783.4	5.51	69.50	1053.4	729.9
42	0.0783	1383.312	1381.4	1.3	1529.9	300.1	1830.0	6.10	72.90	1065.0	764.9
43	0.0837	1433.085	1431.2	1.4	1583.2	285.6	1868.8	6.54	75.00	1077.2	791.6
44	0.0891	1465.777	1463.9	1.6	1617.6	276.6	1894.1	6.85	76.31	1085.4	808.8
45	0.0945	1494.712	1492.8	1.7	1647.7	273.0	1920.7	7.03	76.82	1096.9	823.8
46	0.0999	1515.868	1514.0	1.8	1669.1	272.7	1941.9	7.12	76.87	1107.3	834.6
47	0.1053	1537.798	1535.9	1.9	1691.4	274.0	1965.4	7.17	76.68	1119.7	845.7
48	0.1107	1561.408	1559.5	2.0	1715.5	268.5	1984.0	7.39	77.47	1126.3	857.7
49	0.1161	1585.146	1583.3	2.1	1739.6	271.9	2011.5	7.40	76.98	1141.7	869.8
50	0.1215	1607.542	1605.7	2.2	1762.2	274.8	2037.0	7.41	76.57	1155.9	881.1
51	0.1269	1631.991	1630.1	2.3	1787.0	277.5	2064.5	7.44	76.17	1171.0	893.5
52	0.1323	1652.819	1650.9	2.4	1807.8	281.5	2089.2	7.42	75.60	1185.4	903.9
53	0.1377	1675.169	1673.3	2.6	1830.2	282.8	2112.9	7.47	75.41	1197.9	915.1
54	0.1431	1698.225	1696.3	2.7	1853.3	282.0	2135.3	7.57	75.52	1208.6	926.6
55	0.1485	1719.499	1717.6	2.8	1874.4	287.0	2161.4	7.53	74.80	1224.2	937.2
56	0.1539	1740.602	1738.7	2.9	1895.3	292.6	2187.9	7.48	73.98	1240.2	947.6
57	0.1593	1761.338	1759.5	3.0	1915.7	298.9	2214.6	7.41	73.07	1256.7	957.8
58	0.1647	1786.591	1784.7	3.1	1941.0	305.0	2245.9	7.36	72.19	1275.4	970.5
59	0.1701	1816.042	1814.2	3.2	1970.7	304.3	2275.1	7.48	72.28	1289.7	985.4
60	0.1755	1837.053	1835.2	3.3	1991.3	308.2	2299.4	7.46	71.73	1303.8	995.6
61	0.1809	1859.574	1857.7	3.4	2013.4	313.8	2327.1	7.42	70.91	1320.5	1006.7
62	0.1863	1877.695	1875.8	3.6	2030.7	320.3	2351.0	7.34	69.97	1335.6	1015.4
63	0.1917	1901.948	1900.1	3.7	2054.6	326.4	2380.9	7.30	69.09	1353.6	1027.3
64	0.1971	1924.626	1922.7	3.8	2076.7	332.7	2409.4	7.24	68.17	1371.0	1038.4
65	0.2025	1948.892	1947.0	3.9	2100.5	331.9	2432.4	7.33	68.28	1382.2	1050.3
66	0.2079	1968.306	1966.4	4.0	2119.0	337.2	2456.2	7.28	67.52	1396.7	1059.5
67	0.2133	1993.553	1991.7	4.1	2143.7	343.6	2487.3	7.24	66.58	1415.5	1071.9
68	0.2188	2015.657	2013.8	4.2	2165.0	350.1	2515.1	7.18	65.64	1432.6	1082.5
69	0.2242	2039.385	2037.5	4.3	2188.0	357.0	2545.0	7.13	64.64	1451.0	1094.0
70	0.2296	2054.871	2053.0	4.4	2202.1	364.4	2566.4	7.04	63.57	1465.4	1101.0
71	0.2350	2082.851	2081.0	4.5	2229.5	364.2	2593.7	7.12	63.60	1478.9	1114.7

Knight Piesold Geotechnical Lab.

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
72	0.2404	2105.411	2103.5	4.7	2251.0	370.2	2621.2	7.08	62.73	1495.7	1125.5
73	0.2458	2124.425	2122.5	4.8	2268.7	377.1	2645.8	7.02	61.73	1511.5	1134.4
74	0.2512	2147.145	2145.3	4.9	2290.4	383.6	2674.0	6.97	60.78	1528.8	1145.2
75	0.2566	2172.947	2171.1	5.0	2315.2	389.6	2704.8	6.94	59.91	1547.2	1157.6
76	0.2620	2189.690	2187.8	5.1	2330.3	396.0	2726.3	6.89	58.99	1561.1	1165.2
77	0.2674	2213.986	2212.1	5.2	2353.5	396.3	2749.8	6.94	58.94	1573.1	1176.7
78	0.2728	2225.991	2224.1	5.3	2363.5	403.2	2766.6	6.86	57.94	1584.9	1181.7
79	0.2782	2244.551	2242.7	5.4	2380.4	409.8	2790.2	6.81	56.98	1600.0	1190.2
80	0.2836	2256.953	2255.1	5.5	2390.8	416.3	2807.0	6.74	56.05	1611.6	1195.4
81	0.2971	2312.166	2310.3	5.8	2442.1	428.5	2870.6	6.70	54.27	1649.6	1221.1
82	0.3106	2363.297	2361.4	6.1	2488.8	442.3	2931.1	6.63	52.27	1686.7	1244.4
83	0.3241	2407.866	2406.0	6.4	2528.3	457.7	2986.0	6.52	50.04	1721.8	1264.2
84	0.3376	2461.293	2459.4	6.7	2576.8	466.8	3043.5	6.52	48.72	1755.1	1288.4
85	0.3511	2494.690	2492.8	6.9	2604.0	482.1	3086.1	6.40	46.49	1784.1	1302.0
86	0.3646	2548.827	2546.9	7.2	2652.7	490.4	3143.1	6.41	45.29	1816.7	1326.3
87	0.3781	2590.341	2588.5	7.5	2687.8	504.7	3192.5	6.33	43.22	1848.6	1343.9
88	0.3916	2637.311	2635.4	7.8	2728.4	514.4	3242.8	6.30	41.81	1878.6	1364.2
89	0.4052	2664.002	2662.1	8.0	2747.8	528.6	3276.4	6.20	39.75	1902.5	1373.9
90	0.4187	2685.096	2683.2	8.3	2761.2	542.4	3303.6	6.09	37.75	1923.0	1380.6
91	0.4322	2725.908	2724.0	8.6	2794.7	549.4	3344.2	6.09	36.73	1946.8	1397.4
92	0.4457	2741.542	2739.7	8.9	2802.2	562.1	3364.3	5.99	34.90	1963.2	1401.1
93	0.4592	2776.133	2774.3	9.1	2829.0	569.0	3398.0	5.97	33.89	1983.5	1414.5
94	0.4727	2797.017	2795.1	9.4	2841.6	581.2	3422.8	5.89	32.12	2002.0	1420.8
95	0.4862	2823.127	2821.3	9.7	2859.4	589.3	3448.7	5.85	30.94	2019.0	1429.7
96	0.4997	2832.950	2831.1	10.0	2860.5	600.6	3461.1	5.76	29.32	2030.8	1430.3
97	0.5132	2842.006	2840.1	10.3	2860.8	611.0	3471.8	5.68	27.81	2041.4	1430.4
98	0.5267	2870.235	2868.4	10.5	2880.3	617.5	3497.9	5.66	26.85	2057.7	1440.2
99	0.5402	2875.285	2873.4	10.8	2876.5	627.2	3503.7	5.59	25.45	2065.5	1438.2
100	0.5537	2880.245	2878.4	11.1	2872.5	633.6	3506.1	5.53	24.52	2069.9	1436.2
101	0.5672	2868.483	2866.6	11.4	2851.8	641.2	3493.0	5.45	23.42	2067.1	1425.9
102	0.5807	2879.291	2877.4	11.6	2853.6	646.1	3499.7	5.42	22.71	2072.9	1426.8
103	0.5943	2867.256	2865.4	11.9	2832.8	652.5	3485.3	5.34	21.78	2068.9	1416.4
104	0.6078	2875.390	2873.5	12.2	2831.9	657.0	3488.9	5.31	21.13	2073.0	1415.9
105	0.6213	2869.343	2867.5	12.5	2817.0	662.1	3479.1	5.25	20.39	2070.6	1408.5
106	0.6348	2855.874	2854.0	12.8	2794.9	666.4	3461.3	5.19	19.76	2063.9	1397.5
107	0.6483	2870.576	2868.7	13.0	2800.4	668.1	3468.5	5.19	19.52	2068.3	1400.2
108	0.6618	2867.558	2865.7	13.3	2788.5	671.6	3460.2	5.15	19.01	2065.9	1394.3
109	0.6753	2864.930	2863.1	13.6	2777.1	673.0	3450.0	5.13	18.81	2061.5	1388.5
110	0.6888	2852.830	2851.0	13.9	2756.5	676.9	3433.4	5.07	18.24	2055.1	1378.2
111	0.7023	2859.132	2857.3	14.1	2753.7	679.6	3433.2	5.05	17.86	2056.4	1376.8
112	0.7158	2852.702	2850.8	14.4	2738.6	682.8	3421.4	5.01	17.39	2052.1	1369.3
113	0.7293	2856.927	2855.1	14.7	2733.8	685.3	3419.1	4.99	17.03	2052.2	1366.9
114	0.7428	2857.466	2855.6	15.0	2725.4	688.3	3413.7	4.96	16.60	2051.0	1362.7
115	0.7563	2858.135	2856.3	15.2	2717.2	691.5	3408.6	4.93	16.13	2050.0	1358.6
116	0.7698	2870.547	2868.7	15.5	2720.0	692.0	3412.0	4.93	16.05	2052.0	1360.0
117	0.7833	2868.775	2866.9	15.8	2709.4	694.9	3404.4	4.90	15.63	2049.6	1354.7
118	0.7969	2881.112	2879.2	16.1	2712.1	695.4	3407.5	4.90	15.57	2051.4	1356.1

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress kPa	Minor Eff. Stress kPa	Major Eff. Stress kPa	1:3 Ratio	Pore Press. psi	P kPa	Q kPa
119	0.8104	2868.385	2866.5	16.4	2691.2	697.9	3389.2	4.86	15.20	2043.5	1345.6
120	0.8237	2866.833	2865.0	16.6	2681.0	699.1	3380.1	4.83	15.02	2039.6	1340.5

Knight Piesold Geotechnical Lab.

APPENDIX C2

ROCK LABORATORY TEST RESULTS

(Pages C2-1 to C2-5)

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Kingston, ON, Canada, K7K 6C7
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www.mdeng.ca
Mine Design Engineering

June 04, 2015

Mr. Greg Magoon P.Eng
Knight Piesold Ltd.
Suite 1400 - 750 W. Pender St.,
Vancouver, BC V6C 2T8

Re: Rock mechanics lab testing of core samples (Tintina Project)

Mr. Magoon:

One shipment of seventeen (17) rock core specimens was received from which twelve were subjected to unconfined compression strength testing and five (being too short to test for UCS) were tested to point load failure.

Testing was performed within a Materials Testing System (MTS) Model 815 servo-controlled, electrohydraulic compression testing frame. Each unconfined compression specimen was subjected to a process of preparation that included:

-diamond sawing to prepare cylindrical samples having nearly parallel end faces
-diamond lathing, to prepare sample faces parallel to within + 0.025 mm
-testing to failure within the servo-controlled compression frame; all tests were performed under axial strain control at rates approximating 10-5 s-1, and simultaneous recording of axial force and axial deformation (and circumferential deformation conditions only for unconfined specimens) parameters was conducted, from which determination of standard failure parameters (Young's Modulus and Poisson's ratio, where feasible) was made.

Each point load specimen was manufactured to exhibit a length-to-diameter aspect ratio approximating 1.5-to-1 and was tested to diametral loading failure.

Failure test results, with typical pre- and post-test photographs of each unconfined test sample, are tabled and included.

Yours sincerely,

Peter Lausch, M.Sc., P. Eng.

Summary of Unconfined Compression Failure Test Results
(Tintina Project – May, 2015)

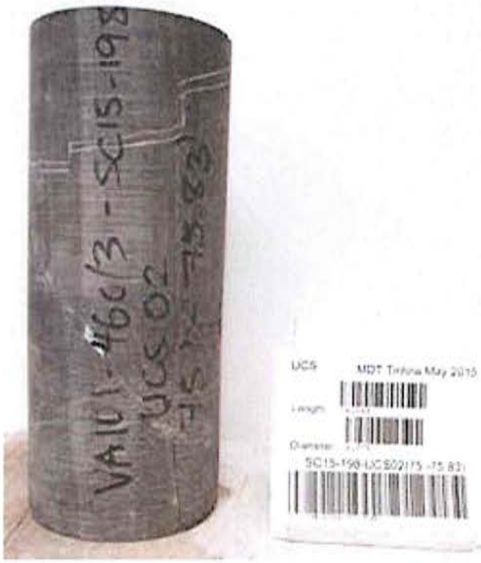
Sample – Hole (Depth, m)	Density (g/cm^3)	Young's Modulus E, (GPa)	Poisson's ratio (μ)	UCS (MPa)	Point Load Index (MPa)
SC15-182-UCS01 (14.00-14.10)	2.66	24.173	0.30	170.6	---
SC15-188 (17.25-18.25)	2.59	10.025	0.37	76.3	---
SC15-187-UCS01 (22.20-22.11)	2.60	19.273	0.15	124.3	---
SC15-183-UCS02 (34.10)	2.30	0.179	---	2.2 (f)	---
SC15-193-UCS01 (51.00-51.79)	2.74	16.537	0.17	106.7	---
SC15-198-UCS01 (55.60-56.20)	2.69	16.049	0.24	42.9	---
SC15-187-UCS02 (61.80-62.50)	2.67	20.782	0.22	56.8	---
SC15-181-UCS01 (72.35-73.25)	2.68	11.560	0.14	50.9 (pf)	---
SC15-198-UCS02 (75.00-75.83)	2.70	8.773	0.27	14.3 (f)	---
SC15-191-UCS01 (84.00-84.90)	2.69	12.050	0.14	36.1 (pf)	---
SC15-198-UCS03 (93.60-94.30)	2.62	0.592	---	1.8 (f)	---
SC15-197-UCS02 (95.00-95.80)	2.60	17.186	0.23	76.8	---
SC15-190-UCS01 (45.70)	---	---	---	---	1.38
SC15-198-UCS04 (27.80-28.60)	---	---	---	---	0.33
SC15-189-UCS01 (92.10)	---	---	---	---	0.32
SC15-197-UCS01 (76.60-77.30)	---	---	---	---	0.41
SC15-183-UCS01 (97.40-98.10)	---	---	---	---	0.21

(f) - indicates sample failure to occur fully along pre-existing foliation surface(s)
(pf) - indicates sample failure to occur partially along pre-existing foliation surface(s)

Pre-Test Specimen Photographs

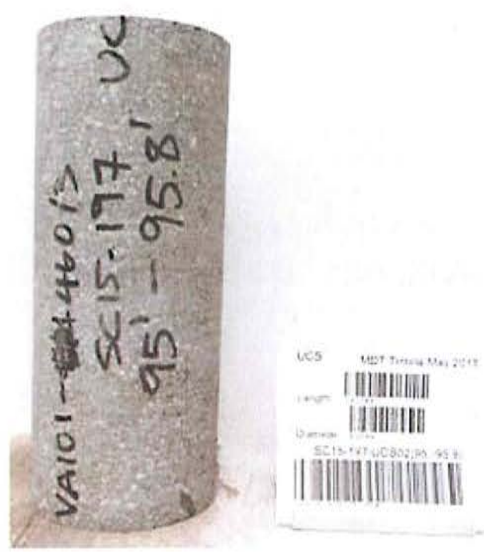

UCS
MDT Tintina May 2015
Length
Diameter


UCS
MDT Tintina May 2015
Length
Diameter


VA101-460/3 - SC15-198
UCS02
UCS
MDT Tintina May 2015
Length
Diameter
SC15-198-UCS02(75 -75.83)


UCS
MDT Tintina May 2015
Length
Diameter
SC15-191-UCS01(84 -84.9)


UCS
MDT Tintina May 2015
Length
Diameter


VA101
SC15-197
95' - 95.8'
UCS
MDT Tintina May 2015
Length
Diameter


MDT Tintina
POINT LOAD
SC15-190-UCS01-(15.7)


UCS04
MDT Tintina
POINT LOAD
SC15-198-UCS01-(27.8-28.0)


SC15-189
UCS01
92.1 ft
MDT Tintina
POINT LOAD
SC15-189-UCS01-(92.1)

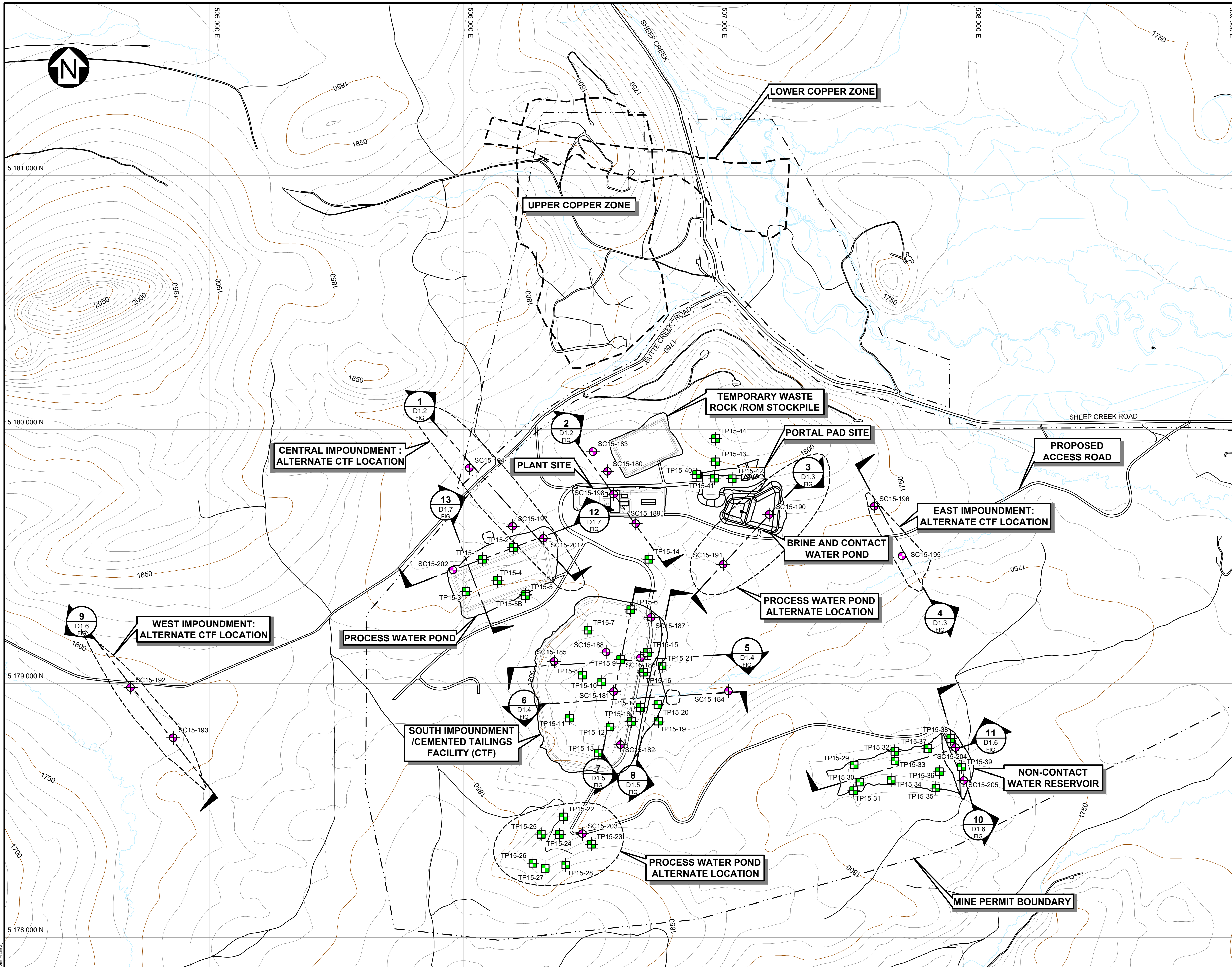

MDT Tintina
POINT LOAD
SC15-184-UCS01-(97.1-98.1)


MDT Tintina
POINT LOAD
SC15-197-UCS01-(76.6-77.3)

APPENDIX D

CROSS SECTIONS

(Pages D-1 to D-7)



LEGEND:

# / ### / FIG	CROSS-SECTION REFERENCE
	DRILL HOLE
	TEST PIT
	ALTERNATE CTF AND PWP LOCATION
	MINE PERMIT BOUNDARY

NOTES:

1. TOPOGRAPHIC BASE MAP FROM 2011 AERIAL LIDAR SURVEY WITH MAP PROJECTION: UTM ZONE 12N AND MAP DATUM: NAD83.
2. CONTOUR INTERVAL IS 10 METERS.
3. ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

SCALE A 150 75 0 250 500 750 m

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

GENERAL ARRANGEMENT AND CTF OPTIONS

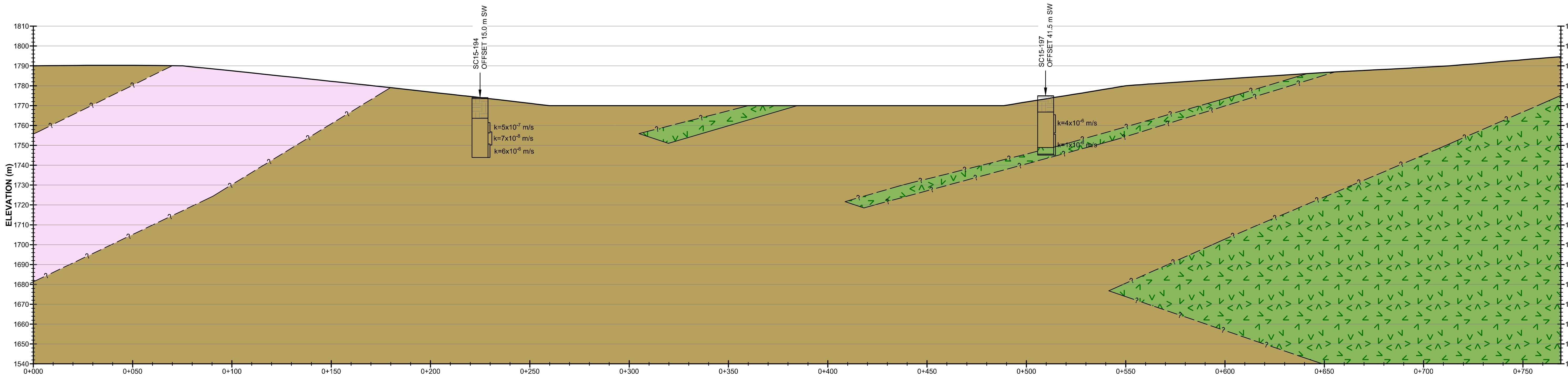
Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-460/3	1

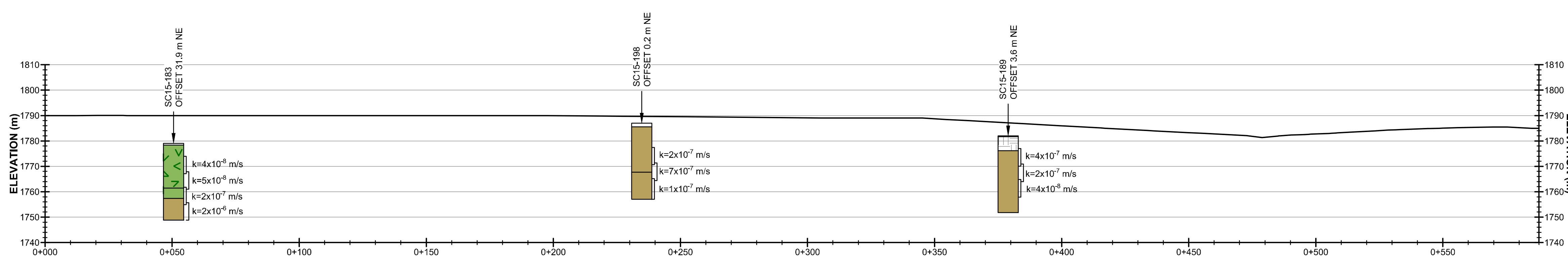
FIGURE D1.1 REV 3

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
3	30JUN'17	ISSUED WITH REPORT	GIM	MJC	KDE

SAVED: M:\1\01\00460\03\A\Acad\FIGS\B01_r3, 6/30/2017 10:53:34 AM, MCOUTTS PRINTED: 6/30/2017 11:03:59 AM, Layout1, MCOUTTS
XREF FILE(S): IMAGE FILE(S):



1 D1.1 FIG **SECTION**
SCALE A



2 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- GRANODIORITE
- LIMESTONE
- k=1x10^{-7} m/s HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 1 & 2

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-460/3	1

FIGURE D1.2	REV 0

0	18APR'16	ISSUED WITH REPORT	GIM	KJM	KDE
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED

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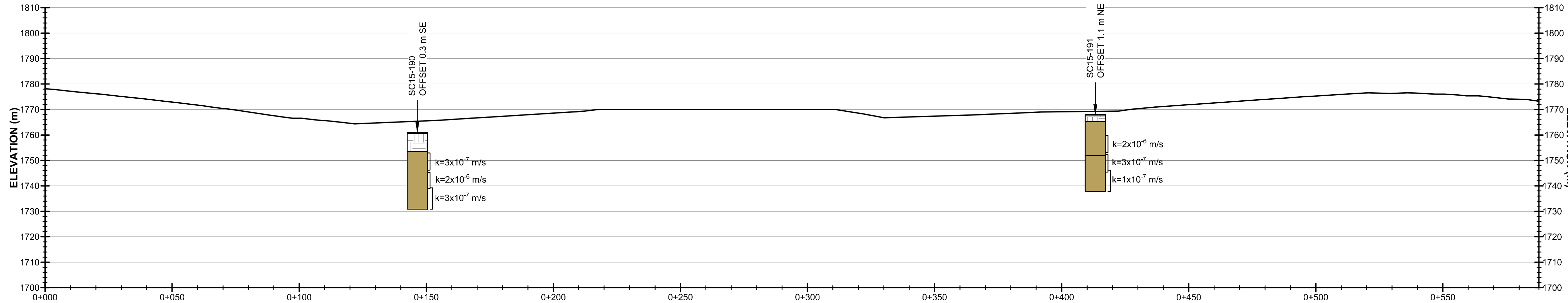
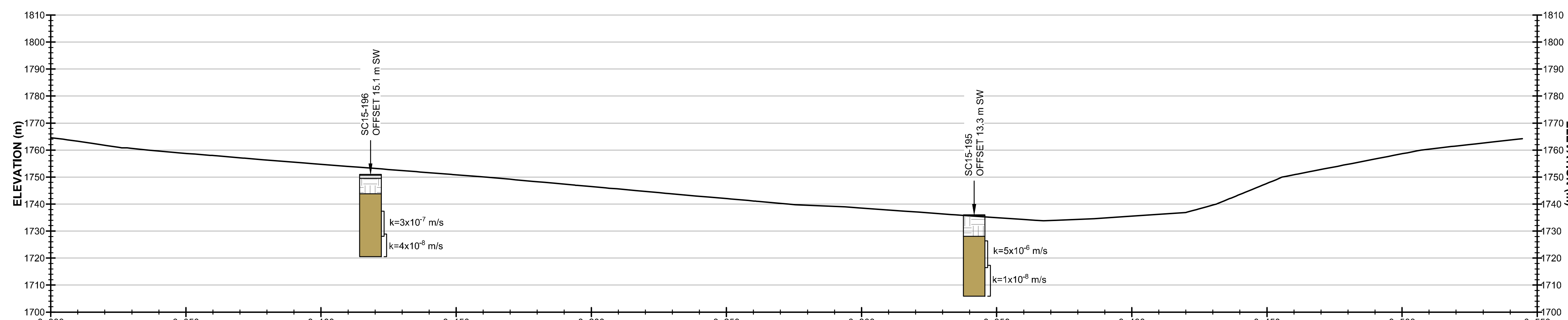


3 D1.1 FIG **SECTION**
SCALE A



4 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- GRANODIORITE
- LIMESTONE
- k=1x10^{-7} m/s — HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	18APR'16	ISSUED WITH REPORT	GIM	KJM	KDE

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 3 & 4

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P/A NO. VA101-460/3 | REF NO. 1

FIGURE D1.3 | REV 0

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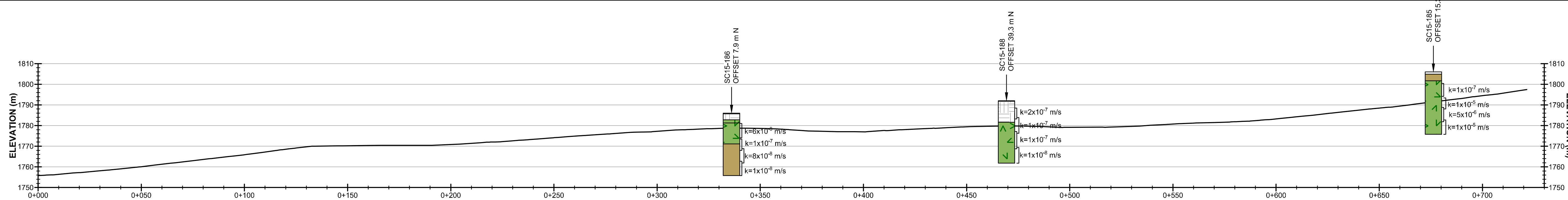
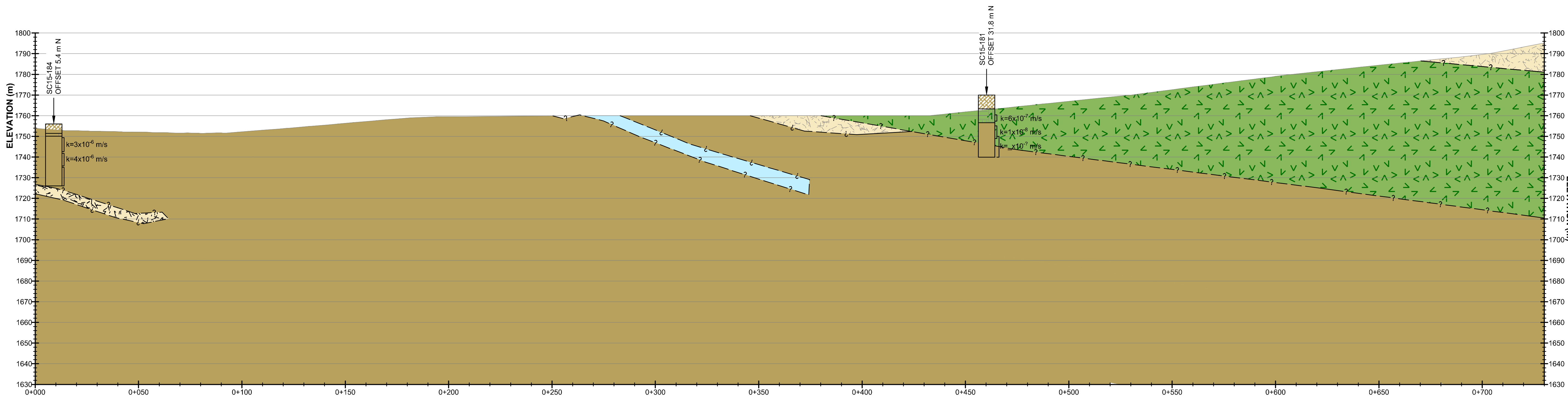


5 D1.1 FIG **SECTION**
SCALE A



6 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- CONGLOMERETE
- GRANODIORITE
- LIMESTONE
- k=1x10^{-7} m/s — HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

0	18APR'16	ISSUED WITH REPORT	GIM	KJM	KDE
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 5 & 6

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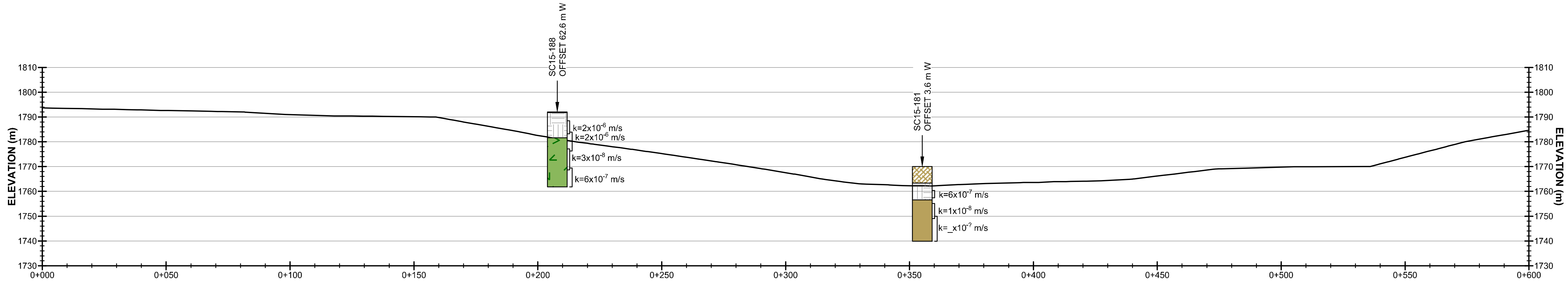
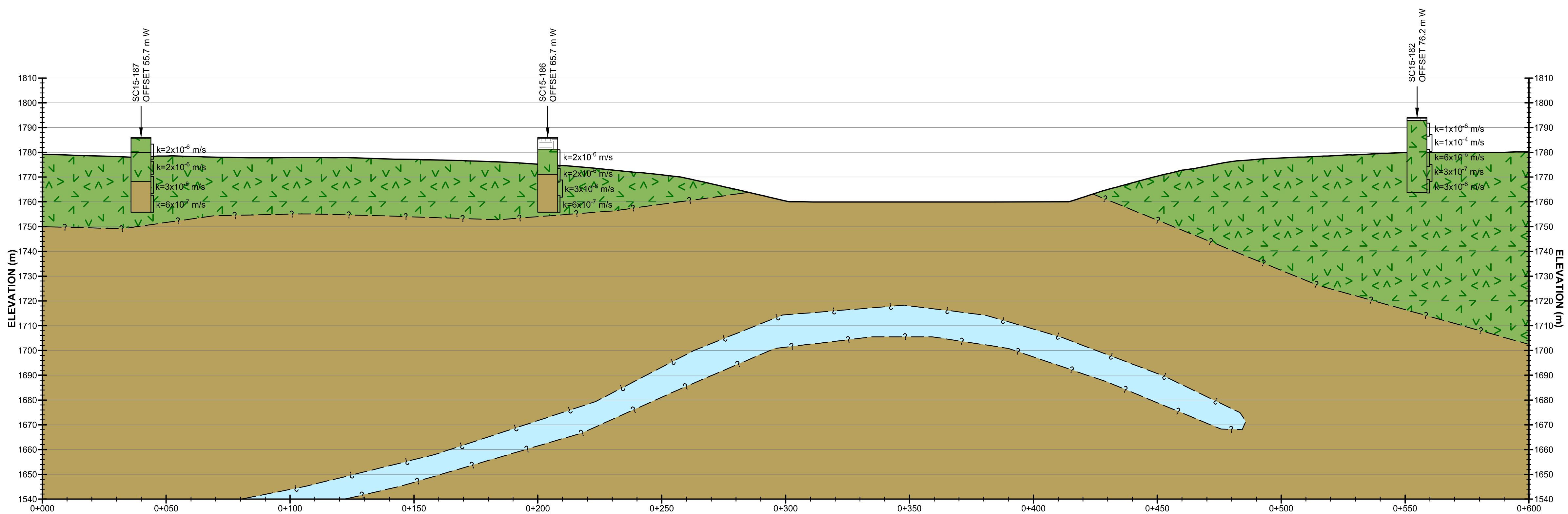
P/A NO. VA101-460/3 | REF NO. 1

FIGURE D1.4 | REV 0



7 D1.1 FIG **SECTION**
SCALE A



8 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- GRANODIORITE
- LIMESTONE
-]k=1x10^{-7} m/s — HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 7 & 8

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P/A NO.	REF NO.
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FIGURE D1.5 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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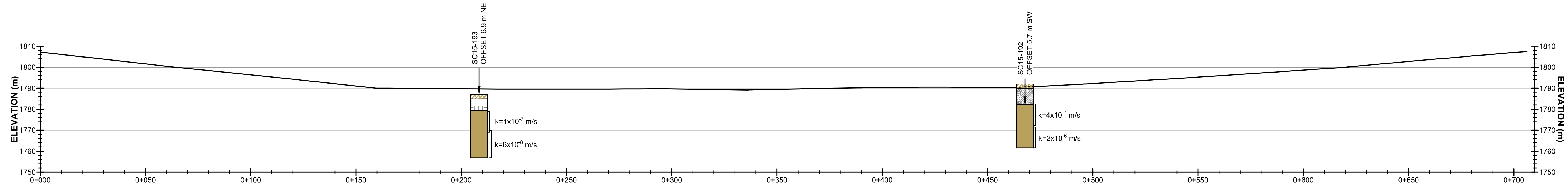
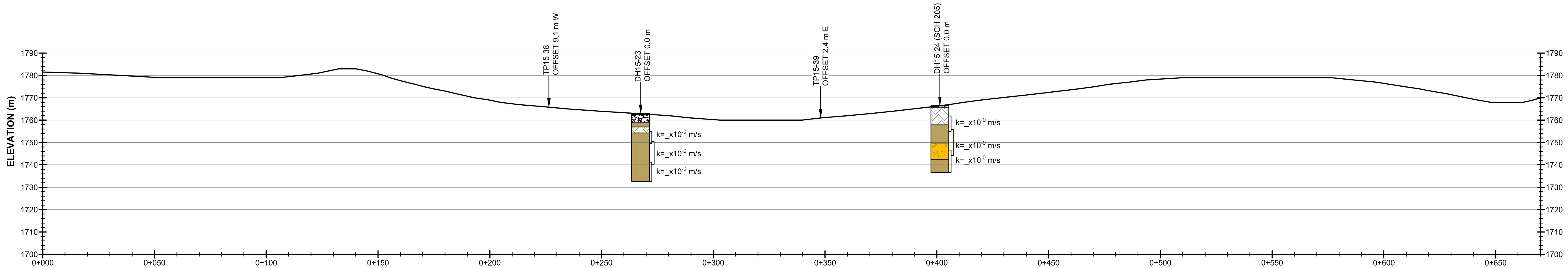
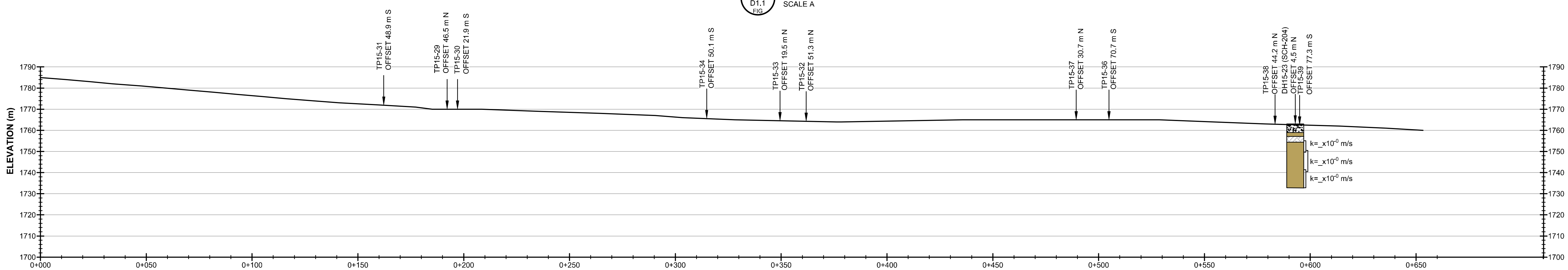


9 D1.1 FIG **SECTION**
SCALE A



10 D1.1 FIG **SECTION**
SCALE A



11 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- GRANODIORITE
- LIMESTONE
-]k=1x10^{-7} m/s — HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 9, 10 & 11

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P/A NO.	REF NO.
VA101-460/3	1

FIGURE D1.6 REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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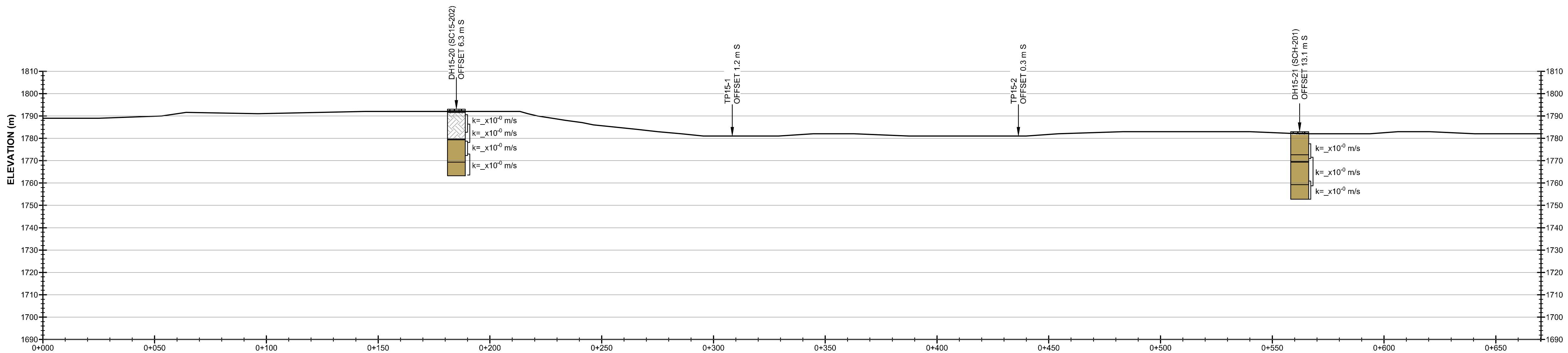
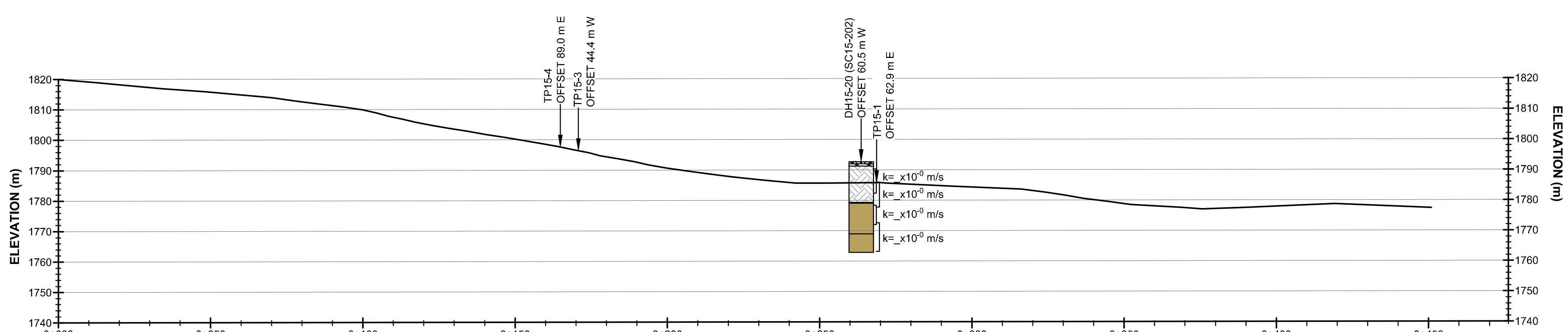


12 D1.1 FIG **SECTION**
SCALE A



13 D1.1 FIG **SECTION**
SCALE A

NOTES:

1. LITHOLOGICAL CROSS SECTION INFORMATION PROVIDED BY TINTINA RESOURCES INC. (APRIL 2015).

LEGEND:

- WEATHERED BEDROCK
- OVERBURDEN
- SHEAR ZONE
- SHALE
- GRANODIORITE
- LIMESTONE
-]k=1x10^{-7} m/s HYDRAULIC CONDUCTIVITY FROM PACKER TESTS, SHOWN IN METRES PER SECOND

SCALE A 20 10 0 20 40 60 80 100 m

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION CROSS SECTIONS 12 & 13

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-460/3	1

FIGURE D1.7	REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
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APPENDIX E

PHOTOGRAPHS

APPENDIX E1

DRILL CORE PHOTOGRAPHS

(Pages E1-1 to E1-72)

Knight Piésold
CONSULTING

PHOTO 1 SC15-180_001_0.0 - 3.2 m

PHOTO 2 SC15-180_002_3.2 - 5.8 m

PHOTO 3 SC15-180_003_5.8 - 8.7 m

PHOTO 4 SC15-180_004_8.7 - 11.5 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 5 SC15-180_005_11.5 - 14.0 m

PHOTO 6 SC15-180_006_14.0 - 16.7m

PHOTO 7 SC15-180_007_16.7 - 19.3 m

PHOTO 8 SC15-180_008_19.3 - 21.9 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 9 SC15-180_009_21.9 - 24.7 m

PHOTO 10 SC15-180_010_24.7 - 27.3 m

PHOTO 11 SC15-180_011_27.3 - 30.2 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 1 SC15-181_001_6.7 - 9.2 m

PHOTO 2 SC15-181_002_9.2 - 11.9 m

PHOTO 3 SC15-181_003_11.9 - 15.2 m

PHOTO 4 SC15-181_004_15.2 - 18.0 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold CONSULTING

PHOTO 5 SC15-181_005_18.0 - 20.95 m

PHOTO 6 SC15-181_006_20.95 - 24.0 m

PHOTO 7 SC15-181_007_24.0 - 26.5 m

PHOTO 8 SC15-181_008_26.5 - 29.2 m

TINTINA RESOURCES INC.
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Knight Piésold
CONSULTING

PHOTO 9 SC15-181_009_29.2 - 30.1 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 1 SC15-182_001_0.0 - 2.7 m

PHOTO 2 SC15-182_002_2.7 - 5.4 m

PHOTO 3 SC15-182_003_5.4 - 8.2 m

PHOTO 4 SC15-182_004_8.2 - 11.0 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-182_005_11.0 - 13.6 m

PHOTO 6 SC15-182_006_13.6 - 16.5 m

PHOTO 7 SC15-182_007_16.5 - 19.3 m

PHOTO 8 SC15-182_008_19.3 - 21.9 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 9 SC15-182_009_21.9 - 24.8 m

PHOTO 10 SC15-182_010_24.8 - 27.6 m

PHOTO 11 SC15-182_011_27.6 - 30.2m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 1 SC15-183_001_0 - 3.5 m

PHOTO 2 SC15-183_002_3.5 - 6.1 m

PHOTO 3 SC15-183_003_6.1 - 9.0 m

PHOTO 4 SC15-183_004_9.0 - 11.5 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-183_005_11.5 - 14.6 m

PHOTO 6 SC15-183_006_14.6 - 17.4 m

PHOTO 7 SC15-183_007_17.4 - 20.0 m

PHOTO 8 SC15-183_008_20.0 - 22.6 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-183_009_22.6 - 25.3 m

PHOTO 10 SC15-183_010_25.3 - 28.0 m

PHOTO 11 SC15-183_011_28.0 - 30.18 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-184_01-02_4.6 - 7.4 m

PHOTO 2 SC15-184_03-04_7.4 - 10.1 m

PHOTO 3 SC15-184_05-06_10.1 - 12.6 m

PHOTO 4 SC15-184_07-08_12.6 - 15.1 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 5 SC15-184_09-10_15.1 - 17.7 m

PHOTO 6 SC15-184_11-12_17.7 - 20.4 m

PHOTO 7 SC15-184_13-14_20.4 - 22.6 m

PHOTO 8 SC15-184_15-16_22.6 - 25.5 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 9 SC15-184_17-18_25.5 - 28.2 m

PHOTO 10 SC15-184_19-20_28.2 - 30.0 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 1 SC15-185_01-02_0 - 3.0 m

PHOTO 2 SC15-185_03-04_3.0 - 6.0 m

PHOTO 3 SC15-185_05-06_6.0 - 8.8 m

PHOTO 4 SC15-185_07-08_8.8 - 11.5 m

TINTINA RESOURCES INC.
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PHOTO 5 SC15-185_09-10_11.5 - 14.2 m

PHOTO 6 SC15-185_11-12_14.2 - 16.8 m

PHOTO 7 SC15-185_13-14_16.8 - 19.5 m

PHOTO 8 SC15-185_15-16_19.5 - 22.3 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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PHOTO 9 SC15-185_17-18_22.3 - 24.8 m

PHOTO 10 SC15-185_19-20_24.8 - 27.9 m

PHOTO 11 SC15-185_21-22_27.9 - 30.2m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-186_001_0 - 2.9 m

PHOTO 2 SC15-186_002_2.9 - 5.7 m

PHOTO 3 SC15-186_003_5.7 - 8.4 m

PHOTO 4 SC15-186_004_8.4 - 11.4 m

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PHOTO 6 SC15-186_006_14.0 - 17.0 m

PHOTO 7 SC15-186_007_17.0 - 19.6 m

PHOTO 8 SC15-186_008_19.6 - 22.4 m

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PHOTO 9 SC15-186_009_22.4 - 25.1 m

PHOTO 10 SC15-186_010_25.1 - 27.7 m

PHOTO 11 SC15-186_011_27.7 - 30.2 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-187_001_0 - 2.9 m

PHOTO 2 SC15-187_002_2.9 - 5.9 m

PHOTO 3 SC15-187_003_5.9 - 8.5 m

PHOTO 4 SC15-187_004_8.5 - 11.3 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 5 SC15-187_005_11.3 - 14.1 m

PHOTO 6 SC15-187_006_14.1 - 16.9 m

PHOTO 7 SC15-187_007_16.9 - 19.7 m

PHOTO 8 SC15-187_008_19.7 - 22.4 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 9 SC15-187_009_22.4 - 25.2 m

PHOTO 10 SC15-187_010_25.2 - 27.9 m

PHOTO 11 SC15-187_011_27.9 - 30.2m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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PHOTO 1 SC15-188_001_0 - 2.9 m

PHOTO 2 SC15-188_002_2.9 - 5.9 m

PHOTO 3 SC15-188_003_5.9 - 8.6 m

PHOTO 4 SC15-188_004_8.6 - 11.4 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-188_005_11.4 - 14.2 m

PHOTO 6 SC15-188_006_14.2 - 16.9 m

PHOTO 7 SC15-188_007_16.9 - 19.7 m

PHOTO 8 SC15-188_008_19.7 - 22.5 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 9 SC15-188_009_22.5 - 25.1 m

PHOTO 10 SC15-188_010_25.1 - 28.0 m

PHOTO 11 SC15-188_011_28.0 - 30.2 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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PHOTO 1 SC15-189_001_0 - 3.2 m

PHOTO 2 SC15-189_002_3.2 - 6.0 m

PHOTO 3 SC15-189_003_6.0 - 9.0 m

PHOTO 4 SC15-189_004_9.0 - 11.6 m

TINTINA RESOURCES INC.
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PHOTO 5 SC15-189_005_11.6 - 14.3 m

PHOTO 6 SC15-189_006_14.3 - 17.3 m

PHOTO 7 SC15-189_007_17.3 - 20.0 m

PHOTO 8 SC15-189_008_20.0 - 22.6 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-189_009_22.6 - 25.1 m

PHOTO 10 SC15-189_010_25.1 - 28.1 m

PHOTO 11 SC15-189_011_28.1 - 30.2 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-190_001_0 - 3.6 m

PHOTO 2 SC15-190_002_3.6 - 6.4 m

PHOTO 3 SC15-190_003_6.4 - 9.0 m

PHOTO 4 SC15-190_004_9.0 - 11.6 m

TINTINA RESOURCES INC.
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PHOTO 5 SC15-190_005_11.6 - 14.2 m

PHOTO 6 SC15-190_006_14.2 - 17.0 m

PHOTO 7 SC15-190_007_17.0 - 19.7 m

PHOTO 8 SC15-190_008_19.7 - 22.3 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-190_009_22.3 - 25.0 m

PHOTO 10 SC15-190_010_25.0 - 27.8 m

PHOTO 11 SC15-190_011_27.8 - 30.2 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-191_001_0 - 4.1 m

PHOTO 2 SC15-191_002_4.1 - 7.6 m

PHOTO 3 SC15-191_003_7.6 - 10.7 m

PHOTO 4 SC15-191_004_10.7 - 13.6 m

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PHOTO 5 SC15-191_005_13.6 - 16.5 m

PHOTO 6 SC15-191_006_16.5 - 19.3 m

PHOTO 7 SC15-191_007_19.3 - 22.1 m

PHOTO 8 SC15-191_008_22.1 - 24.8 m

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PHOTO 9 SC15-191_009_24.8 - 27.6 m

PHOTO 10 SC15-191_010_27.6 - 30.2 m_TD

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CONSULTING

PHOTO 1 SC15-192_001_5.2 - 8.4 m

PHOTO 2 SC15-192_002_8.4 - 11.3 m

PHOTO 3 SC15-192_003_11.3 - 14.1 m

PHOTO 4 SC15-192_004_14.1 - 16.9 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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CONSULTING

PHOTO 5 SC15-192_005_16.9 - 19.8 m

PHOTO 6 SC15-192_006_19.8 - 22.5 m

PHOTO 7 SC15-192_007_22.5 - 25.0 m

PHOTO 8 SC15-192_008_25.0 - 28.1 m

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PHOTO 9 SC15-192_009_28.1 - 30.5 m_TD

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PHOTO 1 SC15-193_001_3.7 - 6.4 m

PHOTO 2 SC15-193_002_6.4 - 9.1 m

PHOTO 3 SC15-193_003_9.1 - 11.9 m

PHOTO 4 SC15-193_004_11.9 - 14.6 m

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CONSULTING

PHOTO 5 SC15-193_005_14.6 - 17.4 m

PHOTO 6 SC15-193_006_17.4 - 20.2 m

PHOTO 7 SC15-193_007_20.2 - 23.1 m

PHOTO 8 SC15-193_008_23.1 - 26.0 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-193_009_26.0 - 28.7 m

PHOTO 10 SC15-193_010_28.7 - 30.2 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-194_01-02_0 - 4.2 m

PHOTO 2 SC15-194_03-04_4.2 - 6.6 m

PHOTO 3 SC15-194_05-06_6.6 - 10.0 m

PHOTO 4 SC15-194_07-08_10.0 - 13.1 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 5 SC15-194_09-10_13.1 - 15.7 m

PHOTO 6 SC15-194_11-12_15.7 - 18.5 m

PHOTO 7 SC15-194_13-14_18.5 - 20.8 m

PHOTO 8 SC15-194_15-16_20.8 - 23.6 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 9 SC15-194_17-18_23.6 - 26.3 m

PHOTO 10 SC15-194_19-20_26.3 - 28.6 m

PHOTO 11 SC15-194_21_28.6 - 30.1 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-195_001_0 - 3.8 m

PHOTO 2 SC15-195_002_3.8 - 6.8 m

PHOTO 3 SC15-195_003_6.8 - 9.5 m

PHOTO 4 SC15-195_004_9.5 - 12.1 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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PHOTO 5 SC15-195_005_12.1 - 15.1 m

PHOTO 6 SC15-195_006_15.1 - 17.7 m

PHOTO 7 SC15-195_007_17.7 - 20.6 m

PHOTO 8 SC15-195_008_20.6 - 23.8 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-195_009_23.8 - 26.6 m

PHOTO 10 SC15-195_010_26.6 - 29.8 m

PHOTO 11 SC15-195_011_29.8 - 30.1m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 1 SC15-196_001_2.4 - 6.0 m

PHOTO 2 SC15-196_002_6.0 - 8.7 m

PHOTO 3 SC15-196_003_8.7 - 11.8 m

PHOTO 4 SC15-196_004_11.8 - 15.0 m

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PHOTO 5 SC15-196_005_15.0 - 17.5 m

PHOTO 6 SC15-196_006_17.5 - 20.3 m

PHOTO 7 SC15-196_007_20.3 - 23.1 m

PHOTO 8 SC15-196_008_23.1 - 25.8 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-196_009_25.8 - 28.6 m

PHOTO 10 SC15-196_010_28.6 - 30.5 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 1 SC15-197_001_0 - 3.3 m

PHOTO 2 SC15-197_002_3.3 - 5.9 m

PHOTO 3 SC15-197_003_5.9 - 8.8 m

PHOTO 4 SC15-197_004_8.8 - 11.6 m

TINTINA RESOURCES INC.
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PHOTO 5 SC15-197_005_11.6 - 14.9 m

PHOTO 6 SC15-197_006_14.9 - 17.8 m

PHOTO 7 SC15-197_007_17.8 - 20.5 m

PHOTO 8 SC15-197_008_20.5 - 23.3 m

TINTINA RESOURCES INC.
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PHOTO 9 SC15-197_009_23.3 - 26.1 m

PHOTO 10 SC15-197_010_26.1 - 28.9 m

PHOTO 11 SC15-197_011_28.9 - 29.9 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
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PHOTO 1 SC15-198_001_0 - 3.6 m

PHOTO 2 SC15-198_002_3.6 - 6.2 m

PHOTO 3 SC15-198_003_6.2 - 9.1 m

PHOTO 4 SC15-198_004_9.1 - 11.6 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-198_005_11.6 - 14.6 m

PHOTO 6 SC15-198_006_14.6 - 17.6 m

PHOTO 7 SC15-198_007_17.6 - 20.4 m

PHOTO 8 SC15-198_008_20.4 - 23.1 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 9 SC15-198_009_23.1 - 26.2 m

PHOTO 10 SC15-198_010_26.2 - 28.9 m

PHOTO 11 SC15-198_011_28.9 - 30.0 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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PHOTO 1 SC15-201_01_0 - 4.1 m

PHOTO 2 SC15-201_02_4.1 - 6.7 m

PHOTO 3 SC15-201_03_6.7 - 9.5 m

PHOTO 4 SC15-201_04_9.5 - 12.3 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-201_05_12.3 - 14.9 m

PHOTO 6 SC15_201_06_14.9 - 17.5 m

PHOTO 7 SC15_201_07_17.5 - 20.3 m

PHOTO 8 SC15_201_08_20.3 - 23.0 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 9 SC15-201_09_23.0 - 25.7 m

PHOTO 10 SC15-201_10_25.7 - 28.4 m

PHOTO 11 SC15-201_11_28.4 - 30.3 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 1 SC15-202_001_0 - 4.2 m

PHOTO 2 SC15-202_002_4.2 - 6.7 m

PHOTO 3 SC15-202_003_6.7 - 9.3 m

PHOTO 4 SC15-202_004_9.3 - 11.8 m

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PHOTO 5 SC15-202_005_11.8 - 14.7 m

PHOTO 6 SC15-202_006_14.7 - 17.3 m

PHOTO 7 SC15_202_007_17.3 - 20.4 m

PHOTO 8 SC15-202_008_20.4 - 23.5 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 9 SC15-202_009_23.5 - 26.2 m

PHOTO 10 SC15-202-010_26.2 - 29.1 m

PHOTO 11 SC15-202_011_29.1 - 29.8 m_TD

TINTINA RESOURCES INC.
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PHOTO 1 SC15-203_001_0 - 5.4 m

PHOTO 2 SC15-203_002_5.4 - 8.9 m

PHOTO 3 SC15-203_003_8.9 - 11.7 m

PHOTO 4 SC15-203_004_11.7 - 14.4 m

TINTINA RESOURCES INC.
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CONSULTING

PHOTO 5 SC15-203_005_14.4 - 17.1 m

PHOTO 6 SC15-203_006_17.1 - 19.8 m

PHOTO 7 SC15-203_007_19.8 - 22.7 m

PHOTO 8 SC15-203_008_22.7 - 25.5 m

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PHOTO 9 SC15-203_009_25.5 - 28.1 m

PHOTO 10 SC15-203_010_28.1 - 30.1 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 1 SC15-204_001_0 - 4.7 m

PHOTO 2 SC15-204_002_4.7 - 8.5 m

PHOTO 3 SC15-204_003_8.5 - 11.1 m

PHOTO 4 SC15-204_004_11.1 - 14.0 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 5 SC15-204_005_14.0 - 16.9 m

PHOTO 6 SC15-204_006_16.9 - 19.5 m

PHOTO 7 SC15-204_007_19.5 - 22.2 m

PHOTO 8 SC15-204_008_22.2 - 25.0 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 9 SC15-204_009_25.0 - 27.7 m

PHOTO 10 SC15-204_010_27.7 - 30.32 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

Knight Piésold
CONSULTING

PHOTO 1 SC15-205_001_0 - 4.5 m

PHOTO 2 SC15-205_002_4.5 - 7.1 m

PHOTO 3 SC15-205_003_7.1 - 10.0 m

PHOTO 4 SC15-205_004_10.0 - 12.8 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 5 SC15-205_005_12.8 - 15.5 m

PHOTO 6 SC15-205_006_15.5 - 17.9 m

PHOTO 7 SC15-205_007_17.9 - 20.7 m

PHOTO 8 SC15-205_008_20.7 - 23.3 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

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CONSULTING

PHOTO 9 SC15-205_009_23.3 - 26.0 m

PHOTO 10 SC15-205_010_26.0 - 28.4 m

PHOTO 11 SC15-205_011_28.4 - 29.87 m_TD

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

APPENDIX E2

SPT PHOTOGRAPHS

(Pages E2-1 to E2-8)

PHOTO 1 SC15-181 SPT01_1.5 - 2.1 m

PHOTO 2 SC15-181 SPT02_3.0 - 3.7 m

PHOTO 3 SC15-181 SPT03_4.6 - 5.2 m

PHOTO 4 SC15-181 SPT04_6.1 - 6.2 m

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

PHOTO 1 SC15-184 SPT01_1.5 - 2.1 m

PHOTO 2 SC15-184 SPT02_3.0 - 3.7 m

PHOTO 3 SC15-184 SPT03_ 4.6 - 5.2 m

TINTINA RESOURCES INC.
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PHOTO 1 SC15-192_SPT01_1.5 - 2.1 m

PHOTO 2 SC15-192_SPT02_3.0 - 3.7 m

PHOTO 3 SC15-192_SPT03_4.6 - 5.2 m

TINTINA RESOURCES INC.
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PHOTO 1 SC15-193_SPT01_1.5 - 2.1 m

PHOTO 2 SC15-193_SPT02_3.0 - 3.7 m

TINTINA RESOURCES INC.
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PHOTO 1 SC15-196_SPT01_0.9 - 1.5 m

PHOTO 2 SC15-196_SPT01_2.4 - 3.0 m

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PHOTO 1 SC15-198_SPT01_1.5 - 1.6 m

TINTINA RESOURCES INC.
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Knight Piésold
CONSULTING

PHOTO 1 SC15-201_SPT01_0 - 0.61 m

PHOTO 2 SC15-202_SPT01_0 - 0.61 m

PHOTO 3 SC15-202_SPT02_1.52 - 2.12 m

PHOTO 4 SC15-203_SPT01_0 - 0.61 m

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PHOTO 5 SC15-203_SPT02_1.52 - 2.12 m

PHOTO 6 SC15-204_SPT01_0 - 0.61 m

PHOTO 7 SC15-205_SPT01_0 - 0.61 m

TINTINA RESOURCES INC.
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APPENDIX F

KP LOGGING METHODOLOGY

APPENDIX F1

KP SOIL LOGGING METHODOLOGY

(Pages F1-1 to F1-2)

SOIL DESCRIPTION (VISUAL-MANUAL PROCEDURE)

<u>Typical Sequence</u>: Principal soil type, lithology (coarse and very coarse soils), particle shape, particle size, secondary soil constituents, gradation, plasticity, colour and odour, compactness/consistency, structure, inclusions, moisture condition (geological interpretation).

IDENTIFICATION OF SOIL TYPE

Group	Principal Soil Type	Particle Size (mm)	Identification
		>300	
Very Coarse	BOULDERS	75 to 300	Particle Size
	COBBLES		Particle Size
Coarse	GRAVEL Coarse	19 -75	Particle Size
	Fine	4.75 -19	
	SAND Coarse	2.0 -4.75	Particle Size
	Medium	0.425 -2.0	
	Fine	0.075 -.425	
Fine Soils (>50% Clay/Silt)	SILT	0.002 to 0.075	Exhibits little plasticity and marked dilatancy, slightly granular or silky to the touch, disintegrates in water, lumps dry quickly, possesses cohesion (the particles stick together to give a relatively firm mass) but can be powdered easily between fingers. Plots below the A-Line on the Plasticity Chart (Plasticity Index verses Liquid Limit). Dilatancy test for identifying silt: Moisten soil sample on hand and then jar it against the other hand several times. Dilatancy is shown by the appearance of a shiny film of water. When the sample is squeezed or pressed with the fingers the surface dulls as it stiffens.
	CLAY	<0.002	Dry lumps can be broken but not powdered between the fingers, they also disintegrate under water but more slowly than silt; smooth to the touch; exhibits plasticity but not dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually showing cracks. Plots above the A-Line on the Plasticity Chart.
Organic Soils	ORGANIC CLAY/SILT	Varies	Contains much organic material
	PEAT	Varies	Predominantly plant remains, low bulk density

COMPOSITE SOIL DESCRIPTION

Descriptive Term		Percentage Range
noun	CLAY, SILT, SAND, GRAVEL, COBBLES, BOULDERS	>35% and main fraction
"and"	and gravel, etc…	> 35%
adjective	gravelly, sandy, silty, etc…	20 – 35%
"some"	some gravel, cobbles, etc…	10 – 20%
"trace"	trace sand, trace silt etc…	1 – 10%

Notes:
(1) Composite soil descriptions should be checked from the results of particle size analyses and Atterberg Limits and any necessary changes should be made to the logs.
(2) For soils with between 20% and 35% cobbles and boulders, the log should read "many cobbles/boulders", as appropriate.

PARTICLE SHAPE
The shape of gravel, cobbles, and boulders are described using the following terms:
angular – sharp corners
subangular – slightly rounded corners
rounded – smooth rounded surface
subrounded – no angular corners
platy – flat, plate shaped

GRADATION
Well graded – having a wide range of grain sizes and substantial amounts of all intermediate sizes
Poorly graded – having a high proportion of particles predominantly of one grain size (uniformly graded) or having particles of large and small sizes with a relatively low proportion of intermediate sizes (gap-graded).

PLASTICITY (Clays and silts)
<u>Non Plastic</u>: a 1/8" (3 mm) thread cannot be rolled at any water content.
<u>Low Plasticity</u>: the thread can barely be rolled.
<u>Medium Plasticity</u>: the thread is easy to roll and not much time is required to reach the plastic limit (i.e. it starts to crumble).
<u>High Plasticity</u>: it takes considerable time rolling to reach the plastic limit.
Plasticity should be confirmed from the results of Atterberg Limits tests.

COLOUR AND ODOUR
Colour and odour of soils described. Odour may indicate organic inclusions or give evidence of soil contamination.
A typical description of colour might be "dark red brown". Descriptors can be added, such as mottled and spotted. Mottled soils are characterized by alternate streaks of oxidized zones (red, orange and yellow) and zones of insufficient oxygen (greys and blues).

COMPACTNESS/CONSISTENCY

Soil Group	Term	Identification
Very Coarse Soils (Cobbles & Boulders)	Loose Dense	By inspection of voids and particle packing in the field
Coarse Soils (Sands & Gravels	Very Loose Loose Compact Dense Very Dense	SPT 'N' value 0 to 4 SPT 'N' value 4 to10 SPT 'N' value 10 to 30 SPT 'N' value 30 to 50 SPT 'N' value >50
Fine Soils (Clays & Silts)	Very Soft Soft Firm Stiff Very Stiff Hard	Undrained Shear Strength (USS) <12 kPa; easily penetrated several cm by fist USS 12-25 kPa; easily penetrated several cm by thumb USS 25-50 kPa; can be penetrated several cm by thumb with moderate effort USS 50-100 kPa; readily indented by thumb but penetrated only with great effort USS 100-200 kPa; readily indented by thumb nail USS > 200 kPa; indented with difficulty by thumb nail
Organic Soils (incl. Peat)	Firm Spongy Plastic	Fibres already compressed together Very compressible and open structure Can be moulded in hand and smears fingers

STRUCTURE

Soil Group	Term	Descriptor
Coarse & Fine Soils	Massive Stratified Laminated Varved Lenses Slickensided Blocky Cemented Leached	No evidence of layering Layers of different soil types that are more than 20 mm thick Layers are less than 20 mm thick (as above), with alternating clay and silt/fine sand layers variable in thickness and shape Discontinuities in clay that are shiny and smooth due to shear displacement The soil has a block-like structure Minerals have precipitated from solution within the soil Minerals have been removed by percolating groundwater
Fine Soils	Fissured Friable Nuggeted	Discontinuities associated with glacial unloading (spacing described as rock joints) Soil crumbles to small pieces when disturbed Soil breaks into small cubes, often due to frost penetration
Organic Soils (including Peat)	Fibrous Amorphous	Plant remains recognizable; retains some strength Recognizable plant remains absent

MOISTURE CONDITION

Condition	Description	Coarse Soils	Fine Soils
Dry	Looks and feels dry	Runs freely through hands	Hard, powdery or friable
Moist	Feels cool, darkened in colour	Tends to cohere	Weakened by moisture, no free water on hands when remoulded
Wet			Weakened by moisture, free water forms on hands when handling
Saturated	Feels cool, darkened in colour and free, and free water is present on the sample		

GEOLOGICAL INTERPRETATION

Where applicable a bracketed term is included to describe soil genesis e.g. Alluvium, Glacial Till, Fluvioglacial Deposits, Fill.

EXAMPLES

SAND, fine to medium, some gravel of quartzite, subangular to subrounded, fine to coarse, trace silt; poorly graded; grey, loose, stratified with trace layers (50 to 100 mm-thick) of silt, trace fine sand, soft, wet. (Alluvium).
PEAT, trace fine to medium sand; grey brown, organic odour, spongy, fibrous, saturated (Organic Swamp).
CLAY/SILT, trace fine sand, trace subrounded medium gravel of granodiorite; medium plasticity, grey, firm, varved with layers (2 to 10 mm-thick) of fine sand, trace roots, moist (Glacial Lake Deposit).
BOULDERS of granite, subangular, trace subangular cobbles; some silt, some subangular fine to coarse gravel, trace sand; orange brown, compact, moist (Colluvium).
SILT, trace fine to medium sand; low plasticity, red brown; stiff, with trace polished and slickensided shear surfaces with 1 to 2 mm of kaolin infill, dry (Residual Soil).
BOULDER sized fragments of sandstone, subangular, many cobble sized fragments, trace subangular to angular fine to coarse gravel size fragments, trace medium to coarse sand; brown grey, dense, some plant remains (Fill).

NOTES

(1) Additional details on logs: equipment used, progress, test results, groundwater observations, details of piezometer/monitoring well installations, ease of excavation and stability of test pits.
(2) Terms such as "CLAY and SAND" should be avoided - either describe as a cohesive or cohesionless soil.
(3) Coarse soils with a clay/silt content of greater than about 35% (e.g. clayey Sand) can exhibit the engineering behaviour of fine soils
(4) Frozen soils described in accordance with ASTM D4083, 2001.

KEY REFERENCES

ASTM D2488-93. Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
Canadian Geotechnical Society, 2006. Canadian Foundation Engineering Manual, 4th Edition.

APPENDIX F2

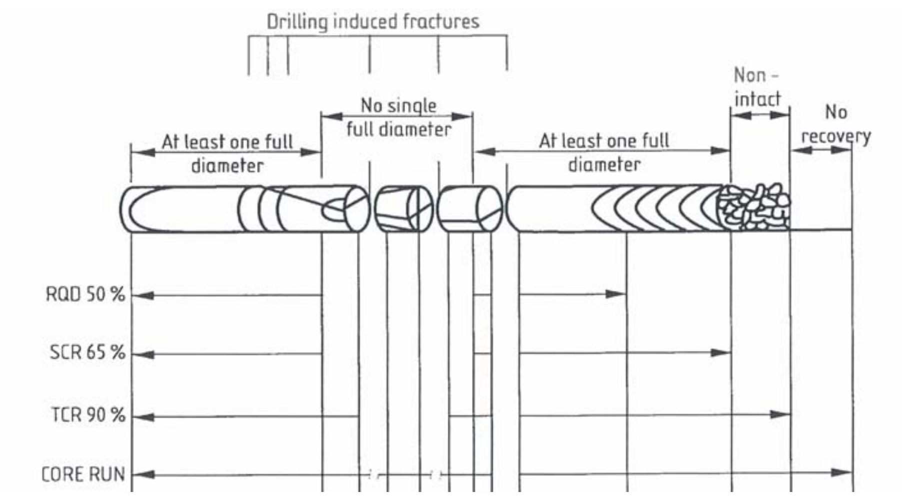
KP ROCK LOGGING METHODOLOGY

(Pages F2-1 to F2-3)

ROCK DESCRIPTION (VISUAL-MANUAL PROCEDURE)

FRACTURE LOG
Total Core Recovery (TCR) (%): Ratio of total length of core recovered (solid and non-intact) to length of the core run.
Solid Core Recovery (SCR) (%): Ratio of total length of solid core recovered to length of the core run.
Rock Quality Designation (RQD) (%): Ratio of total length of solid core pieces longer than 100 mm to length of the core run.
Fracture Index (FI): A count of the number of fractures over a length of rock core of similar intensity of fracturing. Reported as number of fractures/m.
Notes:
(1) 'Solid Core' has a full diameter, but not necessarily a full circumference.
(2) 'Non-intact' core is fragmented.
(3) TCR, SCR and RQD are applied to core runs; FI is applied to sections of core with similar fracture intensity.
(4) TCR applies to soil and rock; SCR, RQD and FI are only applicable to bedrock.
(5) Any drilling induced fractures and incipient fractures should be excluded from the description of the fracture state, but should be described in the text.

Application of Fracture State Terms For Rock Cores:



DESCRIPTION
Typical Sequence: ROCK NAME, grain size, texture, colour, strength, weathering, structure, discontinuities (geological interpretation).

ROCK NAME AND GRAIN SIZE

Sedimentary Rocks:
MUDSTONE/CLAYSTONE (<0.002 mm); SILTSTONE (0.002 – 0.06); SANDSTONE (fine-grained: 0.06 mm to 0.2 mm, medium-grained: 0.2 mm to 0.6 mm, coarse-grained: 0.6 mm to 2 mm); CONGLOMERATE and BRECCIA, (>2 mm); COAL, LIMESTONE, DOLOMITE, CHALK.
Igneous Rocks:
Intrusive Igneous Rocks:
SYENITE, GRANITE, QUARTZ MONZONITE< GRANODIORITE, DIORITE, GABBRO, PYROXENITE, PERIDOTITE, DUNITE (Batholiths, Stocks, Felsic to Mafic).. PEGMATITE, APLITE, DOLERITE (Dykes, Sills – Felsic to Mafic).
Fine grained 0.06 – 2.0 mm, medium grained 2.0 – 6.0 mm, coarse grained 6.0 -20.0 mm, pegmatite – with crystals greater than 20 mm in size.
Extrusive Igneous Rocks:
TRACHYTE, RHYOLITE, DACITE, ANDESITE, BASALT (Felsic to Mafic).
Pyroclastic Rocks:
AGGLOMERATE/PYROCLASTIC BRECCIA (>60 mm rounded/angular fragments).
LAPILLI TUFF (2 to 60 mm fragments), coarse ash CRYSTAL(1)/LITHIC(2) TUFF (0.06 – 2.0 mm fragments), fine ash Tuff (<0.06 mm fragments), VITRIC TUFF (predominantly composed of volcanic glass)
Notes (1) Crystal fragments predominate, (2) Rock Fragments predominate.
Metamorphic Rocks:
Foliated: MIGMATITE; GNEISS; SCHIST (>0.06 mm), PHYLLITE (<0.06 mm), SLATE, MYLONITE.
Non-Foliated: FAULT BRECCIA, MARBLE, QUARTZITE, GRANULITE, HORNFELS, AMPHIBOLITE, SERPENTINITE, ECLOGITE.

TEXTURE
Applicable mainly to igneous rocks.
Descriptors: Equigranular, inequigranular, megacrystic, porphyritic, crystalline, cryptocrtstalline, aphanitic

COLOUR
Value: e.g. Light, dark
Chroma: e.g. Reddish, yellowish
Hue: e.g. Brown, Grey
Descriptors: e.g. Mottled, spotted

STRENGTH

Term	Field Estimate of Strength	UCS (MPa)
Extremely Strong	Specimen can only be chipped with a geological hammer	>250
Very Strong	Many blows of a geological hammer required to fracture sample	100 - 250
Strong	More than one blow of a geological hammer required to fracture sample	50 - 100
Medium Strong	Cannot be scraped or peeled with pocket knife, sample fractures with a single blow from a geological hammer	25 - 50
Weak	Can be peeled with pocket knife with difficulty, shallow indentation made by firm blow with the point of geological hammer	5 -25
Very Weak	Crumbles under firm blows with point of geological hammer, can be peeled with pocket knife	1 - 5
Extremely Weak	Indented by thumb nail	0.25 - 1

WEATHERING

Rock is moderately strong or stronger in fresh state
(Most Igneous & Metamorphic Rocks & Sandstones)

Rock is moderately weak or weaker in fresh state
(Most fine grained Sedimentary Rocks)

1. CLASSIFICATION FOR UNIFORM MATERIALS

Grade	Classifier	Typical Characteristics
I	Fresh	Unchanged.
II	Slightly weathered	Slight discoloration, slight weakening.
III	Moderately weathered	Considerably weakened, penetrative discoloration. Large pieces cannot be broken by hand.
IV	Highly weathered	Can be broken by hand. Does not readily disaggregate (slake) when immersed in water.
V	Completely weathered	Can be crumbled, slakes, original texture apparent.
VI	Residual Soil	Soil derived by in situ weathering but retaining none of original texture or fabric.

2. CLASSIFICATION INCORPORATING MATERIAL AND MASS FEATURES

Class	Classifier	Typical Characteristics
A	Unweathered	Unchanged
B	Partially weathered	Slight brown oxidation, slight weakening and slightly reduced fracture spacing.
C	Distinctly weathered	Further weakened, much closer fracture spacing. Grey reduction.
D	Destructed	Greatly weakened, mottled, ordered lithorelicts in a matrix becoming weakened and disordered, bedding disturbed.
E	Residual or reworked	Matrix with occasional altered, random or 'apparent' lithorelicts, bedding destroyed. Classed as reworked when foreign inclusions are present as a result of transportation.

3. SPECIAL CASES e.g. karst; rocks in arid climates.

1b. ZONAL CLASSIFICATION FOR HETEROGENOUS MASSES WHERE APPROPRIATE **(Descriptions in test pits, excavations and exposures)**

Zone	Proportions of material grades	Typical Characteristics
1	100% G I to G III	Behaves as rock.
2	>90% G I to G III; <10% G IV to G VI	Weak materials along discontinuities, shear strength, stiffness and permeability affected.
3	50% to 90% G I to G III; 10% to 50% G IV to G VI	Rock framework still locked and controls strength and stiffness, matrix controls permeability.
4	30% to 50% G I to G III; 50% to 70% G IV to G VI	Rock framework contributes to strength; matrix or weathering products control stiffness and permeability.
5	<30% G I to G III; >70% G IV to G VI	Weak grades will control behaviour. Corestones may be significant for construction.
6	100% G IV to G VI	May behave as soil although relict fabric may still be significant.

Note: (1) For tropical weathering profiles, where chemical decomposition is the predominant weathering process, 'decomposed' is used instead of 'weathering'.

STRUCTURE

Term	Spacing (mm)
Thinly laminated (sedimentary), very narrowly flow banded (igneous), very narrowly foliated (metamorphic)	< 6
Thickly laminated (sedimentary), narrowly flow banded (igneous), narrowly foliated (metamorphic)	6 - 20
Very thinly bedded (sedimentary)	20 - 60
Thinly bedded (sedimentary)	60 - 200
Medium bedded (sedimentary)	200 -600
Thickly bedded (sedimentary)	600 - 2000
Very thickly bedded (sedimentary)	>2000

DISCONTINUITIES

Joint sets are described separately. The details of the discontinuities are described in the following order:

Spacing$^{(1)}$: Extremely wide (>6 m), very wide (2 to 6m), wide (600 mm to 2 m), moderately close (200 mm to 600 mm), close (60 mm to 200 mm), very close (20 mm to 60 mm), extremely close (<20 mm)

Persistence$^{(2)}$: Very high (>20 m), High (10 to 20 m), medium (3 to 10 m), low (1 to 3 m), very low (< 1 m).

Orientation: Angle of Dip/Dip Direction$^{(1)}$(º).

Small-scale Roughness: Planar, undulating or stepped (qualified as rough, smooth, polished or slickensided, as a prefix).

Aperture$^{(1)}$: Very tight (<0.1 mm), tight (0.1 to 0.25 mm), partly open (0.25 to 0.5 mm), open (0.5 to 2.5 mm), moderately wide (2.5 to 10 mm), wide (>10 mm), very wide (1 to 10 cm), extremely wide (10 to 100 cm), cavernous (>1m).

Infilling: Clean, surface staining (colour), soil infilling (describe strength and composition), decomposed/disintegrated rock (describe strength and weathering grade), mineral coatings (calcite, quartz, chlorite, kaolin etc).

Notes: (1) Not always measurable in core samples. (2) Only measurable in excavations and exposures.

GEOLOGICAL INTERPRETATION

Where possible, a bracketed term is included to describe the rock formation.

EXAMPLES

Descriptions of Core Samples:

(i) SCHIST, green grey mottled orange brown, moderately weak, moderately weathered, very narrowly foliated; foliation planes extremely closely spaced, dipping 10º to 20º, smooth, undulating, open, with orange brown (iron oxide) staining penetrating about 20 mm, green (chlorite) staining and up to 1 mm of soft clay infill; Joints dip 60º to 70º, smooth, planar, partly open with iron oxide staining.

(ii) CRYSTAL TUFF, fine ash, greenish dark grey, very strong, slightly weathered; 2 joint sets: (1) widely-spaced, dipping 5º, rough, undulating with orange brown (iron oxide) staining penetrating 10 mm; (2) sub-vertical, rough, undulating, open, locally with black (manganese) and green (chlorite) staining.

Descriptions of Excavations/Exposures:

(i) SANDSTONE, fine to medium-grained, brownish grey, medium strong, slightly weathered, thickly bedded; bedding planes: widely-spaced, high persistence, dipping 20º/320º, rough, undulating, moderately wide with red brown (iron oxide) staining penetrating about 5 mm; two joint sets: (1) medium spaced, medium persistence, dipping 75º/045º, rough, planar, moderately wide with red brown (iron oxide) staining penetrating 10 mm; (2) closely to medium-spaced, low persistence, dipping 45º/270º, rough, undulating, tight, clean.

(ii) GRANITE, medium-grained, porphyritic, greyish red brown mottled orangish brown, very weak, highly decomposed; some boulder-sized corestones, brownish grey, moderately strong, moderately decomposed; widely-spaced relict joints, high persistence, dipping 20º/270º, smooth, planar, partly open with up to 5 mm of kaolin infill (Zone 5).

REFERENCES: ISRM 1981a: Rock Characterization, Testing and Monitoring, ISRM Suggested Method.
ISRM 1981b: Suggested Method for the Quantitative Description of Discontinuities in Rock Masses.
BS 5930 1999: Code of Practice for Site Investigations.

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TABLE E2.1

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

2015 GEOTECHNICAL SITE INVESTIGATION
ROCK MASS RATING (RMR) CLASSIFICATION SYSTEM

Print Mar/26/15 16:40:55

												VALUE	RATING
Intact Rock Strength	PLST	10	8	6.5	5.5	5	4.5	3	2	1	<1		
	UCS, MPa	250	200	160	140	125	110	75	50	25	< 25		
	Field Est.	chipped by hammer		many blows by hammer to break				single blow		pocket knife			
	RATING	15	14	13	12	11	10	8	6	4	< 3		
RQD	RQD %	100	90	80	70	60	50	40	30	20	0		
	RATING	20	18	16	14	12	10	9	5	4	3		
Joint Spacing	Js, cm	> 200	160	130	90	60	40	20	15	10	<6		
	RATING	20	18	16	14	12	10	9	8	7	5		

								Set 1	Set 2	Set 3	VALUE	RATING
							Orientation					
							J Spacing					
Joint Condition	**Persistence**	< 1 m	1 - 3m	3 - 10m	10 - 20 m	> 20m						
	RATING	6	4	2	1	0						
	Aperture	None	< 0.1 mm	0.1 - 1.0	1 - 5	5 - 10						
	RATING	6	5	4	1	0						
	Roughness	V Rough	Rough	SL Rough	Smooth	Slicks						
	RATING	6	5	3	1	0						
	Infilling	None	Hard Infilling		Soft Infilling							
			< 5 mm	> 5 mm	< 5mm	> 5 mm						
	RATING	6	4	3	2	0						
	Weathering	FRESH	SW	MW	HW	CW						
	RATING	6	5	3	1	0						
							Sub-Total					

							VALUE	RATING
Groundwater	**Inflow** l/min/10m	None	< 10	10 - 25	25 -125	> 125		
		Dry	Damp	Wet	Dripping	Flowing		
	RATING	15	10	7	4	0		

Adjustment for Joint Orientation	DIP OF ADVERSE JOINT SET			VALUE	RATING
	0 - 20	20 - 45	45 - 90		
Strike Perpendicular to Tunnel Axis drive with Dip	Unfavourable	Favourable	Very Favourable		
	-10	-2	0		
Strike Perpendicular to Tunnel Axis drive against Dip	Unfavourable	Unfavourable	Fair		
	-10	-10	-5		
Strike Parallel to Tunnel	Unfavourable	Fair	Very Unfavourable		
	-10	-5	-12		

RMR RATING	80 - 100	60 - 80	40 - 60	20 - 40	0 - 20	
DESCRIPTION	**VERY GOOD**	**GOOD**	**FAIR**	**POOR**	**VERY POOR**	
ROCK CLASS	1	2	3	4	5	

\\knightpiesold.local\VA-Prj$\1\01\00460\03\A\Report\Appendices\E2 KP Rock Logging Methods\[Table E2.1 RMR Classification.xls]RMR-1989 Table

NOTE:

1. REFERENCE: BIENIAWSKI, 1989.

0	30MAR'15	ISSUED WITH REPORT VA101-460/3-1	JBC	GM
REV	DATE	DESCRIPTION	PREP'D	REV'D

APPENDIX B

EOR CONFIRMATION

(Pages B-1 to B-4)

October 2, 2015

File No.:VA101-00460/03-A.01
Cont. No.:VA15-03202

FS 64925
EMS 550121
OHS 550122

Mr. Bob Jacko
Vice President Operations
Tintina Resources Inc.
1110 - 1111 West Georgia Street
Vancouver, British Columbia
Canada, V6E 4M3

Dear Bob,

Re: Tintina Resources Inc. Tailings Storage Facility: Ken Brouwer, P.E. Designation as Engineer of Record

Tintina Resources Inc. (TRI) is completing the design and undertaking permitting for the Black Butte Copper Project. TRI will be required by Senate Bill 409 (SB 409) to designate an Engineer of Record (EOR) for their tailings storage facility (TSF).

SB 409 specified that the EOR must be a Qualified Engineer who is the lead designer for a TSF. A Qualified Engineer is defined as a Professional Engineer who has a minimum of 10 years of direct experience with the design and construction of tailings storage facilities and has the appropriate professional and educational credentials to effectively determine appropriate parameters for the safe design, construction, operation, and closure of a tailings storage facility. A Professional Engineer means a registered Professional Engineer licensed to practice in Montana.

The EOR duties consist of the following tasks:

- Review design and other documents pertaining to the TSF.
- Certify and seal design or other documents pertaining to TSF submitted to the Department of Environmental Quality (DEQ).
- Complete an annual inspection of the TSF.
- Notify the Operator when credible evidence indicates the TSF is not performing as intended.
- Immediately notify the Operator and the DEQ when credible evidence indicates that the TSF presents an imminent threat or a high potential for imminent threat to human health or the environment.
- Notify the DEQ in writing if there is a change in the EOR.

TRI has requested Mr. Ken Brouwer of Knight Piésold Ltd. (KP) fulfil the role and duties of EOR for their tailings storage facility at this early stage of design and permitting, extending through future construction and operations. Mr. Brouwer meets the requirements for the role of EOR. He is a registered Professional Engineer in the State of Montana (License 10020PE) with over thirty years of engineering experience. Mr. Brouwer’s areas of expertise include geotechnical investigations, tailings management, dam design, construction management, hydrogeological evaluation, rock mechanics, heap leach pads, water management, regulatory liaison and permitting support. A short form resume detailing Mr. Brouwer’s project experience and a copy of his Montana Professional Engineer registration are attached. Additional detail can be provided upon request.

This letter has been prepared to confirm that Mr. Brouwer is available and is pleased to fulfil the EOR role for TRI’s tailings storage facility. Mr. Brouwer and KP acknowledge that an Independent Review Panel (IRP) will be retained by TRI to review the design, construction and operation of the tailings storage facility. Mr. Brouwer and KP look forward to working with TRI and the IRP.

Please direct any questions to the undersigned.

Yours truly,
KNIGHT PIESOLD LTD.

MONTANA
Oct 2, 2015
KEN J.
BROUWER
10020 PE
REGISTERED
PROFESSIONAL ENGINEER

Prepared: Ken Brouwer, P.E.
President

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

Approval that this document adheres to Knight Piésold Quality Systems: KE.

Attachments:
Resume: Ken Brouwer, Knight Piésold Ltd.
Ken J. Brouwer, State of Montana Professional Engineer Registration

/kjb

KEN J. BROUWER, P.ENG., P.E.
PRESIDENT

Mr. Ken Brouwer is the President of Knight Piésold Ltd. He has been with Knight Piésold Ltd. since 1985 and has over 30 years of experience in site investigations, design, construction, operation and closure of open pit mines, tailings impoundments, heap leach facilities, and water management systems. His extensive experience includes projects in Canada and throughout the Americas, as well as in Asia, Africa and Europe.

KEY SKILLS / QUALIFICATIONS

- Dam design, groundwater studies, water management, and rock mechanics
- Tailings management, waste rock management, foundation design, and slope stability
- Permitting support and project management
- Registered professional engineer in British Columbia, Northwest Territories, Nunavut, Alaska, Montana, and Washington

SPECIFIC RELEVANT EXPERIENCE

Mr. Brouwer has served as the Project Director, Senior Reviewer and/or Project Manager for many projects including:

- **New Gold Inc., New Afton Mine**, BC, Canada
- **EcuaCorriente S.A., Mirador Copper Project**, Ecuador
- **Stillwater Mining Co., Stillwater and East Boulder Mines**, MT, USA
- **Lundin Mining Corp., Candelaria Mine**, Chile
- **Lundin Mining Corp., Pinto Valley Mine**, AZ, USA
- **Lundin Mining Corp., Neves-Corvo Mine**, Portugal
- **Lundin Mining Corp., Eagle Mine**, MI, USA
- **Zinkgruvan Mining AB, Zinkgruvan Mine**, Sweden
- **HudBay Peru S.A.C., Constancia Project**, Peru
- **Quadra FNX Mining Ltd. (now KGHM), Sierra Gorda Project**, Chile
- **Fluor Daniel / SADE, Alumbrera Mine**, Argentina
- **Silver Standard Resources, Diablillos Project**, Argentina
- **Geologix Explorations Ltd.**, **Tepal Project**, Mexico
- **Kimber Resources Inc., Monterde Project**, Mexico
- **Nystar Campo Morado, Campo Morado Mine**, Mexico
- **Coeur D'Alene Mines Corporation, Palmarejo Project**, Mexico
- **Sunridge Gold Corp., Asmara Projects**, Eritrea
- **Sunridge Gold Corp., Debarwa Project**, Eritrea
- **KGHM Robinson Nevada Mining Company, Robinson Mine**, NV, USA
- **Pebble Limited Partnership, Pebble Project**, AK, USA
- **Thompson Creek Metals Company Inc., Mt. Milligan Project**, BC, Canada
- **Northcliff Resources Ltd., Sisson Project**, NB, Canada
- **Teck Resources Limited, Schaft Creek**, BC, Canada
- **Taseko Mines Ltd., New Prosperity Project**, BC, Canada
- **Casino Mining Corp., Casino Project**, YT, Canada
- **New Gold Inc., Blackwater Project**, BC, Canada
- **North American Tungsten Corporation, Cantung Mine,** NT, Canada
- **Apollo Gold, Montana Tunnels Mine**, MT, USA
- **Abacus Mining and Exploration Corporation, Afton and Ajax Projects**, BC, Canada
- **Avanti Kitsault Mine Ltd., Kitsault Project**, BC, Canada
- **Baffinland Iron Mines Corporation, Mary River Project**, NU, Canada
- **Mount Polley Mine**, BC, Canada
- **Northern Exploration Limited, Kemess North and Kemess South Mine**, BC, Canada

Knight Piésold Ltd.
Canada

EDUCATION

M.Eng. Civil Engineering
University of British Columbia
Canada, 1985

B.A.Sc. Geological Engineering
University of British Columbia
Canada, 1982

SPECIALIZATIONS

- Geotechnical
- Open Pit Slope Stability
- Rock Mechanics
- Mine Permitting
- Mine Tailings Disposal
- Heap Leach Pads
- Dam Design
- Groundwater Studies
- Slope Studies
- Hydrogeology
- Reclamation and Closure
- Project Management

The Montana State Board of Professional Engineers and Land Surveyors

Certifies That It Has Registered and
Authorized to Practice in
The State of Montana

Kenneth J. Brouwer

AS

Professional Engineer

IN TESTIMONY WHEREOF THIS CERTIFICATE HAS BEEN ISSUED BY THE AUTHORITY OF THE BOARD.

CERTIFICATE NO. 10020 PE *ISSUED* October 26, 1990

Not Valid Unless
Current Annual Renewal
Posted Here

Robert S. Custer
Chairman

Fred E. Walter
Secretary

APPENDIX C

DESIGN BASIS

(Pages C-1 to C-3)

Knight Piésold
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TABLE A.1

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

FEASIBILITY DESIGN REPORT
SUMMARY OF DESIGN BASIS FOR THE CTF

Print: Apr/20/2017 13:46:09

ITEM	VALUE	SOURCE (Assumption if none noted)	DATE	Entered By:
1.0 GENERAL				
Site Coordinates	Approximately 506 000 E , 5 181 000 N (UTM NAD 83 Zone 12 N (Lat: 46.78°, Long: -110.92°)	Google Maps	28-Apr-15	GIM
Site Elevation	Approximately 1700 to 1840 masl	10 m Topography from TRI	28-Apr-15	GIM
Codes and Standards	SB 409, ASTM, ICOLD (1989 - 2010), FEMA (2004), Administrative Rules of Montana (2012) and related codes.	Various Sources	4-May-15	JEF
	Reclamation plan structured around the requirements of the Montana Metal Mine Reclamation Act		14-May-15	GIM
Mine Production	Total ore milled = 13.2 million tonnes (Mt)	TRI	10-Oct-15	GIM
	Throughput = 1000 to 3 300 tonnes per day, with peak production during Years 5 to 13 of operations.	TRI	10-Oct-15	GIM
	Tonnes Concentrate Extracted from Ore = 1.41 Mt	TRI	10-Oct-15	GIM
	Operating Mine Life = approximately 15 years	TRI	10-Oct-15	GIM
Climate Conditions	Mean Annual Precipitation = 416 mm	Knight Piesold Preliminary Hydromet Analysis	6-May-15	JEF
	Mean Annual Pond Evaporation = 514 mm	Knight Piesold Preliminary Hydromet Analysis	6-May-15	JEF
	Mean Annual Temperature = 1.9 °C	Knight Piesold Preliminary Hydromet Analysis	14-May-15	JL
	Site Runoff Coefficient = 0.2	Assumed value	6-Aug-15	GIM
	Mean Annual Wind Speed = 2.6 m/s	Western Regional Climate Center Record, Bozeman MTU station	28-Apr-15	GIM
	1 in 2 year 24 hour precipitation = 35 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 5 year 24 hour precipitation = 49 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
Snow & Rainfall Storm Events	1 in 10 year 24 hour precipitation = 58 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 15 year 24 hour precipitation = 64 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 20 year 24 hour precipitation = 67 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 25 year 24 hour precipitation = 70 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 50 year 24 hour precipitation = 79 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 100 year 24 hour precipitation = 88 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 200 year 24 hour precipitation = 96 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 500 year 24 hour precipitation = 108 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 100 year snowpack = 290 mm	Knight Piesold Work File #10 (VA101-460/03)	15-May-15	JL
	Probable Maximum Precipitation 24 hour precipitation = 560 mm	Knight Piesold Work File #14 (VA101-460/03)	26-May-15	GIM
	Probable Maximum Flood 24 hour storm event = 850 mm	Knight Piesold Work File #15 (VA101-460/03)	26-May-15	GIM
Dam Hazard Classification	Dam Hazard Classification of "HIGH" in compliance with State, Federal and International Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	GIM
Geology	Ore deposit hosted in Newland Formation shale (Proterozoic calcareous shale)	Tintina Resources Inc.	6-Aug-15	GIM
Seismic Design Parameters	Operating Basis Earthquake (OBE) = 1/22 year earthquake event	Knight Piésold Work File #9 (VA101-460/03)	6-Aug-15	GIM
	Maximum Design Earthquake (MDE) = 1/10,000 year earthquake event	Senate Bill 409, Knight Piésold Work File #44 (VA101-460/03)	9-Oct-15	GIM
	Earthquake Design Ground Motion (EDGM) = 0.35 g	Knight Piésold Work File #44 (VA101-460/03)	6-Oct-15	GIM
2.0 MINE WASTE MANAGEMENT				
2.1 Waste Properties				
Tailings	Total tailings production = 13.2 Mt	TRI	28-Apr-15	GIM
	Dry density = 2.0 t/m3	Tailings lab testing by KP	28-Apr-15	GIM
	55% stored in surface tailings facility, and 45% pumped underground as paste backfill.	AMEC Preliminary Underground Backfill Plan	28-Apr-15	GIM
	Specific Gravity of Solids = 3.77	SG Value provided by TRI sub-consultant Jeff Austin (2015)	28-Apr-15	GIM
	Single tailings stream (79% solids by weight)	TRI	6-Oct-15	GIM
	Tailings thickened and mixed with 0.5-2% cement, fly ash, or slag.	TRI	6-Oct-15	GIM
Potentially Acid Generating (PAG) Waste Rock	PAG co-disposed with tailings = 0.7 Mt	TRI	12-May-15	GIM
	All waste rock on surface to be disposed in the CTF.	TRI	28-Apr-15	GIM
	0.5 Mt of PAG Waste Rock generated during pre-production years.	Estimate based on AMEC mine plan	6-Aug-15	GIM
	Compacted dry density of waste rock = 2.0 t/m³		28-Apr-15	GIM
	Specific Gravity of Waste Rock = 2.0 t/m3		14-May-15	GIM
	Waste Rock to be placed in tempporary waste rock pad during Construction and moved into CTF basin prior to mill start up.		28-Apr-15	GIM
Topsoil	'A' and 'B' Horizons from topsoil and overburden stripping activities to be stockpiled separately for use in reclamation.	Geomin Resources Inc.	23-Feb-17	GIM
	'A' Horizon = top soils, average thickness of approximately 0.3 m across project site.	Geomin Resources Inc.	23-Feb-17	GIM
	'B' Horizon = subsoils, average thickness of approx. 0.6 m across project site, beneath 'A' Horizon.	Geomin Resources Inc.	23-Feb-17	GIM
	0.9 m topsoil depth assumed for material volume calculations	Geomin Resources Inc.	23-Feb-17	GIM
2.2 Cemented Tailings Facility (CTF)				
Function	The impoundment provides for secure long term storage of approximately 3.56 Mm³ tailings and 0.35 Mm³ PAG waste rock, and 0.3 Mm3 of stormwater storage (4.21 Mm3 total)	Based on TRI production schedule provided October 2015	9-Jul-15	GIM
Concept	55% of total tailings storage codisposed with 0.7 Mt of PAG waste rock within an impoundment formed by a single embankment. Embankment raised in stages and constructed using the downstream method. A HDPE (100 mil) lined impoundment, developed in stages throughout mine life.		6-May-15	GIM
Storage Capacity	Starter impoundment sized for containment of tailings up to year 4 of operations (including two years pre-production to contain Waste Rock produced). Assume embankment constructed using infill borrow from impoundment shaping.		28-Apr-15	GIM
	Staged expansion of the impoundment to provide for ultimate storage capacity.		28-Apr-15	GIM
	Ultimate Embankment at Closure - 55% tailings production and co-disposed waste rock plus storage and freeboard to attenuate IDF.		28-Apr-15	GIM
Dam Hazard Classification	'HIGH' as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (PMF), as per FEMA and ICOLD guidelines.	FEMA, ICOLD	4-May-15	JEF
Flood Management - Catchment Areas	Catchment Area = approximately 35.49 ha	Determined using currently facility and diversion channel layout	14-May-15	GIM
Inflow Design Flood (IDF) Volumes	0.30 Mm3 (based on catchment area and 850 mm IDF runoff depth)		14-May-15	GIM
Design Freeboard	Minimum 2 m freeboard.		6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes		6-Aug-15	GIM
Embankment Height	Maximum height of 46 m	Measured from the highest downstream slope	6-Aug-15	GIM
Basin Grading	Minimum 0.5% to facilitate drainage to water reclaim system and seepage collection sump		29-May-15	GIM
Operational Criteria	Flood management: Precipitation and bleedwater are directed to water reclaim system by selective tailings deposition and basin grading.		28-Apr-15	GIM
	Tailings ultra-thickened with cement and fly ash added to create non-flowable tailings.		6-May-15	GIM
	Mine water pumped to PWP.		28-Apr-15	GIM
	Minimal recovery from bleeding of tailings mass.		28-Apr-15	GIM
	Excess water monitored and treated accordingly.		28-Apr-15	GIM
Closure Criteria	Fill will be placed over the tailings and waste rock to create a level surface. The impoundment will be capped by a non-permeable liner and covered with a minimum 1 m thick layer of non-PAG fill material. Diversion channels will be maintained to direct surface water around CTF.		28-Apr-15	GIM
	The capping layer and downstream embankment slopes are to be covered with a minimum of 12 inches of topsoil from stockpiles and re-vegetated with an appropriate seed mix of local grasses and plants		6-Oct-15	GIM
	The foundation drain system will be maintained to collect seepage. Seepage water will be monitored and treated as needed.		6-Oct-15	GIM
Seepage	Seepage will be controlled through the use of: -HDPE geomembrane to minimize seepage from impoundment. -Foundation drain system.		29-May-15	GIM
	Collected seepage is monitored and pumped to PWP and recycled for mill use.		28-Apr-15	GIM
Seismic	Peak horizontal ground acceleration = 0.35 g (mean hazard value) (MDE)	Knight Piésold Work File #44 (VA101-460/03)	6-Aug-15	GIM
	Earthquake Design Ground Motion (EDGM) = 1/10,000 year event (MDE)	Senate Bill 409, Knight Piésold Work File #44 (VA101-460/03)	6-Aug-15	GIM
Embankment Stability	Permanent embankment slopes to be no steeper than 2.5H:1V to facilitate reclamation, and achieving the minimum required Factors of Safety (FOSmin) for the following loading conditions:		6-Aug-15	GIM
	Evaluated based on site investigation data, laboratory testing of representative samples, and staged embankment configuration		14-May-15	GIM
	During construction (starter dam and dam raises) FOSmin = 1.3	Senate Bill 409	6-Aug-15	GIM
	Normal Operating Conditions FOSmin = 1.5	Senate Bill 409	6-Aug-15	GIM
	Seismic (Post-earthquake loading condition; full liquefaction of tailings FOSmin = 1.2	Senate Bill 409	6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m at closure to provide suitable running width for haul trucks, pipelines, and for potential future raises.		28-Apr-15	GIM
	Minimum 10 m working surfaces during downstream stepouts.		6-Aug-15	GIM
2.3 Process Water Pond (PWP)				
Function	The PWP is designed for storage of 420,000 m3 of process and stormwater.	1 year of process water storeage requirement = 200,000 m3, plus an additional 220,000 m3 for stormwater storage.	14-Jul-15	GIM
Concept	A double HDPE (100 mil) lined impoundment with geotextile barrier between layers of HDPE liner, constructed during pre-production years to contain process water for mill use recycle with additional capacity for storm event storage. Underlay liner and geotextile will collect and drain off leakage from overlay liner.		28-Apr-15	GIM
Storage Capacity	Impoundment of a minimum of 4 months of process water, storm water event water, and surplus to offset evaporation. Water volumes include 200,000 m3 of process water for mill use recycle, water from CTF (60,000 m3) and PMF event storage (160,000 m3).		6-Aug-15	GIM
Dam Hazard Classification	'HIGH' as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (PMF), as per FEMA and ICOLD guidelines.	FEMA, ICOLD	4-May-15	JEF
Flood Management - Catchment Areas	Catchment Area = approximately 19.03 ha	Determined using currently facility and diversion channel layout	14-May-15	GIM
Inflow Design Flood (IDF) Volumes	0.16 Mm3 (based on catchment area and 850 mm IDF runoff depth)		14-May-15	GIM
Design Freeboard	Minimum 2 m with additional freeboard for full containment of IDF for both CTF & PWP, and wave run-up.		6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes		6-Aug-15	GIM
Operational Criteria	Flood management: PWP will be sized to store IDF, surface water will be redirected around facilities by diversion channels.		28-Apr-15	GIM
	Mine water pumped to PWP.		28-Apr-15	GIM
	Excess water monitored and treated accordingly.		28-Apr-15	GIM
Closure Criteria	The pond will be drained off and process water will be treated before release back into water system. Residual slimes within the impoundment will be mixed with cement. The HDPE liner system will be folded into the basin of the impoundment and buried. The disturbed area will be contoured to resemble the surrounding topography and covered with topsoil and revegetated.		14-May-15	GIM
Seepage	Seepage will be controlled through the use of: - Double lined facility consisteing of 100 mil HDPE geomembraned with geotextile sandwiched between liners to collect and drain off leakage from upper liner.		28-Apr-15	GIM
	Collected seepage is monitored and pumped to PWP and recycled for mill use.		28-Apr-15	GIM
Seismic	Peak horizontal ground acceleration = 0.35 g (mean hazard value) (MDE)		6-Aug-15	GIM
	Earthquake Design Ground Motion (EDGM) = 1/10,000 year event (MDE)		6-Aug-15	GIM
Embankment Stability	Permanent embankment slopes to be no steeper than 2.5H:1V to facilitate reclamation, and achieving the minimum required Factors of Safety (FOSmin) for the following loading conditions:		6-Aug-15	GIM
	Evaluated based on site investigation data, laboratory testing of representative samples, and staged embankment configuration		14-May-15	GIM
	End of construction (starter dam and dam raises) FOSmin = 1.3	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM

Knight Piésold
CONSULTING

TABLE A.1

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

FEASIBILITY DESIGN REPORT
SUMMARY OF DESIGN BASIS FOR THE CTF

Print: Apr/20/2017 13:46:09

ITEM	VALUE		SOURCE (Assumption if none noted)	DATE	Entered By:
	Long term (at closure)	FOSmin = 1.5	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
	Seismic (Pseudo-static loading condition)	FOSmin = 1.0	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
	Seismic (Post-earthquake loading condition; full liquefaction of tailings	FOSmin = 1.5	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m at closure to provide suitable running width for haul trucks, pipelines, and for potential future raises.			28-Apr-15	GIM
3.0 WATER MANAGEMENT					
3.1 Water Management Objectives					
Freshwater Requirements & Availability	Approximately 163,000 m3 of make-up water will be required annually, sourced from dewatering of the underground mine workings.		Knight Piésold Ltd Letter Report Ref No. VA15-03200, October 7, 2015	9-Oct-15	GIM
External Water Sources	Water sourced from underground mine workings used for additional process make-up water.			6-Aug-15	GIM
Water Management Plan	Process water recycled for mill use from PWP.			28-Apr-15	GIM
	Water losses due to evaporation offset by mine site dewatering.			28-Apr-15	GIM
	Precipitation and run-off will be transferred to a water treatment plant and released.			6-Oct-15	GIM
	Excess mine inflows to be treated and released in underground LAD facility.			6-Aug-15	GIM
3.2 CTF and PWP Diversion Channels					
Function	Convey non-contact water from undisturbed mine areas during construction and operations.			6-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (850 mm over a 24 hour period)		Knight Piesold, FEMA	15-May-15	JL
Design Life	Construction Phase: 1 year, Operations Phase: 15 years.			6-May-15	JEF
Concept	Channels excavated into bedrock, lined with riprap where required.			6-May-15	JEF
Sediment Control	Diversion Ditches will flow into unlined energy dissapation and sediment control ponds. Ponds will be mucked out during dry periods.			6-Aug-15	GIM
3.3 Non-Contact Water Reservoir					
Function	Provide fresh water storage to offset mine site consumptive use. Water will be released into watershed throughout the dry season. No water from the NCWR will be used by the mine site.			6-May-15	JEF
Concept	Partially unlined impoundment to provide storage and freeboard for the freshwater to be released throughout dry periods to offset mine site consumptive water use. Upstream embankment face will have HDPE liner to prevent seepage through embankment fill.			14-May-15	GIM
Storage Capacity	Storage of 360,000 m3 freshwater and wave run-up.			6-May-15	JEF
Dam Hazard Classification	'LOW" as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.		FEMA, ICOLD, State of MT	15-May-15	JL
Inflow Design Flood (IDF)	1 in 200 year 24 hour precipitation = 96 mm			9-Oct-15	GIM
Flood Management - Catchment Areas	Catchment Area = approximately 58.3 ha		Determined using currently facility layout	9-Oct-15	GIM
Inflow Design Flood (IDF) Volumes	0.06 Mm3 (based on catchment area and 96 mm IDF runoff depth)		Knight Piesold	16-May-15	JL
Design Freeboard	2 m freeboard for full containment of fresh water and wave run-up.			6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes			6-Aug-15	GIM
Operational Criteria	Flood management: Spillway will pass through flood water in excess of required capacity into energy disappation structure.			6-May-15	GIM
	Excess water monitored for flow volumes.			6-May-15	JEF
	Fresh water sourced from Sheep Creek, pumped into the impoundment during the spring freshet.			12-May-15	GIM
Diversion Channel	Channel size to pass the 1 in 100 year 24 hour storm event.			9-Oct-15	GIM
Closure Criteria	The HDPE geomembrane liner will be removed from the upstream face of the embankment, and the embankment will be excavated out to prevent ponding of water post-closure. The embankment fill will be hauled to the CTF to be used as capping material for the CTF closure. The remaining side slopes and embankment footprint area will be cover with topsoil and revegetated.			23-Feb-17	GIM
Seepage	Seepage will be allowed to pass into groundwater system untreated as all water within NCWR is non-contact fresh water.			6-May-15	JEF
Spillway Design	Spillway Designed to convey 1 in 200 year return period flood.			6-May-15	JEF
	Spillway will be excavated into bedrock, and lined with riprap along select locations as needed.			6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m to provide suitable running width for haul trucks, pipelines, and for potential future raises.			6-May-15	JEF
3.4 Foundation Drain Collection Ponds					
Function	Collect groundwater flows and seepage from the foundation drain systems of the CTF and PWP			6-Aug-15	GIM
Concept	HDPE lined (100 mil) excavations to provide storage and freeboard to contain flows from foundation drain system, up to and including the 1 in 100 year 24 hour storm event.			6-Aug-15	GIM
Inflow Design Flood (IDF)	1 in 100 year 24 hour storm event			15-May-15	JL
Design Flood Volumes	2,000 m3 and 1,000 m3 for the CTF and PWP respecitvely (based on expected groundwater inflows to foundation drain system)			6-Aug-15	GIM
Design Freeboard	1 m freeboard for full containment of foundation drain outflows, storm event storage, and wave run-up.			6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes			6-Aug-15	GIM
Operational Criteria	Flood management: SCP will be sized to contain the design flood event including anticipated seepage water.			6-Aug-15	GIM
	Water monitored and treated accordingly.			6-Aug-15	GIM
Closure Criteria	The SCP for the CTF will be maintained in order to collect seepage from the foundation drain system for water quality monitoring. The SCP for the PWP will have the liner removed, and the pond will be filled in with general fill, covered with topsoil and revegetated.			6-Aug-15	GIM
Seepage	Seepage will be controlled through the use of HDPE geomembrane to minimize seepage from pond.			6-Aug-15	GIM
	Collected seepage is monitored and pumped back in to respective facility.			6-Aug-15	GIM
4.0 TAILINGS DISTRIBUTION & RECLAIM PIPELINE SYSTEMS					
4.1 Tailings Stream					
Design Production Rate	Tailings Production Rate of 120.8 tph (tonnes per hour)		Verbally Confirmed by TRI, 2 900 tpd (3,300 tpd minus 400 tpd to concentrate)	6-Aug-15	GIM
Physical Properties	Slurry Solids Content = 79% by weight (wt/wt)		TRI	6-May-15	JEF
	Specific Gravity of Solids = 3.77		SG Value provided by Jeff Austin (2015)	6-May-15	JEF
Plant Site Availability	Plant Site Availability of 92%.		TetraTech	6-May-15	JEF
4.2 Tailings Distribution Pipeline System					
Pipeline Specifications & Design Criteria	Single tailings stream from process mill			6-May-15	JEF
	Tailings Pipeline = 55% of tailings production rate.			6-May-15	JEF
	Single discharge offtake located at south end of CTF			6-Aug-15	GIM
	Tailings pipeline specification - 8" PN150 Steel Pipeline selected due to high pumping pressures.		MG Engineering	6-Oct-15	GIM
Emergency Discharge Plan	Tailings 'Emergency Discharge' plan is to backfill underground in case of tailings pipeline being offline.			6-Oct-15	GIM
Surge Capacity	Tailings pipeline pressure surge capacity = 20%			6-May-15	JEF
Tailings Pump	Tailings pump system to be designed by Tetra Tech			6-Oct-15	GIM
4.3 Mechancial Systems					
Pumping Systems	Two reclaim water systems for reclaim water for reuse in the mill process. Line 1: from PWP to Mill Site Line 2: CTF to PWP.			11-Aug-15	JEF
	Two seepage pumpback systems for return of seepage between HDPE geomembrane layers (leak detection and recovery): Line 1: PWP seepage collection sump recycle to PWP Line 2: CTF seepage collection sump to CTF			11-Aug-15	JEF
	Two pumpback systems for return of foundation drain flows: Line 1: PWP foundation drain collection pond to PWP Line 2: CTF foundation drain collection pond to CTF			11-Aug-15	JEF
	Source water pump system: Sheep Creek			11-Aug-15	JEF
	Two pumping systems for NCWR: Line 1: Sheep Creek source point to NCWR Line 2: NCWR to discharge point in downstream wetlands			27-May-15	GIM
General System Design Criteria	HDPE pipeline. Steel pipeline only if required to meet pipeline pressure requirements			26-May-15	RSS
	Double walled pipeline			26-May-15	RSS
	Pipeline diameter to be determined based on flow requirement			26-May-15	RSS
	HDPE Pipeline pressure selection range: DR 9 (max) to DR21 (min), rating selected to meet pump deadhead pressure capacity			26-May-15	RSS
	Pipeline design velocity: 1.5 - 2 m/s			26-May-15	RSS
	Pipeline alignment: selected to follow existing road alignments where possible			26-May-15	RSS
	No heat tracing or insulation of pipeline			26-May-15	RSS
	Air release/vacuum valves located at all high points and at least every 600 metres			26-May-15	RSS
	Pump specification: either barge or wet well mounted depending on total LOM elevation change.			26-May-15	RSS
	Motors: 0 to 250 HP use 550V motor, >250 HP use 4.16kV motor.			18-Aug-15	MAP
Reclaim Line 1 - PWP to Mill	Line 1 Reclaim system design flowrate = 615 m3/h 100% mill process water requirements and includes consideration of plant availability and 20% design factor.		This is based on the annual value from Tetra Tech (4,130,000 m3/yr) during full production and includes adjustment for 92% mill availability.	18-Aug-15	MAP
	PWP water elevation = ~1792 m		Estimated based on 200,000 m3 throughout operating year	28-May-15	GIM
	Maximum pipeline alignment elevation = 1800 m			28-May-15	GIM
	Plant Site discharge elevation = ~1790 m (top elevation of tank if discharged into Plant reclaim tank)			28-May-15	GIM
	Pump: Submersible pump in riser pipeline + stand-by unit installed on crest of PWP embankment on pad			18-Aug-15	MAP
Reclaim Line 2 - CTF to PWP	Line 2 Reclaim system design flowrate = 75 m3/h		Design to dewater the 1:100 year storm event over a 10 day period = 20.3L/s (Knight Piésold Work File #25)	11-Aug-15	JEF
	CTF Basin floor elevation = 1765 m			11-Aug-15	JEF
	CTF Underdrain sump base elevation = 1761 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1802 m			11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
	PWP closure crest elevation = 1800 m			11-Aug-15	JEF
	Pump: Submersible vertical turbine pump			18-Aug-15	MAP
Seepage Collection and Recycle Pump Line 1 - PWP pond	Line 1 Seepage pump system design flowrate = 29 m3/h		Knight Piésold Work File #26	11-Aug-15	JEF
	PWP Basin floor elevation = 1785 m			11-Aug-15	JEF
	PWP Seepage Collection Sump base elevation = 1780 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1800 m			11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
Seepage Collection and Recycle Pump Line 2 - CFT pond	Line 2 Seepage pump system design flowrate = 0.63 m3/h		Knight Piésold Work File #39	11-Aug-15	JEF
	CTF Basin floor elevation = 1765 m			11-Aug-15	JEF
	CTF Seepage Collection sump base elevation = 1761 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1799 m			11-Aug-15	JEF
	CTF discharge elevation (crest elevation of CTF) = 1799 m			11-Aug-15	JEF
Foundation Drain Collection & Recycle Pump Line 1 - PWP pond	Line 1 Seepage pump system design flowrate = 40 m3/h Design criteria = pump out of 1 in 100 year 24-hour storm event from contributing catchment over ten days.		Run-off and groundwater flows through foundation drains from 1:100 year storm event is 11.02 L/s (Knight Piésold Work File #28)	11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1800 m			11-Aug-15	JEF
	Foundation Drain Collection Pond minimum water level elevation = 1775 m		Assumed value based on topography	11-Aug-15	JEF
	Foundation Drain Collection Pond to be maintained as dry facility			11-Aug-15	JEF
	Pump: Centrifugal pump			18-Aug-15	MAP

Knight Piésold CONSULTING

TABLE A.1

TINTINA RESOURCES INC.
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FEASIBILITY DESIGN REPORT
SUMMARY OF DESIGN BASIS FOR THE CTF

Print: Apr/20/2017 13:46:09

ITEM	VALUE	SOURCE (Assumption if none noted)	DATE	Entered By:
Foundation Drain Collection & Recycle Pump Line 2 - CFT pond	Line 2 Seepage pump system design flowrate = 79 m3/h Design criteria = pump out of 1 in 100 year 24-hour storm event from contributing catchment over ten days.	Run-off and groundwater flows through foundation drains from 1:100 year storm event is 22.18 L/s (Knight Piésold Work File #6)	11-Aug-15	JEF
	CTF discharge elevation (crest elevation of CTF) = 1799 m		11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1799 m		11-Aug-15	JEF
	Foundation Drain Collection Pond minimum water level elevation = 1750 m	Assumed value based on topography	11-Aug-15	JEF
	Foundation Drain Collection Pond to be maintained as dry facility		11-Aug-15	JEF
	Pump: Centrifugal pump		18-Aug-15	MAP
Non-Contact Water Reservoir Pump System Line 1 - Sheep Creek to NCWR	Source water pump design flowrate = 215 m3/h	Design criteria = To fill the NCWR with 300,000 m3 of freshwater supply during in a 2-month freshet period assuming an additional 50,000 - 60,000 m3 reports to the NCWR from natural runoff.	11-Aug-15	JEF
	Source water minimum water level elevation = 1710 m	Based on collection point specified by Allan Kirk, cross point between Sheep Creek and county road	11-Aug-15	JEF
	NCWR Embankment Crest Elevation = 1776.5 m	As measured in Civ3D model	11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1776.5 m	Embankment crest is higher than intervening terrain.	11-Aug-15	JEF
	Pump: Vertical turbine pump		18-Aug-15	MAP
Non-Contact Water Reservoir Pump System Line 1 - NCWR to Discharge Spillway	Source water pump design flowrate = 42 m3/h	Assumes draining draining of facility prior to next season freshet sourcing (i.e. 10 months discharge from system, 2 months of filling during freshet)	11-Aug-15	JEF
	Intake water level elevation = 1765 m	Lowest point in reservoir, as measured in Civ3D model	11-Aug-15	JEF
	NCWR Embankment Crest Elevation = 1776.5 m	As measured in Civ3D model	11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1776.5 m	Embankment crest is higher than intervening terrain.	11-Aug-15	JEF
	Pump: Pontoon-mounted centrifugal pump		18-Aug-15	MAP
Instrumentation and Monitoring	Pressure gauges on each pump unit discharge line Flowmeter on main discharge line from Pump Station Reclaim VFD control: feedback loop from level control in Plant-site reclaim tank		26-May-15	RSS
5.0 Temporary Waste Rock Storage Pad				
Design Concept	Design of a temporary pad to store 500,000 t of pre-production and early operations PAG waste, including seepage collection measures.		6-Aug-15	GIM
Seepage control	HDPE geomembrane liner angled towards a run-off collection sump and culvert.		6-Aug-15	GIM
Surface water control	Run-off will be transferred via solid pipeline to a contact water pond located near the portal pad		23-Feb-17	GIM
6.0 MISCELLANEOUS				
Instrumentation and Monitoring	Vibrating wire piezometers to measure pore water pressure in the embankments and tailings mass.		6-May-15	JEF
	Inclinometers installed on embankments as required		6-May-15	JEF
	Flow monitoring equipment for foundation drain system outlet pipes.		6-May-15	JEF
	Pressure gauges and flowmeters on discharge lines of pump units.		6-May-15	JEF
Construction Materials	Bulking factor for overburden (Dry to moist SAND with some silt) is 12% before compaction, 5% after compaction		7-May-15	GIM
	Bulking factor for rock fill is 40-50% before compaction, 20% after compaction	Based on measured in situ rock density of 2.6 t/m3 and an assumed compacted rock density of 2 to 2.2 t/m3	6-Aug-15	GIM

\\KPL\VA-Prj$\1\01\00460\03\A\Report\2 - CTF WWMS Design for MOP Application\Rev 6\Appendices\Appendix A - Design Basis\[A

0	20APR'17	ISSUED WITH REPORT VA101-460/3-2	JEF	GIM
REV	DATE	DESCRIPTION	PREP'D	REV'D

APPENDIX D

DESIGN DRAWINGS

(Pages B-1 to B-40)

BLACK BUTTE COPPER PROJECT	
DRAWING NUMBERS	DESCRIPTION
C0002	INDEX SHEET
C0003	CONSTRUCTION MATERIAL SPECIFICATIONS
C1001	GENERAL ARRANGEMENT
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN
C2002	CEMENTED TAILINGS FACILITY HDPE LINER SYSTEM LAYOUT PLAN
C2003	CEMENTED TAILINGS FACILITY SECTIONS AND DETAILS
C2004	CEMENTED TAILINGS FACILITY BASIN FOUNDATION DRAIN SYSTEM PLAN
C2006	CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SECTIONS
C2008	CEMENTED TAILINGS FACILITY WASTE ROCK CO-DISPOSAL PLATFORM PLAN
C2010	CEMENTED TAILINGS FACILITY INSTRUMENTATION PLAN
C2011	CEMENTED TAILINGS FACILITY INSTRUMENTATION SECTIONS AND DETAILS
C3001	PROCESS WATER POND GRADING PLAN
C3002	PROCESS WATER POND HDPE LINER AND SEEPAGE COLLECTION LAYOUT PLAN
C3003	PROCESS WATER POND SECTIONS
C3004	PROCESS WATER POND BASIN FOUNDATION DRAIN SYSTEM PLAN
C3008	PROCESS WATER POND FOUNDATION DRAIN DETAILS
C3010	PROCESS WATER POND INSTRUMENTATION LAYOUT PLAN AND DETAIL
C4001	NON-CONTACT WATER RESERVOIR GRADING PLAN
C4002	NON-CONTACT WATER RESERVOIR HDPE LINER AND INSTRUMENTATION LAYOUT PLAN
C4003	NON-CONTACT WATER RESERVOIR SECTIONS
C4004	NON-CONTACT WATER RESERVOIR SPILLWAY CHANNEL PLAN AND PROFILE
C4005	NON-CONTACT WATER RESERVOIR SPILLWAY SECTIONS
C4006	NON-CONTACT WATER RESERVOIR DIVERSION CHANNEL PLAN
C4007	NON-CONTACT WATER RESERVOIR DIVERSION CHANNEL PROFILE AND SECTION
C5001	CEMENTED TAILINGS FACILITY DIVERSION CHANNEL PLAN AND PROFILE
C5002	PROCESS WATER POND DIVERSION CHANNEL PLAN AND PROFILE
C5003	DIVERSION CHANNEL TYPICAL SECTIONS
C5004	DIVERSION CHANNEL ENERGY DISSIPATOR PLAN AND SECTION
C5005	EROSION CONTROL BMP TYPICAL SECTIONS AND DETAILS SHEET 1 OF 2
C5006	EROSION CONTROL BMP TYPICAL SECTIONS AND DETAILS SHEET 2 OF 2
C6100	TAILINGS DELIVERY SYSTEM PLAN
C6200	CEMENTED TAILINGS FACILITY WATER MANAGEMENT SYSTEMS PIPING AND INSTRUMENTATION DIAGRAM
C6210	CEMENTED TAILINGS FACILITY SEEPAGE COLLECTION AND RECYCLE SYSTEM AND CEMENTED TAILINGS FACILITY RECLAIM SYSTEM PLAN AND PROFILE
C6220	CEMENTED TAILINGS FACILITY WATER MANAGEMENT SYSTEMS TYPICAL SECTION - 1 OF 2
C6230	CEMENTED TAILINGS FACILITY WATER MANAGEMENT SYSTEMS TYPICAL SECTIONS - 2 OF 2
C6250	RECLAIM WATER DELIVERY SYSTEM PROCESS WATER POND TO MILL SITE PIPING AND INSTRUMENTATION DIAGRAM
C6260	RECLAIM WATER DELIVERY SYSTEM PROCESS WATER POND TO MILL SITE PLAN AND PROFILE
C6270	RECLAIM WATER DELIVERY SYSTEM PROCESS WATER POND TO MILL SITE TYPICAL SECTIONS
C6300	FOUNDATION DRAIN PUMPBACK SYSTEM PIPING AND INSTRUMENTATION DIAGRAM
C6310	FOUNDATION DRAIN PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY PLAN AND PROFILE
C6320	FOUNDATION DRAIN PUMPBACK SYSTEM PROCESS WATER POND PLAN AND PROFILE
C6330	RECLAIM WATER DELIVERY SYSTEM SEEPAGE COLLECTION AND PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY AND PROCESS WATER POND TYPICAL SECTIONS
C6400	NON-CONTACT WATER RESERVOIR SUPPLY AND DISCHARGE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM
C6410	NON-CONTACT WATER RESERVOIR SUPPLY SYSTEM PLAN AND PROFILE
C6420	NON-CONTACT WATER RESERVOIR SUPPLY SYSTEM SECTIONS AND DETAILS

BLACK BUTTE COPPER PROJECT	
DRAWING NUMBERS	DESCRIPTION
C6430	NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM PLAN AND PROFILE
C6440	NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM TYPICAL SECTIONS
C6500	PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM PIPING & INSTRUMENTATION DIAGRAM
C6510	PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM PLAN AND PROFILE
C6520	PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM TYPICAL SECTIONS AND DETAIL
C7001	TEMPORARY WASTE ROCK STORAGE PAD GRADING PLAN
C7002	TEMPORARY WASTE ROCK STORAGE PAD HDPE LINER AND SEEPAGE COLLECTION SYSTEM LAYOUT PLAN
C7003	TEMPORARY WASTE ROCK STORAGE PAD SECTIONS AND DETAILS
C8001	CEMENTED TAILINGS FACILITY, PROCESS WATER POND, NON-CONTACT WATER RESERVOIR AND ROM STOCKPILE POST CLOSURE TOPOGRAPHIC MAP
C8002	CEMENTED TAILINGS FACILITY RECLAMATION SECTION AND DETAIL

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DRAWING LIST

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C0001	0

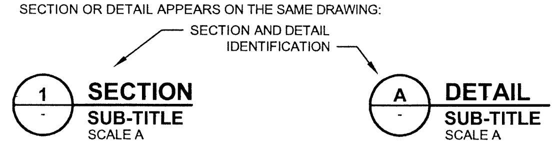
DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

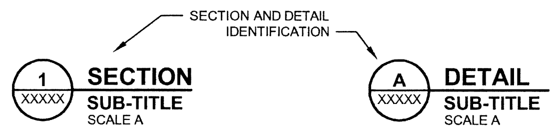
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP		
REVISIONS						

SECTIONAL VIEW AND DETAIL IDENTIFICATION

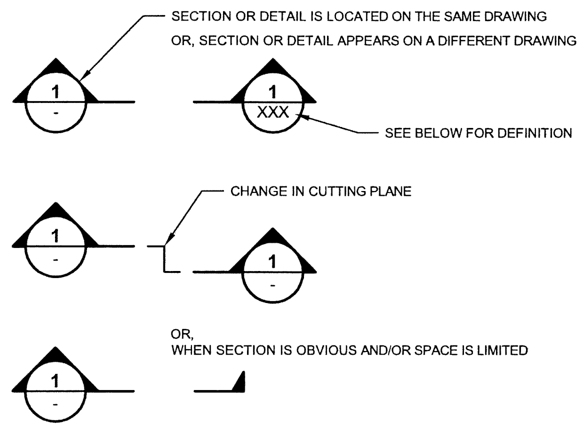
SECTION OR DETAIL APPEARS ON THE SAME DRAWING:



SECTION OR DETAIL APPEARS ON A DIFFERENT DRAWING:

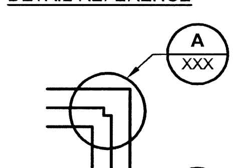


SECTION LOCATION ARROWS

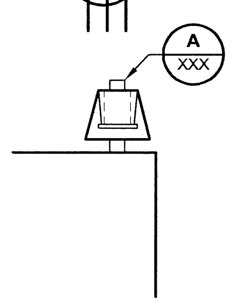


XXX =	"C2110"	NUMBER REFERS TO THE DRAWING FROM WHICH THE SECTION OR DETAIL IS CALLED UP IN DIFFERENT FACILITY.

DETAIL REFERENCE

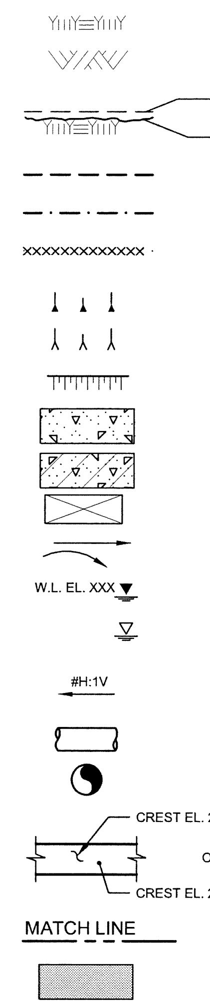


LOCATED AND IDENTIFIED THUS, THE DETAIL ENLARGEMENT WILL BE IN THE SAME ATTITUDE AND POSITION RELATIVE TO THE DRAWING AS THE PART CIRCLED.



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



FOUNDATION TREATMENT
OVERBURDEN
MINIMUM EXCAVATION LINE
APPROX. (OR ASSUMED) ROCK SURFACE
GEOTEXTILE
HDPE GEOMEMBRANE
GEONET
FILL SLOPE SYMBOL
CUT SLOPE SYMBOL
SLOPE - CONCRETE FACE
1ST STAGE CONCRETE
2ND STAGE CONCRETE
OPENING OR BLOCKOUT
FLOW DIRECTION
WATER LEVEL
INFERRED GROUNDWATER LEVEL.
SLOPE (ARROW POINTS DOWN SLOPE)
PIPE END
TUBULAR SECTION ON END
INDICATE AN AREA ON PLAN VIEW
MATCH LINE
WATER

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

INDEX SHEET

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C0002	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD		

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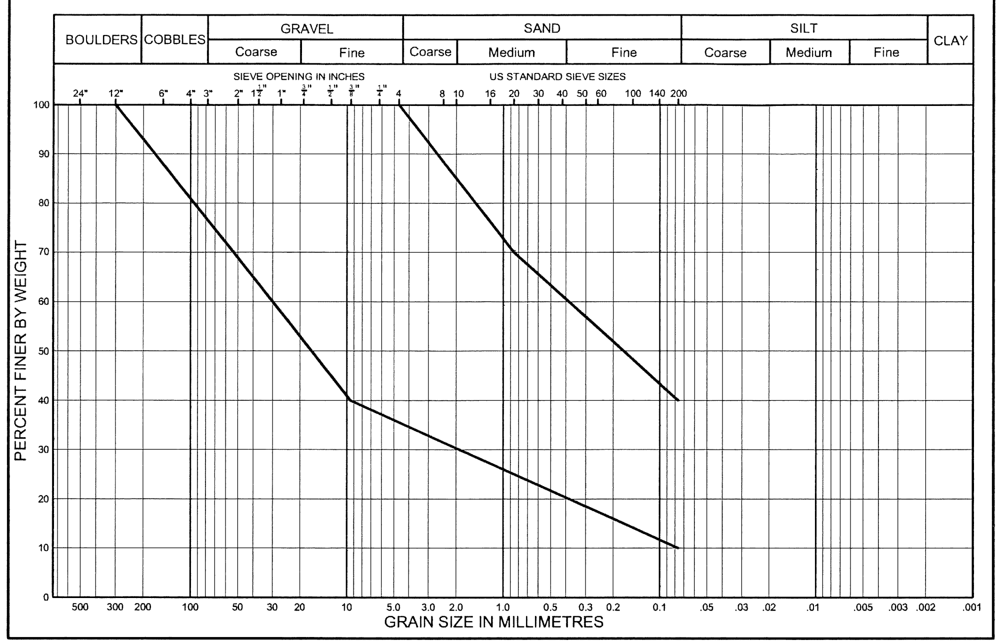
XREF FILE(S): IMAGE FILE(S):

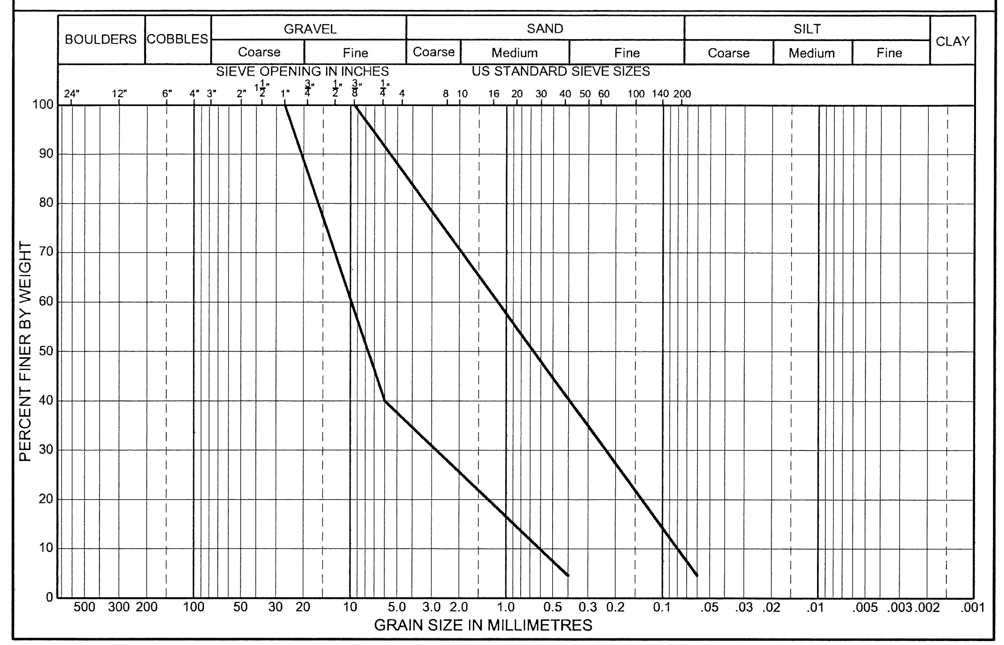
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE A - EMBANKMENT FILL



UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE C - DRAINAGE GRAVEL

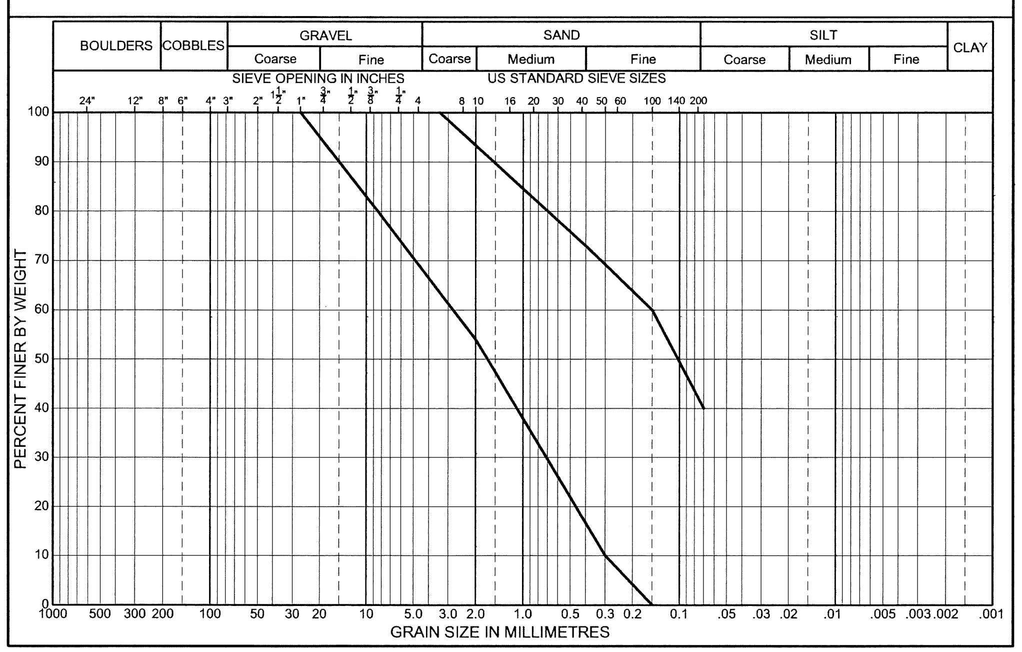


MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE	MATERIAL TYPE	PLACING AND COMPACTION REQUIREMENTS
A	EMBANKMENT FILL	ZONE A MATERIAL SHALL CONSIST OF HARD, DUTABLE FRESH TO MODERATELY WEATHERED ROCK FILL WITH A MAXIMUM PARTICLE SIZE OF 300mm AND PLACED IN 500mm THICK LIFTS WITHIN THE MAIN EMBANKMENT ZONE. THE MATERIAL SHALL BE FREE OF CLAY, LOAM, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED AND SPREAD IN HORIZONTAL LIFTS BY A DOZER. COMPACTION OF ZONE A WILL BE TO 95% MODIFIED PROCTOR LABORATORY DENSITY WITH A SMOOTH DRUM VIBRATORY ROLLER.
B	SUB-GRADE BEDDING	ZONE B MATERIAL SHALL CONSIST OF DURABLE, FRESH TO WEATHERED ROCK FILL WITH A MAXIMUM PARTICLE SIZE OF 1" AND PLACED IN 300mm THICK LIFTS ON THE BASIN SURFACE AND UPSTREAM SIDE OF ANY EMBANKMENT. THE MATERIAL SHALL BE FREE OF CLAY, LOAM, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED AND SPREAD IN HORIZONTAL LIFTS BY A DOZER. COMPACTION OF ZONE B WILL BE TO 95% MODIFIED PROCTOR LABORATORY DENSITY WITH A SMOOTH DRUM VIBRATORY ROLLER.
C	DRAINAGE GRAVEL	THIS MATERIAL WILL BE FREE DRAINING, DURABLE CRUSHED ROCK. THE MATERIAL SHALL BE FREE OF CLAY, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED IN 500mm THICK LIFTS AND SPREAD BY DOZER OR MANUALLY PLACED BY EXCAVATOR.

UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE B - SUB-GRADE BEDDING



NOTES:

1. THESE MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS APPLY TO ALL COMPONENTS OF THE WORKS EXCEPT WHERE NOTED OTHERWISE. MATERIALS SUBJECT TO REVIEW PRIOR TO CONSTRUCTION.
2. THE MAXIMUM DIMENSION OF ANY PARTICLE SHALL NOT EXCEED 2/3 OF THE MAXIMUM LIFT THICKNESS.
3. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS.
4. ALL FILL MATERIALS SHALL BE FREE OF ORGANIC AND DELETERIOUS MATTER, AND SOFT FRIABLE PARTICLES.

FOR INFORMATION ONLY

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CONSTRUCTION MATERIAL SPECIFICATIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C0003	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	K.	K.

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C0003\C0003, 10/15/2015 10:42:20 AM , PPETKOVIC PRINTED: 10/19/2015 9:34:18 AM, C0003, WLAHODA
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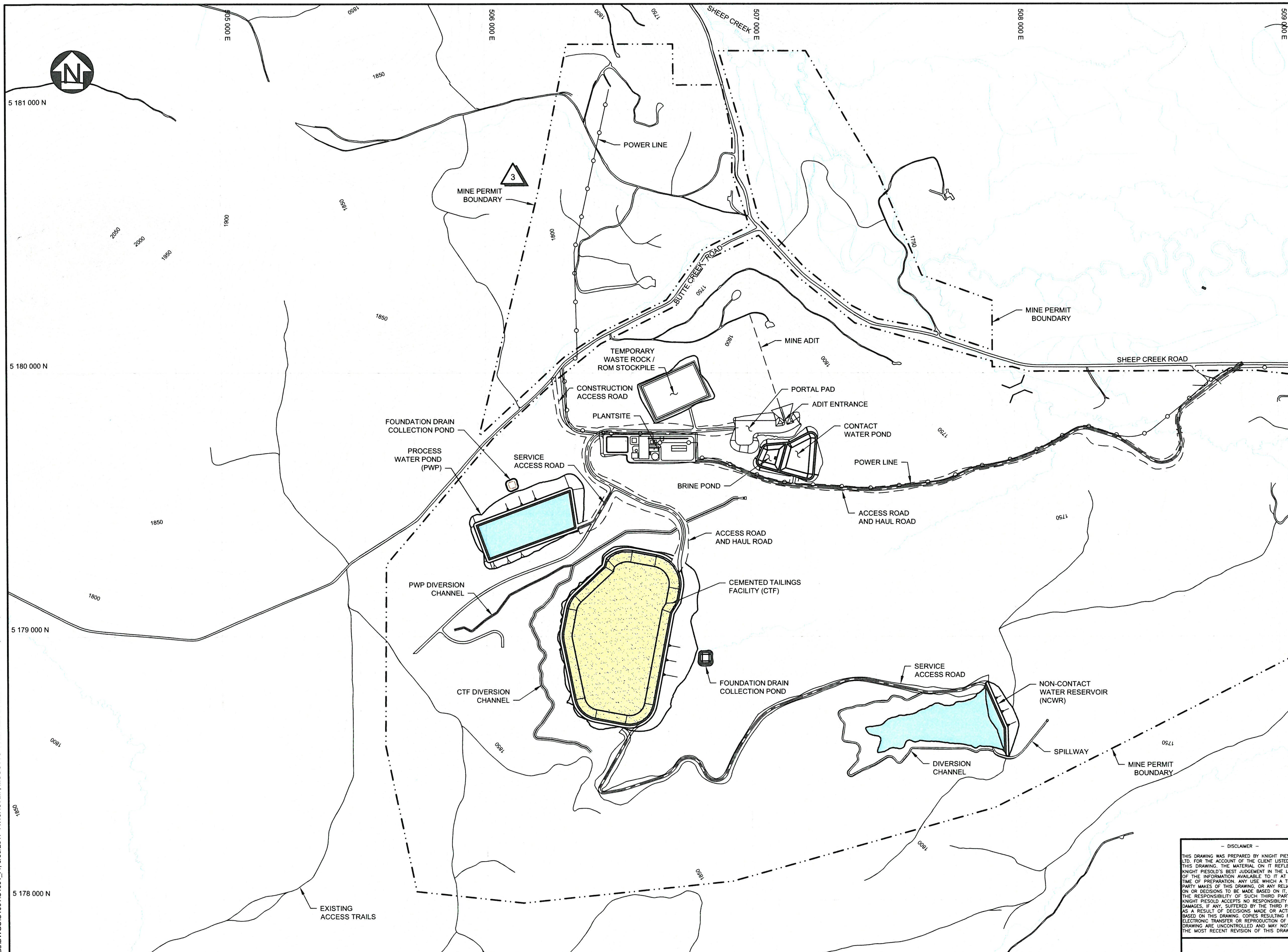

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC, DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 5 METERS.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

150 75 0 250 500 750 m
SCALE A

– DISCLAIMER –

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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BLACK BUTTE COPPER PROJECT

GENERAL ARRANGEMENT

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C1001	4

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
4	30JUN'17	ROADS AND POWERLINES UPDATED	GIM	MJC		
3	27APR'17	NORTHWESTERN MINE PERMIT BOUNDARY UPDATED	GIM	WAL	KDE	KDE
2	20MAY'16	UPDATED POWERLINE AND BCWP ADDED	MAP	KJM	KDE	KDE
1	29APR'16	ISSUED FOR INFORMATION	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

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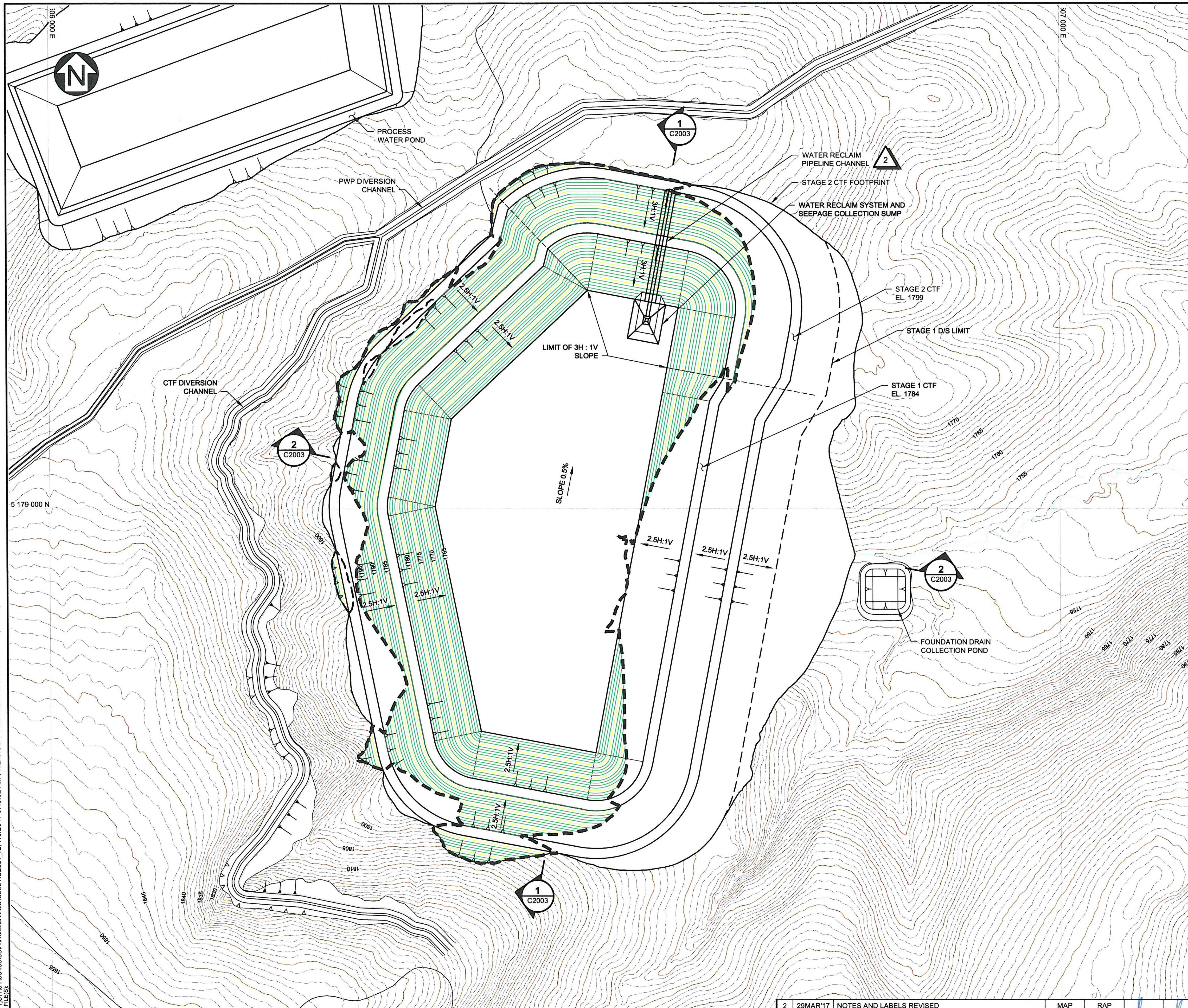

LEGEND:

EXCAVATION CONTOURS

ORIGINAL STRIPPED GROUND CONTOURS TO BE REGRADED

CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES, DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. FILL CONTOURS NOT SHOWN FOR CLARITY.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY GRADING PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2001	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2003	CEMENTED TAILINGS FACILITY SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	29MAR'17	NOTES AND LABELS REVISED	MAP	RAP		
1	29APR'16	CTF FOUNDATION POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

SAVED: \\KPL\VA-Prj$\1\01\00460\03\A\cad\DWGS\C2001\C2001_r2, 7/5/2017 9:49:02 AM , WLAHODA PRINTED: 7/5/2017 9:54:15 AM, C2001, WLAHODA
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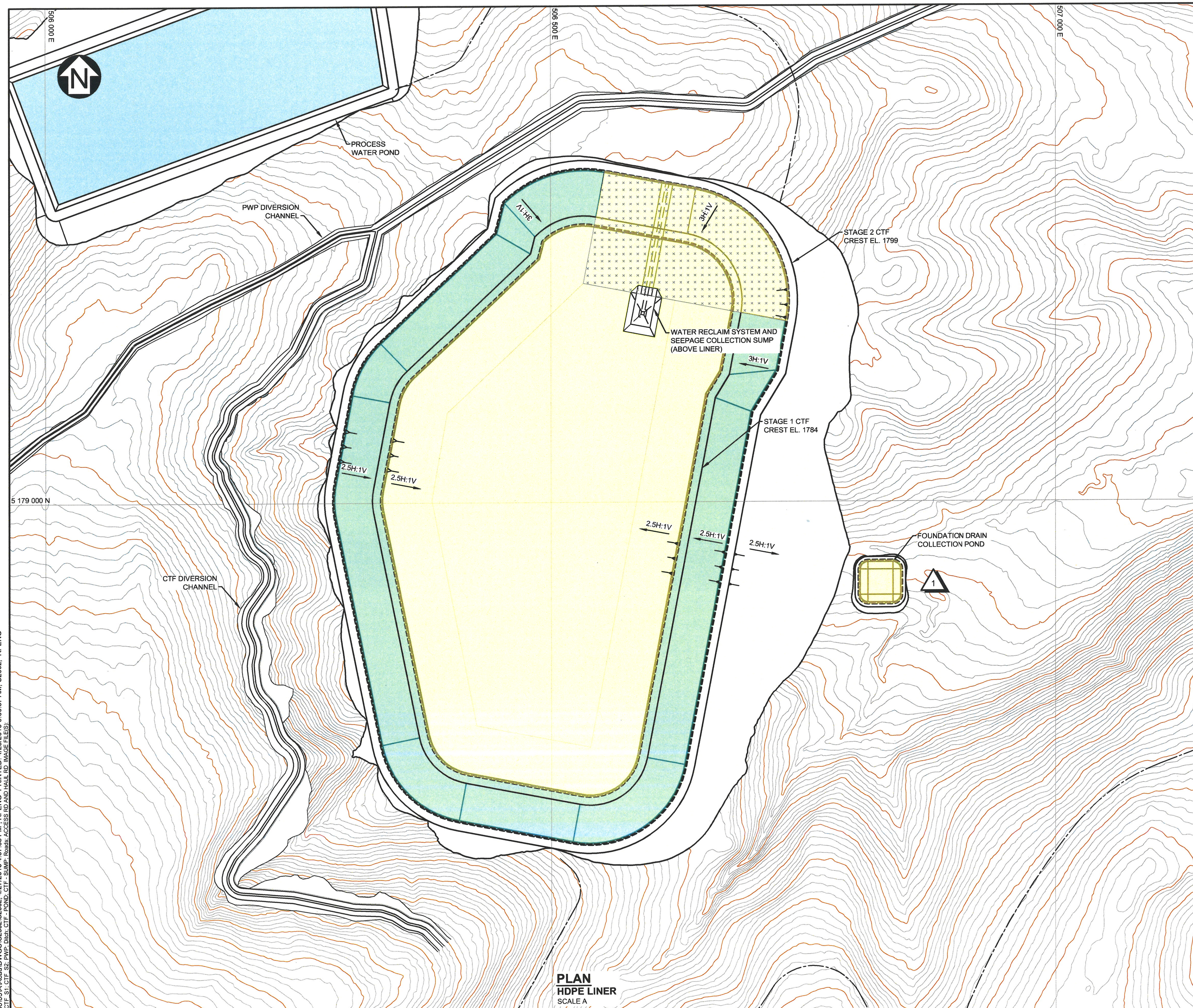

PLAN
HDPE LINER
SCALE A

LEGEND:

- STAGE 1 LINER SYSTEM
- STAGE 2 LINER SYSTEM
- TEXTURED 100MIL HDPE GEOMEMBRANE
- LINER SYSTEM ANCHOR TRENCH

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. HDPE LINER CONFIGURATION SHOWN ON DRG. C2005.
6. TEXTURED HDPE LINER REQUIRED TO FACILITATE FILL PLACEMENT FOR HAUL RAMP.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

– DISCLAIMER –

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
HDPE LINER SYSTEM LAYOUT
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2002	1

DRG. NO.	DESCRIPTION
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	K.	K.
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2002\C2002, 4/27/2016 4:57:38 PM , RPENG PRINTED: 4/28/2016 9:30:57 AM, C2002, RPENG
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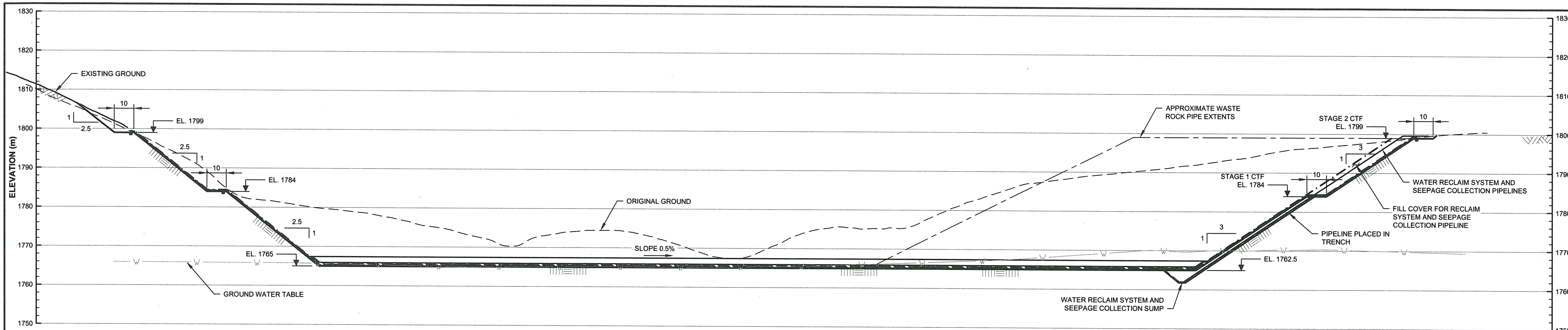
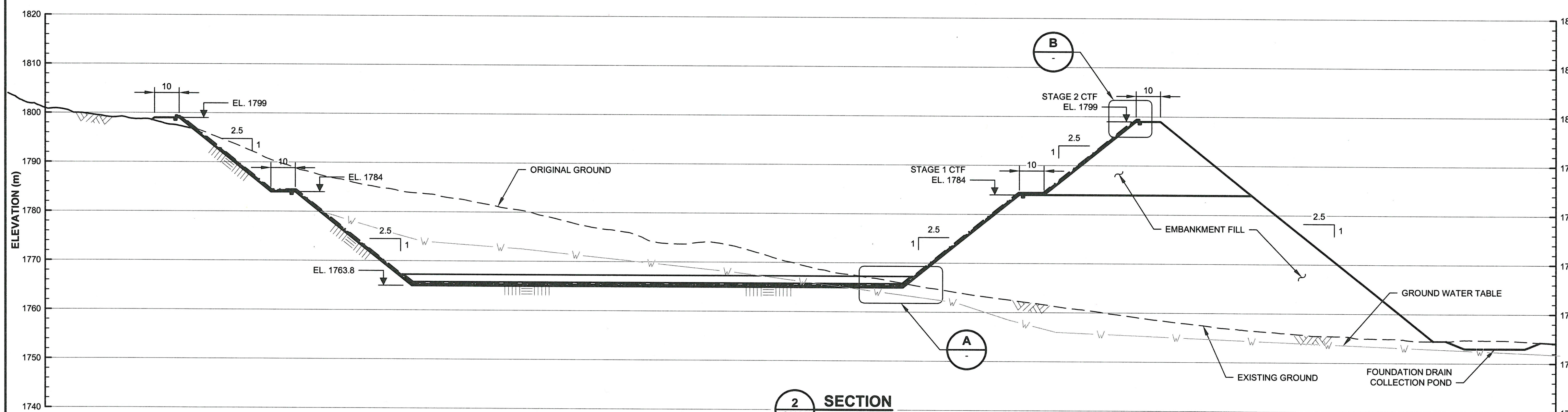
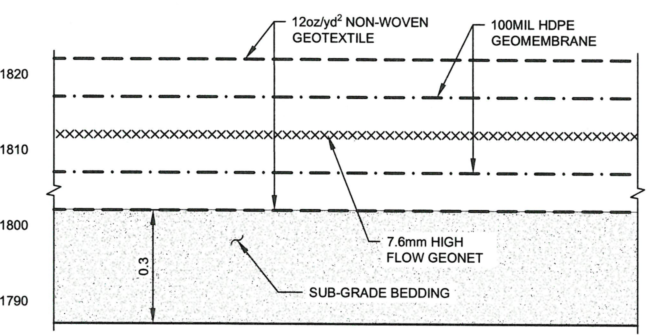


1 / C2001 SECTION
HORIZONTAL: SCALE A
VERTICAL: SCALE B



2 / C2001 SECTION
HORIZONTAL: SCALE A
VERTICAL: SCALE B



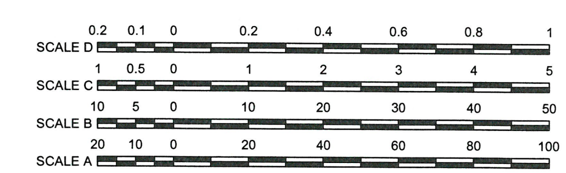
C / - DETAIL
LINER SYSTEM DETAILS
SCALE D

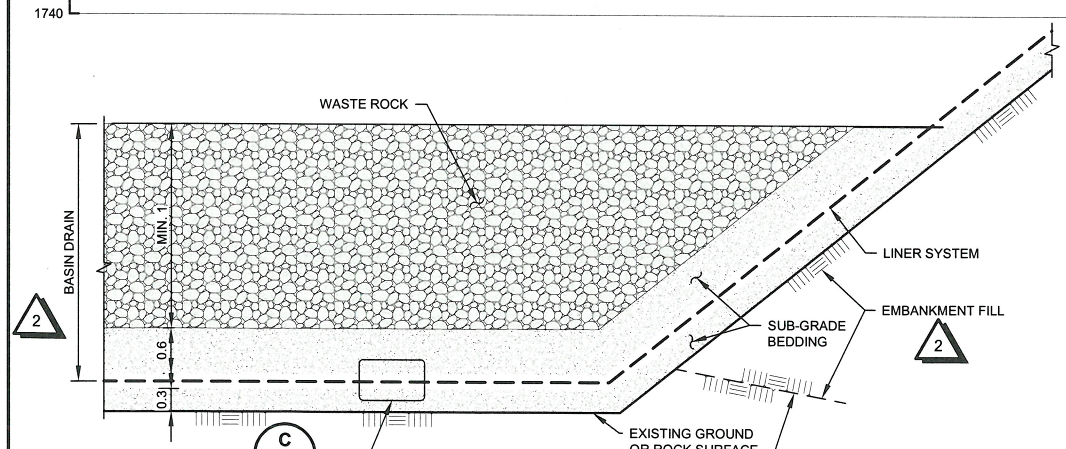
FOR INFORMATION ONLY

NOTES: 2

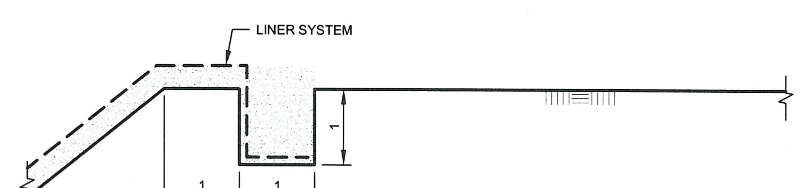
1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

BASIN DRAIN THICKNESS BASED ON AVAILABLE WASTE ROCK VOLUME
2. THE WASTE ROCK LAYER IN DETAIL "A" HAS NO MATERIAL OR COMPACTION SPECIFICATIONS.





A / - SECTION
BASIN DRAIN
SCALE C



B / - DETAIL
ANCHOR TRENCH DETAIL
SCALE C

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2003	2

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR17	NOTES AND LABELS REVISED	GIM	RAF		
1	29APR'16	GROUND WATER TABLE ADDED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KJB	KJB

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2005	CEMENTED TAILINGS FACILITY DETAILS
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2003\C2003_r2, 4/20/2017 3:56:43 PM , RFAHHAM PRINTED: 4/20/2017 3:57:40 PM, C2003, RFAHHAM
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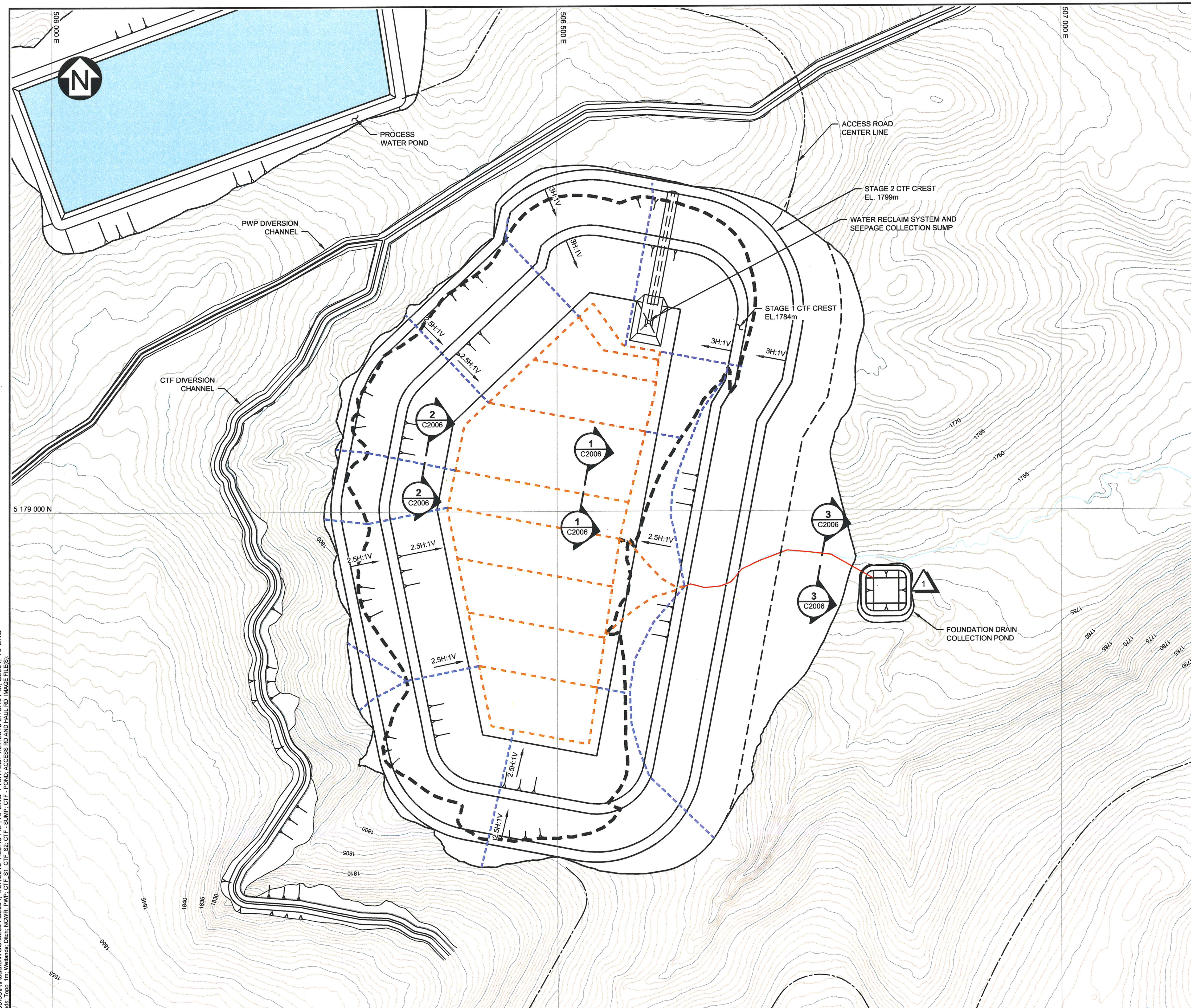

LEGEND:

- 250mm (10") N12 WT PE OUTLET PIPE
- 200mm (8") N12 ST PE DRAIN PIPE (BASIN FLOOR)
- 100mm (4") N12 ST PE DRAIN PIPE (CUT SLOPES)
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. DRAIN TRENCHES WILL BE SLOPED TOWARDS OUTLET PIPE CONNECTION AT A MINIMUM GRADE OF 0.5%.
5. LAST 10m OF OUTLET PIPE WILL BE SOLID PIPE BACKFILLED WITH IMPERMEABLE MATERIAL.
6. OUTLET PIPE WILL EMPTY INTO A WEIR TO MEASURE PIPE FLOW.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY BASIN FOUNDATION DRAIN SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2004	1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF SEEPAGE POND REVISED	MAP	RAP		
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

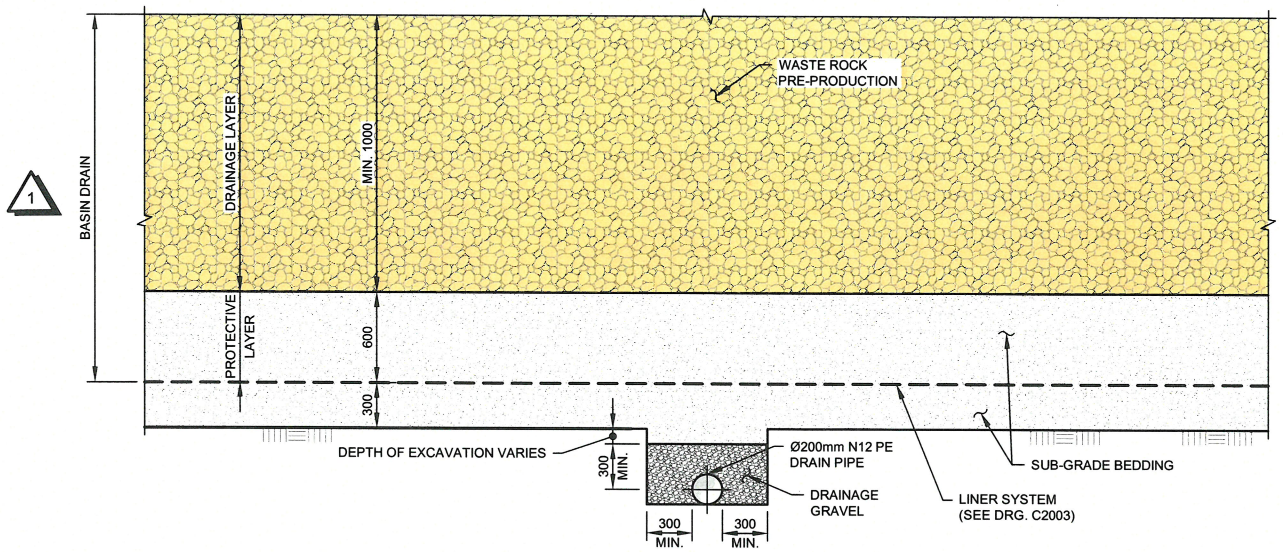
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

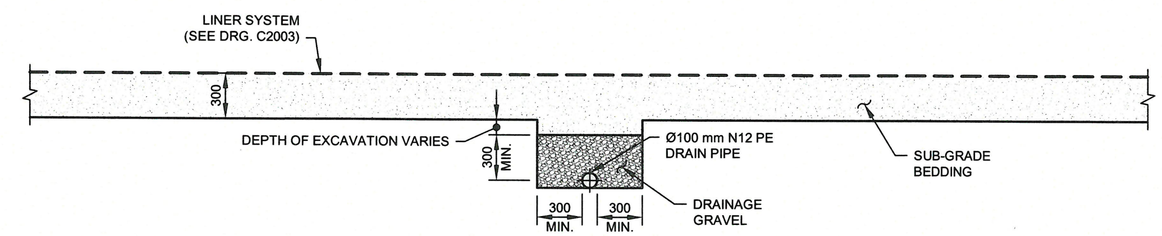
DRG. NO.	DESCRIPTION
C2006	CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SYSTEM SECTIONS

REFERENCE DRAWINGS

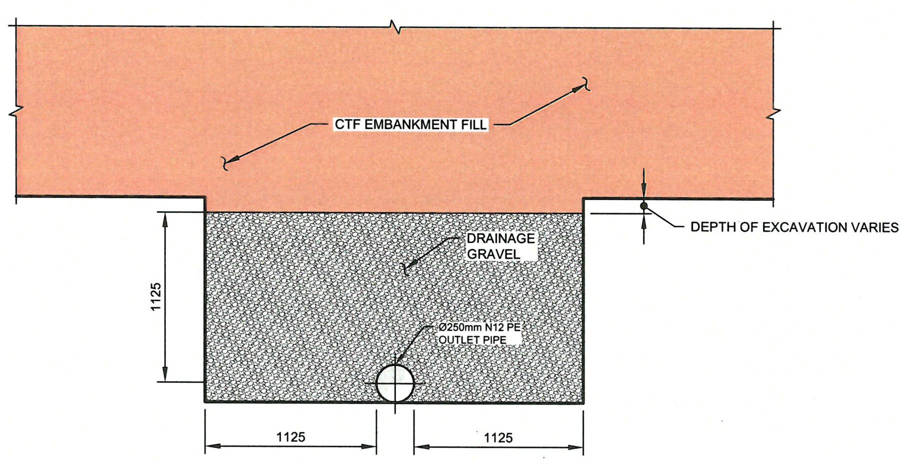
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2004\C2004, 4/27/2016 1:55:43 PM , RPENG PRINTED: 4/27/2016 2:18:40 PM, C2004, RPENG
XREF FILE(S): Hydro, Roads; Topo_1m; Wetlands; Ditch; NOWR; PWP; CTF_S1; CTF_S2; CTF - SUMP; CTF - POND; ACCESS RD AND HAUL RD IMAGE FILE(S):



1 C2004 **TYPICAL SECTION**
BASIN FLOOR (BELOW LINER) 1
SCALE A



2 C2004 **TYPICAL SECTION**
UPSTREAM EMBANKMENT SLOPE 1
SCALE A



3 C2004 **TYPICAL SECTION**
OUTLET PIPE (BELOW EMBANKMENT FILL) 1
SCALE A

CTF FOUNDATION DRAIN SUMMARY TABLE

PIPE TYPE	PIPE OUTER DIAMETER (mm)	D NOMINAL DIAMETER	T DRAINAGE GRAVEL THICKNESS (mm)
BASIN FLOOR	231.1	8" (200mm)	300
UPSTREAM EMBANKMENT SLOPE	121.9	4" (100mm)	300
OUTLET PIPE	289.6	10" (250mm)	1125

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.
2. DRAIN PIPE ARE N12 ST PE PIPE (OR SIMILAR).
3. OUTLET PIPE IS N12 WT PE PIPE (OR SIMILAR).
4. THE WASTE ROCK MAKING UP THE DRAINAGE LAYER DOES NOT HAVE ANY MATERIAL OR COMPACTION SPECIFICATIONS.

FOR INFORMATION ONLY

SCALE A 0.4 0.2 0 0.4 0.8 1.2 1.6 2.0 m

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2006	1

DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE
C2004	CTF BASIN FOUNDATION DRAIN SYSTEM - PLAN

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	20APR'17	NOTES AND LABELS REVISED	GIM	RAF		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JSL	NSD	KDE	KDE

REVISIONS

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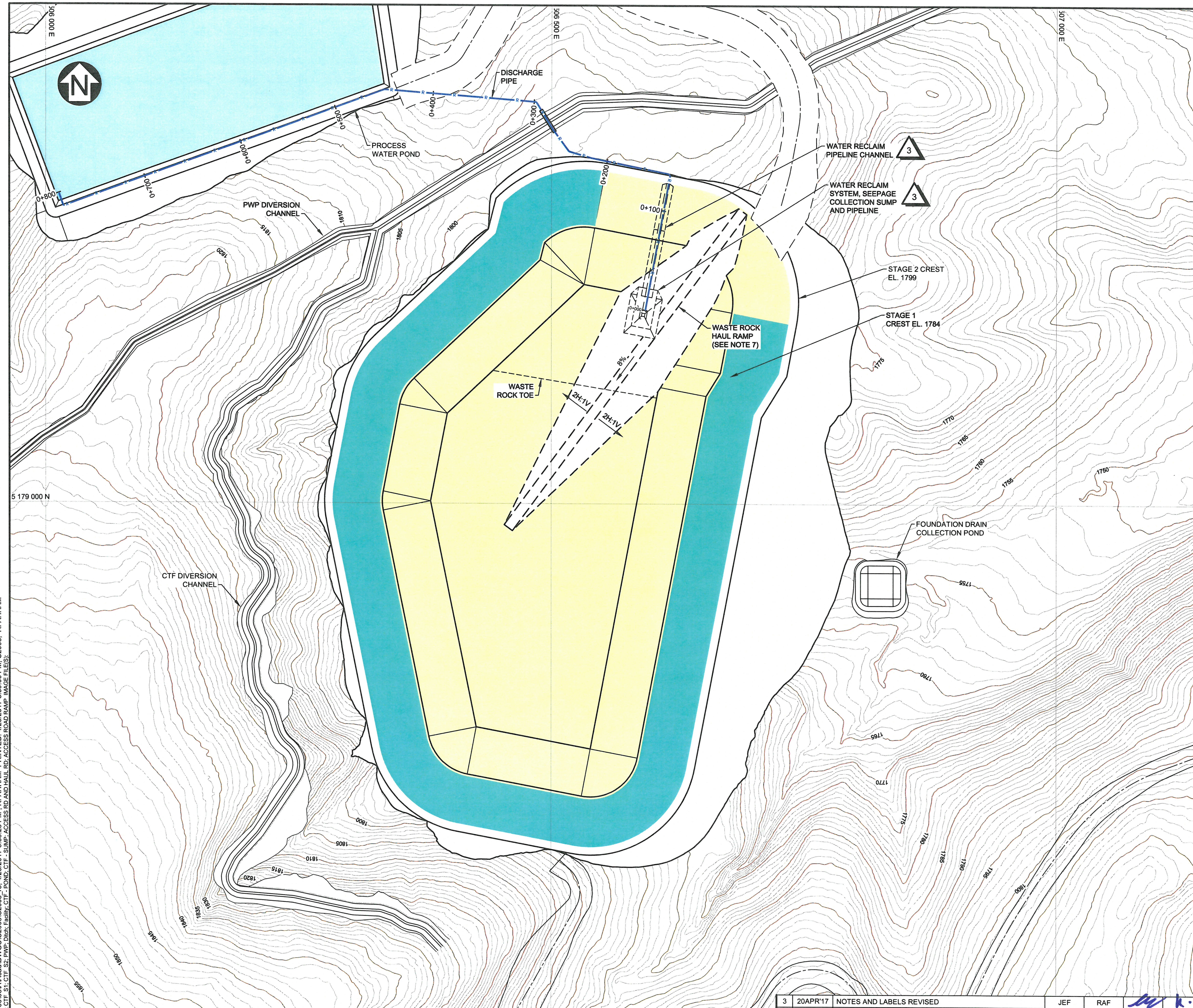


LEGEND:

- STAGE 1 LINER SYSTEM
- STAGE 2 LINER SYSTEM

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEBRUARY 3, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. WASTE ROCK WILL BE PLACED AROUND WATER RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP IN SUCH A MANNER AS TO PREVENT INUNDATION OF THE RECLAIM SYSTEM BY TAILINGS.
6. WASTE ROCK WILL BE PLACED OR SIDE CAST OFF HAUL RAMP AS NEEDED.
7. HAUL RAMP WILL BE CONSTRUCTED USING SURPLUS FILL FROM CTF EXCAVATION DETAILS TO BE FINALIZED WITH MINE OPERATOR.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY WASTE ROCK CO-DISPOSAL PLATFORM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2008	3

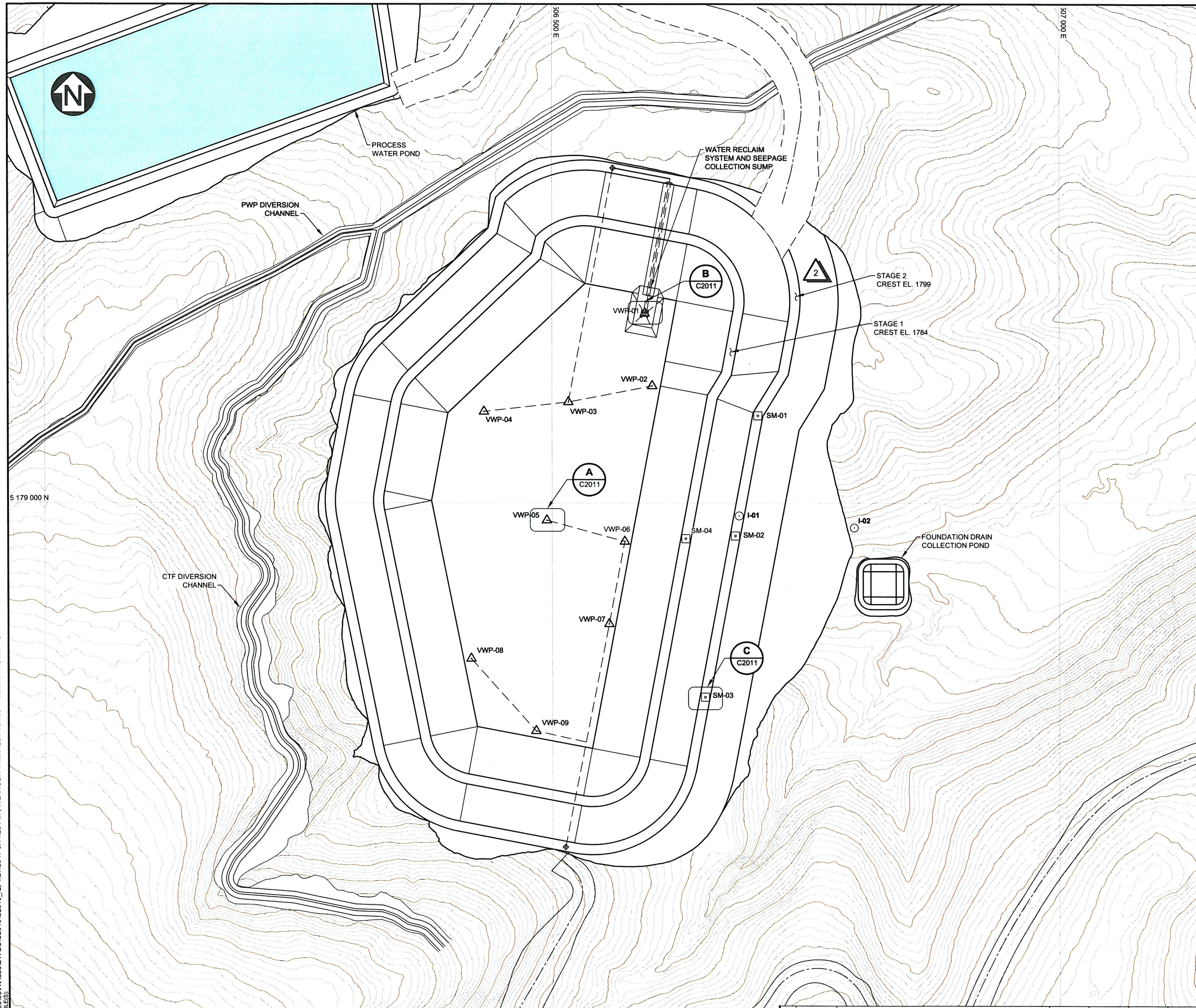
REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
3	20APR'17	NOTES AND LABELS REVISED	JEF	RAF		
2	20MAY'16	INVALID SECTION REFERENCE REMOVED	JEF	MJC	KDE	KDE
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2008\C2008_r3, 4/20/2017 3:58:28 PM, RFAHHAM PRINTED: 4/20/2017 3:59:06 PM, C2008, RFAHHAM
XREF FILE(S): Topo_1m; CTF_S1; CTF_S2; PWP; Ditch; Facility; CTF - POND; CTF - SUMP; ACCESS RD AND HAUL RD; ACCESS ROAD RAMP IMAGE FILE(S):



LEGEND:

- △ VIBRATING WIRE PIEZOMETER
- ⊡ SURVEY MONUMENT
- ⊙ INCLINOMETER
- ⊕ VIBRATING WIRE PIEZOMETER READ OUT BOX
- — — VIBRATING WIRE PIEZOMETER LEADS

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. FILL CONTOURS NOT SHOWN FOR CLARITY.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY INSTRUMENTATION PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2010	2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	27APR'17	LABEL REVISED	MAP	WAL	K:	K:
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION
C2011	CEMENTED TAILINGS FACILITY INSTRUMENTATION DETAILS

REFERENCE DRAWINGS

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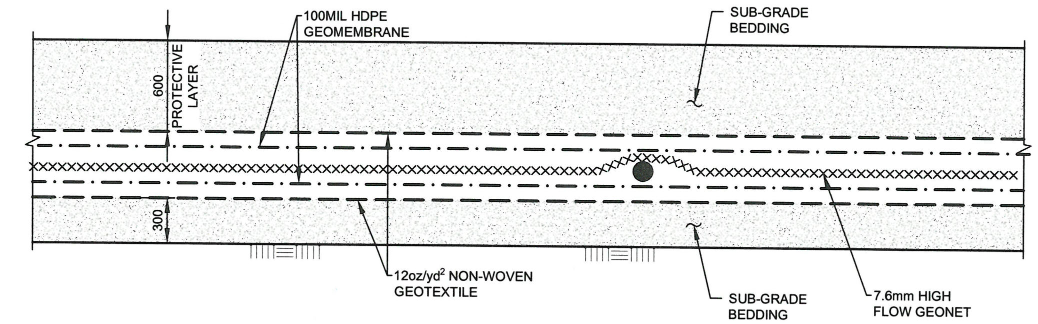
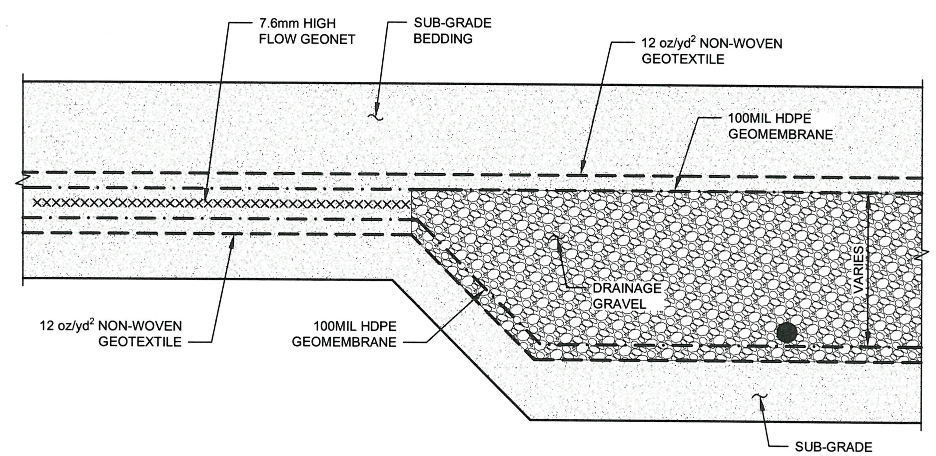


A C2010 **DETAIL**
TYPICAL VIBRATING WIRE PIEZOMETER INSTALLATION IN BASIN DRAIN 2
SCALE A

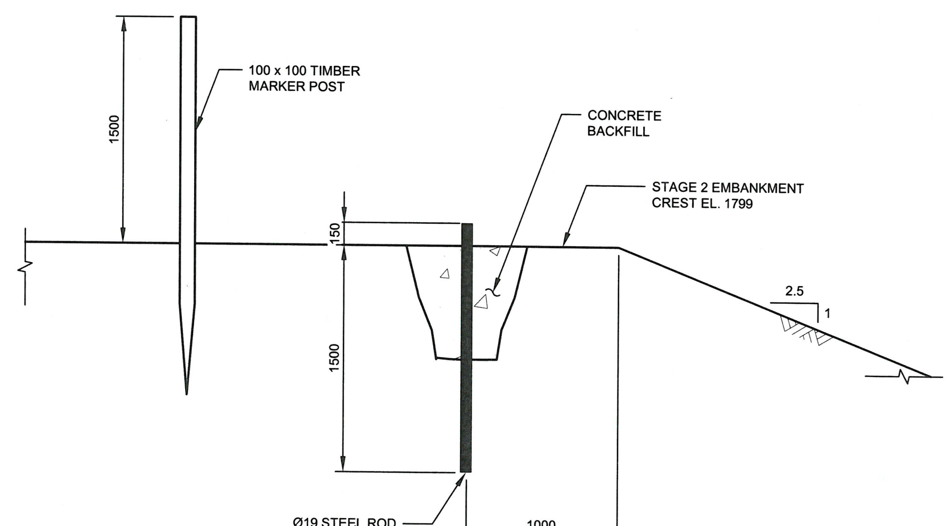
SUMMARY OF VIBRATING WIRE PIEZOMETER INSTALLATIONS					
IDENTIFICATION	LEAD LENGTH	LOCATION			DATE INSTALLED
		EASTING (m)	NORTHING (m)	ELEVATION (m)	
VWP-01	-	506,591	5,179,187	1762.8	-
VWP-02	-	506,598	5,179,115	1763.1	-
VWP-03	-	506,515	5,179,099	1763.3	-
VWP-04	-	506,433	5,179,090	1763.4	-
VWP-05	-	506,494	5,178,982	1763.9	-
VWP-06	-	506,571	5,178,961	1763.9	-
VWP-07	-	506,555	5,178,880	1764.3	-
VWP-08	-	506,420	5,178,846	1764.6	-
VWP-09	-	506,483	5,178,774	1764.9	-

SUMMARY OF SURVEY MOMUMENT INSTALLATIONS				
IDENTIFICATION	LOCATION			DATE INSTALLED
	EASTING (m)	NORTHING (m)	ELEVATION (m)	
SM-01	506,703	5,179,086	1799	-
SM-02	506,680	5,178,967	1799	-
SM-03	506,650	5,178,808	1799	-
SM-04	506,631	5,178,964	1784	-

SUMMARY OF SURVEY INCLINOMETERS INSTALLATIONS				
IDENTIFICATION	LOCATION			DATE INSTALLED
	EASTING (m)	NORTHING (m)	ELEVATION (m)	
I-01	506684	5,178,987	1799	-
I-02	506798	5178975	1758	-



B C2010 **DETAIL**
TYPICAL VIBRATING WIRE PIEZOMETER INSTALLATION IN SEEPAGE COLLECTION SUMP
SCALE A



C C2010 **DETAIL**
TYPICAL SURVEY MONUMENT INSTALLATION
SCALE A

LEGEND:

● VIBRATING WIRE PIEZOMETER TIP

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.
3. VIBRATING WIRE PIEZOMETER TIP AND CABLE TO BE SECURELY TAPED TO GEOMEMBRANE.
4. INCLINOMETERS TO BE INSTALLED AFTER CONSTRUCTION BY QUALIFIED CONTRACTORS.

FOR INFORMATION ONLY

SCALE A 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY INSTRUMENTATION SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2011	2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR'17	NOTES AND LABELS REVISED	GIM	RAF		
1	20JUL'16	DETAIL B - NOTE REVISED	GIM	WAL	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION
C2010	CEMENTED TAILINGS FACILITY INSTRUMENTATION PLAN

REFERENCE DRAWINGS

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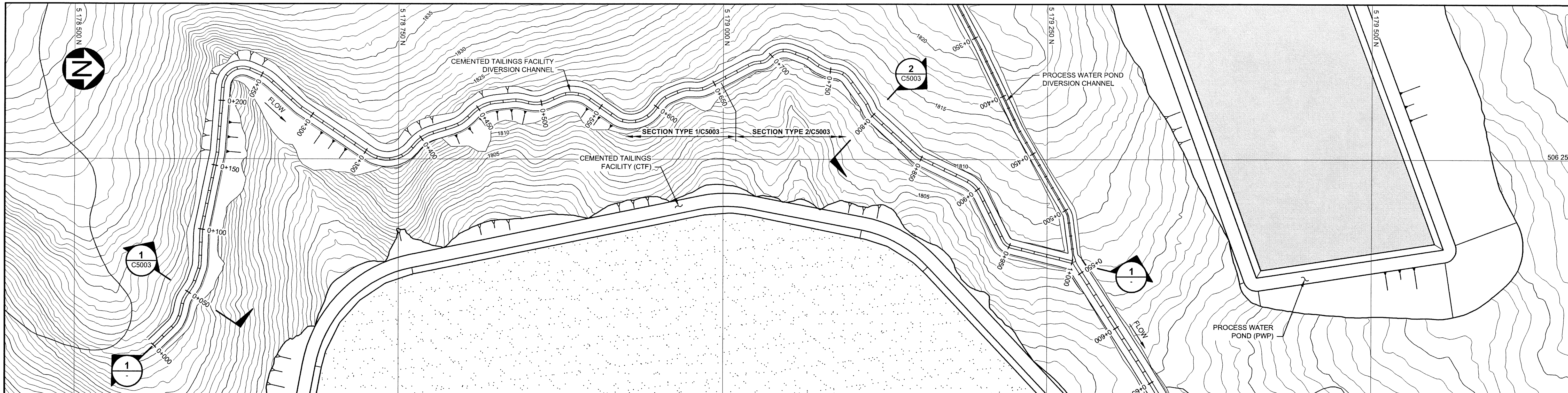
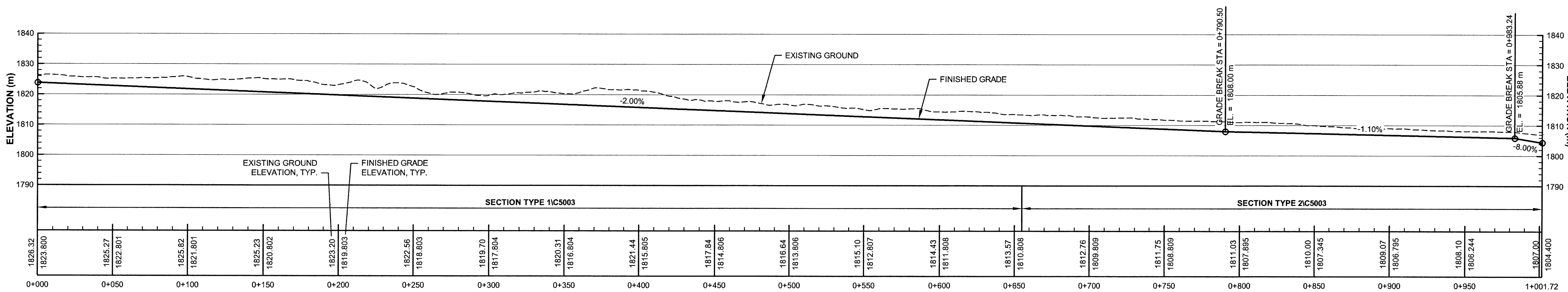


PLAN
CTF DIVERSION CHANNEL
SCALE A



1
-
SECTION
PROFILE ALONG CHANNEL CENTERLINE
HORIZONTAL: SCALE A
VERTICAL: SCALE B

SCALE B 15 7.5 0 25 50 75 m
SCALE A 30 15 0 50 100 150 m

FOR INFORMATION ONLY

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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CEMENTED TAILINGS FACILITY DIVERSION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5001	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5003	DIVERSION CHANNEL - TYPICAL SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD	K.K.	K.K.

SAVED: M:\1\01\00460\03\A\acad\DWGS\C5001\C5001, 10/16/2015 10:31:03 AM , PPETKOVIC PRINTED: 10/16/2015 10:31:08 AM, C5001, PPETKOVIC
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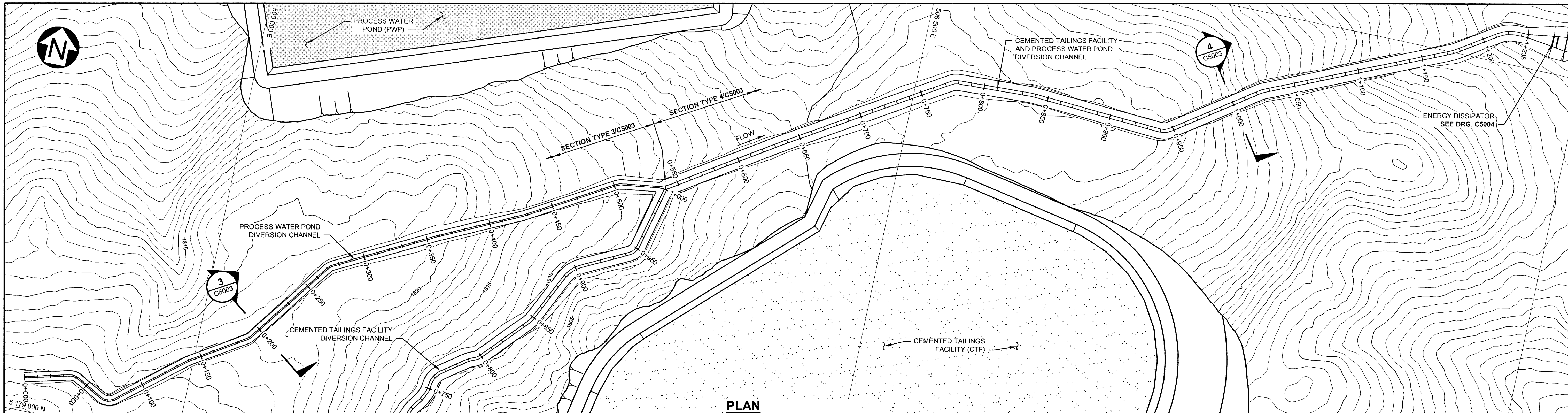
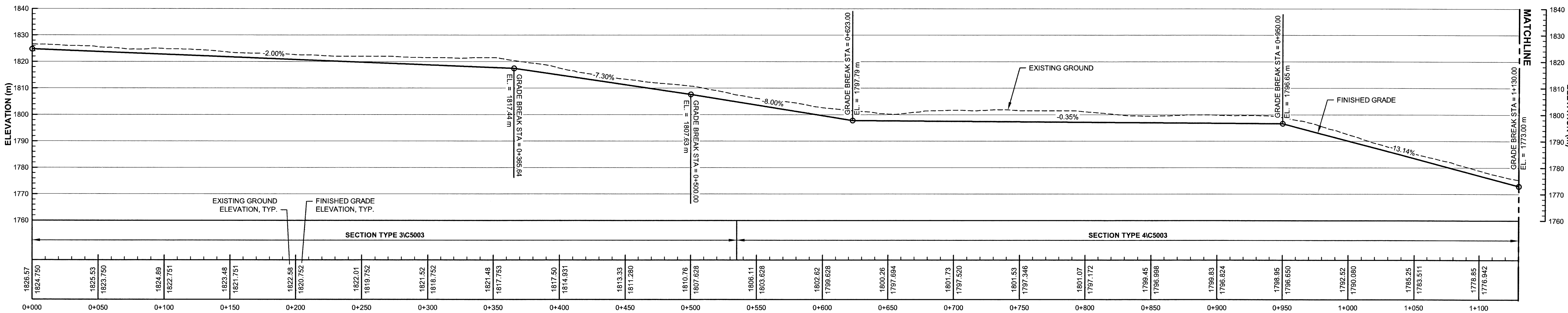
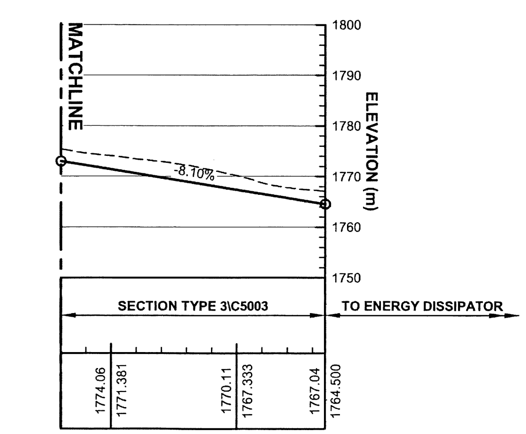


PLAN
PWP DIVERSION CHANNEL
SCALE A



Station	Existing ground	Finished grade
0+000	1826.57	1824.750
0+050	1825.53	1823.750
0+100	1824.89	1822.751
0+150	1823.48	1821.751
0+200	1822.58	1820.752
0+250	1822.01	1819.752
0+300	1821.52	1818.752
0+350	1821.48	1817.753
0+400	1817.50	1814.931
0+450	1813.33	1811.280
0+500	1810.76	1807.628
0+550	1806.11	1803.628
0+600	1802.62	1799.628
0+650	1800.26	1797.694
0+700	1801.73	1797.520
0+750	1801.53	1797.346
0+800	1801.07	1797.172
0+850	1799.45	1796.998
0+900	1799.83	1796.824
0+950	1798.95	1796.650
1+000	1792.52	1790.080
1+050	1785.25	1783.511
1+100	1778.85	1776.942



Station	Existing ground	Finished grade
1+150	1774.06	1771.381
1+200	1770.11	1767.333
1+235	1767.04	1764.500

PROFILE
PROFILE ALONG CHANNEL CENTERLINE
HORIZONTAL: SCALE A
VERTICAL: SCALE B

FOR INFORMATION ONLY

SCALE B: 15 7.5 0 25 50 75 m
SCALE A: 30 15 0 50 100 150 m

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN / SECTION BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEB 03, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND DIVERSION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5002	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5004	DIVERSION CHANNEL - ENERGY DISSIPATOR - PLAN AND DETAILS
C5003	DIVERSION CHANNEL - TYPICAL SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	JSL	NSD		

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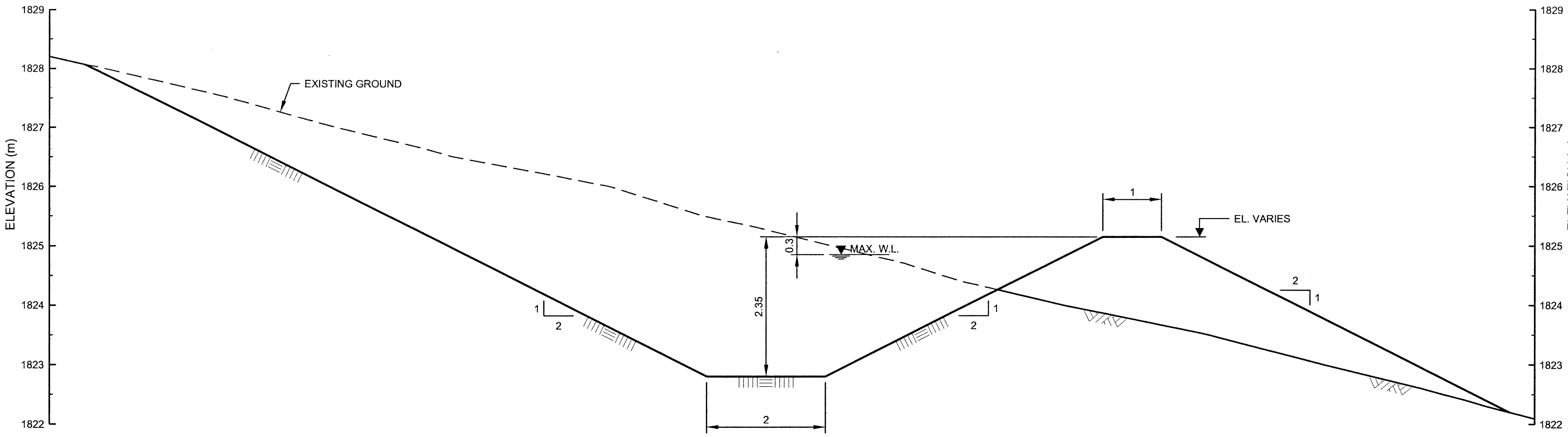
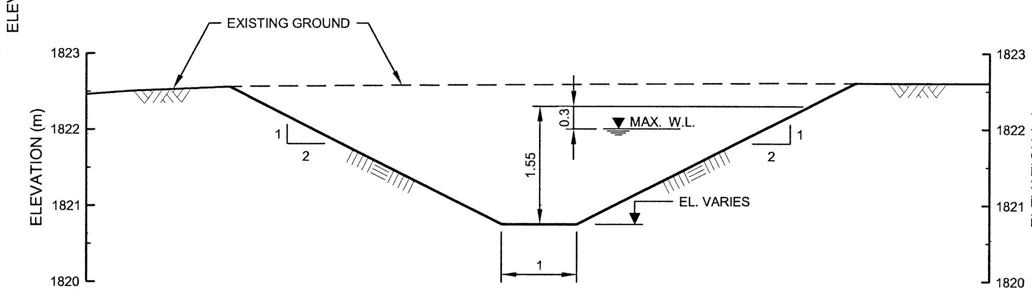
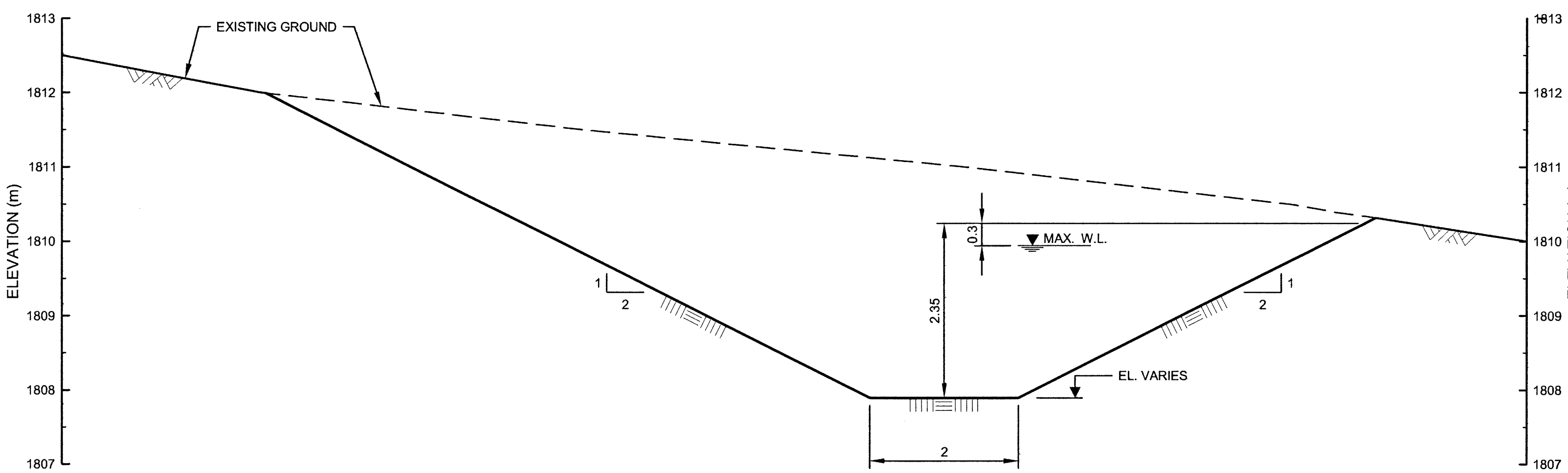


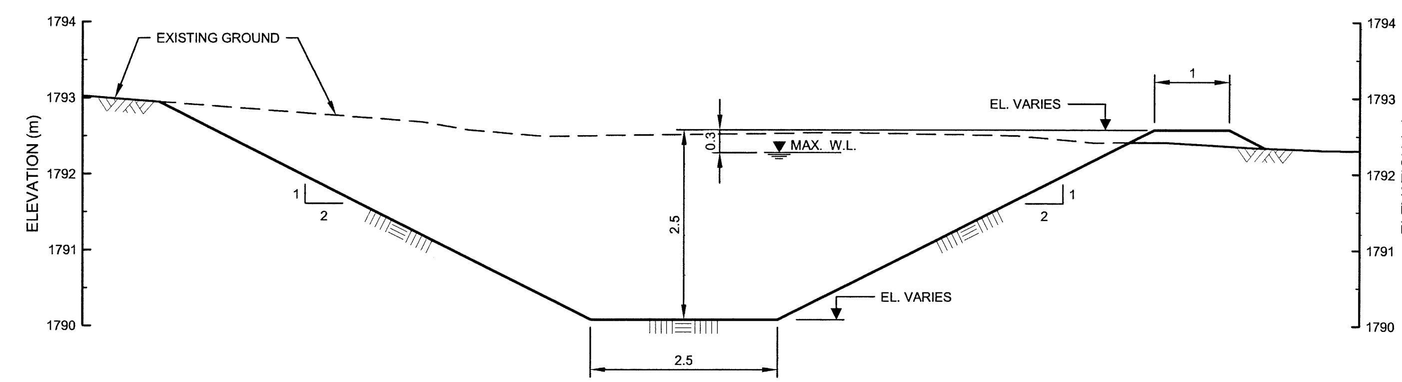
1 C5001 SECTION TYPE 1
CTF DIVERSION CHANNEL (CUT AND FILL)
SCALE A



3 C5002 SECTION TYPE 3
PWP DIVERSION CHANNEL
SCALE A



2 C5001 SECTION TYPE 2
CTF DIVERSION CHANNEL (ALL CUT)
SCALE A



4 C5002 SECTION TYPE 4
CTF AND PWP DIVERSION CHANNEL
SCALE A

FOR INFORMATION ONLY

SCALE A 1 0.5 0 1 2 3 4 5 m

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. MAXIMUM WATER LEVEL (MAX. W.L.) BASED ON ANTICIPATED WATER DEPTH DURING THE PROBABLE MAXIMUM FLOOD (PMF).

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BLACK BUTTE COPPER PROJECT

DIVERSION CHANNEL TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5003	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C5003\C5003, 10/16/2015 10:33:22 AM , PPETKOVIC PRINTED: 10/16/2015 10:33:25 AM, Layout1, PPETKOVIC
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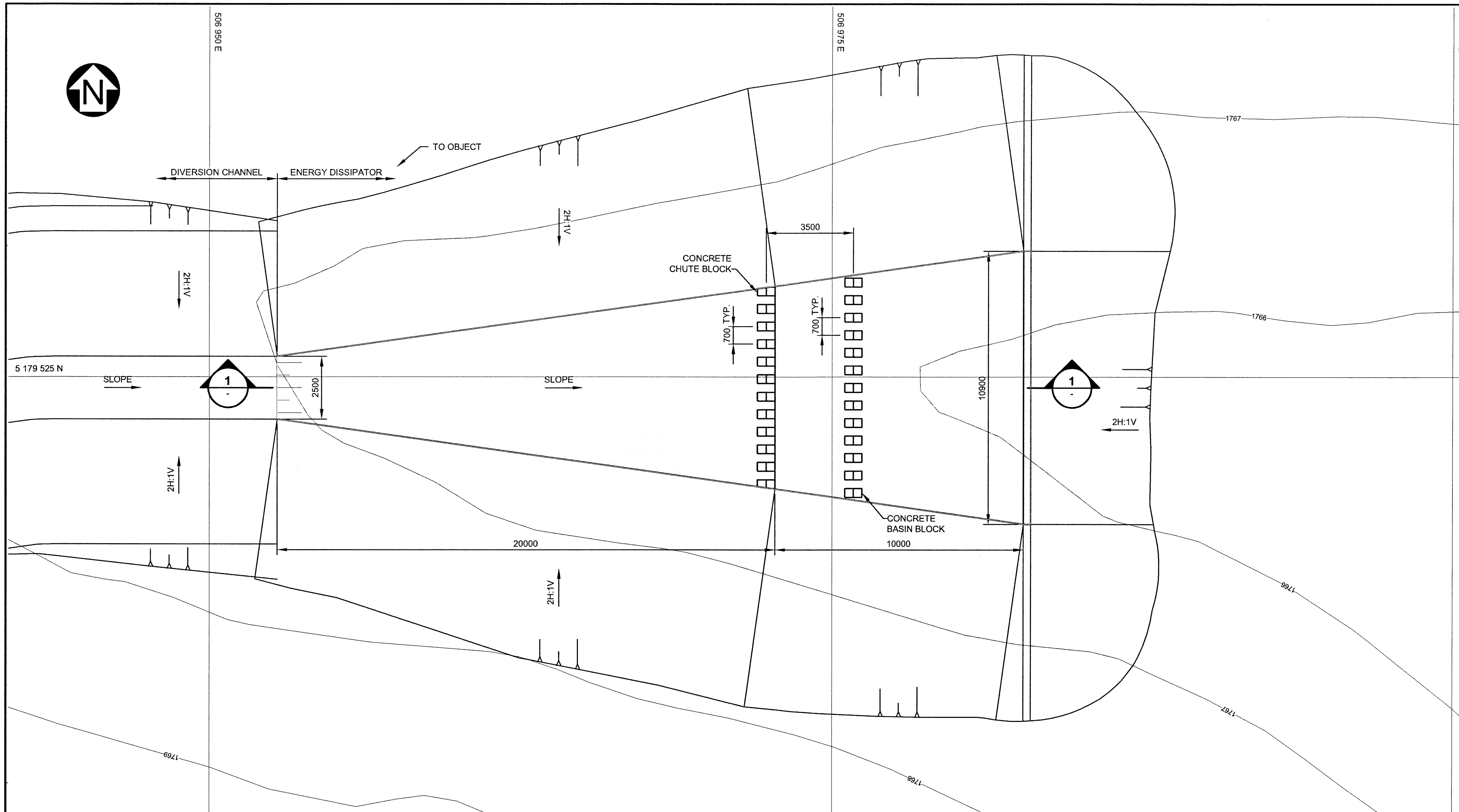
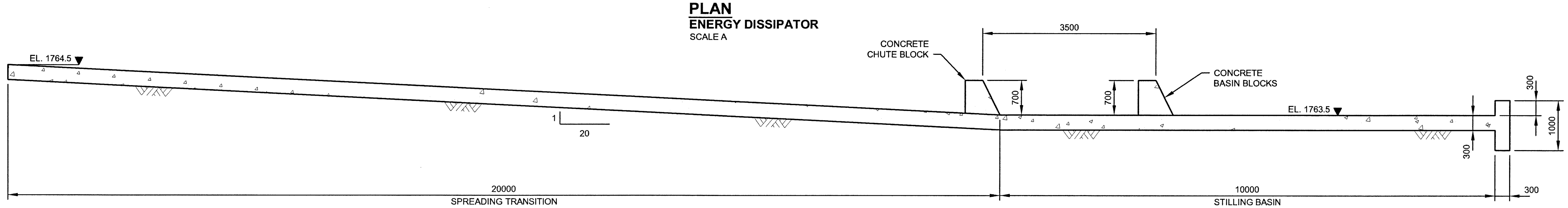


PLAN
ENERGY DISSIPATOR
SCALE A



1 SECTION
SCALE B

LEGEND:

CONCRETE

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE B 1000 500 0 1000 2000 3000 4000 5000 mm

SCALE A 2 1 0 2 4 6 8 10 m

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BLACK BUTTE COPPER PROJECT

DIVERSION CHANNEL
ENERGY DISSIPATOR
PLAN AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5004	0

REFERENCE DRAWINGS

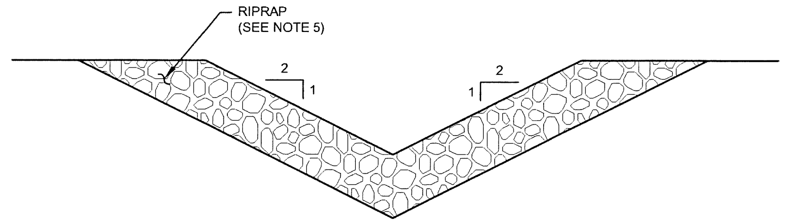
DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE

REVISIONS

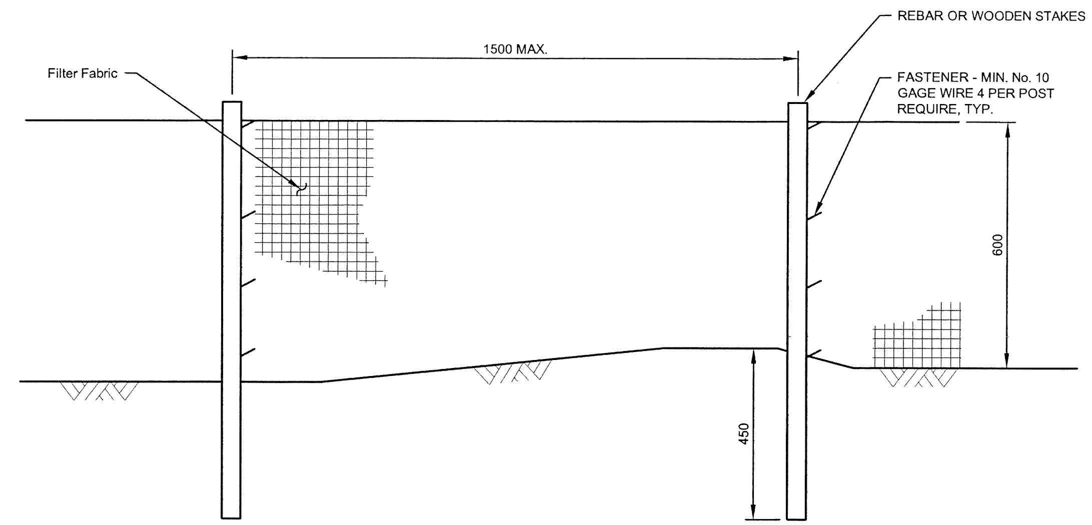
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

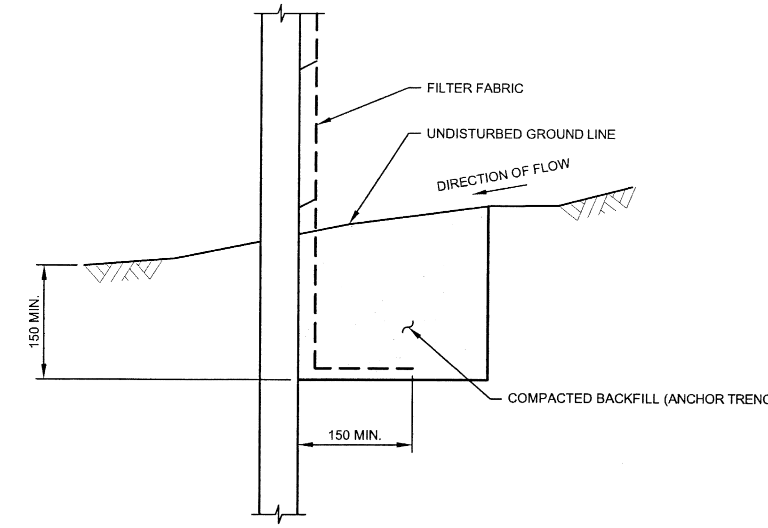
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		



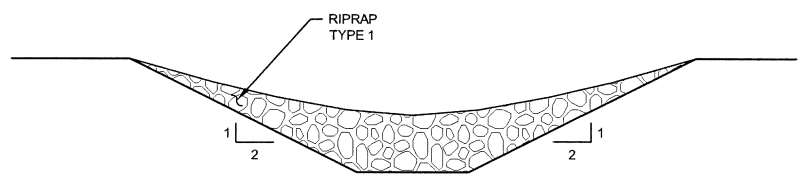
(CD)(DD) **COLLECTION AND DIVERSION DITCH**
NTS



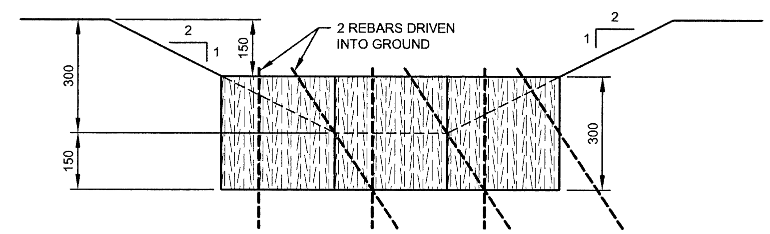
(SF) **SILT FENCING PROFILE**
SCALE A



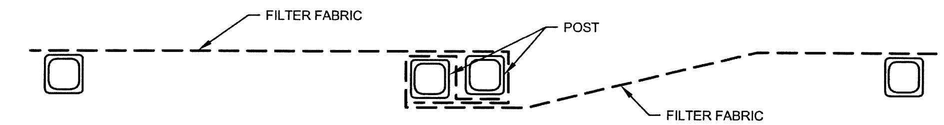
(SF) **SILT FENCING CROSSING SECTION**
SCALE B



(RD) **ROCK DAM CROSSING SECTION**
SCALE A



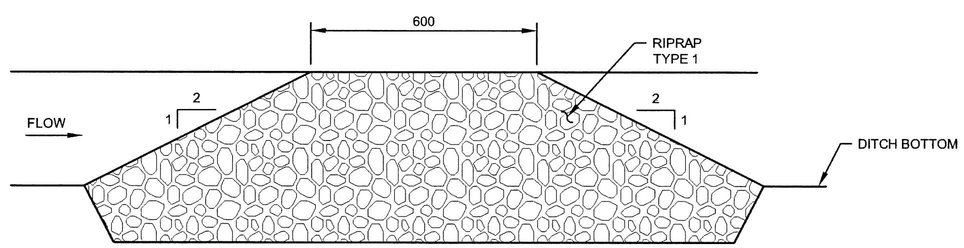
(ST) **STRAW BALE CROSSING SECTION**
SCALE A



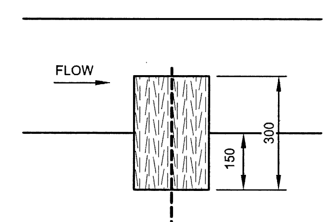
(SF) **ATTACHING TWO SILT FENCES**
SCALE B

NOTES:

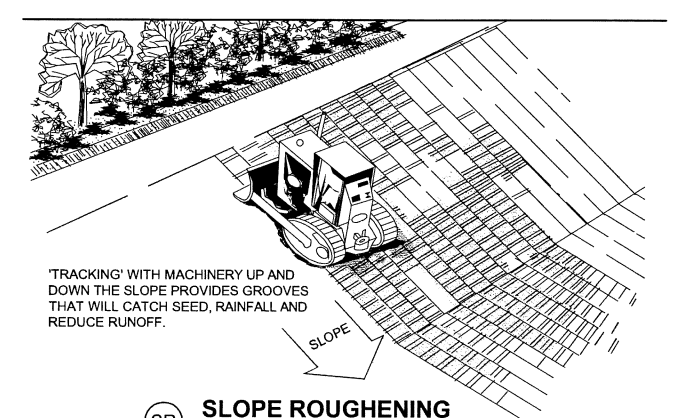
1. ALL SEDIMENT AND EROSION CONTROL MEASURES MUST BE CONSTRUCTED, STABILIZED AND FUNCTIONAL BEFORE SITE DISTURBANCE BEGINS.
2. SITE GRADING SURFACE WATER RUNOFF TO BE DIRECTED TO THE SEDIMENT TRAPS AT ALL TIMES DURING SITE DISTURBANCE ACTIVITIES UNTIL FINAL STABILIZATION IS ACHIEVED.
3. THE CONTRACTOR 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.
4. 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.
5. ONLY REQUIRED WHEN ERODIBLE SOILS HAVE BEEN EXPOSED.



(RD) **ROCK DAM PROFILE**
SCALE A



(ST) **STRAW BALE PROFILE**
SCALE A



(SR) **SLOPE ROUGHENING**
NTS

FOR INFORMATION ONLY

SCALE B: 100 50 0 100 200 300 400 500 m

SCALE A: 200 100 0 200 400 600 800 1000 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

EROSION CONTROL BMP
TYPICAL SECTIONS AND DETAILS
SHEET 1 OF 2

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

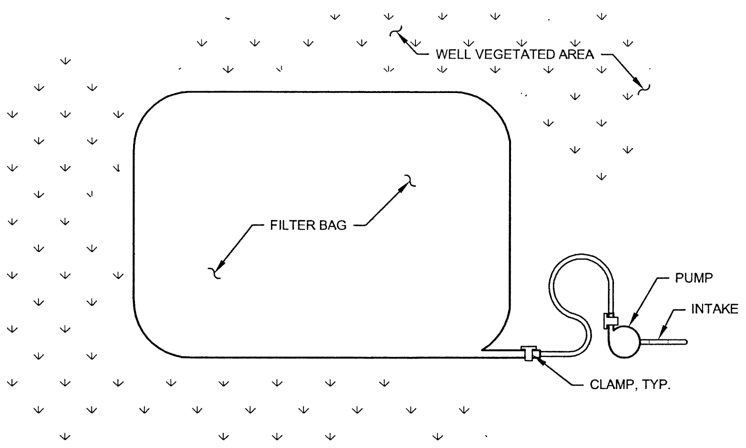
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

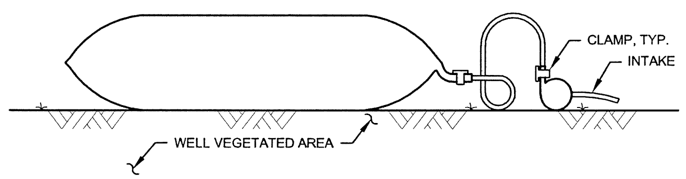
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	PP	K.	K.

REVISIONS

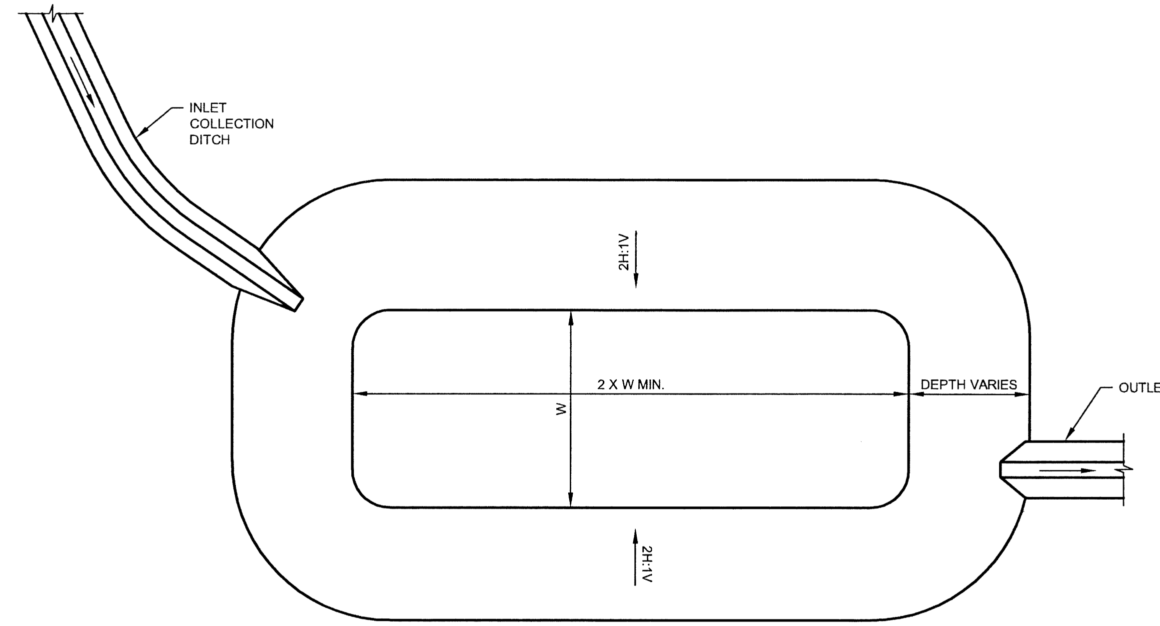
P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5005	0



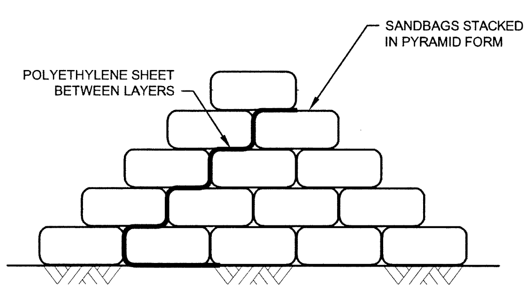
(FB) **FILTER BAG PLAN**
SCALE A



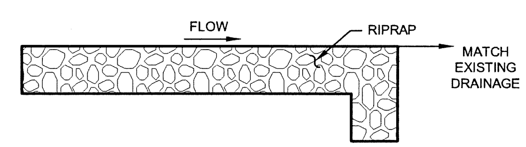
(FB) **FILTER BAG ELEVATION**
SCALE A



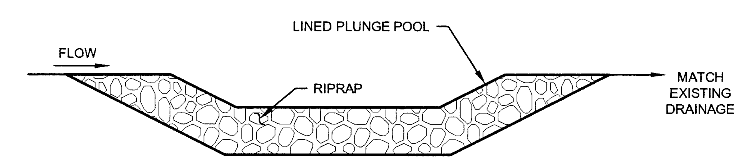
(SB) **SEDIMENT BASIN PLAN**
SCALE B



(DS) **TEMPORARY STREAM DIVERSION STRUCTURE**
NTS



TYPE 1
SMALL DRAINAGES



TYPE 2
LARGER DRAINAGES

(ED) **ROCK ENERGY DISSIPATOR**
NTS

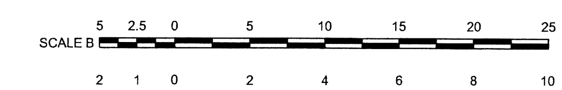
SEDIMENT BASIN GENERAL NOTES:

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 EMT.
3. SEDIMENT BASINS MAY HAVE PUMP OR 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 QUANTITIES 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 ⅓ 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



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CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

EROSION CONTROL BMP
TYPICAL SECTIONS AND DETAILS
SHEET 2 OF 2

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5006	0

REFERENCE DRAWINGS

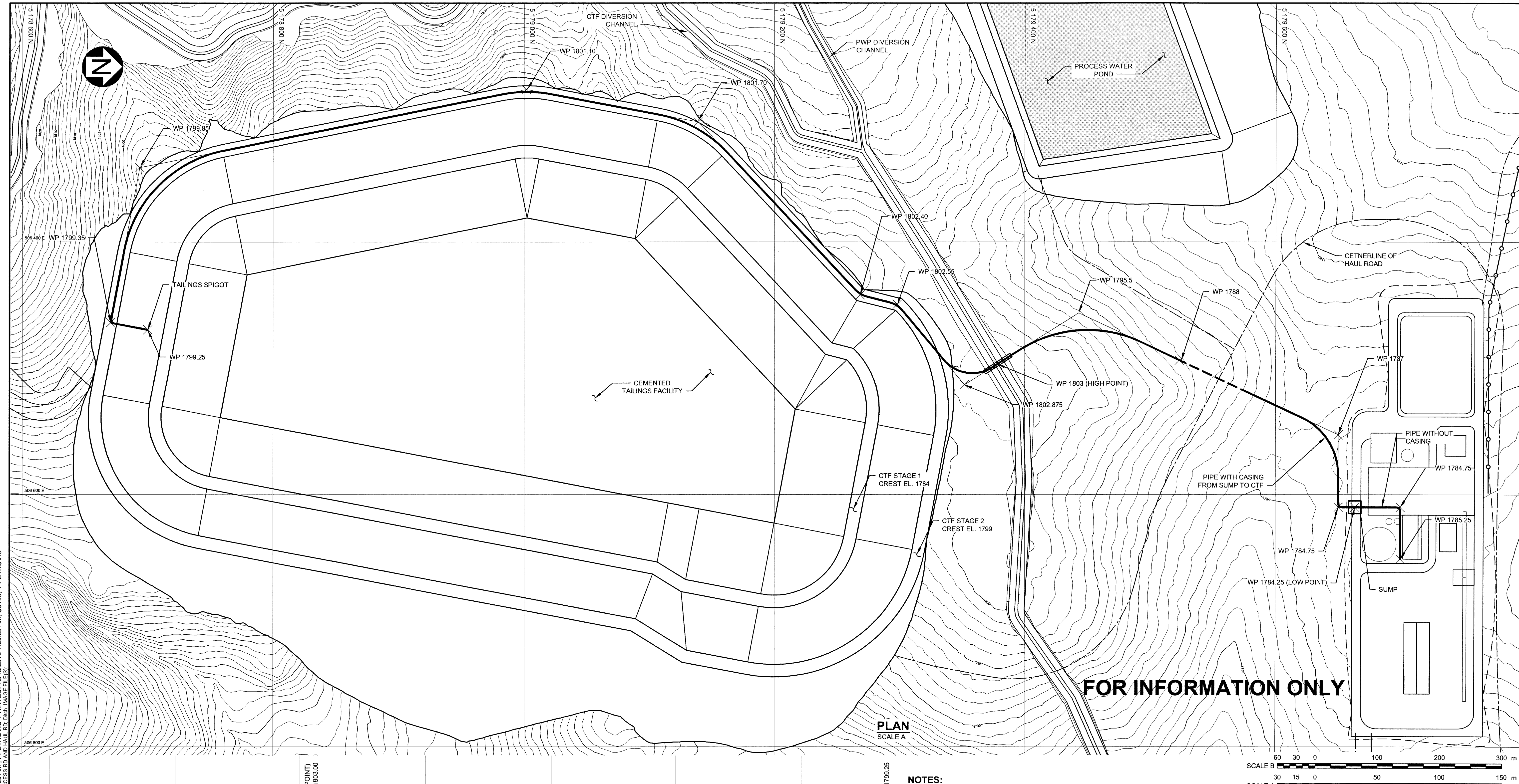
DRG. NO.	DESCRIPTION
-	-

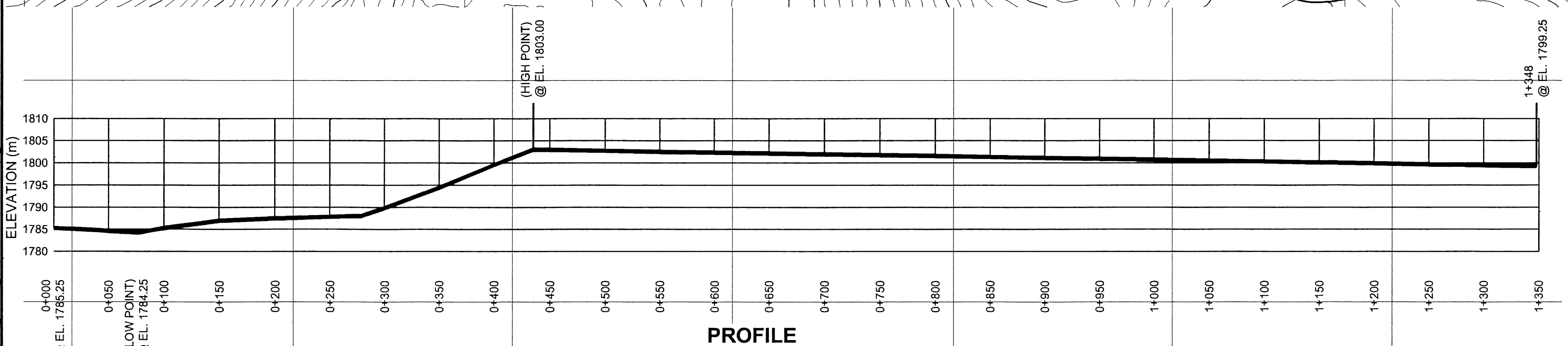
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	PP	K.	K.





PROFILE
PIPELINE
SCALE B

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PIPELINE LAYOUT BASED ON INFORMATION PROVIDED BY MG ENGINEERING, DATED (SEP 29, 2015).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. TAILINGS DELIVERY SYSTEM DESIGNED BY MG ENGINEERING.
6. PIPELINE CONSTRUCTED USING 8" STEEL PN 150 PIPE.
7. PIPELINE INSULATED TO PROTECT FROM FREEZING.
8. TAILINGS PUMP TO BE DESIGNED BY TETRA TECH.

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BLACK BUTTE COPPER PROJECT

TAILINGS DELIVERY SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6100	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

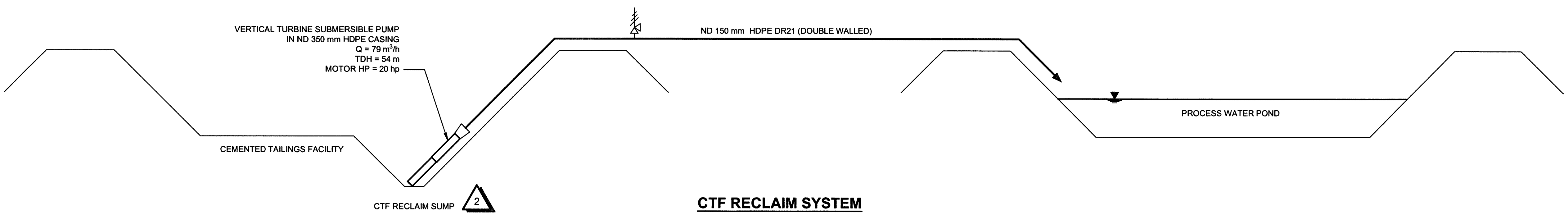
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	K.	K.

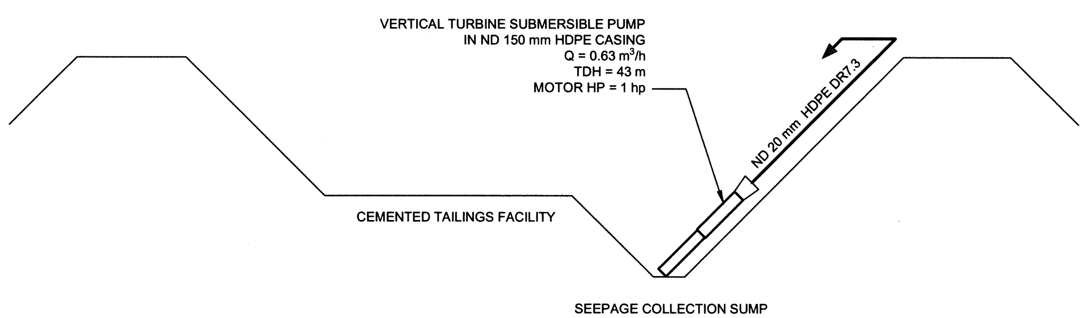
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6100\C6100, 10/16/2015 7:28:50 AM, PPETKOVIC PRINTED: 10/16/2015 7:29:05 AM, C6100, PPETKOVIC
XREF FILE(S): Facility: CTF_S2; CTF_S1; WROCK STORAGE; Topo_1m; PWP; NCWR; ACCESS RD AND HAUL RD; Ditch; IMAGE FILE(S):

LEGEND:

- DISCHARGE PIPE 2
- FLOW DIRECTION
- COMBINATION AIR VALVE
- REDUCER
- SUBMERSIBLE PUMP



CTF RECLAIM SYSTEM



CTF SEEPAGE COLLECTION AND RECYCLE SYSTEM

FOR INFORMATION ONLY

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
WATER MANAGEMENT SYSTEMS
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6200	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6210	CEMENTED TAILINGS TO PROCESS WATER POND - PLAN AND PROFILE

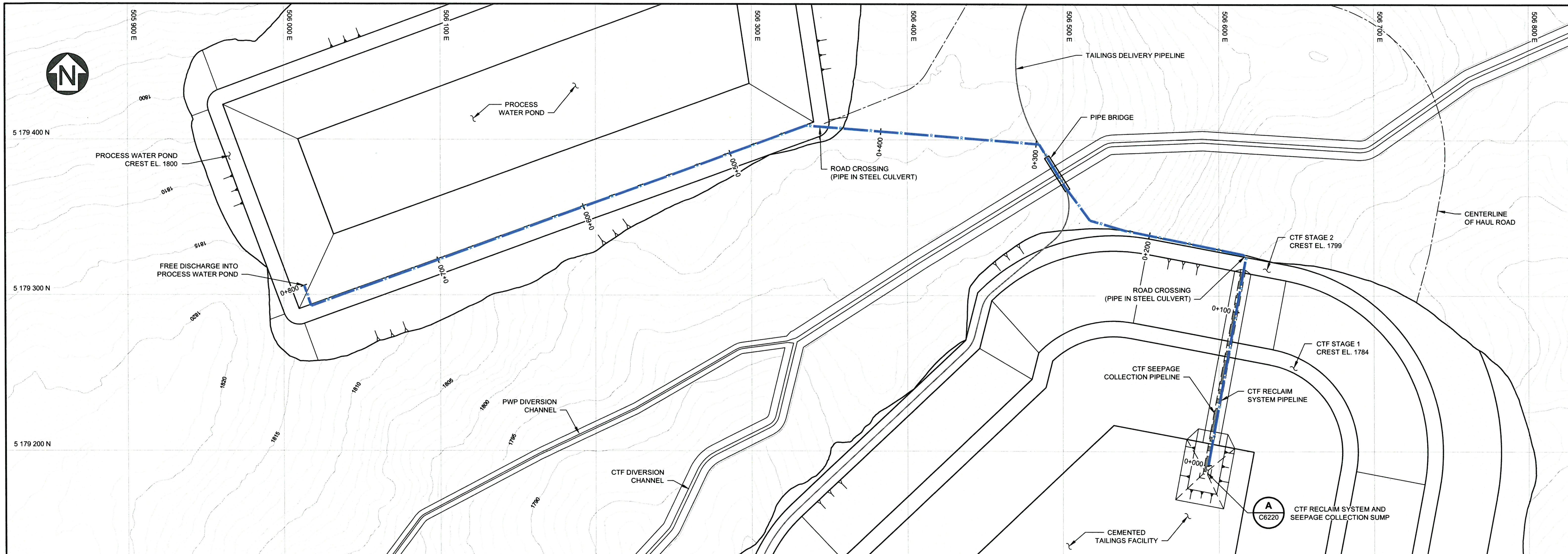
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

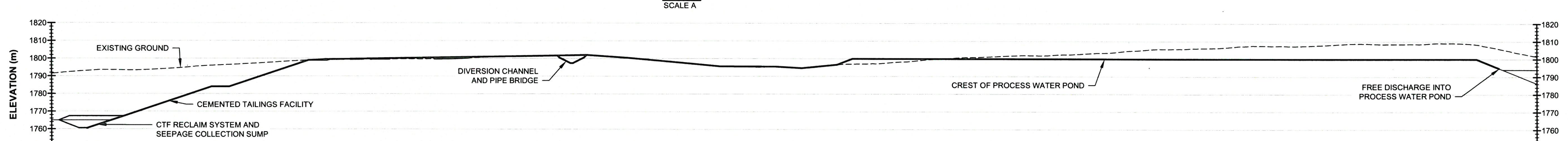
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR'17	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAF		
1	29APR'16	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAP	KJB	KJB
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KJB	KJB

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6200\C6200_r2, 4/21/2017 8:05:23 AM , RFAHHAM PRINTED: 4/21/2017 8:25:06 AM, C6200, RFAHHAM
XREF FILE(S): IMAGE FILE(S):



PLAN

SCALE A



STATION (m)	-0+020	0+000	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800	0+821
GROUND ELEVATION	1791.48	1793.06	1797.50	1799.94	1800.99	1794.72	1800.76	1805.17	1807.82	1805.77	1801.55
INVERT ELEVATION			1790.43	1800.56	1800.85	1794.96	1800.00	1800.00	1800.00		
DESIGN PROFILE	33% | 0% | 33%			SLOPE VARIES			SLOPE 0%			-40%	
PIPE DATA	125.68 m - ND 150 mm HDPE DR21			695.81 m - ND 150 HDPE DR 21							

PROFILE

SCALE A

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

LEGEND:

RECLAIM SYSTEM PIPELINE

SEEPAGE COLLECTION PIPELINE

FOR INFORMATION ONLY

SCALE A 25 12.5 0 25 50 75 100 125 m

DRG. NO.	DESCRIPTION
C6230	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS (2 OF 2)
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS (1 OF 2)
C6200	CEMENTED TAILINGS FACILITY - WATER MANAGEMENT SYSTEMS - P&ID

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	27APR'17	LABELS ADJUSTED	GIM	WAL	K.	K.
1	29APR'16	PIPE DATA REVISED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KJB	KJB

REVISIONS

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY SEEPAGE COLLECTION AND RECLAIM SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6210	2

SAVED: M:\1\01\00460\03\A\cad\DWGS\C6210\C6210_r2, 4/27/2017 3:14:11 PM , WLAHODA PRINTED: 4/27/2017 3:23:51 PM, layout, WLAHODA
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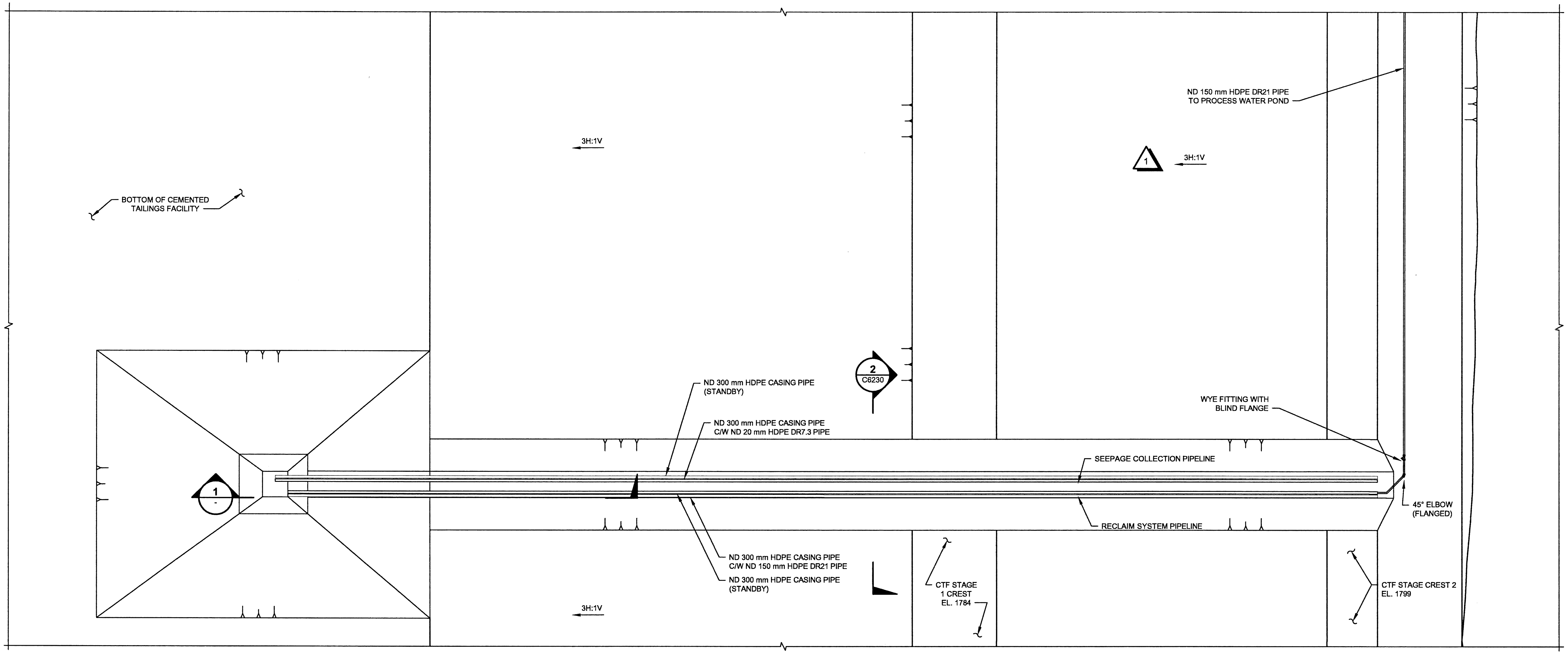


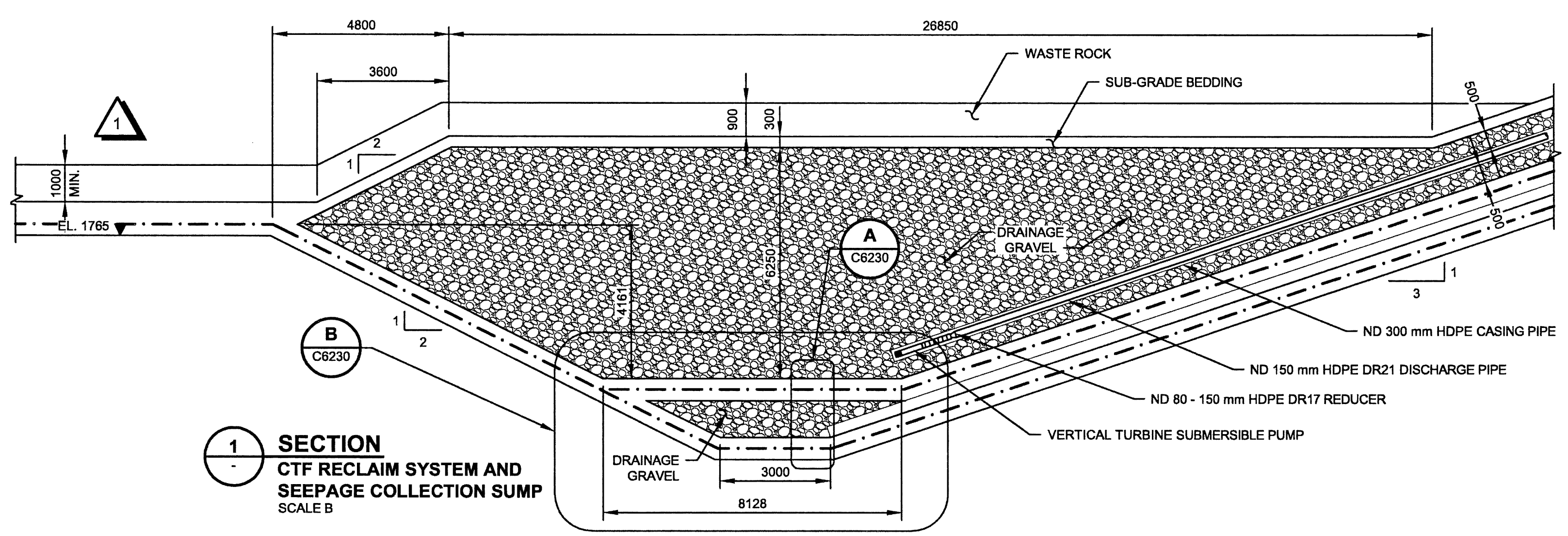
A C6210 **DETAIL**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE A

FOR INFORMATION ONLY

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

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



1 - **SECTION**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE B

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
WATER MANAGEMENT SYSTEMS
TYPICAL SECTIONS - 1 OF 2

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6220	1

DRG. NO.	DESCRIPTION
C6230	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 2 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	SLOPE AND WASTE ROCK THICKNESS REVISED	GIM	RAP		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KDE	KDE

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6220\C6220_r1, 4/27/2016 3:57:58 PM , RPENG PRINTED: 4/27/2016 3:58:11 PM, C6220, RPENG
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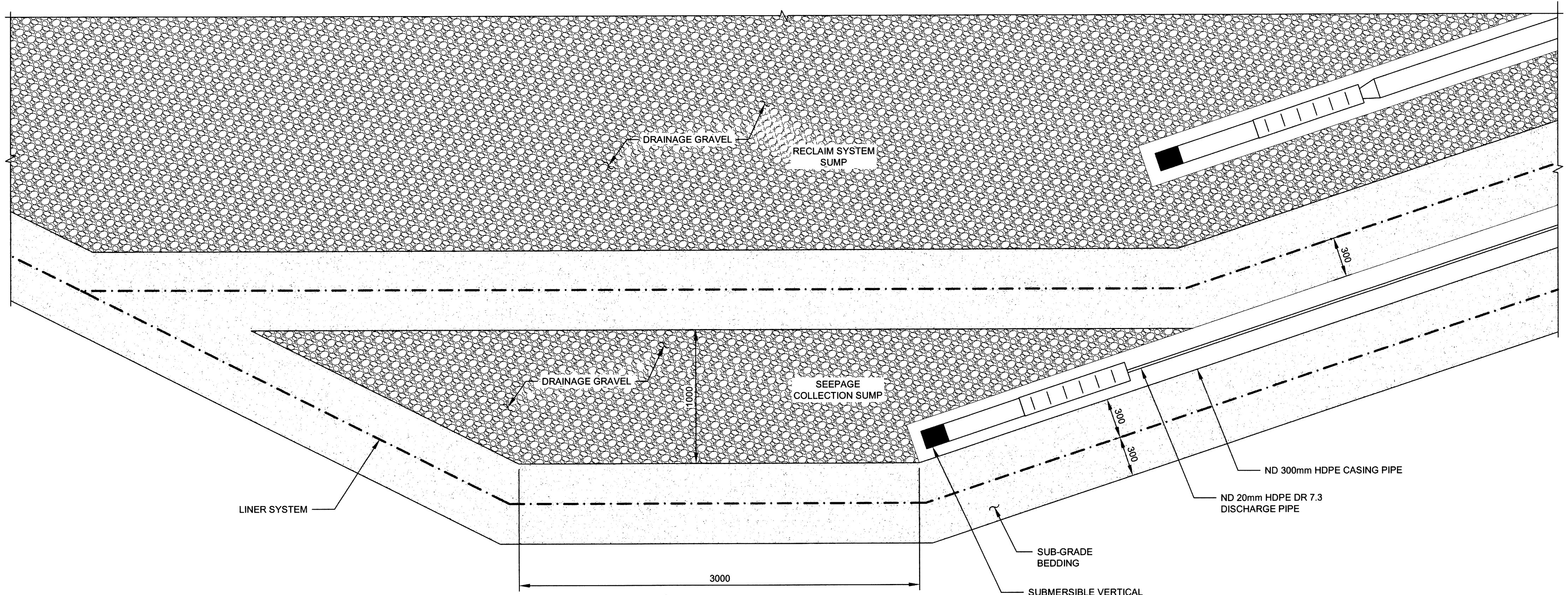
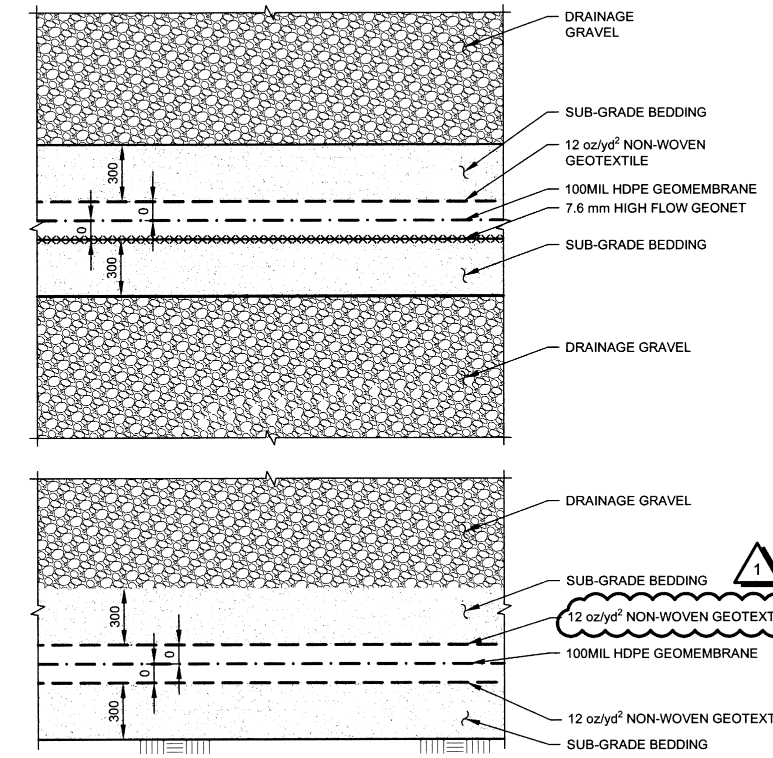
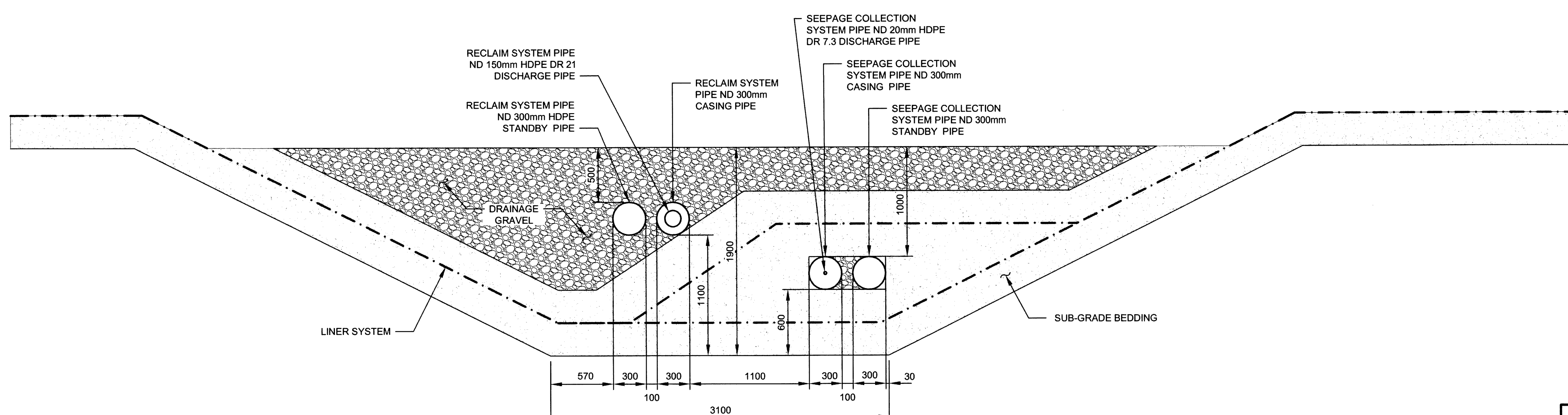


B C6220 **DETAIL**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE A



A C6220 **SECTION**
LINER CONFIGURATION
NTS



2 C6220 **SECTION**
SCALE B

FOR INFORMATION ONLY

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

SCALE A 2 1 0 2 4 6 8 10 m

SCALE B 3 1.5 0 5 10 15 m

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
WATER MANAGEMENT SYSTEMS
TYPICAL SECTIONS - 2 OF 2

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6230	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 1 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	20JUL'16	SECTION A REVISED - NON-WOVEN GEOTEXTILE ADDED	GIM	WAL		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6230\C6230_r1, 7/20/2016 2:39:48 PM , WLAHODA PRINTED: 7/20/2016 2:45:05 PM, layout, WLAHODA
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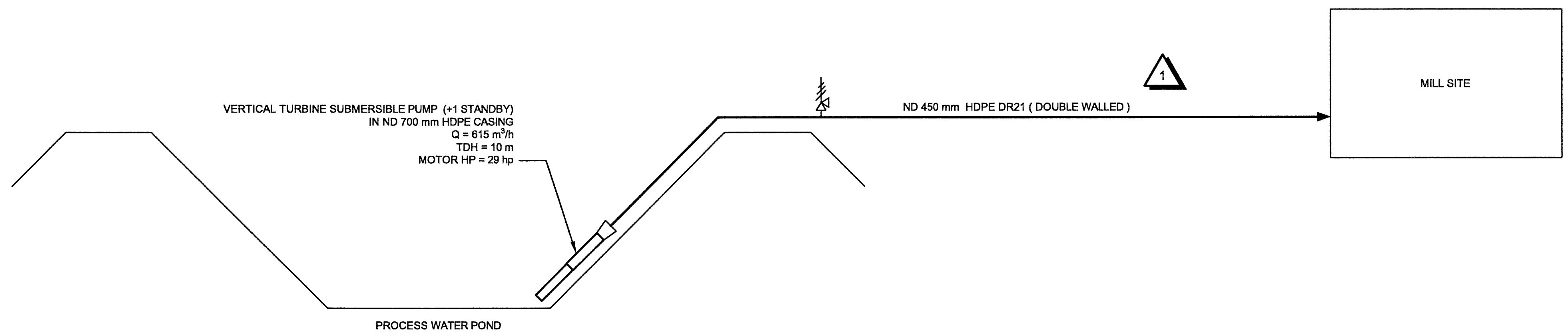

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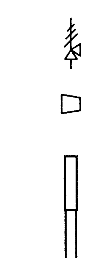

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BLACK BUTTE COPPER PROJECT

RECLAIM WATER DELIVERY SYSTEM
PROCESS WATER POND TO MILL SITE
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6250	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6260	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP	KJB	KJB
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB

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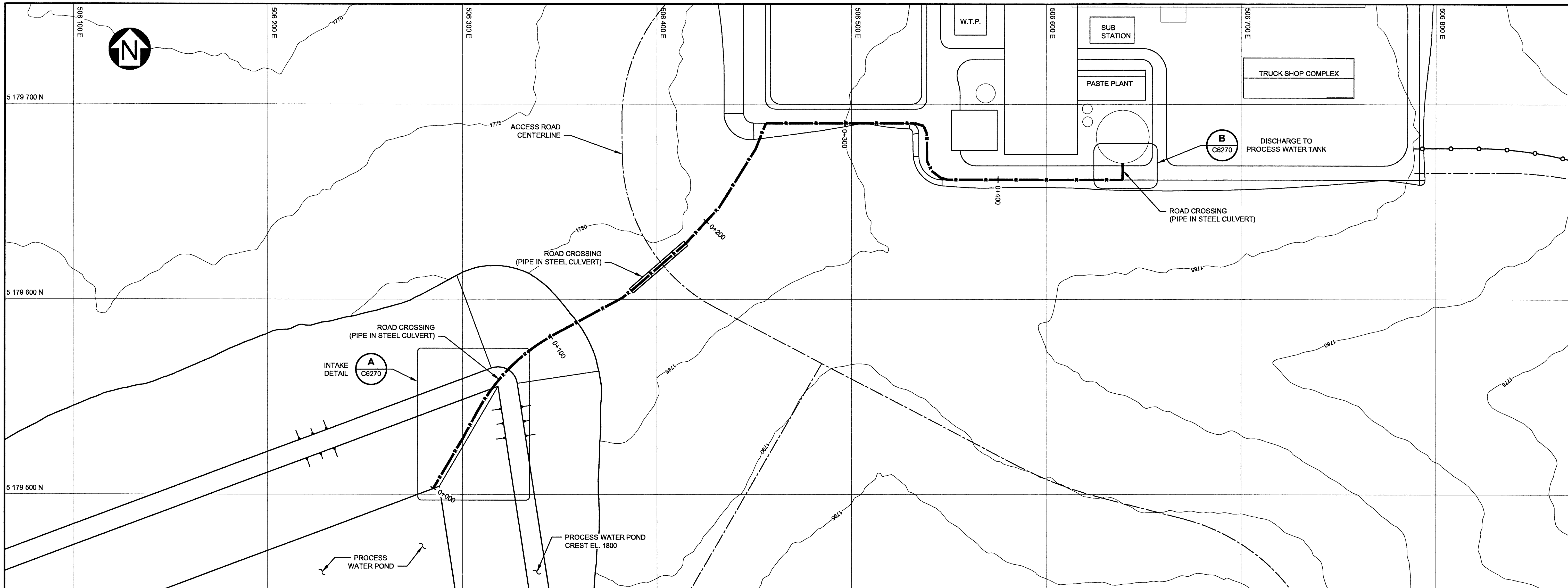


PLAN
SCALE A

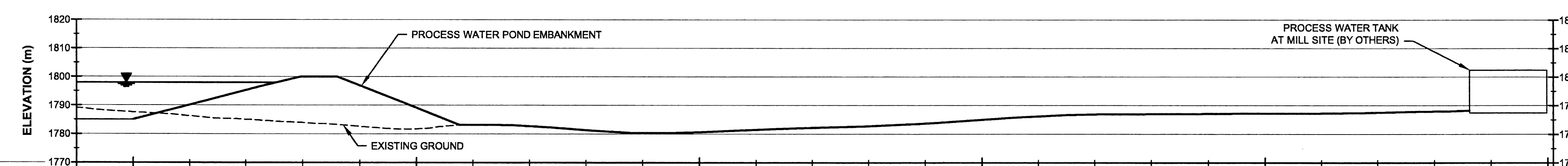
LEGEND:

RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY



STATION (m)	0+000	0+100	0+200	0+300	0+400	0+500
EXISTING GROUND ELEVATION	1789.14 / 1787.61	1781.72	1780.59	1784.96	1787.27	1789.00
INVERT ELEVATION	1785.05	1783.09	1780.59	1784.97	1787.27	
DESIGN PROFILE	25% — 0% — -40% — SLOPE VARIES					
PIPE SLOPE	ND 450 mm HDPE DR21 LENGTH = 472 m					

1

PROFILE
SCALE A

SCALE A 20 10 0 20 40 60 80 100 m

DRG. NO.	DESCRIPTION
C6250	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - P&ID
C6270	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP		
0	15OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	KJB	KJB

REVISIONS

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

**RECLAIM WATER DELIVERY SYSTEM
PROCESS WATER POND TO MILL SITE
PLAN AND PROFILE**

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6260	1

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6260\C6260_r1, 4/27/2016 3:36:01 PM , RPENG PRINTED: 4/27/2016 3:36:12 PM, layout, RPENG
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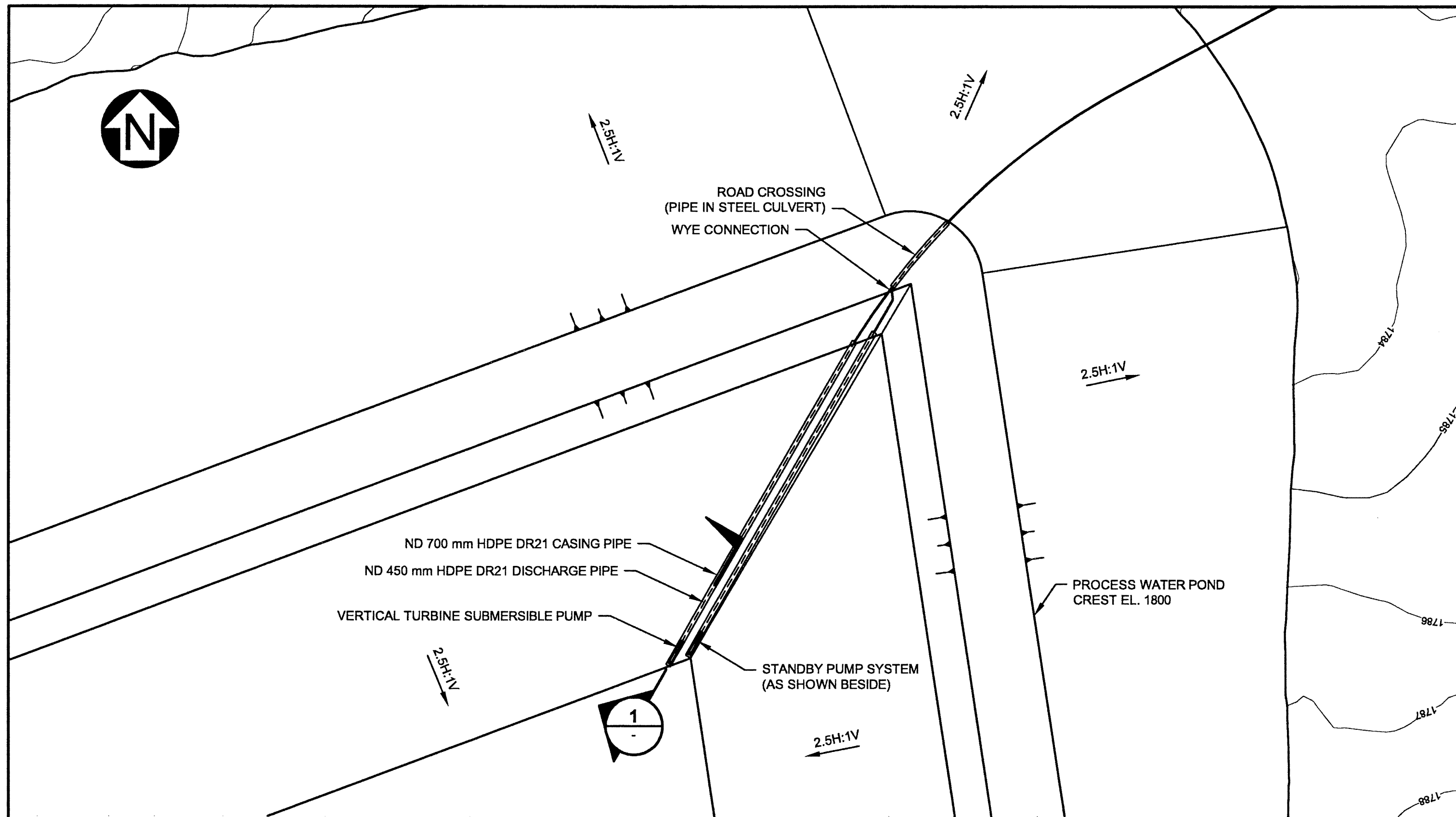
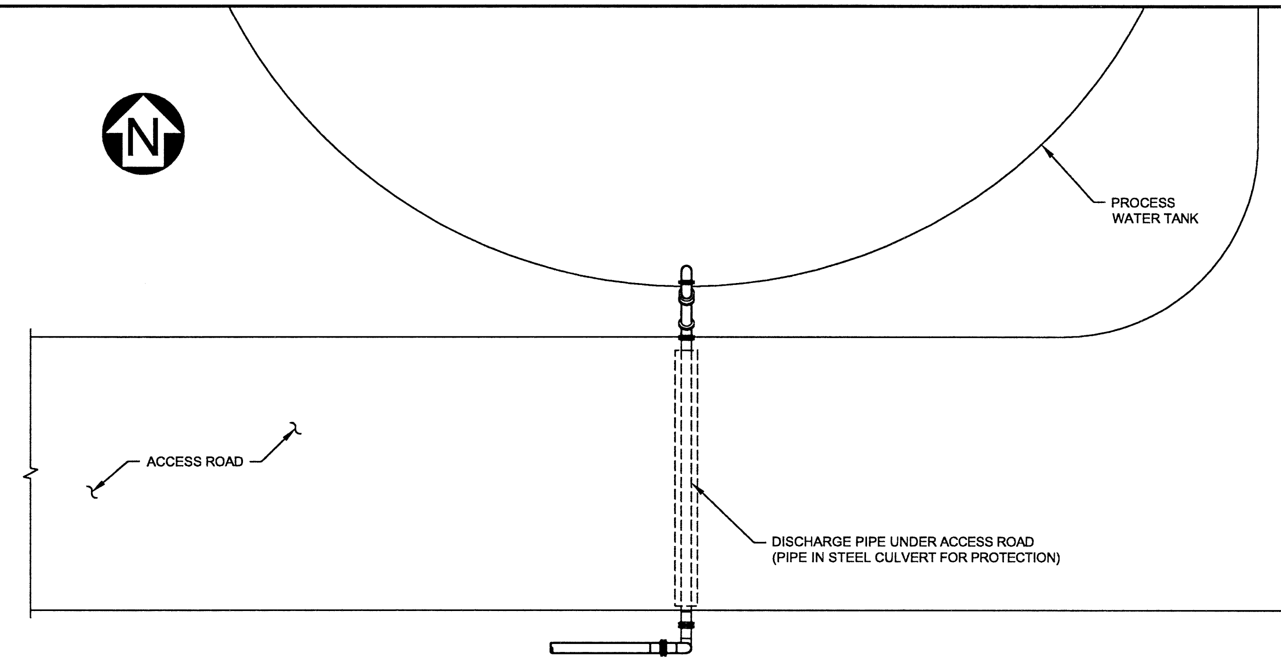
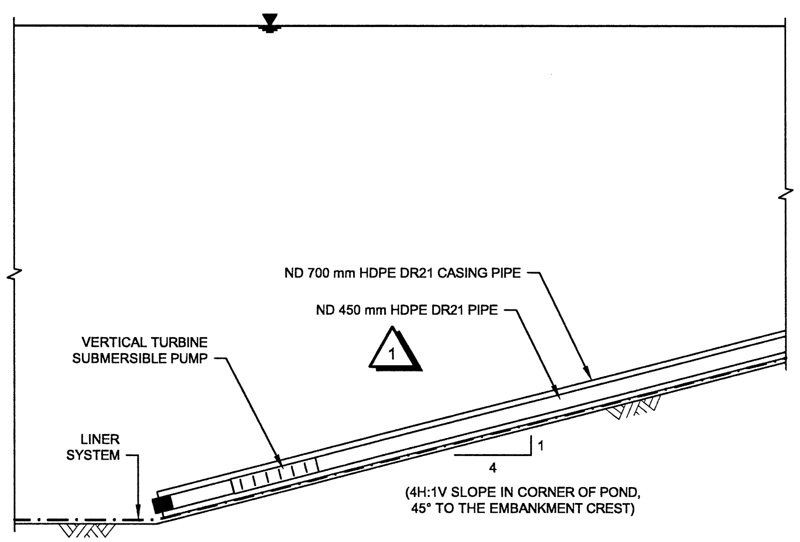


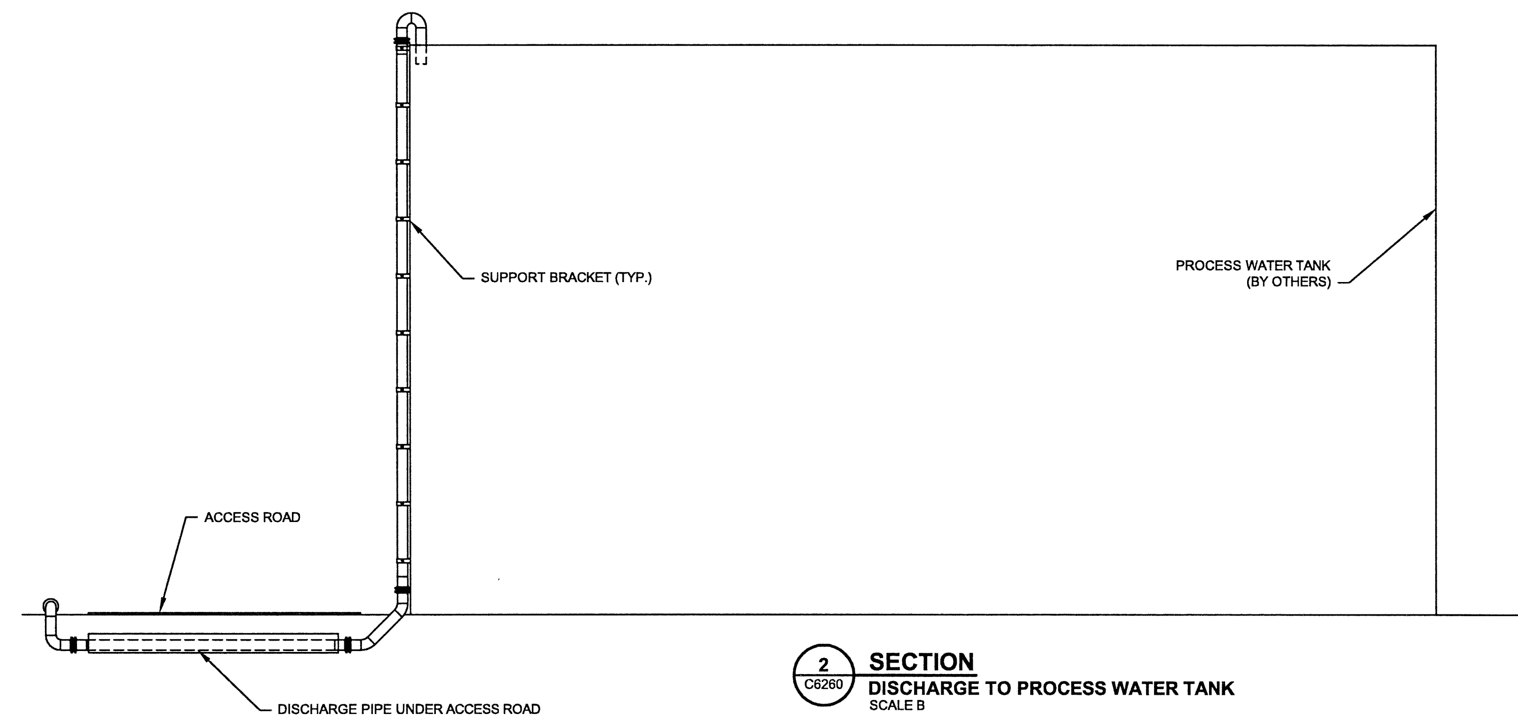
A DETAIL C6260
PROCESS WATER POND INTAKE
SCALE A



B DETAIL C6260
DISCHARGE TO PROCESS WATER TANK
SCALE B



1 SECTION C6260
PROCESS WATER POND INTAKE
SCALE B



2 SECTION C6260
DISCHARGE TO PROCESS WATER TANK
SCALE B

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE A 10 5 0 10 20 30 40 50 m
SCALE B 2 1 0 2 4 6 8 10 m

DRG. NO.	DESCRIPTION
C6260	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP	K.J.	K.L.
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB

REVISIONS

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

**RECLAIM WATER DELIVERY SYSTEM
PROCESS WATER POND TO MILL SITE
TYPICAL SECTIONS**

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6270	1

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6270\C6270_r1, 4/27/2016 3:34:35 PM , RPENG PRINTED: 4/27/2016 3:34:48 PM, C6004, RPENG
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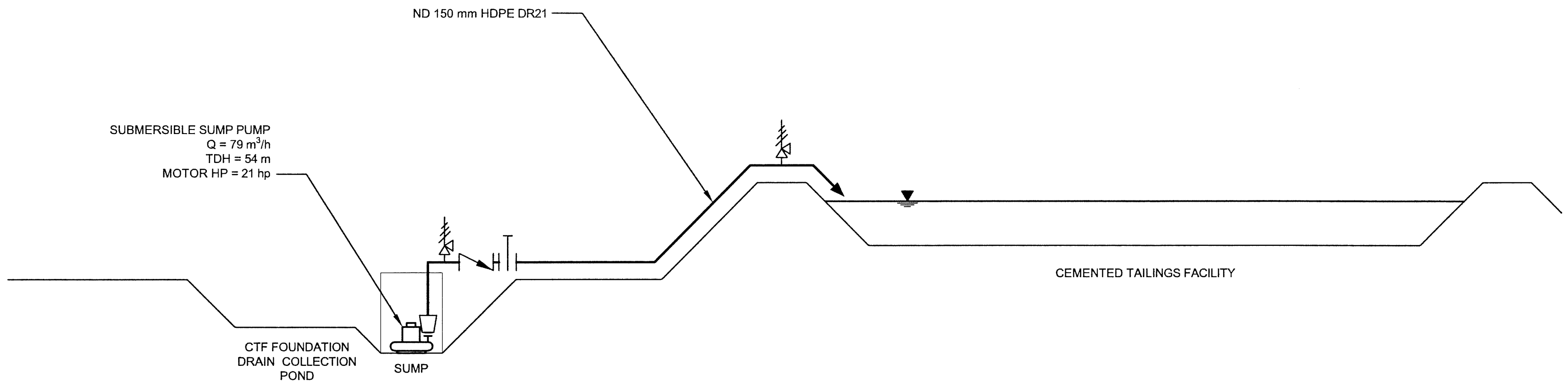
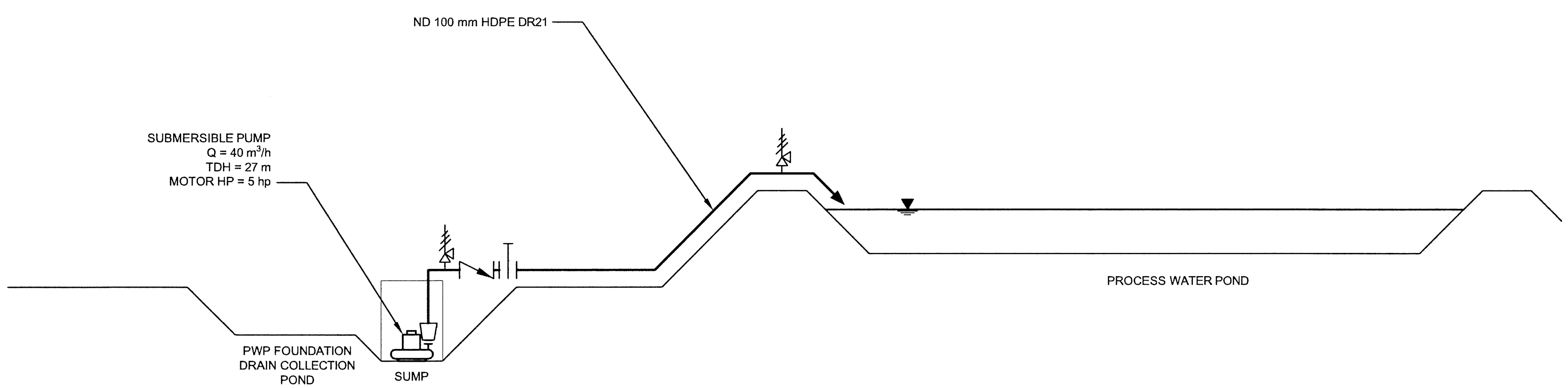
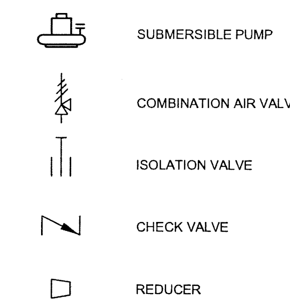


CEMENTED TAILINGS FACILITY FOUNDATION DRAIN PUMPBACK SYSTEM



PROCESS WATER POND FOUNDATION DRAIN PUMPBACK SYSTEM

LEGEND:



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BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6300	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6320	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - PWP - PLAN AND PROFILE
C6310	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - CTF - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	K.	K.

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6300\C6300, 10/16/2015 8:49:50 AM , PPETKOVIC PRINTED: 10/16/2015 8:49:54 AM, layout, PPETKOVIC
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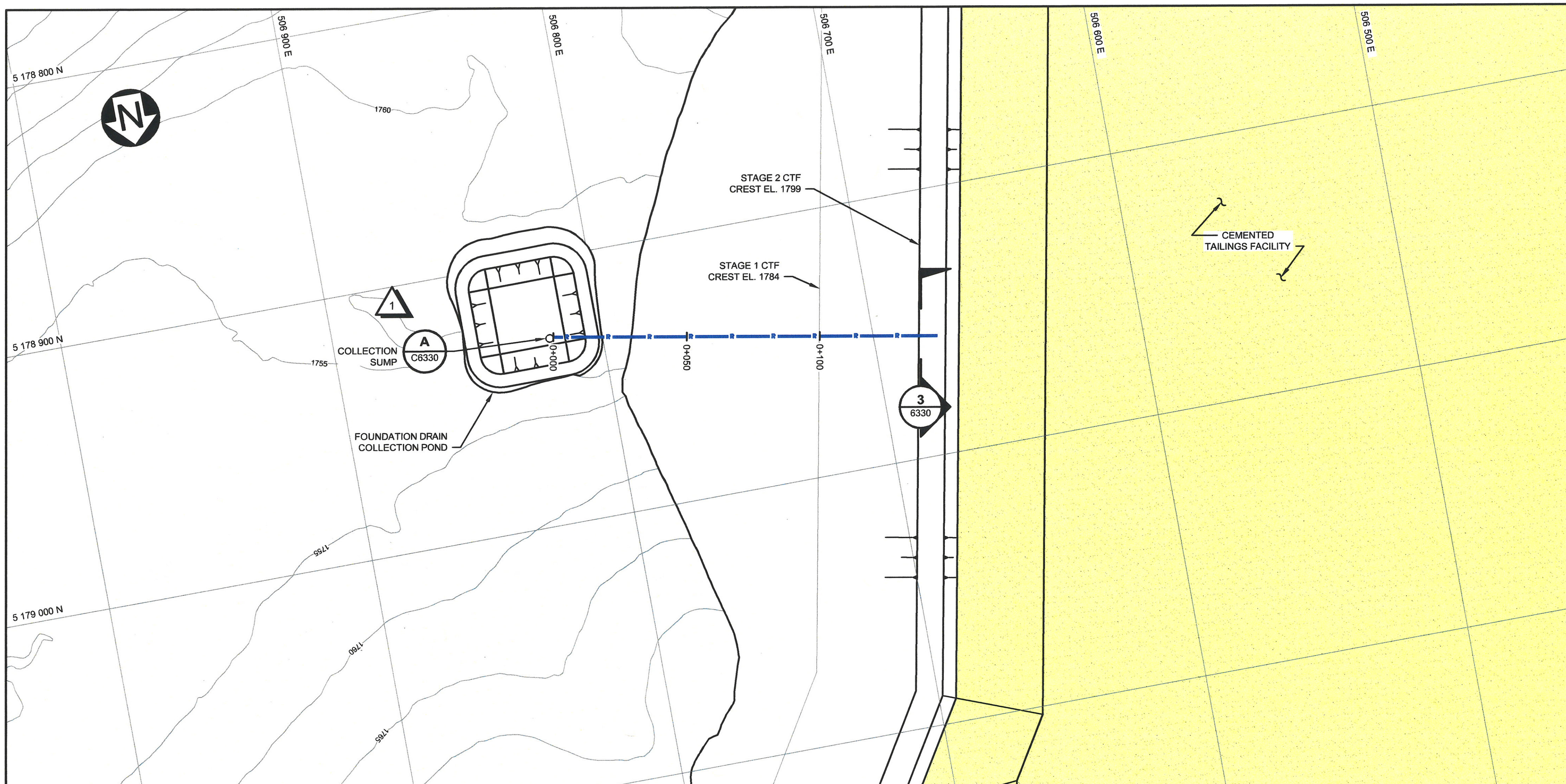
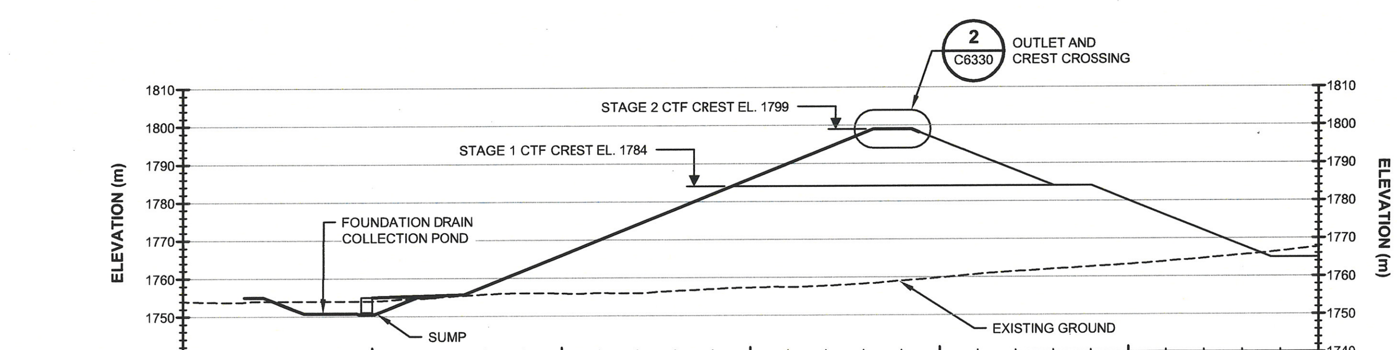


PLAN
SCALE A



STATION (m)		0+000	0+050	0+100	0+150	0+200	0+250
EXISTING GROUND ELEVATION	1753.95	1754.00	1755.94	1757.33	1759.81	1763.22	1767.64
INVERT ELEVATION		1754.99	1765.98	1785.98			
DESIGN PROFILE		2.8%	40%		0% -40%		
PIPE DATA		ND 150 HDPE DR21 LENGTH = 145 m					

PROFILE
SCALE A

LEGEND:

—R— RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

– DISCLAIMER –

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Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6310	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	K.	K.
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6310\C6310, 4/28/2016 9:33:51 AM , RPENG PRINTED: 4/28/2016 9:41:04 AM, C6310, RPENG
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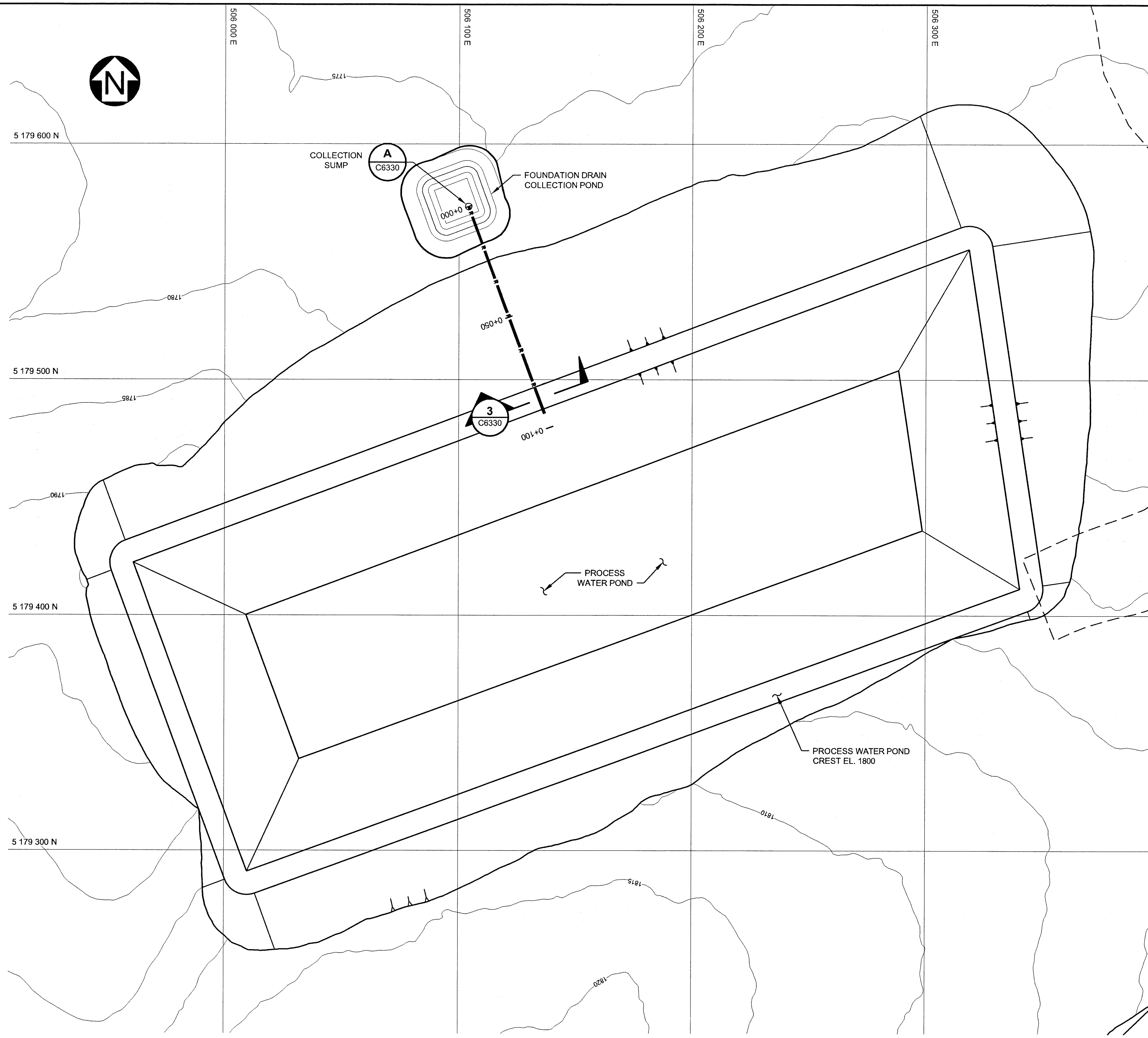
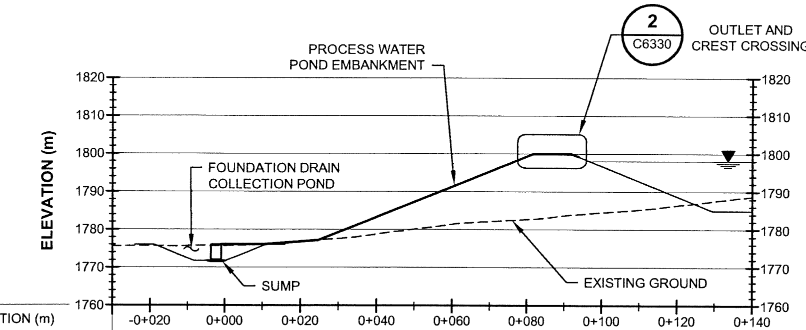


PLAN
SCALE A



STATION (m)	-0+020	0+000	0+020	0+040	0+060	0+080	0+100	0+120	0+140
EXISTING GROUND ELEVATION	1775.73	1775.67	1776.68	1778.78	1781.38	1782.69	1784.54	1786.42	1788.74
INVERT ELEVATION		1776.00 / 1776.78	1783.32	1791.32	1799.32				
DESIGN PROFILE		0% / 8%	40%			0% / -40%			
PIPE DATA	ND 100 HDPE DR21 LENGTH = 94 m								

PROFILE
SCALE A

LEGEND:

—R— RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

– DISCLAIMER –
THIS DRAWING WAS PREPARED BY KNIGHT PIÉSOLD LTD. FOR THE ACCOUNT OF THE CLIENT LISTED ON THIS DRAWING. THE MATERIAL ON IT REFLECTS KNIGHT PIÉSOLD'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 PIÉSOLD 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.

Knight Piésold
CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM PROCESS WATER POND PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6320	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

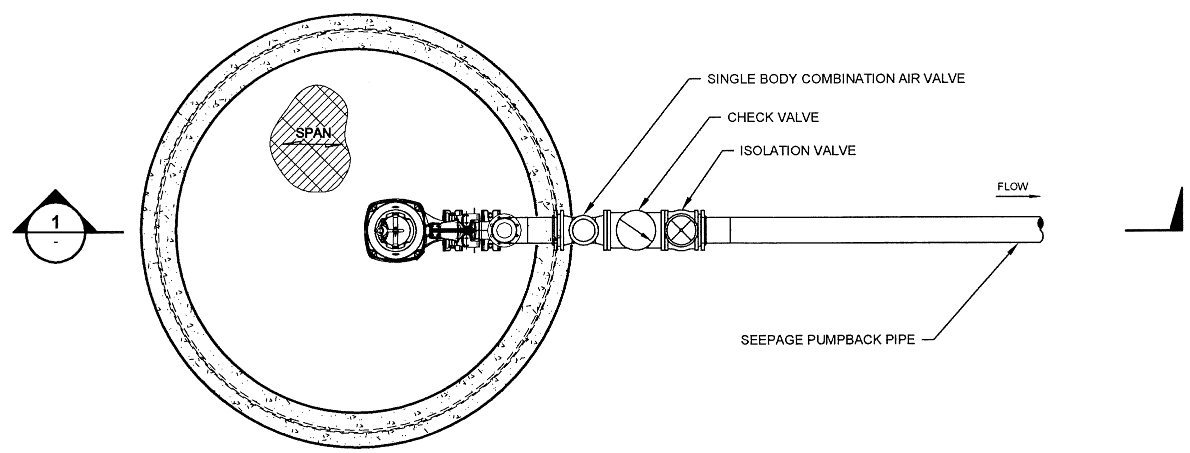
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

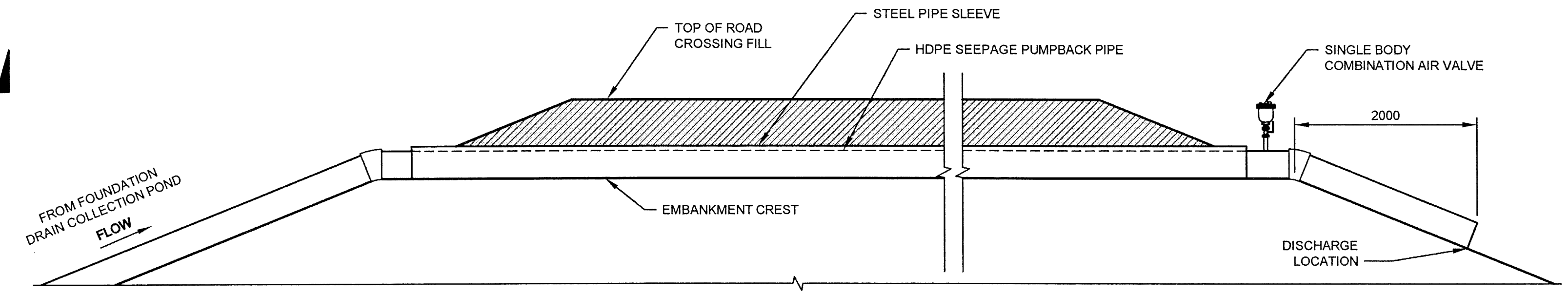
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM		

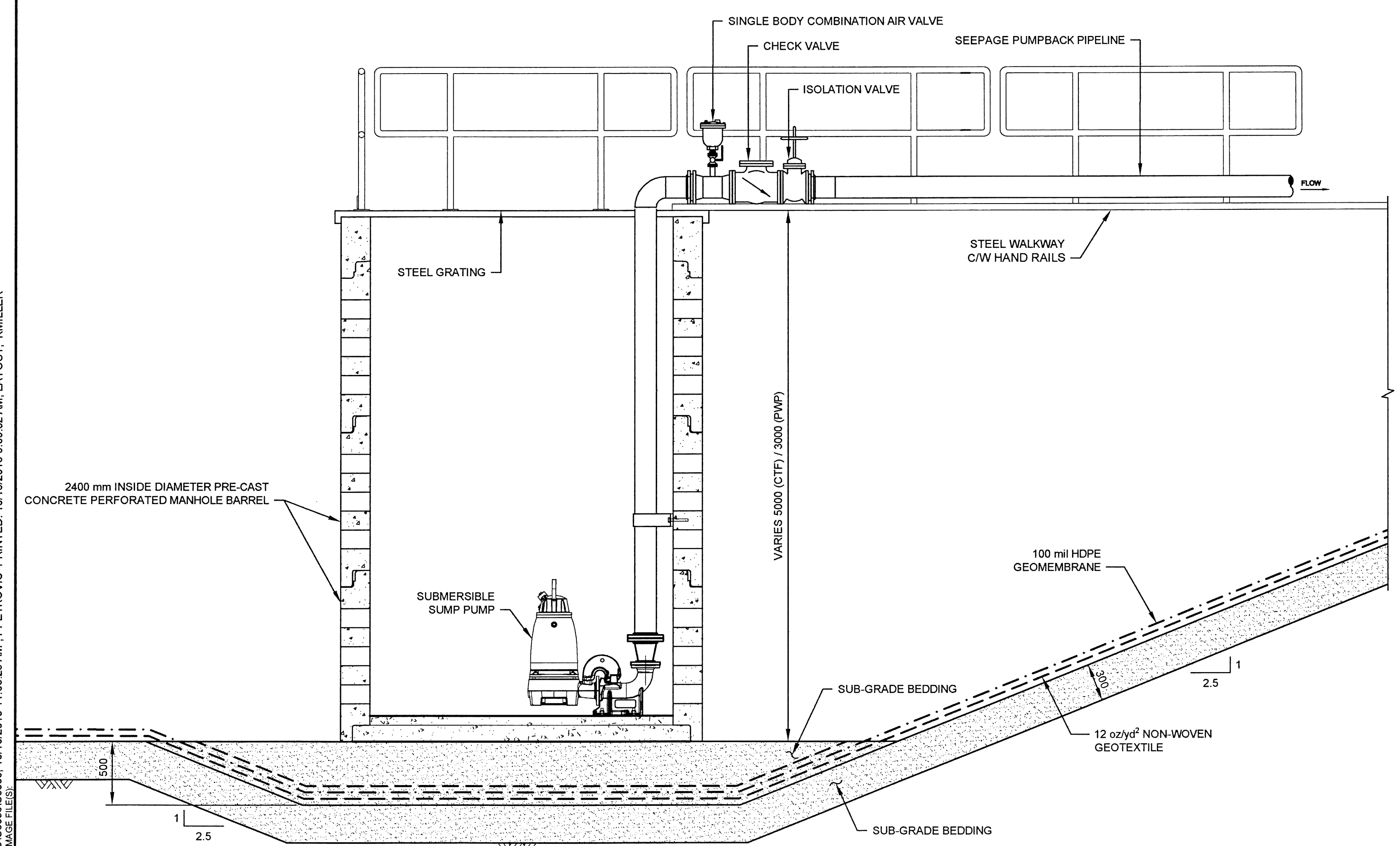
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6320\C6320, 10/16/2015 8:57:10 AM, PPETKOVIC PRINTED: 10/16/2015 8:57:15 AM, layout, PPETKOVIC
XREF FILE(S): Topo_1m; Facility_PWP; CTF_S2 PROCESS WATER POND IMAGE FILE(S):



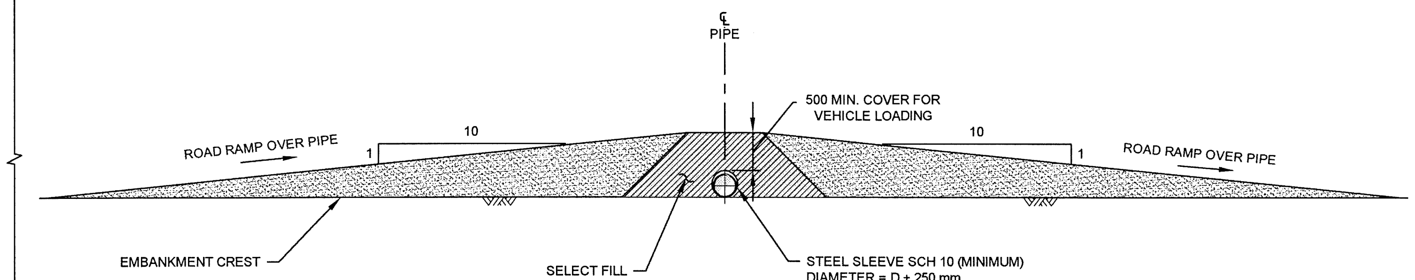
A 6310 A 6320 **DETAIL**
SUMP IN FOUNDATION DRAIN COLLECTION POND
NTS



2 6320 2 C6310 **DETAIL**
OUTLET AND CREST CROSSING
NTS



1 - **SECTION**
SUMP IN FOUNDATION DRAIN COLLECTION POND
NTS



3 - **SECTION**
ROAD CROSSING
NTS

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6320	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - PWP - PLAN AND PROFILE
C6310	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - CTF - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM		

REVISIONS

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN POND & PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY AND PROCESS WATER POND TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6330	0

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6330\C6330, 10/15/2015 11:08:28 AM, PPETKOVIC PRINTED: 10/16/2015 9:09:32 AM, LAYOUT, KMILLER
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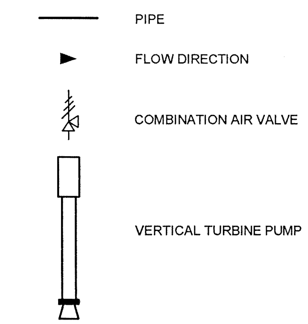
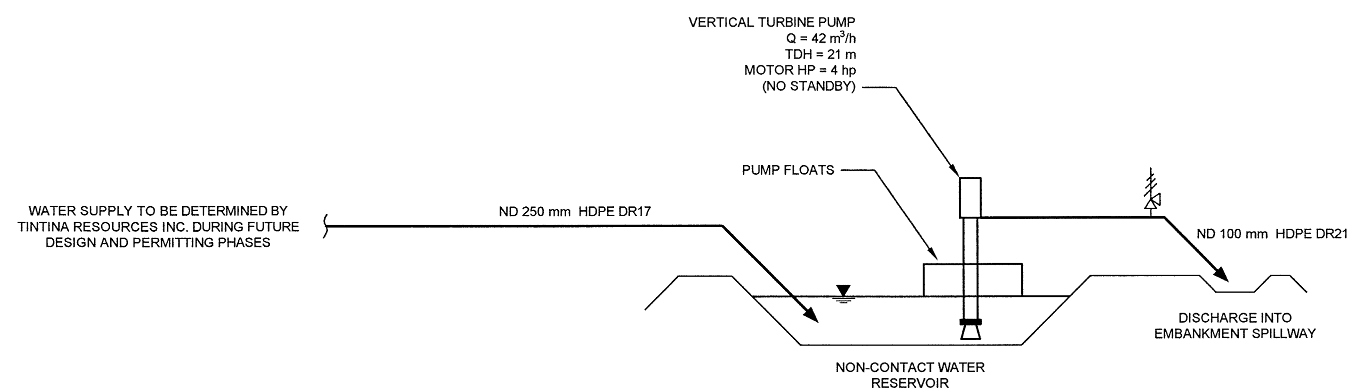
LEGEND:





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Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR SUPPLY AND DISCHARGE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6400	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6430	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	16NOV'15	ISSUED FOR MOP APPLICATION	MAP	KJM	[signature]	[signature]
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6400\C6400, 11/18/2015 8:40:15 AM , KMILLER PRINTED: 11/18/2015 8:40:21 AM, LAYOUT, KMILLER
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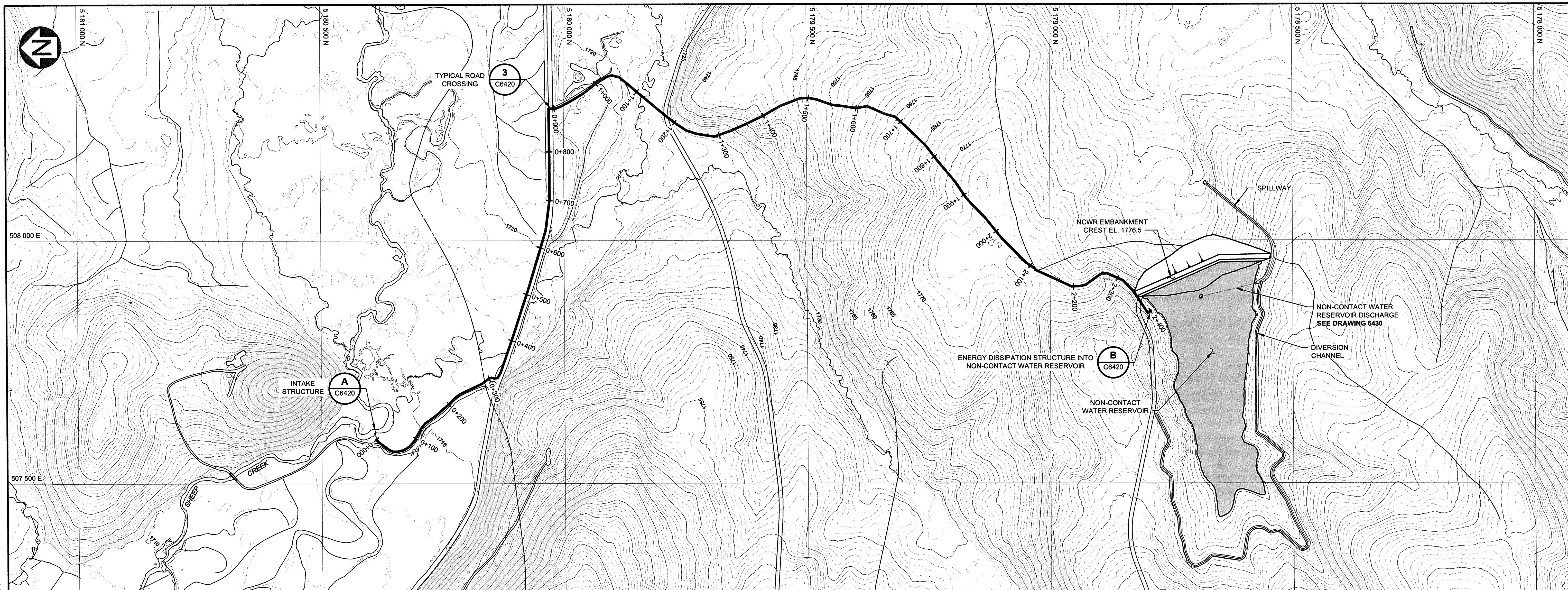
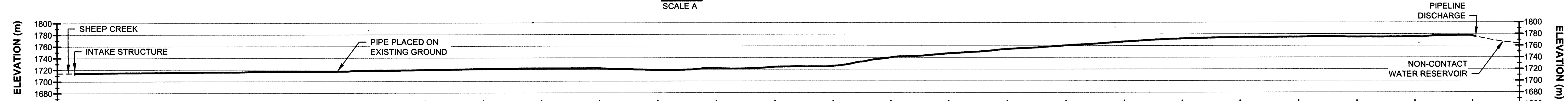


PLAN
SCALE A



STATION (m)	0+000	0+100	0+200	0+300	0+400	0+500	0+600	0+700	0+800
GROUND ELEVATION	1714.00	1714.99	1715.57	1716.58	1717.00	1718.00	1719.67	1720.99	1722.00
DESIGN ELEVATION	1714.00	1714.99	1715.57	1716.58	1717.00	1718.00	1719.67	1720.99	1722.00

STATION (m)	0+900	1+000	1+100	1+200	1+300	1+400	1+500	1+600	1+700
GROUND ELEVATION	1722.43	1719.00	1722.36	1724.41	1725.90	1740.23	1747.11	1754.67	1760.61
DESIGN ELEVATION	1722.43	1719.00	1722.36	1724.41	1725.90	1740.23	1747.11	1754.67	1760.61

STATION (m)	1+800	1+900	2+000	2+100	2+200	2+300	2+400	2+481
GROUND ELEVATION	1767.12	1772.33	1774.61	1774.93	1774.90	1775.33	1776.68	1763.80
DESIGN ELEVATION	1767.12	1772.33	1774.61	1774.93	1774.90	1775.33	1776.68	1763.80

DESIGN PROFILE	SLOPE VARIES (0.8% AVG.) ; SLOPE VARIES (7% AVG.) ; SLOPE VARIES (0% AVG.)
PIPE DATA	ND 250 mm HDPE DR17 LENGTH = 2406 m

PROFILE
SCALE A

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

LEGEND:

NON-CONTACT WATER SUPPLY

PROPOSED ACCESS ROADS

FOR INFORMATION ONLY

SCALE A 80 40 0 100 200 300 400 m

- DISCLAIMER -

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Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR SUPPLY SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6410	1

DRG. NO.	DESCRIPTION
C6400	NON-CONTACT WATER RESERVOIR - SUPPLY AND DISCHARGE SYSTEM - P&ID
C6420	NON-CONTACT WATER RESERVOIR - SUPPLY SYSTEM - TYPICAL SECTIONS
C6430	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	30JUN'17	ROADS UPDATED	GIM	MJC		
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KDE	KDE

REVISIONS

SAVED: M:\1\10\00460\03\A\Acad\DWGS\C6410\C6410_r1, 6/30/2017 11:23:16 AM , MCOUTTS PRINTED: 6/30/2017 11:40:10 AM, C6410, MCOUTTS
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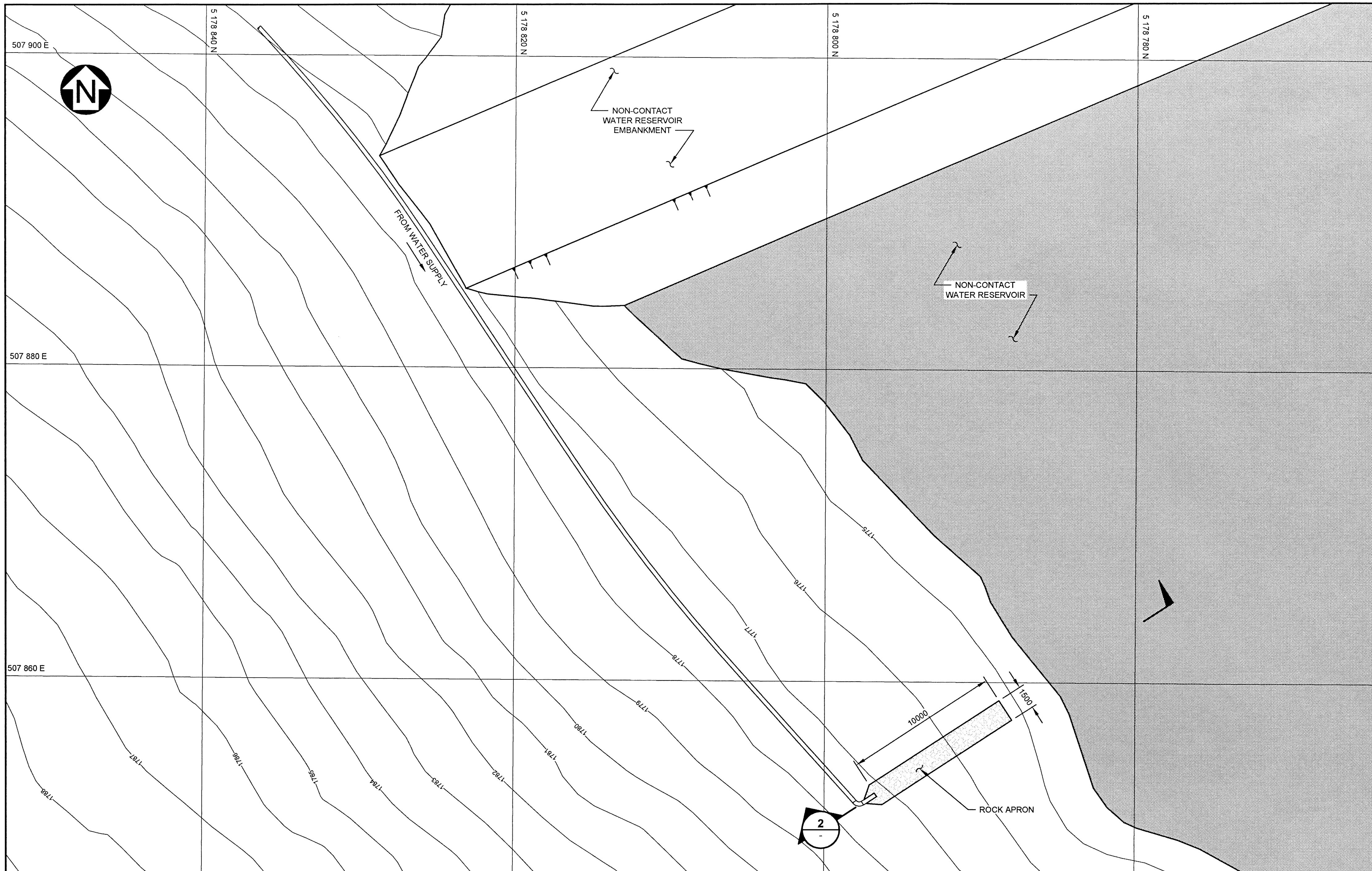
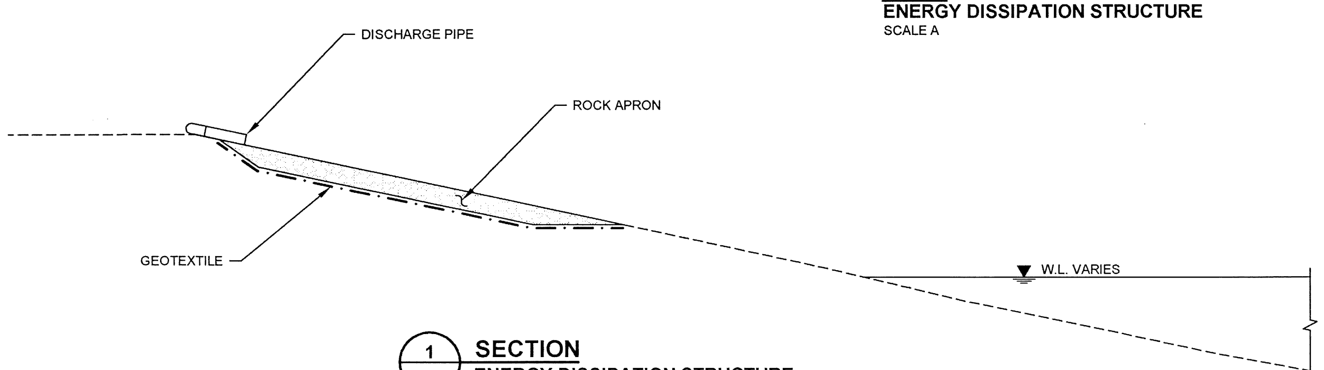


PLAN
ENERGY DISSIPATION STRUCTURE
SCALE A



1 - **SECTION**
ENERGY DISSIPATION STRUCTURE
SCALE B

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12N.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. WATER SUPPLY TO BE DETERMINED BY TINTINA RESOURCES INC. DURING FUTURE DESIGN AND PERMITTING PHASES.

FOR INFORMATION ONLY

SCALE A 3 1.5 0 5 10 15 m
SCALE B 2 1 0 2 4 6 8 10 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR SUPPLY SYSTEM DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6420	1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	16NOV'15	ISSUED FOR MOP APPLICATION	MAP	KJM		
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KDE	KDE

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6420\C6420, 11/18/2015 8:37:30 AM , KMILLER PRINTED: 11/18/2015 8:41:48 AM, C6420, KMILLER
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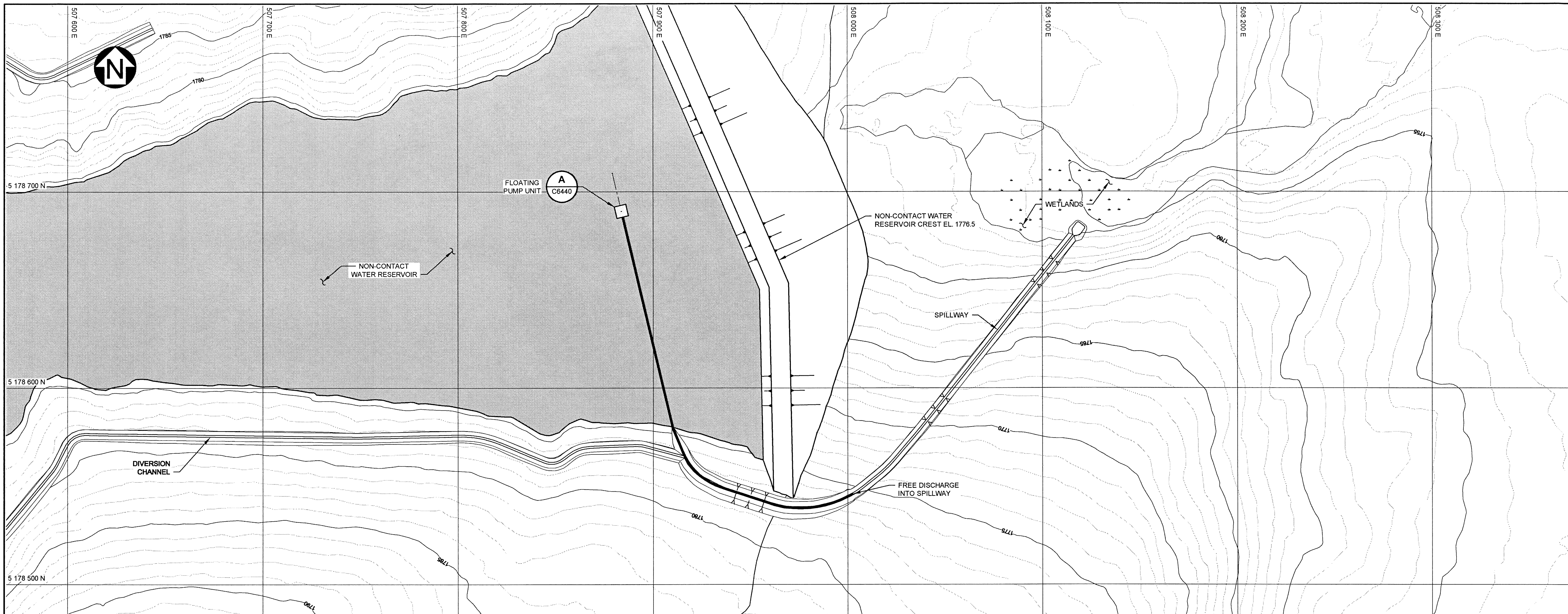


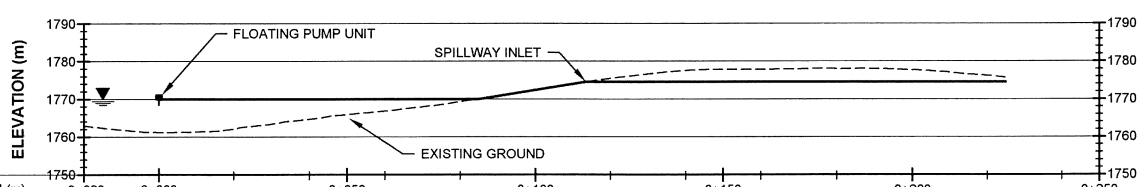
PLAN
SCALE A

LEGEND:

NON-CONTACT WATER DISCHARGE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.



STATION (m)	-0+020	0+000	0+050	0+100	0+150	0+200	0+250
GROUND ELEVATION	1762.91	1761.18	1765.89	1772.49	1777.85	1777.69	
DESIGN ELEVATION		1770.00	1770.00	1772.38	1774.50	1774.50	
DESIGN PROFILE		0%		15.85%		0%	
PIPE DATA		ND 100 mm HDPE DR21 DISCHARGE PIPE LENGTH = 225 m					

PROFILE
SCALE A

SCALE A 20 10 0 20 40 60 80 100 m

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6400	NON-CONTACT WATER RESERVOIR - SUPPLY AND DISCHARGE SYSTEM - P&ID
C6440	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	K.	K.

REVISIONS

Knight Piésold
CONSULTING

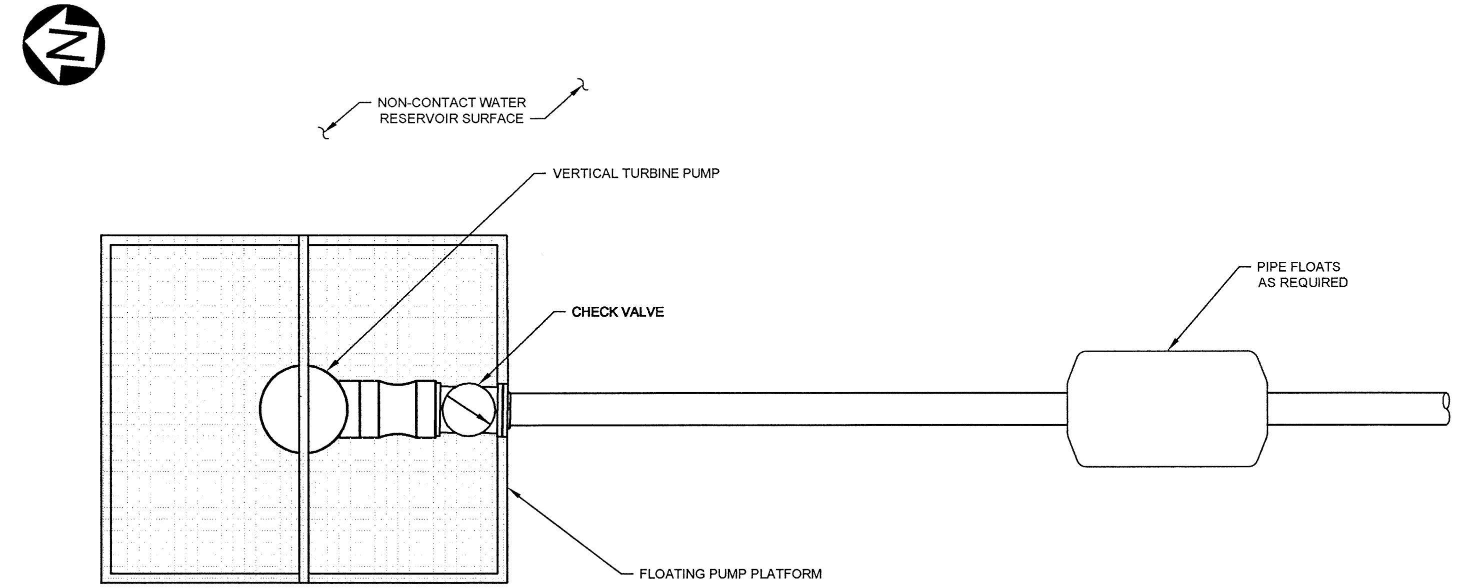
TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

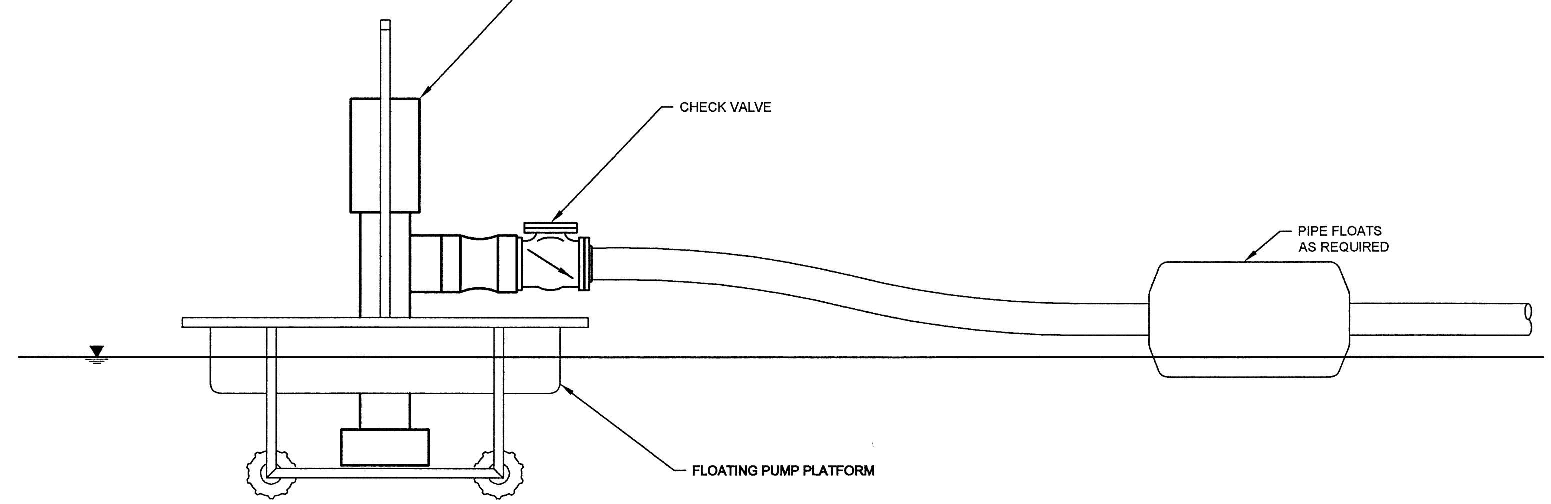
NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6430	0

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6430\C6430, 10/15/2015 11:37:32 AM , PPETKOVIC PRINTED: 10/16/2015 9:20:18 AM, C6430, KMILLER
XREF FILE(S): Topo_1m, NCWR, Roads, Hydro, Wetlands, NCWR-SPILL IMAGE FILE(S):



A DETAIL
C6430
FLOATING PUMP UNIT
SCALE A



1 SECTION
C6430
FLOATING PUMP UNIT
SCALE A

SCALE A 0.4 0.2 0 0.4 0.8 1.2 1.6 2.0 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6440	0

FOR INFORMATION ONLY

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6430	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	K.	K.

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6440\C6440, 10/15/2015 11:01:01 AM , PPETKOVIC PRINTED: 10/16/2015 9:21:45 AM, layout, KMILLER
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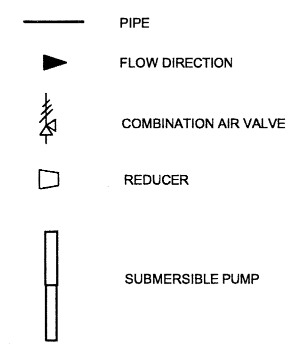

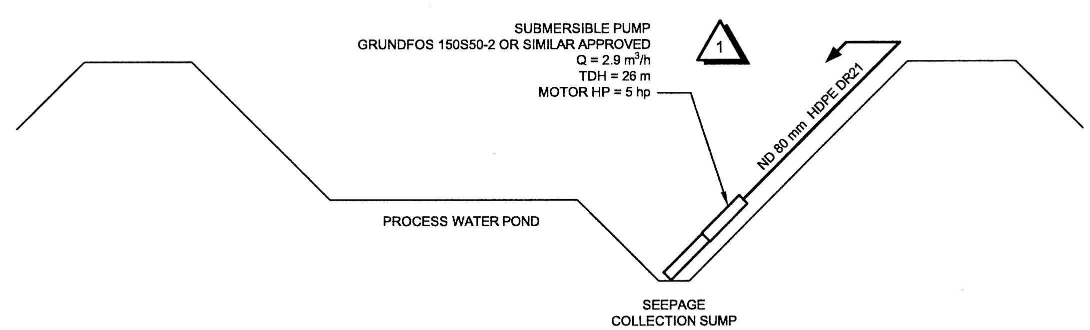

PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM

FOR INFORMATION ONLY

Knight Piésold
CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND
SEEPAGE COLLECTION & RECYCLE SYSTEM
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6500	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6510	PROCESS WATER POND - SEEPAGE COLLECTION & RECYCLE - PLAN & PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAP		
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB

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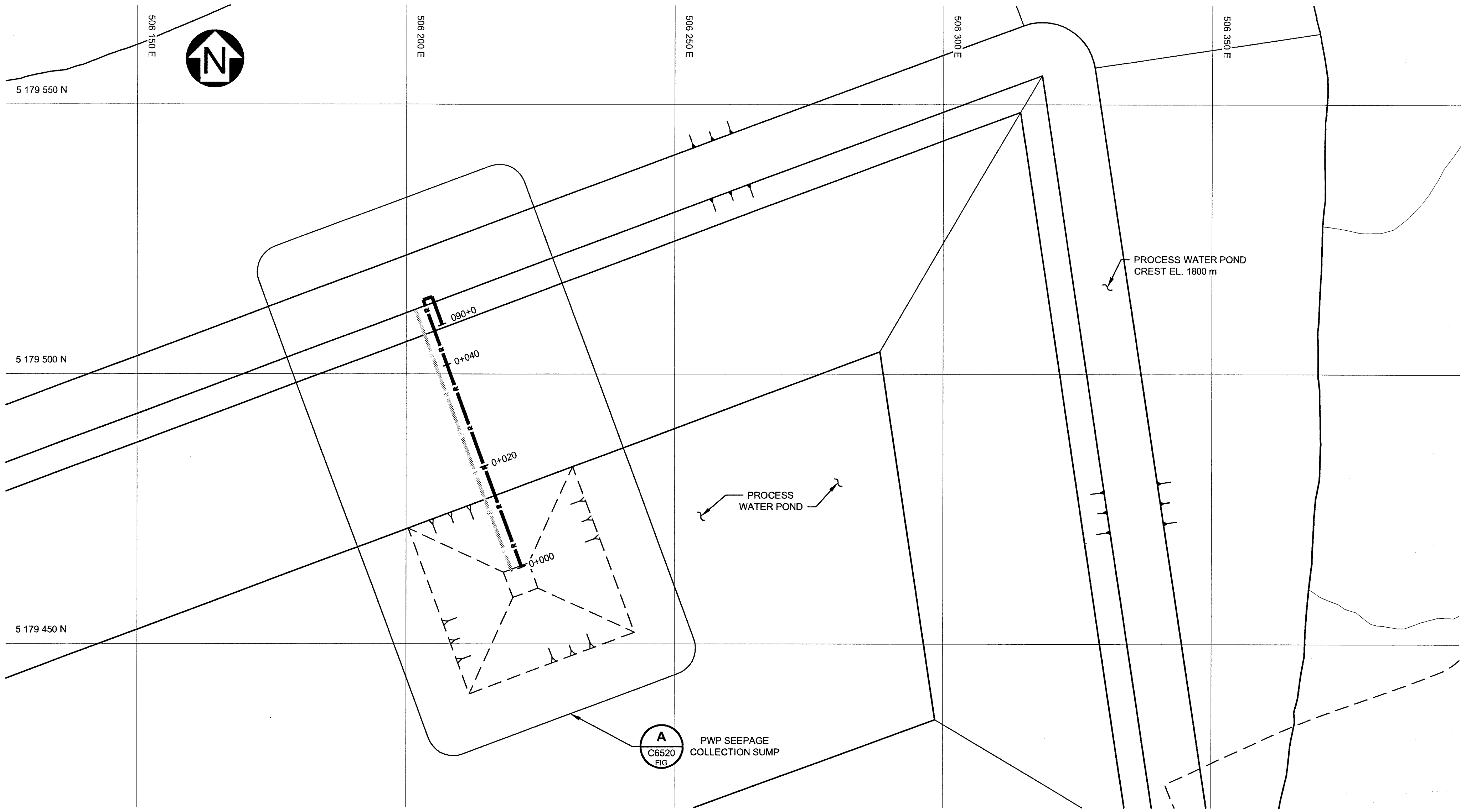


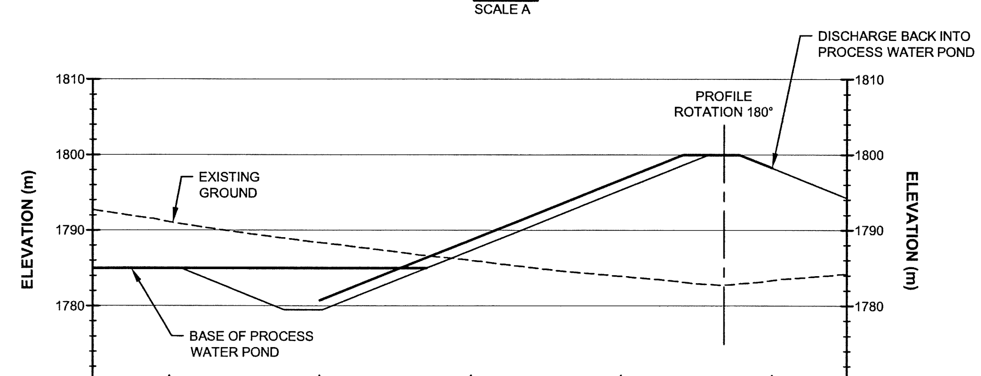
PLAN
SCALE A

LEGEND:

R — RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.



STATION (m)	-0+030	-0+020	0+000	0+020	0+040	0+060	0+070
EXISTING GROUND ELEVATION	1792.72	1791.08	1788.35	1786.01	1783.90	1783.37	1784.21
PIPE INVERT ELEVATION				1788.69	1796.69	1798.25	
DESIGN PROFILE			SLOPE = 40% 0% -40%				
PIPE DATA			ND 80 mm HDPE DR21 LENGTH = 60 m				

PROFILE
SCALE A

SCALE A 10 5 0 10 20 30 40 50 m

FOR INFORMATION ONLY

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6510	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	K.	K.

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6510\C6510, 10/16/2015 9:25:04 AM , KMILLER PRINTED: 10/16/2015 11:31:18 AM, layout, PPETKOVIC
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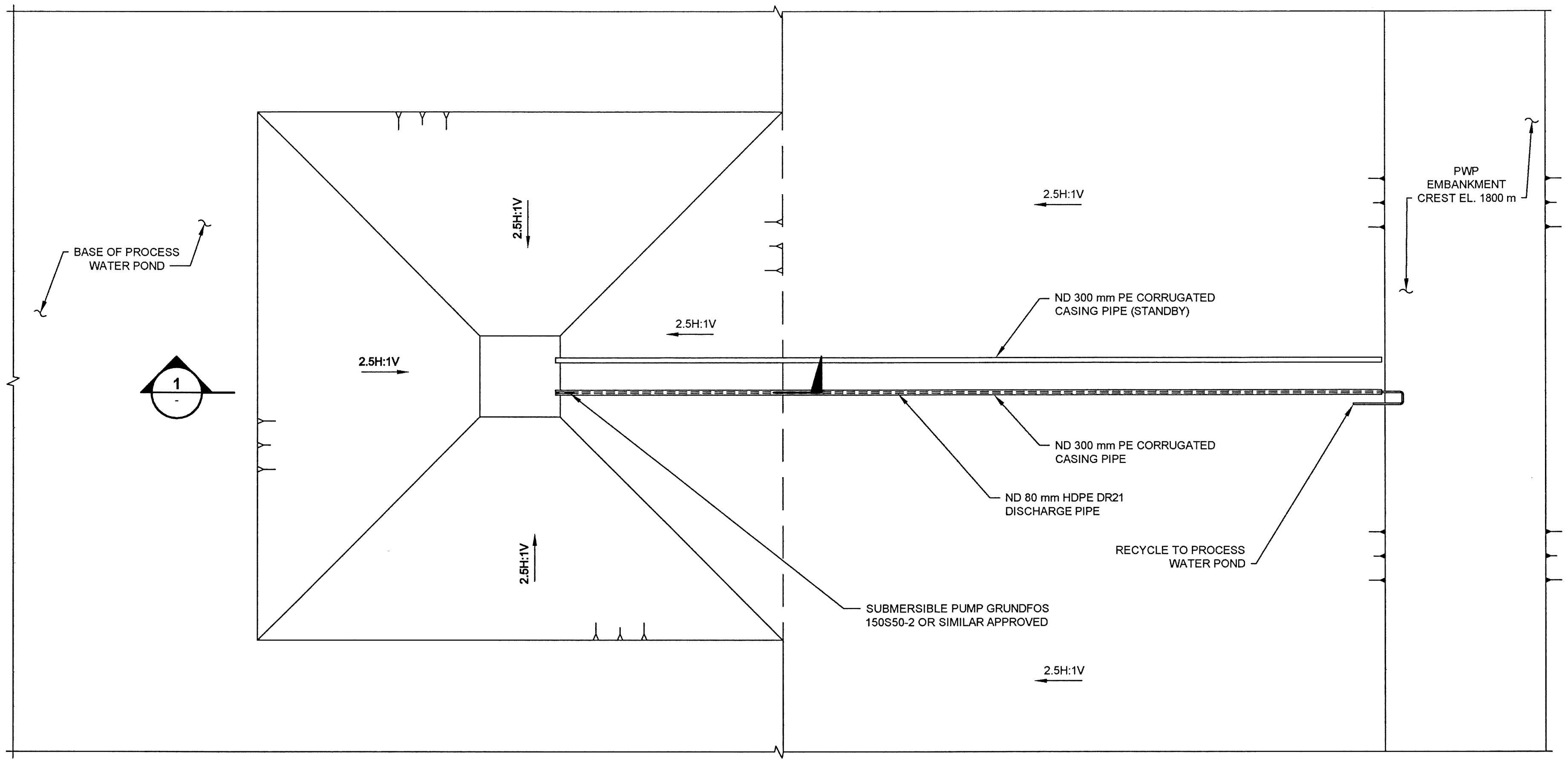
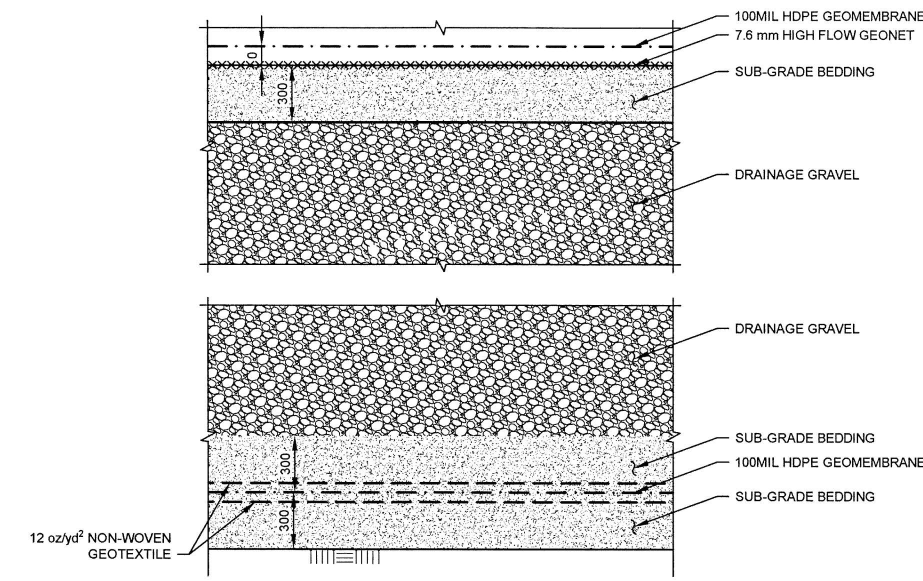
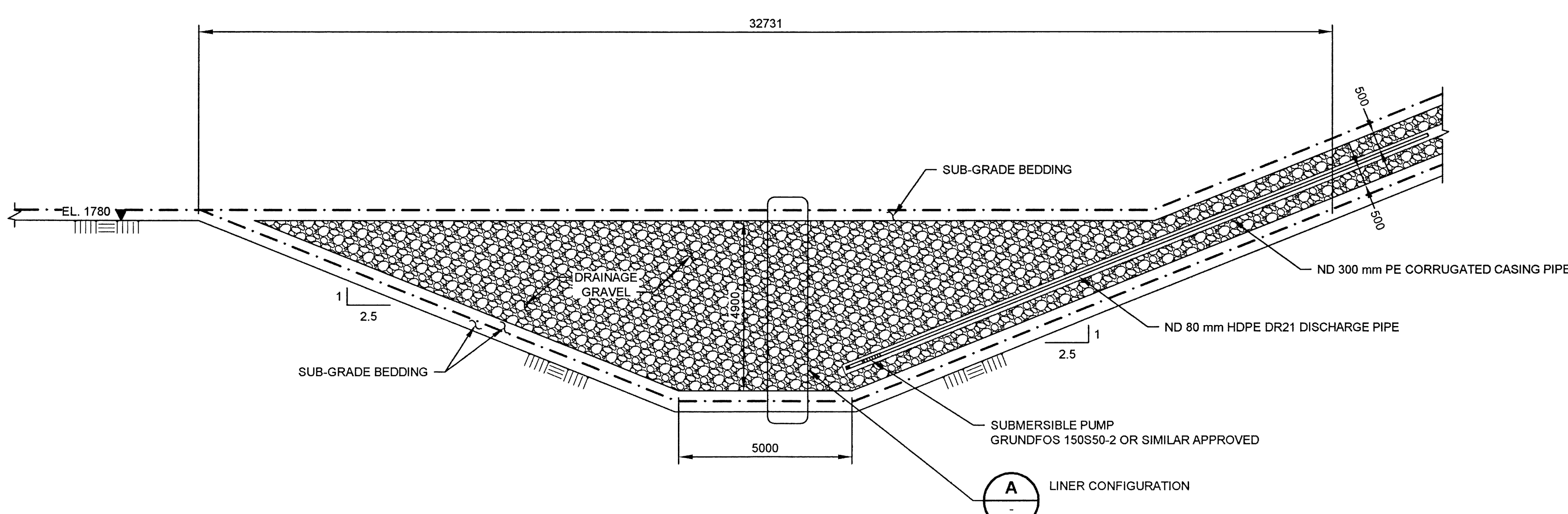


A C6510 **DETAIL**
PWP SEEPAGE COLLECTION SUMP
SCALE A



A - **SECTION**
LINER CONFIGURATION
NTS



1 - **SECTION**
PWP SEEPAGE COLLECTION SUMP
SCALE A

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

SCALE A 4 2 0 4 8 12 16 20 m
SCALE B 2 1 0 2 4 6 8 10 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6520	0

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 1 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	K.B.	K.B.

REVISIONS

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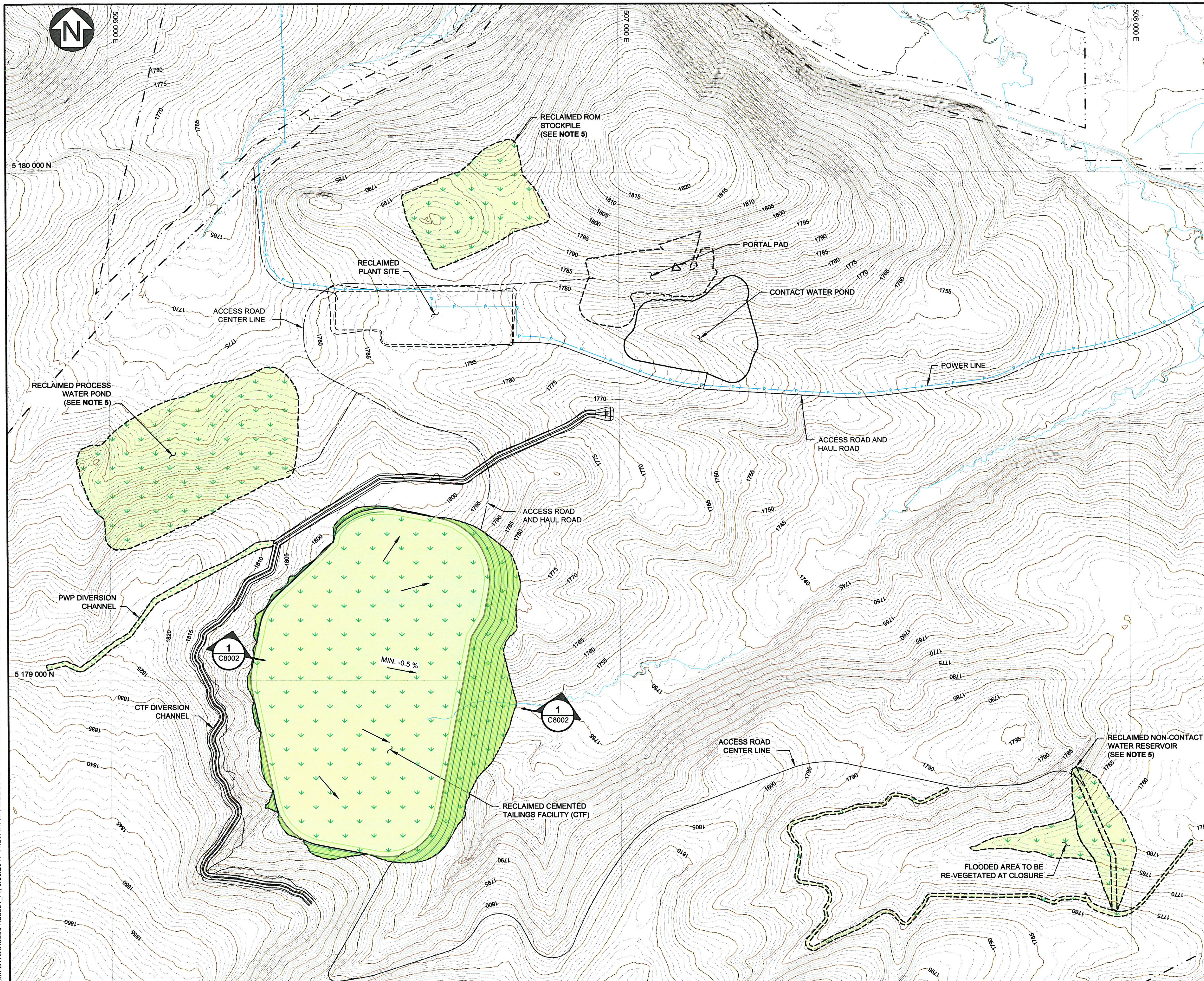

LEGEND:

RECLAIMED AREA

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEB 03, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. PWP, NCWR, AND ROM STOCKPILE AREAS WILL BE CONTOURED AT RECLAMATION TO APPROXIMATE THE ORIGINAL TOPOGRAPHY.
6. PLANT SITE, PORTAL PAD, CONTACT WATER POND, AND ACCESS ROADS CLOSURE PLAN WILL BE DEVELOPED BY TETRA TECH.
7. (3) THE CTF DIVERSION CHANNEL PERIMETERS AND OUT-SLOPING FILL WILL BE REVEGETATED FOLLOWING CONSTRUCTION AND WILL REMAIN IN CLOSURE.

FOR INFORMATION ONLY

80 40 0 100 200 300 400 m
SCALE A

PLAN
SCALE A

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CTF, PWP, NCWR AND ROM STOCKPILE POST CLOSURE TOPOGRAPHIC MAP

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C8001	4

DRG. NO.	DESCRIPTION
C8002	CTF RECLAMATION - SECTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
4	30JUN'17	POWERLINES UPDATED	GIM	MJC	K.	K.
3	20APR'17	NOTES REVISED	GIM	RAF	KDE	KDE
2	06MAR'17	NCWR SPILLWAY & DIV. CHANNEL RECLAIM AREA ADDED	GIM	WAL	KDE	KDE
1	29APR'16	MINOR REVISIONS	GIM	RAP	KDE	KDE
0	16OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KJB	KJB

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C8001\C8001_r4, 6/30/2017 11:26:47 AM, MCOUTTS PRINTED: 6/30/2017 11:41:24 AM, C8001, MCOUTTS
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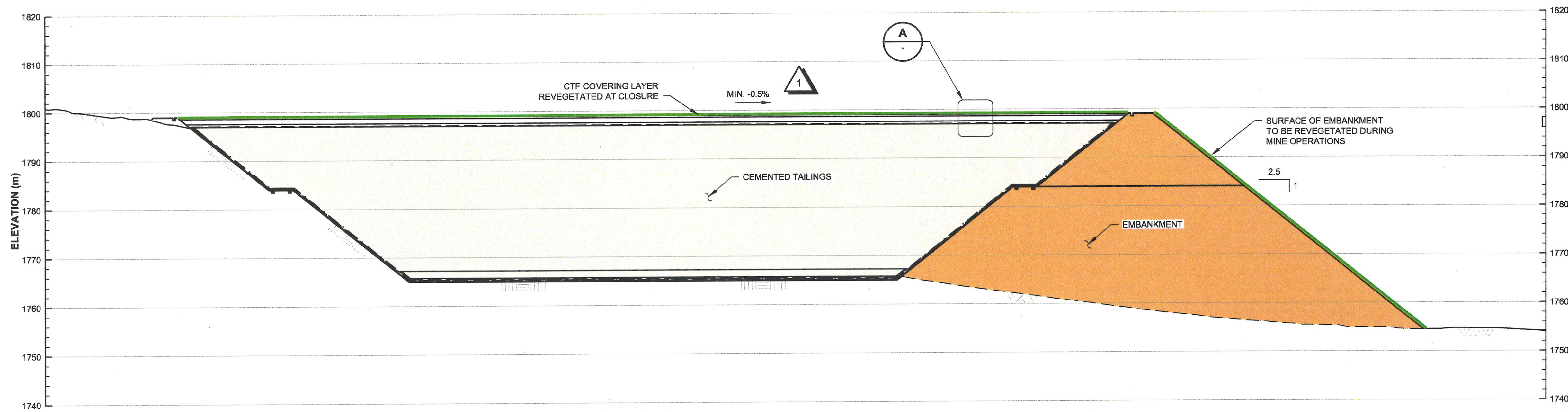
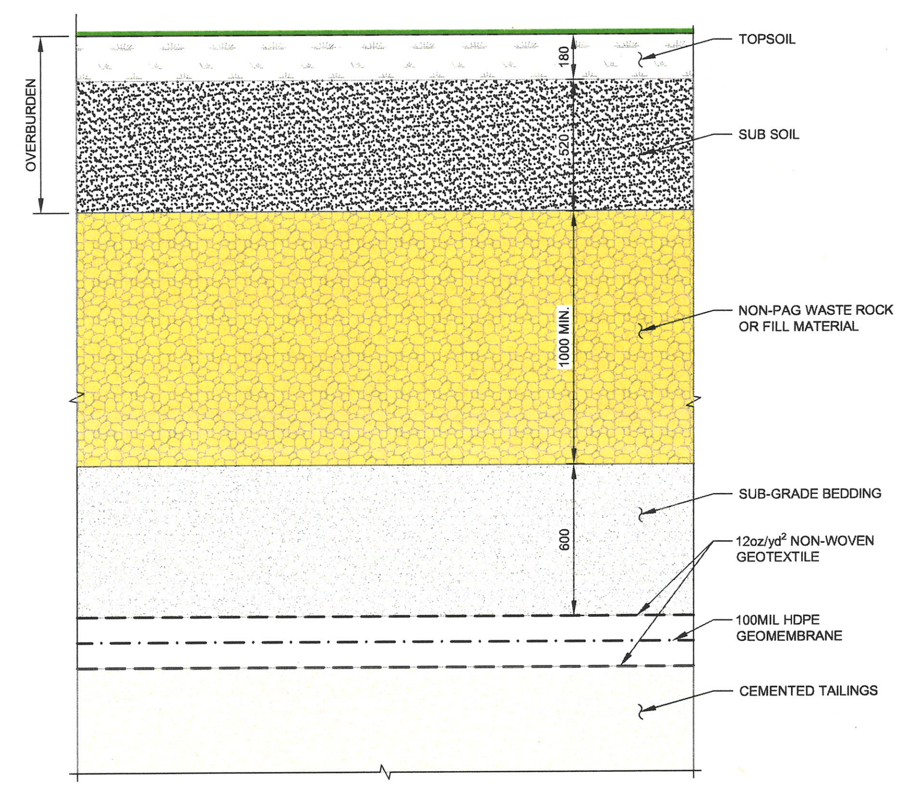


1 C8001 **SECTION**
HORIZONTAL: SCALE A
VERTICAL: SCALE B



A - **DETAIL**
CTF CLOSURE COVER DETAILS
SCALE C

NOTES:

1. TAILINGS SURFACE WILL BE LEVELED USING SUB-GRADE BEDDING AS NEEDED.
2. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE C: 0.3 0.15 0 0.5 1.0 1.5 m
SCALE B: 10 5 0 10 20 30 40 50 m
SCALE A: 20 10 0 20 40 60 80 100 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CTF RECLAMATION SECTION

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C8002	1

DRG. NO.	DESCRIPTION
C8001	CTF, PWP, NCWR AND ROM STOCKPILE - POST CLOSURE TOPOGRAPHIC MAP

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF SLOPE ADDED	GIM	RAP	KJB	KJB
0	16OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KJB	KJB

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C8002\C8002_r1, 4/27/2016 3:38:30 PM , RPENG PRINTED: 4/27/2016 3:39:26 PM, C8002, RPENG
XREF FILE(S): IMAGE FILE(S):

APPENDIX E

TAILINGS PHYSICAL TESTING RESULTS

(Pages E-1 to E-7)

Knight Piésold CONSULTING

UNDRAINED SETTLING TEST

Project No. VA101-460/03

Project:	Black Butte Copper	Sample ID:	LCT Tailings Virgin Material	Test Date:	9/3-9/10/2015
Target Solids :	79%	Actual Solids:	79.4%	Tested By:	JK/DB

Initial Parameters

a. Cylinder (Tare) Weight =	184	g	d. Moisture Content (from drying test) =	**26.0**	%
b. Initial Slurry Volume =	440	ml	e. Initial Slurry Bulk Density [(c-a)/b] =	2.37	g/cm³
c. Tare + Initial Slurry Weight =	1228	g	f. Weight of Water [(c-a)/(1+ 1/(d/100))] =	216	g
Time of Readings 03-Sep-15	10:24 AM		g. Weight of Solids [(c-a)/(1+ d/100)] =	829	g

On-going Readings

	Date of Reading	Time of Reading	A. Total Cylinder Weight (g)	B. Total Cylinder Volume (ml)	C. Settled Slurry Volume (ml)	D. Water Recovery [(B-C)/f] (%)	E. Volume Reduction of Solids [1-C/b] (%)	F. Slurry Bulk Density [(A-a-(B-C))/C] (g/cm³)	G. Slurry Dry Density [g/C] (g/cm³)	H. Moisture Content [(f-(B-C))/g] (%)
1	03-Sep-15	10:41 AM	1228	440	440	0	0	2.37	1.88	26.01
2	03-Sep-15	10:59 AM	1228	440	440	0	0	2.37	1.88	26.01
3	03-Sep-15	11:29 AM	1228	440	440	0	0	2.37	1.88	26.01
4	03-Sep-15	12:25 PM	1228	440	440	0	0	2.37	1.88	26.01
5	03-Sep-15	01:31 PM	1228	440	435	2	1	2.39	1.91	25.40
6	03-Sep-15	02:36 PM	1228	440	430	5	2	2.41	1.93	24.80
7	03-Sep-15	03:22 PM	1228	440	430	5	2	2.41	1.93	24.80
8	03-Sep-15	04:26 PM	1228	440	430	5	2	2.40	1.93	24.80
9	04-Sep-15	09:03 AM	1228	440	415	12	6	2.46	2.00	22.99
10	04-Sep-15	03:55 PM	1228	440	414	12	6	2.46	2.00	22.87
11	05-Sep-15	11:30 AM	1228	440	414	12	6	2.46	2.00	22.87
12	08-Sep-15	08:39 AM	1227	440	414	12	6	2.46	2.00	22.87
13	10-Sep-15	08:21 AM	1227	440	414	12	6	2.46	2.00	22.87

S:\Tailings settling and Consol data\2015\Black Butte\[L2015-061 Black Butte LCT Settling Rev 0.xls]unset 01-Oct-15 09:12 AM

Knight Piésold CONSULTING

DRAINED SETTLING TEST AND FALLING HEAD PERMEABILITY TEST

Project No. VA101-460/03

Project: Black Butte Copper | Sample ID: LCT Tailings Virgin Material | Test Date: 9/3-9/16/2015

Target Solids : 79% | Actual Solids: 78.3% | Tested By: JK/JB

Initial Parameters

a. Cylinder (Tare) Weight =	186 g		d. Moisture Content (from drying test) =	**27.7** %
b. Initial Slurry Volume =	525 ml		e. Initial Slurry Bulk Density [(c-a)/b] =	2.32 g/cm³
c. Tare + Initial Slurry Weight =	1405 g		f. Weight of Water [(c-a)/(1+ 1/(d/100))] =	265 g
Time of Readings	03-Sep-15	10:21 AM	g. Weight of Solids [(c-a)/(1+ d/100)] =	955 g

On-going Readings

	Date of Reading	Time of Reading	A. Total Cylinder Weight (before decant) (g)	B. Total Cylinder Volume (ml)	C. Settled Slurry Volume (ml)	D. Water Volume [B-C] (ml)	E. Drainage Volume Collected (ml)	F. Decanted Water Volume (ml)	G. Slurry Bulk Density [(A-a-(B-C))/C] (g/cm³)	H. Slurry Dry Density [g/C] (g/cm³)
1	03-Sep-15	10:40 AM	1401	525	520	5	4	0	2.33	1.84
2	03-Sep-15	01:34 PM	1389	510	500	10	16	2	2.39	1.91
3	03-Sep-15	04:20 PM	1382	495	488	7	21	5	2.44	1.96
4	04-Sep-15	08:55 AM	1364	480	480	0	33	0	2.46	1.99
5	04-Sep-15	03:54 PM	1362	478	478	0	36	0	2.46	2.00
6	05-Sep-15	11:30 AM	1360	478	478	0	37	0	2.46	2.00

Falling Head Permeability Test

	Data Readings, Ti (hours)	Initial Water Height, hi (cm)	Initial Solids Height, Hi (cm)	Finishing Time, Tf (hours)	Final Water Height, hf (cm)	Final Solids Height, Hf (cm)	Drainage Collected (ml)	Elapsed Time, T (hours)	Ave. Solids Thickness, H (cm)	Permeability k H/3600T*ln(hi/hf) (cm/sec)
1	0.00	34.9	16.1	0.00	32.8	16.1	46	31.37	16.1	8.8E-06
2	0.00	32.8	16.1	0.00	31.9	16.1	24	16.33	16.1	7.6E-06
3	0.00	31.9	16.1	0.00	30.4	16.1	34	23.63	16.1	9.1E-06
4	0.00	30.4	16.1	0.00	26.0	16.1	95	72.50	16.1	9.6E-06
5	0.00	26.0	16.1	0.00	24.9	16.1	29	23.62	16.1	8.2E-06
									AVG.	8.7E-06

S:\Tailings settling and Consol data\2015\Black Butte\[L2015-061 Black Butte LCT Settling Rev 0.xls]dranset 01-Oct-15 09:12 AM

Knight Piésold CONSULTING

SETTLING AND DRYING TEST (including Evaporation Control)

Project No. VA101-460/03

Project: Black Butte Copper
Target Solids : 79%
Sample ID: LCT Tailings Virgin Material
Actual Solids 80.5%
Test Date: 9/3-9/30/15
Tested By: JK/JB

Initial Parameters for Settling and Drying Test

a. Beaker (Tare) Weight = 408.97 g
b. Initial Slurry Volume = 440 cm³
c. Tare + Initial Slurry Weight = 1407.6 g
Time of Readings 10:22 AM

d. Moisture Content (from drying test) = **24.2** %
e. Initial Slurry Bulk Density [(c-a)/b] = 2.27 g/cm³
f. Weight of Water [(c-a)/(1+ 1/(d/100))] = 195 g
g. Weight of Solids [(c-a)/(1+ d/100)] = 804 g
h. Tailings Solids Specific Gravity = 3.778
i. Solids Volume [g/h] = 212.8 cm³

Initial Parameters for Evaporation Control

x. Beaker Tare Weight = 413 g
y. Initial Weight of Beaker = 1472 g
z. Beaker Cross-Sectional Area = 81.39 cm²

On-going Readings

	Date of Reading	Time of Reading	A. Total Remaining Weight (g)	B. Total Remaining Volume (cm³)	C. Settled Slurry Volume (cm³)	D. Decanted Water Volume (if any) (cm³)	E. Shrinkage Crack Volume (estimated) (cm³)	F. Net. Slurry Volume [C-E] (cm³)	G. Volume Reduction [(b-F)/b] (%)	H. Slurry Dry Density [g/F] (g/cm³)	I. Moisture Content [(A-a)/g]-1 (%)	J. Saturation (A-a-g)/(B-i) (%)	Comments	Evaporation Control: Total Weight After Decant (g)	Evaporation Control: Decanted Weight (if any) (g)	Evaporation Control: Evap. (mm)
1	03-Sep-15	10:38 AM	1407	435.0	405.0	0.7		405.0	8.0	1.98	24.2	100.0	Water Decanted	1471	0	0
2	03-Sep-15	1:33 PM	1404	425.0	400.0	9.4		400.0	9.1	2.01	23.8	100.0	Water Decanted	1468	0	1
3	03-Sep-15	4:18 PM	1392	405.0	395.0	8.5		395.0	10.2	2.03	22.3	98.4	Water Decanted	1464	0	1
4	04-Sep-15	8:53 AM	1369	390.0	390.0	0.0		390.0	11.4	2.06	19.4	88.1	no free water	1445	0	3
5	04-Sep-15	3:53 PM	1365	386.0	386.0	0.0		386.0	12.3	2.08	18.9	87.7	no free water	1439	0	4
6	05-Sep-15	11:30 AM	1349		384.8		13.3	371.5	15.6	2.16	17.0	86.1	Specimen pulling from sides	1419	0	6
7	08-Sep-15	8:25 AM	1297		364.7		31.1	333.6	24.2	2.41	10.5	69.8	Specimen measured	1347	0	15
8	09-Sep-15	4:00 PM	1280		364.7		32.5	332.2	24.5	2.42	8.4	56.3	Specimen measured	1313	0	19
9	10-Sep-15	8:16 AM	1274		364.7		33.1	331.6	24.6	2.42	7.6	51.2	Specimen measured	1292	0	22
10	11-Sep-15	7:57 AM	1266		364.7		33.1	331.6	24.6	2.42	6.6	44.8	Specimen measured	1263	0	26
11	14-Sep-15	8:30 AM	1255		364.7		34.5	330.2	25.0	2.43	5.3	36.2	Specimen measured	1185	0	35
12	15-Sep-15	8:02 AM	1252		361.4		32.8	328.5	25.3	2.45	4.9	34.2	Specimen measured	1156	0	39
13	17-Sep-15	7:57 AM	1248		361.4		32.8	328.5	25.3	2.45	4.4	30.8	Specimen measured	1101	0	46
14	18-Sep-15	10:02 AM	1247		361.4		32.8	328.5	25.3	2.45	4.3	29.6	Specimen measured	1073	0	49
15	22-Sep-15	8:36 AM	1242		361.4		32.8	328.5	25.3	2.45	3.7	25.5	Specimen measured	968	0	62
16	25-Sep-15	9:55 AM	1240		361.4		32.8	328.5	25.3	2.45	3.3	23.1	Specimen measured	898	0	70
17	30-Sep-15	4:00 PM	1236		361.4		32.8	328.5	25.3	2.45	2.9	20.0	Specimen measured	783	0	85

S:\Tailings settling and Consol data\2015\Black Butte\[L2015-061 Black Butte LCT Settling Rev 0.xls]Graphs 01-Oct-15 09:12 AM

Notes:

Knight Piésold CONSULTING

TABLE 1.0

Black Butte Copper
VA101-460/03
LCT Tailings Virgin Material

SUMMARY OF TAILINGS SEDIMENTATION TEST RESULTS
79%

Undrained Settling Test				Drained Settling Test					Settling and Drying Test			Additional
Solids Content (%)	Slurry Dry Density (g/cm³)	Total Water Recovery (%)	Portion of Initial Water Retained in Tailings prior to Onset of Evaporation (%)	Solids Content (%)	Slurry Dry Density (g/cm³)	Total Water Recovery (%)	Portion of Initial Water Retained in Tailings prior to Onset of Evaporation (%)	Average Permeability (cm/sec)	Solids Content (%)	Slurry Dry Density (g/cm³)	Total Evaporation (mm)	Water Recovered in Drained Test (%)
79.4	2.00	12.1	87.9	78.3	2.00	16.9	83.1	8.7E-06	80.5	2.45	84.6	4.9

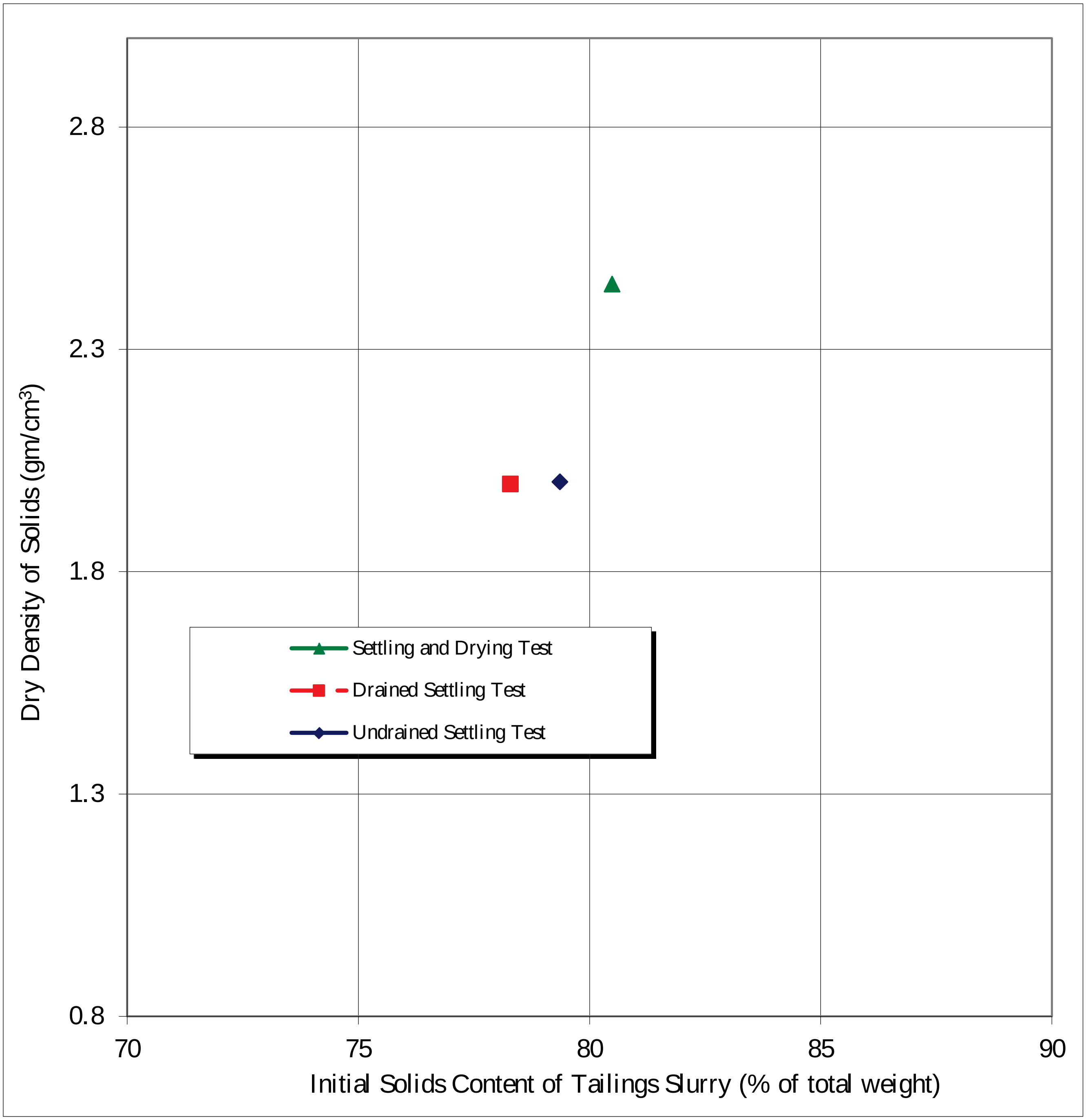
S:\Tailings settling and Consol data\2015\Black Butte\[L2015-061 Black Butte LCT Settling Rev 0.xls]Graphs 01-Oct-15 09:12 AM

Knight Piésold CONSULTING

FIGURE 1.1

Black Butte Copper
VA101-460/03
LCT Tailings Virgin Material

TAILINGS DEPOSITION METHOD VS. DRY DENSITY
79.0%



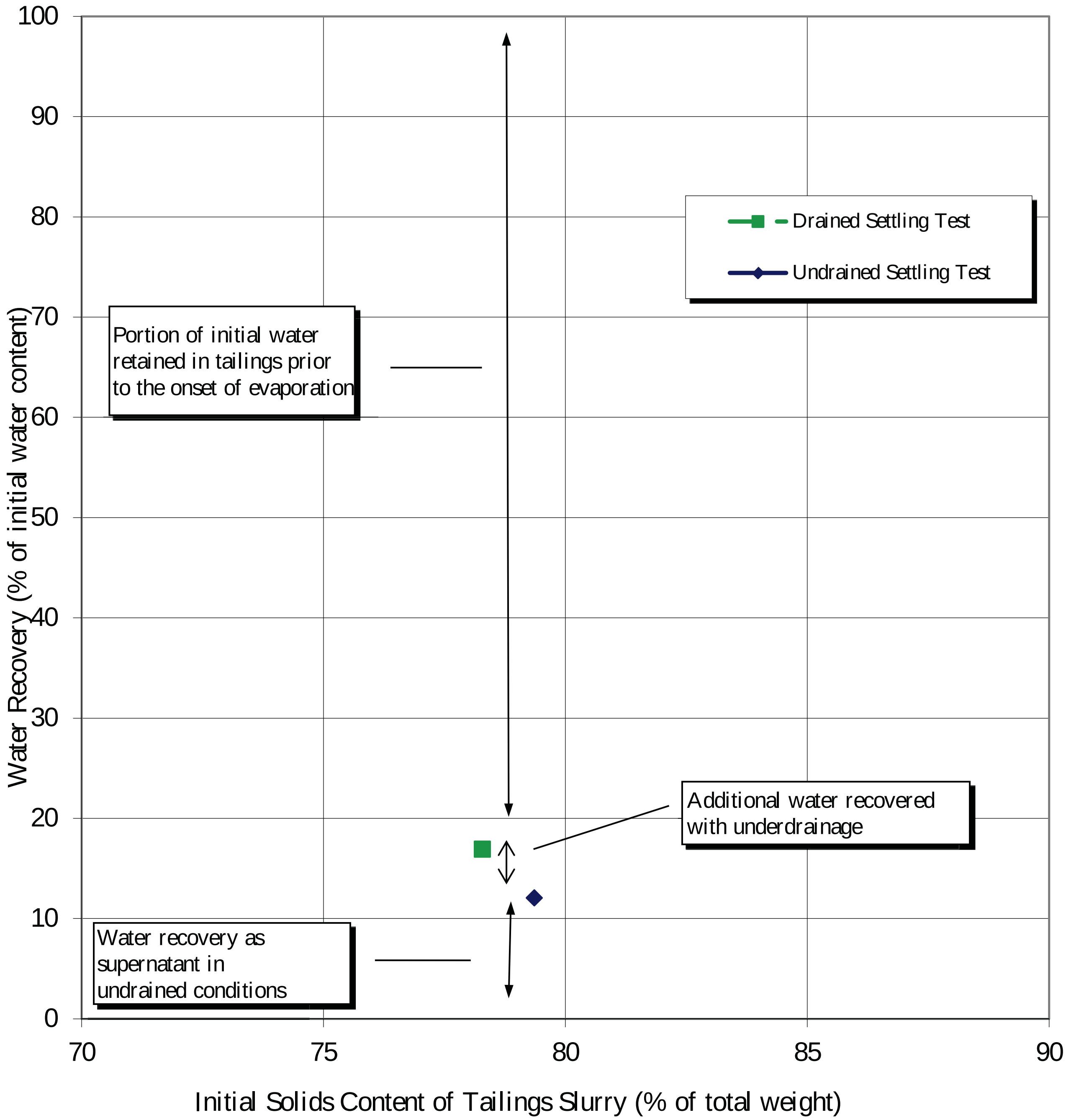
S:\Tailings settling and Consol data\2015\Black Butte\[L2015-061 Black Butte LCT Settling Rev 0.xls]Graphs kgb 01-Oct-15 09:12 AM

Knight Piésold CONSULTING

FIGURE 1.2

Black Butte Copper
VA101-460/03
LCT Tailings Virgin Material

TAILINGS DEPOSITION METHOD VS. WATER RECOVERY
79%



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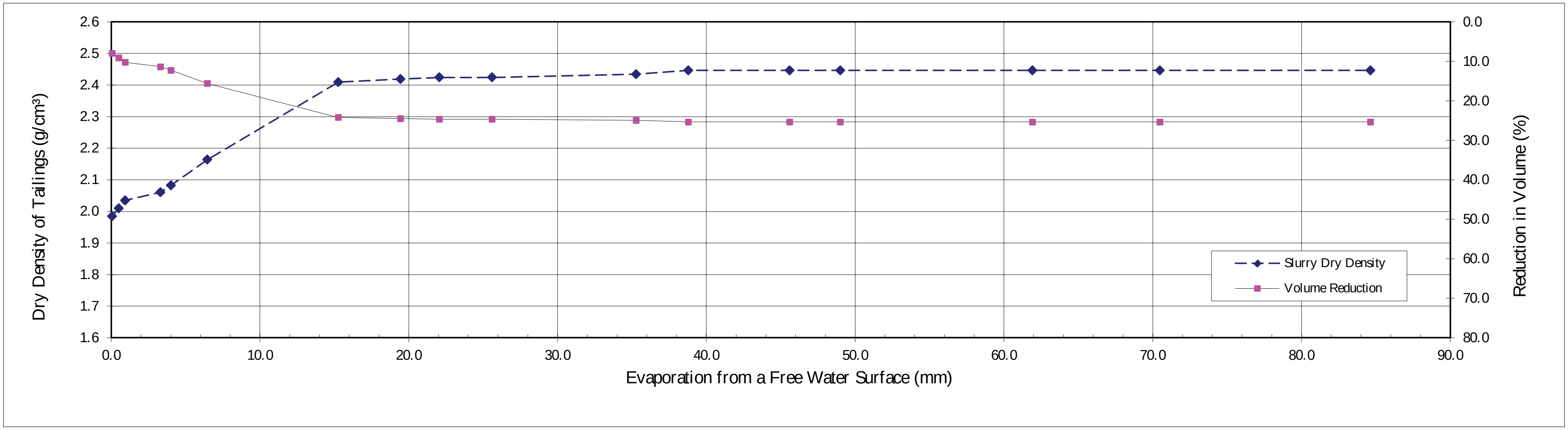
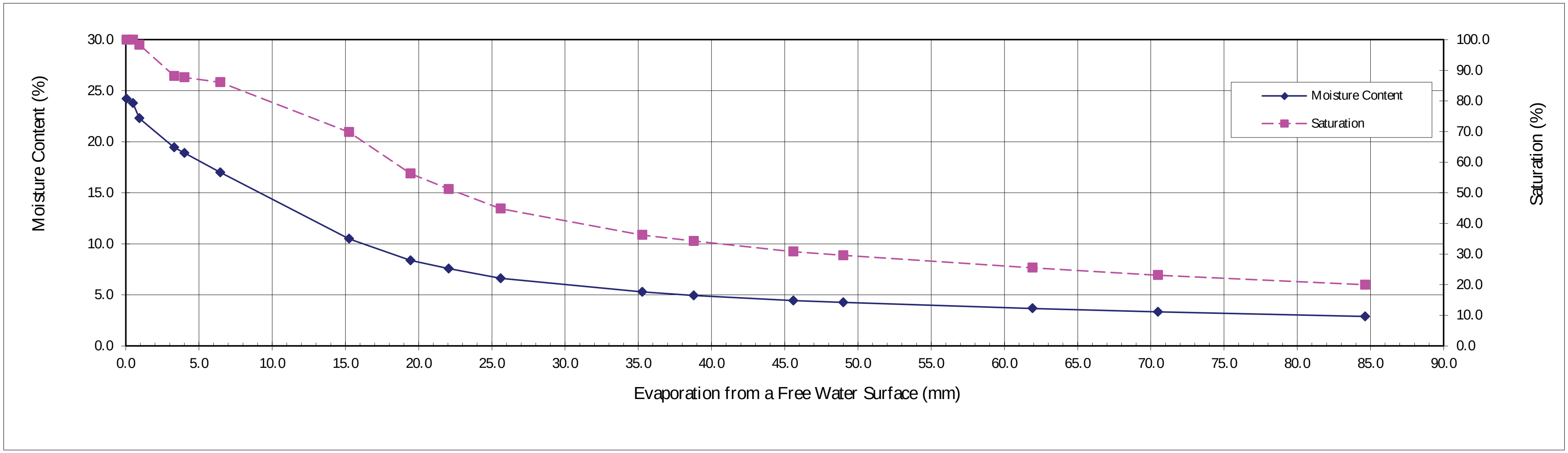
Knight Piésold CONSULTING

FIGURE 1.3

Black Butte Copper
VA101-460/03

LCT Tailings Virgin Material
VARIATION OF TAILINGS PARAMETERS WITH ONGOING EVAPORATION
79%





APPENDIX F

SITE WIDE WATER BALANCE

(Pages F-1 to F-11)

July 6, 2017

File No.:VA101-00460/03-A.01
Cont. No.:VA17-01139

Mr. Jerry Zieg
Vice President, Exploration
Tintina Resources Inc. (Vancouver)
10th Floor - 595 Howe Street
Vancouver, British Columbia
Canada, V6C 2T5

Dear Jerry,

Black Butte Copper Project Water Balance – Updated Surface Water Transfer to Water Treatment Plant

The Black Butte Copper Project (the Project) is a proposed underground copper mine located approximately 32 km north of White Sulphur Springs, Montana. An update to the life-of-mine site wide water balance model has been completed by Knight Piésold (KP) to incorporate the transfer of surface water from the Process Water Pond and the Cemented Tailings Facility to the Water Treatment Plant, with subsequent treatment and release to the environment. Surface water includes direct precipitation on mine facilities, as well as runoff contributing to mine facilities. This letter details the model parameters, assumptions, and results.

This water balance is an update to the KP letter *Black Butte Copper Project Water Balance – Updated Surface Water Transfer to Water Treatment Plant* (KP, 2016) issued to Tintina Resources Inc. (Tintina) on April 28, 2016.

The model was developed using the GoldSim© modeling platform. Deterministic and stochastic approaches were used, and 15 years were modeled including two pre-production years and 13 years of operations.

1 – MODEL PARAMETERS AND ASSUMPTIONS

The following sections outline the parameters and assumptions that were used to create the water balance model. The model results are dependent on these assumptions, and only valid if the parameters remain as outlined below.

1.1 GENERAL

Cemented tailings disposal is the chosen waste management method for the Project. The tailings will be impounded in the CTF, as shown on Figure 1. The PWP will store water from various inputs such as mill circulating load and the mill reclaim water. The PWP also collects surface water runoff and precipitation reporting to the PWP, including the water transferred from the CTF; all of which will be conveyed to the WTP, treated, and released to the environment.

Make-up water for the PWP will be sourced from the water treatment plant from the RO Reject water. In addition, freshwater will be supplied to the mill for special uses from underground dewatering after it has been treated in the WTP. Any treated water not being used for mine operations will be released to the environment.

Meteorological parameters for the model were developed by KP using site specific data in conjunction with regional data as described in KP's meteorological data analysis memo VA15-02445 (KP, 2015). The determined mean monthly precipitation and evaporation values are used as inputs in the model for each year. It is also assumed that the precipitation from November through to March falls as snow and accumulates as snowpack until the spring, when it melts during April and May. Therefore, the precipitation that accumulates between November and March will report to the PWP during April and May. A stochastic model was created with monthly coefficient of variations for the precipitation record to simulate dry year and wet year conditions.

The mill input and output requirements, along with miscellaneous freshwater requirements (truck wash, dust control etc.), were provided to KP by Tetra Tech (TT) via email correspondence with Jianhui Huang, dated September 16, 2015 (TT, 2015). The mill requirements were provided as annual rates for the life of mine. The preliminary inputs to the water balance model are shown in Table 1.

Table 1 Water Balance Inputs

Component	Units	Value	Source
Hydrometeorology			
Mean Annual Precipitation	mm	416	KP
Mean Annual Pond Evaporation	mm	514	KP
Runoff Coefficient (Undisturbed Ground)	mm	0.2	KP
Runoff Coefficient (Disturbed Ground /Facility Footprints)	mm	1.0	KP (Assumes no seepage from facilities)
Ore Production			
Ore Water to Mill	m^3/yr	12,000 to 52,000	John Huang, TT[1]
Tailings Production			
Nominal Mill Process rate	tonne/day	3,300	Tintina
Tailings Dry Density	tonne/m^3	2.0	Tintina
Tailings Specific Gravity	-	3.77	Tintina
Tailings Solids Content	-	74%[2]	Tintina
Tailings Water to CTF	m^3/yr	51,000 to 221,000	John Huang, TT[1]
Tailings Water to Underground	m^3/yr	42,000 to 186,000	John Huang, TT[1]
Water Lost to Voids	%	100%	Assumption
Mill Process			
Freshwater Requirements	m^3/yr	44,000 to 192,000	John Huang, TT[1]
Water lost to Concentrate	m^3/yr	4,000 to 16,000	John Huang, TT[1]
Thickener Overflow	m^3/yr	938,000 to 4,107,000	John Huang, TT[1]
Required Water from the PWP	m^3/yr	979,000 to 4,286,000	John Huang, TT[1]
Other Freshwater Use	m^3/yr	49,000	John Huang, TT
Underground Dewatering	m^3/yr	995,000	Hydrometrics

NOTES:
1. Range of values for the life of mine, based on the production schedule.
2. A tailings solids content of 74% was utilized in the water balance model to provide a conservative estimate of mill water consumption. A tailings solids content of 79% was utilized for all other design work.

1.2 WATER MANAGEMENT

The PWP has been designed for a maximum operating volume of 200,000 m^3. This analysis assumes a minimum allowable pond volume of 120,000 m^3 and a maximum allowable volume of 200,000 m^3, thereby defining the operating range as 120,000 m^3 to 200,000 m^3.

The PWP starting volume of 120,000 m^3, likely sourced from underground dewatering, will be in-place two months prior to the start of operations. The PWP monthly make-up water is calculated as additional water required to satisfy mill water requirements once the minimum allowable volume is reached in the PWP, and is represented by the RO Reject water as shown on Figure 2.

Each modeled mine year starts in June, as it was assumed that the mill would initially begin operations following the spring freshet period (April and May) of the first year of operations. It is assumed that pond water accumulating in the CTF will be pumped to the PWP immediately. Surface water, as runoff, and direct precipitation reporting to the mill is assumed to be routed to the WTP.

A large percentage of runoff within the CTF and PWP catchment areas will be diverted via a surface water diversion ditch system and discharged downstream (Figure 1); however, there is still a portion of the catchment area surface runoff that reports to the respective facilities. The runoff coefficient for undisturbed ground was assumed to be 0.2 based on the Manhattan Design Standards report (Thomas, et al. 2008). A runoff coefficient of 1.0 was assumed for disturbed ground surfaces, as the facilities will be geomembrane-lined and therefore impervious. It was also conservatively assumed that there would be no seepage from lined facilities.

The portion of the surface water runoff that is not diverted around the CTF and PWP (Figure 1), as well as the precipitation that falls directly on the two facilities will be collected in the PWP and routed to the WTP for treatment prior to release to the environment. The make-up water required to operate the mill will be sourced from underground dewatering.

The water balance schematic, shown on Figure 2, was used as the basis for model development and shows the annual inflows and outflows from the facilities during the sixth year of production (year 6) under mean climatic conditions.

The site water management plan, as interpreted by KP based on discussions with Tintina, is described below:

- The primary source of reclaim water for the mill is the PWP.
- Surface water reporting to the CTF will be transferred to the PWP.
- Surface water reporting to the PWP, including that transferred from the CTF, will be transferred to the WTP where it will be treated prior to discharge to the environment.
- Additional make-up water required by the mill is assumed to be supplied from the water treatment plant and stored in the PWP.

Evaporation and direct precipitation on the PWP pond were accounted for in the water balance. The surface area was calculated for each time-step using the Depth-Area-Capacity (DAC) data for the facility.

1.3 GENERAL MODEL LIMITATIONS

The following limitations should be considered when reviewing the results of the water balance model.

- Increasing consolidation of the tailings was not accounted for in the model; instead it was assumed that all water locked in the cemented tailings voids is not recoverable (void loss).
- Snowpack, snowmelt and sublimation parameters are based on estimates as no detailed study has been conducted.

2 – WATER BALANCE MODEL RESULTS

Three separate scenarios were modeled using the life-of-mine water balance in order to obtain an understanding of the water requirements of the PWP during operations. The model was run deterministically for the mean case, and stochastically for the abnormally wet (95^{th} percentile) and abnormally dry (5^{th} percentile) cases. A gamma distribution was assumed for the precipitation data in the stochastic models and a Monte Carlo simulation was executed using 5,000 iterations. The estimated monthly precipitation volumes reporting to the proposed mine site, and the resulting effects on the volumes in the PWP, have been presented in terms of probabilities of occurrence for the three scenarios:

- **Scenario 1 – Mean**: The model was run deterministically and the results correspond to mean monthly climatic conditions (Figure 2).
- **Scenario 2 – 95^{th} Percentile (Wet)**: The results correspond to abnormally wet conditions, and represent the climatic conditions to be exceeded once every 20 years, on average.
- **Scenario 3 – 5^{th} Percentile (Dry)**: The results correspond to abnormally dry conditions, and represent the climatic conditions expected to be exceeded 19 years out of 20, on average (i.e. volumes will not exceed these values more than once every 20 years, on average).

The estimated PWP pond volume prior to the surface water transfer to the WTP and groundwater transfer to the PWP is shown on Figure 3, for all three climatic scenarios. The volume trends show that there is sufficient storage capacity in the PWP during abnormally wet year scenarios (95th percentile). The PWP pond volume, after surface water transfer to the WTP and groundwater transfer to the PWP, is shown on Figure 4; which shows that the pond volume for each scenario is similar after the water transfer is included in the model. The amount of water transferred to the WTP and released to the environment is greater than the amount required to keep the pond volume within the mean scenario operating range for mean and abnormally wet conditions. The results for all 3 scenarios are outlined in the sections below.

2.1 SCENARIO 1 RESULTS (MEAN)

The PWP will be supplemented with approximately 162,000 m^3 of groundwater make-up throughout the year, on average. The average annual surface water transfer from the PWP to the WTP is 110,000 m^3. The annual make-up requirements (RO Reject) and surface water transfer to the WTP, for the life of mine, are shown in Table 2.

Table 2 Scenario 1: Mean PWP Make-Up Water Requirements and Surface Water Transfers (m^3)

Year	Total Make-up (RO Reject) Water to PWP	Surface Water Transfer from PWP to WTP
1	109,000	107,000
2	142,000	110,000
3	179,000	110,000
4	181,000	110,000
5	184,000	110,000
6	181,000	110,000
7	187,000	110,000
8	193,000	110,000
9	190,000	110,000
10	186,000	110,000
11	184,000	110,000
12	142,000	110,000
13	56,000	110,000

It should be noted that make-up water is only required during the winter months. The PWP fluctuates between approximately 120,000 m^3 and 160,000 m^3, after the surface water and RO Reject transfers.

2.2 SCENARIO 2 RESULTS (95TH PERCENTILE, ABNORMALLY WET)

The make-up requirements are the same under abnormally wet climatic conditions as mean climatic conditions (Table 2 above), but the average annual surface water transfer from the PWP to the WTP is increased to 232,000 m^3 per year, on average. The annual surface water transfer volumes to the WTP are summarized in Table 3.

Table 3 Scenario 2: 95th Percentile (Abnormally Wet) Annual Surface Water Transfer to WTP (m^3)

Year	Surface Water Transfer to WTP
1	227,000
2	231,000
3	232,000
4	232,000
5	230,000
6	234,000
7	235,000
8	232,000
9	233,000
10	232,000
11	230,000
12	231,000
13	232,000

The PWP pond volume fluctuates between 120,000 m^3 and 160,000 m^3 under wet climatic conditions, which is the same as Scenario 1, as shown on Figure 4. This is achieved by transferring a larger volume of surface water from the PWP to the WTP, and releasing it to the environment (232,000 m^3), than the volume of groundwater that is transferred back to the PWP (110,000 m^3).

2.3 SCENARIO 3 RESULTS (5%TH PERCENTILE, ABNORMALLY DRY)

The make-up requirements are the same under abnormally dry climatic conditions as mean climatic conditions, but the average annual surface water transfer from the PWP to the WTP is reduced to 34,000 m^3 per year. The annual surface water transfer volumes to the WTP are summarized in Table 4.

Table 4 Scenario 3: 5th Percentile (Abnormally Dry) Annual Surface Water Transfer to WTP (m^3)

Year	Surface Water Transfer to WTP
1	32,000
2	35,000
3	34,000
4	34,000
5	35,000
6	34,000
7	35,000
8	35,000
9	34,000
10	34,000
11	34,000
12	34,000
13	35,000

The PWP pond volume remains the same as that for Scenarios 1 and 2, as shown on Figure 4. The volume of surface water that is transferred from the PWP to the WTP, and released to the environment (34,000 m^3), is less than the volume of groundwater that is transferred back to the PWP (110,000 m^3) in this Scenario.

3 – CONCLUSIONS AND RECOMMENDATIONS

It is necessary to supplement the PWP with make-up water from the WTP in order to achieve the design minimum pond volume based on the water balance and the conditions outlined in this letter. The results of the three scenarios modeled are outlined below:

All Scenarios
- Average annual groundwater make-up required to sustain the minimum pond volume = 162,000 m^3

Scenario 1 (Mean Conditions)
- Average annual surface water volume transferred from the PWP to the WTP = 110,000 m^3

Scenario 2 (Abnormally Wet Year)
- Average annual surface water volume transferred from the PWP to the WTP = 232,000 m^3

Scenario 3 (Abnormally Dry Year)
- Average annual surface water volume transferred from the PWP to the WTP = 34,000 m^3

It is recommended that the life-of-mine water balance model be updated as further information becomes available.

Please contact the undersigned with any questions or comments.

Yours truly,
Knight Piésold Ltd.

Prepared: Mediha Hodzic, P.Eng.
Project Engineer

Reviewed: Ken Embree, P.Eng.
Managing Principal

MONTANA
July 6, 2017
KEN J.
BROUWER
10020 PE
REGISTERED
PROFESSIONAL ENGINEER

Reviewed: Ken Brouwer, P.E.
President

Approval that this document adheres to Knight Piésold Quality Systems:

Attachments:

Figure 1 Rev 2	Water Balance Model – Catchment Area Figure
Figure 2 Rev 4	Annual Water Balance Schematic – Mean Case – Year 6
Figure 3 Rev 2	Process Water Pond Monthly Volumes – Estimate Prior to Water Transfers
Figure 4 Rev 2	Process Water Pond Monthly Volumes – Post Water Transfers

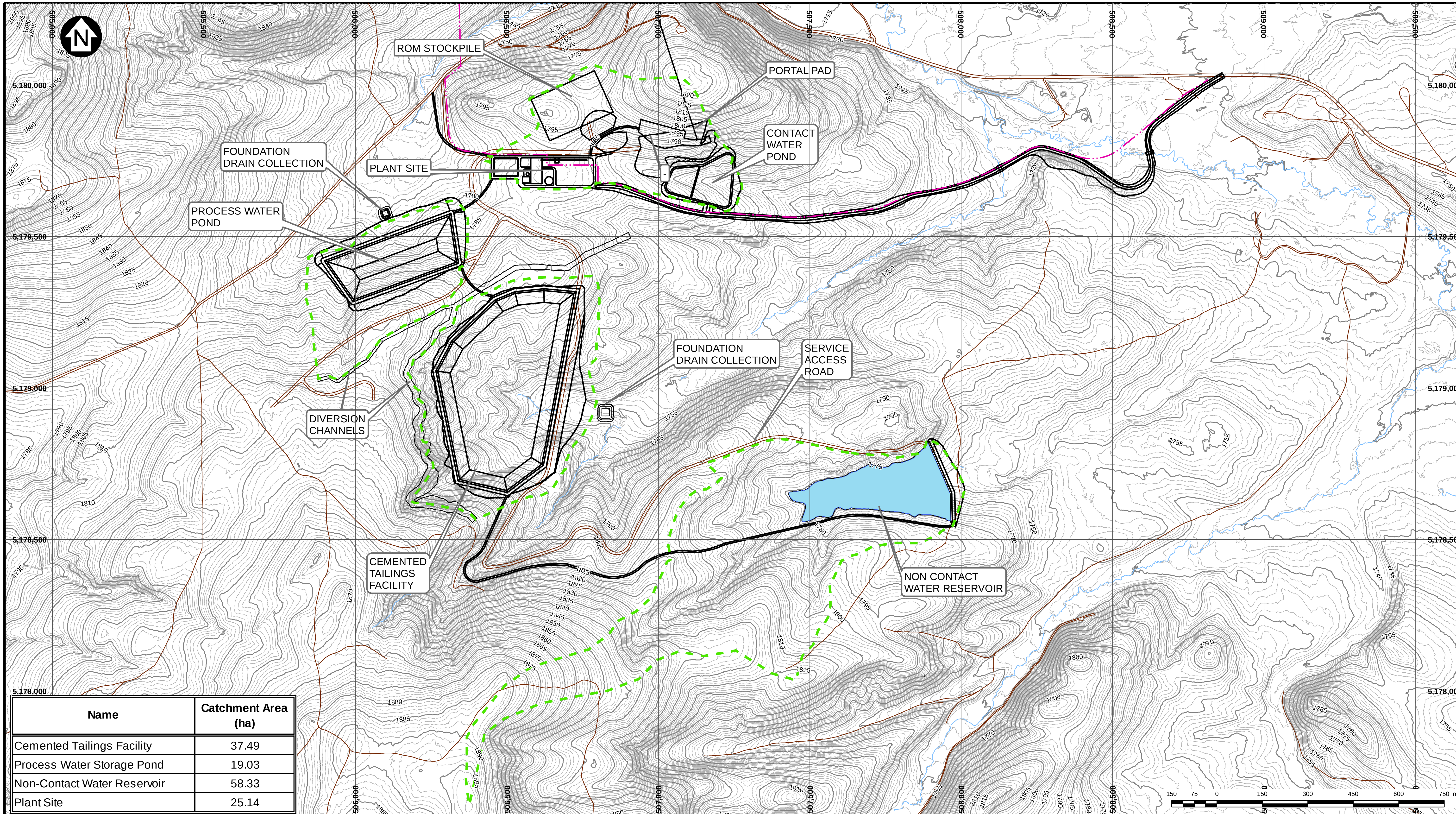
<u>References:</u>

Knight Piésold Ltd. (KP). 2015. *Black Butte Copper Project Meteorology Data Analysis Update*. Doc. No. VA101-460/3, VA15-02445. Prepared for Tintina Resources Inc. May 27, 2015.

Knight Piésold Ltd. (KP). 2016. *Black Butte Copper Project Water Balance – Updated Surface Water Transfer to Water Treatment Plant*. Doc. No. VA101-460/3, VA16-00564. Prepared for Tintina Resources Inc. April 28, 2016.

Tetra Tech (TT). 2015. Huang, Jianhui. "Update; Amec Mining." Message to Bob Jacko and Greg Magoon. September 16, 2015. E-mail.

Thomas, Dean, and Hoskins. *Design Standards and Specification Policy*. Manhattan, Montana: Town of Manhattan, Montana, 2008.



Name	Catchment Area (ha)
Cemented Tailings Facility	37.49
Process Water Storage Pond	19.03
Non-Contact Water Reservoir	58.33
Plant Site	25.14

LEGEND:

- ROAD
- CONTOUR (1 m)
- CONTOUR (5 m)
- STREAM
- POWERLINE
- CATCHMENT BOUNDARY
- MINE FACILITIES

NOTES:

1. BASE MAP: LIDAR 1 m CONTOURS AND STREAMS.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 12N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:12,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. CONTOUR INTERVAL IS 1 METRE.

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

WATER BALANCE MODEL CATCHMENT AREA FIGURE

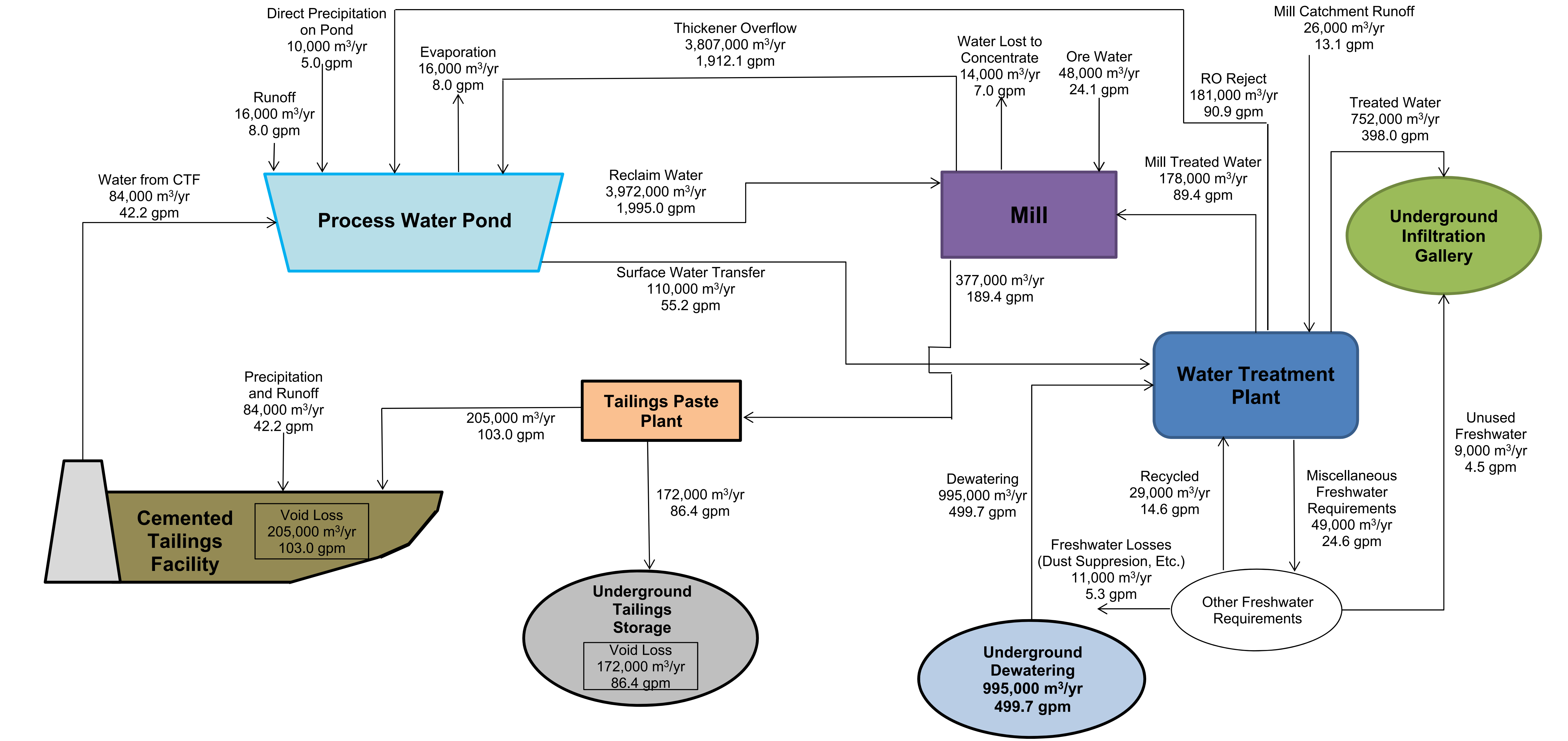
Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-460/3	VA17-01139

FIGURE 1 REV 2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
2	07JUL'17	ISSUED WITH LETTER	KK	KK	KJB

SAVED: M:\1\01\00460\03\A\GIS\Figs\VA17-01139 Water Balance Catchments\Fig1_WaterBalanceModelCatchmentArea.mxd; Jul 06, 2017 9:46 AM; kkrauszova



NOTES:

1. ALL WATER VOLUMES ARE EXPRESSED IN UNITS OF CUBIC METRES PER YEAR AND GPM EQUIVALENTS.
2. WATER IN TAILINGS PASTE IS ASSUMED TO BE UNRECOVERABLE.
3. SEEPAGE IS ASSUMED TO BE ZERO AS THE FACILITIES ARE LINED.

4	26APR'17	ISSUED WITH LETTER	BW	MH
REV	DATE	DESCRIPTION	PREP'D	RVW'D

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

ANNUAL WATER BALANCE SCHEMATIC
MEAN CASE - YEAR 6

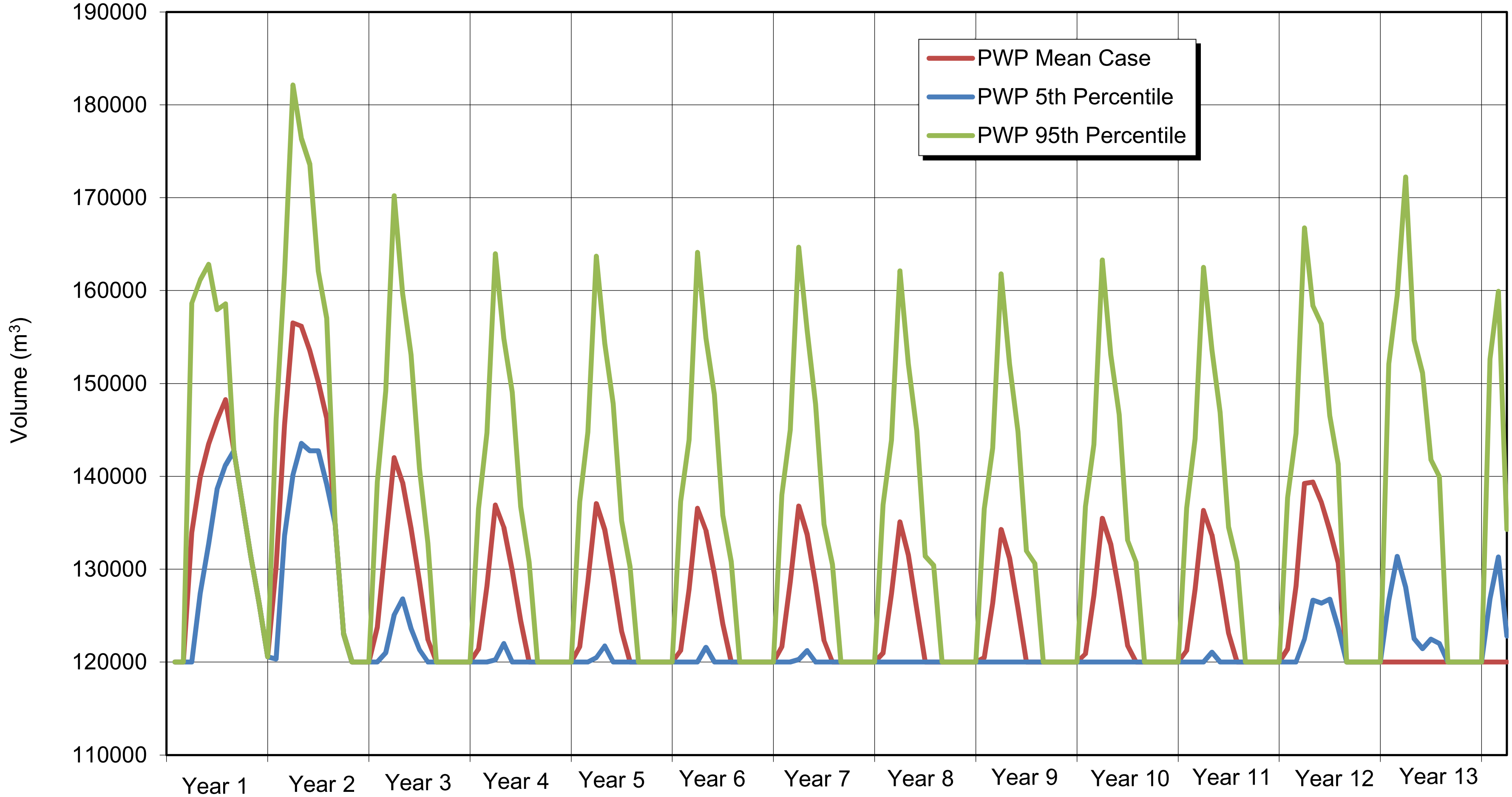
Knight Piésold CONSULTING

P/A NO. VA101-460/3

REF. NO. VA17-00734

FIGURE 2

REV 4



NOTES:

1. AN INITIAL VOLUME OF 120,000 m³ IS ADDED TO THE PWP 2 MONTHS PRIOR TO THE START OF OPERATIONS.

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND
MONTHLY VOLUMES
ESTIMATE PRIOR TO WATER TRANSFERS

Knight Piésold CONSULTING

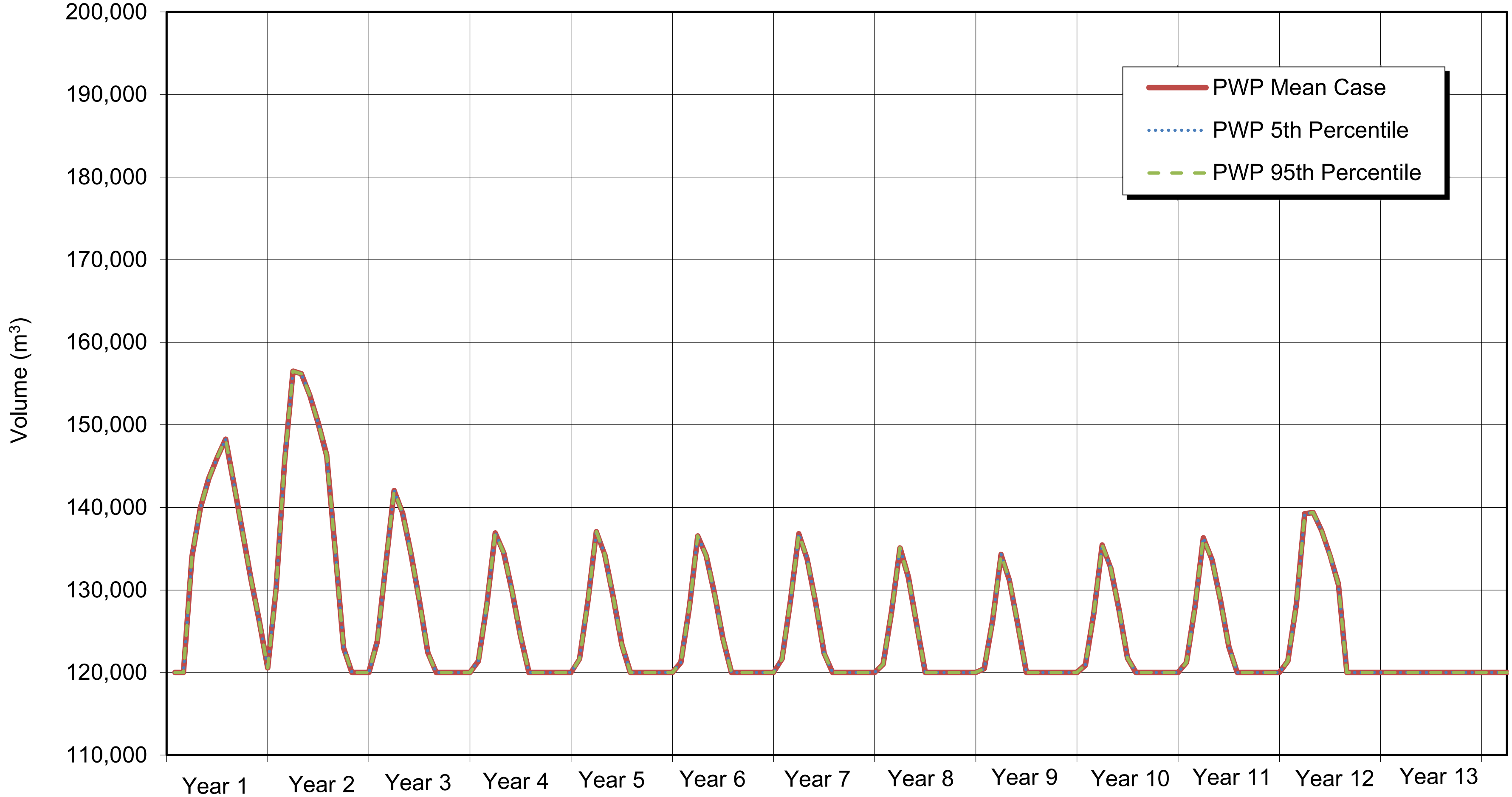
P/A NO. VA101-460/3

REF. NO. VA17-01139

FIGURE 3

REV 2

REV	DATE	DESCRIPTION	PREP'D	RVW'D
2	28APR'17	ISSUED WITH LETTER	MH	GM



NOTES:

1. AN INITIAL VOLUME OF 120,000 m^3 IS ADDED TO THE PWP 2 MONTHS PRIOR TO THE START OF OPERATIONS.

2	28APR'17	ISSUED WITH LETTER	MH	GM
REV	DATE	DESCRIPTION	PREP'D	RVW'D

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND
MONTHLY VOLUMES
POST WATER TRANSFERS

Knight Piésold CONSULTING

P/A NO. VA101-460/3

REF. NO. VA17-01139

FIGURE 4

REV 2

APPENDIX G

CTF DAM BREACH RISK ASSESSMENT

(Pages G-1 to G-14)

Knight Piésold
CONSULTING

www.knightpiesold.com

MEMORANDUM

To:	Mr. Jerry Zieg	Date:	August 11, 2017
Copy To:	Bob Jacko	File No.:	VA101-00460/03-A.01
From:	Greg Magoon	Cont. No.:	VA17-01339
Re:	Black Butte Copper Project – CTF Dam Breach Risk Assessment		

1 – INTRODUCTION

This memo, prepared by Knight Piésold Ltd. (KP), summarizes the dam breach risk assessment for the Cemented Tailings Facility (CTF) at the Black Butte Copper Project (the Project). Specifically, this assessment presents an examination of foundation and embankment instability, overtopping, and internal erosion effects as these relate to the hypothetical potential for an embankment breach with subsequent release of tailings to the downstream environment.

The purpose of this memo is to identify and characterize the risks associated with a hypothetical breach of the CTF embankment. A dam breach is characterized by the sudden rapid and uncontrolled release of water or tailings solids from the impoundment. It is recognized that there are other types of failure (e.g. uncontrolled contaminated seepage), however these types of failures are not included in this assessment.

1.1 LEGISLATED REQUIREMENTS

Montana Code Annotated (MCA) 82-4-376 describes the design document requirements for an operator proposing to expand an existing tailings storage facility or develop a new tailings storage facility and is the governing legislation for preparation of the expansion design (MCA 82-4-3, 2015). The requirements include:

"*a dam breach analysis, a failure modes and effects analysis or other appropriate detailed risk assessment, and an observation method plan addressing residual risk;*"

This memo fulfills the above statutory requirements for the design document.

2 – LIKELIHOOD AND CONSEQUENCE RATING CRITERIA

Risk is represented by the product of the likelihood of an event occurring and the consequences of that event:

Risk = Likelihood x Consequence

In general terms, risk is higher when the likelihood and consequence of failure is higher, and risk is lower when the likelihood and consequence is lower. Likelihood can be further resolved into the probability of a certain event or loading condition occurring (e.g. the return period of an earthquake) and the probability of a failure occurring coincident with that event (e.g. how likely is it that the earthquake will cause deformation that constitutes failure). Therefore, likelihood can be further described as follows:

Likelihood = Probability of Loading Conditions x Probability of Coincident Failure

The probability of an event occurring is generally easier to define quantitatively, whereas the probability of failure due to an event (the imposed loading conditions of the event) is evaluated through deterministic safety analyses.

2.1 LIKELIHOOD

2.1.1 Probability of Loading Conditions

The probability of the occurrence of a loading condition is directly associated with the risk of an event occurring. A more frequent or likely event, or loading condition, may result in a need to reduce the probability of failure associated with the event if the potential consequences are severe and cannot be altered.

Normal operating conditions are considered a certainty, and are expected to occur once or more on an annual basis. Rainfall and seismic events can be classified based on the probabilistic return period associated with an event under consideration. For instance, a 1 in 1,000 year return period wet month is expected to occur once every 1,000 years. Such an event is unlikely to occur, but has a small probability of occurrence in each and every year. Larger rainfall events, like the Probable Maximum Precipitation (PMP), are even less likely and are considered to be very rare, maximum credible events.

The loading conditions imposed by an event considered in this risk assessment are defined based on the probability levels presented in Table 2.1. The category corresponding to the probability of the loading condition has been qualitatively defined.

Table 2.1 Probability of Loading Conditions

Category	Probability of Loading Condition
Very Rare	One event per 10,000 years or deterministic based maximum credible event
Unlikely	One event per 1,000 years
Possible	One event per 100 years
Likely	One event per 10 years
Certain	One or more events per year

2.1.2 Probability of Coincident Failure

The definitions of four categories of failure probability are presented in Table 2.2 below. Each category is defined with a category value and a general description of the conditions for the value assigned. These categories provide a connection to the safety analyses used to demonstrate adequate dam safety under the loading conditions considered.

Table 2.2 Probability of Coincident Failure

Category	Description
Not Credible	Failure mode not credible for loading condition and initiating events under consideration
Very Low	Robust analysis demonstrates stable condition, exceeds design requirements, with appropriately conservative assumptions and with consideration of sensitivity analyses
Low	Analysis demonstrates marginal performance in considered loading condition, meets design requirements, however analysis technique not as robust or sensitivity range does not capture full range of conditions
Moderate	Does not meet minimum requirements under loading conditions or failure mode cannot be analyzed in a practical manner

2.2 CONSEQUENCES

Four categories of consequence are defined in Table 2.3. The consequence of failure varies from Minor to Catastrophic and qualitatively describes the severity of the potential damage if failure were to occur. A consequence definition will not be evaluated if the probability of coincident failure is Not Credible.

Table 2.3 Consequence Definitions

Category	Description
Minor	Minor deformation, local area of impact
Moderate	Serious deformation, but no uncontrolled release of containment
Major	Uncontrolled release, contained within project area
Catastrophic	Uncontrolled release, off-site impact

Minor and Moderate consequence categories are generally consistent with Level 1 and Level 2 unusual occurrences, respectively, as defined in the Tailings Operations Maintenance and Surveillance (TOMS) Manual (KP Ref. No VA101-460/03-4, July 2017)). These two levels of consequence do not lead to uncontrolled release of impounded materials, and are acceptable if the level of deformation is expected for the loading condition under consideration.

A minor consequence is considered to be a deformation that is aesthetic and easily repairable. An example of a consequence with a minor severity is some localized surface erosion or slumping of an embankment slope, or localized cracking on the CTF embankment crest or slopes. Typically, this sort of deformation would require increased daily surveillance to monitor displacement until the problem is understood and minor repairs are completed.

A moderate consequence is defined as a deformation or erosion impacting the crest width, or crest cracking that is progressively increasing, provided there is no uncontrolled release of impounded materials. These are conditions that represent a potential emergency, if sustained or allowed to progress, but no emergency situation is imminent. A field investigation to identify the cause of the deformation will be required, and corrective repairs will be performed to return the facility to operating condition.

Major and Catastrophic categories are both consistent with Level 3 emergency conditions in the TOMS Manual, defined as an actual or imminent failure of containment. A consequence severity threshold adopted for this analysis defines the mine site boundary as a key spatial limitation to the consequence definitions. A Major consequence is defined as a breach outflow that is contained within the project area. A breach outflow that is not contained within the project area and has an off-site impact is defined as a Catastrophic consequence. A conservative assumption that failure consequences are potentially catastrophic can be made to simplify the risk analysis for dam safety decision making purposes.

Major and Catastrophic consequences are unacceptable. Either consequence requires a very low probability of failure or a very rare probability of the event occurring in order to manage the risk.

3 – CEMENTED TAILINGS FACILITY DESIGN

The CTF is designed to store 55% of all tailings generated in the mill over the mine life and 100% of waste rock brought to surface. The CTF has a storage capacity of 4.3 Mm^3, which includes additional capacity for temporary storage of storm water up to and including the Probable Maximum Flood (PMF) event.

The tailings will be thickened to a paste consistency and mixed with a binding agent (cement and/or fly ash), to achieve a solids content of approximately 79%. The binding agents will harden the tailings after deposition to create a non-flowable mass.

The CTF will be constructed using cut-fill methods, with rock fill excavated from the impoundment basin area used to construct the confining embankment.

The CTF incorporates a double liner system that consists of a layer of 7.6 mm high-flow geonet sandwiched between layers of 100 mil HDPE geomembrane. The liner system will cover the full interior of the CTF basin and will incorporate an underlying prepared subgrade comprising processed material obtained from impoundment shaping.

A basin drain will be installed in the CTF (above the geomembrane) using sub-grade bedding material and waste rock generated from the mine and surface construction during the pre-production phase. The basin drain will flow into a wet well sump and pump that comprises the water reclaim system. The basin drain will collect the small amount of water released from the tailings as the cement sets and the mass solidifies (referred to as tailings bleed water) and any water that percolates through the tailings mass and convey it to the water reclaim system to be pumped to the Process Water Pond for storage and mill use. This will facilitate a low phreatic level within the tailings mass and will reduce the head on the geomembrane, which is an effective measure to minimize potential seepage through any small defects in the geomembrane.

The CTF incorporates a foundation drain to collect groundwater flows and seepage below the CTF geomembrane, and to convey all collected flows to a foundation drain collection pond downstream of the CTF. The foundation drain comprises an interconnected grid of perforated pipes of various diameter along with surrounding drainage gravel to collectively manage groundwater flows. The foundation drains flow to the foundation drain collection pond located at the downstream toe of the CTF embankment. Collected water will be pumped back into to the CTF and subsequently transferred to the PWP, or be pumped directly to the on-site water treatment plant.

Plan views and sections of the CTF and its components are shown on Drawings C2001, C2002, C2003, and C2004. Details of the CTF design are presented in KP Report "Waste and Water Management Design for MOP Application" (VA101-460/03-4, Rev 8, July 2017).

4 – DAM BREACH RISK ASSESSMENT

A number of risks have been evaluated for likelihood of causing a breach of the CTF.

Three primary hazards have been considered for the hypothetical dam breach:

- Foundation and slope instability
- Overtopping of the embankments, and
- Internal erosion and piping.

The likelihood of these hazards occurring and the associated consequences of a breach of the facilities are assessed below.

4.1 DESIGN BASIS

MCA 82-4-3 requires that new tailings dams in Montana be able to withstand the greater of either the 1 in 10,000 year earthquake event, or the Maximum Credible Earthquake (MCE). To comply with MCA 82-4-3 guidelines the Maximum Design Earthquake (MDE) and Earthquake Design Ground Motion (EDGM) has been defined as the 1 in 10,000 year earthquake event which corresponds to a Peak Ground Acceleration (PGA) of 0.35 g. The PGA was defined using the United States Geological Survey (USGS) Uniform Hazard Response Spectra (available on the USGS website http://geohazards.usgs.gov/hazardtool/application.php) for the 1 in 10,000 year return period.

New tailings dams operating in Montana must be built to handle an Inflow Design Flood (IDF) equivalent to the PMF event. The CTF is designed to accommodate the PMF, which was determined to be equal to the Probable Maximum Precipitation (PMP) event (560 mm) combined with a 1 in 100 year snow accumulation (290 mm), resulting in a PMF of 850 mm equivalent precipitation over a 24 hour period.

4.2 FOUNDATION AND SLOPE INSTABILITY

Three main loading conditions for foundation and slope instability were considered for this assessment:

- Normal operating conditions (embankment weight, loading during embankment construction, nominal pore pressure from groundwater, etc.)
- Earthquake events or other factors causing a reduction of material strength, and
- Impoundment flooding increasing lateral loading with pore pressure increase.

Under normal operating conditions the probability of loading conditions occurring is “Likely”, as loading conditions include placement of material during construction, haul traffic, tailings deposition, and waste rock placement. However, the probability of the MDE or IDF occurring is considered “Very Rare”, since those events have a return period of 1 in 10,000 years or greater (in comparison to the 15 year mine life).

Foundation and slope instability was evaluated as part of the design process for the CTF. Stability analyses were completed for end of construction, operating, and post-closure conditions. Both static and seismic conditions were evaluated and it was assumed for the purpose of the analysis that the CTF is flooded by the IDF.

The results of the stability analyses are shown in Table 4.1, and they show that the CTF exceeds the target Factor of Safety requirements under all conditions. As such, the probability of failure for each loading condition is considered to be “Very Low”.

Table 4.1 Results of CTF Stability Analyses

Loading Condition	End of Construction		Operating Conditions		Post-Closure	
	Static	Seismic	Static	Seismic	Static	Seismic
Required Minimum Factor of Safety	**1.3**	**1.2**	**1.5**	**1.2**	**1.5**	**1.2**
Upstream	2.5	n/a	2.5	1.6	n/a	n/a
Downstream	2.3	n/a	2.3	1.5	2.3	1.5

Details of the analyses are presented in the KP Design Report “Waste and Water Management Design for MOP Application (KP Ref. No. VA101-460/03-2, Rev 8, July 2017).

Tailings deposited in the CTF will be mixed with a binding agents (cement and/or fly-ash) prior to deposition, and once set will be a non-flowable mass. In the very unlikely event of a breach of the CTF embankment and tearing of the liner system the tailings may slump in place, but will not flow out to the downstream receiving environment. As such, the consequence of failure under normal operating conditions or an earthquake event is considered to be “Moderate”.

Table 4.2 summarizes the risk ratings developed for foundation and slope instability hazards.

Table 4.2 Risk Ratings for Foundation and Slope Instability

Failure Mode	Likelihood		Consequences
	Probability of Loading Condition	Probability of Failure	
Normal Operating Conditions [1]	Likely	Very Low	Moderate
Earthquake Events (or other loss of material strength)	Very Rare	Very Low	Moderate
Flood Events	Very Rare	Very Low	Moderate

NOTES:
1. THE LOADING CONDITION IS DEFINED AS NORMAL OPERATING CONDITIONS.

4.3 OVERTOPPING

Overtopping considers the potential for a supernatant pond or flood inflows to rise higher than the embankment crest leading to water discharging over the embankment crest. A release of water over the top of the embankment has the potential to cause erosion of the embankment and breaching of the impoundment. The risk of overtopping is managed primarily through the prescription of design freeboard, and appropriate water management practices to maintain a minimal pond volume in the facility.

Four main loading conditions for overtopping were considered in this assessment:

- Normal operating conditions with the tailings delivery and water reclaim systems working as designed
- Pipeline rupture allowing reclaim water to spill back into the CTF
- Flooding of the impoundment due to storm events, and
- Earthquake event causing embankment deformation and subsequent overtopping.

The CTF will be operated with a minimal a pond volume, with a water reclaim system in place to remove any surface water from the facility. The only water loading possible under normal operating conditions will be from direct precipitation and runoff, and tailings bleed water. The facility will also incorporate at least 2 m freeboard, in addition to storage capacity for the IDF. Therefore, the possibility of loading conditions occurring are “Certain” (due to annual precipitation and tailings inflow), however the probably of a breach occurring under normal operating conditions is “Not Credible” as any inflows to the CTF would be within design capacity.

Tailings delivery and water reclaim pipelines extend adjacent to the CTF, and a rupture of either pipeline may allow tailings or reclaim water to spill back into the CTF. While the probability of a pipeline rupture during the life of the mine is “Likely”, the volume of material that would report to the CTF would not be sufficient to exceed the design capacity therefore the Probability of Failure is considered “Not Credible”.

The CTF is designed to withstand the 1 in 10,000 earthquake, therefore both the Probability of Loading and the Probability of Failure (i.e. sufficient embankment deformation to cause a breach of containment) are “Very Rare” and “Very Low”, respectively.

The CTF is designed to contain storm inflows up to and including the PMF event without encroaching on freeboard. The CTF filling schedule, shown on Figure 4.1, shows that the CTF has capacity to contain the IDF, plus a 2 m freeboard allowance for wave run-up, throughout the life of the mine. Therefore both the Probability of Loading and the Probability of Failure are “Very Rare” and “Very Low”, respectively.

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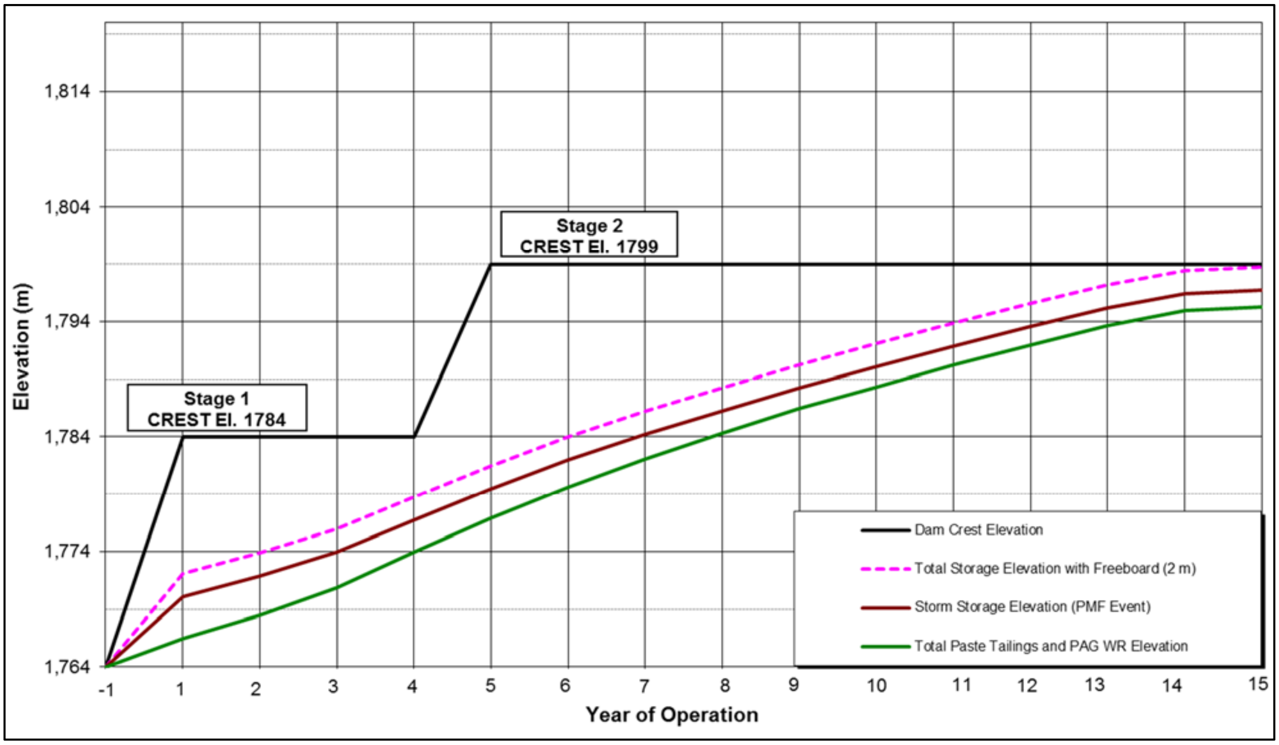

Figure 4.1 CTF Filling Schedule

The tailings deposited in the CTF will be cemented and non-flowable, and if an embankment breach occurred there could be in-place slumping of the tailings, but no release to downstream environment. If overtopping and a subsequent embankment breach occurred due to any of the loading conditions, then a release of any impounded water is assumed. However because overtopping could only occur in the event of a storm event flooding the impoundment, any water released would be too dilute to have an adverse environmental impact. As such, the consequence of a breach is considered “Moderate” as there is no release of tailings, only accumulated precipitation.

Table 4.3 Risk Ratings for Overtopping

Loading Condition	Likelihood		Consequences [2]
	Probability of Loading Conditions	Probability of Failure	
Normal Operating Conditions [1]	Certain	Not Credible	-
Pipeline Rupture	Likely	Not Credible	-
Earthquake Events	Very Rare	Very Low	Moderate
Flood Events	Very Rare	Very Low	Moderate

NOTES:
1. THE LOADING CONDITION IS DEFINED AS NORMAL OPERATING CONDITIONS.
2. A CONSEQUENCE RATING IS NOT PROVIDED IF FAILURE IS NOT CREDIBLE FOR THE LOADING CONDITION UNDER CONSIDERATION.

4.4 INTERNAL EROSION AND PIPING

Internal erosion and piping has the potential to occur through an embankment or through the foundation of an embankment that is impounding water. Internal erosion typically develops progressively and is caused by seepage, starting from either the downstream or upstream side of the embankment or foundation. Piping can occur as the erosion develops to create a pathway for seepage. Fill materials can be carried with the water as the seepage path develops, which has the potential to gradually increase the erosion area. Potential breach mechanisms associated with internal erosion include gross enlargement of the pipe hole, unravelling of the toe of the embankment slope, crest settlement leading to overtopping, and instability of the downstream slope.

Four conditions must typically exist for internal erosion and piping to occur:

1. There must be a source of water and a seepage flow path.
2. There must be erodible material along the flow path and this material must be carried by the seepage flow.
3. The material directly above the material being eroded must be able to form and support the “roof” of the pipe.
4. There must be an unprotected exit (open and unfiltered) from which the eroded material may escape.

Under normal operating conditions the CTF will have no operating pond present as a source of water. However, water may temporarily pond within the CTF immediately following precipitation events. In addition, the CTF impoundment excavation may intercept groundwater, which would be conveyed beneath the impoundment by the foundation drain system. Due to the presence of groundwater and temporary flooding from precipitation/storm events, condition 1 is assumed to be possible during operations.

The CTF embankment will be constructed using rockfill from the excavation of the facility, and the foundation comprises weathered bedrock. The CTF is a lined facility, and therefore the embankment does not incorporate any zones of fine grained material to act as a seepage barrier, which would be susceptible to erosion and piping. Given the absence of erodible and transportable material in the embankment and foundations, condition 2 does not exist. Subsequently, if piping cannot occur in the embankment fill then condition 3 cannot exist.

There are no seepage barriers along the downstream face of the CTF embankment, therefore seepage could potentially daylight on the downstream face of the impoundment, as per condition 4. Therefore condition 4 is assumed to have some potential to exist.

The main loading condition necessary for internal erosion is the presence of a water source. This condition is considered “Certain” to occur at least on a temporary basis due to precipitation and groundwater. However, the other conditions necessary for internal erosion and piping to occur are prevented by the seepage control measures and embankment fill material used. Therefore, the Probability of Failure for an embankment breach due to internal erosion and piping is considered “Not Credible”.

Table 4.4 summarizes the risk ratings for internal erosion and piping.

Table 4.4 Risk Ratings for Internal Erosion and Piping

Loading Condition	Likelihood		Consequences [3]
	Probability of Loading Conditions	Probability of Failure	
Normal Operating Conditions [1]	Certain	Not Credible	-
Precipitation / Flood Events	Certain	Not Credible	-

NOTES:

1. THE LOADING CONDITION IS DEFINED AS NORMAL OPERATING CONDITIONS.
3. A CONSEQUENCE RATING IS NOT PROVIDED IF FAILURE IS NOT CREDIBLE FOR THE LOADING CONDITION UNDER CONSIDERATION.

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5 – SUMMARY

This dam breach risk assessment presents an examination of foundation and embankment instability, overtopping, and internal erosion and piping for the CTF. The assessment considered loading during maximum normal operating conditions, and additional loading from seismic events, flood events, and malfunctions of the reclaim water and tailings distribution systems.

The likelihood of embankment failure and uncontrolled loss of tailings due to foundation and slope instability under static conditions is "Very Low". The risk assessment considered the seepage and stability analyses completed for the CTF design, which included conservative assumptions related to material properties and pore pressure conditions.

Overtopping of the embankment would only be credible for severe flood events and for large earthquake-induced deformation. The risk of flood-induced overtopping is very low, and is managed by maintaining the prescribed design freeboard for the life of the mine. The design freeboard comprises storm storage freeboard and additional minimum freeboard (2 m) for wave run-up. The storm storage freeboard is based on the PMF, which is theoretically the largest flood resulting from a combination of the most severe meteorological and hydrologic conditions that could conceivably occur at the project site. An earthquake could potentially induce deformations and settlement of the embankment crest, which could theoretically lead to a potential loss of freeboard and overtopping. However this has a very low probability of occurrence as the CTF is designed to withstand the 1 in 10,000 year earthquake event, and would have to be simultaneously flooded by a storm event at the time of failure. The risk of earthquake-induced deformation leading to overtopping is very low.

Internal erosion and piping of the embankment under normal operating conditions is not a credible failure mode. The primary sources of water for seepage are temporary flooding from precipitation/storm events and groundwater flows beneath the CTF. Groundwater flows will be conveyed beneath the impoundment via the foundation drain system. Water temporarily impounded in the CTF (such as precipitation) will be safely contained until it is removed via the water reclaim system. Lastly, the embankment fill materials used to construct the CTF will be free draining rockfill, and not susceptible to piping and erosion.

Table 5.1 summarizes the risk ratings for the hazard categories.

Table 5.1 Summary of Risk Ratings

Hazard	Failure Mode	Likelihood		Consequences
		Probability of Loading Conditions	Probability of Failure	
Foundation and Slope Instability	Normal Operating Conditions	Likely	Very Low	Moderate
	Earthquake Events	Very Rare	Very Low	Moderate
	Flood Events	Very Rare	Very Low	Moderate
Overtopping	Normal Operating Conditions	Certain	Not Credible	-
	Pipeline Rupture	Likely	Not Credible	-
	Earthquake Events	Very Rare	Very Low	Moderate
	Flood Events	Very Rare	Very Low	Moderate
Internal Erosion and Piping	Normal Operating Conditions	Certain	Not Credible	-
	Precipitation / Flood Events	Certain	Not Credible	-

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6 – CONCLUSIONS

The probability of failure for the various hazards (foundation and slope instability, overtopping, internal erosion and piping) is either not credible or "Very Low". The CTF is designed for the storage of non-flowable cemented tailings, and is not a water retaining impoundment. Therefore the resulting consequences of failure for the credible but "Very Low" probability items are "Moderate". This indicates an overall "Very Low" risk related to a breach of the CTF.

7 – CERTIFICATION

This memo was prepared and reviewed by the undersigned.

PROFESSIONAL PROVINCE OF G. I. D. MAGOON # 36097 BRITISH COLUMBIA ENGINEER

August 11, 2017

Prepared: ______________________

Greg Magoon, P.Eng.
Project Engineer

Reviewed: ______________________

Ken Embree, P.Eng.
Managing Principal, Vancouver

MONTANA KEN J. BROUWER 10020 PE REGISTERED PROFESSIONAL ENGINEER

Aug 11, 2017

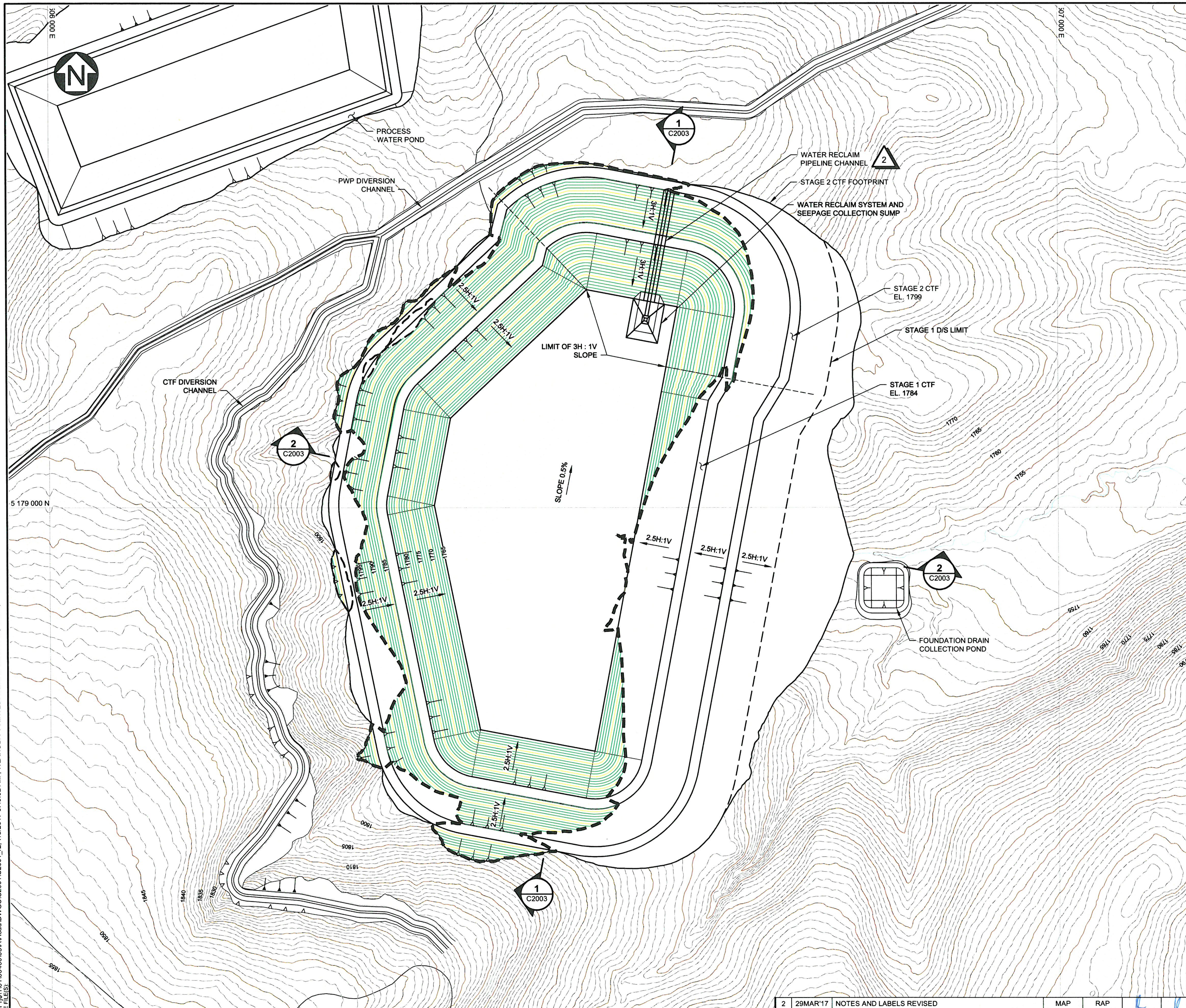
Reviewed: ______________________

Ken Brouwer, P.E.
President

Approval that this document adheres to Knight Piésold Quality Systems: K.

Attachments:

Drawing C2001 Rev 2	Grading Plan
Drawing C2002 Rev 1	HDPE Liner System Layout Plan
Drawing C2003 Rev 2	Section and Details
Drawing C2004 Rev 1	Basin Foundation Drain System Plan



LEGEND:

- EXCAVATION CONTOURS
- ORIGINAL STRIPPED GROUND CONTOURS TO BE REGRADED
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES, DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. FILL CONTOURS NOT SHOWN FOR CLARITY.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

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CEMENTED TAILINGS FACILITY GRADING PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2001	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2003	CEMENTED TAILINGS FACILITY SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	29MAR'17	NOTES AND LABELS REVISED	MAP	RAP		
1	29APR'16	CTF FOUNDATION POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

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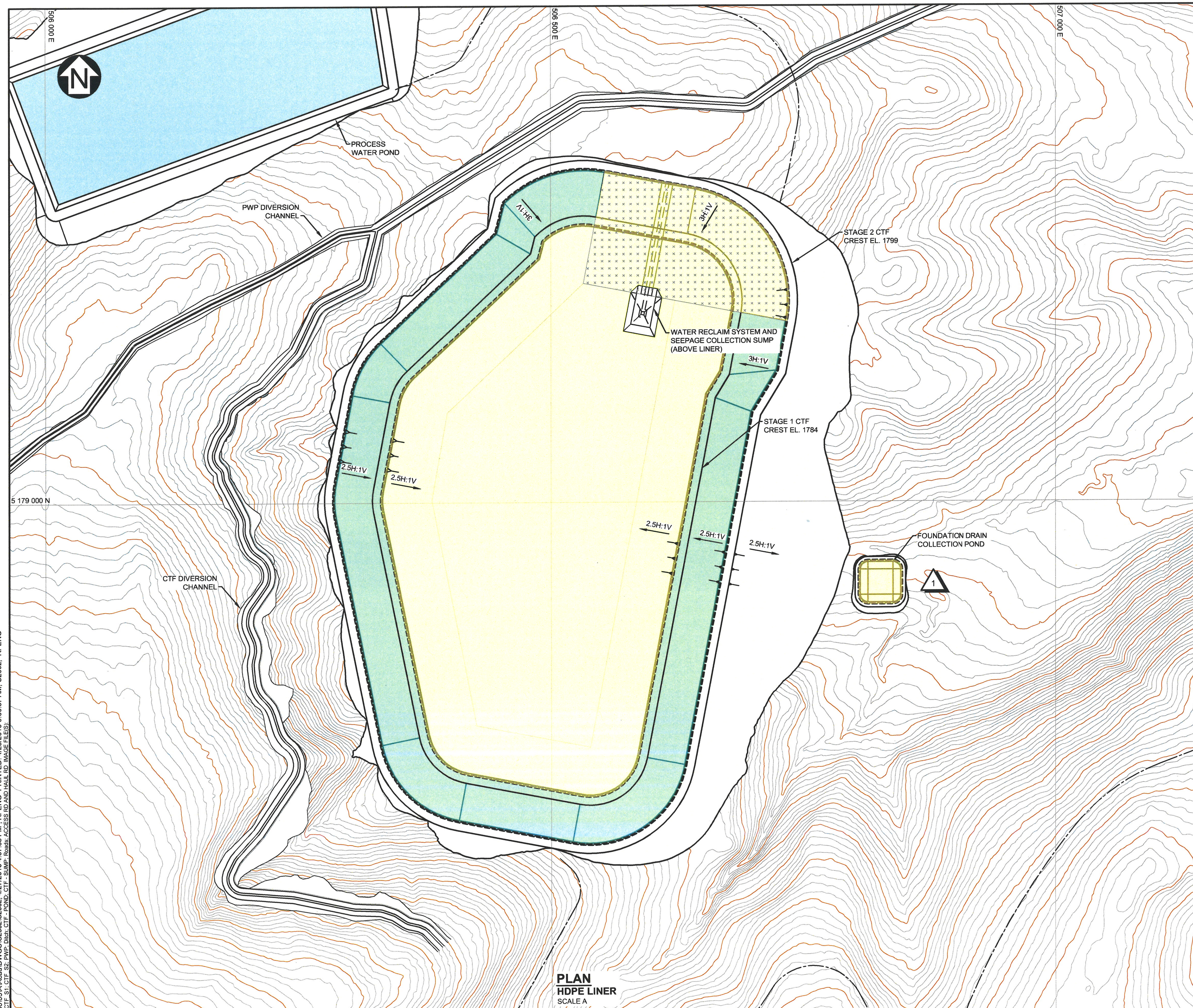

PLAN
HDPE LINER
SCALE A

LEGEND:

- STAGE 1 LINER SYSTEM
- STAGE 2 LINER SYSTEM
- TEXTURED 100MIL HDPE GEOMEMBRANE
- LINER SYSTEM ANCHOR TRENCH

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. HDPE LINER CONFIGURATION SHOWN ON DRG. C2005.
6. TEXTURED HDPE LINER REQUIRED TO FACILITATE FILL PLACEMENT FOR HAUL RAMP.

FOR INFORMATION ONLY

40 20 0 40 80 120 160 200 m
SCALE A

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CEMENTED TAILINGS FACILITY
HDPE LINER SYSTEM LAYOUT
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2002	1

DRG. NO.	DESCRIPTION
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	K.L.	
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

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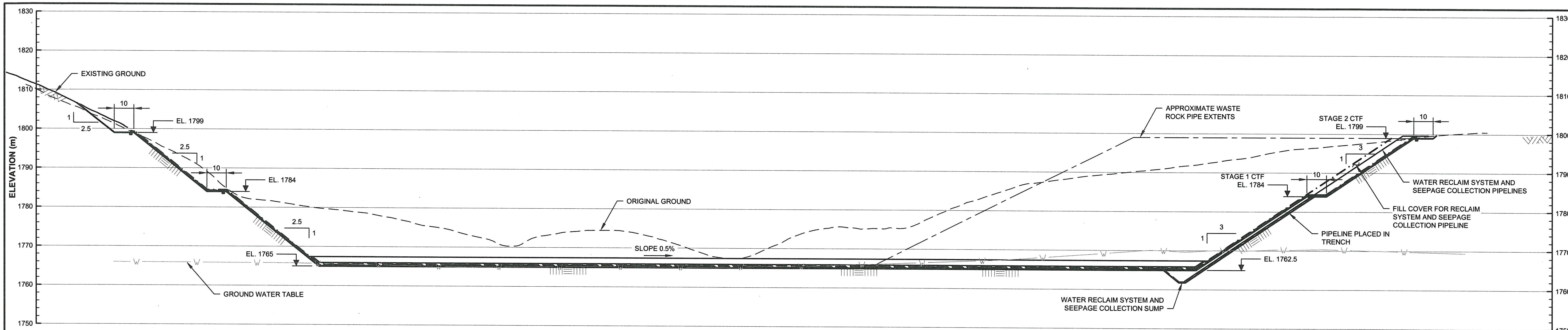

1 C2001 **SECTION**
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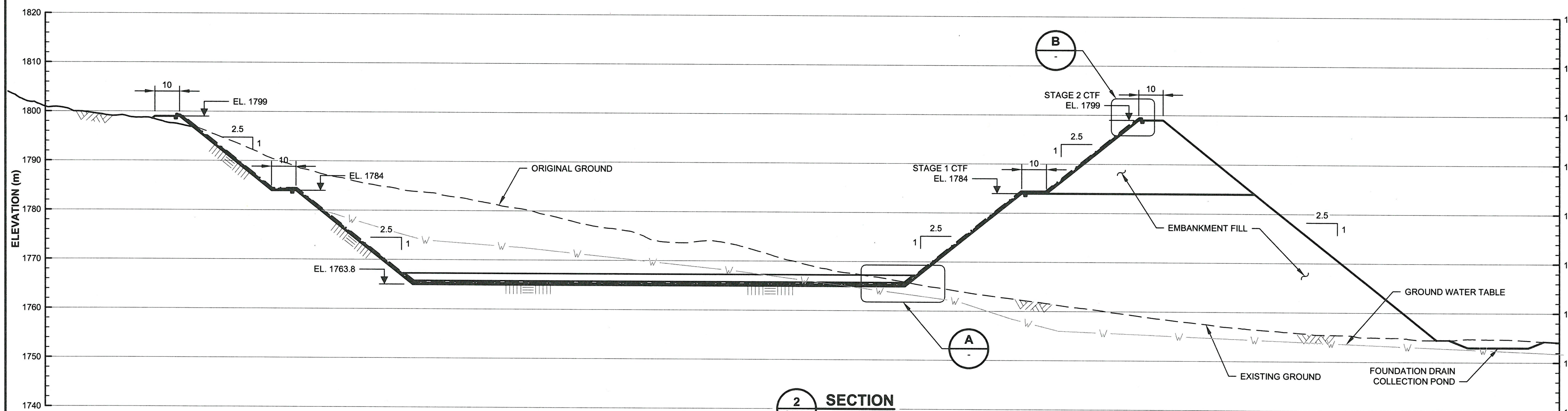
VERTICAL: SCALE B



2 C2001 **SECTION**
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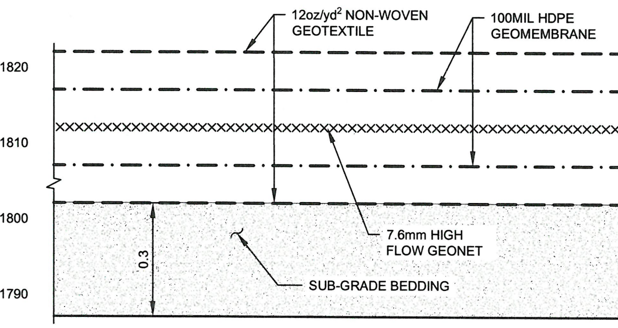


C **DETAIL**
LINER SYSTEM DETAILS
SCALE D

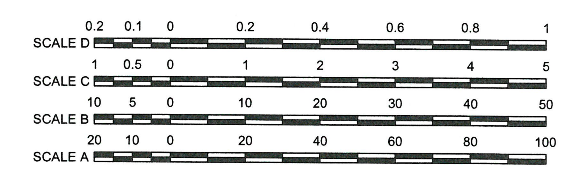
FOR INFORMATION ONLY

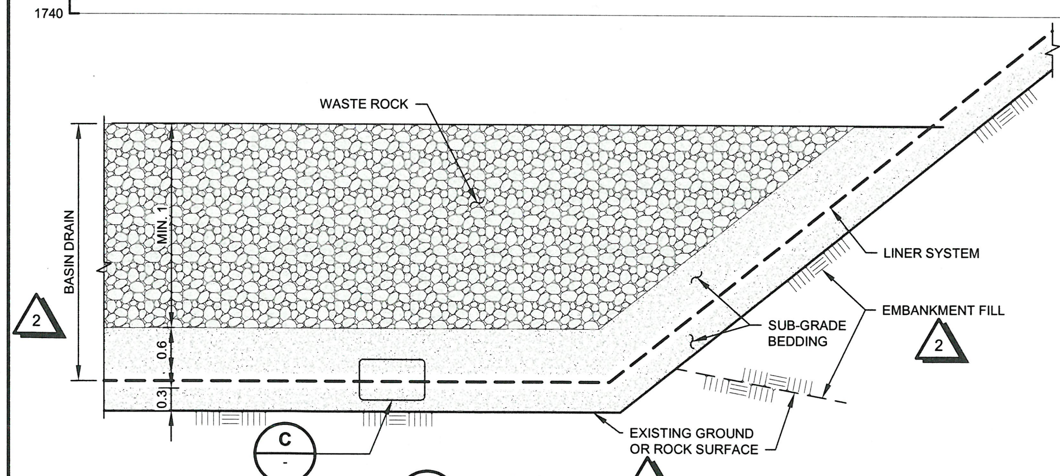
NOTES: 2

1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

BASIN DRAIN THICKNESS BASED ON AVAILABLE WASTE ROCK VOLUME

2. THE WASTE ROCK LAYER IN DETAIL "A" HAS NO MATERIAL OR COMPACTION SPECIFICATIONS.





A **SECTION**
BASIN DRAIN
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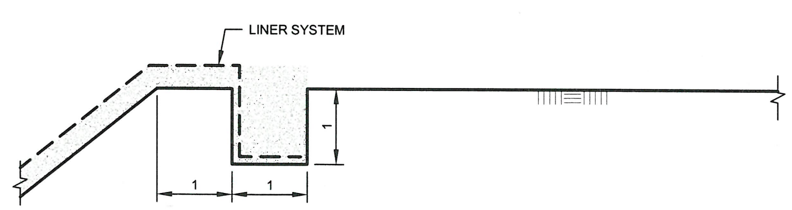

B **DETAIL**
ANCHOR TRENCH DETAIL
SCALE C

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CEMENTED TAILINGS FACILITY SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2003	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2005	CEMENTED TAILINGS FACILITY DETAILS
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR17	NOTES AND LABELS REVISED	GIM	RAF		
1	29APR'16	GROUND WATER TABLE ADDED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KJB	KJB

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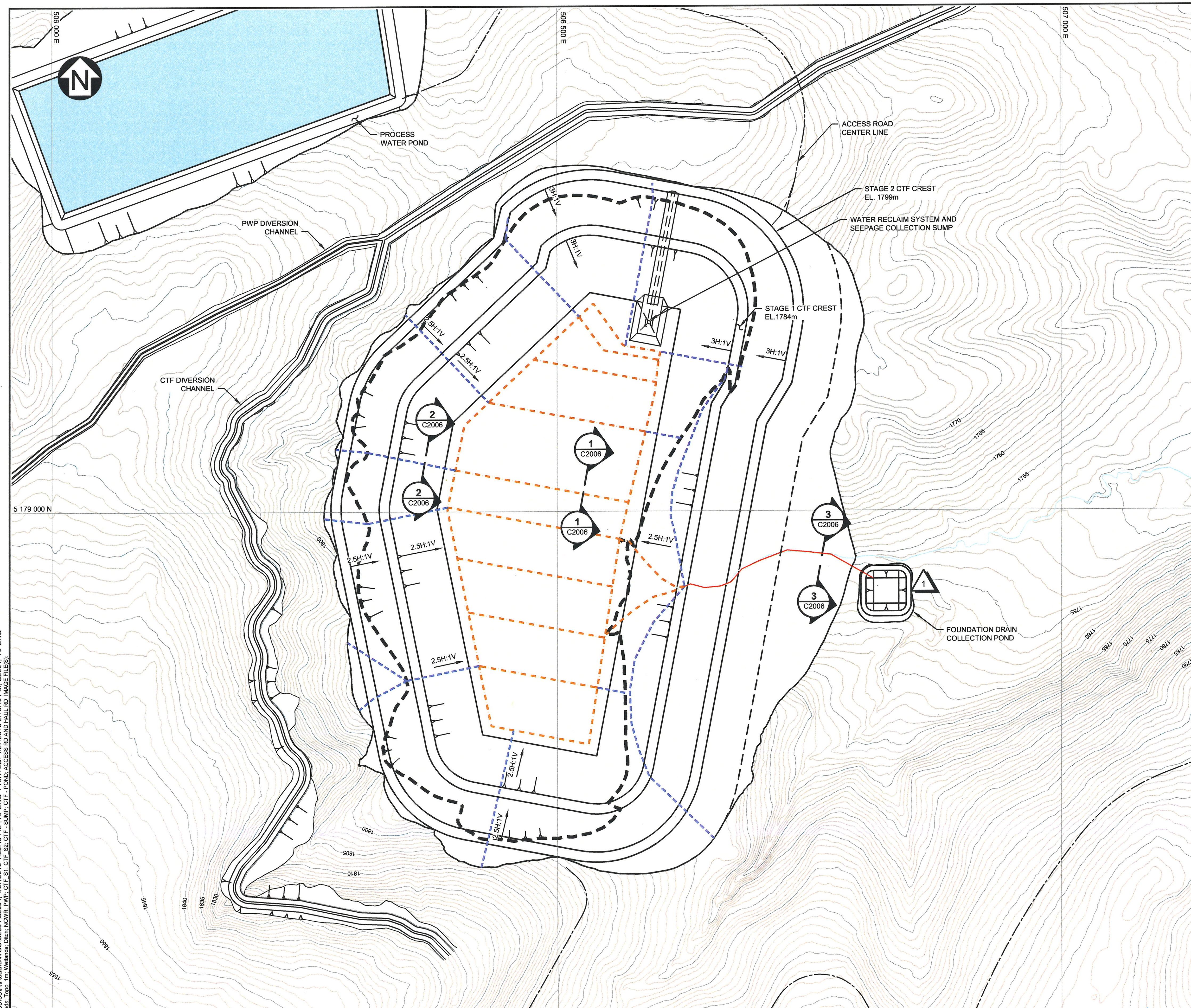

LEGEND:

- 250mm (10") N12 WT PE OUTLET PIPE
- 200mm (8") N12 ST PE DRAIN PIPE (BASIN FLOOR)
- 100mm (4") N12 ST PE DRAIN PIPE (CUT SLOPES)
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. DRAIN TRENCHES WILL BE SLOPED TOWARDS OUTLET PIPE CONNECTION AT A MINIMUM GRADE OF 0.5%.
5. LAST 10m OF OUTLET PIPE WILL BE SOLID PIPE BACKFILLED WITH IMPERMEABLE MATERIAL.
6. OUTLET PIPE WILL EMPTY INTO A WEIR TO MEASURE PIPE FLOW.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY BASIN FOUNDATION DRAIN SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2004	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2006	CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SYSTEM SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF SEEPAGE POND REVISED	MAP	RAP		
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

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XREF FILE(S): Hydro; Roads; Topo_1m; Wetlands; Ditch; NOWR_PWP; CTF_S1; CTF_S2; CTF - SUMP; CTF - POND; ACCESS RD AND HAUL RD IMAGE FILE(S):

APPENDIX H

TAILINGS DELIVERY SYSTEM DESIGN

(Pages H-1 to H-17)

PROJECT MEMORANDUM 001 Rev. 01
TAILINGS PIPELINE FEASIBILITY STUDY

1.0 PURPOSE

Knight Piesold Ltd. (KPL) has been retained by Tintina Resources Inc. (TRI) to perform a feasibility study on the tailing management facilities at their Black Butte Copper project in central Montana, USA. Approximately 45% of the tailings produced are used for cemented paste back-filling of underground stopes. The remaining tailings are stored in a surface tailings facility. KPL has retained MG Engineering Inc. (MG) to develop a conceptual piping system (pump discharge to spigot) to deliver the excess tailings to the surface tailings facility. This memorandum summarizes the design of the proposed tailings pipeline system and will be incorporated into KPL's overall feasibility study report.

2.0 GENERAL DESCRIPTION

Background

The proposed Black Butte copper mine (Mine) is located 85 km south-southeast of Great Falls, Montana (see Fig. 1).

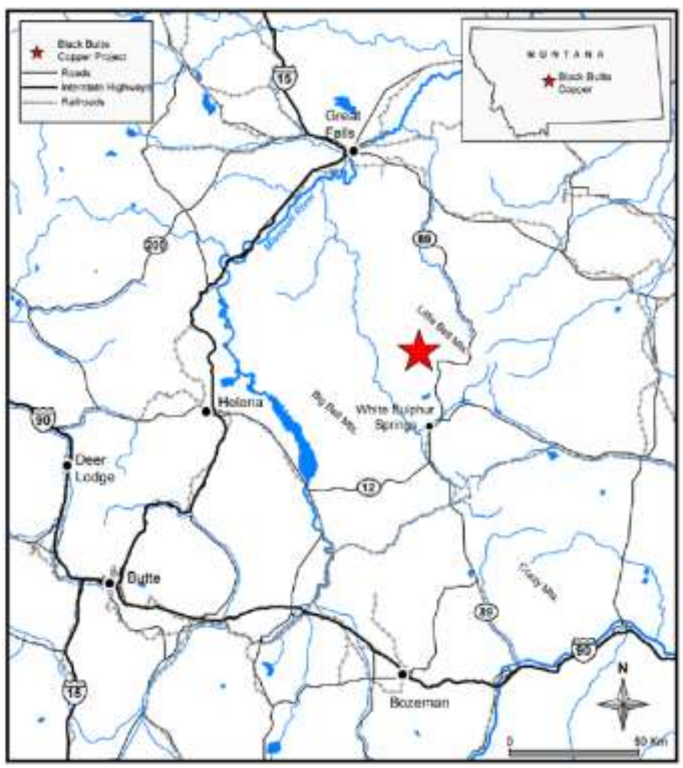

Figure 1: Location of proposed Black Butte copper mine (TRI)

The ore body is located below lightly forested, rolling hills with a nominal surface elevation of 1780 m above mean sea level (AMSL). The central Montana region has a semi-arid climate with cold winters. Nearby Great Falls, MT has average low temperatures of -10°C in December and January, and may see extreme low temperatures below -40°C. Daily low temperatures may drop below the freezing point of water for about eight months out of the year. Since the Mine location is 800 m higher than Great Falls, site temperatures would be expected to be about 5C° cooler on average (using 6.4C°/km low altitude lapse rate).

"Fixed" Facilities

The copper ore is recovered by underground mining methods and delivered to a concentrator (Plant) located ~1.0 km south of the Mine, at an elevation of 1782 m AMSL. The Plant processes 139 metric tonnes per hour (tph) of ore and generates 120.8 tph of tailings. For the purposes of this analysis, it is assumed that ore and operating variability causes the instantaneous tailings production to vary by ±10%.

TRI has opted to use cemented paste for both the underground tailings facility (UTF or stopes) and surface "cemented tailings facility" (CTF). The tailings are thickened to a high yield stress "paste" and mixed with a binding agent ("cement") for disposal. The cemented paste is pumped either to the UTF (~45% of the time) or to the CTF (~55% of the time); there is no flow splitting.

It is understood that TRI intends to use the same paste pump(s) to deliver paste to both the UTF and the CTF. The paste pump station will be designed (by others) as part of the Paste Plant design. The design pressure of the pump station is determined by the pipeline with the highest pressure requirement. The route of the pipeline to the UTF is not known, and it will change over the life of the Mine as the pour location moves from stope to stope. The Johnny Lee ore bodies are between 150 m (Upper Zone) and 500 m (Lower Zone) below the final CTF spigot elevation, which will decrease the UTF pump pressure by 33 to 110 bar relative to a CTF paste pipeline of the same size and length. For this study it is assumed that the CTF pump pressure will set the paste pump station pressure and power requirements.

The center of the CTF impoundment is located ~600 m south of the Plant in a valley that slopes downwards from west to east. The CTF is a paddock formed by a perimeter berm. The berm is built up in stages, with an initial crest elevation of 1784 m and a final crest elevation of 1799 m. The CTF also stores potentially acid generating waste rock, so a haul road runs from the Plant to the northeast corner of the berm. A water diversion channel runs above the west and north sides of the CTF. The channel has an elevation of ~1825 m at the south end and ~1775 m at the northeast end. The current KPL tailings deposition plan has the waste rock disposal area at the north end of the CTF and a single paste discharge point (spigot) at the south end of the CTF.

3.0 DESIGN BASIS

The design basis for the on-surface cemented paste pipeline is given in Table 1.

Table 1: Design Basis for Tailings System

Item	Units	Quantity	Comments
Plant elevation	m amsl	1782	KPL
Initial crest elevation	m amsl	1784	KPL
Final crest elevation	m amsl	1799	KPL
Nominal tailings tonnage	t/h	120.8	92% availability
Tailings specific gravity	t/m^3	3.77	KPL (~40% pyrite)
Binder specific gravity	t/m^3	3.0	OPC/FA
Binder addition rate	-	5%	Est. (7% for backfill)
Paste solids specific gravity	t/m^3	3.73	Combined
Nominal paste tonnage	t/h	126.8	Solids only
Paste solids content	%w/w	74.0	KPL
Paste volume concentration	%v/v	43.5	Calculated
Paste specific gravity	t/m^3	2.19	Calculated
Nominal paste flow	m^3/h	78.2	Calculated
Design paste flow range	m^3/h	71 to 86	Process variability

4.0 DESIGN CONSIDERATIONS

The following issues are considered in the routing and pipe selection for the Black Butte CTF paste transfer pipeline:

Double-Wall Pipe Secondary Containment

TRI has requested that double-wall (i.e. cased) pipe be used to provide secondary for environmental protection between the Plant and the CTF berm. Secondary containment is not required on the CTF berm because a rupture of the on-berm piping would result in paste flowing into the impoundment. Paste will not easily flow through the annulus between the pipe and the casing, so it must be forced through by the pump. Since the paste can discharge out either end of the casing, it is assumed that the pressure rating of the casing is at least half the design pressure of the pump and pipe.

Note: Double-wall pipe is just one option for secondary containment on this type of pipeline. There are other options that are equally effective for containment. It is suggested that a trade-off study of other secondary containment options be carried out in the next design phase of the project.

Corrosion

Overland slurry pipelines may be subjected to external corrosion, internal corrosion, and internal erosion. If this corrosion is allowed to go unchecked, sections of the pipeline will eventually need to be replaced to prevent leaks or rupture. Coatings are used mitigate external corrosion but are not suitable for internal corrosion protection of slurry lines; the flowing slurry quickly erodes the coating away. HDPE pipes are corrosion resistant but are only suitable for pressures up to ~20 bar (290 psi), which is too low for this paste pipeline (at least near the Plant). Stainless steel pipelines are too expensive, especially with heavy wall pipes.

The two common ways to deal with internal corrosion are by increasing the wall thickness of the steel pipe or installing a liner (HDPE, rubber, etc.). Thick walled pipe is the preferred method since it is easier to install, monitor, and repair. The "sacrificial" steel increases the actual pressure rating of the pipe so it adds to the factor of safety in the initial years of operation (i.e. until it is worn away). However, if the slurry is too corrosive the amount of extra steel required would be excessive and difficult to predict, so a corrosion resistant liner is preferred.

No corrosion information is available on the Black Butte tailings or process water. However, it is known that the tailings contain a significant amount of potentially acid generating sulphide minerals, which often leads to corrosive slurry/water. The paste and water will be assumed to be corrosive to carbon steel until proven otherwise by corrosion testing. The pipeline is assumed to be HDPE-lined steel.

A cased pipe may also be subjected to corrosion of the metal forming the walls of the annulus and the spacers. Unless the pipe profile allows it to be self-draining (to the ends or sumps along the route) then water can build up in the annulus; usually from condensation but possibly water left over from the hydrotest or a pinhole leak in the main pipe.

Intermittent Operation

A conventional tailings pipeline operates continuously whenever the Plant is operating. The CTF pipeline operates for three or four days, and then it is idle for three or four days. Because the paste is cemented and the pipeline is located in a region that drops well below freezing, it is not possible to leave the paste in the pipeline during the idle periods.

Flushing

If a conventional tailings pipeline shuts down when the line is full of slurry, the solids fall out of suspension and form a loosely-packed bed on the bottom of the pipe. Depending on the solids concentration of the slurry, this bed takes up between one-third and one-half of pipe's cross section. As long as the pipe slope is not too steep (>10%) the bed will remain in place indefinitely while the line is stopped, although it may pack tighter over time. On restart, water flows in the free path above the bed and its turbulence quickly lifts the solids back into suspension and erodes the bed away.

With an un-cemented paste pipeline the slurry already is near its settled (bed) concentration so little bulk settling occurs when flow ceases. An open flow path along the entire length of the pipe is unlikely, so clearing the pipe by resuspension is not a viable option. However, for idealized paste (time and shear independent) it also means that there is no change in the paste rheology, so the pipeline can be restarted simply by bringing it back up to operating pressure. For real paste the restart pressure may be higher than operating pressure. (Note: For those not familiar with time-dependent rheology, a simple analogy is normal friction: static (restart) friction is higher than sliding (operating) friction.)

With a cemented paste pipeline the situation for short duration (<1 hr.) cessations in flow is essentially the same as for un-cemented paste. However, for longer flow cessations, curing of the binder becomes an issue. The apparent yield stress rises and the flowability decreases until it is no longer possible to restart the pipeline using the pump. The cement will eventually set hard and the pipeline may need to be abandoned. It is unlikely that a cemented paste pipeline could be restarted if left stagnant for three or four days. As a result, it is necessary to flush the line with water at the end of each paste pour. High pressure water is used to push the paste out of the line and then the water is left flowing for a period to wash binder residue out of the pipe. Flushing a near-horizontal cemented paste pipeline requires a water source with an operating pressure that is at least as high as the design operating pressure when transporting paste.

Drainage

At the end of the flushing operation the pipeline will be full of water unless there is some way to drain it. With a down-sloped pipeline this is easily accomplished: the water free-drains out the low end of the pipe with no operator input. With an up-sloped pipeline the drainage needs to be back towards the pump; usually into a sump after the operator opens a drain valve.

With a “V” shaped pipeline profile it is not possible to drain to either end of the pipeline: water will be trapped in the low points. Drains can be installed at each low point to let the water in the pipe drain through a valve (and the casing annulus free-drain) into a sump. The number of low points should be minimized because the valve and flanges are leak risks, the tee is a wear (leak) risk, and the sump needs to be emptied. During the winter, the sump will need to be emptied quickly to avoid freezing.

The other option is to drain as much water out of the pipe as possible and then use compressed air to blow the water out of the pipeline, either directly or by pushing a pig (swab) through the line. If the air pressure can exceed 1.03 bar, the tailings pipeline needs to be designed and built as a pressure pipeline (e.g. to B31.3) and, in many jurisdictions the pipe must be registered with the Boiler Branch.

Cold Weather

Pipelines transporting fluids in locations that experience extended periods below that fluid’s freezing point are at risk of freezing. A frozen pipe will be inoperable and (when the fluid is water based) the crystallization expansion may cause the pipe to yield or rupture. The freezing risk increases as the ambient temperature drops, the pipeline diameter decreases, the flow rate of the fluid decreases, and the time in the pipe increases. The Black Butte site can drop well below freezing during more than half the year, the paste line has a small diameter, the paste has a low velocity when the pipeline is operating, and the system is regularly idle for days at a time: the freezing risk is very high. However, there are proven ways to mitigate the freezing risk.

Burial below the frost depth: Burial is the best way to protect a pipe from freezing; a pipe full of water can be left stagnant indefinitely. It is the standard method used to protect fire mains and long distance slurry pipelines. The frost depth varies, but is likely in the 1.0 to 2.0 m range. Burial also has the advantage that it supports and anchors the pipe, and it protects it from most external damage (e.g. being hit by a vehicle). The main disadvantage of burial is that it is difficult to monitor the condition of the pipe or observe leaks.

Insulation: Insulation is effective as long as the pipe is operating; the friction loss in the flowing paste is converted into heat, partially offsetting the heat loss through the insulation. This is sufficient to keep the paste from freezing during the relatively short period that it is in the pipe. However, insulation will not protect a stagnant pipeline during a prolonged cold period because it only reduces heat transfer, it does not eliminate it. At an air temperature of -40°C, an uninsulated 0.2 m (8”) pipe full of water at 10°C would start to freeze in less than an hour, and adding 0.1 m of insulation would increase that to about a day (depends on type of insulation, wind, etc.). To get four days protection would require ~0.4 m of insulation. The air space in the annulus of the cased section of the pipeline will provide some extra insulation to the inner pipeline, but the protection level is difficult to assess.

Insulation plus trickle flow: Maintaining a water flow that is just enough that the water is still a few degrees above freezing when it exits the pipe will prevent freezing even in a bare pipe. Adding insulation decreases the required water flow (by reducing heat loss) and protects the pipeline during short power outages. However, pumping a continuous stream of water into the CTF during cold weather periods is likely to cause operational issues in the impoundment. This option is more appropriate for areas with short and infrequent cold periods.

Insulation plus drainage: Drainage is effective because there is nothing to freeze when the pipeline is not operating. Adding insulation protects the pipe during the drainage period and short power outages. The main disadvantages of this system are that not all pipeline profiles are easily drainable and the pipe will experience significant thermal expansion/contraction: a 1000 m pipe will contract 0.5 m if its temperature drops by 45C°. Introducing fluid into a very cold pipe can also cause operational issues (i.e. freezing of the leading edge of the slug).

Insulation plus heat tracing: Heat tracing (usually electrical tape) delivers heat energy between the pipe and insulation. If the heat delivered equals the heat lost through the insulation, the pipe can be left stagnant indefinitely. The insulation both minimizes the heating energy required and protects the pipe during short power outages. This option also eliminates most of the expansion/contraction and cold restart issues.

Leakage

Considerable effort and expense will go into preventing a release of paste or flush water into the surrounding environment. Nevertheless, good pipeline design should always assume that a major leak is possible anywhere along the pipe. Not all leak locations will have the same impact: a leak that flows into the CTF a score of metres upstream of the spigot does not matter; a leak that flows into a fish bearing stream will be a major issue. A route that minimizes the length of pipe where a leak would not be contained by the surrounding terrain is usually preferred unless it would cause other risk factors (e.g. higher pressure).

Summary

For this study it is assumed that the paste pipeline is HDPE-lined carbon steel with double-wall containment for the segments off the CTF berm. The pipeline will be installed on the surface, and profiled to allow drainage of the pipe and casing. Where possible the pipe will be run through areas where leakage from a ruptured pipe would be contained by the terrain profile.

5.0 ROUTE OPTIONS

The CTF pipeline route and profile is essentially fixed for the life of the Mine. The only significant change will be the 15 m increase in elevation of the on-berm portion of the pipeline as the impoundment grows. For this type of pipeline, “route optimization” effectively means selecting a route that minimizes installation and operating difficulties, as well as the pipe’s overall length. Three route options have been identified.

Option 1: North Plant Exit to South CTF Spigot

The base case option assumes that the paste pipeline follows the haul road from the Plant to the CTF and then runs down the east berm of the CTF before turning west to the spigot point (see Fig. 2). The total pipe length is 1800 m.

The advantage of this route is that the pipeline right-of-way (RoW) is mostly in place. The haul road only needs to be widened by ~2 metres and the CTF berm crest can be used as is. The RoW cost is mainly building the berms for protection and isolation of the pipe. Haul roads are built with relatively shallow slopes and the CTF berm is flat so pipeline construction is easy. There is no need to construct pipeline crossings because the pipeline always stays on the east side of the haul road and the pipe will use the road bridge to cross the water channel. Finally, the haul road is regularly travelled by the waste rock trucks and people accessing the CTF, so a leak that occurs outside the CTF impoundment is likely to be noticed even if it happens between dedicated route inspections.

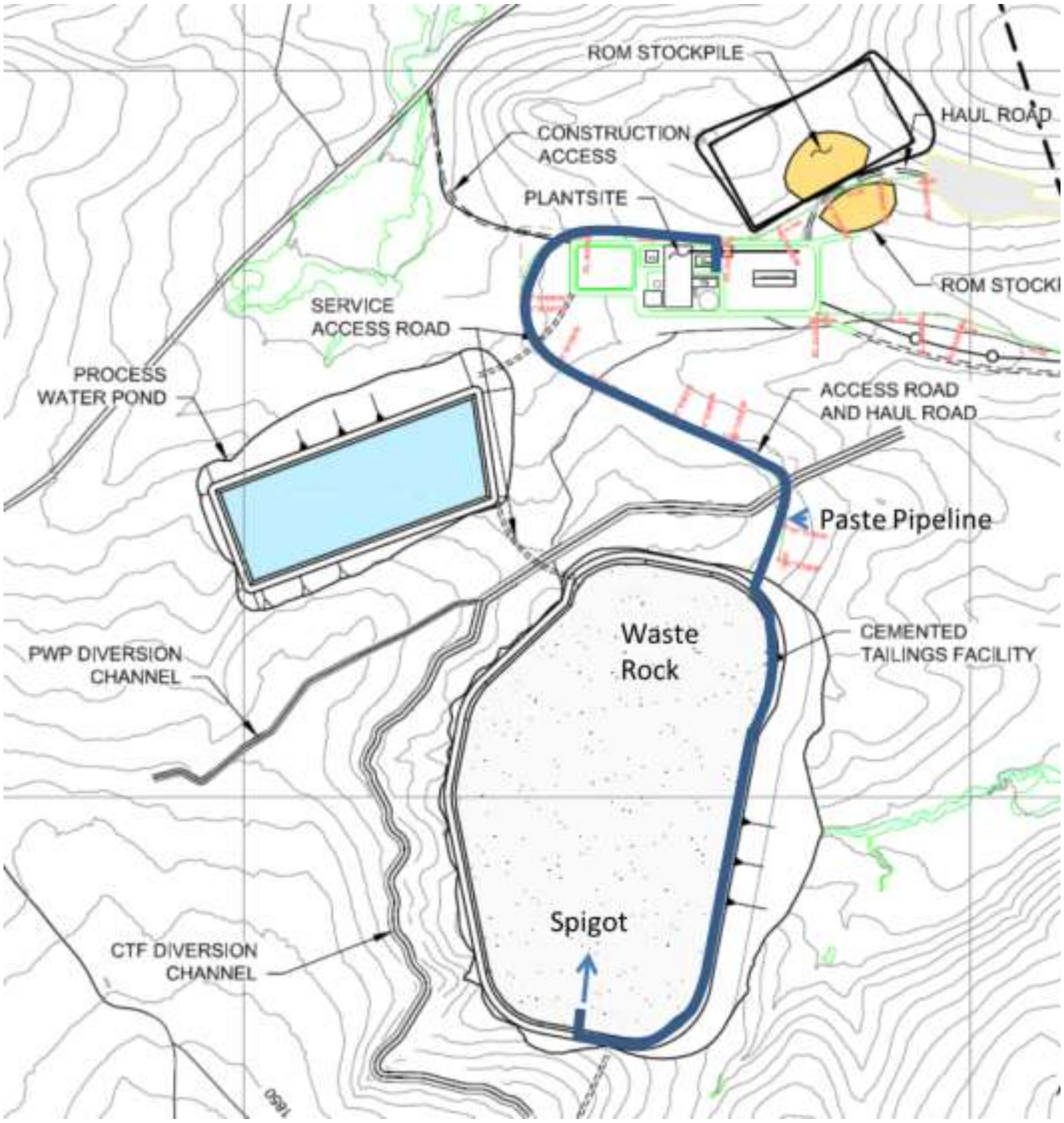

Figure 2: Option 1 pipeline route: North Plant to South CTF Spigot

One problem with the base case route is that it is long. Joining the haul road on the north side of the Plant means it has to loop around the west end of the Plant and then double back. There is a small ridge (~20 m high) between the Plant and the CTF. To maintain shallow grades, the haul road loops around the north flank and east end of this ridge before reaching the northeast corner of the CTF (see Fig. 2). As a result of this circuitous route, it takes 1000 m of pipe to reach the CFT, even though the straight line distance is only 400 m. This 600 m of extra pipe is all in the off-berm section, which is expensive (double-walled) and where a leak would be most problematic. It also increases the overall pumping pressure/power by ~50%.

Another problem with this route is that it is "W" shaped, which increases the complexity of draining the pipe and the casing. Sumps will be required on the west end of the Plant and where the pipeline moves up onto the CTF berm.

Option 2: South Plant Exit to North CTF Spigot

This route exits the south side of the Plant, crosses the haul road, runs up the north flank of the ridge, crosses the water channel, and then drops down onto the north berm of the CTF. The on-berm section of the paste pipeline will go straight across the crest and discharge into the CTF through the spigot (see Fig. 3). The total pipe length is 600 m. This route is only one-third the length of the Option 1 route and, all else being equal, the pump pressure and power will drop by a similar amount.

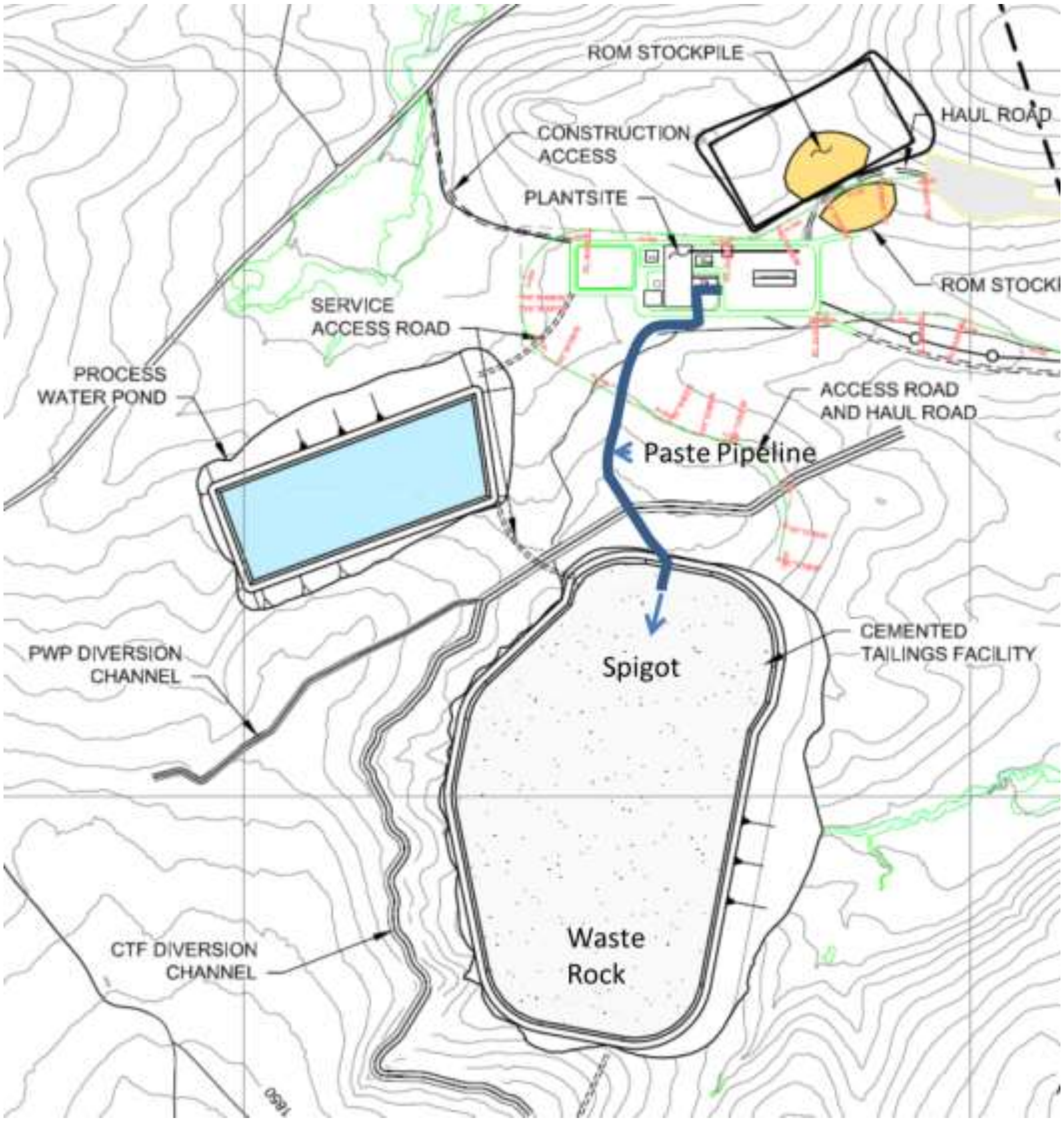

Figure 3: Option 2 pipeline route: South Plant to North CTF spigot

The ridge has a spur that runs from the top down to a saddle at the southwest corner of the Plant. Running the pipeline up this spur gives a continuously rising profile to the top of the ridge (roughly where it crosses the PWP diversion channel). This will allow the first 500 m of the pipe and casing to drain back to a sump that is in or near the Plant. The remaining 100 m will free-drain into the CTF. Running the uphill pipe slightly to the west of the spur will cause any leaks to flow to the west, where they will be trapped between the spur, the Process Water Pond berm, and the Plant.

From the high point the pipe runs to the southeast, angling down the south flank of the ridge to the spigot location, which is assumed to be the middle of the north CTF berm. A shallow sloped mound on the berm crest will allow the pipe to have downslope all the way to the spigot. Because the north CTF berm abuts against the south flank of the ridge, any leaks will either flow into the impoundment or be trapped in the small space between the ridge and berm.

The result is a short pipeline (inexpensive to build and operate), with a profile that is "Λ" shaped (easily drained), and good containment of potential leaks along the entire route.

A disadvantage of this route is that a new RoW (with crossings for the haul road and the water canal) needs to be built. While a new RoW will be more expensive per metre than widening the haul road, this is partially off-set by the shorter route length.

The main disadvantage of this route is that it would require the CTF to be reconfigured to put the waste rock disposal area and the water reclaim system in the south end of the impoundment. The haul road would also need to be extended to the south end of the impoundment.

Option 3: South Plant exit to South CTF Spigot

If the waste rock is kept in the north end of the CTF then the paste spigot needs to be at the south end. The route selected to achieve this is identical to Option 2 from the Plant to the top of the ridge (for the reasons described above). From the top of the ridge there are two ways the paste pipeline can run to the south end of the CTF: down the east berm or down the west berm. Both routes are of similar length, but the west berm route has a few advantages:

- The pipe does not cross the path of trucks delivering waste rock to the north end of the CTF.
- The berm is on the upstream end of the valley containing the CTF; any spillage out of the impoundment area would be trapped between the berm and the valley wall.
- The berm is very small in that location; in several locations the crest abuts right up to the hillside. It would be inexpensive to slope that section of the berm downward towards the south. A 0.5% slope (~3.5 m drop) would be adequate to allow the flush water to self-drain out of the spigot.

A pipeline running down the west berm is recommended. The approximate pipeline route is shown in Fig. 4. The total pipe length is 1300 m. This route is three-quarters the length of the Option 1 route and, all else being equal the pump pressure and power will drop by a similar amount.

The advantages and disadvantages are as outlined for Option 2. While this option is 700 m longer than Option 2, the extra length is all in the on-berm section where the pipe is less expensive (single wall) and a potential spill is containable.

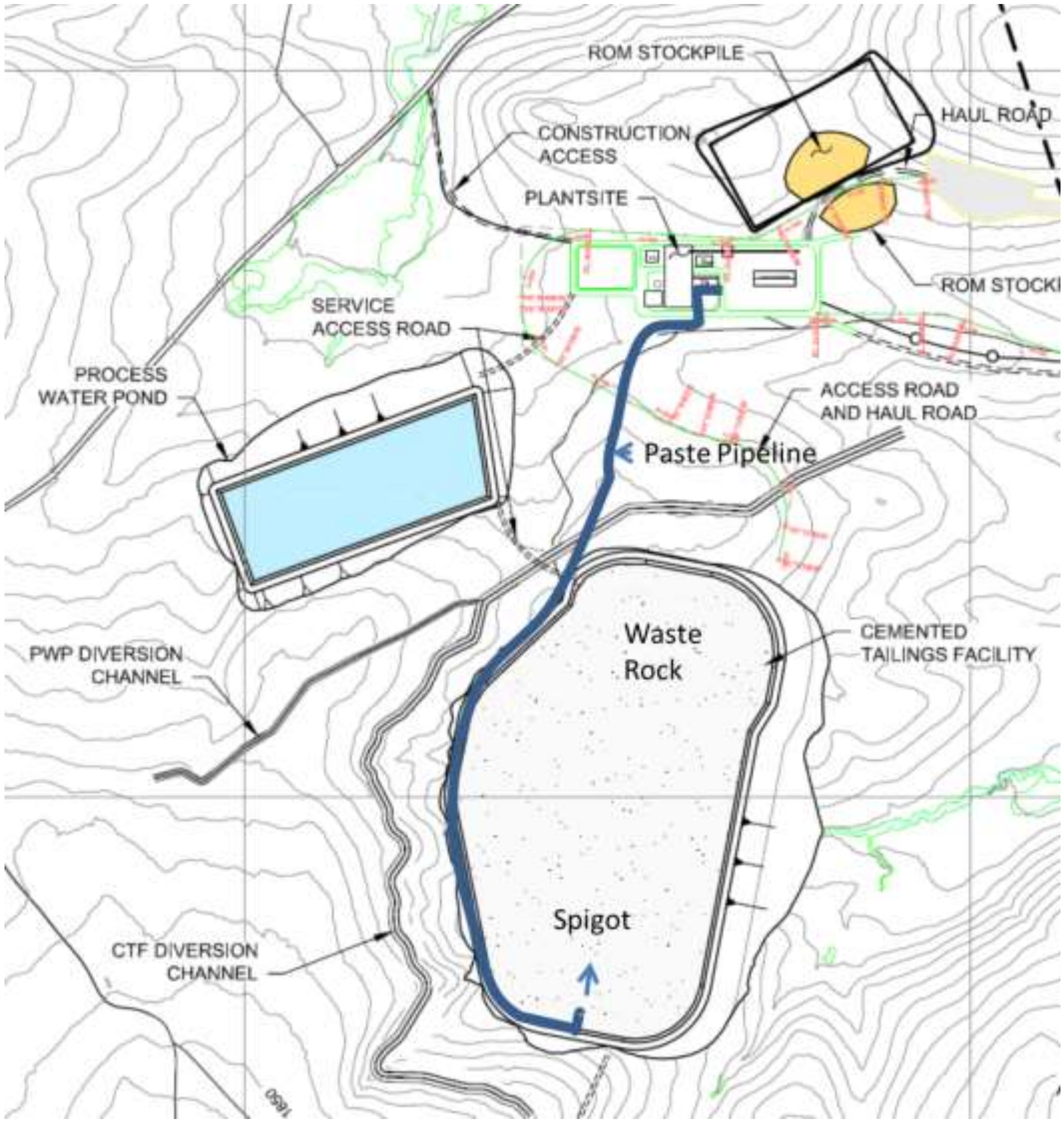

Figure 4: Option 3 pipeline route: South Plant to South CTF spigot

6.0 RHEOLOGY-BASED PRELIMINARY SIZING

As the Mine is still in the pre-feasibility phase, there is no information available on the rheology of the cemented paste being transferred for surface disposal. However, its rheological properties can be estimated based on the operation and economics of other cemented paste back-fill systems.

The Paste Plant will be designed (by others) to prepare a "recipe" (i.e. a mixture of tailings solids, binder, and water) that produces a cured paste that meets the needs of the back-filling operation (e.g. some minimum 28 day UCS) without excessive binder usage. Since binder is a major operating cost item and paste is always over-hydrated, the cured UCS can be increased more economically by thickening than by binder addition. As a result, the solids content of cemented paste tends to be as high as the selected thickening and pumping equipment can reliably produce and transfer to the stopes. Typically this results in a paste with a yield stress in the 200 to 400 Pa range.

The cured strength of the paste going to the CTF will not need to be as high as cured paste going to the UTF, which needs to stabilize the walls and roof of an underground stope. The CTF paste can be weakened by adding water or reducing binder. While adding water will make the paste easier to pump, reducing binder will give greater operating cost savings. Therefore, it is assumed that the rheology of the paste going to the CTF is essentially the same as what goes the UTF. For this analysis, it is assumed that the cemented paste is a Bingham plastic with a yield stress in the middle of the typical range: 300 Pa.

The laminar-turbulent transition velocity of high yield stress Bingham plastic paste is nearly pipe diameter independent and can be approximated by the Slatter-Wasp model:

$$V_c = 26\sqrt{\tau_y/\rho}$$

Where V_c is the transition velocity (m/s), τ_y is the yield stress (Pa), and ρ is the slurry density (kg/m^3). For 2190 kg/m^3 paste with a 300 Pa yield stress the transition velocity would be 9.6 m/s. This is well above a reasonable operating velocity (1 to 4 m/s), so the CFT pipeline will operate in the laminar flow regime.

In theory, the hydraulic gradient of flowing paste can be decreased to any arbitrary value if the pipe diameter is large enough. In practice, it has been found that there is bed build up if the pipe gets too large. The simplified description of this phenomenon is that the coarsest particles settle through the sheared paste and settle on the bottom of the pipe. In laminar flow there are no eddies to resuspend the particles so they will form a bed unless they are pushed through the pipe by the paste's drag forces.

The presence of a bed restricts the effective flow area and causes the pressure gradient to increase over time until it stabilizes. If the pump does not have sufficient pressure to transfer the paste at this higher pressure gradient, the pipeline will be plugged. The literature indicates that bed formation is unlikely if the average velocity is over 1 m/s and the pressure gradient is above 2000 Pa/m. These values will be used for preliminary design.

The bulk velocity in a full pipe is found using:

$$V = \frac{Q}{2827\,D^2}$$

Where V is the bulk velocity (m/s), Q is the slurry flow rate (m^3/h), and D is the pipe's inside diameter (m). For a nominal paste flow of 78.2 m^3/h the pipe's inside diameter needs to be smaller than 0.166 m (6.55 in.) to have a bulk velocity that exceeds 1 m/s.

High yield stress pastes in laminar flow tend to have a relatively flat pressure gradient curve (except at very low flow rates); the pressure loss only weakly increases as the flow rate increases. For initial sizing it is adequate to assume:

$$\frac{P}{L} \approx \frac{5\,\tau_y}{D}$$

Where *P/L* is the pressure loss gradient (Pa/m). For 300 Pa paste to have a pressure gradient over 2000 Pa/m the inside diameter of the pipe could be as large as 0.75 m (30 in). The paste pipe sizing will be velocity limited and the pipe will have a nominal size of either NB200 or NB150 (8” or 6”).

7.0 PRESSURE-BASED SIZING

A fundamental property of paste is that its rheology (particularly the yield stress) is strongly affected by changes in the water content. Adding a small amount of water will result in a small increase in the paste volume but a large drop in the pipeline pressure gradient. This property is used in gravity paste back-fill systems to allow the flow rate and pressure profile to be controlled from the surface (i.e. “rheology control”), even as the tailings properties and pipeline routing change over time. For a surface paste pipeline this same property can be used to set the system pressure based on the pump’s capability and the strength of the pipeline.

A pumping system is made of a number of separate pieces of equipment: pump, pipe, flanges, valves, instruments, etc. Each piece of equipment has a certain pressure rating, and for some pieces the steps between pressure ratings are quite large. For example, ANSI B16.5 flanges in the pressure range of interest are available as PN100 (600#), PN150 (900#), and PN250 (1500#) that have nominal pressure ratings of 100, 150, and 250 bar respectively. The mass of a set of 8 in. welding neck flanges at these pressure classes are 124 kg, 201 kg, and 303 kg respectively, and the costs rise proportionately. High pressure slurry valves and some instruments have the same pressure class steps.

Standard pipe also has pressure class steps related to the schedule, although the pressure depends on the pipe size and material. For grade B carbon steel (13.8 bar allowable stress) with a 12.5% thickness allowance, the nominal pressure ratings for 8 in pipe are: Sch. 60 = 113 bar; Sch. 100 = 166 bar; Sch. 160 = 253 bar. The mass of these pipes are 53, 76, and 111 kg/m respectively, and the costs rise proportionately.

Based on these pressure rating steps the logical piping system ratings are: PN100, PN150 bar, or PN250. Table 2 summarizes the pressure-based design for the three route options assuming either 8” or 6” paste pipelines. The HDPE liner used to protect the carbon steel has a minimum thickness of 9.5 mm (0.375 in.), but is made thicker if required to meet the velocity requirements. The piping system rating selected is the lowest that would make the operating pressure less than the system pressure. The exception to this is Opt 2: 6” which was set at PN150 to match an assumed UTF pump rating (it could be a PN100 system). For preliminary design it is assumed that the pipe rating is the same for the entire length of the route.

Table 2: Preliminary Design of Paste Pipeline Options

	Units	Opt 1: 8"	Opt 1: 6"	Opt 2: 8"	Opt 2: 6"	Opt 3: 8"	Opt 3: 6"	Comments:
Pipe length	m	1800	1800	600	600	1300	1300	Fig. 2, 3, & 4
Fitting equivalent length	m	200	200	150	150	175	175	Estimated
Total equivalent length	m	2000	2000	750	750	1475	1475	
Elevation change	m	17	17	17	17	17	17	Final berm height
Paste flow rate, design	m3/h	78.2	78.2	78.2	78.2	78.2	78.2	
Paste yield stress, design	Pa	300	300	300	300	300	300	
Paste specific gravity	t/m3	2.19	2.19	2.19	2.19	2.19	2.19	
Steel pipe OD	in	8.625	6.625	8.625	6.625	8.625	6.625	
Steel pipe schedule		160	XXS	60	80	100	160	
Steel pipe wall thickness	in	0.906	0.864	0.406	0.432	0.594	0.719	
HDPE liner thickness	in	0.375	0.375	0.625	0.375	0.375	0.375	3/8" min
Pipeline ID	in	6.063	4.147	6.563	5.011	6.687	4.437	
Pipeline ID	m	0.1540	0.1053	0.1667	0.1273	0.1698	0.1127	
Bulk velocity, design flow	m/s	1.17	2.49	1.00	1.71	0.96	2.18	>1 m/s
Pressure loss gradient	Pa/m	9740	14240	8998	11785	8831	13310	>2000 Pa/m
Pump operating pressure	Bar	198.5	288.5	71.1	92.0	133.9	200.0	
Steel pipe pressure rating	Bar	253.6	314.8	113.6	157.4	166.2	262.0	20 ksi steel
Piping system rating		**PN250**	**N/A**	**PN100**	**PN150**	**PN150**	**PN250**	Flange/valve class
Pumping power	kW	**479**	**696**	**172**	**222**	**323**	**483**	90% eff
Paste yield stress, max.	Pa	**379**	**259**	**428**	**496**	**337**	**376**	at pressure limit
Pump operating pressure	Bar	249.8	249.5	99.9	149.8	150.0	249.7	< nominal PN
Casing length	m	1000	1000	590	590	590	590	Off-berm only
Casing pipe OD	in	16.000	12.750	16.000	12.750	16.000	12.750	
Casing thickness	in	0.844	0.843	0.375	0.406	0.500	0.688	>50% pipe syst rating
Casing pressure rating	Bar	127.3	159.6	56.6	76.9	75.4	130.3	20 ksi steel
Steel, main pipe	t	240	176	36	29	114	106	allows 5% for flanges
Steel, casing	t	231	184	61	52	81	88	allows 5% for spacers
Steel, total	t	**471**	**360**	**96**	**82**	**195**	**194**	
HDPE liner, main pipe	t	**10.3**	**7.4**	**6.6**	**2.9**	**8.1**	**5.7**	

Based on this analysis, it is noted that:

- Using a 6 in. pipeline for the Option 1 route is not a viable option for 300 Pa paste unless PN420 (2500#) flanges and valves are used. To stay within the 250 bar limit, the yield stress would be limited to 259 Pa.
- The Option 2 (8 in. and 6 in.) systems can pump paste throughout the normal yield stress range (i.e. up to 400 Pa).
- The Option 3 (6 in.) system can pump paste throughout the normal yield stress range (i.e. up to 400 Pa). However, the Option 3 (8 in.) system will be limited to ~337 Pa unless the pressure class is raised to PN250.

Pump selection is not part of the current study, but it is noted that the double piston pumps often used for paste back-fill usually have a pressure limit of 130 to 150 bar, although at least one such pump is available that can handle 240 bar (i.e. Schwing KSP w/ rock valve).

8.0 COSTS

Basis of Estimate

Table 3 summarizes the unit costs used to develop the order of magnitude (OOM) capital cost/expense (CAPEX) estimate for the six pipelines considered (i.e. three routes and two pipe sizes). The costs do not include drainage sump(s) or heat tracing.

Table 3: Unit Costs for OOM CAPEX

	Units	Opt 1: 8"	Opt 1: 6"	Opt 2: 8"	Opt 2: 6"	Opt 3: 8"	Opt 3: 6"	Comments:
Steel	$/t	2000	2000	2000	2000	2000	2000	Coated
Installation, pipe & casing	$/in/m	25	25	25	25	25	25	
Liner	$/t	2500	2500	2500	2500	2500	2500	
Liner installation	$/in/m	10	10	10	10	10	10	
Insulation	$/in/m	12	12	12	12	12	12	Supply and install
RoW overland	$/m	25	25	200	200	200	200	
RoW berm	$/m	10	10	25	25	100	100	

The main difference between the options is the RoW costs for the various sections. For Option 1 “RoW overland” the haul road is widened and two containment berms are added either side of the pipe. For Option 1 “RoW berm” a single berm is installed behind the pipeline to prevent leakage flow eastwards across the crest. For Options 2 and 3 “RoW overland” a new road will be constructed (not as wide as the haul road) as well as the two containment berms. For Option 2 “RoW berm” a sloped ramp is built across the crest (to allow drainage to the spigot), as well as two containment berms to direct spills to the impoundment. Option 3 “RoW berm” is similar to Option 2, but the ramp is much higher at the upstream end, which increases the average cost per metre.

Capital Cost (CAPEX)

Table 4 summarizes the OOM costs of the six paste pipeline options.

Table 4: OOM CAPEX, Relative Costs of Options

	Units	Opt 1: 8"	Opt 1: 6"	Opt 2: 8"	Opt 2: 6"	Opt 3: 8"	Opt 3: 6"	Comments:
Pipe steel	US$M	0.481	0.352	0.072	0.059	0.228	0.212	
Pipe installation	US$M	0.388	0.298	0.129	0.099	0.280	0.215	
Liner HDPE	US$M	0.026	0.019	0.016	0.007	0.020	0.014	
Liner installation	US$M	0.123	0.088	0.047	0.035	0.097	0.067	
Casing steel	US$M	0.462	0.367	0.121	0.104	0.161	0.177	
Casing installation	US$M	0.400	0.319	0.236	0.188	0.236	0.188	
Insulation	US$M	0.275	0.217	0.114	0.091	0.187	0.147	
RoW	US$M	0.033	0.033	0.118	0.118	0.189	0.189	
Subtotal, direct costs	**US$M**	**2.187**	**1.693**	**0.854**	**0.702**	**1.398**	**1.209**	No pump station
Contingency (25%)	US$M	0.547	0.423	0.214	0.175	0.350	0.302	
Indirect costs	US$M	0.500	0.500	0.450	0.450	0.500	0.500	
Capital cost (CAPEX)	US$M	**3.234**	**2.616**	**1.518**	**1.327**	**2.248**	**2.012**	

Operating Cost (OPEX)

Table 5: OOM OPEX, Relative Costs of Options

	Units	Opt 1: 8"	Opt 1: 6"	Opt 2: 8"	Opt 2: 6"	Opt 3: 8"	Opt 3: 6"	Comments:
Pumping power	US$M/yr	0.108	0.157	0.039	0.050	0.073	0.109	$50/MW-h, 4500 hr/yr
Pipeline and RoW maint.	US$M/yr	0.044	0.034	0.017	0.014	0.028	0.024	2% of direct cost
Pipeline monitoring	US$M/yr	0.030	0.030	0.015	0.015	0.020	0.020	
Flushing and drainage	US$M/yr	0.030	0.030	0.015	0.015	0.015	0.015	
Subtotal, operating costs	**US$M/yr**	**0.212**	**0.251**	**0.086**	**0.094**	**0.136**	**0.168**	
Contingency (25%)	US$M/yr	0.053	0.063	0.021	0.024	0.034	0.042	
Operating cost (OPEX)	**US$M/yr**	**0.264**	**0.313**	**0.107**	**0.118**	**0.170**	**0.210**	

"Pipeline monitoring" involves driving the length of the pipeline and doing a visual inspection. This is done at the start of each paste pour and at least once a day while the paste pipeline is operating. Monitoring is more frequent for Option 1 off-berm pipe because it is longer and the route is not as well contained.

"Flushing and drainage" occurs at the end of each paste pouring cycle (i.e. 50 times per year) when the line is cleaned. It mainly involves operating the drain valves and emptying the sump(s). Option 1 will have at least two sumps, while Options 2 and 3 only have one sump (at the Plant).

9.0 RECOMMENDATIONS AND CONCLUSIONS

If only the paste pumping system (i.e. the pump and the pipeline) is considered, then one of the Option 2 pipelines is clearly the best choice: the least expensive, the lowest operating pressure, the lowest power usage, and the most pumping options. Either pipe size would be acceptable; the choice would depend on the UTF system design.

However, the paste transfer pipeline is not an isolated entity; it is part of the overall tailings system. There would be significant ramifications to moving the waste rock disposal area and water reclaim system to the south end of the impoundment. The advantages of the shorter paste pipeline would be partially offset by the longer return water pipeline. The round trip for trucks hauling waste rock would increase from 2.4 km to ~4 km, increasing haulage costs (time and fuel) and possibly requiring an additional truck. The haul road would need to be extended to the south end of the CTF, either along or beside the east berm. These items would off-set much of the savings obtained by the shorter paste pipeline route.

Option 1 has the highest CAPEX and OPEX, the highest operating pressures, a profile that makes drainage more difficult, and much of its off-berm route does not have natural leakage containment. This option is not recommended.

The Option 3 route is recommended as the "go forward" option. The preferred pipe size is 8 in. because the operating pressure allows a PN150 system, which will give more pump selection options.

The main concern with the Opt 3:8" system is its inability to handle 400 Pa paste. This will be a concern if the UTF pipeline system is designed to handle paste at the high end of the typical yield stress range. Failure to adjust the yield stress when switching from the UTF to the CTF could plug the surface pipeline. This cannot be addressed further until Paste Plant design and design rheology for the

UTF paste is available. There will be opportunities in the detailed design phase to drop the operating pressure (e.g. thinner wall pipe on the berm, moving the spigot to the south west corner of the CTF, minor route modifications, etc.) which will increase the maximum paste yield stress the system can handle, if necessary.

DJH/djh

APPENDIX I

TOMS MANUAL

(Pages I-1 to I-88)

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT



TAILINGS OPERATIONS, MAINTENANCE AND SURVEILLANCE (TOMS) MANUAL

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VA101-460/3-4
Rev 0
July 7, 2017

Knight Piésold
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TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

TAILINGS OPERATIONS, MAINTENANCE AND SURVEILLANCE (TOMS) MANUAL
VA101-460/3-4

Rev	Description	Date
0	Issued in Final	July 7, 2017

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ABBREVIATIONS

ARM....Administrative Rules of Montana
ARD.... acid rock drainage
BBCP / the Project.... Black Butte Copper Project
CTF.... Cemented Tailings Facility
EDGM....earthquake design ground motion
FEMA....Federal Emergency Management Agency
FMEA....Failure Mode Effects Assessment
HDPE....High Density Polyethylene
PWP....Process Water Pond
FOS.... Factor of Safety
ICOLD.... International Commission on Large Dams
MCA 82-4-3.... Montana Code Annotated, Title 82, Chapter 4, Part 3
MCE.... Maximum Credible Earthquake
MDE.... Maximum Design Earthquake
MDEQ.... Montana Department of Environmental Quality
MOP....Mine Operating Permit
Mt....million tonnes
NCWR.... Non-Contact Water Reservoir
PMP....Probable Maximum Precipitation
PMF....Probable Maximum Flood
PWP....Process Water Pond
TOMS....Tailings Operation, Maintenance, and Surveillance
tpd....tonnes per day
TRI....Tintina Resources Inc.
WTP....Water Treatment Plant

1 – INTRODUCTION

1.1 SCOPE OF MANUAL

The Black Butte Copper Project (BBCP/Project) is an underground copper mine proposed for development by Tintina Resources Inc. (TRI). The mine's primary surface facilities include the mill, Cemented Tailings Facility (CTF), Process Water Pond (PWP), and Non-Contact Water Reservoir (NCWR). The CTF is designed to store all tailings and waste rock with a minimal pond volume throughout the life of mine. All process water for mill use and recycle will be stored in the PWP. The NCWR will store excess water collected during the spring freshet, to be released throughout the dry season to offset mine site consumptive use.

This Tailings Operations, Maintenance and Surveillance (TOMS) Manual has been prepared and should be referenced for operations and monitoring activities for the CTF, related facilities including the PWP and NCWR, and ancillary facilities and structures. The TOMS Manual has been developed to comply with Montana State law, as described in Montana Code Annotated (MCA) Tile 82 Chapter 4 Part 3 Section 79 (82-4-379).

The principal objectives of the TOMS Manual are the following:

- To describe the roles and responsibilities of TRI site personnel, third party consultants, and regulators for the management of the facilities
- To identify the operation, maintenance, surveillance, and inspection requirements
- To define training requirements for those involved in the operation of the facilities, and
- To provide details on the emergency processes, plans and procedures.

It is important to note that the Project is currently in the design and permitting phase, and is not yet in operation. Therefore, facilities, structures, equipment, site personnel, and procedures outlined in the document should not be considered finalized, and they will be updated as development of the mine progresses.

1.2 MANUAL STRUCTURE

The TOMS Manual presents the required information in the following nine sections:

Section 1.0 - Introduction

Section 2.0 - Roles and Responsibilities

Section 3.0 - TOMS Manual Distribution and Updates

Section 4.0 - Description of Facilities

Section 5.0 - Operations, Maintenance and Surveillance

Section 6.0 - Safety Inspections, Reporting and Reviews

Section 7.0 - Emergency Preparedness and Response Plans

Section 8.0 - References

Section 9.0 - Certification

2 – ROLES AND RESPONSIBILITIES

This section provides a guideline to the roles and responsibilities of TRI site personnel, third party consultants, and the Montana Department of Environmental Quality (MDEQ), as well as other relevant regulatory agencies.

2.1 TRI SITE PERSONNEL

Key roles and responsibilities for TRI site personnel are listed in Table 2.1. This is a conceptual staff list as the BBCP is still in the design and permitting phase. However, appropriate personnel will be hired by TRI to complete and comply with their responsibilities. The Vice President of Operations has the ultimate responsibility for BBCP's operations.

Table 2.1 Roles and Responsibilities

Position	Responsibilities
Vice President of Operations	• Provide oversight and leadership for activities required for the safe operation of the mine site. • Ensure operations protocols comply with state law and current health and safety standards. • Overall project review and implementation, and budget allocation.
Corporate Environmental Manager and Manager of Environmental Affairs	• Provide oversight and leadership for activities for environmentally responsible operation of the mine site. • Communications with government agencies and stakeholders. • Plan, coordinate, supervise, direct and review all activities related to environmental functions (leak detection, water quality, and impoundment water balance), land reclamation, and tailings management at the mine. This includes areas of environmental compliance, permitting, reclamation and closure, sustainability, solid/hazardous waste management, storm water, air quality, potable water, environmental reporting. • Implementation of Emergency Action Plan. • Ensure TRI complies with all applicable environmental laws and rules. • Gain familiarity with the TOMS Manual, and update and distribute the current version when necessary.
Dam Safety Manager	• Responsible for the safe operations of the CTF, PWP and NCWR, including overall operations, maintenance, and surveillance. • Plan, coordinate, supervise, and review all activities relating to the CTF, PWP and NCWR construction, operation and emergency preparedness and response plan.
Mine Superintendent	• Responsible for the day-to-day operations of the CTF and PWP, and must frequently report to the Dam Safety Manager. • Conduct frequent routine inspections of the CTF and PWP. • Responsible for inspection, maintenance, review and oversight of the CTF and PWP operations, which include tailings management, tailings delivery system, water reclaim system, and CTF basin drain.

	• Maintain CTF and PWP water balance. • Responsible for sufficiently task training all CTF and CTF related personnel.
Environmental Co-ordinator(s)	• Routine dam safety inspections for the CTF, PWP and NCWR. • Maintaining necessary water levels for the NCWR, and the required discharge out of the NCWR. • Maintaining environmental systems, wildlife protection and annual permit reporting. • Monitoring and sampling of groundwater monitoring wells. • Organizing and reporting on all reclamation activities.
Manager of Engineering and Geology	• Geotechnical instrumentation monitoring, review and compilation (survey monuments, inclinometers, piezometers, etc.). • Surveying of CTF and PWP and data transmission to Manager of Environmental Affairs and Dam Safety Manager.
Health and Safety Supervisor	• Responsible for completing the emergency response planning, ensuring the emergency action plan is up to date and available at the site office, safety training and job hazard assessment. • Will act as, and/or train others to be, the Incident Commander in the event of a Level 3 Emergency Conditions.

2.2 REGULATORY AGENCIES

The jurisdiction for regulation of tailings storage facilities resides with MDEQ. MDEQ is responsible for ensuring that the applicable legislative requirements outlined in MCA 82-4-379, relating to this TOMS Manual, are met by TRI.

MSHA (Mine Safety and Health Administration) is responsible for administering the conditions of the Federal Mine Safety and Health Act of 1977 (Mine Act) and enforcing compliance with mandatory safety and health standards.

2.3 ENGINEER OF RECORD

The Engineer of Record (EOR) cannot be an employee of the operator or the permit holder and is responsible for the following:

- Review design and other documents pertaining to the CTF, PWP and NCWR
- Certify and seal designs or other documents pertaining to the CTF submitted to MDEQ
- Complete an annual inspection of the CTF and related facilities, review instrumentation records, and certify an updated TOMS manual which reflects current operation conditions
- Notify the operator when credible evidence indicates the CTF is not performing as intended, and
- Immediately notify the operator and MDEQ when credible evidence indicates that the CTF presents an imminent threat or has a high potential for imminent threat to human health or the environment.

The EOR is also responsible for providing construction oversight as specified in the Construction Management Plan. The current EOR is Ken Brouwer, P.E., of Knight Piésold Ltd.

2.4 INDEPENDENT REVIEW PANEL

An Independent Review Panel (IRP) consisting of three independent review engineers or scientists will be assigned to review the design and construction of the CTF. The IRP is responsible for reviewing the design document, underlying analysis, and assumptions and ensuring these are compliant with MCA 82-4-376. The IRP will assess the practicable application of current technology in the proposed design, submit review comments and indicate any recommended modifications. The members of the IRP are as follows:

- Mr. Peter Lighthall
- Mr. Jim Swaisgood, and
- Dr. Dirk Van Zyl.

The IRP is required to be reassembled at least every five years following MDEQ approval of the design document. The IRP will complete the following:

- Inspection of the CTF, PWP and NCWR
- Review of TOMS Manual and associated records
- Interview people with responsibilities identified in the TOMS Manual, and
- Review EOR inspection reports, corrective action plans, records associated with construction, and any other information relating to the CTF that the IRP needs to ensure that it is constructed, operated, and maintained as designed, can be closed as intended, and meets acceptable engineering standards.

2.5 COMPETENCY AND TRAINING

New personnel (full time or contract) that work within the mine property must comply with the training requirements of the Federal Mine Safety and Health Act of 1977. Personnel whose activities at the site exceed 40 consecutive hours must receive 24 hours of Part 48 New Miner Training. Personnel working at the site must attend a site-specific health and safety induction training session before commencing work.

Additional training for personnel involved in the operation, maintenance, inspection and surveillance of the CTF and associated facilities will be provided on an individual basis depending on the specific work the individual is required to perform. New personnel will be accompanied by a qualified TRI representative while working on site until they have proven a satisfactory level of work competence. Competence is assessed by the supervisor through visual observation of personnel behavior.

Appropriate site personnel are responsible for being continually aware of the condition of the CTF, PWP and NCWR. They must be able to reasonably recognize abnormal operating conditions at all related facilities. Anything observed outside the standard operating conditions, as outlined in this TOMS Manual, must be reported to a supervising manager.

Personnel in supervisory positions must fully understand and be able to implement the TOMS Manual requirements. They must also ensure that all applicable mine personnel and contractors understand the requirements presented in the TOMS Manual.

3 – TOMS MANUAL DISTRIBUTION AND UPDATES

3.1 TOMS MANUAL DISTRIBUTION LIST

One hard copy of the up-to-date TOMS Manual will be maintained in the offices of the following individuals:

- Vice President of Operations
- Manager of Environmental Affairs
- Manager of Engineering and Geology, and
- Engineer of Record (off-site).

3.2 TOMS MANUAL REVIEW REQUIREMENTS

Operating procedures, personnel, and enforced laws will likely change during operation of the mine. Changes (procedural and personnel) that affect the content of the TOMS Manual need to be updated. An update may comprise the entire TOMS Manual or may be limited to specific pages or sections.

The following procedures will be followed when updating the TOMS Manual:

- Each updated page must be clearly marked with the version number and date. The replaced pages must be filed and kept on record in the office of the Manager of Environmental Affairs.
- A letter of transmittal that clearly identifies the distribution list must accompany each update of the TOMS Manual. A copy of each transmittal letter must be kept in the Manager of Environmental Affairs office.
- All updates must be reviewed by the EOR. Approval of the TOMS Manual revisions will be certified by EOR seal on the letter of transmittal.
- The Manager of Environmental Affairs is responsible for ensuring that the TRI copies of the TOMS Manual (both electronic and hardcopies) are updated.
- The EOR is responsible for updating the EOR's hardcopy of the TOMS Manual.

3.3 REFERENCES AND SUPPORTING DOCUMENTS

References and other supporting documents specifically relevant to the operation of the CTF and this TOMS Manual include the following:

- Waste and Water Management Design for MOP Application.

All reference material relating to the CTF (to date) are listed in Table 3.1. Limited documents are available at this time as the Project is currently in the design and permitting phase.

Table 3.1 Design Reference Documents

Date Issued	Report	Consultant
October 15, 2015	Waste and Water Management Design for MOP Application	Knight Piésold Ltd.
December 3, 2015	Waste and Water Management Feasibility Design	Knight Piésold Ltd.
April 27, 2016	2015 Geotechnical Site Investigation Report	Knight Piésold Ltd.

3.4 REGULATORY DOCUMENTS AND REQUIREMENTS

Montana adopted new regulations into State law in 2015 for the operation, design and expansion of tailings storage facilities, as per Montana Code Annotated (MCA) 82-4-3, Metal Mine Reclamation.

Historically, engineering design, scheduling and management of tailings facilities have been developed and managed in-house by mine operator's engineering staff. MCA 82-4-3, as of 2015, requires the mine operator to designate an EOR for the facility. The responsibilities of the EOR are described in Section 2.3.

4 – OVERVIEW OF WASTE AND WATER MANAGEMENT FACILITIES

4.1 GENERAL

The design basis and specific information on the waste and water management facilities are presented in this section. This information provides background and context for the operating, maintenance, and surveillance protocols that are required during construction, operation, and closure of the Project. The Project is still in the design and permitting phase, and therefore the start date for construction and operations has not yet been confirmed.

Details of the design basis for the waste and water management facilities are presented in Appendix A. A general arrangement of the site is presented in Drawing C1001. This drawing, and all other design drawings referenced in this section, are presented in Appendix B.

4.1.1 Project Location

The Project is located 17 miles north of White Sulphur Springs in Meagher County, Montana. The site is situated 2 miles west of U.S. Highway 89 and 19 miles downstream of the Smith River and Sheep Creek confluence. The surface facilities for the Project will be located in a saddle on Sawmill Hill, with CTF being situated 1 mile from Sheep Creek. The site is accessible by maintained gravel and forest service roads.

4.2 CEMENTED TAILINGS FACILITY

The CTF is designed to store 55% of all tailings generated in the mill over the 15 year mine life and 100% of waste rock brought to surface. The remainder of the tailings will be used for underground mine backfill. The design used the October 2015 production schedule as the design basis.

The CTF has a storage capacity of 4.3 Mm^3, which include 3.6 Mm^3 of cemented tailings (7.12 Mt at a settled density of 2 t/m^3), 0.4 Mm^3 of waste rock (0.7 Mt at a density of 2.0 t/m^3), with additional capacity for temporary storage of direct precipitation of storm water up to and including the Probable Maximum Flood (PMF) event of 0.3 Mm^3. The tailings volume accounts for the removal of concentrate from the ore.

4.2.1 Embankment Staging

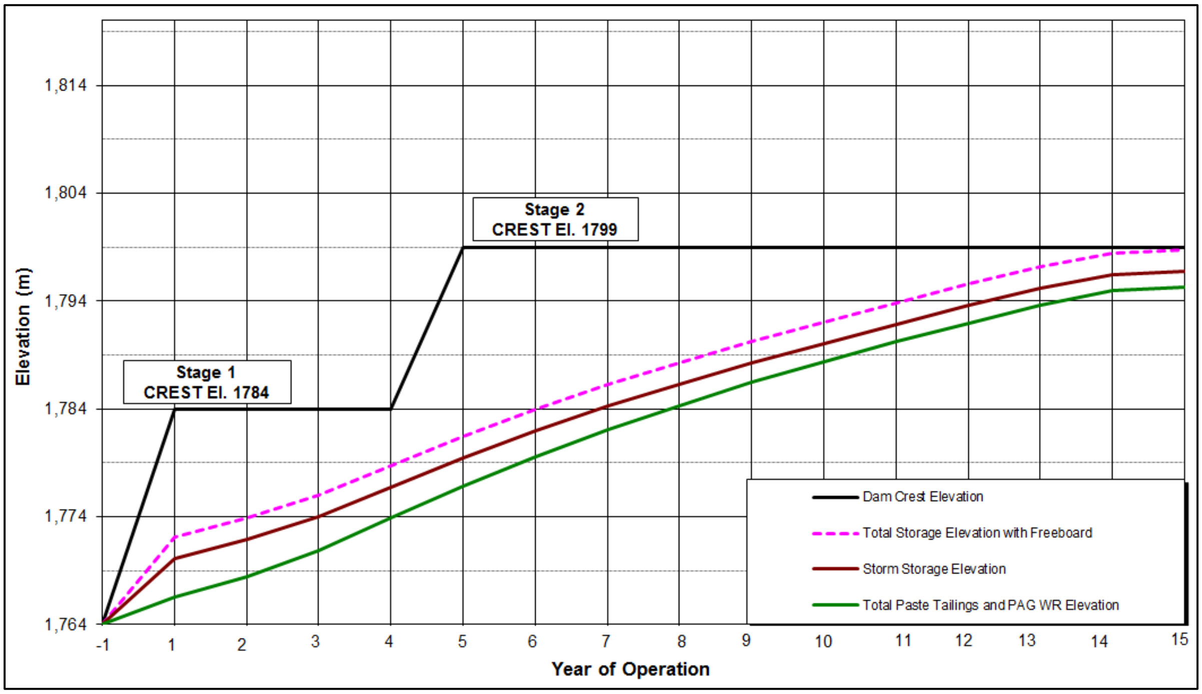
The CTF will be developed in two stages throughout the life of the mine. This offers the following advantages:

- 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 practice (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 a higher level of safety and potential cost savings. It also enhances knowledge and understanding of site-specific conditions.
- The ability to reduce initial capital costs and defer some capital expenditures until the mine is operating.

Stage 1 will be constructed with the liner system installed to El. 1,784 m prior to commencement of milling operations. The Stage 1 CTF will provide storage for 5 years of surface tailings deposition and waste rock placement. It is anticipated that a surplus of fill material will be available at the completion of the Stage 1 construction phase. This excess material will be placed and compacted on the CTF embankment in preparation for the Stage 2 construction to El. 1,799 m. Additional surplus material will be stockpiled for use in closure of the CTF. Construction of Stage 2 will occur during years 4 to 5. All remaining stripping and grubbing, excavation, and fill placement will occur during this time, as well as the installation of the liner system to the ultimate crest elevation of El. 1,799 m.

The preliminary filling schedule and embankment stages are shown on Figure 4.1. 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, and
- Tailings surface slopes.



NOTES:

1. Filling schedule based on preliminary production schedule from Tetra Tech (Oct. 2015) and includes storage of 55% total tailings and 0.7 Mt of waste rock.
2. Storm storage volume is estimated on the basis of containing the PMF event.
3. A minimum freeboard of 2 m will be maintained.

Figure 4.1 CTF Filling Schedule

4.2.2 Lining System and Seepage Control

The CTF incorporates a double liner system that consists of a layer of 7.6 mm high-flow geonet between two layers of 100 mil HDPE geomembrane. The liner system is placed on the upstream embankment face and full CTF basin with an underlying prepared subgrade comprising processed material obtained from impoundment shaping.

The seepage control measures incorporated into the CTF are as follows:

- Two layers of 100 mil HDPE geomembrane with a layer of high-flow geonet. The geomembrane is effectively impermeable, with seepage only possible through defects that may occur during fabrication and/or installation. Any seepage through the upper geomembrane will be collected and transferred to a seepage collection sump and pump system at the north end of the facility.
- The cemented tailings are low permeability with a hydraulic conductivity in the order of $8x10^{-8}$ m/sec. The tailings are highly thickened prior to deposition, and most of the remaining interstitial water will remain trapped in the tailings, with limited bleed water.
- A basin drain will be constructed above the geomembrane to maintain low head on the geomembrane, thereby minimizing the potential for seepage.
- Minimal water will collect in the facility. Runoff, precipitation and limited bleed water from the tailings will be directed to a water reclaim system within the impoundment. Water from the reclaim system will be pumped to the PWP for storage and mill use.
- A foundation drain system will be constructed to collect groundwater and potential seepage beneath the geomembrane. The foundation drain will discharge into the foundation drain collection pond and water will be pumped into the CTF and then to the PWP through the water reclaim system.

4.2.3 Basin drain

A basin Drain will be installed on the CTF basin floor (above the geomembrane) using processed material generated from the mine and surface construction during the pre-production phase. It will be connected to the wet well sump and pump system located in the CTF. The basin drain system will collect tailings bleed water and any water that percolates through the tailings mass and convey it to the water reclaim system to be pumped to the PWP. This will facilitate a low phreatic level within the tailings mass and will reduce the head on the geomembrane, which is an effective measure to minimize potential seepage.

The basin drain will be constructed using processed waste rock, which will be crushed to meet the material specifications necessary to prevent damage to the geomembrane and promote free drainage. The CTF basin floor will be graded at a minimum of 0.5% towards the wet well sump. The processed waste rock will be placed over the HDPE geomembrane across the entire basin floor to create a full drain.

4.2.4 Foundation Drains

The CTF foundation drains are designed to collect groundwater flows and seepage below the CTF geomembrane, and to convey all collected flows to a foundation drain collection pond downstream of the CTF.

The CTF foundation drain has the following components:

- Drains on the CTF cut slopes
- Drains on the CTF basin floor
- Drains beneath CTF embankments (areas of fill), and
- Outlet drain.

The foundation drains comprise an interconnected grid of pipes with various diameters and surrounding drainage gravel to manage groundwater flows. The foundation drains flow to the foundation drain collection pond located at the downstream toe of the CTF embankment. Collected water will be pumped into to the CTF and subsequently transferred to the PWP through the reclaim water system. The collection pond will be a 100 mil HDPE geomembrane lined pond with a submersible turbine pump. An HDPE pipeline will convey the flows from the pond to the CTF.

Details of the CTF foundation drains e shown on Drawings C2004 and C2006. Details of the foundation drain collection pond are shown on C6330. Details of the foundation drain collection pond pump are shown on Drawings C6300, C6310, and C6330.

4.2.5 Embankment Cross Section

The CTF has a single embankment to close off the east end of the impoundment, allowing for natural topographic containment to the west. The CTF will be constructed using a cut-fill balance, where excavated materials from impoundment shaping will provide the required storage capacity and fill material for the confining embankment.

The embankment is a homogeneous rockfill embankment. The internal (upstream) slope of the embankment is 2.5H:1V to facilitate geomembrane placement. The external (downstream) slope is also 2.5H:1V to facilitate concurrent reclamation of the embankment during operations. The embankment crest width will be 10 m to allow working space for tailings and reclaim water pipelines and traffic. The maximum embankment height is approximately 46 m on the downstream side and 35 m on the upstream side.

The majority of embankment fill will be general fill sourced from excavation as part of the CTF impoundment shaping. The material is expected to consist of fresh to moderately weathered rock fill. Organics and loamy overburden material will be removed and stockpiled.

The geomembrane will be placed on subgrade bedding material that will provide a protective layer between the geomembrane and natural ground or embankment fill materials. The subgrade bedding material will be primarily sourced from weathered bedrock and select fresh rock that meets the required material specifications. General rock fill will be processed as required to meet the material specifications. Non-woven geotextile fabric will be placed between the geomembrane and subgrade bedding.

The CTF plan is shown on Drawing C2001. The CTF sections and details are shown on Drawing C2003.

4.2.6 Embankment Freeboard

Tailings will be deposited strategically from the embankment and southern basin perimeter. The CTF will be maintained with a minimal volume of stored water, and the tailings surface will be developed to direct surface water towards the wet well sump and pump system.

Under these conditions, sufficient storage capacity will be available to contain all surface tailings, waste rock, runoff, and precipitation (up to and including the PMF storm event) while maintaining a minimum freeboard of 2 m. Construction will be staged such that the minimum freeboard requirement is maintained, even during the design storm event.

4.2.7 Seepage Collection Sump

A seepage collection system is provided to collect potential seepage through the upper HDPE geomembrane and direct it through the geonet, via gravity, to a sump and pump system at a low point in the CTF basin. Water collected in the sump will be pumped through a riser pipe to the embankment crest and returned to the CTF, and subsequently the PWP through the reclaim water system.

The seepage collection system includes a sump filled with drainage gravel that is deep enough to allow operation of a submersible pump that can be raised and lowered through a protective pipe. The bottom of the pipe will be perforated (in the sump) for pump operation. An additional drain pipe is included for redundancy. The pump will have a high/low water level primer to control pumping (switch on when the water level reaches a high water mark and switch off when the water level reaches the low water mark).

Potential seepage through the lower geomembrane will be intercepted by the CTF foundation drain, as discussed in Section 4.2.4.

Details of the seepage collection system are shown on Drawings C6200, C6210, C6220 and C6230.

4.2.8 Water Reclaim System

The water reclaim system serves two purposes:

- To allow the removal of water that may be released from the cemented tailings (minimal bleed water expected) and conveyed to the reclaim system by the basin drain system.
- To allow the collection and removal of precipitation and runoff (surface water) in the CTF.

All collected water will be pumped to the PWP.

The water reclaim system consists of a wet well sump that extends to surface. The CTF basin drain system will be integrated with the reclaim sump to promote flow to the sump.

The sump comprises a lined depression filled with drainage gravel in the low point of the CTF. The sump will be deep enough to allow the operation of a submersible pump that can be raised and lowered through a protective pipe. The drainage gravel will be covered with waste rock to facilitate water flow to the sump, and help prevent migration of tailings fines into the drainage gravel.

The bottom of the pipe will be perforated (in the sump) for pump operation. The pipe will extend in a channel on the embankment face to the embankment crest and will be surrounded by a layer of drainage gravel to allow water infiltration into the system. An additional drain pipe is included for redundancy. The drainage gravel will be surrounded by suitable fill material sourced from excavation of the impoundment. Subgrade bedding material will be placed to protect the geomembrane. The internal slope of the CTF is 3H:1V at the sump location to facilitate the placement of drainage gravel and subgrade bedding materials.

The drainage gravel used to construct the wet well sump will be free draining, durable crushed rock which will be sourced from either select fill excavated during impoundment shaping, waste rock from mine pre-production, or quarried from local sources as needed.

The wet well pump will have a high/low water level primer to switch on when the water level in the sump reaches the high water level mark, and switch off when the water level reaches the low water level mark. The system has been designed to pump out a 1 in 100 year 24-hr rainfall event over a period of 10 days (approximately 20 L/s) through a HDPE pipeline to the southeast corner of the PWP (a pipeline length of approximately 730 m).

Details of the CTF reclaim system are shown on Drawings C6200, C6210, C6220 and C6230.

4.2.9 Tailings Delivery and Deposition

Tailings will be delivered from the mill to the south end of the CTF via an 8-inch PN150 steel pipeline. The pipeline will run along the west crest of the impoundment and discharge tailings at the southernmost point of the CTF. The pipeline will be double-walled between the mill site and the CTF to capture and contain tailings in the event of the pipeline leak. Double walled pipe will not be required on the CTF crest as tailings will flow into the CTF in the event of a leak.

Operations will occur in freezing temperatures for a significant portion of each year and there is a risk of a freezing and subsequent rupture of the pipeline. Therefore the pipeline will be insulated to protect against freezing. Additionally, the pipeline will be flushed with water and drained when not in use so that no standing water or tailings is left in the pipeline.

The tailings delivery system is shown on Drawing C6100.

4.2.10 Waste Rock Co-disposal

Approximately 500,000 t of waste rock will be generated during the first two years of operations (pre-production and ramp up), and a total of 700,000 t of waste rock will be generated over the life of the mine. The waste rock has potential for acid generation and metal leaching, and will be co-disposed with the tailings in the CTF during mining operations.

4.2.10.1 Pre-Production Waste Rock Management

Approximately 500,000 t of waste rock will be generated during the pre-production period. This waste rock will be temporarily stockpiled on an HDPE lined pad, located northwest of the mine portal pad, and will be transferred into the CTF once installation of the geomembrane across the basin floor has been completed. A portion of the waste rock will be crushed and spread over the entire basin floor to create the basin drain system prior to beginning tailings deposition, as described in Section 4.2.3. Additional waste rock will be placed on the basin drain system, as needed.

4.2.10.2 Waste Rock Co-Disposal During Operations

Waste rock will be delivered to and stored in the CTF during operations and integrated with the basin drain and water reclaim system. Waste rock generated throughout the life of the mine will be placed in the CTF around the water reclaim system, which will promote drainage into the reclaim sump. A ramp will be constructed into the basin of the CTF so that waste rock can be hauled into the impoundment by haul trucks and spread with a dozer.

Waste rock will be intermittently generated throughout the life of the mine, with an additional 200,000 t (approximately) produced during mining operations. The haul ramp into the CTF basin will be maintained to facilitate waste rock placement throughout the life of the mine. The waste rock will extend up the slopes of the CTF basin. Subgrade material made from processed waste rock will be placed on the geomembrane prior to waste rock deposition to protect the liner system. The exposed waste rock pile will be built at a 2H:1V slope. The waste rock placement will be staged such that the working surface and water reclaim system will not become inundated by tailings deposition.

The design of the waste rock co-disposal system is illustrated in Drawing C2008.

4.2.11 Diversion Channel

The CTF diversion channel is designed to carry the predicted peak flow generated during a PMF event. The channel will be constructed with side slopes of 2H:1V. Excavated fill material will be placed alongside the channel as berms, or used as construction material along the fill sections of the diversion channel. It is currently assumed that the channel will be predominantly cut in rock and will need little erosion protection. Where erosion protection is required, (e.g. sections of deep overburden or filled downslopes) engineered soil stabilization (e.g. concrete filled or vegetated geocell products) or riprap will be used to prevent erosion of the channel bed during high flows. The base width of the various channel sections ranges from 1.0 m to 2.5 m, while the channel depth ranges from 1.2 m to 2.5 m. The channels were designed to maintain a 0.3 m freeboard during the storm event.

Steel pipe bridges will be constructed to allow tailings delivery and reclaim water pipelines to pass over the diversion channel.

An energy dissipation structure is included to reduce the runoff velocities and energy at the outlet of the diversion channel. A spreading transition still basin was chosen as the design concept for the energy dissipater, which includes the following components:

- Spreading transition
- Chute blocks at the entrance to the stilling basin
- Basin blocks, and
- End sill.

Construction details are illustrated on Drawings C5001 to C5004.

4.3 PROCESS WATER POND

The PWP is a double-lined facility that stores all contact water from the PWP and CTF, including contact water from precipitation and run-off, and water from the foundation drain collection pond. The PWP has a capacity of 420,000 m^3 to provide storage for mill water recycle and storm storage. The PWP is designed with an operational capacity of 120,000 m^3 to 200,000 m^3, which maintains sufficient volume of water to offset evaporation while providing a minimum of 4 months process water supply. Under average climatic conditions the PWP will have up to 80,000 m^3 of capacity to allow for temporary water storage caused by variances in operations. The operational volumes have been optimized such that wetter than average year conditions would not encroach on the storm storage above 200,000 m^3. The additional 220,000 m^3 of capacity allows for storage of water from storm events.

The PWP is designed to store storm water transferred from the CTF. The design provides for storage of up to the 1 in 500 year storm event. A wet well sump and pump system within the CTF will be used to transfer water to the PWP. The PWP does not have capacity to store the PMF event volumes for both the CTF and PWP. Therefore, the CTF will have capacity to store runoff and direct precipitation from the PMF event until there is capacity to pump the water from the CTF to the PWP.

4.3.1 Liner and Seepage Collection and Reclaim System

The PWP is a double-lined impoundment that has two layers of 100 mil HDPE geomembrane with a 7.6 mm high flow geonet layer sandwiched between the geomembrane layers. The geonet will act as a conduit for potential leakage through the upper geomembrane. Any seepage into the geonet will be directed via gravity to a sump and pump reclaim system at a low point in the PWP basin. Water collected in the sump will be pumped through a riser pipe to the embankment crest, and back into the PWP. An underlying subgrade bedding layer will be installed to protect the lining system.

The seepage reclaim system includes a sump filled with drainage gravel that is deep enough to allow operation of a submersible pump that can be raised and lowered through a protective pipe. The bottom of the pipe will be perforated (in the sump) for pump operation. An additional drain pipe is included for redundancy. The pump will have a high/low water level primer to control pumping (switch on when the water level reaches a high water mark and switch off when the water level reaches the low water mark).

Potential seepage through the lower geomembrane will be intercepted by the PWP foundation drain system, as discussed in Section 4.3.2.

Details of the PWP liner system are shown on Drawing C3003. Details of the seepage collection system are shown on Drawings C6500, C6510, and C6520.

4.3.2 Foundation Drains

The PWP foundation drains will collect groundwater flows below the PWP geomembrane, and to convey all collected flows to a foundation drain collection pond downstream of the PWP.

The PWP foundation drain system has the following components:

- Drains on the PWP cut slopes, installed beneath the geomembrane
- Drains on the PWP basin floor, installed beneath the geomembrane
- Drains beneath PWP embankments, and
- Outlet drain.

The foundation drain system comprises an interconnected grid of pipes with various diameters and surrounding drainage gravel to manage groundwater flows.

The foundation drains flow to a foundation drain collection pond located downstream (north) of the PWP embankment. Collected water will be pumped back to the PWP. The collection pond will be a 100 mil HDPE geomembrane lined pond with a submersible turbine pump. An HDPE pipeline will convey the flows back to the PWP.

Details of the PWP foundation drain system are shown on Drawings C3004 and C3008. Details of the PWP foundation drain collection pond are shown on Drawing C6330. Details of the collection pond pump system are shown on Drawings C6300, C6310, C6320 and C6330.

4.3.3 Embankment Cross Section

The PWP will be constructed prior to the start of mining operations. The embankment is a homogeneous rockfill embankment. The internal (upstream) slope of the impoundment is 2.5H:1V to facilitate geomembrane placement. The external slope (downstream) is also 2.5H:1V to facilitate reclamation of the downstream slopes, which can be completed during the early operations period.

The crest width will be 10 m to allow working space for pipelines and traffic. The maximum embankment height is approx. 23 m.

The majority of embankment fill will be general fill sourced from excavation as part of the cut-fill balance for the PWP impoundment shaping. The material will consist of fresh to moderately weathered rock fill. All organics and loamy material will be removed and stockpiled.

The geomembrane will be placed on prepared subgrade bedding material that will provide a protective layer between the geomembrane and natural ground or other fill materials. The fill will be primarily sourced from weathered bedrock and select fresh rock that meets the required material specifications. General rock fill will be processed as required to meet the material specifications. Non-woven geotextile fabric will be placed between the geomembrane and subgrade bedding.

The PWP plan is shown on Drawing C3001. Sections and details are shown on Drawing C3003.

4.3.4 Embankment Freeboard

The PWP has been designed to maintain a minimum of 2 m of freeboard at all times. This is in addition to sufficient capacity to contain the required amount of process water, run-off, precipitation, and the design storm event (PMF) reporting directly to the PWP. Additionally, run-off and precipitation reporting to the CTF for storm events up to and including the 1 in 500 year 24 hour storm event will be pumped into the PWP for storage and recycle.

4.3.5 Water Reclaim System

The PWP supplies mine process water to the reclaim tank located at the mill. The reclaim system has been sized to pass through the annual requirement of 4 Mm^3 of process water during full production.

The intake for the reclaim system includes a 30 HP centrifugal pump located on a pad on the crest of the PWP embankment, at the northeast corner. A stand-by pump will be provided as back-up. The pump intake line will be installed down the side of the pond.

A double-walled 18-inch DR21 HDPE pipeline conveys the flows from the PWP to the reclaim tank. The pipeline alignment crosses the main haul road to the mill site perimeter road, and will be anchored with earthen berms as required. The pipeline will discharge into the top of the reclaim tank at the mill site.

Plans and details of the water reclaim pump system and pipeline alignment are shown on Drawings C6250, C6260 and C6270.

4.3.6 Diversion Channel

The PWP diversion channel is designed to carry the predicted peak flow generated during a PMF event. The channel is designed to converge the CTF diversion channel, and the combined flows will be intercepted by the downstream energy dissipation structure.

The channel will be constructed with side slopes of 2H:1V. Excavated fill material will be placed alongside the channel as berms, or used as construction material along the fill sections of the diversion channel. It is currently assumed that the channel will be predominantly cut in rock and will need little erosion protection. Where erosion protection is required, (e.g. sections of deep overburden or filled downslopes) engineered soil stabilization (e.g. concrete filled or vegetated geocell products) or riprap will be used to prevent erosion of the channel bed during high flows. The base width of the various channel sections ranges from 1.0 m to 2.5 m, while the channel depth ranges from 1.2 m to 2.5 m. The channels were designed to maintain a 0.3 m freeboard during the storm event.

Construction details are illustrated on Drawings C5001 to C5004.

4.4 NON-CONTACT WATER RESERVOIR

4.4.1 General

The NCWR will be filled with approximately 360,000 m^3 of water from Sheep Creek during high flow periods (spring freshet) on an annual basis. This water will be discharged to the environment during periods of low flow to provide compensation for water consumed by the mine process. The water will be pumped from an intake on Sheep Creek and discharged from the NCWR impoundment to the downstream catchment as required. Existing surface flows will be diverted around the NCWR.

The intake structure includes a wet well system located adjacent to Sheep Creek outside of the designated wetland area, which is fed by a gravity pipeline from the creek. The concrete wet well structure is an alternative to installing a pump directly in the creek. The wet well will be less invasive, provide protection for mechanical components, and allow ease of access for operations and maintenance. A 90 HP vertical turbine pump will be lowered into the wet well during the spring freshet to pump the required volume of water.

A 10-inch DR17 HDPE pipeline will convey the flows from the intake structure to the NCWR. The pipeline alignment will follow existing roads and pathways, to simplify installation, and will be buried if necessary under or adjacent to public roads. The pipeline will be located on the side of the road which minimizes the number of road crossings, and anchored with earthen berms as required. The pipeline will discharge into the NCWR from the crest onto the geomembrane liner on the upstream embankment face. An additional layer of HDPE geomembrane (rub sheet) will be placed at the discharge point to protect the geomembrane.

4.4.2 Embankment Fill Zones

The NCWR embankment will be constructed with general fill material sourced from the impoundment shaping of the CTF. The embankment is a homogeneous rockfill embankment. Aside from topsoil removal within the embankment footprint, no impoundment shaping will be completed for the NCWR as the basin will remain an unlined facility. The upstream face of the embankment will be lined with a 100 mil HDPE geomembrane to reduce seepage. The upstream and downstream faces of the embankment have 2.5H:1V slopes to facilitate geomembrane placement and operational re-vegetation. The crest of the embankment will be 10 m wide to accommodate traffic and pipelines. The toe of the geomembrane will be tied into dense natural ground by an anchor trench.

4.4.3 Spillway Configuration

A spillway is included to prevent overtopping of the embankment and safely route the design storm event through the NCWR, and discharge it to the wetlands downstream (as it would were the NCWR not there). The spillway is sized for the 1 in 200 year 24 hour storm.

The spillway will be constructed on the south side of the facility in the natural topography of the abutment, as shown on Drawing C4004. The invert elevation will be 1,774.5 m, which is 2 m below the embankment crest elevation of 1,776.5 m. The maximum water level during the design storm event is 1,774.7 m, allowing 1.8 m of freeboard in the spillway. The outlet geometry is a trapezoidal weir with a base width of 1 m, maximum depth of 1.3 m, and side slopes of 2H:1V, as shown on Drawing C4005. The weir transitions into a trapezoidal channel with a base width of 1 m and depth of 1 m, which discharges into the natural channel downstream of the NCWR embankment. The spillway will be predominantly cut in rock and will be lined with riprap as required to prevent erosion of the channel bed during high flows.

4.4.4 Seepage and Discharge Management

Water will be pumped from the NCWR during periods of low precipitation, as required to offset a portion of the mine site consumptive water use. A pump will be located on a pad on the crest of the NCWR, adjacent to the spillway, which will draw water from the base of the reservoir and discharge into the spillway. Some seepage from the NCWR it anticipated, and will be monitored based on pond elevation. Pumping rates will be adjusted as needed to ensure that the required volume of water discharged from the NCWR on a seasonal and an annual basis.

The pump location and pipeline alignment are illustrated on Drawing C6430. Details of the NCWR discharge system are shown on Drawing C6440.

4.4.5 Runoff Diversion

Runoff into the NCWR basin must be diverted around the facility and discharged to the environment. A diversion ditch will be constructed to direct surface flows around the south side of the NCWR. The diversion channel will connect to the NCWR spillway and water will discharge directly downstream of the NCWR embankment.

The diversion ditch is designed to safely convey the 1 in 100 year peak instantaneous discharge with 0.3 m of freeboard during the flood event. The base width of the ditch is 1.0 m, with a depth of 1.15 m and sides slopes of 1V:1.5H.

Details of the runoff diversion channel are shown in Drawings C4006 and C4007.

5 – OPERATIONS, MAINTENANCE, AND SURVEILLANCE

5.1 INTRODUCTION

The mine components and associated facilities must be inspected and maintained regularly to ensure that any changes to the conditions, performance, or any potentially hazardous conditions can be identified and promptly addressed.

The maintenance and inspection responsibilities for the various facilities and components are discussed in Section 2 of this Manual. Additional details of the specific operation, maintenance and surveillance requirements for each component are provided in the following sections. The routine operational surveillance requirements are summarized as follows:

- CTF, PWP and NCWR embankments should be routinely monitored for signs of settlement, deformation, seepage and/or erosion etc.
- Tailings delivery and water reclaim pipelines should be checked for leaks, corrosion, or other signs of damage
- Check for ponding water on the CTF, or if surface water is not present, inspect for dusting risk/potential
- Check water levels in the PWP and NCWR, and for ponding of water over the cemented tailings in the CTF
- Record flow rates into the CTF and PWP foundation drain seepage collection ponds
- Record flow rates through the CTF water reclaim and seepage collection systems, and
- Check surface drainage structures (diversion channels, spillways, ditches and culverts etc.) after storm events for blockage, erosion, and damage.

Detailed routine operations surveillance requirements are provided in the sections below.

5.2 QUANTITATIVE PERFORMANCE PARAMETERS

Quantitative Performance Parameters (QPPs) are parameters that can be easily measured and evaluated on-site without complex calculation or data interpretation. QPPs are a good reference to quickly assess the performance of the facilities.

Details regarding the QPPs are presented in the specific sections below. The QPP list will be expanded throughout the development of the Project as it progresses through construction and operations.

5.3 CTF OPERATIONS

The CTF provides permanent storage of cemented tailings and temporary storage of inflow water until it is transferred to the PWP by the water reclaim system. Details of the CTF design are discussed in Section 4.2.

5.3.1 Operational Objectives

The operational objectives of the CTF include:

- Safe permanent storage of cemented tailings
- Co-disposal of waste rock disposal with tailings

- Management and retention of all incident precipitation and runoff up to the PMF storm event
- Provision of at least 2 m of freeboard in addition to potential storm events, and
- Diversion of runoff around the CTF.

5.3.2 Operational Requirements

The CTF embankment will be constructed of earth and rock fill generated from the excavation of the CTF basin. The embankment will be constructed in two stages. The first stage will be constructed during the initial mine development, and the second stage in Years 4 to 5 once the mine is fully operational. Throughout the entire life of the mine, upkeep and maintenance will be critical for preserving the functionality of the CTF.

The requirements for embankment design and operating parameters for the CTF are as follows:

- Maximum storage of 3.6 Mm^3 of cemented tailings
- Maximum storage of 0.4 Mm^3 of waste rock
- Additional storage of 0.3 Mm^3 water from PMF storm event
- Embankment slopes of 2.5H:1V
- Crest width of 10 m
- Minimum freeboard of 2 m, and
- Minimal pond volume maintained (all supernatant water transferred to PWP via water reclaim system).

The current requirements for the diversion channel and operating parameters are as follows:

- Base width: 1 to 2.5 m (see Drawings C5001 to C5004 for details)
- Ditch depth: 1.2 to 2.5 m (see Drawings C5001 to C5004 for details)
- Freeboard: 0.3 m, and
- Side slope: 1V:2H.

The embankments and diversion channel must meet the operating parameters before mine operations begin. Waste rock deposition and tailings deposition is required to stop if the volume of the contents exceeds the maximum operating requirements. If it is discovered during a monitoring inspection that one of these operating parameters does to comply with the specifications above, the problem must be assessed for its risks, and the appropriate steps must be taken to mitigate this risk, and regain the embankment to its original and stable condition.

5.3.3 Instrumentation

Instrumentation will be installed in the CTF embankments to provide monitoring systems throughout the life of the mine. The following instrumentation may be installed in the CTF embankments and/or foundations:

- Vibrating wire piezometers
- Survey monuments, and
- Inclinometers.

Survey monuments and inclinometers will be installed to monitor the settlement, creep, or any form of movement or deviation of the embankment slopes. Vibrating wire piezometers will monitor pore pressures on top of and inside of the liner system in order to verify that the basin drain and seepage collection systems are functioning as designed. Instrumentation measurements that are considered to be acceptable operating parameters are to be determined.

A conceptual instrumentation plan is presented in Drawing C2010. The final number and placement of monitoring instruments will be determined during construction and ongoing operations.

5.3.4 Surveillance and Maintenance

Regular surveillance of the CTF embankments and associated structures is necessary to maintain safe operations. Typical observations made during the surveillance include:

- Evidence indicating embankment structure deformation (e.g. slope bulging, cracks on the crest or crest settlement)
- Evidence indicating seepage, run-off or erosion, and
- Possible evidence suggesting internal erosion (piping) within the embankments (wet spots, seepage, etc.).

The embankments and associated structures do not require regular maintenance; however, specific maintenance items may be identified as a result of regular observations and surveillance of the embankments. Maintenance items may include:

- Fill erosion gullies with properly compacted soil material. Seed or riprap repaired area to stabilize from future erosion
- Fill wildlife burrows
- Maintain grass cover by spraying weeds, fertilizing and watering as needed
- Maintain grading of the embankment crest to prevent potholes, rutting or other potential for standing water to accumulate
- Maintain fences to provide site security and to exclude wildlife from the embankment. Repair and/or re-vegetate damaged embankment surfaces, and
- Perform regular inspections of the embankment and abutments to identify potential maintenance items.

The integrity of the HDPE geomembrane liner system must be maintained to minimize potential seepage from the CTF over the long term. While it will not be possible to inspect or repair sections of the liner system once they are submerged beneath tailings, the exposed sections should be inspected as part of the routine surveillance tasks. Typical surveillance observations for the geomembrane include:

- Identification of defects in the geomembrane such as tears and holes
- Damage or degradation to geomembrane as a result of environmental exposure (e.g. ice, wind, UV damage, etc.), and
- Identification of excess tension in the geomembrane.

Repairs to the liner system are required to be scheduled with a third party geosynthetics installer if any defects or damage is identified.

5.3.5 Monitoring Inspections

An outline of the surveillance plan for the CTF embankment is shown in Table 5.3.

Table 5.1 CTF Embankment Surveillance Plan

Facility	Monitoring Inspection	Frequency
CTF Embankments	Record slope deviation measurements from inclinometers	During Construction: Bi-Weekly Post-Construction: Monthly
	Record settlement reading from survey monuments	During Construction: Bi-Weekly Post-Construction: Monthly
	Inspect geomembrane for defects and damages, which include holes, tears, and thinning or weakening of membrane.	During Construction: As installation occurs Post-Construction: Bi-Monthly
	Inspect for cracking, slumping, erosion, slope failure, and any other deformational features in the upstream slope, downstream slope and embankment crest.	Monthly
	Inspect for daylighting seeps on the downstream embankment slope/benches, water pooling/ponding, soft/wet areas	Monthly
	Inspect for nonconformities in the embankment's original operating parameters, including slope gradient, crest width, embankment height, etc.	Annually
CTF Diversion Channel	Inspect for debris left in channel, and erosion or slumping of the channels walls	After high precipitation events, otherwise Monthly

An immediate response is required when an inspection item does not comply with the standard of operation. A Supervising Manager must be informed immediately, and action or investigation must begin as soon as possible to recover the original conditions of the embankment.

5.4 CTF BASIN DRAIN AND WATER RECLAIM SYSTEMS

The basin drain has been developed to drain water that may percolate through the cemented tailings, and water that has been expelled in the tailings consolidation process. Water collected by the basin drain will be fed to the water reclaim system. Further details of the basin drain and water reclaim systems are described in Section 4.2.

5.4.1 Operational Objectives

The operational objectives of the CTF basin drain are as follows:

- Allow collection and removal of precipitation and run-off water that has accumulated on the tailings surface or infiltrated through the tailings mass
- Allow for tailings bleed water to flow beneath the cemented tailings mass to the water reclaim sump

  Lower hydrostatic pressure acting on upper geomembrane to minimize potential seepage, and
- Remove contact water from the CTF and convey it to the PWP.

5.4.2 Operational Requirements

The current design requirements and operating parameters are as follows:

- The drainage gravel filled sump is to be located at the north end of the CTF basin, with submerged pumps to remove water
- Minimum basin floor grade of 0.5% towards the water reclaim system sum
- Sub-grade bedding overlying the basin floor, with unprocessed waste rock placed overtop of the bedding layer in a minimum 1 m thick layer to allow flow of contact water to the sump, and
- Reclaim water pipeline system to allow transfer to the PWP.

Inspection of the basin floor to confirm the correct grade has been achieved must be completed before the liner system is installed. Appropriate material testing of the sub-grade bedding must be conducted to confirm the correct material specifications have been met prior to placement on the liner system.

5.4.3 Instrumentation

The performance of the basin drain and water reclaim system will be monitored by vibrating wire piezometers that will be installed in select locations. Additionally, flow meters will be installed in the reclaim pump system to monitoring the flowrate of water removed.

5.4.4 Surveillance and Maintenance

Regular surveillance of the basin drain and water reclaim system is necessary in both providing the mine with a sufficient volume of water for processing, as well as ensuring tailings bleed water, seepage and surface water that has accumulated in the CTF are properly drained. Typical surveillance observations made during surveillance include:

- Evidence of leaks, ruptures, or breaks within water reclaim pipeline
- Inspect for evidence damaged or malfunctioning pumps
- Inspect of fines accumulation within sump and pump system
- Test reclaim water quality, and
- Record vibrating wire piezometer readings to confirm that the systems are effective in maintaining low head pressure on the liner system.

5.4.5 Monitoring Inspections

An outline of the surveillance protocols for the basin drain system are found in Table 5.4.

Table 5.2 CTF Basin Drain Surveillance Plan

Facility	Monitoring Inspection	Frequency
CTF Basin Drain System	Record water level measurements from VW piezometers	Normal Precipitation: Weekly High Precipitation: Daily until normal water levels are achieved
	Inspect liner system geomembrane over the tailings basin for defects and damages, which include holes, tears, and thinning or weakening of membrane.	During Construction: As installation occurs
Water Reclaim System	Check reclaim system flow rates to PWP	Weekly
	Monitor pumps within the water reclaim system for electrical current draw for changes in pump system demand, or unexpected pressure change within pipe system	Daily
	Monitor quality of reclaim water	Weekly

5.5 TAILINGS DELIVERY AND DEPOSITION SYSTEM

The tailings delivery system has been developed to transport tailings from the mill into the CTF. Tailings will be discharged to form a sloping surface, allowing the drainage of precipitation off the cemented tailings, and into the water reclaim system. Additional details on the tailings delivery and deposition system are provided in Section 4.2.

5.5.1 Operational Objectives

The operational objectives of the tailings delivery and deposition system are as follows:

- Provide effective and consistent means of transportation for tailings to CTF
- Fully contain tailings within delivery system until discharged into CTF, and
- Distribute tailings in a sloping fashion to prevent water ponding on tailings surface.

5.5.2 Operational Requirements

The tailings pipeline alignment follows the access road from the mill to the northern end of the CTF. The pipeline then runs along the western edge of the basin terminating at the south end of the CTF. The tailings pipeline will be double walled from the mill to the CTF in order to provide secondary containment, and single walled from along the CTF crest. Tailings will be deposited using spigot offtakes between the north and south ends of the CTF, however tailings will be preferentially deposited from the south end to promote surface drainage towards the water reclaim sump. Using strategic distribution of the tailings via the spigot offtakes, the surface of the cemented tailings mass will slope north to direct water toward the wet well sump. A tailings solids content of approximately 79% is targeted for operations. The tailings system will be insulated to prevent freezing in cold conditions.

5.5.3 Surveillance and Maintenance

Regular surveillance of the tailings delivery system is necessary to maintain safe operations. Typical observations made during the surveillance include:

- Evidence indicating leak or rupture within the tailings piping, such as tailings or water flow from the casing annulus
- Evidence of blockage occurring within the tailings piping
- Evidence of freezing of tailings within the piping, and
- Recurrent water pooling on specific areas of the cemented tailings surface or water accumulation on tailings surface for extended periods.

The tailings delivery system should not require frequent maintenance, however, the system should be monitored regularly. Mechanical repairs to the tailings delivery system, caused by ruptures or leaks, should be repaired as soon as possible by a qualified repair service if any defects or damage is identified. However, specific maintenance items that can be completed by the TRI staff include:

- Maintain sufficient slope gradient of cemented tailings surface to promote drainage towards the water reclaim system
- Fill low areas on tailings surface that tend to accumulate water, and
- Flush water through pipes when delivery system is not in used.

Pressure gauges or power draw gauges should be installed in the piping system to ensure that the pipes are operating at normal conditions. Significantly high pressures or a large power draws could indicate obstructions in flow, while significantly low pressures or low power draws may indicate ruptures or leaks. The range of measurements that will be regarded as acceptable operating conditions are to be determined.

Flow gauges will be recorded and summed to accurately measure remaining storage of CTF, as well as make predictions and calculations for future operations.

5.5.4 Monitoring Inspections

An outline of the surveillance protocols for the tailings delivery system is provided in Table 5.5.

Table 5.3 Tailings Delivery System Surveillance Plan

Facility	Monitoring Inspection	Frequency
Tailings Delivery System	Inspect surface of tailings for significant occurrences of water pooling	Bi-Weekly
	Monitor pumps within the water reclaim system for electrical current draw for changes in pump system demand, or unexpected pressure change within pipe system	Daily
	Record tailings flow meter (flowrate and total volume pumped)	Daily
	Visually inspect the tailings pipelines and casing outlets for evidence of leaks or ruptures	Daily
	Complete camera inspection of casing check for corrosion or leaks	Annually

5.6 FOUNDATION DRAINS

The foundation drains are designed to collect groundwater and seepage under the geomembrane at the CTF and PWP. The foundation drains transport accumulated water to their respective collection ponds. Water from the CTF foundation drain collection pond is pumped back into the CTF, to be collected by the water reclaim system and pumped to the PWP. Water in the PWP foundation drain collection pond is pumped directly back to the PWP for storage and mill reuse. Further details of the foundation drain systems can be found in Section 4.3.

5.6.1 Operational Objectives

The operational objectives for the foundation drains and foundation drain collection ponds are as follows:

- Intercept groundwater flows beneath the liner system, and prevent uplift pressure on the liner system, and
- Intercept and transfer any seepage through the liner system.

5.6.2 Operational Requirements

The foundation drains comprise a pipe network placed in trenches and covered with drainage gravel. The pipe network is installed in the following locations:

- Perforated pipe installed on CTF and PWP cut slopes
- Perforated pipe installed on CTF and PWP basin floor, and
- Solid outflow pipe underneath the CTF and PWP embankments.

The foundation drains will be field fit during construction to best intercept any observed groundwater seepages. The trench and pipe network will be graded so that water is freely directed to the outflow pipes, and subsequently to the foundation drain collection ponds.

5.6.3 Surveillance and Maintenance

The performance of the liner system can be assessed with frequent water quality and flow monitoring of the foundation drains. Typical observation and surveillance items include the following:

- Record flow rate and total flow for the foundation drains, and
- Test water quality from the foundation drain collection ponds.

The range of measurements that will be regarded as acceptable operating conditions are to be determined.

5.6.4 Monitoring Inspections

An outline of the surveillance protocols for the BBCP embankments are found in Table 5.6:

Table 5.4 Foundation Drain Systems and Foundation Drain Collection Ponds Surveillance Plan

Facility	Monitoring Inspection	Frequency
Foundation Drain Systems and Foundation Drain Collection Ponds (CTF and PWP)	Measure water level in foundation drain collection pond	Weekly
	Observe incoming flow looking for sediment or other indications that the foundation drain system is having erosional effects on the facility foundations	Weekly
	Record flow rate and total flow to collection pond	Daily
	Test water quality	Bi-Weekly

5.7 PROCESS WATER POND

The PWP is designed to store all process and contact water for mill use and treatment. Design details of the PWP are summarized in Section 4.3.

5.7.1 Operational Objectives

The operational objectives of the PWP include:

- Safe storage of contact and process water for mill use.
- Management and retention of all incident precipitation and runoff up to the PMF storm event, which includes at least 2 m of freeboard in these events.
- Precipitation water from the CTF up to and including the 1 in 500 year storm event will be transferred to the PWP for storage and treatment.
- Diversion of runoff around the PWP.

5.7.2 Operational Requirements

The PWP embankments will be constructed using rock excavated from the construction of the PWP basin, which has undergone processing to meet construction material specifications. Throughout the entire life of the mine, upkeep and maintenance will be of the critical for preserving the functionality of the PWP embankments.

The current embankment design requirements and PWP operating parameters are as follows:

- Storage of approx. 200,000 m^3 of water for mill use, including an operational variance in the event of a drier or wetter than average year
- Additional storage of 220,000 m^3 for the PMF storm event
- Embankment slopes: 2.5H:1V
- Embankment height: 23 m
- Crest width: 10 m, and
- Freeboard: 2 m.

The current diversion channel design requirements and operating parameters are as follows:

- Base width: 1 to 2.5 m (see Drawings C5001 to C5004 for details)
- Ditch depth: 1.2 to 2.5 m (see Drawings C5001 to C5004 for details)

- Freeboard: 0.3 m, and
- Side slope: 1V:2H.

The PWP and diversion channel must be constructed to meet the design requirements before mine operations begin. Transfer of water into the PWP is required to stop if the total volume of contained water exceeds the storm event capacity and freeboard allowance. If one of the operating parameters does to comply with the specifications above, the problem must be assessed for its risks, and the appropriate steps must be taken to mitigate this risk and regain the embankment to its designed condition.

5.7.3 Instrumentation

Instrumentation will be installed in the PWP embankments and foundations to provide monitoring systems throughout the life of the mine. The following instrumentation may be installed in the PWP embankments:

- Survey monuments, and
- Vibrating wire piezometers.

Survey monuments will be installed to monitor the settlement, creep, or any form of movement or deviation of the embankment slopes. Vibrating wire piezometers will monitor head pressures within the liner system, to determine if the seepage collection system is operating as designed.

A conceptual instrumentation plan is presented in Drawing C3010. The final number and placement of monitoring instruments will be determined during construction and ongoing operations.

5.7.4 Surveillance and Maintenance

Regular surveillance of the PWP and associated structures is necessary to maintain safe operations. Typical observations made during the surveillance include:

- Evidence indicating embankment structure deformation (e.g. slope bulging, cracks on the crest or crest settlement)
- Evidence indicating seepage, run-off or erosion, and
- Possible evidence suggesting internal erosion (piping) within the embankments (wet spots, seepage, etc.).

The embankments and associated structures do not require regular maintenance; however, specific maintenance items may be identified as a result of regular observations and surveillance of the embankments. Maintenance items may include:

- Fill erosion gullies with properly compacted soil material. Seed or riprap repaired area to stabilize from future erosion.
- Fill wildlife burrows.
- Maintain grading of the embankment crests to prevent potholes, rutting or other potential for standing water to accumulate.
- Maintain fences to provide site security and to exclude wildlife from the embankments.
- Perform regular inspections of the embankments and abutments to identify potential maintenance items.

The integrity of the HDPE geomembrane liner system must be maintained to minimize seepage from the PWP over the long term. Typical surveillance observations for the geomembrane include:

- Identification of defects in the geomembrane such as tears and holes
- Damage or degradation to geomembrane as a result of environmental exposure (e.g. ice, wind, UV damage, etc.), and
- Identification of excess tension in the geomembrane.

The PWP liner should be inspected for punctures and seam rips each spring to determine if ice flows caused damage to the liner system. Repairs to the liner system are required to be scheduled with a third party geosynthetics installer if any defects or damage is identified.

Repairs to the geomembrane are required to be scheduled with a third party geosynthetics installer if any defects or damage is identified. The water level in the PWP can be temporarily reduced in order to provide access for repairs.

5.7.5 Monitoring Inspections

An outline of the surveillance plan for the CTF embankment is found in Table 5.7:

Table 5.5 Process Water Pond Surveillance Plan

Facility	Monitoring Inspection	Frequency
PWP Embankments	Record pond water level	Water collection period: Weekly High Precipitation: Daily until normal water levels are achieved
	Record slope deviation measurements from survey monuments	During Construction: Bi-weekly Post-Construction: Monthly
	Record pressures readings from VW piezometers	Monthly
	Inspect liner system for defects and damages, which include holes, tears, and thinning or weakening of membrane.	During Construction: As installation occurs Post-Construction: Bi-Monthly
	Inspect embankment for cracking, slumping, erosion, slope failure, and any other deformational features in the upstream slope, downstream slope and embankment crest.	Monthly
	Inspect for daylighting seeps on the downstream embankment slope/benches, water pooling/ponding, soft/wet areas	Monthly
	Inspect for nonconformities in the embankment's original operating parameters, including slope gradient, crest width, embankment height, etc.	Annually
PWP Diversion Channel	Inspect for debris left in channel, and erosion or slumping of the channels walls	After high precipitation events, otherwise Monthly

5.8 NON-CONTACT WATER RESERVOIR

The NCWR is designed to provide storage of excess surface water flows from the spring freshet, to be released during the dry season to offset mine site consumptive use. The water will be extracted from Sheep Creek in periods of high flow and pumped into the NCWR. The water will be pumped out of the basin as needed to the downstream receiving area during the dry season. The NCWR includes the following components:

- Embankment
- Spillway
- Run-off diversion ditch, and
- Floating pump system.

Further details on the NCWR are discussed in Sections 4.4.

5.8.1 Operational Objectives

The operational objectives of the NCWR include:

- Safe storage of non-contact fresh water collected during high-flow periods
- Management and transportation of precipitation and run-off for up to the 1 in 200 year storm event, and
- Diversion of runoff around the NCWR.

5.8.2 Operating Requirements

The NCWR embankment will be constructed of rock fill generated from the excavation of the CTF basin. The spillway situated at the south end of the embankment will prevent overtopping of the dam in the case that storm inflows exceed the capacity of the NCWR.

Water will be pumped to the NCWR via a wet well sump and pump systems in Sheep Creek, located immediately northeast of the mine site. A floating pump station will remove water from the NCWR and release it to the wetlands immediately downstream of the embankment on an as-needed basis. Throughout the entire life of the mine, upkeep and maintenance will be of the critical for preserving the functionality of the embankment.

It should be noted that the NCWR is not intended to indefinitely retain water, and is expected to slowly leak water throughout its operational life.

The current requirements for the embankment design and operating parameters are as follows:

- Storage of 360,000 m^3 of water
- Embankment slope: 2.5H:1V
- Crest elevation: 1,776.5 m
- Freeboard (from embankment crest to spillway invert): 1.8 m, and
- Crest width: 10 m.

The current requirements for the spillway design and operating parameters are as follows:

- Invert elevation: 1,774.5 m
- Invert depth: 1 m
- Side slope: 2H:1V, and
- Base width: 1 m.

The current requirements for the run-off diversion ditch and operating parameters are as follows:

- Base width: 1 m
- Ditch depth: 1.15 m
- Freeboard: 0.3 m, and
- Side slope: 1V:1.5H.

The embankments, spillway, and run-off diversion ditch must be constructed to meet the operating parameters before mine operations begin. The filling of the NCWR during the spring freshet is required to stop if the water volume exceeds the specified reserve catchment volume. If it is discovered during a monitoring inspection that one of these operating parameters does not comply with the specifications above, the problem must be assessed for its risks, and the appropriate steps must be taken to mitigate this risk, and return the embankment to its original and stable condition.

5.8.3 Instrumentation

A survey monument will be installed on the NCWR embankment crest to allow settlement monitoring throughout the life of the mine. The settlement measurements which will be regarded as normal or acceptable operating conditions are to be determined.

5.8.4 Surveillance and Maintenance

Regular surveillance of the NCWR embankments, spillway and run-off diversion ditch is necessary to maintain safe operations. Typical observations made during the surveillance include:

- Evidence indicating structure deformation (e.g. slope bulging, cracks on the crest or crest settlement), and
- Evidence indicating excessive seepage, run-off, or erosion of the embankment foundation and abutments.

The embankments and associated structures do not require regular maintenance; however, specific maintenance items may be identified as a result of regular observations and surveillance of the embankments. Maintenance items may include:

- Fill erosion gullies with properly compacted soil material. Seed or riprap repaired area to stabilize from future erosion.
- Fill wildlife burrows.
- Maintain grass cover by spraying weeds, fertilizing and watering as needed.
- Maintain grading of the embankment crests to prevent potholes, rutting or other potential for standing water to accumulate.
- Maintain fences to provide site security and to exclude wildlife from the embankments. Repair and/or re-vegetate damaged embankment surfaces.
- Perform regular inspections of the embankments and abutments to identify potential maintenance items.

5.8.5 Monitoring Inspection Plan

An outline of the surveillance plan for the NCWR is found in Table 5.8.

Table 5.6 Non-Contact Water Reservoir Surveillance Plan

Facility	Monitoring Inspection	Frequency
NCWR Embankment	Record settlement reading from survey monument	Monthly
	Measure water level in NCWR basin	Daily when filling NCWR during spring freshet, until target water level is reached Weekly under normal operating conditions
	Measure water gauge (flow rate and total water volume)	Daily when pumping
	Inspect for cracking, slumping, erosion, slope failure, and any other deformational features in the NCWR embankment.	Weekly Daily after high-flow event
	Inspect for daylighting seeps on the downstream embankment slope/benches, water pooling/ponding, soft/wet areas	Weekly
	Inspect for nonconformities in the NCWR structures' original operating parameters	Annually
NCWR Diversion Channel	Inspect for debris left in channel, and erosion or slumping of the channels walls	After high precipitation events, otherwise Monthly

An immediate response is required when an inspection item does not comply with the standard of operation. A supervising manager must be informed immediately, and action or investigation must begin as soon as possible to recover the original conditions of the embankment.

5.9 MINE SITE WATER BALANCE AND WATER MANAGEMENT

Effective water management is critical to ensure uninterrupted processing and waste management operations. The primary water source for the Project is groundwater collected from the underground mine workings. This water will be used primarily for ore processing, with surplus water being treated and released. Other sources of water include:

- Precipitation and runoff collected by the CTF, PWP, and other ancillary facilities
- Groundwater and seepage water collected by the foundation drain systems, and
- Tailings bleed water, collected by the CTF basin drain system.

Other modes of water consumption or losses include:

- Evaporation from the PWP
- Water locked in the cemented tailings
- Dust control, truck wash supply, and
- Miscellaneous freshwater requirements for mine site personnel.

A mine site water balance is necessary to identify and characterize key variables that influence water demands and water supply requirements. A water balance model was prepared using historic and current data collected on a monthly basis with the operating requirements. The mine site water balance should be updated for each major design phase using the most current data available. Once operations commence the water balance should be updated annually to ensure it is representative of site conditions.

The following data must be recorded monthly in order to develop a clear understanding of the mine site water balance:

- Precipitation and evaporation
- Water pumped from underground mine dewatering processes
- Direct consumptive use of water used in milling processes
- Tailings quantity for underground backfill and surface storage
- Consumptive use of water for mine site maintenance (dust control, truck washing, employee facilities etc.)
- Water treated and released to downstream environments, and
- Flows recovered from foundation drain collection systems (CTF and PWP).

Additionally, water levels in the NCWR must be tracked on the monthly basis to ensure that the volume of water released to the downstream environment is sufficient to offset mine site water use.

6 – INSPECTIONS, REPORTING AND REVIEWS

6.1 REGULATORY DOCUMENTS

A copy of regulatory documents prepared by TRI or consultants related to the construction, operation and maintenance of the CTF, PWP and NCWR will be provided to the EOR at the same time as submission to MDEQ or MSHA.

6.2 ANNUAL EOR INSPECTION

As per MCA 82-4-381, the EOR will inspect the tailings impoundment annually during operations or as required during closure pursuant to a reclamation plan under MCA 82-4-336. The requirements for the annual inspection are as follows:

- The EOR will prepare a report describing the scope of the inspection and actions recommended to ensure the impoundment is being properly operated and maintained.
- The EOR will submit the report to TRI and MDEQ and immediately notify MDEQ and TRI if the facility presents an imminent threat or the potential for an imminent threat to human health or the environment.

The following actions will be taken if the annual inspection report contains recommendations:

- TRI will prepare a corrective action plan and schedule to guide the implementation of the recommendations made by the EOR.
- TRI will submit the corrective action plan and schedule to the EOR.
- The EOR will review the corrective action plan and schedule and verify that the proposed corrective actions will address the recommendations made in the annual inspection report.
- TRI will submit the verified corrective action plan and schedule to MDEQ within 120 days following the date of the inspection.
- TRI will implement the corrective action plan in accordance to the implementation schedule.

6.3 PERIODIC IRP REVIEWS

As per MCA 82-4-380, at least every 5 years TRI must assemble an IRP review in accordance with the IRP requirements (MCA 82-4-377). The IRP must conduct the following:

- Inspect the CTF, PWP, NCWR and ancillary facilities.
- Review the TOMS Manual and records collected in association with the Manual.
- Interview people with responsibilities identified in the TOMS Manual.
- Review EOR annual inspection reports, corrective actions, records associated with construction, and any other aspect, plan, record, document, design, model, or report related to the facility that the IRP needs to ensure that the facility is constructed, operated, and maintained as designed and is functioning, can be closed as intended, and meets acceptable engineering standards.
- The IRP will prepare a report detailing the scope of review and include any recommendations resulting from the review.
- The IRP will immediately notify MDEQ and TRI if there is an imminent threat to human health or the environment.
- The final review report must be signed by each IRP member and provided to MDEQ and TRI.

TRI will provide all documents and records necessary for the IRP to complete the periodic review.

If recommendations are made by the IRP, the following actions will be completed:

- TRI will prepare a corrective action plan and schedule effectively implementing the recommendations included in the IRP report. TRI will submit the corrective action plan and schedule to the IRP within 60 days after receipt of the IRP report.
- The IRP will review the corrective action plan and schedule to determine whether the corrective action plan and schedule proposed by the operator will effectively implement the recommendations included in the IRP's report.
  Within 30 days after receipt of approval from the IRP, the operator will submit the corrective action plan with an implementation schedule to the department.

6.4 REPORTING

In the event that TRI is unable to comply with any of the terms and conditions of the operating permit, due to any cause, TRI will:

- Immediately notify MDEQ of the failure to comply.
- Immediately take action to stop, contain, and clean up unauthorized discharges or otherwise stop the non-compliance, correct the problem, and if applicable, repeat sampling and analysis of any non-compliance immediately.
- Submit a detailed written report to MDEQ within thirty (30) days (5 days for upsets and bypasses), unless requested earlier by MDEQ. The report will contain a description of the non-compliance, including exact dates and times, if the non-compliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent recurrence of the non-compliance.

7 – EMERGENCY PREPAREDNESS PLAN

7.1 GENERAL

An Emergency Preparedness Plan (EPP) will be developed to enable TRI to identify emergency and hazardous conditions threatening the facilities, expedite effective response actions to prevent failure, and reduce loss of life and property damage should failure occur. The EPP will be written prior to the start of the construction phase.

The following section identifies the levels of emergency conditions that will be applied when developing the EPP.

7.1.1 EMERGENCY CONDITIONS

Three levels of emergency conditions (or warning signs) can be identified with respect to the site operations. These are defined as follows:

- Level 1 - Unusual conditions that do not yet represent a potential emergency, but do require prompt investigation and resolution.
- Level 2 - Conditions that represent a potential emergency if sustained or allowed to progress, but no emergency situation is imminent.
- Level 3 - An emergency defined by either failure of a significant component of the impoundment and/or associated facility or a significant failure of the performance of a component of the impoundment. Such failure may have already occurred, or be imminent.

Typical situations that would be classified under the three levels of emergency conditions (Level 1, 2 or 3) will be defined as part of the EPP preparation, however the following subsections present a general summary of typical responses that can be expected for each emergency level.

7.1.1.1 Notification Procedures

Level 1- Unusual Conditions

The action in the event of a Level 1 Emergency Condition will typically involve an investigation, intensified monitoring, inspecting and/or testing, and defining and implementing possible corrective, measures.

The notification procedures are as follows:

- The person first noticing a Level 1 Emergency Condition shall notify the Environmental Manager.
- The Environmental Manager will immediately notify the Vice President of Operations, Environmental Manager and the EOR.
- Corrective actions will be determined and initiated, monitoring will be intensified.
- The Level 1 response and notification flowchart in the EPP will be followed.

Construction equipment will be available at the mine including, but not limited to, an excavator, a grader, haul trucks and a bulldozer. Material will be available for use in repairing or remediation of any damaged areas.

Level 2 - Potential Emergency

The notification procedures for a Level 2 Emergency Condition are as follows:

- The person first noticing a Level 2 Emergency Condition shall notify the Environmental Manager and/or Mine Superintendent. They will immediately notify the Vice President of Operations, Environmental Manager, EOR and Sheriff as well as initiate corrective actions and intensified monitoring.
- An action plan will be determined and initiated; monitoring will be intensified.
- Follow the Level 2 response and notification flowchart in the EPP.

Level 3 - Emergency Condition

The Sheriff must be contacted immediately so emergency services can begin evacuations of all at-risk people and close roads as needed. This is an extremely urgent situation when an impoundment failure is occurring or cannot be prevented and is about to occur. There could be the potential for flash flooding downstream of the impoundment due to the release of water and tailings solids. This could result in the flooding of private residences and roads. During an impoundment breach, the closest downstream residence could be affected in less than 10 minutes.

The notification procedure for a Level 3 Emergency Condition is as follows:

- The person noticing a Level 3 Emergency Condition shall notify the Environmental Manager and/or Mine Superintendent. They will immediately notify Sheriff / 911.
- The Environmental Manager and/or Mine Superintendent will notify the TRI Incident Commander, Vice President of Operations, Corporate Environmental Manager and EOR as well as initiate corrective actions and/or intensified monitoring, as appropriate.
- The Incident Commander and Corporate Environmental Manager will notify the appropriate Government Agencies.
- The Incident Commander will take control of the situation and implement the Level 3 EPP.
- The Level 3 Emergency Response and Notification flowchart in the EPP will be followed.

Names and telephone numbers for the key emergency contacts will be provided in the EPP.

The person who initiated the communication should then stand-by at a safe location near the problem area and await further instructions or decisions. All those involved in emergency response, after first having communicated with the appropriate parties, should then work towards determining the first steps in the emergency response, with respect to the protection of human life and health, environment and property. These first steps should consider two key types of action:

- Actions to prevent the situation from worsening, and
- Actions to reduce the consequences of the impending or actual failure.

Any such action must be presented to the Incident Commander and Corporate Environmental Manager who will decide on its implementation in consultation with Emergency Services and MDEQ.

7.2 FAILURE MODES AND EFFECTS ANALYSIS

A Failure Modes and Effects Analysis (FMEA) has not been completed for the Project at this time. If required, a FMEA can be completed as part of the ongoing design of the Project in order to identify potential hazards and mitigation measures that have not yet been accounted for in the waste and water management systems design.

8 – REFERENCES

State of Montana (MT), 2015. Title 82. Minerals, Oil, and Gas Chapter 4. Reclamation. Part 3. *Metal Mine Reclamation (MCA 82-4-301 et. Seq.)* Retrieved from: http://leg.mt.gov/bills/mca_toc/82_4.htm (accessed October 28, 2015).

9 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

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APPENDIX A

DESIGN BASIS

(Pages A-1 to A-4)

Knight Piésold CONSULTING

TABLE A.1

TINTINA RESOURCES INC.
BLACK BUTTE COPPER PROJECT

FEASIBILITY DESIGN REPORT
SUMMARY OF DESIGN BASIS FOR THE CTF

Print: Jul/06/2017 15:24:57

ITEM	VALUE	SOURCE (Assumption if none noted)	DATE	Entered By:
1.0 GENERAL				
Site Coordinates	Approximately 506 000 E , 5 181 000 N (UTM NAD 83 Zone 12 N (Lat: 46.78°, Long: -110.92°)	Google Maps	28-Apr-15	GIM
Site Elevation	Approximately 1700 to 1840 masl	10 m Topography from TRI	28-Apr-15	GIM
Codes and Standards	SB 409, ASTM, ICOLD (1989 - 2010), FEMA (2004), Administrative Rules of Montana (2012) and related codes.	Various Sources	4-May-15	JEF
	Reclamation plan structured around the requirements of the Montana Metal Mine Reclamation Act		14-May-15	GIM
Mine Production	Total ore milled = 13.2 million tonnes (Mt)	TRI	10-Oct-15	GIM
	Throughput = 1000 to 3 300 tonnes per day, with peak production during Years 5 to 13 of operations.	TRI	10-Oct-15	GIM
	Tonnes Concentrate Extracted from Ore = 1.41 Mt	TRI	10-Oct-15	GIM
	Operating Mine Life = approximately 15 years	TRI	10-Oct-15	GIM
Climate Conditions	Mean Annual Precipitation = 416 mm	Knight Piesold Preliminary Hydromet Analysis	6-May-15	JEF
	Mean Annual Pond Evaporation = 514 mm	Knight Piesold Preliminary Hydromet Analysis	6-May-15	JEF
	Mean Annual Temperature = 1.9 °C	Knight Piesold Preliminary Hydromet Analysis	14-May-15	JL
	Site Runoff Coefficient = 0.2	Assumed value	6-Aug-15	GIM
	Mean Annual Wind Speed = 2.6 m/s	Western Regional Climate Center Record, Bozeman MTU station	28-Apr-15	GIM
	1 in 2 year 24 hour precipitation = 35 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 5 year 24 hour precipitation = 49 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
Snow & Rainfall Storm Events	1 in 10 year 24 hour precipitation = 58 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 15 year 24 hour precipitation = 64 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 20 year 24 hour precipitation = 67 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 25 year 24 hour precipitation = 70 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 50 year 24 hour precipitation = 79 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 100 year 24 hour precipitation = 88 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 200 year 24 hour precipitation = 96 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 500 year 24 hour precipitation = 108 mm	Knight Piesold Preliminary Hydromet Analysis Work file #14 (VA101-460/3)	6-Oct-15	GIM
	1 in 100 year snowpack = 290 mm	Knight Piesold Work File #10 (VA101-460/03)	15-May-15	JL
	Probable Maximum Precipitation 24 hour precipitation = 560 mm	Knight Piesold Work File #14 (VA101-460/03)	26-May-15	GIM
	Probable Maximum Flood 24 hour storm event = 850 mm	Knight Piesold Work File #15 (VA101-460/03)	26-May-15	GIM
Dam Hazard Classification	Dam Hazard Classification of "HIGH" in compliance with State, Federal and International Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	GIM
Geology	Ore deposit hosted in Newland Formation shale (Proterozoic calcareous shale)	Tintina Resources Inc.	6-Aug-15	GIM
Seismic Design Parameters	Operating Basis Earthquake (OBE) = 1/22 year earthquake event	Knight Piésold Work File #9 (VA101-460/03)	6-Aug-15	GIM
	Maximum Design Earthquake (MDE) = 1/10,000 year earthquake event	Senate Bill 409, Knight Piésold Work File #44 (VA101-460/03)	9-Oct-15	GIM
	Earthquake Design Ground Motion (EDGM) = 0.35 g	Knight Piésold Work File #44 (VA101-460/03)	6-Oct-15	GIM
2.0 MINE WASTE MANAGEMENT				
2.1 Waste Properties				
Tailings	Total tailings production = 13.2 Mt	TRI	28-Apr-15	GIM
	Dry density = 2.0 t/m3	Tailings lab testing by KP	28-Apr-15	GIM
	55% stored in surface tailings facility, and 45% pumped underground as paste backfill.	AMEC Preliminary Underground Backfill Plan	28-Apr-15	GIM
	Specific Gravity of Solids = 3.77	SG Value provided by TRI sub-consultant Jeff Austin (2015)	28-Apr-15	GIM
	Single tailings stream (79% solids by weight)	TRI	6-Oct-15	GIM
	Tailings thickened and mixed with 0.5-2% cement, fly ash, or slag.	TRI	6-Oct-15	GIM
Potentially Acid Generating (PAG) Waste Rock	PAG co-disposed with tailings = 0.7 Mt	TRI	12-May-15	GIM
	All waste rock on surface to be disposed in the CTF.	TRI	28-Apr-15	GIM
	0.5 Mt of PAG Waste Rock generated during pre-production years.	Estimate based on AMEC mine plan	6-Aug-15	GIM
	Compacted dry density of waste rock = 2.0 t/m³		28-Apr-15	GIM
	Specific Gravity of Waste Rock = 2.0 t/m3		14-May-15	GIM
	Waste Rock to be placed in tempporary waste rock pad during Construction and moved into CTF basin prior to mill start up.		28-Apr-15	GIM
Topsoil	'A' and 'B' Horizons from topsoil and overburden stripping activities to be stockpiled separately for use in reclamation.	Geomin Resources Inc.	23-Feb-17	GIM
	'A' Horizon = top soils, average thickness of approximately 0.3 m across project site.	Geomin Resources Inc.	23-Feb-17	GIM
	'B' Horizon = subsoils, average thickness of approx. 0.6 m across project site, beneath 'A' Horizon.	Geomin Resources Inc.	23-Feb-17	GIM
	0.9 m topsoil depth assumed for material volume calculations	Geomin Resources Inc.	23-Feb-17	GIM
2.2 Cemented Tailings Facility (CTF)				
Function	The impoundment provides for secure long term storage of approximately 3.56 Mm³ tailings and 0.35 Mm³ PAG waste rock, and 0.3 Mm3 of stormwater storage (4.21 Mm3 total)	Based on TRI production schedule provided October 2015	9-Jul-15	GIM
Concept	55% of total tailings storage codisposed with 0.7 Mt of PAG waste rock within an impoundment formed by a single embankment. Embankment raised in stages and constructed using the downstream method. A HDPE (100 mil) lined impoundment, developed in stages throughout mine life.		6-May-15	GIM
Storage Capacity	Starter impoundment sized for containment of tailings up to year 4 of operations (including two years pre-production to contain Waste Rock produced). Assume embankment constructed using infill borrow from impoundment shaping.		28-Apr-15	GIM
	Staged expansion of the impoundment to provide for ultimate storage capacity.		28-Apr-15	GIM
	Ultimate Embankment at Closure - 55% tailings production and co-disposed waste rock plus storage and freeboard to attenuate IDF.		28-Apr-15	GIM
Dam Hazard Classification	'HIGH' as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (PMF), as per FEMA and ICOLD guidelines.	FEMA, ICOLD	4-May-15	JEF
Flood Management - Catchment Areas	Catchment Area = approximately 35.49 ha	Determined using currently facility and diversion channel layout	14-May-15	GIM
Inflow Design Flood (IDF) Volumes	0.30 Mm3 (based on catchment area and 850 mm IDF runoff depth)		14-May-15	GIM
Design Freeboard	Minimum 2 m freeboard.		6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes		6-Aug-15	GIM
Embankment Height	Maximum height of 46 m	Measured from the highest downstream slope	6-Aug-15	GIM
Basin Grading	Minimum 0.5% to facilitate drainage to water reclaim system and seepage collection sump		29-May-15	GIM
Operational Criteria	Flood management: Precipitation and bleedwater are directed to water reclaim system by selective tailings deposition and basin grading.		28-Apr-15	GIM
	Tailings ultra-thickened with cement and fly ash added to create non-flowable tailings.		6-May-15	GIM
	Mine water pumped to PWP.		28-Apr-15	GIM
	Minimal recovery from bleeding of tailings mass.		28-Apr-15	GIM
	Excess water monitored and treated accordingly.		28-Apr-15	GIM
Closure Criteria	Fill will be placed over the tailings and waste rock to create a level surface. The impoundment will be capped by a non-permeable liner and covered with a minimum 1 m thick layer of non-PAG fill material. Diversion channels will be maintained to direct surface water around CTF.		28-Apr-15	GIM
	The capping layer and downstream embankment slopes are to be covered with a minimum of 12 inches of topsoil from stockpiles and re-vegetated with an appropriate seed mix of local grasses and plants		6-Oct-15	GIM
	The foundation drain system will be maintained to collect seepage. Seepage water will be monitored and treated as needed.		6-Oct-15	GIM
Seepage	Seepage will be controlled through the use of: -HDPE geomembrane to minimize seepage from impoundment. -Foundation drain system.		29-May-15	GIM
	Collected seepage is monitored and pumped to PWP and recycled for mill use.		28-Apr-15	GIM
Seismic	Peak horizontal ground acceleration = 0.35 g (mean hazard value) (MDE)	Knight Piésold Work File #44 (VA101-460/03)	6-Aug-15	GIM
	Earthquake Design Ground Motion (EDGM) = 1/10,000 year event (MDE)	Senate Bill 409, Knight Piésold Work File #44 (VA101-460/03)	6-Aug-15	GIM
Embankment Stability	Permanent embankment slopes to be no steeper than 2.5H:1V to facilitate reclamation, and achieving the minimum required Factors of Safety (FOSmin) for the following loading conditions:		6-Aug-15	GIM
	Evaluated based on site investigation data, laboratory testing of representative samples, and staged embankment configuration		14-May-15	GIM
	During construction (starter dam and dam raises) FOSmin = 1.3	Senate Bill 409	6-Aug-15	GIM
	Normal Operating Conditions FOSmin = 1.5	Senate Bill 409	6-Aug-15	GIM
	Seismic (Post-earthquake loading condition; full liquefaction of tailings FOSmin = 1.2	Senate Bill 409	6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m at closure to provide suitable running width for haul trucks, pipelines, and for potential future raises.		28-Apr-15	GIM
	Minimum 10 m working surfaces during downstream stepouts.		6-Aug-15	GIM
2.3 Process Water Pond (PWP)				
Function	The PWP is designed for storage of 420,000 m3 of process and stormwater.	1 year of process water storeage requirement = 200,000 m3, plus an additional 220,000 m3 for stormwater storage.	14-Jul-15	GIM
Concept	A double HDPE (100 mil) lined impoundment with geotextile barrier between layers of HDPE liner, constructed during pre-production years to contain process water for mill use recycle with additional capacity for storm event storage. Underlay liner and geotextile will collect and drain off leakage from overlay liner.		28-Apr-15	GIM
Storage Capacity	Impoundment of a minimum of 4 months of process water, storm water event water, and surplus to offset evaporation. Water volumes include 200,000 m3 of process water for mill use recycle, water from CTF (60,000 m3) and PMF event storage (160,000 m3).		6-Aug-15	GIM
Dam Hazard Classification	'HIGH' as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.	FEMA, ICOLD, State of MT	4-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (PMF), as per FEMA and ICOLD guidelines.	FEMA, ICOLD	4-May-15	JEF
Flood Management - Catchment Areas	Catchment Area = approximately 19.03 ha	Determined using currently facility and diversion channel layout	14-May-15	GIM
Inflow Design Flood (IDF) Volumes	0.16 Mm3 (based on catchment area and 850 mm IDF runoff depth)		14-May-15	GIM
Design Freeboard	Minimum 2 m with additional freeboard for full containment of IDF for both CTF & PWP, and wave run-up.		6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes		6-Aug-15	GIM
Operational Criteria	Flood management: PWP will be sized to store IDF, surface water will be redirected around facilities by diversion channels.		28-Apr-15	GIM
	Mine water pumped to PWP.		28-Apr-15	GIM
	Excess water monitored and treated accordingly.		28-Apr-15	GIM
Closure Criteria	The pond will be drained off and process water will be treated before release back into water system. Residual slimes within the impoundment will be mixed with cement. The HDPE liner system will be folded into the basin of the impoundment and buried. The disturbed area will be contoured to resemble the surrounding topography and covered with topsoil and revegetated.		14-May-15	GIM
Seepage	Seepage will be controlled through the use of: - Double lined facility consisteing of 100 mil HDPE geomembraned with geotextile sandwiched between liners to collect and drain off leakage from upper liner.		28-Apr-15	GIM
	Collected seepage is monitored and pumped to PWP and recycled for mill use.		28-Apr-15	GIM
Seismic	Peak horizontal ground acceleration = 0.35 g (mean hazard value) (MDE)		6-Aug-15	GIM
	Earthquake Design Ground Motion (EDGM) = 1/10,000 year event (MDE)		6-Aug-15	GIM
Embankment Stability	Permanent embankment slopes to be no steeper than 2.5H:1V to facilitate reclamation, and achieving the minimum required Factors of Safety (FOSmin) for the following loading conditions:		6-Aug-15	GIM
	Evaluated based on site investigation data, laboratory testing of representative samples, and staged embankment configuration		14-May-15	GIM
	End of construction (starter dam and dam raises) FOSmin = 1.3	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM

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SUMMARY OF DESIGN BASIS FOR THE CTF

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ITEM	VALUE		SOURCE (Assumption if none noted)	DATE	Entered By:
	Long term (at closure)	FOSmin = 1.5	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
	Seismic (Pseudo-static loading condition)	FOSmin = 1.0	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
	Seismic (Post-earthquake loading condition; full liquefaction of tailings	FOSmin = 1.5	US Army Corps of Engineers, 2003 guidelines	6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m at closure to provide suitable running width for haul trucks, pipelines, and for potential future raises.			28-Apr-15	GIM
3.0 WATER MANAGEMENT					
3.1 Water Management Objectives					
Freshwater Requirements & Availability	Approximately 163,000 m3 of make-up water will be required annually, sourced from dewatering of the underground mine workings.		Knight Piésold Ltd Letter Report Ref No. VA15-03200, October 7, 2015	9-Oct-15	GIM
External Water Sources	Water sourced from underground mine workings used for additional process make-up water.			6-Aug-15	GIM
Water Management Plan	Process water recycled for mill use from PWP.			28-Apr-15	GIM
	Water losses due to evaporation offset by mine site dewatering.			28-Apr-15	GIM
	Precipitation and run-off will be transferred to a water treatment plant and released.			6-Oct-15	GIM
	Excess mine inflows to be treated and released in underground LAD facility.			6-Aug-15	GIM
3.2 CTF and PWP Diversion Channels					
Function	Convey non-contact water from undisturbed mine areas during construction and operations.			6-May-15	JEF
Inflow Design Flood (IDF)	Probable Maximum Flood (850 mm over a 24 hour period)		Knight Piesold, FEMA	15-May-15	JL
Design Life	Construction Phase: 1 year, Operations Phase: 15 years.			6-May-15	JEF
Concept	Channels excavated into bedrock, lined with riprap where required.			6-May-15	JEF
Sediment Control	Diversion Ditches will flow into unlined energy dissapation and sediment control ponds. Ponds will be mucked out during dry periods.			6-Aug-15	GIM
3.3 Non-Contact Water Reservoir					
Function	Provide fresh water storage to offset mine site consumptive use. Water will be released into watershed throughout the dry season. No water from the NCWR will be used by the mine site.			6-May-15	JEF
Concept	Partially unlined impoundment to provide storage and freeboard for the freshwater to be released throughout dry periods to offset mine site consumptive water use. Upstream embankment face will have HDPE liner to prevent seepage through embankment fill.			14-May-15	GIM
Storage Capacity	Storage of 360,000 m3 freshwater and wave run-up.			6-May-15	JEF
Dam Hazard Classification	'LOW" as per FEMA, ICOLD and State of Montana Dam Safety Guidelines.		FEMA, ICOLD, State of MT	15-May-15	JL
Inflow Design Flood (IDF)	1 in 200 year 24 hour precipitation = 96 mm			9-Oct-15	GIM
Flood Management - Catchment Areas	Catchment Area = approximately 58.3 ha		Determined using currently facility layout	9-Oct-15	GIM
Inflow Design Flood (IDF) Volumes	0.06 Mm3 (based on catchment area and 96 mm IDF runoff depth)		Knight Piesold	16-May-15	JL
Design Freeboard	2 m freeboard for full containment of fresh water and wave run-up.			6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes			6-Aug-15	GIM
Operational Criteria	Flood management: Spillway will pass through flood water in excess of required capacity into energy disappation structure.			6-May-15	GIM
	Excess water monitored for flow volumes.			6-May-15	JEF
	Fresh water sourced from Sheep Creek, pumped into the impoundment during the spring freshet.			12-May-15	GIM
Diversion Channel	Channel size to pass the 1 in 100 year 24 hour storm event.			9-Oct-15	GIM
Closure Criteria	The HDPE geomembrane liner will be removed from the upstream face of the embankment, and the embankment will be excavated out to prevent ponding of water post-closure. The embankment fill will be hauled to the CTF to be used as capping material for the CTF closure. The remaining side slopes and embankment footprint area will be cover with topsoil and revegetated.			23-Feb-17	GIM
Seepage	Seepage will be allowed to pass into groundwater system untreated as all water within NCWR is non-contact fresh water.			6-May-15	JEF
Spillway Design	Spillway Designed to convey 1 in 200 year return period flood.			6-May-15	JEF
	Spillway will be excavated into bedrock, and lined with riprap along select locations as needed.			6-Aug-15	GIM
Embankment Crest Width	Minimum 10 m to provide suitable running width for haul trucks, pipelines, and for potential future raises.			6-May-15	JEF
3.4 Foundation Drain Collection Ponds					
Function	Collect groundwater flows and seepage from the foundation drain systems of the CTF and PWP			6-Aug-15	GIM
Concept	HDPE lined (100 mil) excavations to provide storage and freeboard to contain flows from foundation drain system, up to and including the 1 in 100 year 24 hour storm event.			6-Aug-15	GIM
Inflow Design Flood (IDF)	1 in 100 year 24 hour storm event			15-May-15	JL
Design Flood Volumes	2,000 m3 and 1,000 m3 for the CTF and PWP respecitvely (based on expected groundwater inflows to foundation drain system)			6-Aug-15	GIM
Design Freeboard	1 m freeboard for full containment of foundation drain outflows, storm event storage, and wave run-up.			6-Aug-15	GIM
Embankment Slopes	2.5H:1V Side Slopes			6-Aug-15	GIM
Operational Criteria	Flood management: SCP will be sized to contain the design flood event including anticipated seepage water.			6-Aug-15	GIM
	Water monitored and treated accordingly.			6-Aug-15	GIM
Closure Criteria	The SCP for the CTF will be maintained in order to collect seepage from the foundation drain system for water quality monitoring. The SCP for the PWP will have the liner removed, and the pond will be filled in with general fill, covered with topsoil and revegetated.			6-Aug-15	GIM
Seepage	Seepage will be controlled through the use of HDPE geomembrane to minimize seepage from pond.			6-Aug-15	GIM
	Collected seepage is monitored and pumped back in to respective facility.			6-Aug-15	GIM
4.0 TAILINGS DISTRIBUTION & RECLAIM PIPELINE SYSTEMS					
4.1 Tailings Stream					
Design Production Rate	Tailings Production Rate of 120.8 tph (tonnes per hour)		Verbally Confirmed by TRI, 2 900 tpd (3,300 tpd minus 400 tpd to concentrate)	6-Aug-15	GIM
Physical Properties	Slurry Solids Content = 79% by weight (wt/wt)		TRI	6-May-15	JEF
	Specific Gravity of Solids = 3.77		SG Value provided by Jeff Austin (2015)	6-May-15	JEF
Plant Site Availability	Plant Site Availability of 92%.		TetraTech	6-May-15	JEF
4.2 Tailings Distribution Pipeline System					
Pipeline Specifications & Design Criteria	Single tailings stream from process mill			6-May-15	JEF
	Tailings Pipeline = 55% of tailings production rate.			6-May-15	JEF
	Single discharge offtake located at south end of CTF			6-Aug-15	GIM
	Tailings pipeline specification - 8" PN150 Steel Pipeline selected due to high pumping pressures.		MG Engineering	6-Oct-15	GIM
Emergency Discharge Plan	Tailings 'Emergency Discharge' plan is to backfill underground in case of tailings pipeline being offline.			6-Oct-15	GIM
Surge Capacity	Tailings pipeline pressure surge capacity = 20%			6-May-15	JEF
Tailings Pump	Tailings pump system to be designed by Tetra Tech			6-Oct-15	GIM
4.3 Mechancial Systems					
Pumping Systems	Two reclaim water systems for reclaim water for reuse in the mill process. Line 1: from PWP to Mill Site Line 2: CTF to PWP.			11-Aug-15	JEF
	Two seepage pumpback systems for return of seepage between HDPE geomembrane layers (leak detection and recovery): Line 1: PWP seepage collection sump recycle to PWP Line 2: CTF seepage collection sump to CTF			11-Aug-15	JEF
	Two pumpback systems for return of foundation drain flows: Line 1: PWP foundation drain collection pond to PWP Line 2: CTF foundation drain collection pond to CTF			11-Aug-15	JEF
	Source water pump system: Sheep Creek			11-Aug-15	JEF
	Two pumping systems for NCWR: Line 1: Sheep Creek source point to NCWR Line 2: NCWR to discharge point in downstream wetlands			27-May-15	GIM
General System Design Criteria	HDPE pipeline. Steel pipeline only if required to meet pipeline pressure requirements			26-May-15	RSS
	Double walled pipeline			26-May-15	RSS
	Pipeline diameter to be determined based on flow requirement			26-May-15	RSS
	HDPE Pipeline pressure selection range: DR 9 (max) to DR21 (min), rating selected to meet pump deadhead pressure capacity			26-May-15	RSS
	Pipeline design velocity: 1.5 - 2 m/s			26-May-15	RSS
	Pipeline alignment: selected to follow existing road alignments where possible			26-May-15	RSS
	No heat tracing or insulation of pipeline			26-May-15	RSS
	Air release/vacuum valves located at all high points and at least every 600 metres			26-May-15	RSS
	Pump specification: either barge or wet well mounted depending on total LOM elevation change.			26-May-15	RSS
	Motors: 0 to 250 HP use 550V motor, >250 HP use 4.16kV motor.			18-Aug-15	MAP
Reclaim Line 1 - PWP to Mill	Line 1 Reclaim system design flowrate = 615 m3/h 100% mill process water requirements and includes consideration of plant availability and 20% design factor.		This is based on the annual value from Tetra Tech (4,130,000 m3/yr) during full production and includes adjustment for 92% mill availability.	18-Aug-15	MAP
	PWP water elevation = ~1792 m		Estimated based on 200,000 m3 throughout operating year	28-May-15	GIM
	Maximum pipeline alignment elevation = 1800 m			28-May-15	GIM
	Plant Site discharge elevation = ~1790 m (top elevation of tank if discharged into Plant reclaim tank)			28-May-15	GIM
	Pump: Submersible pump in riser pipeline + stand-by unit installed on crest of PWP embankment on pad			18-Aug-15	MAP
Reclaim Line 2 - CTF to PWP	Line 2 Reclaim system design flowrate = 75 m3/h		Design to dewater the 1:100 year storm event over a 10 day period = 20.3L/s (Knight Piésold Work File #25)	11-Aug-15	JEF
	CTF Basin floor elevation = 1765 m			11-Aug-15	JEF
	CTF Underdrain sump base elevation = 1761 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1802 m			11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
	PWP closure crest elevation = 1800 m			11-Aug-15	JEF
	Pump: Submersible vertical turbine pump			18-Aug-15	MAP
Seepage Collection and Recycle Pump Line 1 - PWP pond	Line 1 Seepage pump system design flowrate = 29 m3/h		Knight Piésold Work File #26	11-Aug-15	JEF
	PWP Basin floor elevation = 1785 m			11-Aug-15	JEF
	PWP Seepage Collection Sump base elevation = 1780 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1800 m			11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
Seepage Collection and Recycle Pump Line 2 - CFT pond	Line 2 Seepage pump system design flowrate = 0.63 m3/h		Knight Piésold Work File #39	11-Aug-15	JEF
	CTF Basin floor elevation = 1765 m			11-Aug-15	JEF
	CTF Seepage Collection sump base elevation = 1761 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1799 m			11-Aug-15	JEF
	CTF discharge elevation (crest elevation of CTF) = 1799 m			11-Aug-15	JEF
Foundation Drain Collection & Recycle Pump Line 1 - PWP pond	Line 1 Seepage pump system design flowrate = 40 m3/h Design criteria = pump out of 1 in 100 year 24-hour storm event from contributing catchment over ten days.		Run-off and groundwater flows through foundation drains from 1:100 year storm event is 11.02 L/s (Knight Piésold Work File #28)	11-Aug-15	JEF
	PWP discharge elevation (crest elevation of PWP) = 1800 m			11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1800 m			11-Aug-15	JEF
	Foundation Drain Collection Pond minimum water level elevation = 1775 m		Assumed value based on topography	11-Aug-15	JEF
	Foundation Drain Collection Pond to be maintained as dry facility			11-Aug-15	JEF
	Pump: Centrifugal pump			18-Aug-15	MAP

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Print: Jul/06/2017 15:24:57

ITEM	VALUE	SOURCE (Assumption if none noted)	DATE	Entered By:
Foundation Drain Collection & Recycle Pump Line 2 - CFT pond	Line 2 Seepage pump system design flowrate = 79 m3/h Design criteria = pump out of 1 in 100 year 24-hour storm event from contributing catchment over ten days.	Run-off and groundwater flows through foundation drains from 1:100 year storm event is 22.18 L/s (Knight Piésold Work File #6)	11-Aug-15	JEF
	CTF discharge elevation (crest elevation of CTF) = 1799 m		11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1799 m		11-Aug-15	JEF
	Foundation Drain Collection Pond minimum water level elevation = 1750 m	Assumed value based on topography	11-Aug-15	JEF
	Foundation Drain Collection Pond to be maintained as dry facility		11-Aug-15	JEF
	Pump: Centrifugal pump		18-Aug-15	MAP
Non-Contact Water Reservoir Pump System Line 1 - Sheep Creek to NCWR	Source water pump design flowrate = 215 m3/h	Design criteria = To fill the NCWR with 300,000 m3 of freshwater supply during in a 2-month freshet period assuming an additional 50,000 - 60,000 m3 reports to the NCWR from natural runoff.	11-Aug-15	JEF
	Source water minimum water level elevation = 1710 m	Based on collection point specified by Allan Kirk, cross point between Sheep Creek and county road	11-Aug-15	JEF
	NCWR Embankment Crest Elevation = 1776.5 m	As measured in Civ3D model	11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1776.5 m	Embankment crest is higher than intervening terrain.	11-Aug-15	JEF
	Pump: Vertical turbine pump		18-Aug-15	MAP
Non-Contact Water Reservoir Pump System Line 1 - NCWR to Discharge Spillway	Source water pump design flowrate = 42 m3/h	Assumes draining draining of facility prior to next season freshet sourcing (i.e. 10 months discharge from system, 2 months of filling during freshet)	11-Aug-15	JEF
	Intake water level elevation = 1765 m	Lowest point in reservoir, as measured in Civ3D model	11-Aug-15	JEF
	NCWR Embankment Crest Elevation = 1776.5 m	As measured in Civ3D model	11-Aug-15	JEF
	Maximum pipeline alignment elevation = 1776.5 m	Embankment crest is higher than intervening terrain.	11-Aug-15	JEF
	Pump: Pontoon-mounted centrifugal pump		18-Aug-15	MAP
Instrumentation and Monitoring	Pressure gauges on each pump unit discharge line Flowmeter on main discharge line from Pump Station Reclaim VFD control: feedback loop from level control in Plant-site reclaim tank		26-May-15	RSS
5.0 Temporary Waste Rock Storage Pad				
Design Concept	Design of a temporary pad to store 500,000 t of pre-production and early operations PAG waste, including seepage collection measures.		6-Aug-15	GIM
Seepage control	HDPE geomembrane liner angled towards a run-off collection sump and culvert.		6-Aug-15	GIM
Surface water control	Run-off will be transferred via solid pipeline to a contact water pond located near the portal pad		23-Feb-17	GIM
6.0 MISCELLANEOUS				
Instrumentation and Monitoring	Vibrating wire piezometers to measure pore water pressure in the embankments and tailings mass.		6-May-15	JEF
	Inclinometers installed on embankments as required		6-May-15	JEF
	Flow monitoring equipment for foundation drain system outlet pipes.		6-May-15	JEF
	Pressure gauges and flowmeters on discharge lines of pump units.		6-May-15	JEF
Construction Materials	Bulking factor for overburden (Dry to moist SAND with some silt) is 12% before compaction, 5% after compaction		7-May-15	GIM
	Bulking factor for rock fill is 40-50% before compaction, 20% after compaction	Based on measured in situ rock density of 2.6 t/m3 and an assumed compacted rock density of 2 to 2.2 t/m3	6-Aug-15	GIM

\\KPL\VA-Prj$\1\01\00460\03\A\Report\4 - TOMS Manual\Rev A\Appendices\Appendix A - Design Basis\[Appendix A - Design Basis.:

0	20APR'17	ISSUED WITH REPORT VA101-460/3-4	JEF	GIM
REV	DATE	DESCRIPTION	PREP'D	REV'D

APPENDIX B

DESIGN DRAWINGS

(Pages B-1 to B-40)

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

1 / - 1 / XXX SEE BELOW FOR DEFINITION

CHANGE IN CUTTING PLANE

1 / - 1 / -

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

1 / -

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

DETAIL REFERENCE

A / XXX

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

A / XXX

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

FOUNDATION TREATMENT

OVERBURDEN

MINIMUM EXCAVATION LINE

APPROX. (OR ASSUMED) ROCK SURFACE

GEOTEXTILE

HDPE GEOMEMBRANE

XXXXXXXXXXXXX GEONET

FILL SLOPE SYMBOL

CUT SLOPE SYMBOL

SLOPE - CONCRETE FACE

1ST STAGE CONCRETE

2ND STAGE CONCRETE

OPENING OR BLOCKOUT

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

WATER

FOR INFORMATION ONLY

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

INDEX SHEET

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C0002	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

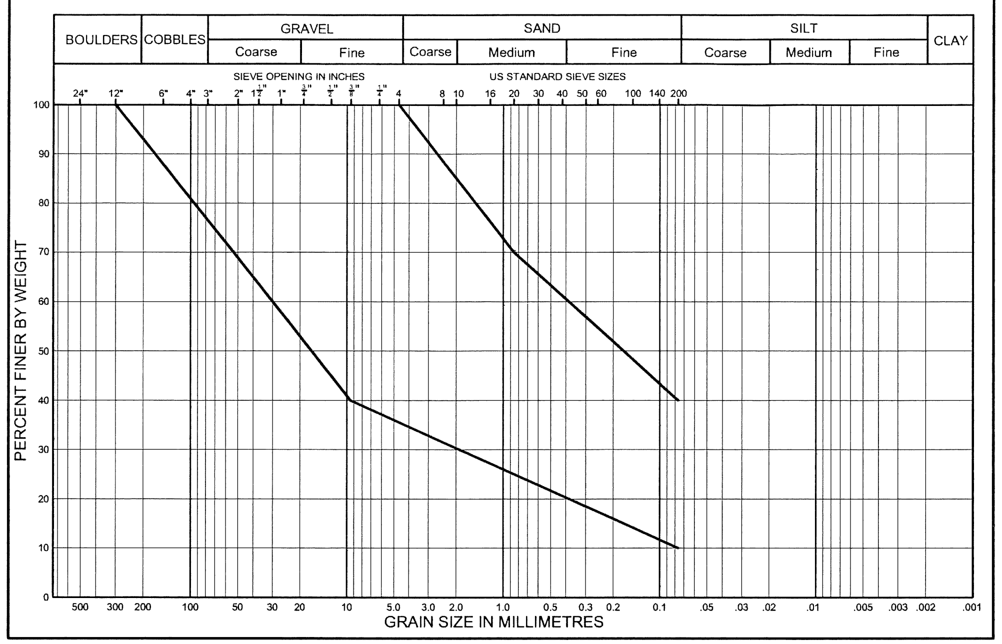
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	[signature]	[signature]

REVISIONS

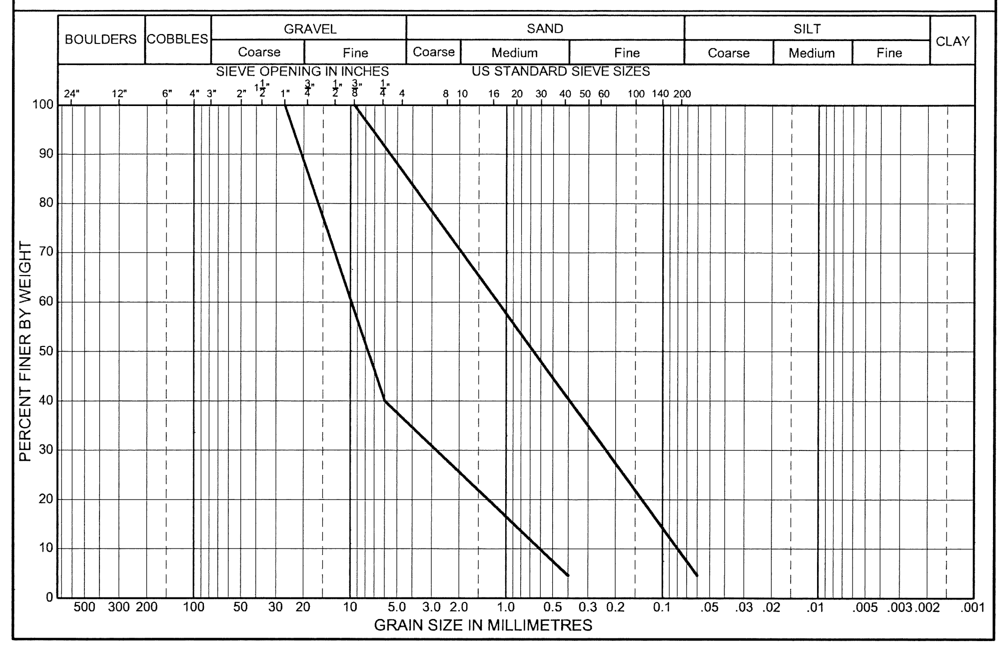
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE A - EMBANKMENT FILL



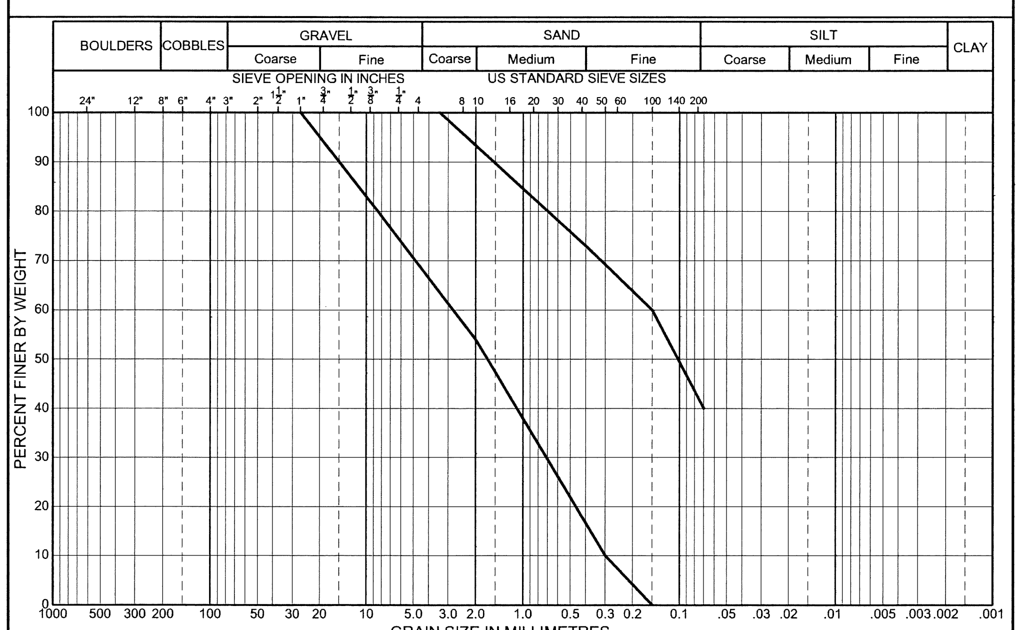
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE C - DRAINAGE GRAVEL



UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE B - SUB-GRADE BEDDING



MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE	MATERIAL TYPE	PLACING AND COMPACTION REQUIREMENTS
A	EMBANKMENT FILL	ZONE A MATERIAL SHALL CONSIST OF HARD, DUTABLE FRESH TO MODERATELY WEATHERED ROCK FILL WITH A MAXIMUM PARTICLE SIZE OF 300mm AND PLACED IN 500mm THICK LIFTS WITHIN THE MAIN EMBANKMENT ZONE. THE MATERIAL SHALL BE FREE OF CLAY, LOAM, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED AND SPREAD IN HORIZONTAL LIFTS BY A DOZER. COMPACTION OF ZONE A WILL BE TO 95% MODIFIED PROCTOR LABORATORY DENSITY WITH A SMOOTH DRUM VIBRATORY ROLLER.
B	SUB-GRADE BEDDING	ZONE B MATERIAL SHALL CONSIST OF DURABLE, FRESH TO WEATHERED ROCK FILL WITH A MAXIMUM PARTICLE SIZE OF 1" AND PLACED IN 300mm THICK LIFTS ON THE BASIN SURFACE AND UPSTREAM SIDE OF ANY EMBANKMENT. THE MATERIAL SHALL BE FREE OF CLAY, LOAM, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED AND SPREAD IN HORIZONTAL LIFTS BY A DOZER. COMPACTION OF ZONE B WILL BE TO 95% MODIFIED PROCTOR LABORATORY DENSITY WITH A SMOOTH DRUM VIBRATORY ROLLER.
C	DRAINAGE GRAVEL	THIS MATERIAL WILL BE FREE DRAINING, DURABLE CRUSHED ROCK. THE MATERIAL SHALL BE FREE OF CLAY, TREE STUMPS OR OTHER DELETERIOUS OR ORGANIC MATTER. THE MATERIAL WILL BE PLACED IN 500mm THICK LIFTS AND SPREAD BY DOZER OR MANUALLY PLACED BY EXCAVATOR.

NOTES:

1. THESE MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS APPLY TO ALL COMPONENTS OF THE WORKS EXCEPT WHERE NOTED OTHERWISE. MATERIALS SUBJECT TO REVIEW PRIOR TO CONSTRUCTION.
2. THE MAXIMUM DIMENSION OF ANY PARTICLE SHALL NOT EXCEED 2/3 OF THE MAXIMUM LIFT THICKNESS.
3. ALL DRAWINGS TO BE READ IN CONJUNCTION WITH THE TECHNICAL SPECIFICATIONS.
4. ALL FILL MATERIALS SHALL BE FREE OF ORGANIC AND DELETERIOUS MATTER, AND SOFT FRIABLE PARTICLES.

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CONSTRUCTION MATERIAL SPECIFICATIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C0003	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	L.	K.

REVISIONS

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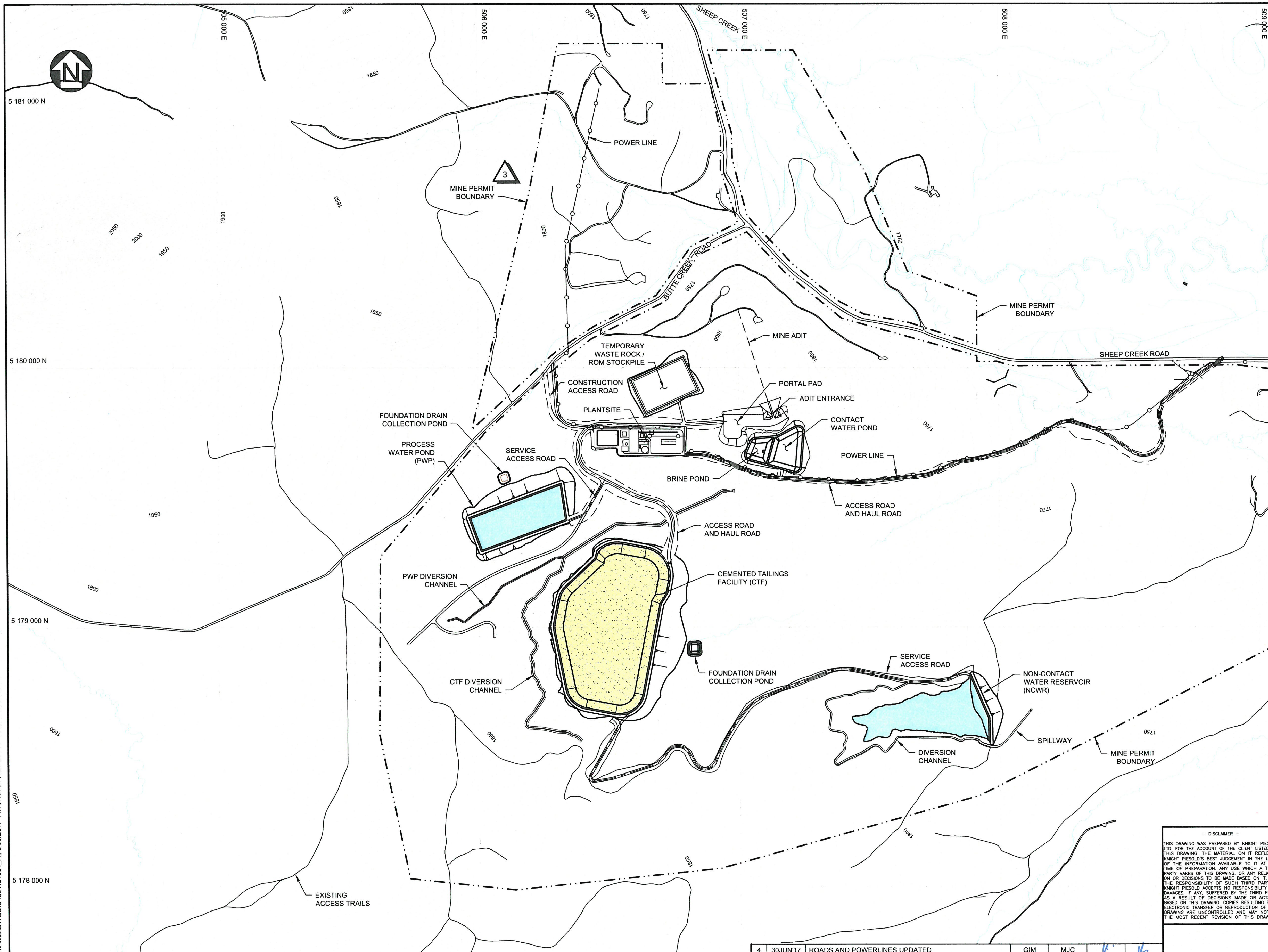

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC, DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 5 METERS.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

150 75 0 250 500 750 m
SCALE A

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GENERAL ARRANGEMENT

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C1001	4

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
4	30JUN'17	ROADS AND POWERLINES UPDATED	GIM	MJC		
3	27APR'17	NORTHWESTERN MINE PERMIT BOUNDARY UPDATED	GIM	WAL	KDE	KDE
2	20MAY'16	UPDATED POWERLINE AND BCWP ADDED	MAP	KJM	KDE	KDE
1	29APR'16	ISSUED FOR INFORMATION	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C1001\C1001_r4, 6/30/2017 11:18:43 AM, MCOUTTS PRINTED: 6/30/2017 11:36:45 AM, C1001, MCOUTTS
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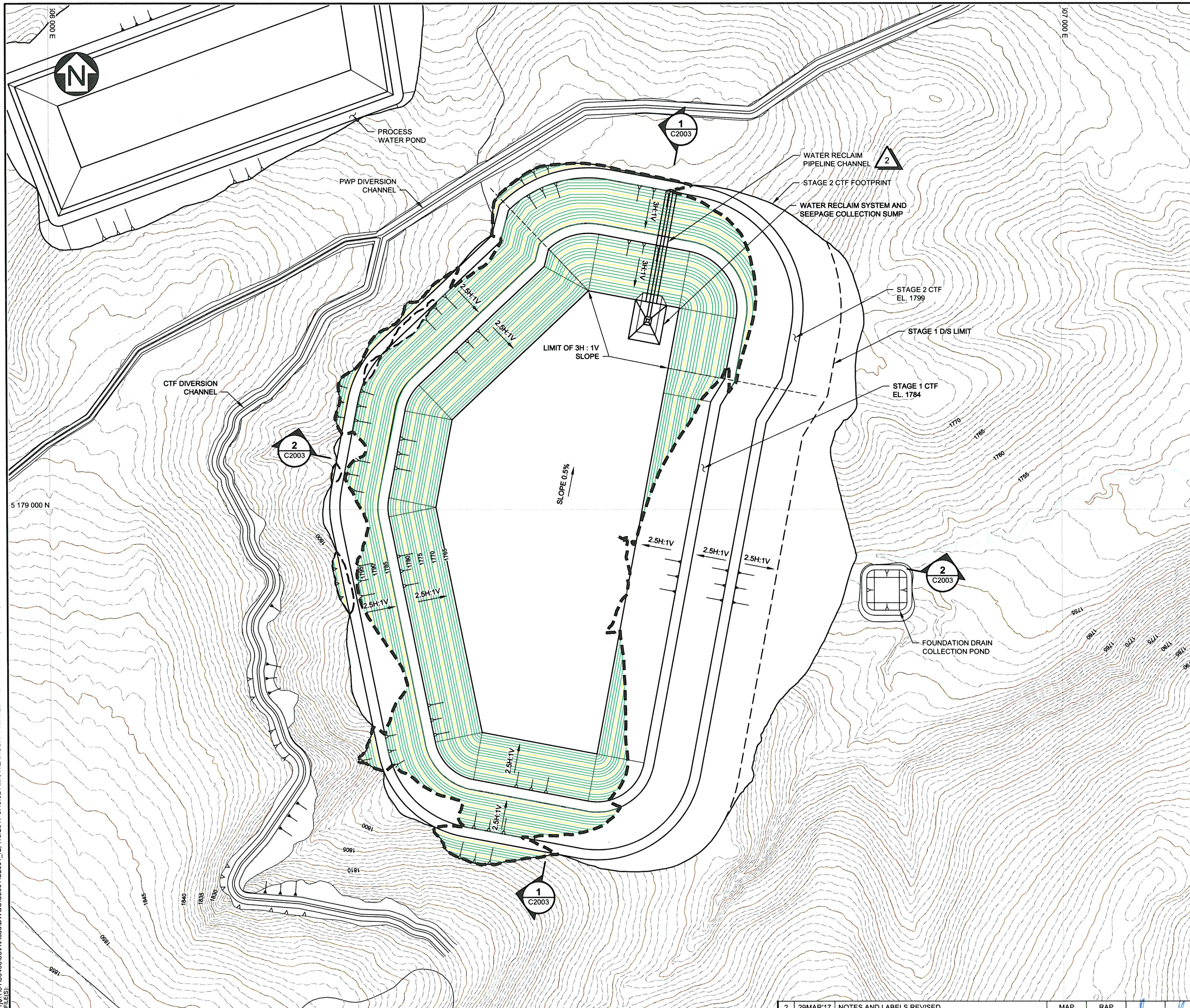

LEGEND:

- EXCAVATION CONTOURS
- ORIGINAL STRIPPED GROUND CONTOURS TO BE REGRADED
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES, DATED (FEB 03, 2011).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. FILL CONTOURS NOT SHOWN FOR CLARITY.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

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CEMENTED TAILINGS FACILITY GRADING PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2001	2

DRG. NO.	DESCRIPTION
C2003	CEMENTED TAILINGS FACILITY SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	29MAR'17	NOTES AND LABELS REVISED	MAP	RAP		
1	29APR'16	CTF FOUNDATION POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

SAVED: \\KPL\VA-Prj$\1\01\00460\03\A\cad\DWGS\C2001\C2001_r2, 7/5/2017 9:49:02 AM , WLAHODA PRINTED: 7/5/2017 9:54:15 AM, C2001, WLAHODA
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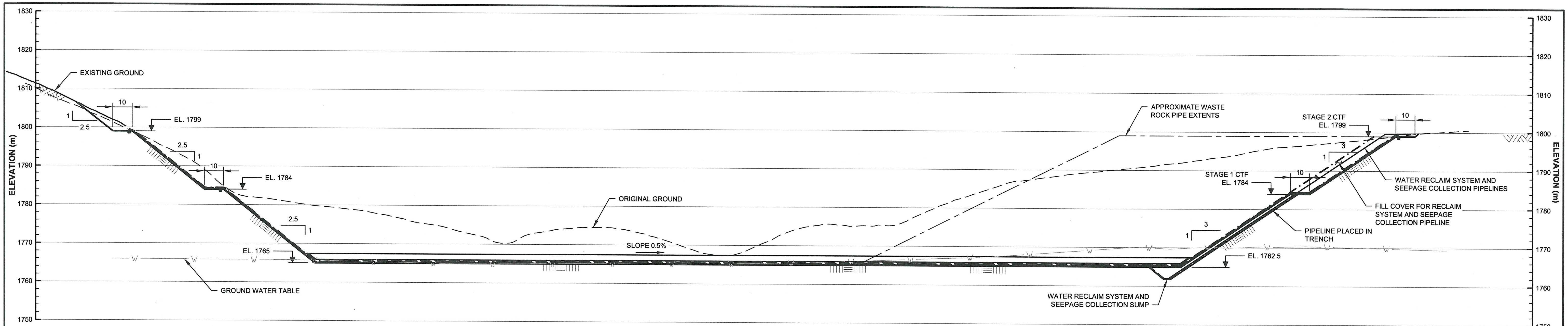
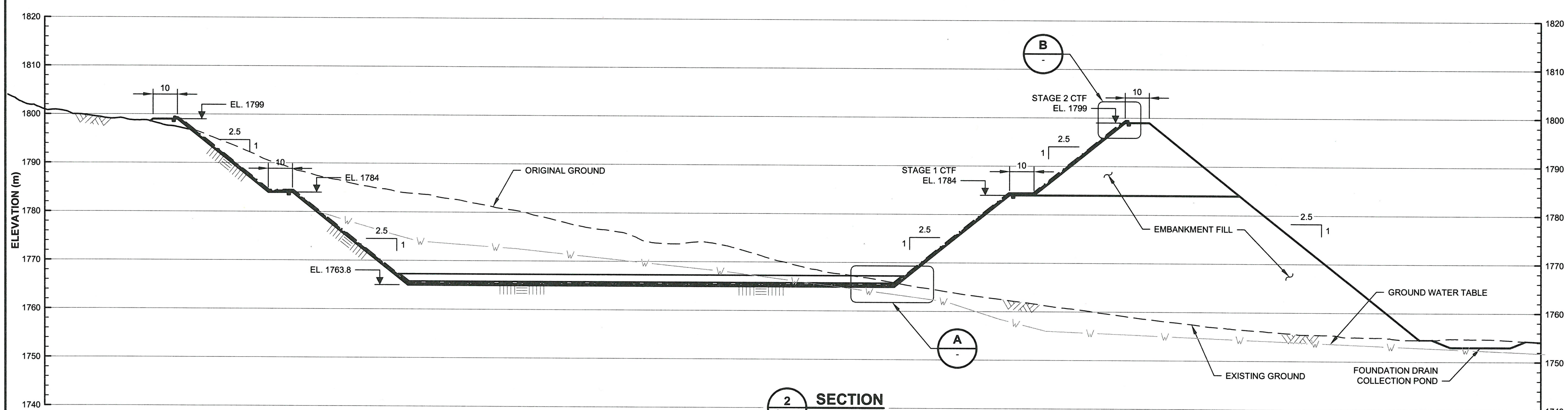
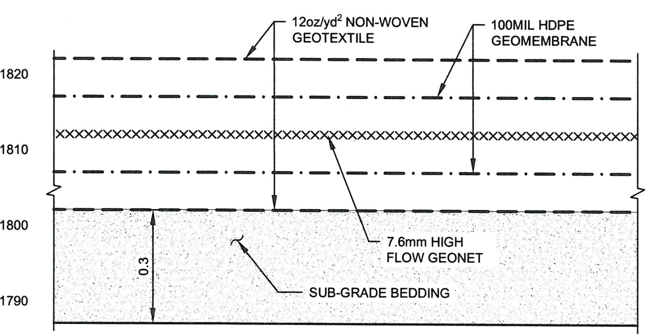


1 SECTION (C2001)
HORIZONTAL: SCALE A
VERTICAL: SCALE B



2 SECTION (C2001)
HORIZONTAL: SCALE A
VERTICAL: SCALE B



C DETAIL
LINER SYSTEM DETAILS
SCALE D

FOR INFORMATION ONLY

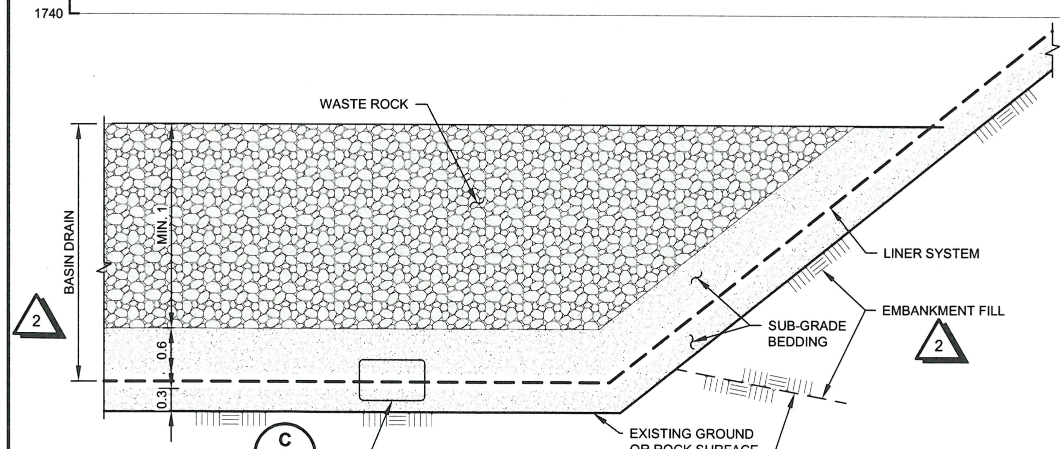
NOTES: 2

1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

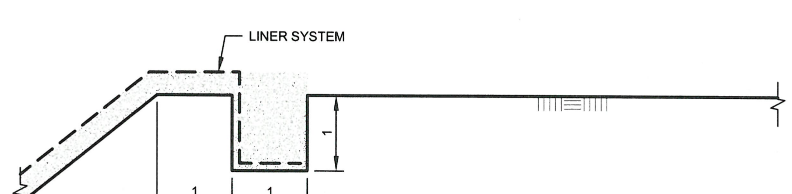
BASIN DRAIN THICKNESS BASED ON AVAILABLE WASTE ROCK VOLUME

2. THE WASTE ROCK LAYER IN DETAIL "A" HAS NO MATERIAL OR COMPACTION SPECIFICATIONS.

SCALE D: 0.2 0.1 0 0.2 0.4 0.6 0.8 1 m
SCALE C: 1 0.5 0 1 2 3 4 5 m
SCALE B: 10 5 0 10 20 30 40 50 m
SCALE A: 20 10 0 20 40 60 80 100 m



A SECTION
BASIN DRAIN
SCALE C



B DETAIL
ANCHOR TRENCH DETAIL
SCALE C

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY SECTIONS AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2003	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2005	CEMENTED TAILINGS FACILITY DETAILS
C2001	CEMENTED TAILINGS FACILITY GRADING PLAN

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR17	NOTES AND LABELS REVISED	GIM	RAF		
1	29APR'16	GROUND WATER TABLE ADDED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KJB	KJB

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2003\C2003_r2, 4/20/2017 3:56:43 PM, RFAHHAM PRINTED: 4/20/2017 3:57:40 PM, C2003, RFAHHAM
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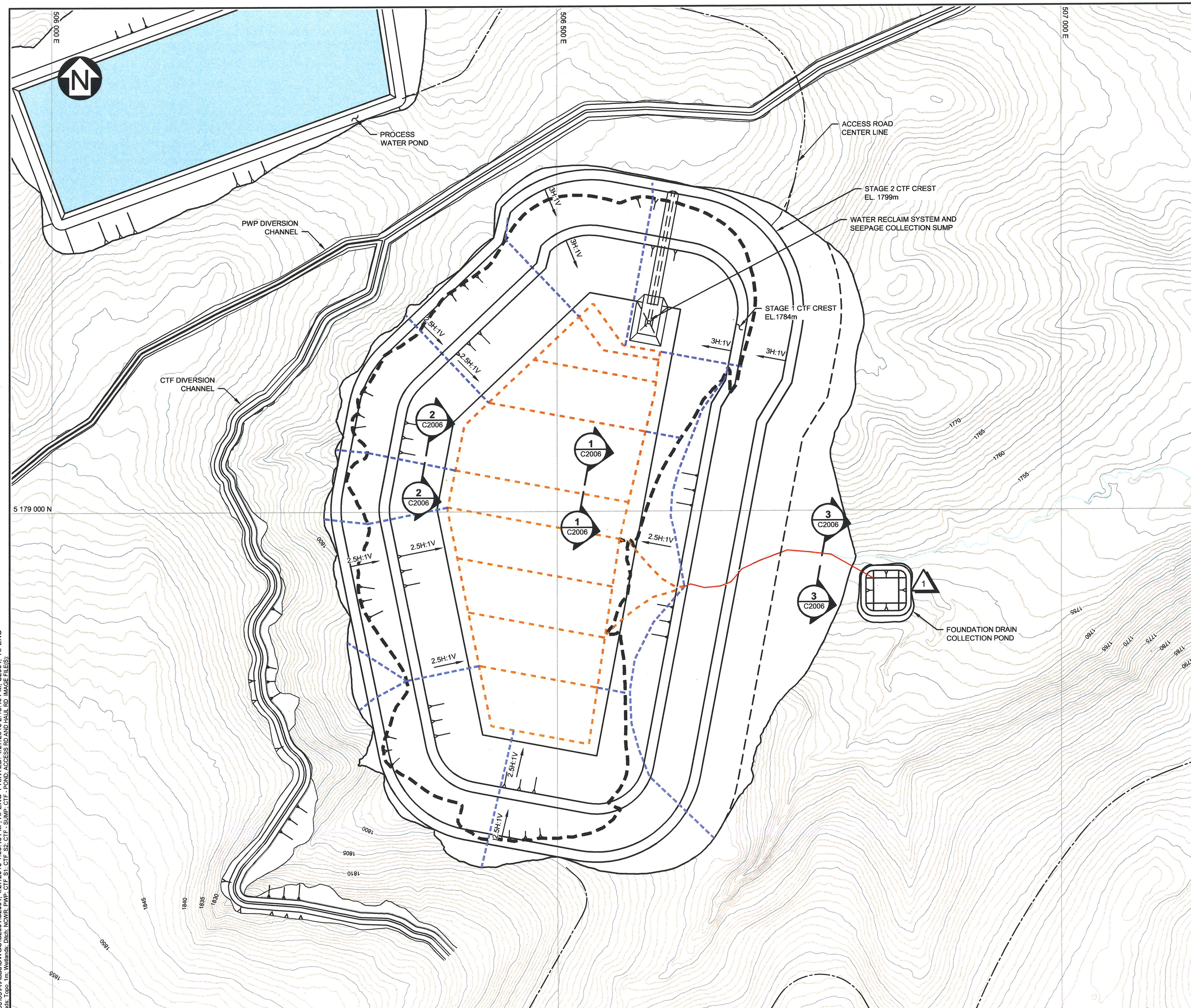

LEGEND:

- 250mm (10") N12 WT PE OUTLET PIPE
- 200mm (8") N12 ST PE DRAIN PIPE (BASIN FLOOR)
- 100mm (4") N12 ST PE DRAIN PIPE (CUT SLOPES)
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. DRAIN TRENCHES WILL BE SLOPED TOWARDS OUTLET PIPE CONNECTION AT A MINIMUM GRADE OF 0.5%.
5. LAST 10m OF OUTLET PIPE WILL BE SOLID PIPE BACKFILLED WITH IMPERMEABLE MATERIAL.
6. OUTLET PIPE WILL EMPTY INTO A WEIR TO MEASURE PIPE FLOW.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

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CEMENTED TAILINGS FACILITY BASIN FOUNDATION DRAIN SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2004	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2006	CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SYSTEM SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF SEEPAGE POND REVISED	MAP	RAP	K	K
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

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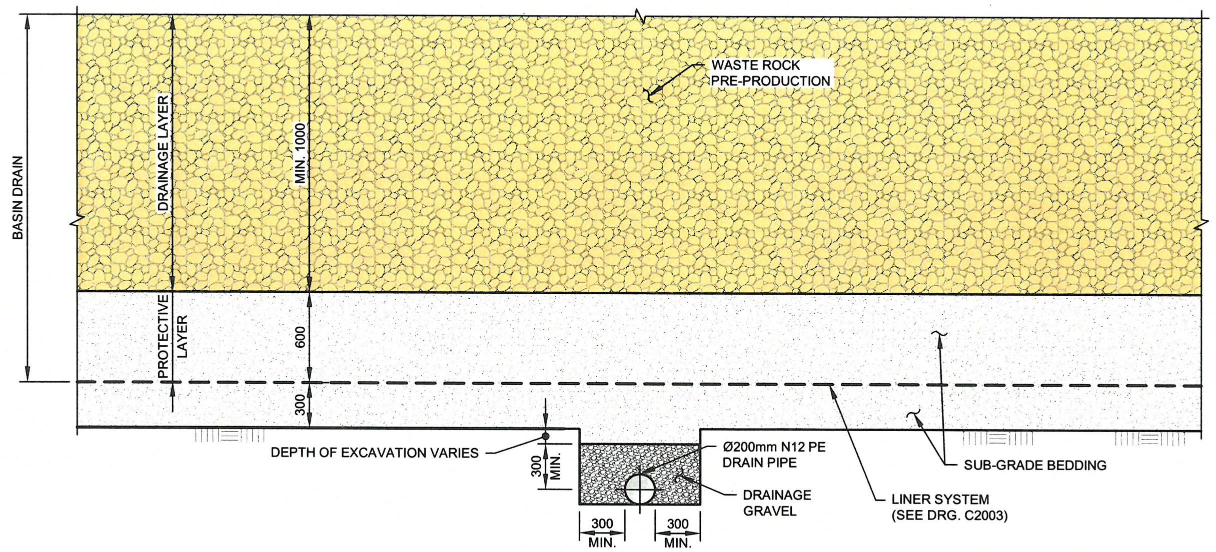
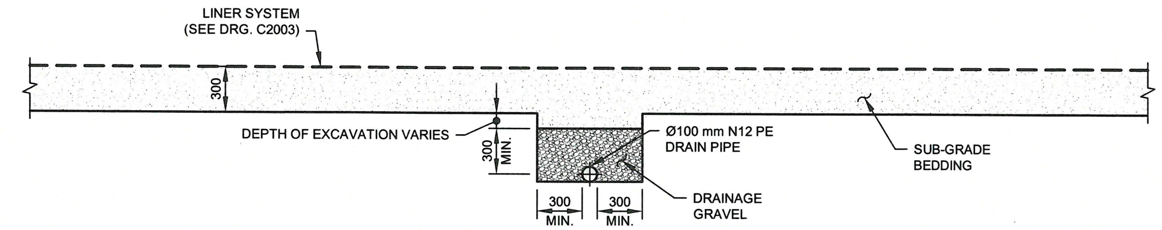
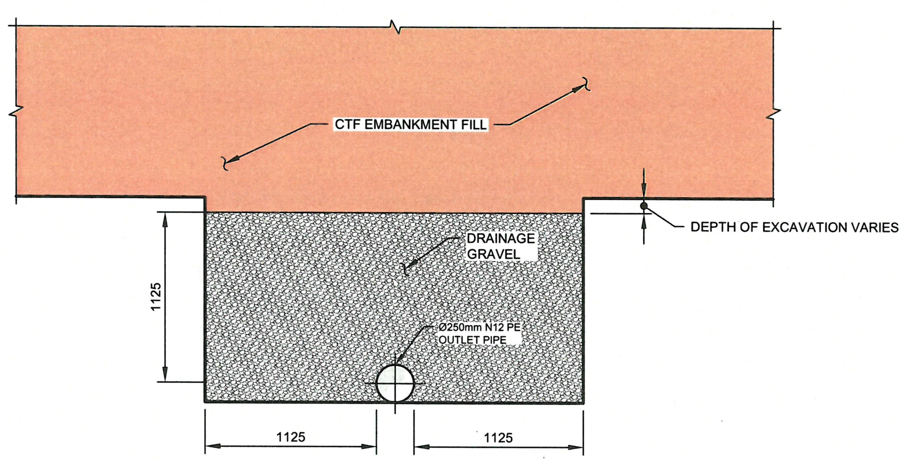


1 C2004 **TYPICAL SECTION**
BASIN FLOOR (BELOW LINER) 1
SCALE A



2 C2004 **TYPICAL SECTION**
UPSTREAM EMBANKMENT SLOPE 1
SCALE A



3 C2004 **TYPICAL SECTION**
OUTLET PIPE (BELOW EMBANKMENT FILL) 1
SCALE A

CTF FOUNDATION DRAIN SUMMARY TABLE

PIPE TYPE	PIPE OUTER DIAMETER (mm)	D NOMINAL DIAMETER	T DRAINAGE GRAVEL THICKNESS (mm)
BASIN FLOOR	231.1	8" (200mm)	300
UPSTREAM EMBANKMENT SLOPE	121.9	4" (100mm)	300
OUTLET PIPE	289.6	10" (250mm)	1125

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.
2. DRAIN PIPE ARE N12 ST PE PIPE (OR SIMILAR).
3. OUTLET PIPE IS N12 WT PE PIPE (OR SIMILAR).
4. THE WASTE ROCK MAKING UP THE DRAINAGE LAYER DOES NOT HAVE ANY MATERIAL OR COMPACTION SPECIFICATIONS.

FOR INFORMATION ONLY

SCALE A 0.4 0.2 0 0.4 0.8 1.2 1.6 2.0 m

Knight Piésold
CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY FOUNDATION DRAIN SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2006	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE
C2004	CTF BASIN FOUNDATION DRAIN SYSTEM - PLAN

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	20APR'17	NOTES AND LABELS REVISED	GIM	RAF		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JSL	NSD	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2006\C2006_r1, 4/20/2017 3:44:43 PM , RFAHHAM PRINTED: 4/20/2017 3:45:07 PM, C2006, RFAHHAM
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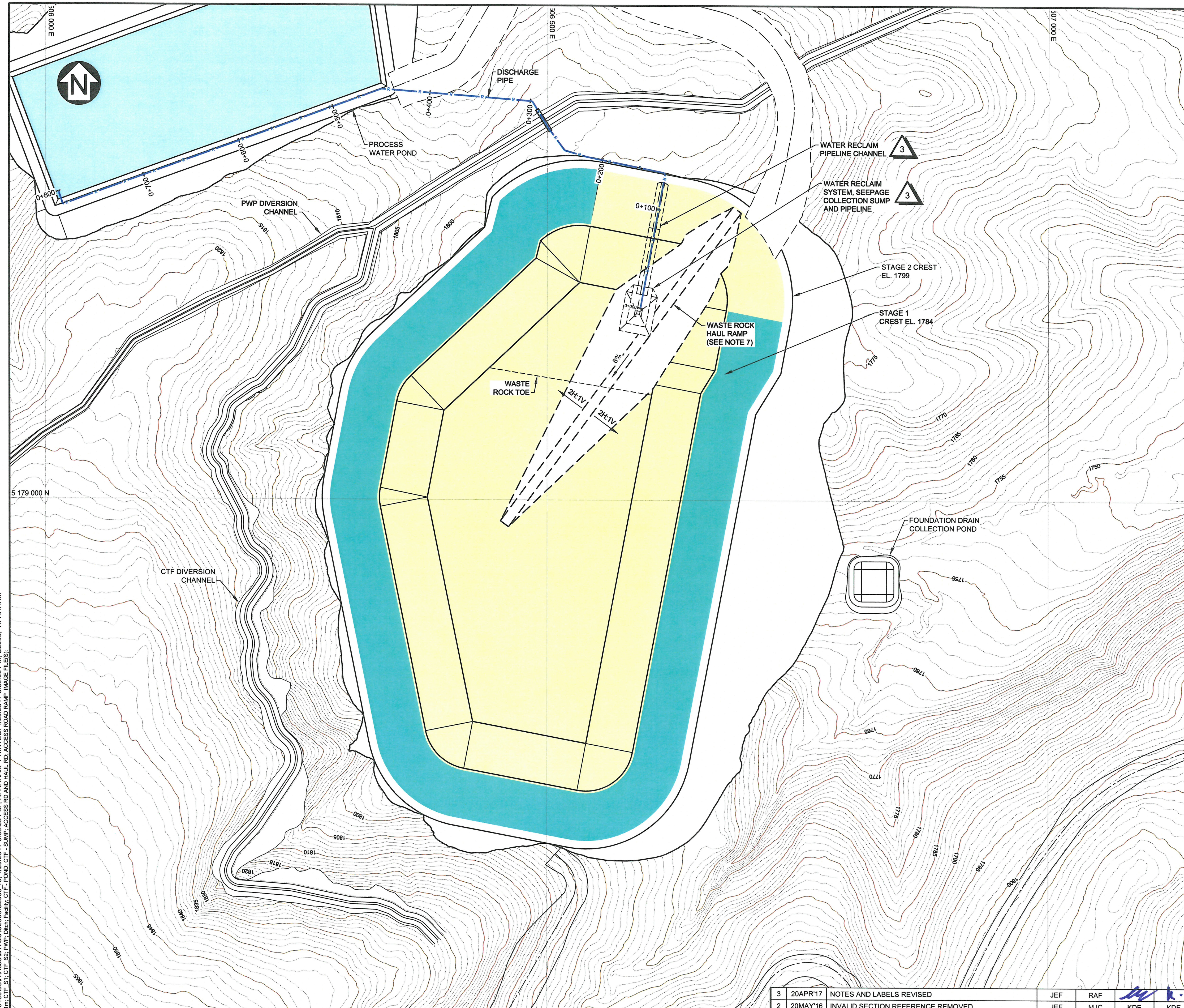


LEGEND:

- STAGE 1 LINER SYSTEM
- STAGE 2 LINER SYSTEM

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEBRUARY 3, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. WASTE ROCK WILL BE PLACED AROUND WATER RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP IN SUCH A MANNER AS TO PREVENT INUNDATION OF THE RECLAIM SYSTEM BY TAILINGS.
6. WASTE ROCK WILL BE PLACED OR SIDE CAST OFF HAUL RAMP AS NEEDED.
7. HAUL RAMP WILL BE CONSTRUCTED USING SURPLUS FILL FROM CTF EXCAVATION DETAILS TO BE FINALIZED WITH MINE OPERATOR.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY WASTE ROCK CO-DISPOSAL PLATFORM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2008	3

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

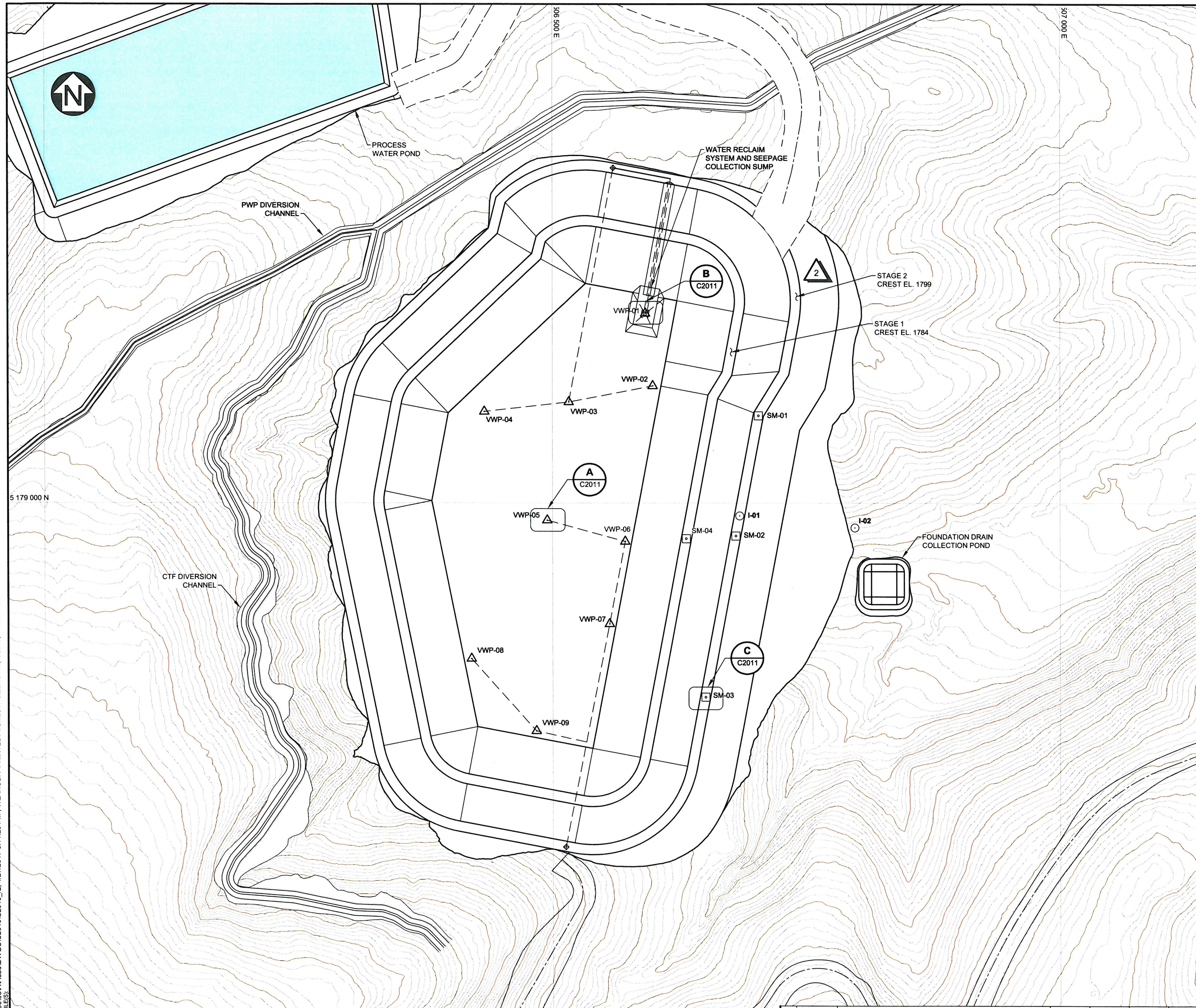
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
3	20APR'17	NOTES AND LABELS REVISED	JEF	RAF		
2	20MAY'16	INVALID SECTION REFERENCE REMOVED	JEF	MJC	KDE	KDE
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2008\C2008_r3, 4/20/2017 3:58:28 PM , RFAHHAM PRINTED: 4/20/2017 3:59:06 PM, C2008, RFAHHAM
XREF FILE(S): Topo_1m; CTF_S1; CTF_S2; PWP; Ditch; Facility; CTF - POND; CTF - SUMP; ACCESS RD AND HAUL RD; ACCESS ROAD RAMP IMAGE FILE(S):



LEGEND:

- △ VIBRATING WIRE PIEZOMETER
- ⊡ SURVEY MONUMENT
- ⊙ INCLINOMETER
- ⊕ VIBRATING WIRE PIEZOMETER READ OUT BOX
- — — VIBRATING WIRE PIEZOMETER LEADS

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. FILL CONTOURS NOT SHOWN FOR CLARITY.

FOR INFORMATION ONLY

SCALE A 40 20 0 40 80 120 160 200 m

Knight Piésold
CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY INSTRUMENTATION PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C2010	2

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C2011	CEMENTED TAILINGS FACILITY INSTRUMENTATION DETAILS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	27APR'17	LABEL REVISED	MAP	WAL	K	K
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C2010\C2010_r2, 4/27/2017 3:11:29 PM , WLAHODA PRINTED: 4/27/2017 3:23:13 PM, C2010, WLAHODA
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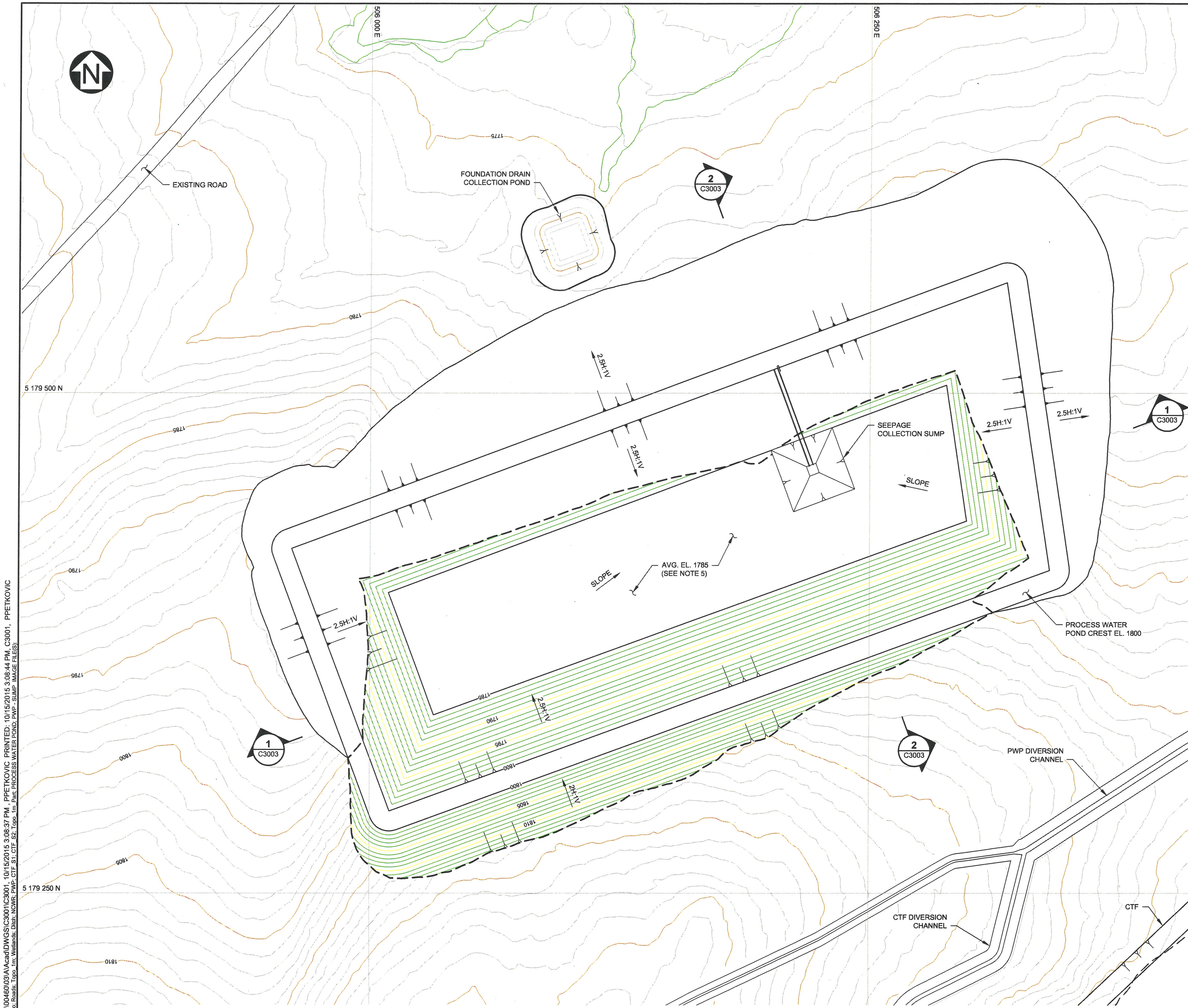

LEGEND:

EXCAVATION CONTOURS

CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. FILL CONTOURS NOT SHOWN FOR CLARITY.
5. BASIN TO BE GRADED AT A MINIMUM 0.5% TOWARDS SEEPAGE COLLECTION SUMP.

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

– DISCLAIMER –

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BLACK BUTTE COPPER PROJECT

PROCESS WATER POND GRADING PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C3001	0

REFERENCE DRAWINGS

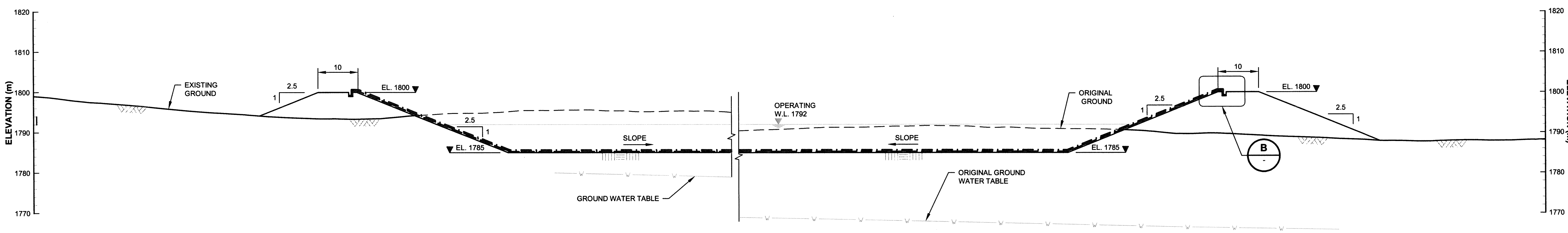
DRG. NO.	DESCRIPTION
C3003	PROCESS WATER POND SECTIONS

REVISIONS

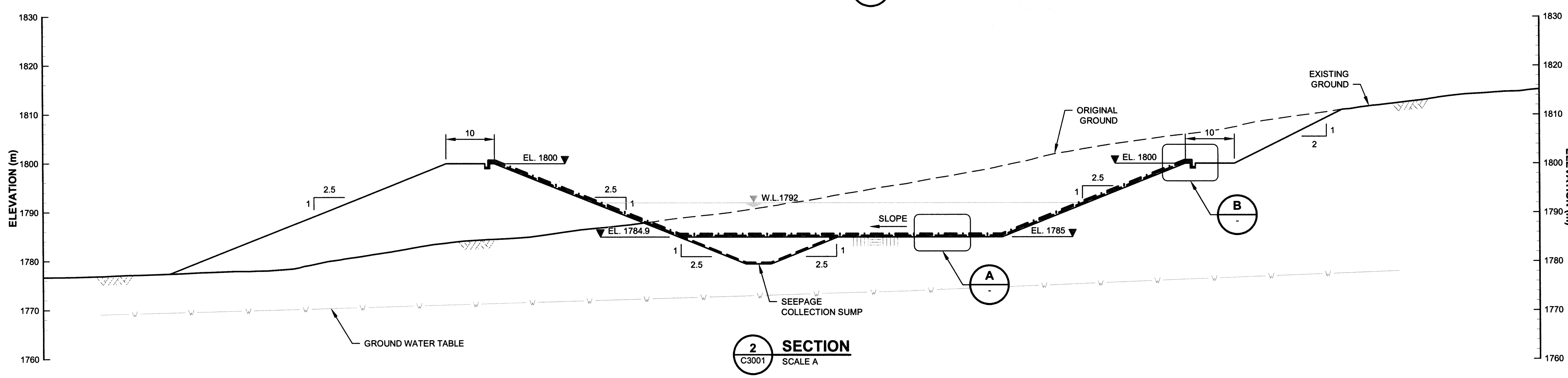
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	K.K.	K.K.

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C3001\C3001, 10/15/2015 3:08:37 PM , PPETKOVIC PRINTED: 10/15/2015 3:08:44 PM, C3001, PPETKOVIC
XREF FILE(S): Hydro_Roads; Topo_1m_Wetlands_Ditch; NCWR; PWP; CTF_S1; CTF_S2; Topo_1m_Part; PROCESS WATER POND; PWP - SUMP IMAGE FILE(S):



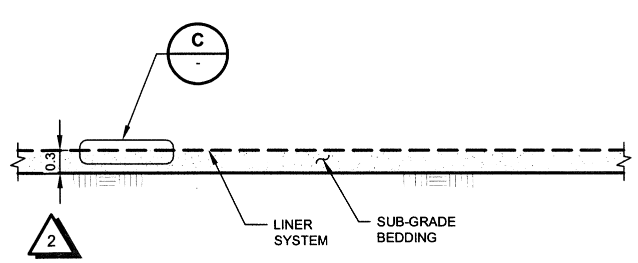
1 C3001 **SECTION** SCALE A



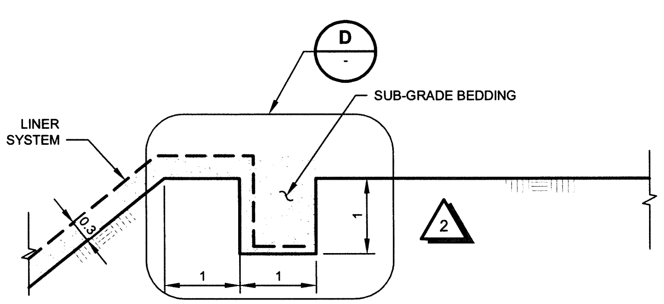
2 C3001 **SECTION** SCALE A

NOTES:

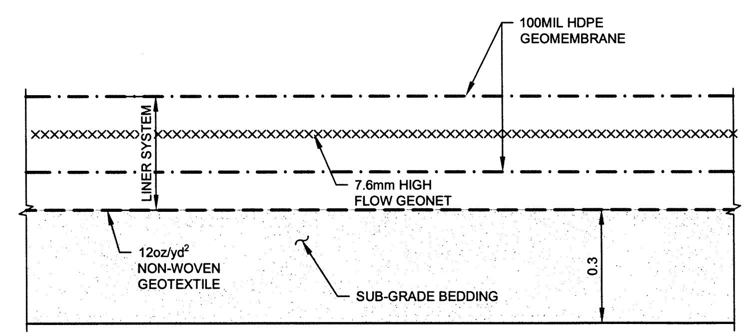
1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. DEPTH TO GROUNDWATER BELOW PWP FROM POTENTIOMETRIC SURFACE MAP CONTOURS PROVIDED BY HYDROMETRICS (2017).



A **DETAIL** **LINER SYSTEM PLACEMENT DETAILS**



B **DETAIL** **LINER SYSTEM ANCHOR DETAILS**



C **DETAIL** **LINER SYSTEM DETAILS**

FOR INFORMATION ONLY

SCALE A 4 2 0 4 8 12 16 20 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C3003	2

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	21APR'17	NOTES REVISED	GIM	RAF		
1	29APR'16	GROUND WATER TABLE ADDED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	KDE	KDE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION
C3001	PROCESS WATER POND - GRADING PLAN

REFERENCE DRAWINGS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C3003\C3003, 4/21/2017 11:45:18 AM , RFAHHAM PRINTED: 4/21/2017 1:46:52 PM, C3003, RFAHHAM
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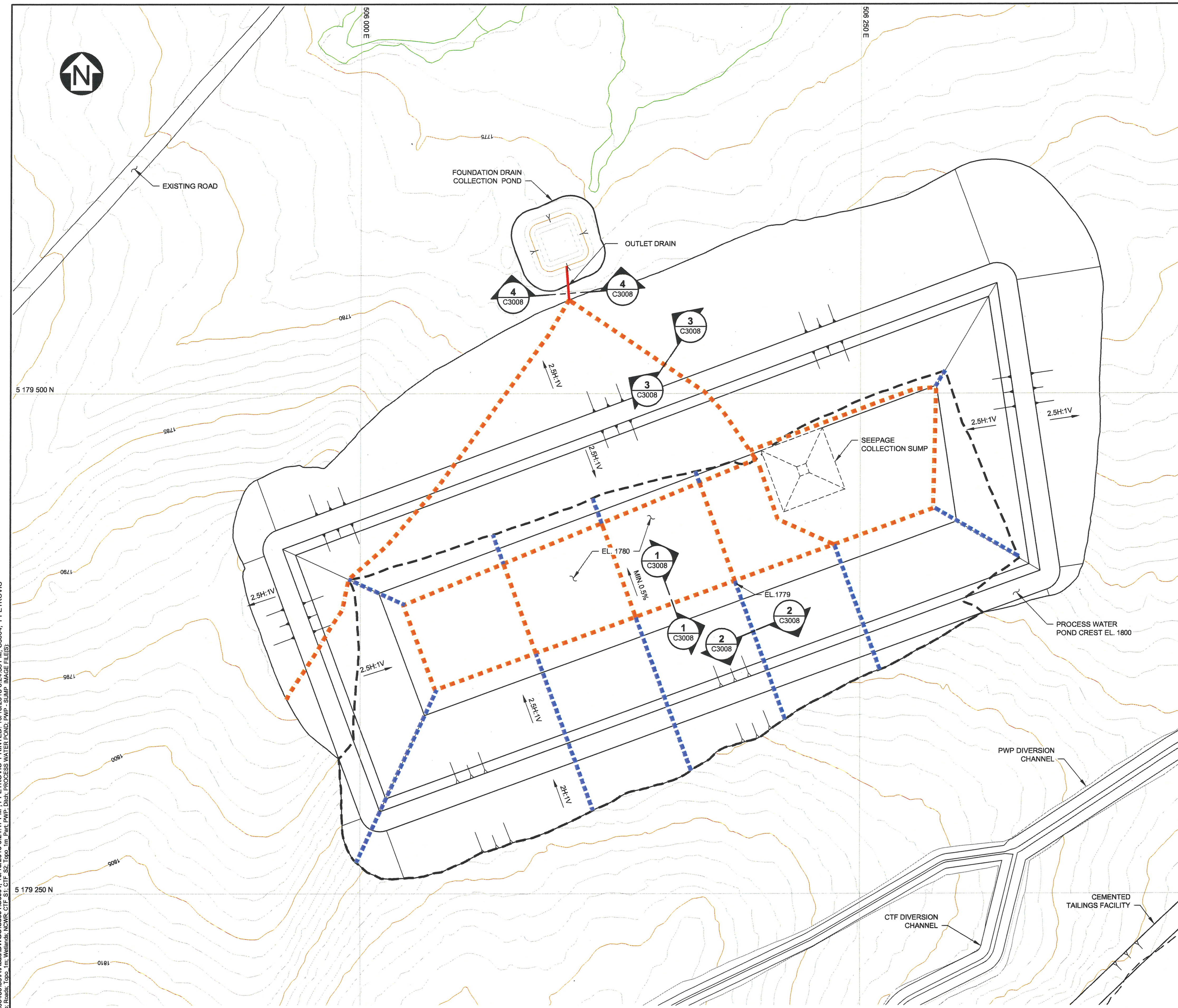

LEGEND:

- 6" N12 WT PE OUTLET PIPE
- 6" N12 ST PE DRAIN PIPE (BASIN FLOOR)
- 4" N12 ST PE DRAIN PIPE (SLOPE)
- CUT/FILL TRANSITION

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
4. FILL CONTOURS NOT SHOWN FOR CLARITY.
5. DRAIN TRENCHES WILL BE SLOPED TOWARDS OUTLET PIPE CONNECTION AT A MINIMUM GRADE OF 0.5%.
6. LAST 10m OF OUTLET PIPE WILL BE SOLID PIPE BACKFILLED WITH IMPERMEABLE MATERIAL.
7. OUTLET PIPE WILL EMPTY INTO A WEIR TO MEASURE PIPE FLOW.

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND BASIN FOUNDATION DRAIN SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C3004	0

DRG. NO.	DESCRIPTION
C3008	PROCESS WATER POND FOUNDATION DRAIN DETAILS

REFERENCE DRAWINGS

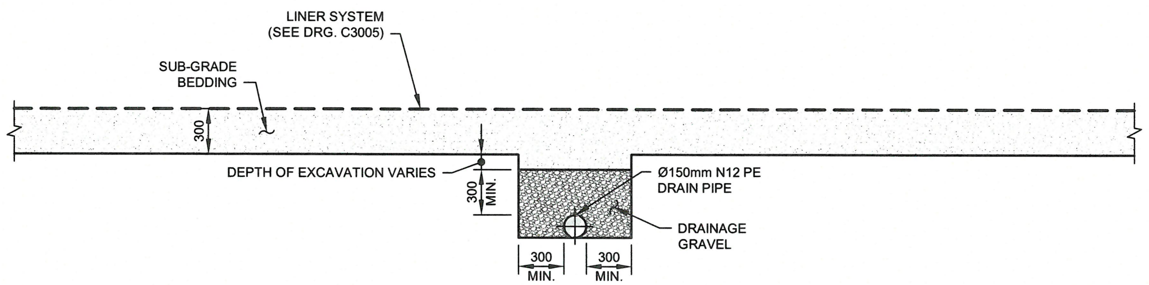
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

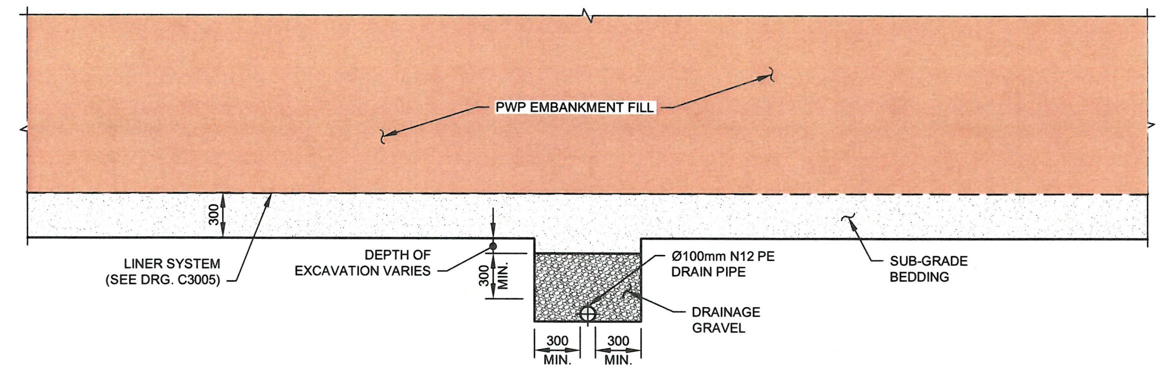
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	NSD	K.	K.

REVISIONS

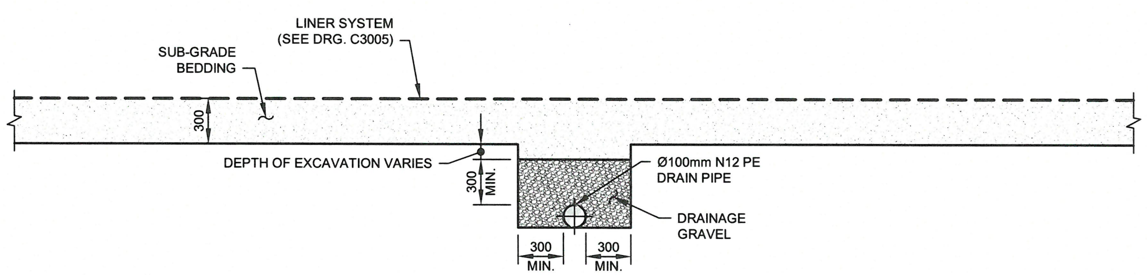
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C3004\C3004, 10/15/2015 3:24:47 PM , PPETKOVIC PRINTED: 10/15/2015 3:24:55 PM, C3004, PPETKOVIC
XREF FILE(S): Hydro; Roads; Topo_1m; Wetlands; NCWR; CTF_S1; CTF_S2; Topo_1m_Part; PWP_Ditch; PROCESS WATER POND; PWP - SUMP IMAGE FILE(S):



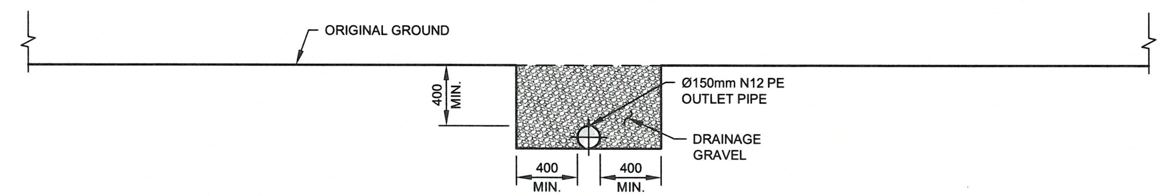
1 C3004 **TYPICAL SECTION**
BASIN FLOOR (BELOW LINER) 1
SCALE A



3 C3004 **TYPICAL SECTION**
BELOW EMBANKMENT FILL 1
SCALE A



2 C3004 **TYPICAL SECTION**
UPSTREAM EMBANKMENT SLOPE 1
SCALE A



4 C3004 **TYPICAL SECTION**
OUTLET PIPE (NO OVERLYING EMBANKMENT FILL) 1
SCALE A

PWP FOUNDATION DRAIN SUMMARY TABLE

PIPE TYPE	PIPE OUTER DIAMETER (mm)	D NOMINAL DIAMETER	T DRAINAGE GRAVEL THICKNESS (mm)
BASIN FLOOR	175.3	6" (150mm)	300 - 575
SLOPE PIPE	121.9	4" (100mm)	300
OUTLET PIPE	175.3	6" (150mm)	300 - 400

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.
2. DRAIN PIPES ARE N12 ST PE PIPE (OR SIMILAR APPROVED).
3. OUTLET PIPE IS N12 WT PE PIPE (OR SIMILAR APPROVED).

FOR INFORMATION ONLY

SCALE A 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND
FOUNDATION DRAIN DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C3008	1

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	20APR'17	SECTION TITLES REVISED	GIM	RAF		
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	KDE	KDE

REVISIONS

DRG. NO.	DESCRIPTION
C3004	PROCESS WATER POND BASIN FOUNDATION DRAIN SYSTEM PLAN

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C3008\C3008, 4/20/2017 2:52:52 PM , RFAHHAM PRINTED: 4/20/2017 4:03:47 PM, C3008, RFAHHAM
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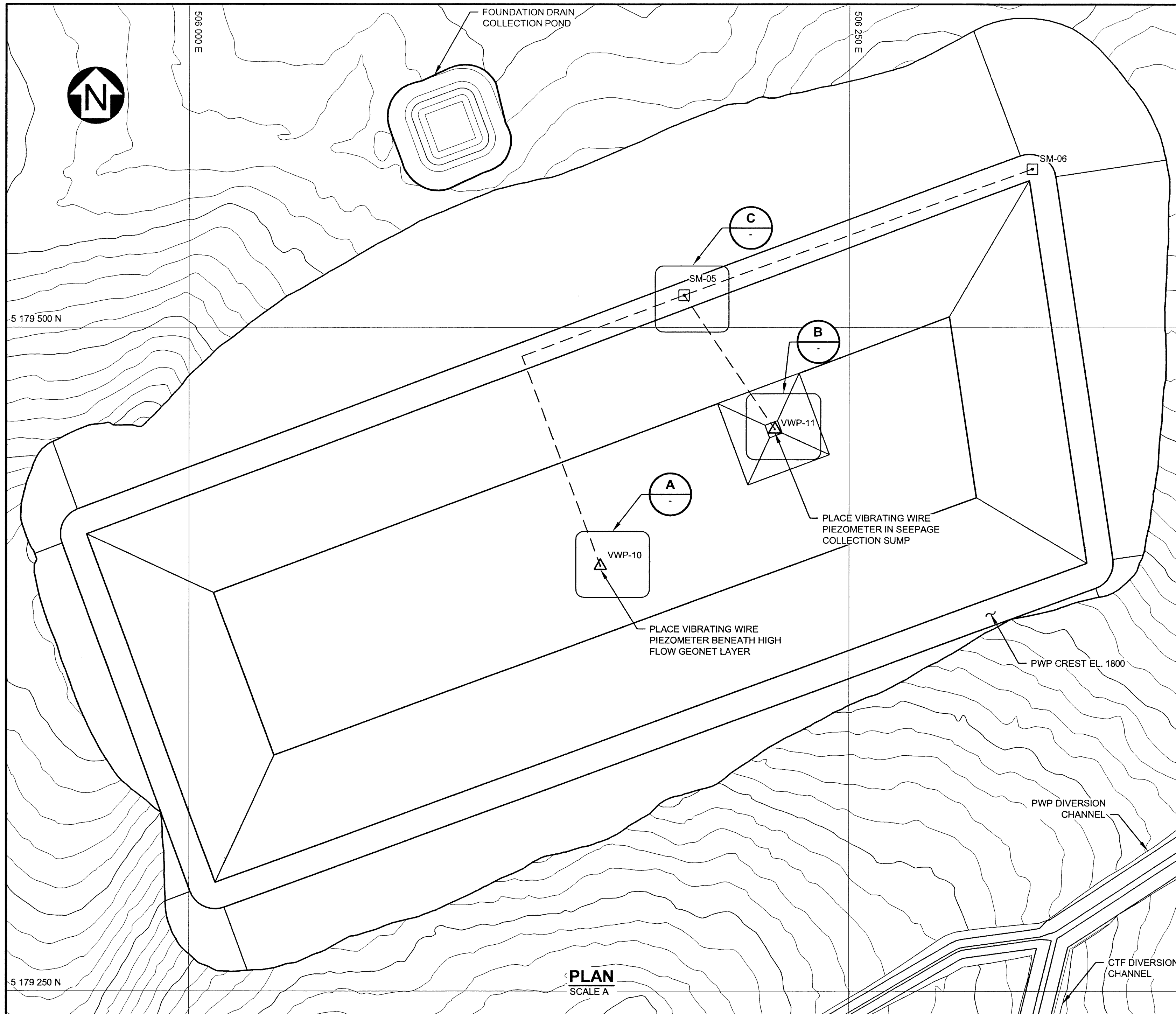
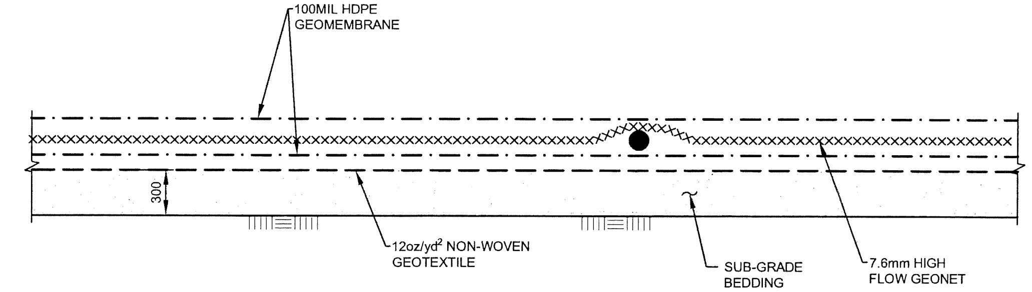
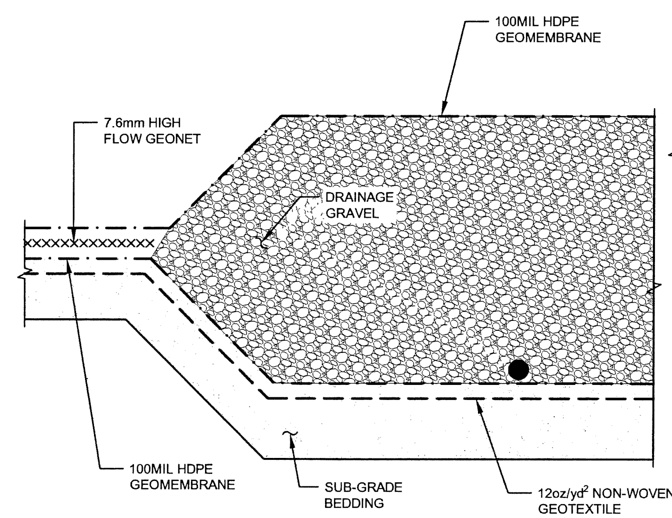


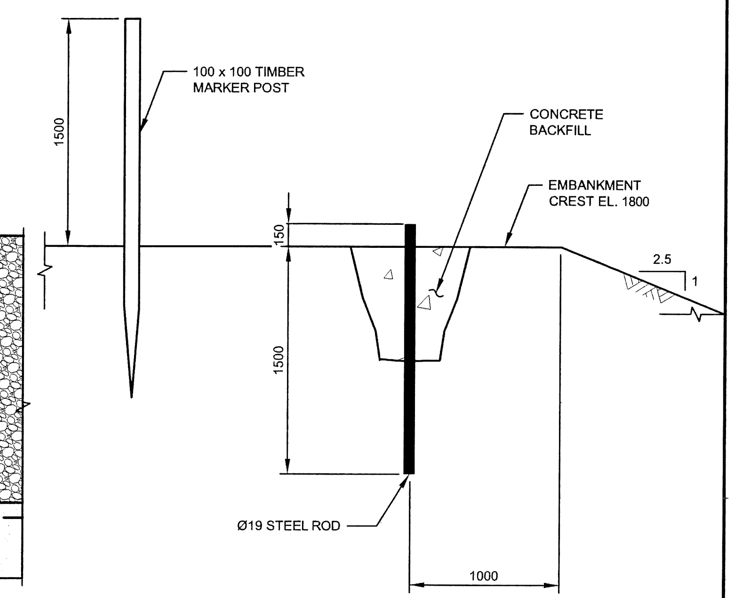
PLAN
SCALE A



A DETAIL
TYPICAL VIBRATING WIRE PIEZOMETER TO BE SECURELY TAPED TO 100MIL HDPE GEOMEMBRANE
SCALE A



B DETAIL
TYPICAL VIBRATIONS WIRE PIEZOMETER INSTALLATION IN SEEPAGE COLLECTION SUMP
SCALE B



C DETAIL
TYPICAL SURVEY MONUMENT INSTALLATION
SCALE A

FOR INFORMATION ONLY

SCALE B 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE A 20 10 0 20 40 60 80 100 m

SUMMARY OF VIBRATING WIRE PIEZOMETER INSTALLATIONS

IDENTIFICATION	LEAD LENGTH	LOCATION			DATE INSTALLED
		EASTING (m)	NORTHING (m)	ELEVATION (m)	
VWP-10	-	506,155	5,179,410	1780	-
VWP-11	-	506,196	5,179,467	1780	-

SUMMARY OF SURVEY MOMUMENT INSTALLATIONS

IDENTIFICATION	LOCATION			DATE INSTALLED
	EASTING (m)	NORTHING (m)	ELEVATION (m)	
SM-05	506,187	5,179,512	1800	-
SM-06	506,319	5,179,559	1800	-

LEGEND:

- △ VIBRATING WIRE PIEZOMETER
- ● VIBRATING WIRE PIEZOMETER TIP
- ⊡ SURVEY MONUMENT
- — — VIBRATING WIRE PIEZOMETER LEADS

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEB 03, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. FILL CONTOURS NOT SHOWN FOR CLARITY.
6. VIBRATING WIRE PIEZOMETER TIP TO BE SECURELY TAPED TO GEOMEMBRANE.

Knight Piésold
CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND
INSTRUMENTATION
LAYOUT PLAN AND DETAILS

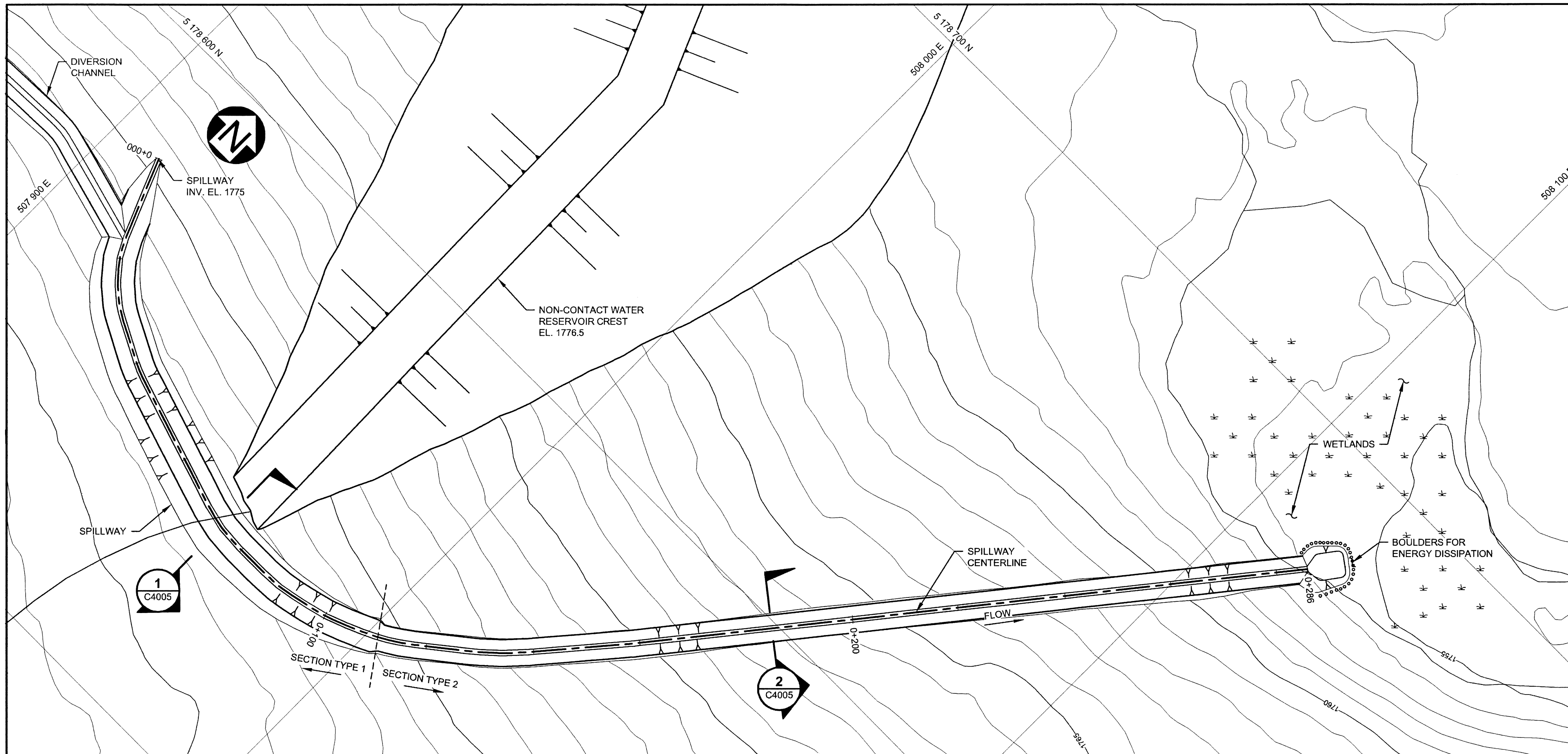
P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C3010	0

REFERENCE DRAWINGS

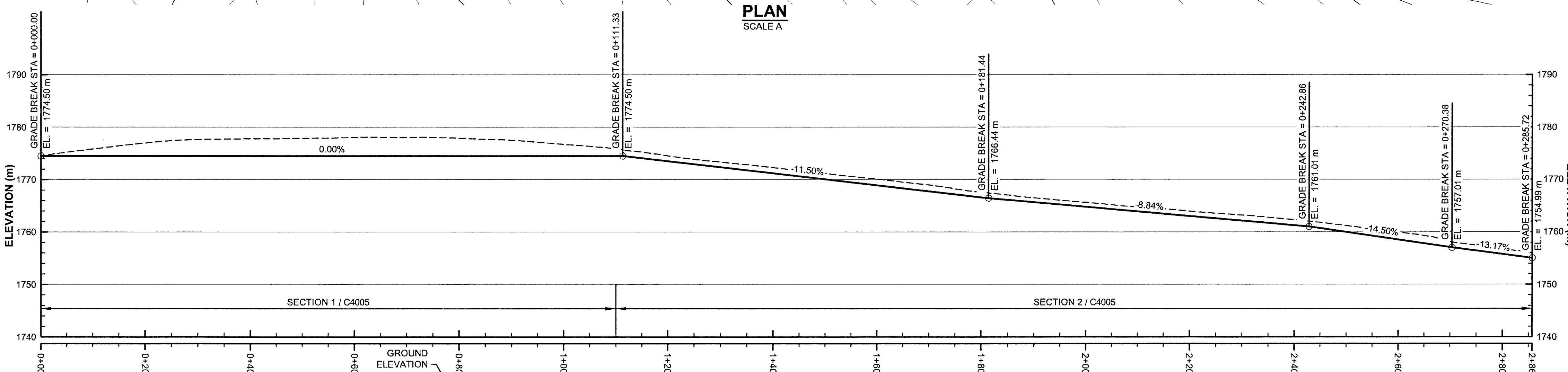
DRG. NO.	DESCRIPTION
C3001	PROCESS WATER POND GRADING PLAN

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP		



PLAN
SCALE A



Ground elevation	1776.99	1777.80	1778.04	1777.90	1776.71	1774.54	1772.27	1770.10	1767.56	1765.62	1763.96	1762.31	1759.94	1756.75
Channel invert elevation	1774.50	1774.50	1774.50	1774.50	1774.50	1773.50	1771.20	1768.90	1766.60	1764.80	1763.03	1761.26	1758.52	1755.75

1 - **PROFILE**
ALONG SPILLWAY
SCALE A

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE A 10 5 0 10 20 30 40 50 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR SPILLWAY CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C4004	0

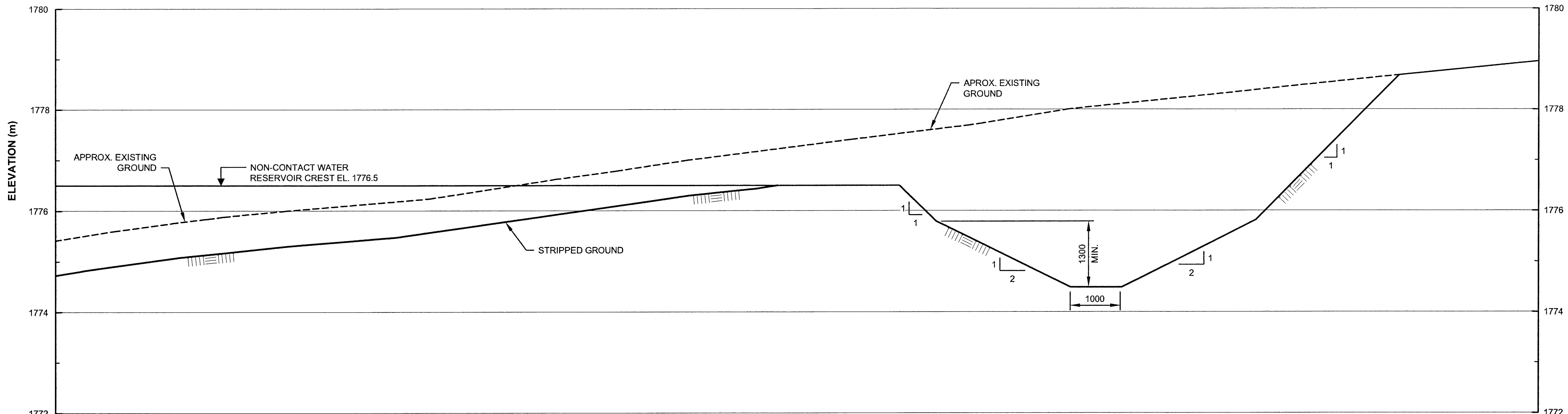
REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C4005	NON-CONTACT WATER RESERVOIR SPILLWAY SECTIONS

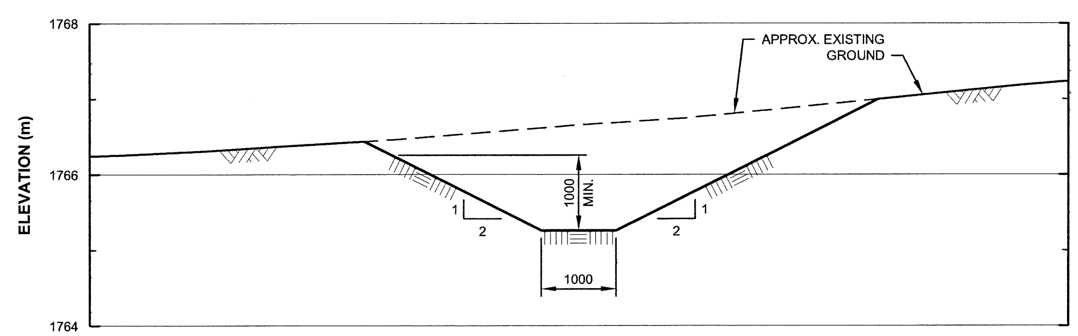
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD	K	K

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C4004\C4004, 10/15/2015 4:06:05 PM , PPETKOVIC PRINTED: 10/15/2015 4:06:10 PM, C4004, PPETKOVIC
XREF FILE(S): NCWR_Topo_Im_Hydro_Roads_NCWR-SPILL_Wetlands IMAGE FILE(S):



SECTION TYPE 1 (1 / C4004)
TYPICAL SPILLWAY SECTION
SCALE A



SECTION TYPE 2 (2 / C4004)
TYPICAL SPILLWAY SECTION
SCALE A

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. 1H : 1V CUT OR SHALLOWER CAN BE USED ABOVE SPILLWAY CHANNEL FLOW PATH.

FOR INFORMATION ONLY

SCALE A 1 0.5 0 1 2 3 4 5 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR SPILLWAY SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C4005	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C4004	NON-CONTACT WATER RESERVOIR SPILLWAY CHANNEL PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD	K.	K.

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C4005\C4005, 10/15/2015 4:02:52 PM , PPETKOVIC PRINTED: 10/15/2015 4:02:57 PM, C4005, PPETKOVIC
XREF FILE(S): IMAGE FILE(S):

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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**NON-CONTACT WATER RESERVOIR
DIVERSION CHANNEL
PLAN**

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C4006	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C4007	NON-CONTACT WATER RESERVOIR DIVERSION DITCH PROFILE & SECTION

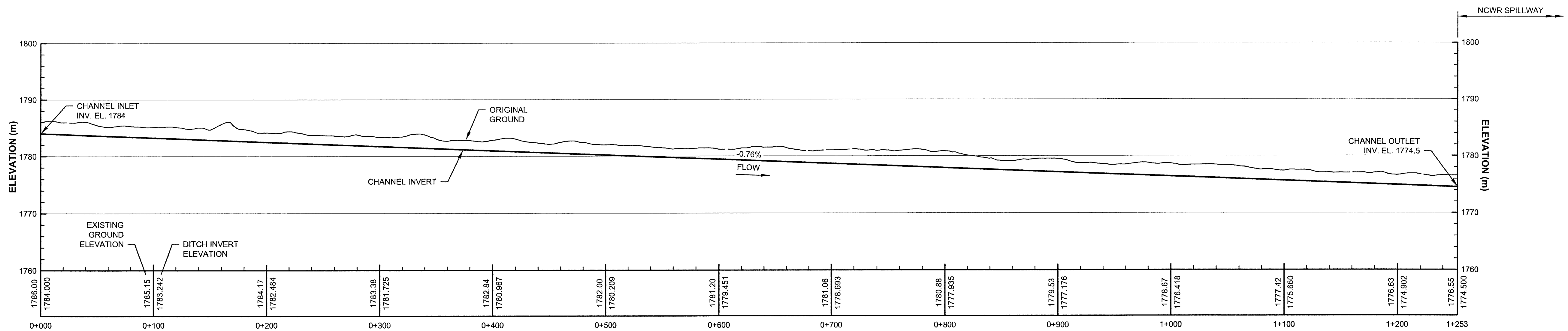
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C4006\C4006, 10/15/2015 4:11:27 PM , PPETKOVIC PRINTED: 10/15/2015 4:11:34 PM, C4006, PPETKOVIC
XREF FILE(S): NCWR_Topo_lim_Hydro_Roads_NCWR-SPILL_Wetlands_ACCESS RD AND HAUL RD IMAGE FILE(S):

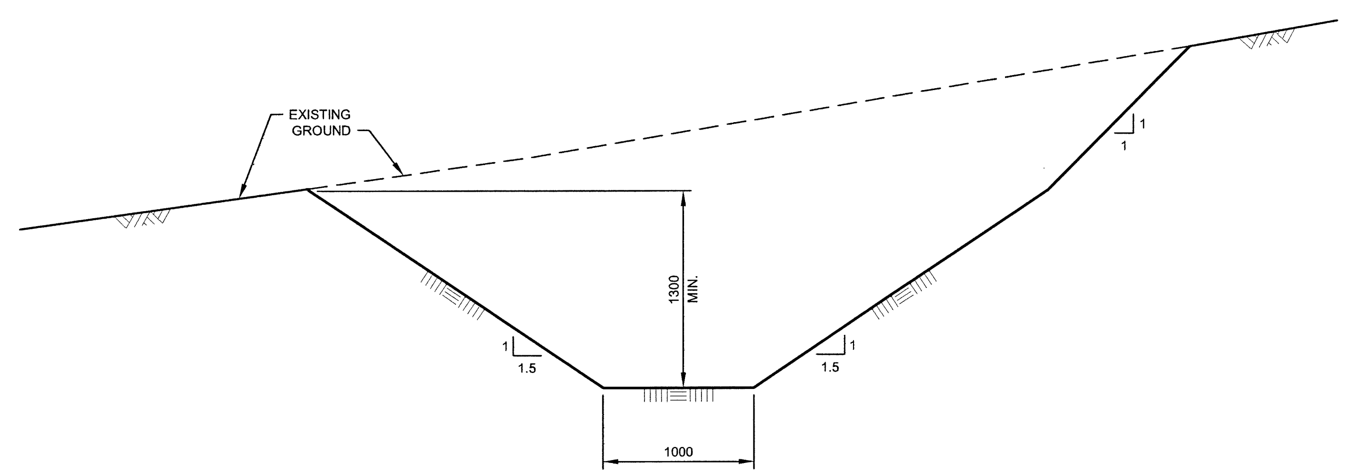


1 / C4006 PROFILE

ALONG CHANNEL CENTERLINE

HORIZONTAL: SCALE A

VERTICAL: SCALE B



2 / C4006 SECTION

SCALE C

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE C 500 250 0 500 1000 1500 2000 2500 mm

SCALE B 8 4 0 10 20 30 40 m

SCALE A 40 20 0 40 80 120 160 200 m

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BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR DIVERSION CHANNEL PROFILE AND SECTION

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C4007	0

DRG. NO.	DESCRIPTION
C4006	NON-CONTACT WATER RESERVOIR DIVERSION DITCH PLAN

REFERENCE DRAWINGS

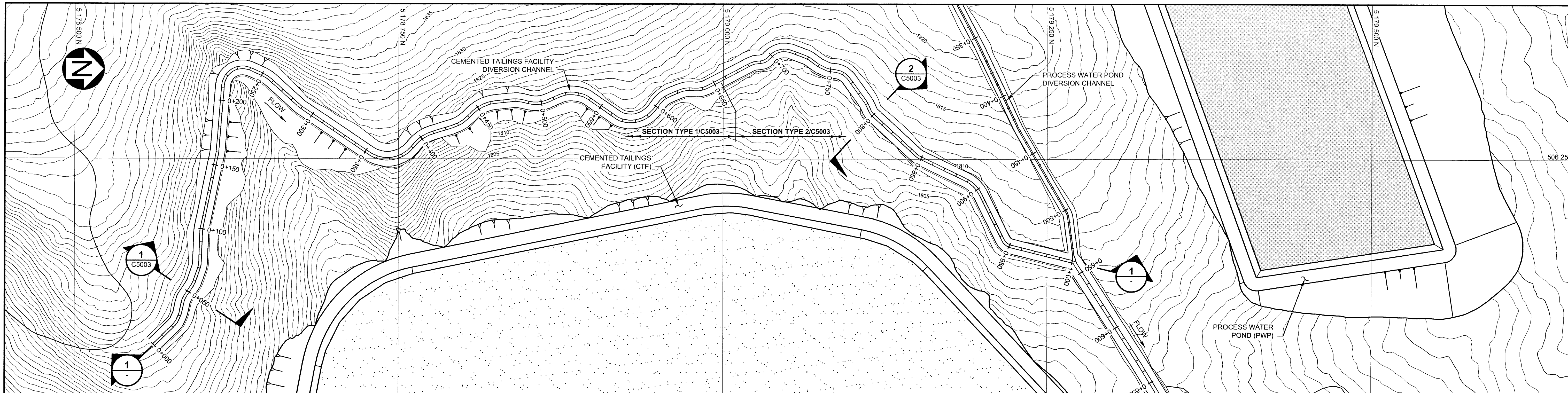
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

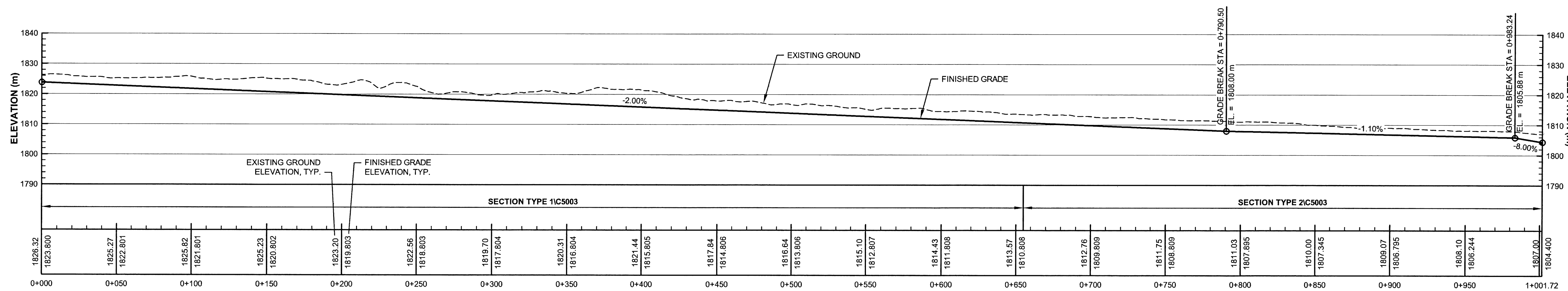
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C4007\C4007, 10/15/2015 4:15:34 PM , PPETKOVIC PRINTED: 10/15/2015 4:15:45 PM, C4007, PPETKOVIC
XREF FILE(S): IMAGE FILE(S):



PLAN
CTF DIVERSION CHANNEL
SCALE A



SECTION
PROFILE ALONG CHANNEL CENTERLINE
HORIZONTAL: SCALE A
VERTICAL: SCALE B

SCALE B 15 7.5 0 25 50 75 m
SCALE A 30 15 0 50 100 150 m

FOR INFORMATION ONLY

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
DIVERSION CHANNEL
PLAN AND PROFILE

DRG. NO.	DESCRIPTION
C5003	DIVERSION CHANNEL - TYPICAL SECTIONS

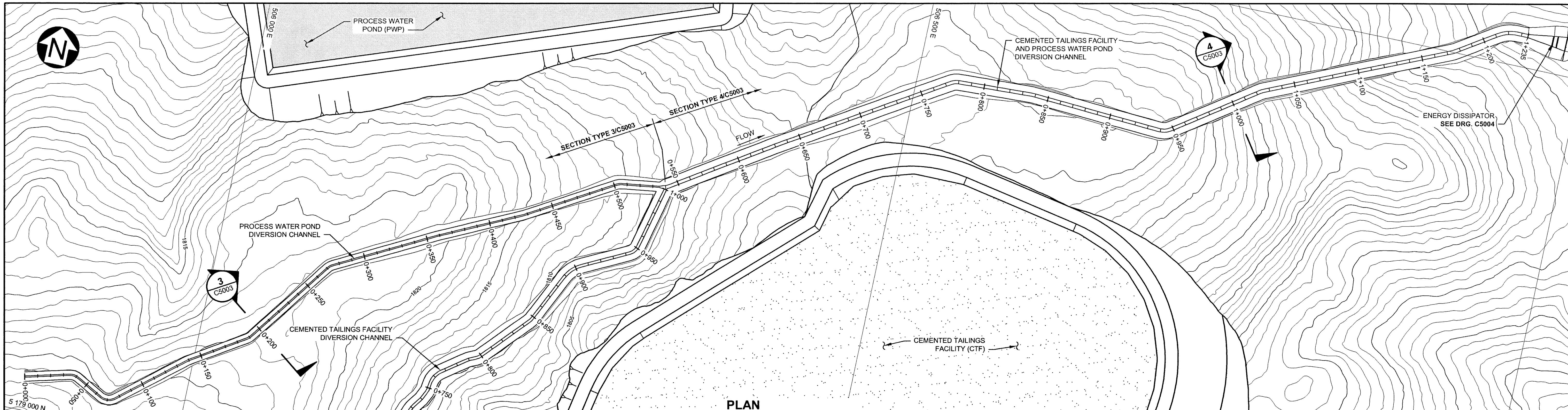
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

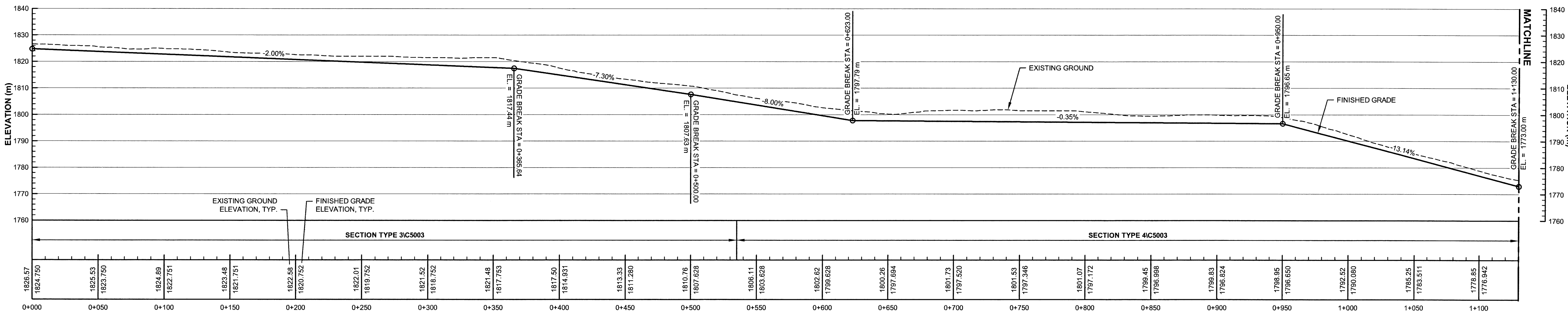
REVISIONS

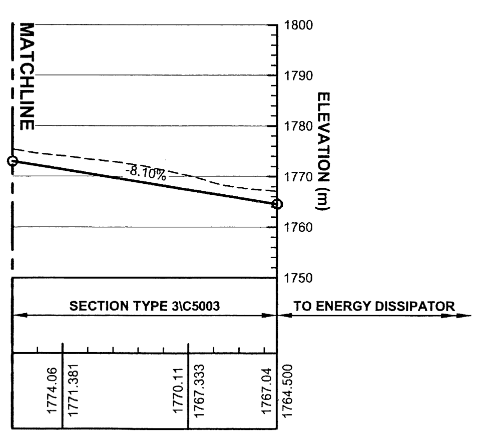
P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5001	0

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C5001\C5001, 10/16/2015 10:31:03 AM , PPETKOVIC PRINTED: 10/16/2015 10:31:08 AM, C5001, PPETKOVIC
XREF FILE(S): Hydro; Roads; Topo_1m; Wetlands; Ditch; PWP; CTF_S2 IMAGE FILE(S):



PLAN
PWP DIVERSION CHANNEL
SCALE A





PROFILE
PROFILE ALONG CHANNEL CENTERLINE
HORIZONTAL: SCALE A
VERTICAL: SCALE B

FOR INFORMATION ONLY

SCALE B 15 7.5 0 25 50 75 m
SCALE A 30 15 0 50 100 150 m

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PLAN / SECTION BASED ON INFORMATION PROVIDED BY TINTINA RESOURCES INC., DATED FEB 03, 2011.
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

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CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

PROCESS WATER POND DIVERSION CHANNEL PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5002	0

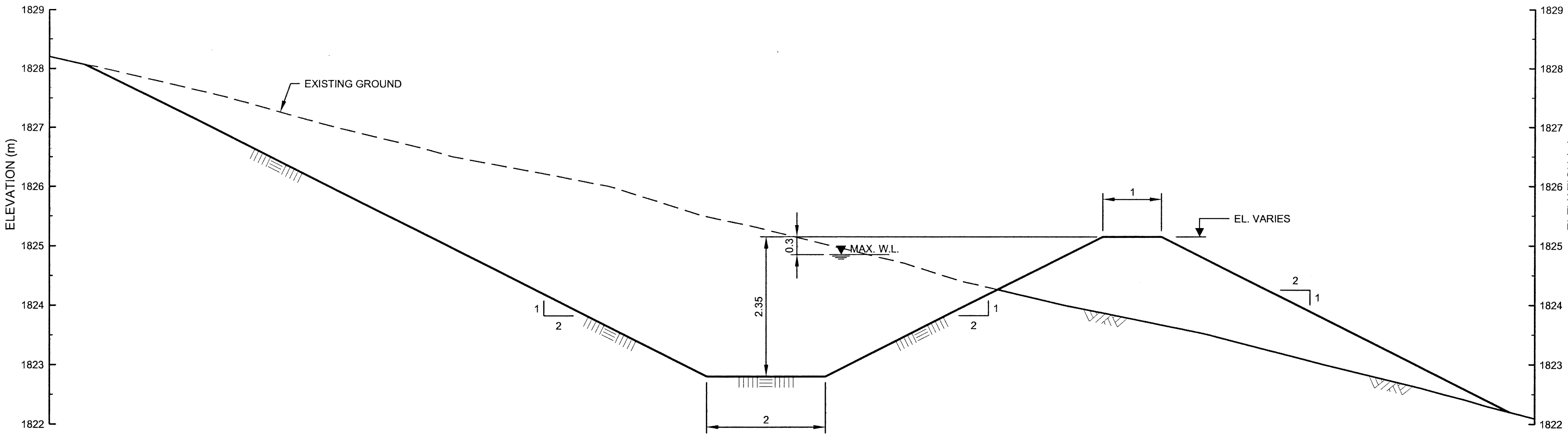
REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5004	DIVERSION CHANNEL - ENERGY DISSIPATOR - PLAN AND DETAILS
C5003	DIVERSION CHANNEL - TYPICAL SECTIONS

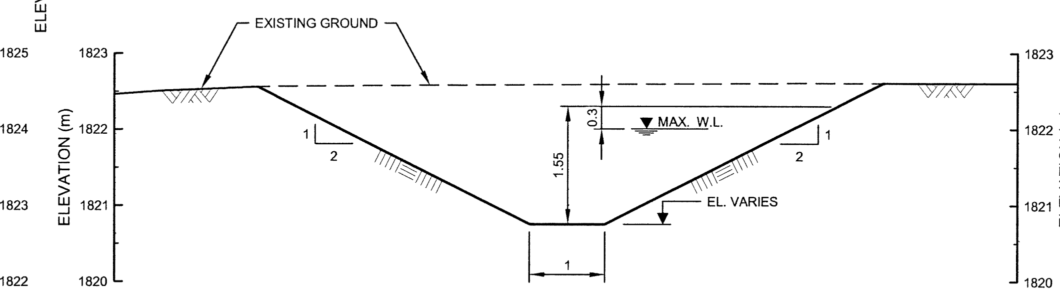
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	JSL	NSD		

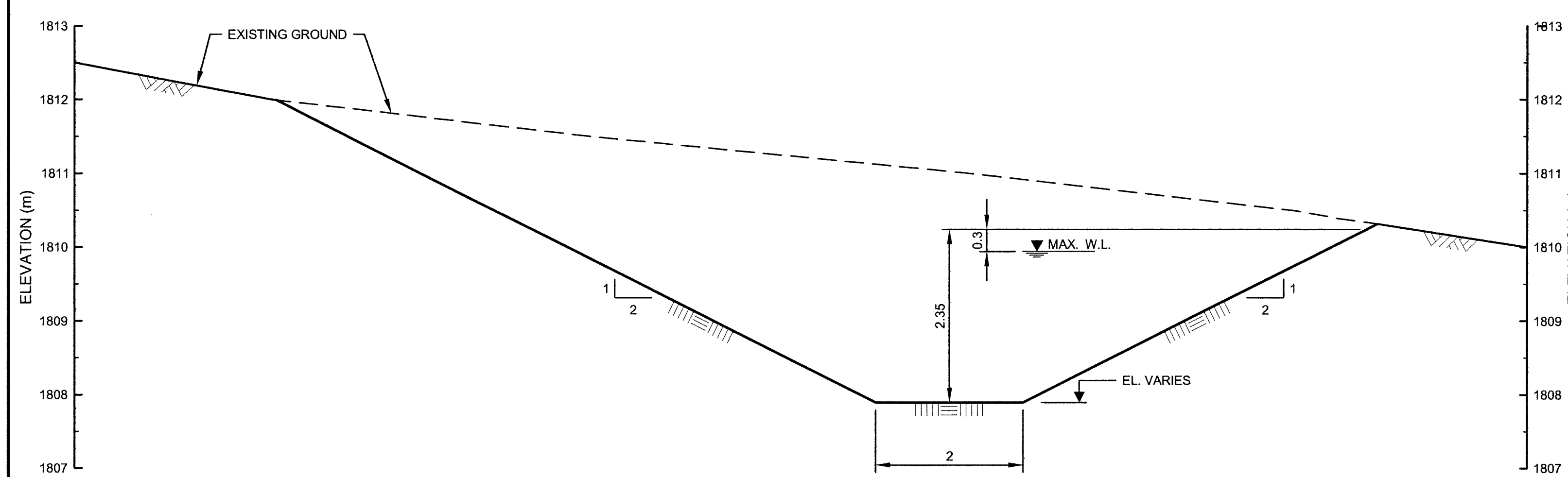
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C5002\C5002, 10/16/2015 10:32:27 AM , PPETKOVIC PRINTED: 10/16/2015 10:32:31 AM, C5002, PPETKOVIC
XREF FILE(S): Hydro; Roads; Topo_1m; Wetlands; Ditch; PWP; CTF_S2 IMAGE FILE(S):



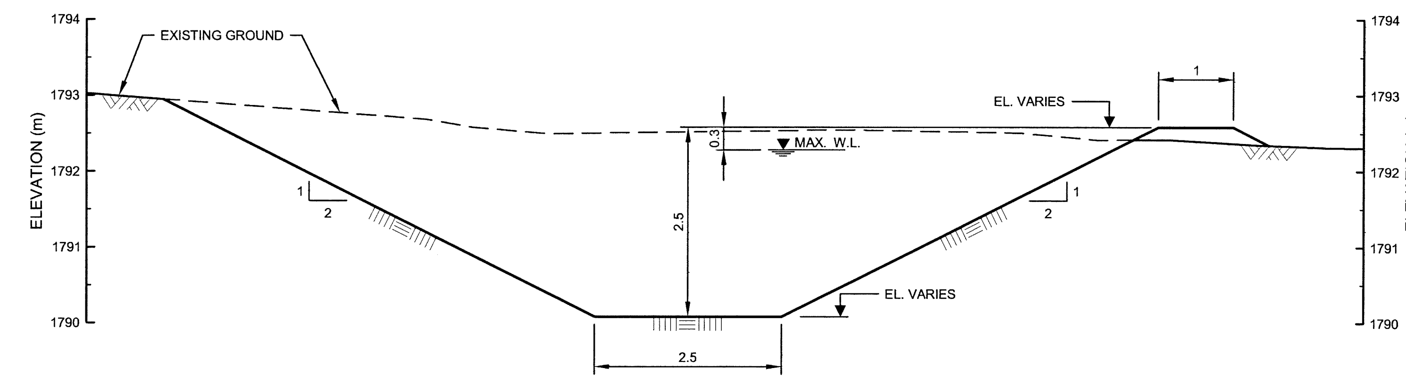
SECTION TYPE 1
1 / C5001
CTF DIVERSION CHANNEL (CUT AND FILL)
SCALE A



SECTION TYPE 3
3 / C5002
PWP DIVERSION CHANNEL
SCALE A



SECTION TYPE 2
2 / C5001
CTF DIVERSION CHANNEL (ALL CUT)
SCALE A



SECTION TYPE 4
4 / C5002
CTF AND PWP DIVERSION CHANNEL
SCALE A

FOR INFORMATION ONLY

SCALE A 1 0.5 0 1 2 3 4 5 m

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. MAXIMUM WATER LEVEL (MAX. W.L.) BASED ON ANTICIPATED WATER DEPTH DURING THE PROBABLE MAXIMUM FLOOD (PMF).

Knight Piésold CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

DIVERSION CHANNEL
TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5003	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C5003\C5003, 10/16/2015 10:33:22 AM , PPETKOVIC PRINTED: 10/16/2015 10:33:25 AM, Layout1, PPETKOVIC
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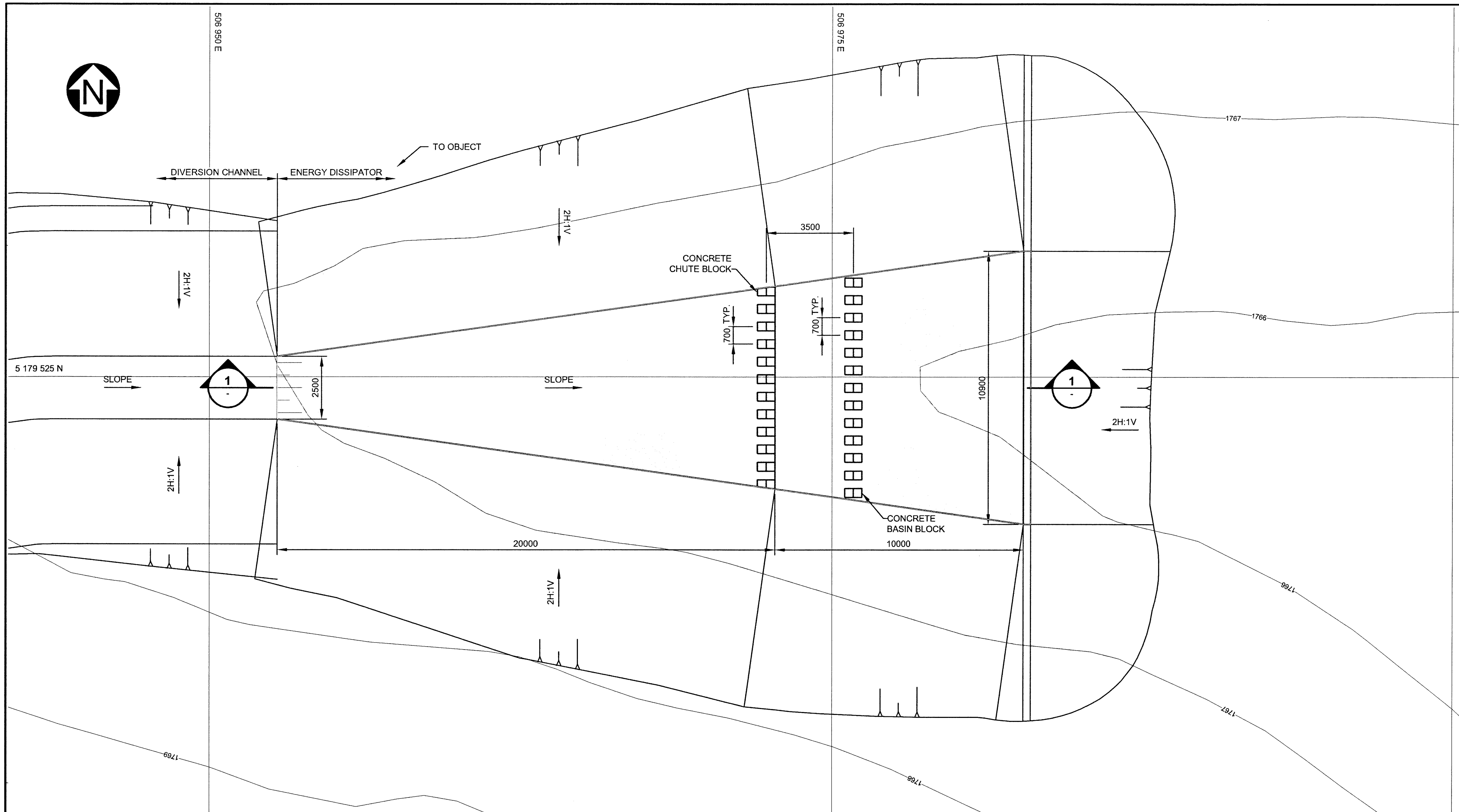
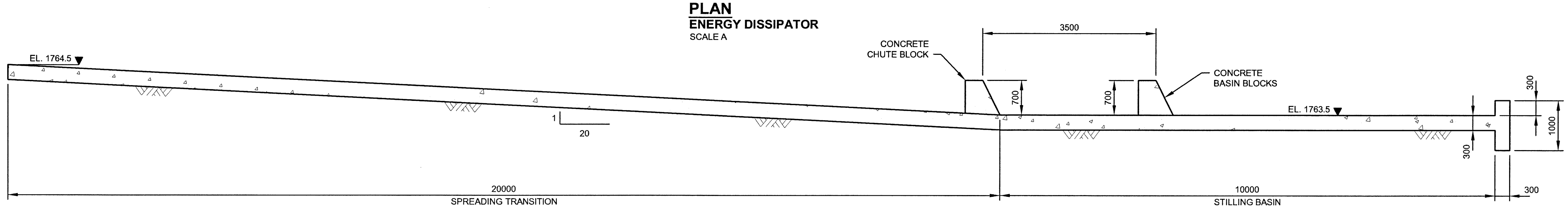


PLAN
ENERGY DISSIPATOR
SCALE A



1 SECTION
SCALE B

LEGEND:

CONCRETE

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE B 1000 500 0 1000 2000 3000 4000 5000 mm

SCALE A 2 1 0 2 4 6 8 10 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

DIVERSION CHANNEL ENERGY DISSIPATOR PLAN AND DETAILS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C5004	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5002	PWP DIVERSION CHANNEL - PLAN AND PROFILE
C5001	CTF DIVERSION CHANNEL - PLAN AND PROFILE

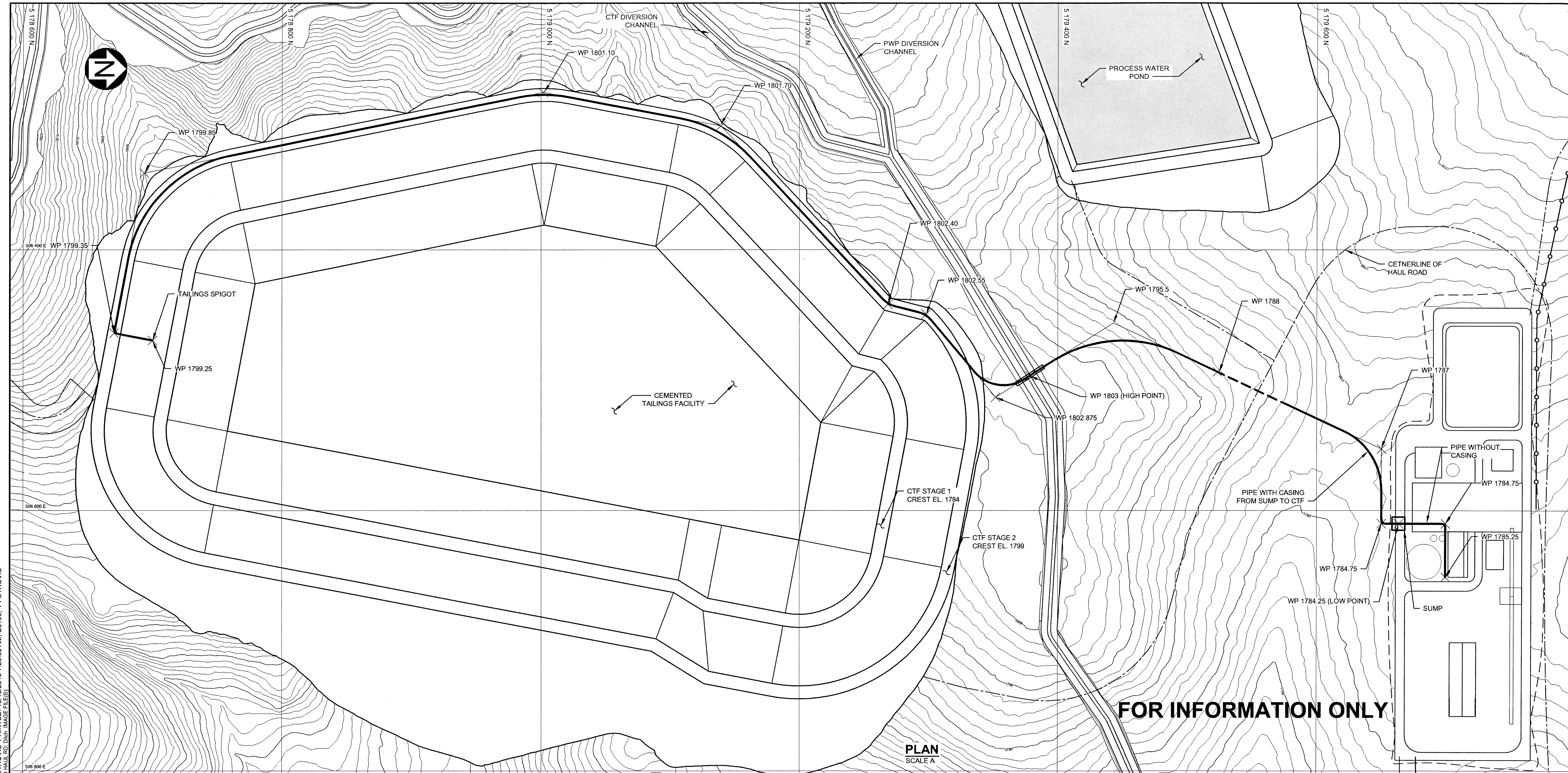
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

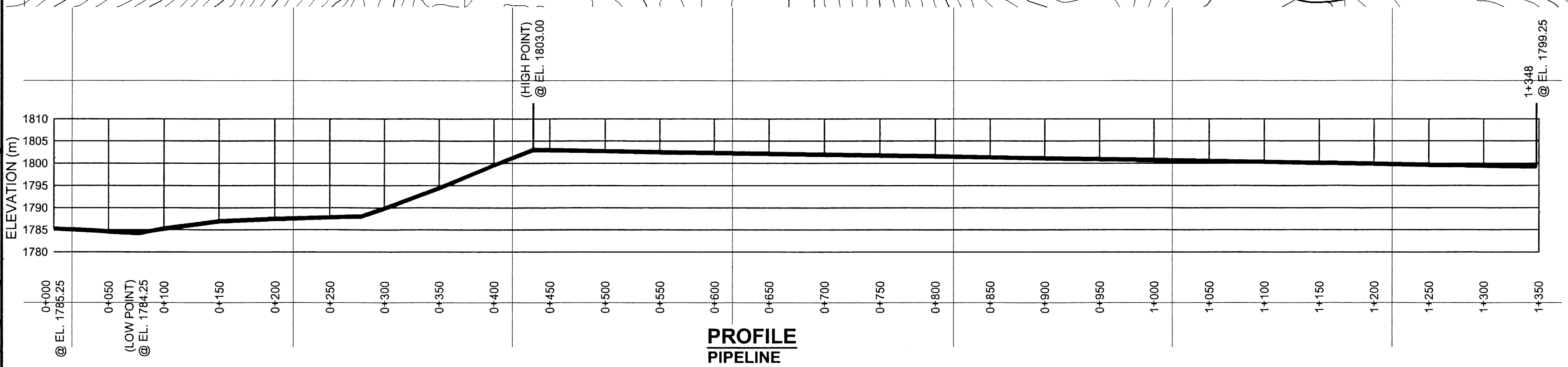
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MH	NSD		

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C5004\C5004, 10/16/2015 10:34:51 AM , PPETKOVIC PRINTED: 10/16/2015 10:34:54 AM, Layout1, PPETKOVIC
XREF FILE(S): Ditch_Topo_tm_Part IMAGE FILE(S):



PLAN
SCALE A

SCALE B 60 30 0 100 200 300 m
SCALE A 30 15 0 50 100 150 m



PROFILE
PIPELINE
SCALE B

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. PIPELINE LAYOUT BASED ON INFORMATION PROVIDED BY MG ENGINEERING, DATED (SEP 29, 2015).
3. CONTOUR INTERVAL IS 1 METER.
4. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.
5. TAILINGS DELIVERY SYSTEM DESIGNED BY MG ENGINEERING.
6. PIPELINE CONSTRUCTED USING 8" STEEL PN 150 PIPE.
7. PIPELINE INSULATED TO PROTECT FROM FREEZING.
8. TAILINGS PUMP TO BE DESIGNED BY TETRA TECH.

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

TAILINGS DELIVERY SYSTEM PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6100	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

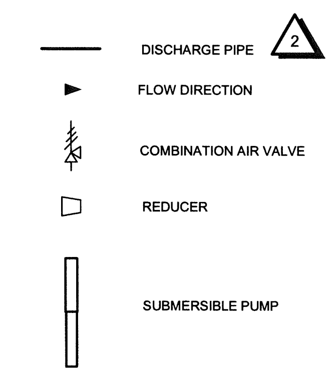
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

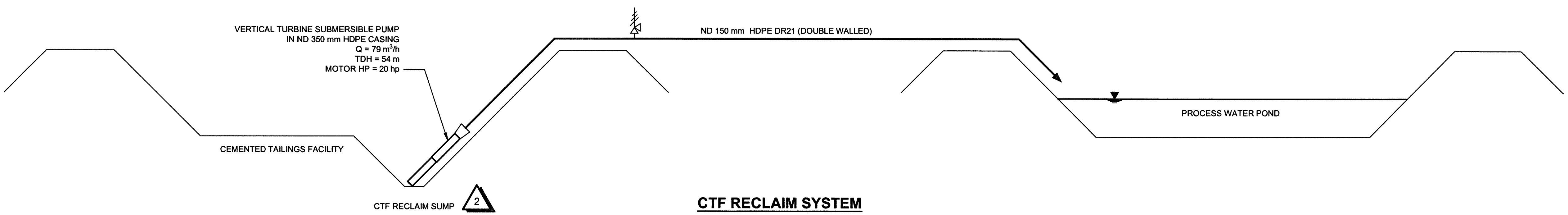
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	GIM	PP	K.	K.

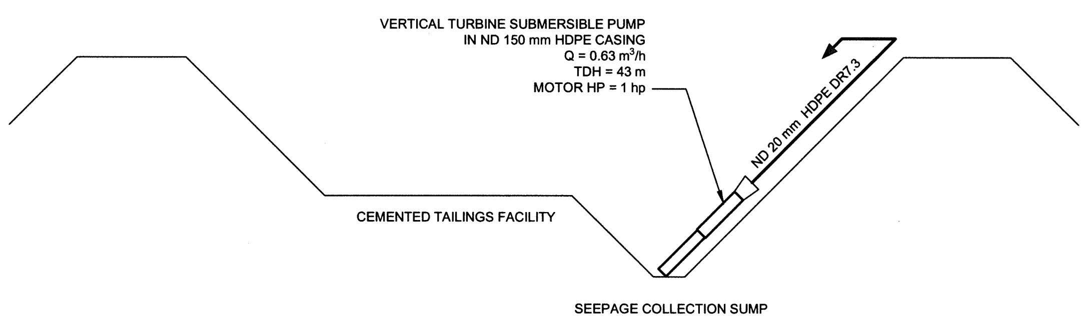
SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6100\C6100, 10/16/2015 7:28:50 AM, PPETKOVIC PRINTED: 10/16/2015 7:29:05 AM, C6100, PPETKOVIC
XREF FILE(S): Facility: CTF; S2: CTF; S1: WROCK STORAGE; Topo_1m; PWP; NCWR; ACCESS RD AND HAUL RD; Ditch IMAGE FILE(S):

LEGEND:





CTF RECLAIM SYSTEM



CTF SEEPAGE COLLECTION AND RECYCLE SYSTEM

FOR INFORMATION ONLY

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
WATER MANAGEMENT SYSTEMS
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6200	2

REFERENCE DRAWINGS

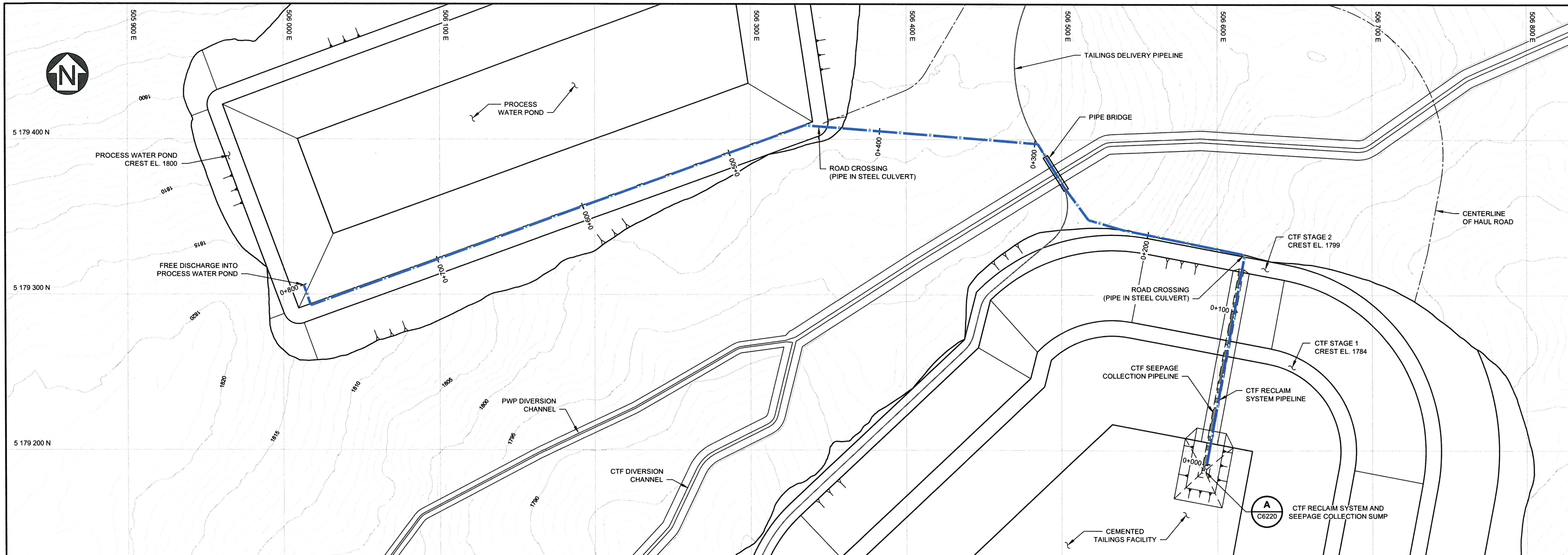
DRG. NO.	DESCRIPTION
C6210	CEMENTED TAILINGS TO PROCESS WATER POND - PLAN AND PROFILE

REVISIONS

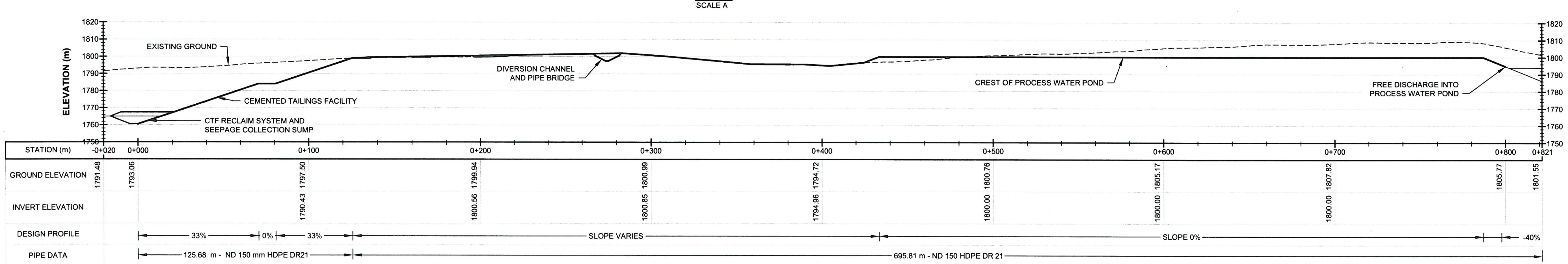
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	20APR'17	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAF		
1	29APR'16	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAP	KJB	KJB
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KJB	KJB



PLAN
SCALE A



PROFILE
SCALE A

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

LEGEND:

RECLAIM SYSTEM PIPELINE
SEEPAGE COLLECTION PIPELINE

FOR INFORMATION ONLY

SCALE A 25 12.5 0 25 50 75 100 125 m

DRG. NO.	DESCRIPTION
C6230	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS (2 OF 2)
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS (1 OF 2)
C6200	CEMENTED TAILINGS FACILITY - WATER MANAGEMENT SYSTEMS - P&ID

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
2	27APR'17	LABELS ADJUSTED	GIM	WAL	K.	K.
1	29APR'16	PIPE DATA REVISED	GIM	RAP	KDE	KDE
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KJB	KJB

REVISIONS

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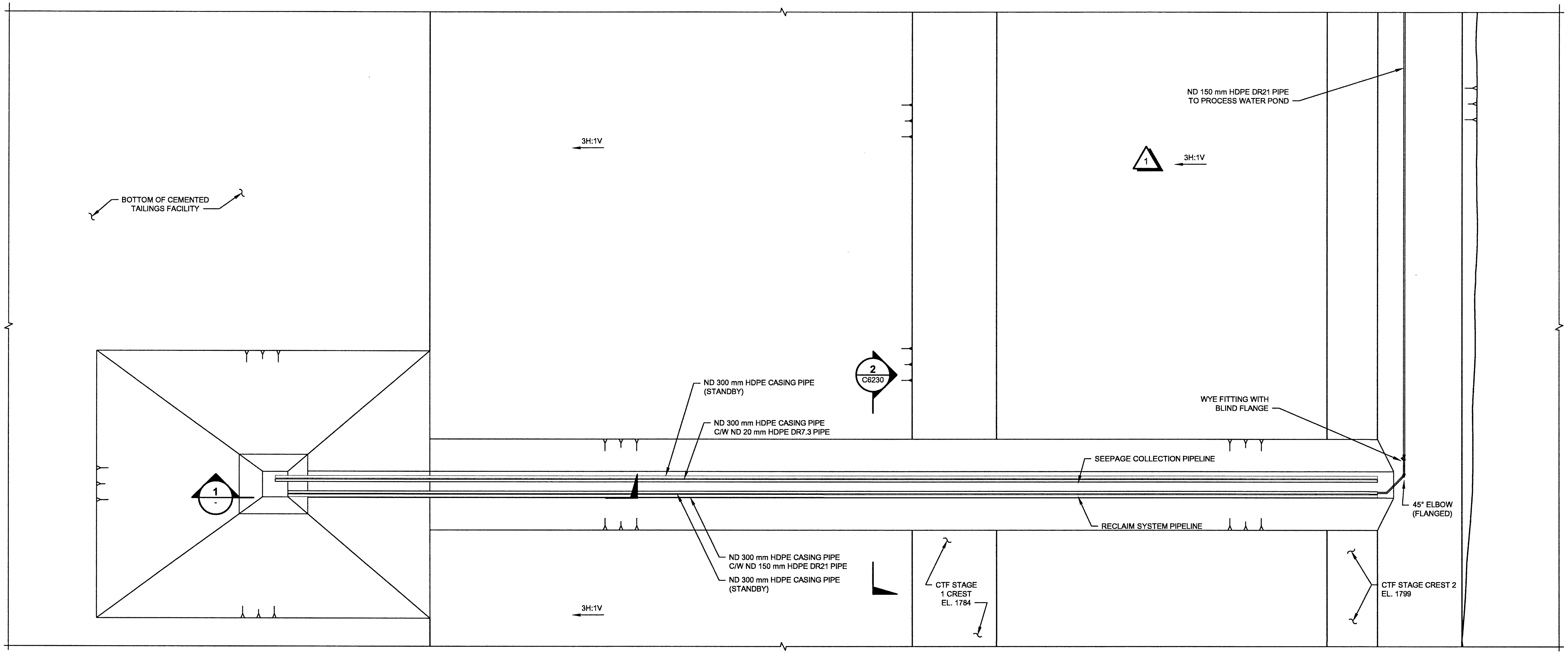
BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY SEEPAGE COLLECTION AND RECLAIM SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6210	2

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6210\C6210_r2, 4/27/2017 3:14:11 PM , WLAHODA PRINTED: 4/27/2017 3:23:51 PM, layout, WLAHODA
XREF FILE(S): IMAGE FILE(S):



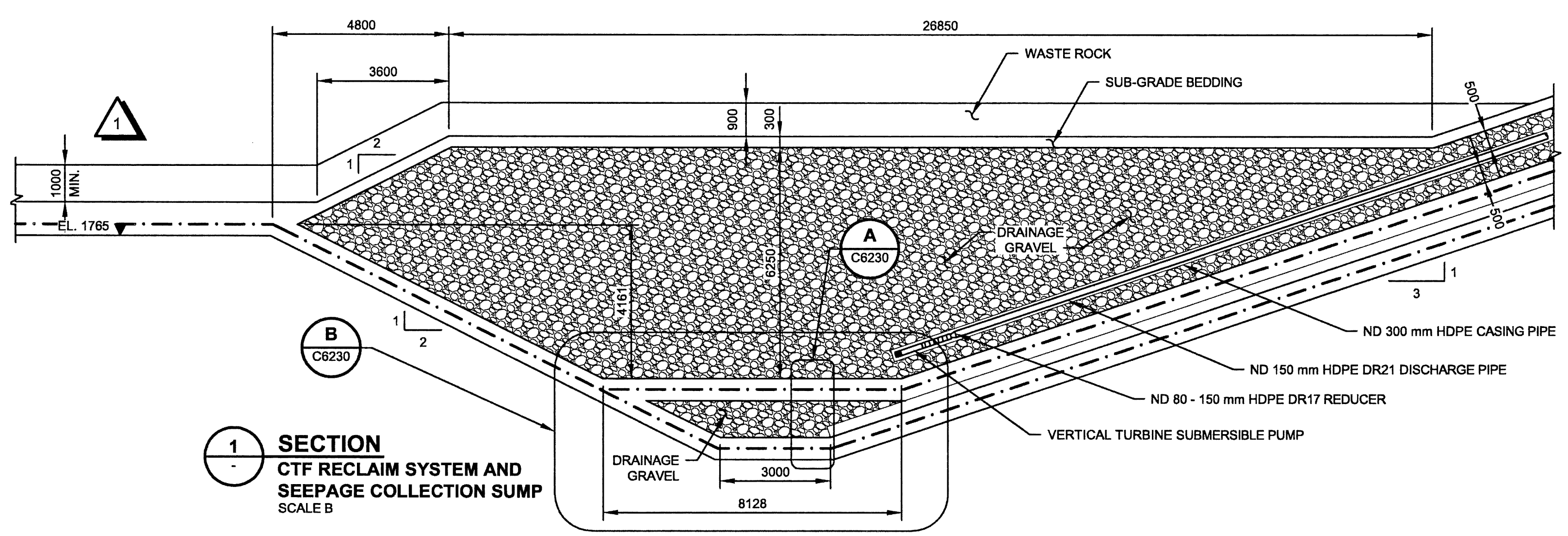
A C6210 **DETAIL**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE A

FOR INFORMATION ONLY

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

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



1 - **SECTION**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE B

– DISCLAIMER –
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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY WATER MANAGEMENT SYSTEMS TYPICAL SECTIONS - 1 OF 2

DRG. NO.	DESCRIPTION
C6230	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 2 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	SLOPE AND WASTE ROCK THICKNESS REVISED	GIM	RAP		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KDE	KDE

REVISIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6220	1

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6220\C6220_r1, 4/27/2016 3:57:58 PM, RPENG PRINTED: 4/27/2016 3:58:11 PM, C6220, RPENG
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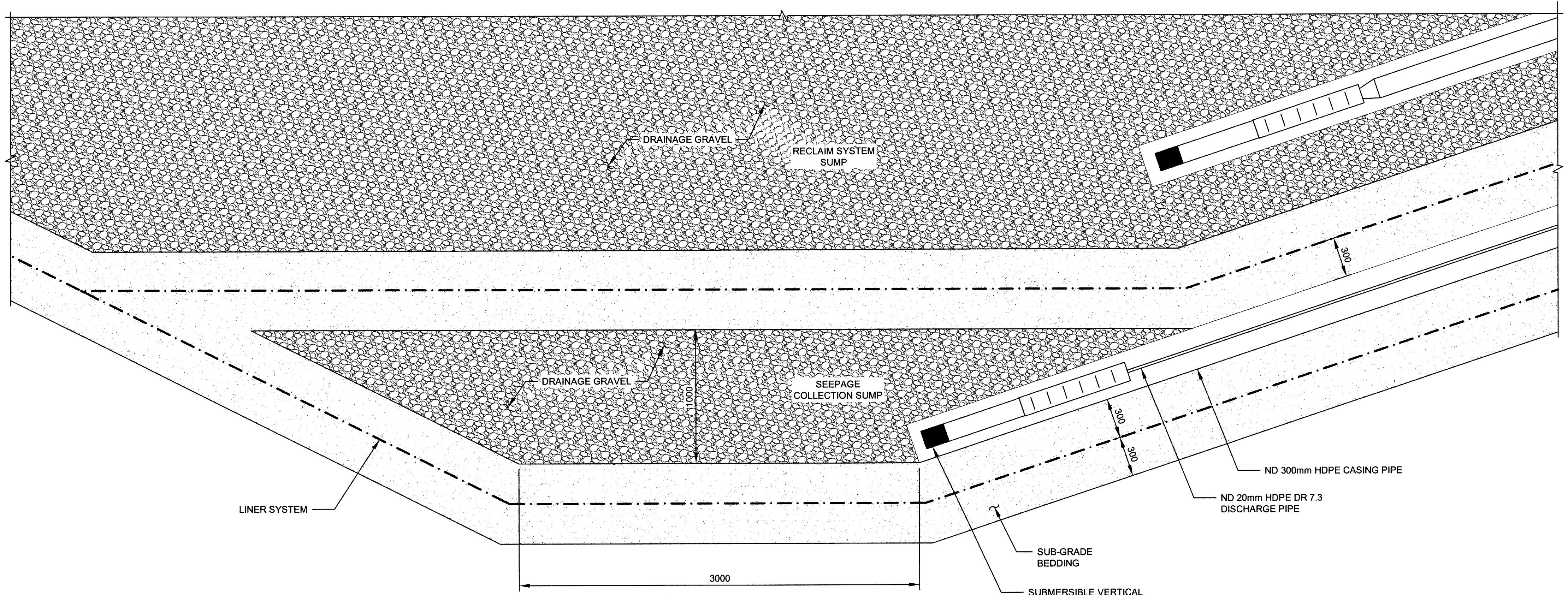
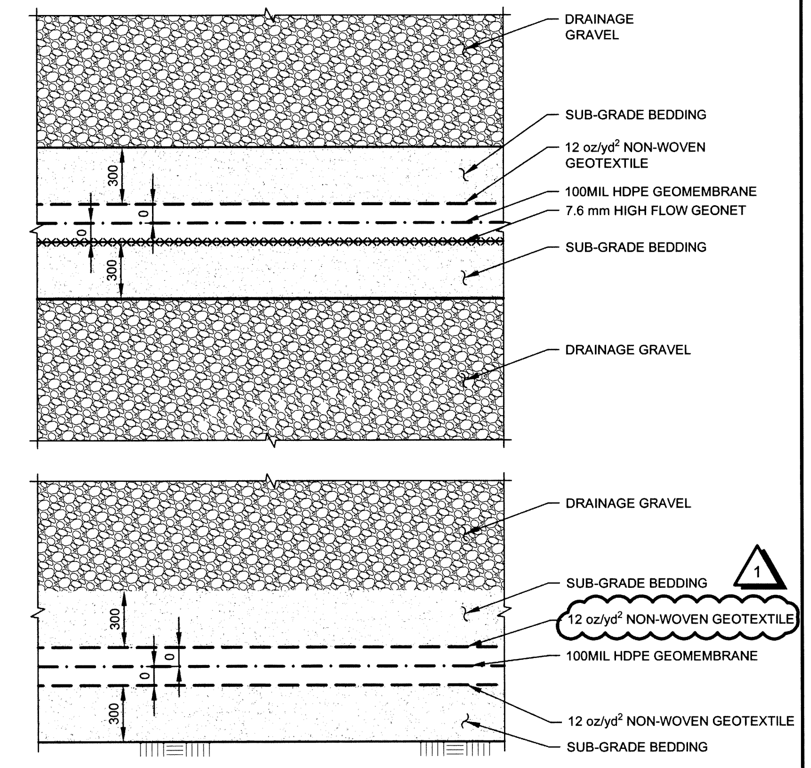
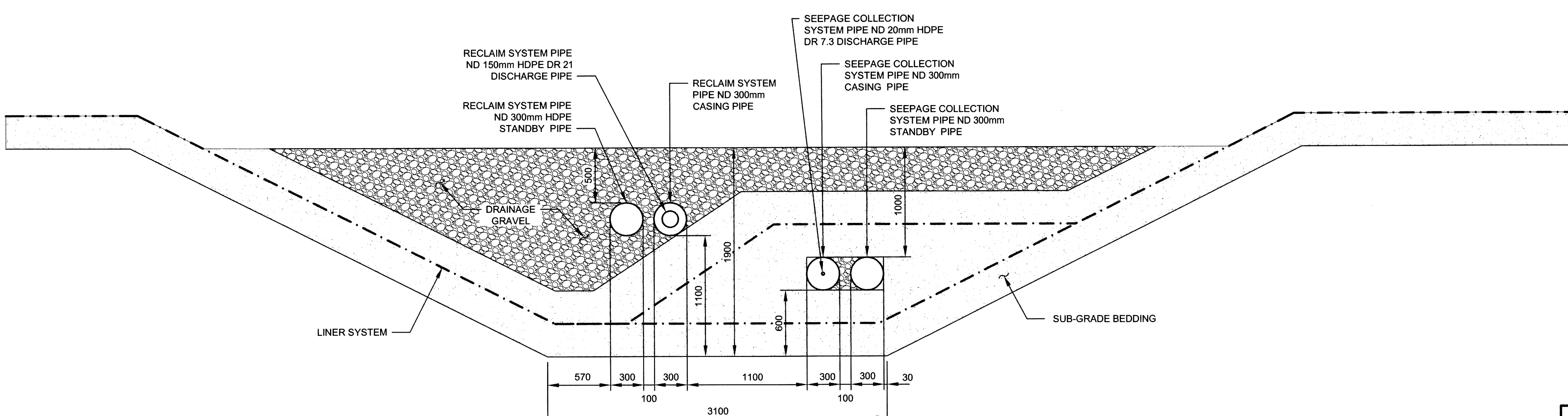


B C6220 **DETAIL**
CTF RECLAIM SYSTEM AND SEEPAGE COLLECTION SUMP
SCALE A



A C6220 **SECTION**
LINER CONFIGURATION
NTS



2 C6220 **SECTION**
SCALE B

FOR INFORMATION ONLY

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

SCALE A 2 1 0 2 4 6 8 10 m
SCALE B 3 1.5 0 5 10 15 m

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BLACK BUTTE COPPER PROJECT

CEMENTED TAILINGS FACILITY
WATER MANAGEMENT SYSTEMS
TYPICAL SECTIONS - 2 OF 2

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6230	1

DRG. NO.	DESCRIPTION
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 1 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	20JUL'16	SECTION A REVISED - NON-WOVEN GEOTEXTILE ADDED	GIM	WAL		
0	15OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	KDE	KDE

REVISIONS

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6230\C6230_r1, 7/20/2016 2:39:48 PM , WLAHODA PRINTED: 7/20/2016 2:45:05 PM, layout, WLAHODA
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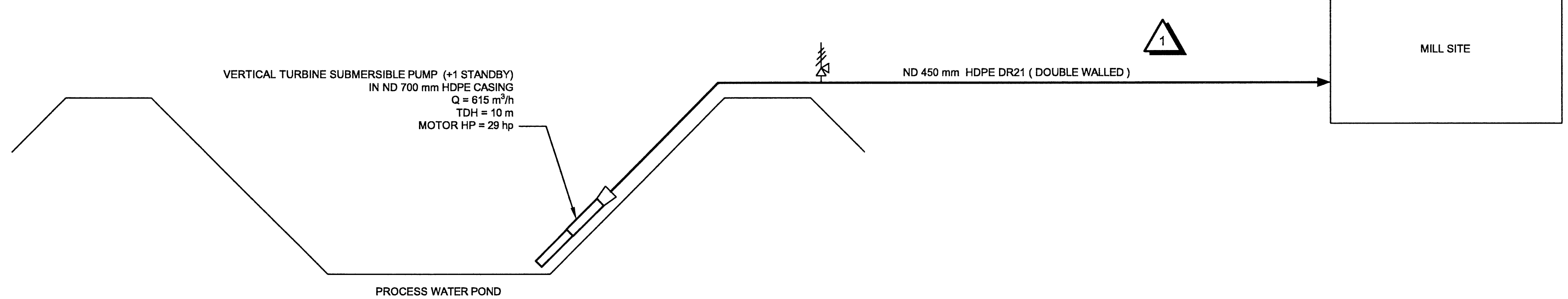
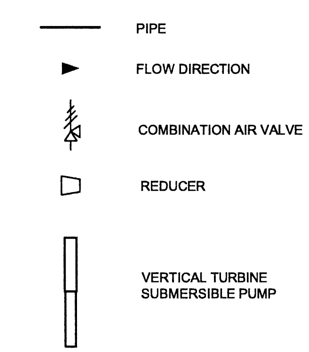


LEGEND:



FOR INFORMATION ONLY

C6260	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - PLAN AND PROFILE
DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP	K	K
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB
REVISIONS						

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

RECLAIM WATER DELIVERY SYSTEM PROCESS WATER POND TO MILL SITE PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6250	1

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6250\C6250_r1, 4/27/2016 3:36:59 PM , RPENG PRINTED: 4/27/2016 3:37:09 PM, LAYOUT, RPENG
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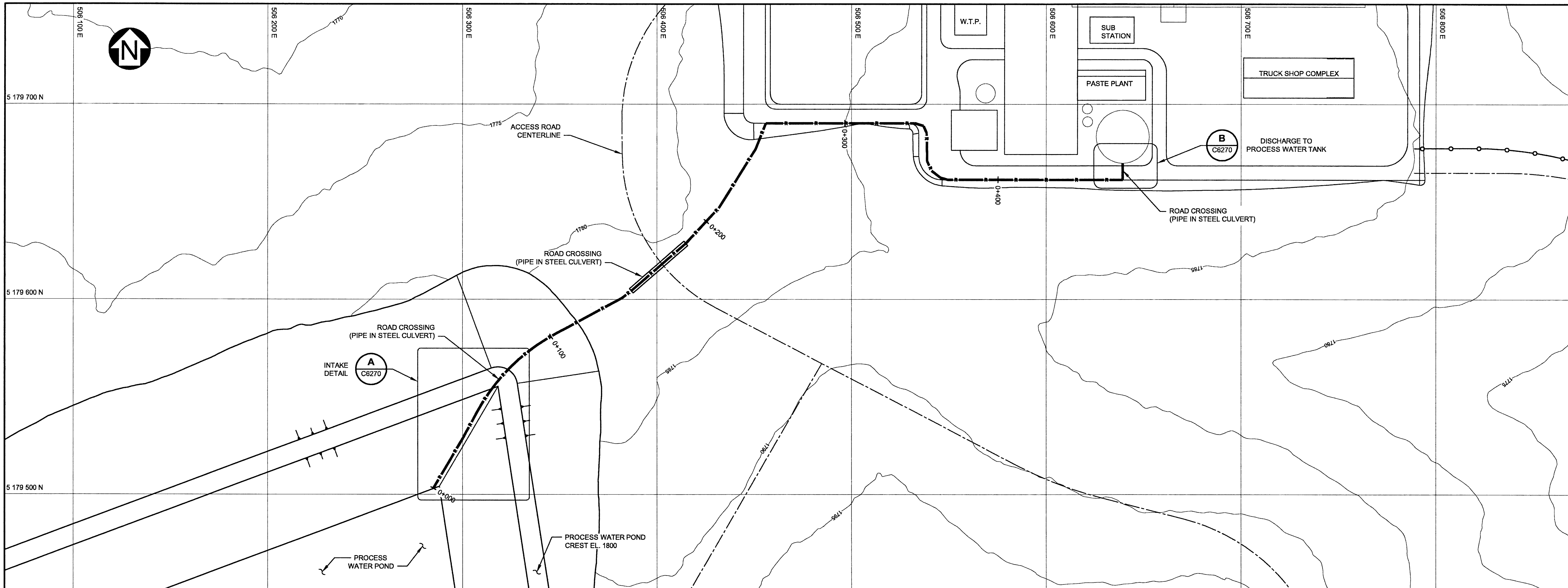


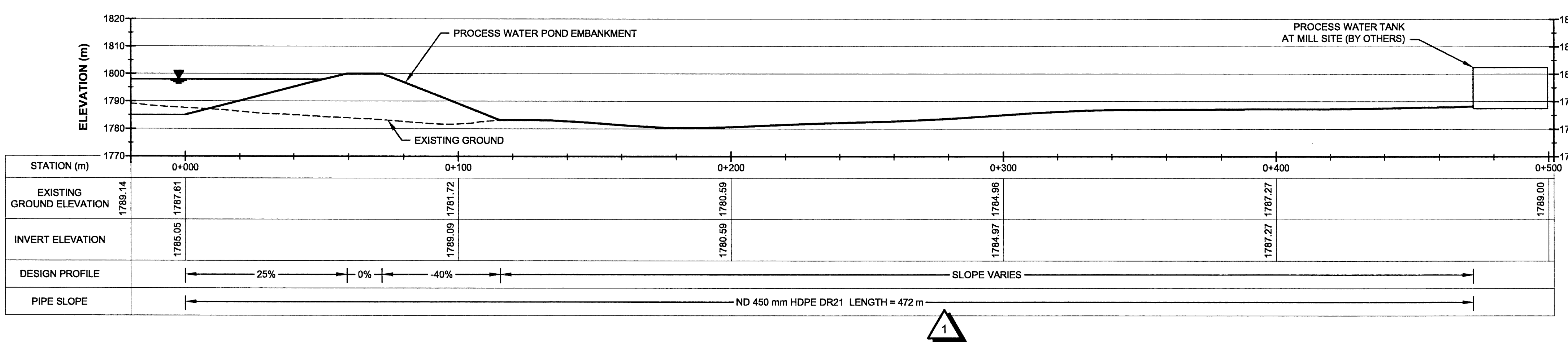
PLAN
SCALE A

LEGEND:

RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.



PROFILE
SCALE A

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

DRG. NO.	DESCRIPTION
C6250	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - P&ID
C6270	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP	K.	K.
0	15OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	KJB	KJB

REVISIONS

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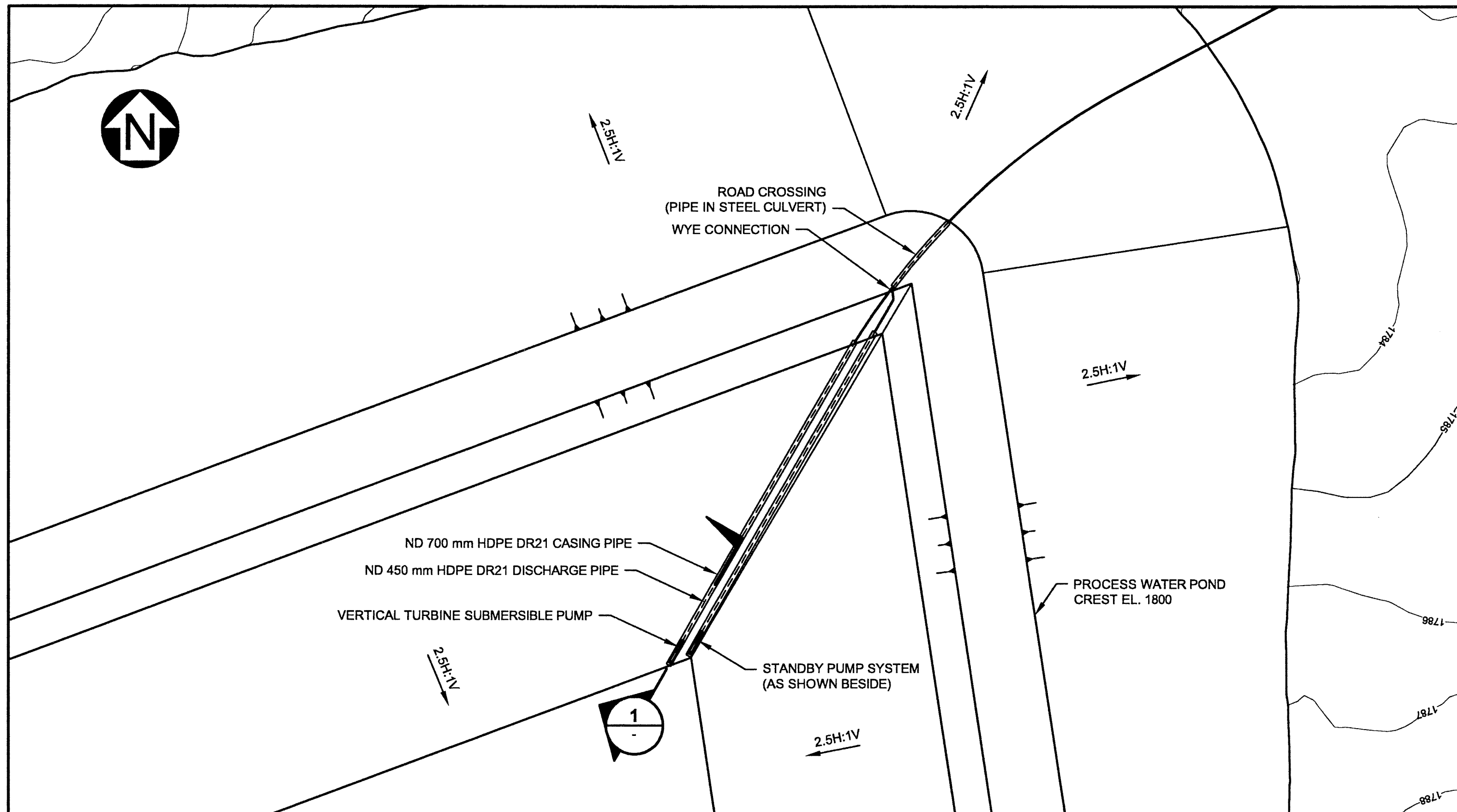
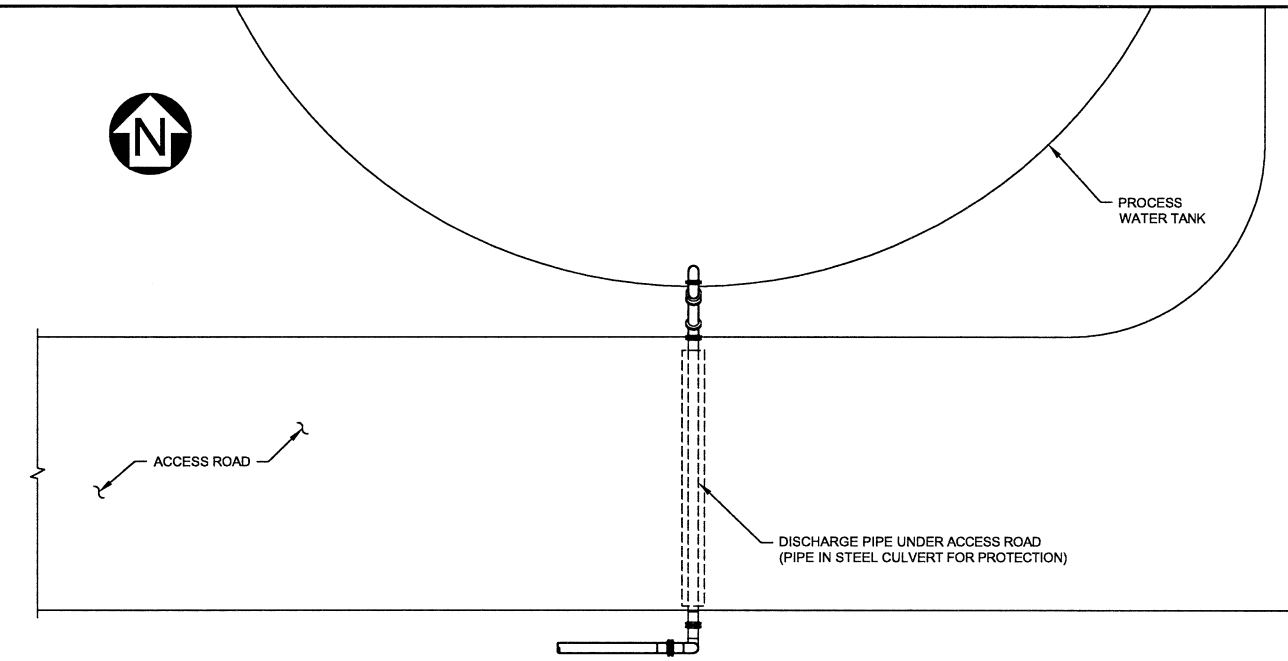
BLACK BUTTE COPPER PROJECT

RECLAIM WATER DELIVERY SYSTEM PROCESS WATER POND TO MILL SITE PLAN AND PROFILE

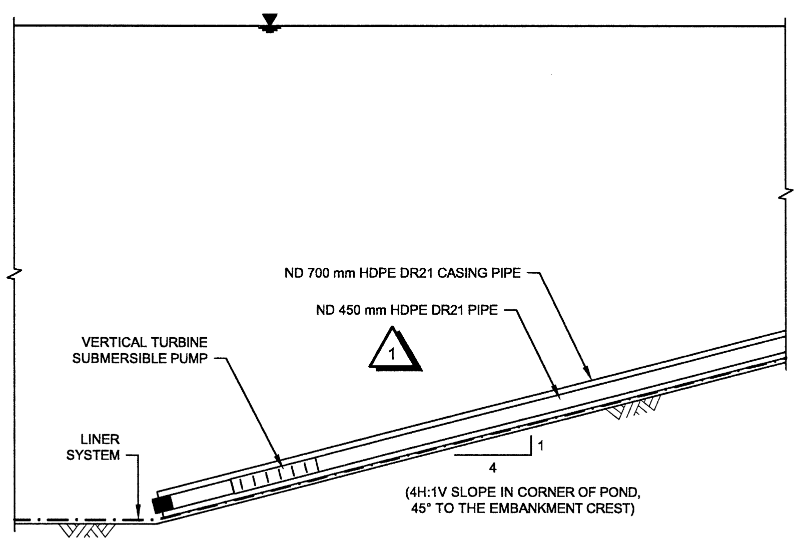
P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6260	1



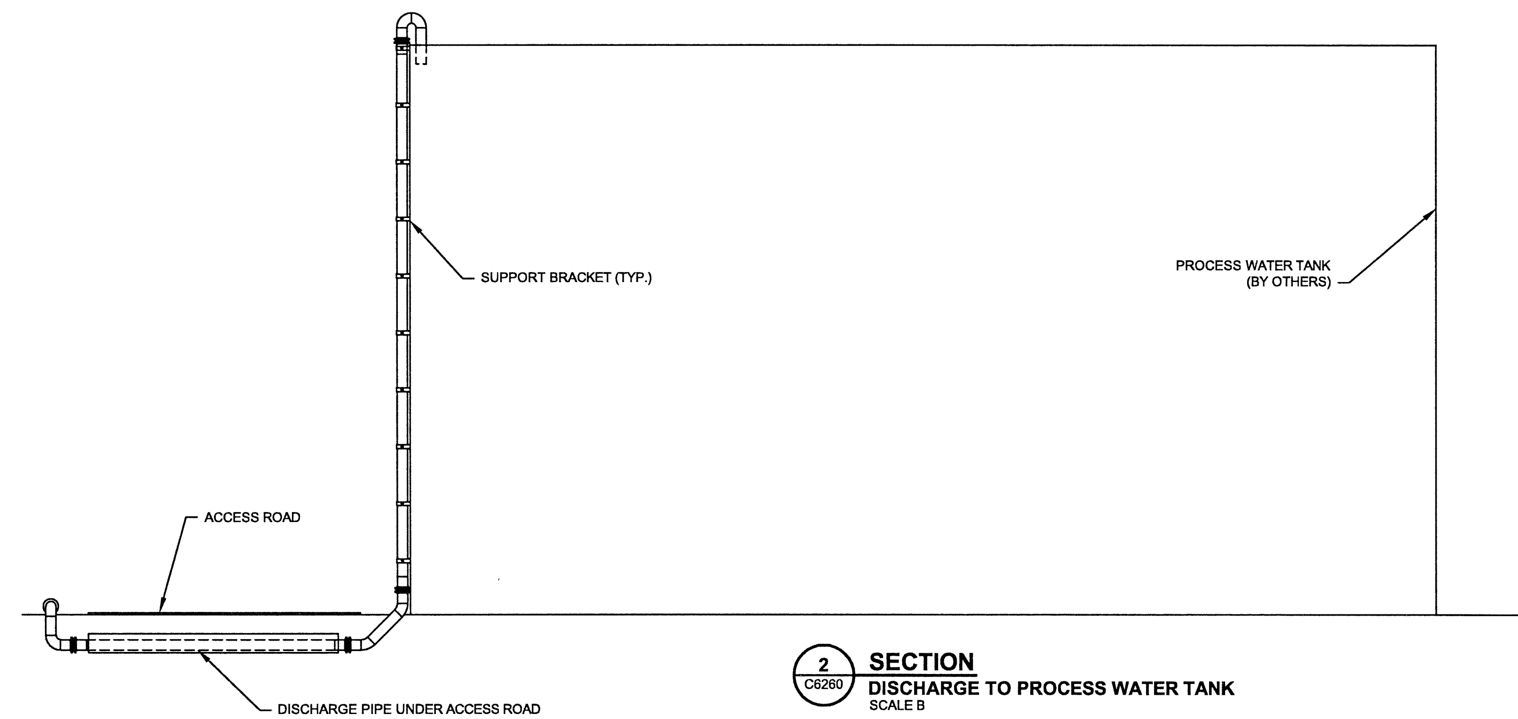
DETAIL A / C6260
PROCESS WATER POND INTAKE
SCALE A



DETAIL B / C6260
DISCHARGE TO PROCESS WATER TANK
SCALE B



SECTION 1 / C6260
PROCESS WATER POND INTAKE
SCALE B



SECTION 2 / C6260
DISCHARGE TO PROCESS WATER TANK
SCALE B

NOTES:

1. DIMENSIONS AND ELEVATIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

SCALE A: 10 5 0 10 20 30 40 50 m
SCALE B: 2 1 0 2 4 6 8 10 m

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BLACK BUTTE COPPER PROJECT

RECLAIM WATER DELIVERY SYSTEM
PROCESS WATER POND TO MILL SITE
TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6270	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6260	RECLAIM WATER DELIVERY SYSTEM - PWP TO MILL SITE - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	DISCHARGE PIPE SIZE REVISED	GIM	RAP	K.I.L.	
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6270\C6270_r1, 4/27/2016 3:34:35 PM , RPENG PRINTED: 4/27/2016 3:34:48 PM, C6004, RPENG
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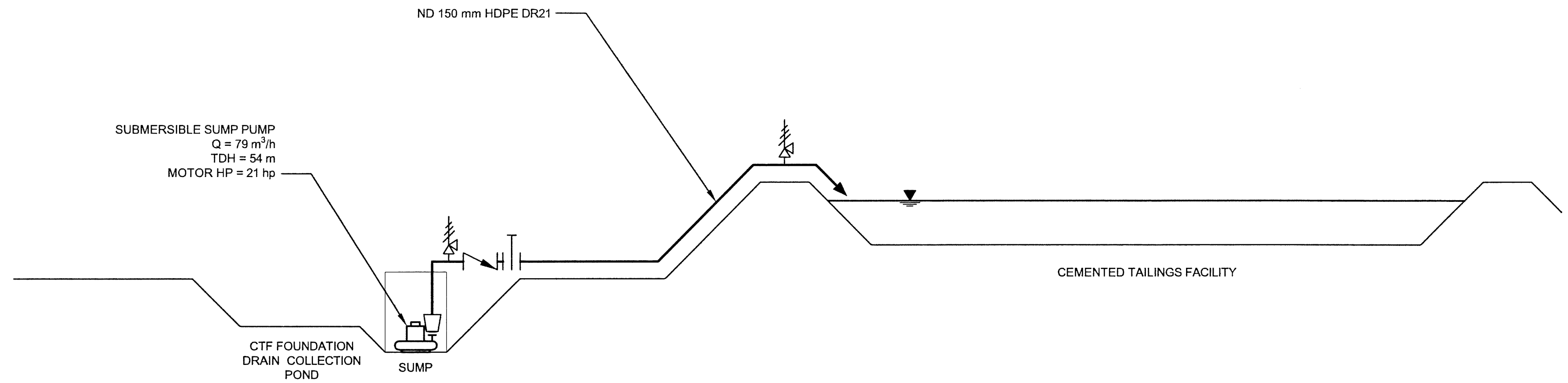
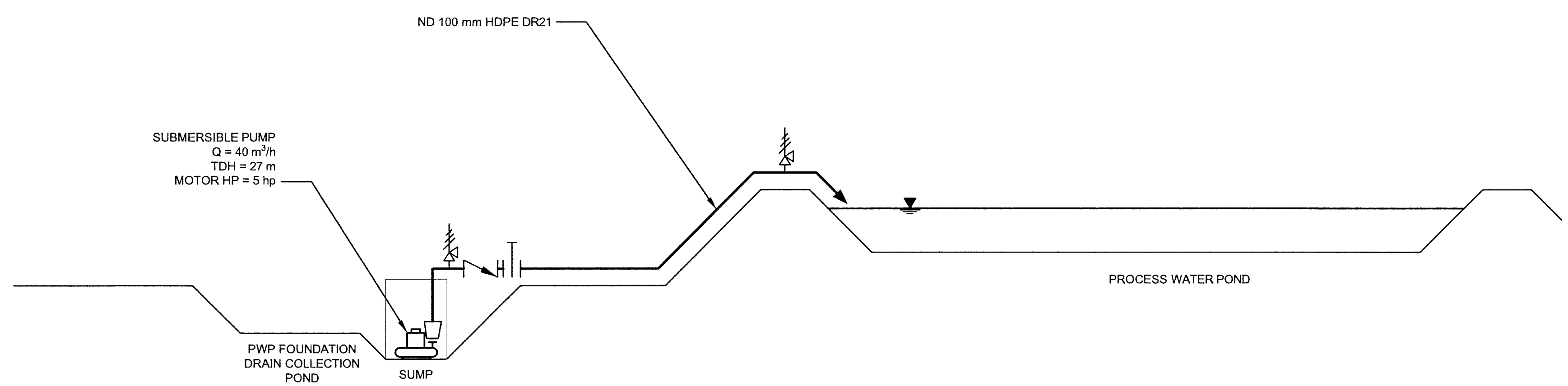


CEMENTED TAILINGS FACILITY FOUNDATION DRAIN PUMPBACK SYSTEM



PROCESS WATER POND FOUNDATION DRAIN PUMPBACK SYSTEM

LEGEND:

- SUBMERSIBLE PUMP
- COMBINATION AIR VALVE
- ISOLATION VALVE
- CHECK VALVE
- REDUCER

FOR INFORMATION ONLY

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BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6300	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6320	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - PWP - PLAN AND PROFILE
C6310	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - CTF - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	K.	K.

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6300\C6300, 10/16/2015 8:49:50 AM , PPETKOVIC PRINTED: 10/16/2015 8:49:54 AM, layout, PPETKOVIC
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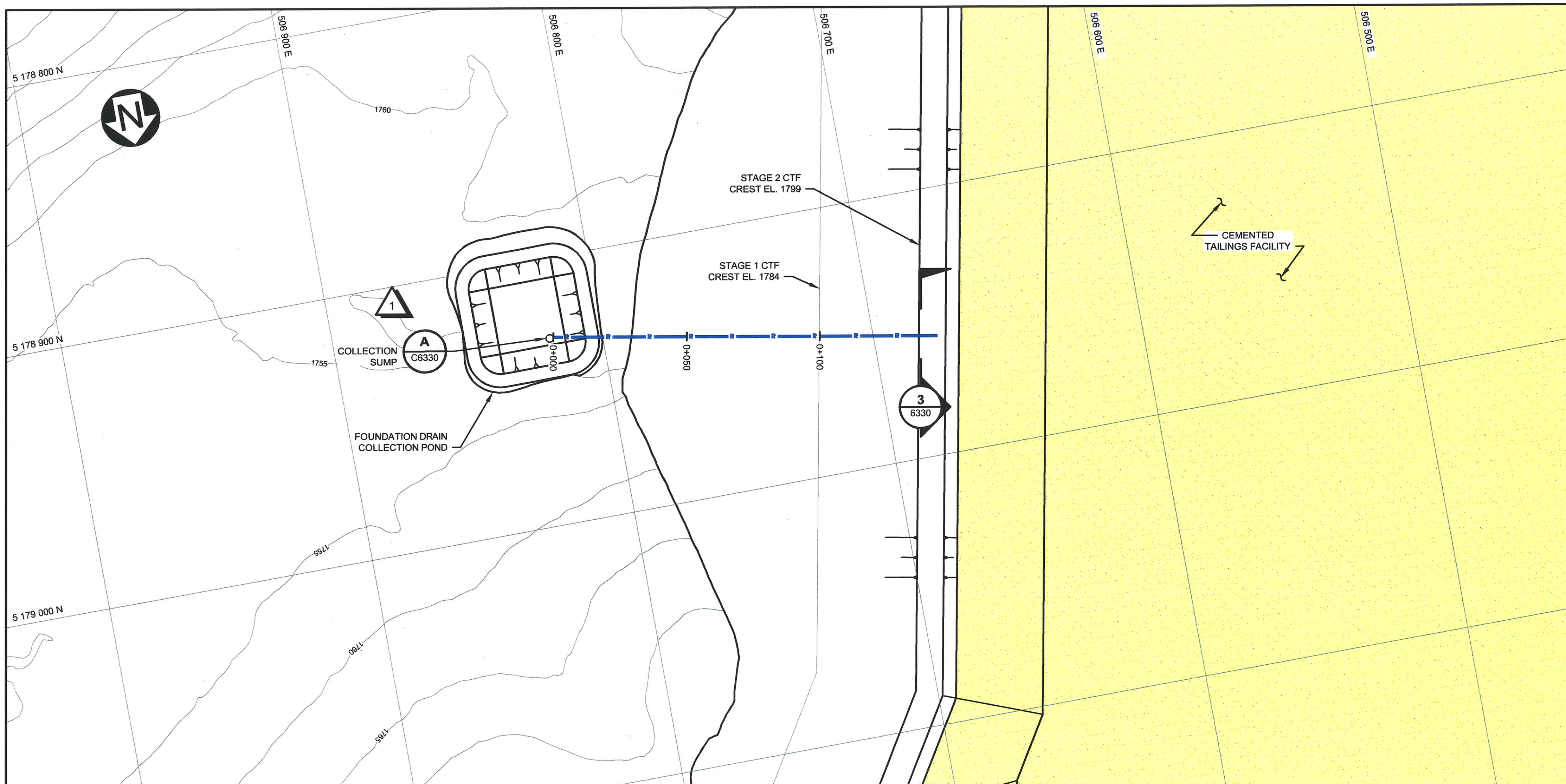
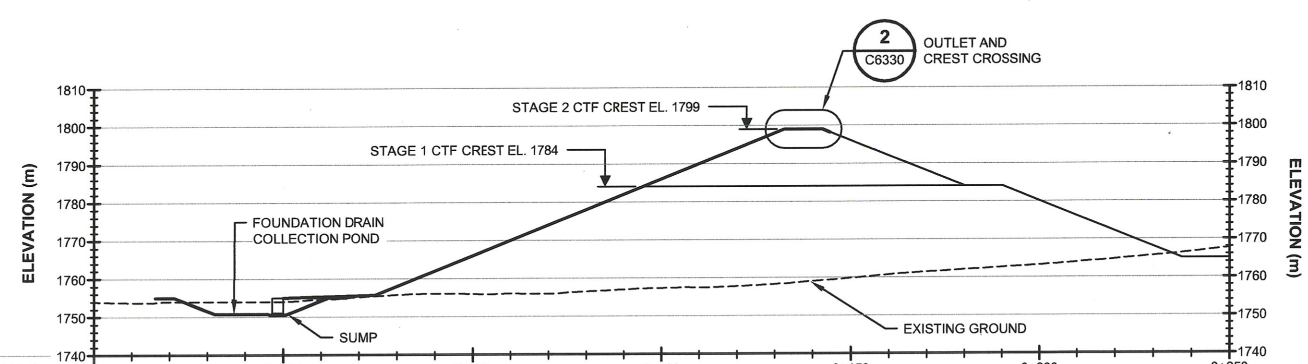


PLAN
SCALE A



STATION (m)		0+000	0+050	0+100	0+150	0+200	0+250
EXISTING GROUND ELEVATION	1753.95	1754.00	1755.94	1757.33	1759.81	1763.22	1767.64
INVERT ELEVATION		1754.99	1765.98	1785.98			
DESIGN PROFILE		←2.8%→ ← 40% → 0% ← -40%					
PIPE DATA		← ND 150 HDPE DR21 LENGTH = 145 m →					

PROFILE
SCALE A

LEGEND:

RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

20 10 0 20 40 60 80 100 m
SCALE A

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BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6310	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	CTF FOUNDATION DRAIN POND REVISED	MAP	RAP	K.	K.
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KDE	KDE

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6310\C6310, 4/28/2016 9:33:51 AM , RPENG PRINTED: 4/28/2016 9:41:04 AM, C6310, RPENG
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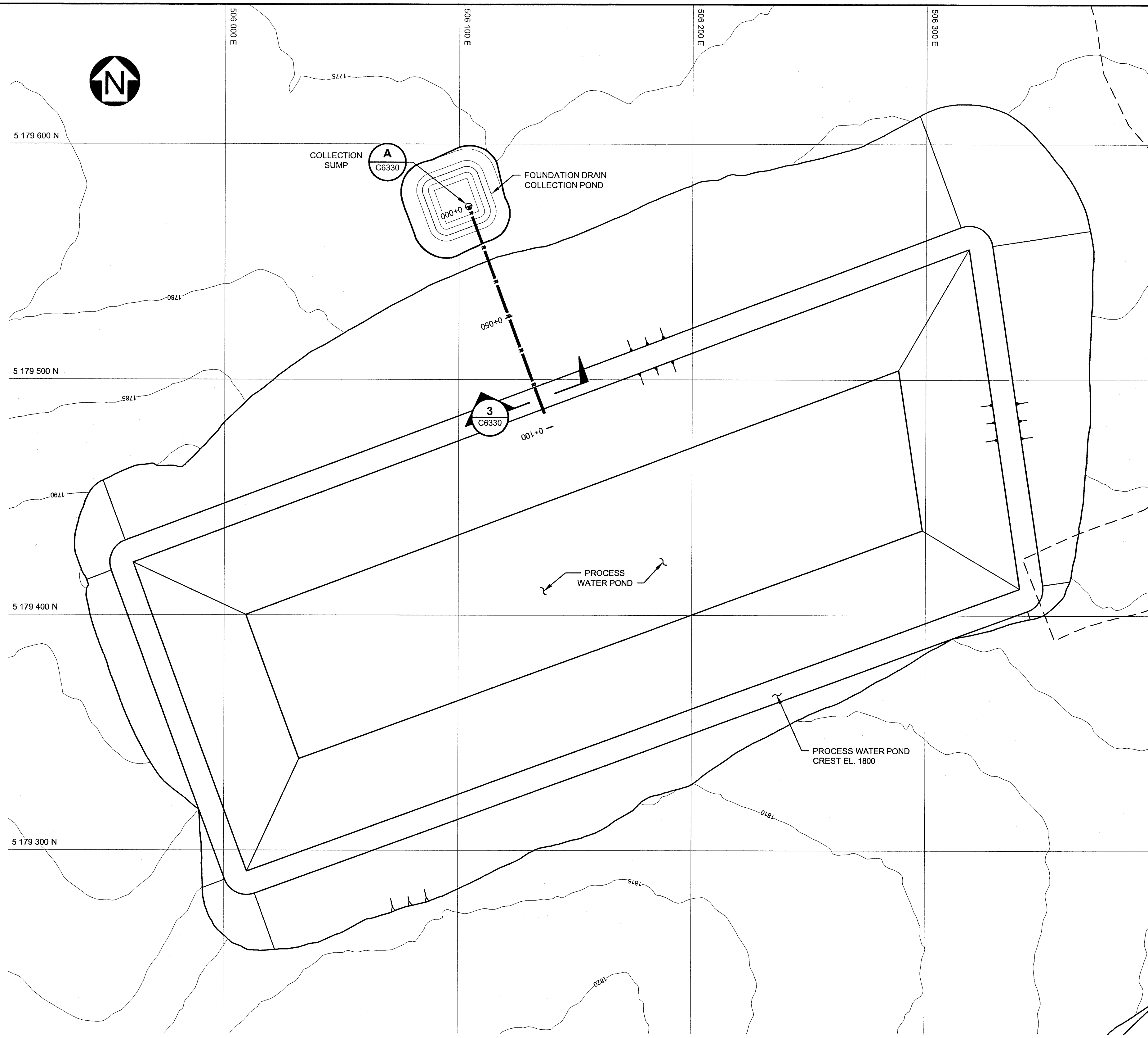
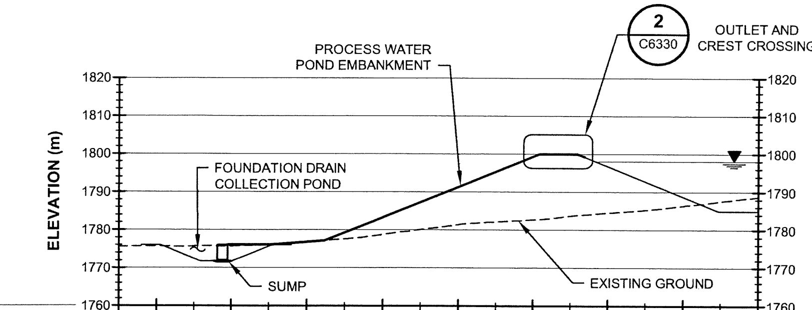


PLAN
SCALE A



STATION (m)	-0+020	0+000	0+020	0+040	0+060	0+080	0+100	0+120	0+140
EXISTING GROUND ELEVATION	1775.73	1775.67	1776.68	1778.78	1781.38	1782.69	1784.54	1786.42	1788.74
INVERT ELEVATION		1776.00	1776.78	1783.32	1791.32	1799.32			
DESIGN PROFILE	0%	8%	40%	0%	-40%				
PIPE DATA	ND 100 HDPE DR21 LENGTH = 94 m								

PROFILE
SCALE A

LEGEND:

—R— RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

SCALE A 20 10 0 20 40 60 80 100 m

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BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN PUMPBACK SYSTEM PROCESS WATER POND PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6320	0

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	15OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	K.•	K.•

REVISIONS

SAVED: M:\1\10\00460\03\A\Acad\DWGS\C6320\C6320, 10/16/2015 8:57:10 AM, PPETKOVIC PRINTED: 10/16/2015 8:57:15 AM, layout, PPETKOVIC
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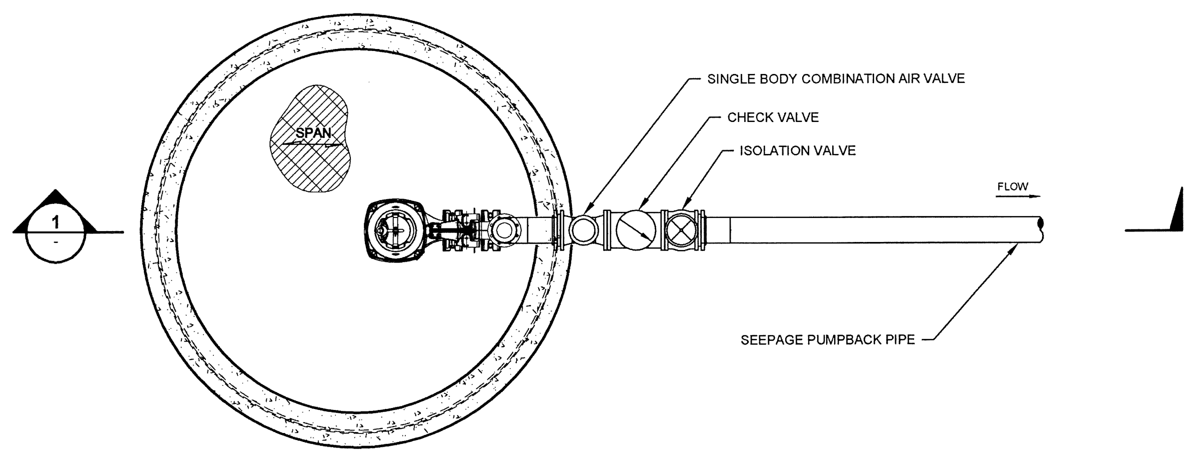
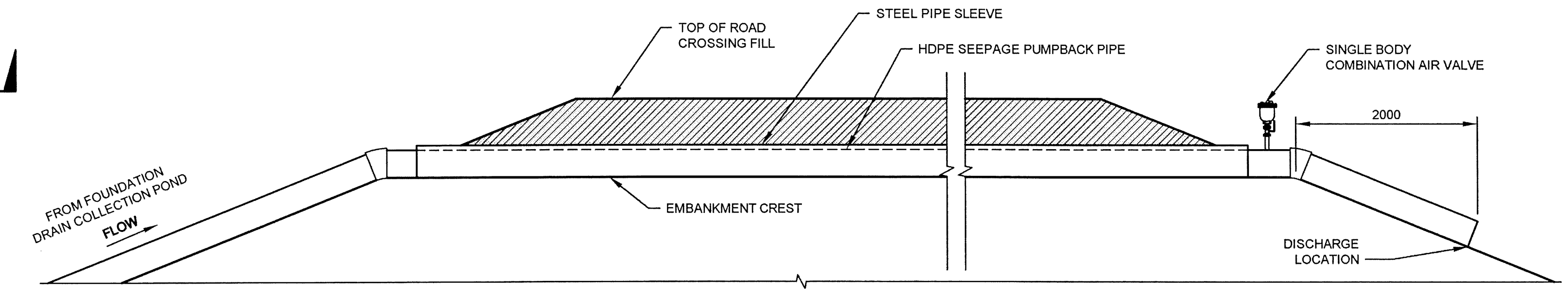
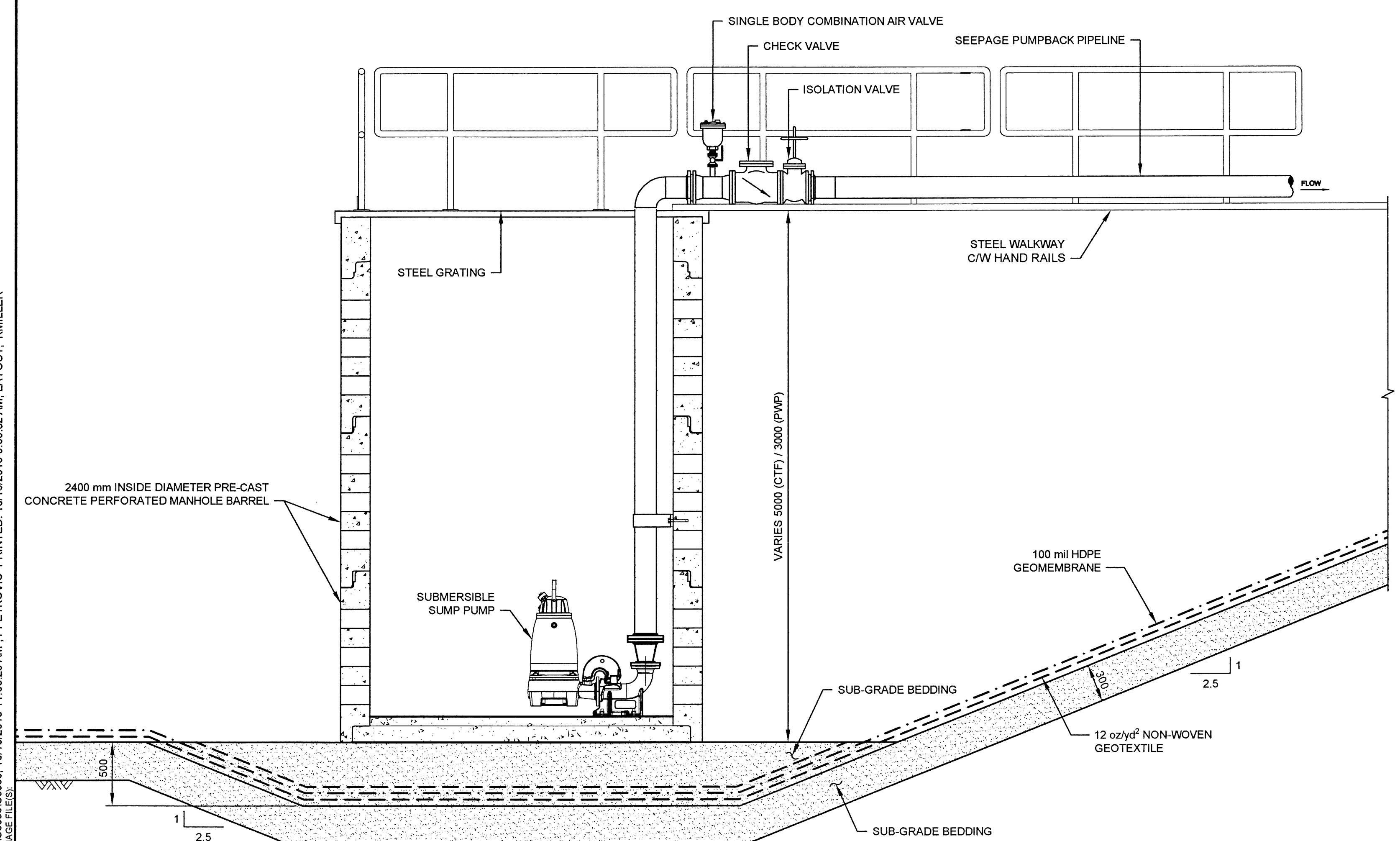


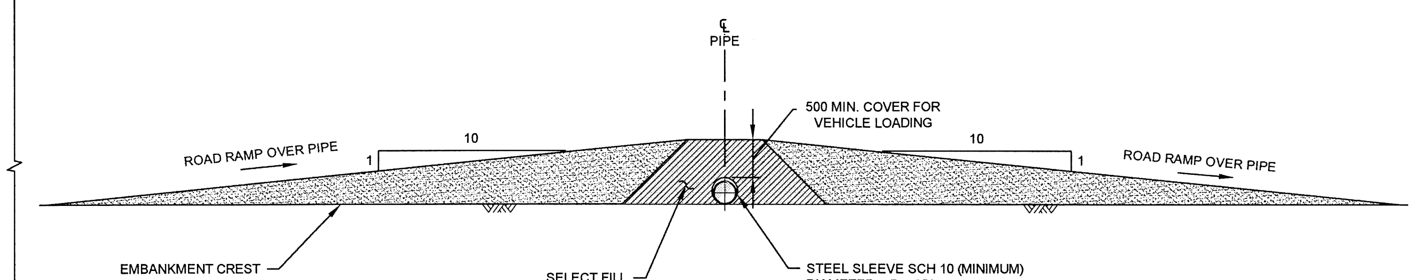
A 6310 A 6320 **DETAIL**
SUMP IN FOUNDATION DRAIN COLLECTION POND
NTS



2 6320 2 C6310 **DETAIL**
OUTLET AND CREST CROSSING
NTS



1 **SECTION**
SUMP IN FOUNDATION DRAIN COLLECTION POND
NTS



3 **SECTION**
ROAD CROSSING
NTS

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS, UNLESS NOTED OTHERWISE.

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6320	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - PWP - PLAN AND PROFILE
C6310	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - CTF - PLAN AND PROFILE
REFERENCE DRAWINGS	

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
REVISIONS						

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM		
REVISIONS						

1 82 of 87
B-35 of 40

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CONSULTING

TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

FOUNDATION DRAIN POND & PUMPBACK SYSTEM CEMENTED TAILINGS FACILITY AND PROCESS WATER POND TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6330	0

SAVED: M:\1\01\00460\03\A\Acad\DWGS\C6330\C6330, 10/15/2015 11:08:28 AM, PPETKOVIC PRINTED: 10/16/2015 9:09:32 AM, LAYOUT, KMILLER
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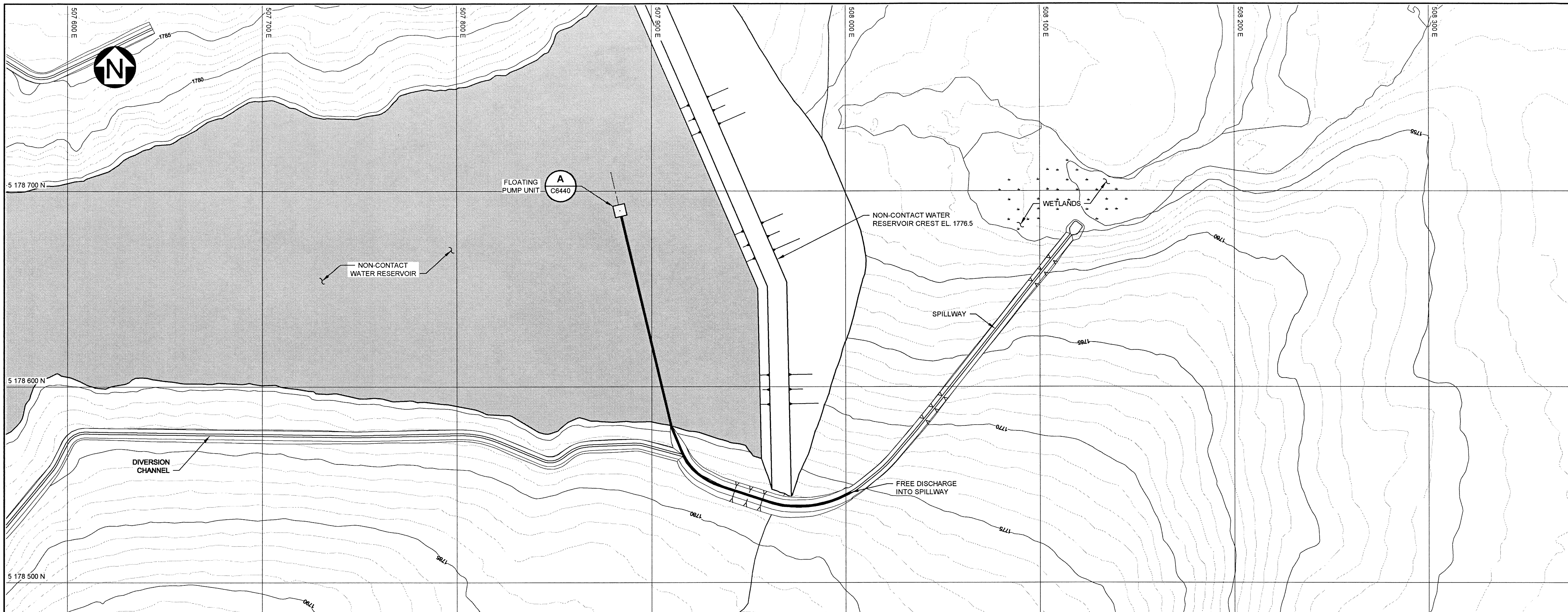


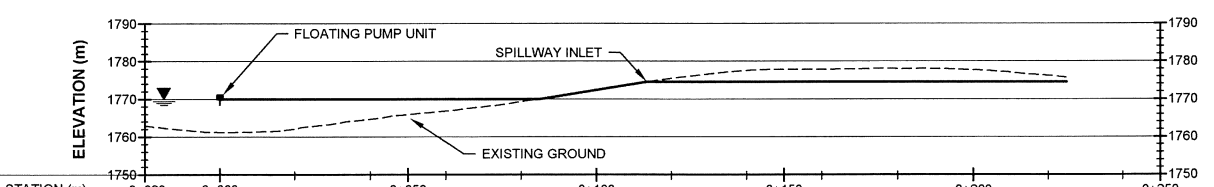
PLAN
SCALE A

LEGEND:

NON-CONTACT WATER DISCHARGE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.



STATION (m)	-0+020	0+000	0+050	0+100	0+150	0+200	0+250
GROUND ELEVATION	1762.91	1761.18	1765.89	1772.49	1777.85	1777.69	
DESIGN ELEVATION		1770.00	1770.00	1772.38	1774.50	1774.50	
DESIGN PROFILE		0%		15.85%	0%		
PIPE DATA		ND 100 mm HDPE DR21 DISCHARGE PIPE LENGTH = 225 m					

PROFILE
SCALE A

SCALE A 20 10 0 20 40 60 80 100 m

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TINTINA RESOURCES INC.

BLACK BUTTE COPPER PROJECT

NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM PLAN AND PROFILE

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6400	NON-CONTACT WATER RESERVOIR - SUPPLY AND DISCHARGE SYSTEM - P&ID
C6440	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM		

REVISIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6430	0

F 33 of 87
B 36 of 40

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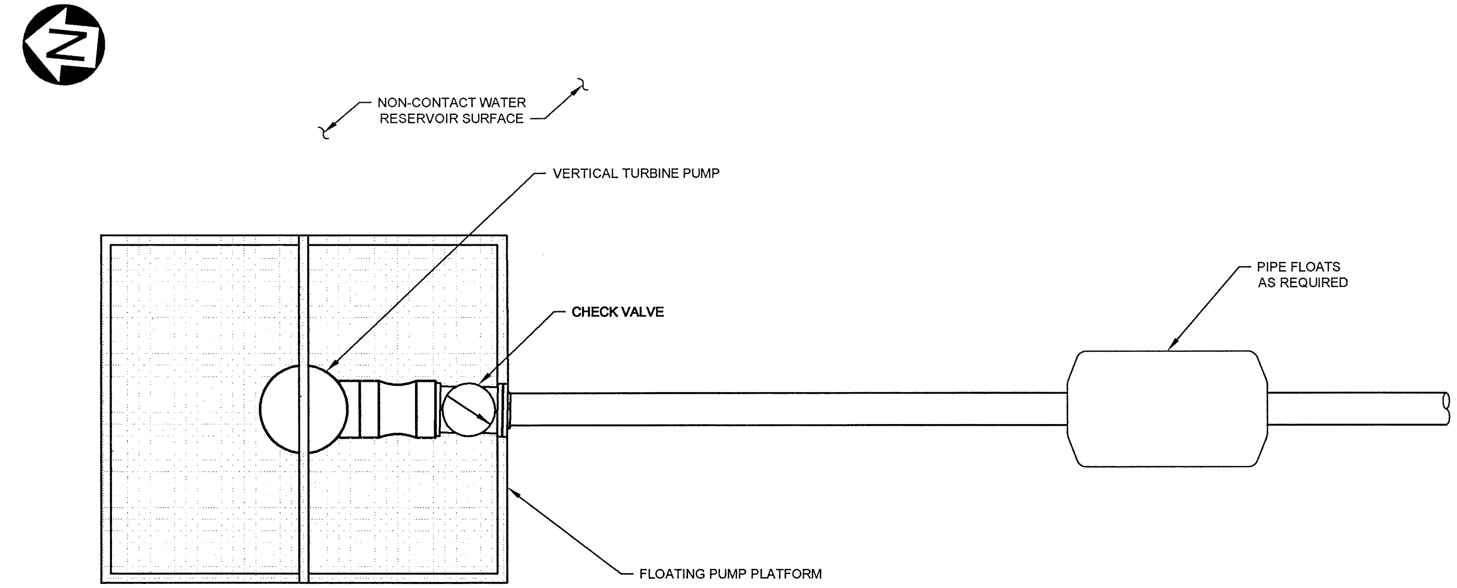
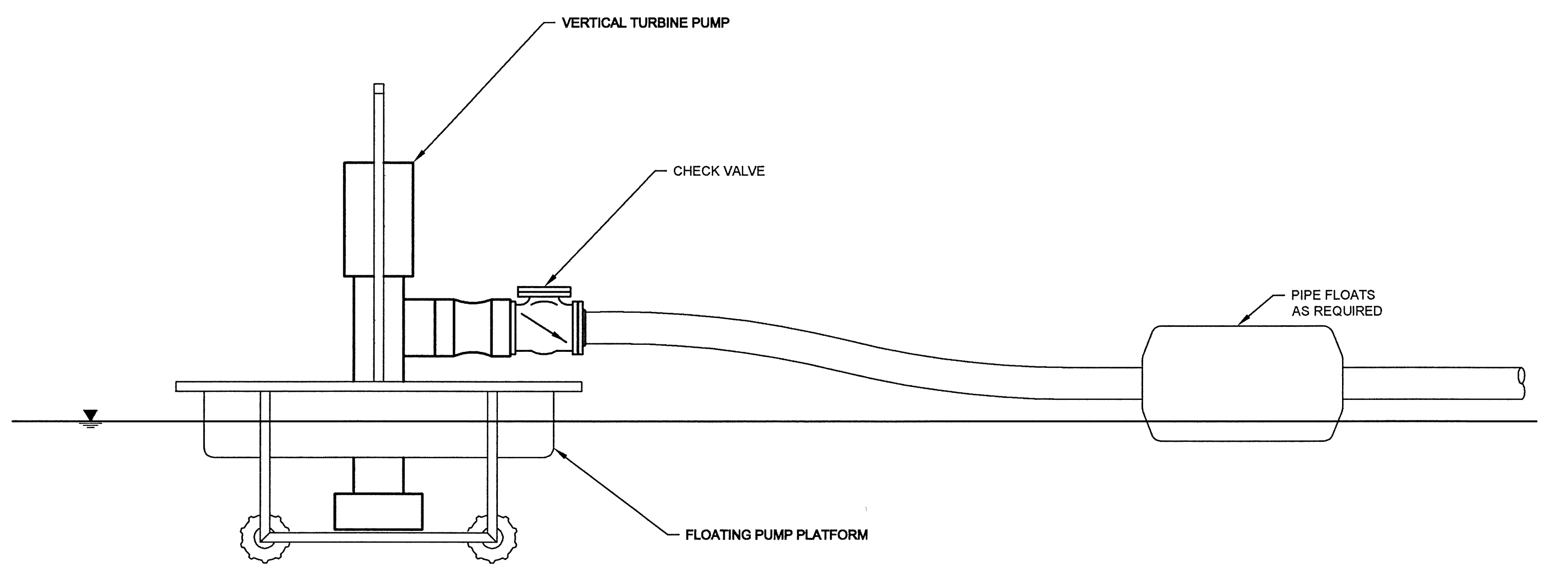
XREF FILE(S): Topo_1m, NCWR, Roads, Hydro, Wetlands, NCWR-SPILL IMAGE FILE(S):



A C6430 **DETAIL**
FLOATING PUMP UNIT
SCALE A



1 C6430 **SECTION**
FLOATING PUMP UNIT
SCALE A

SCALE A 0.4 0.2 0 0.4 0.8 1.2 1.6 2.0 m

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NON-CONTACT WATER RESERVOIR DISCHARGE SYSTEM TYPICAL SECTIONS

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6430	NON-CONTACT WATER RESERVOIR - DISCHARGE SYSTEM - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	JEF	KJM	K.	K.

REVISIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6440	0

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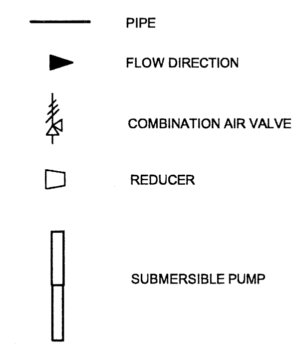

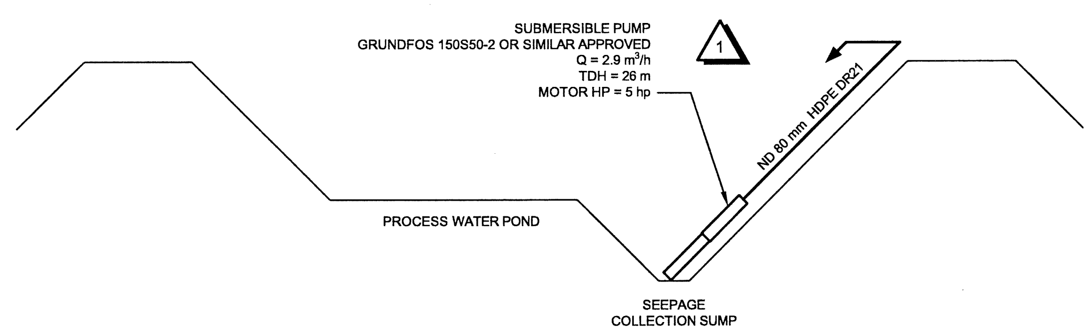

PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM

FOR INFORMATION ONLY

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BLACK BUTTE COPPER PROJECT

PROCESS WATER POND SEEPAGE COLLECTION & RECYCLE SYSTEM PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6500	1

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C6510	PROCESS WATER POND - SEEPAGE COLLECTION & RECYCLE - PLAN & PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
1	29APR'16	VERTICAL PUMP SPECIFICATION REVISED	GIM	RAP		
0	16OCT'15	ISSUED FOR MOP APPLICATION	MAP	KJM	KJB	KJB

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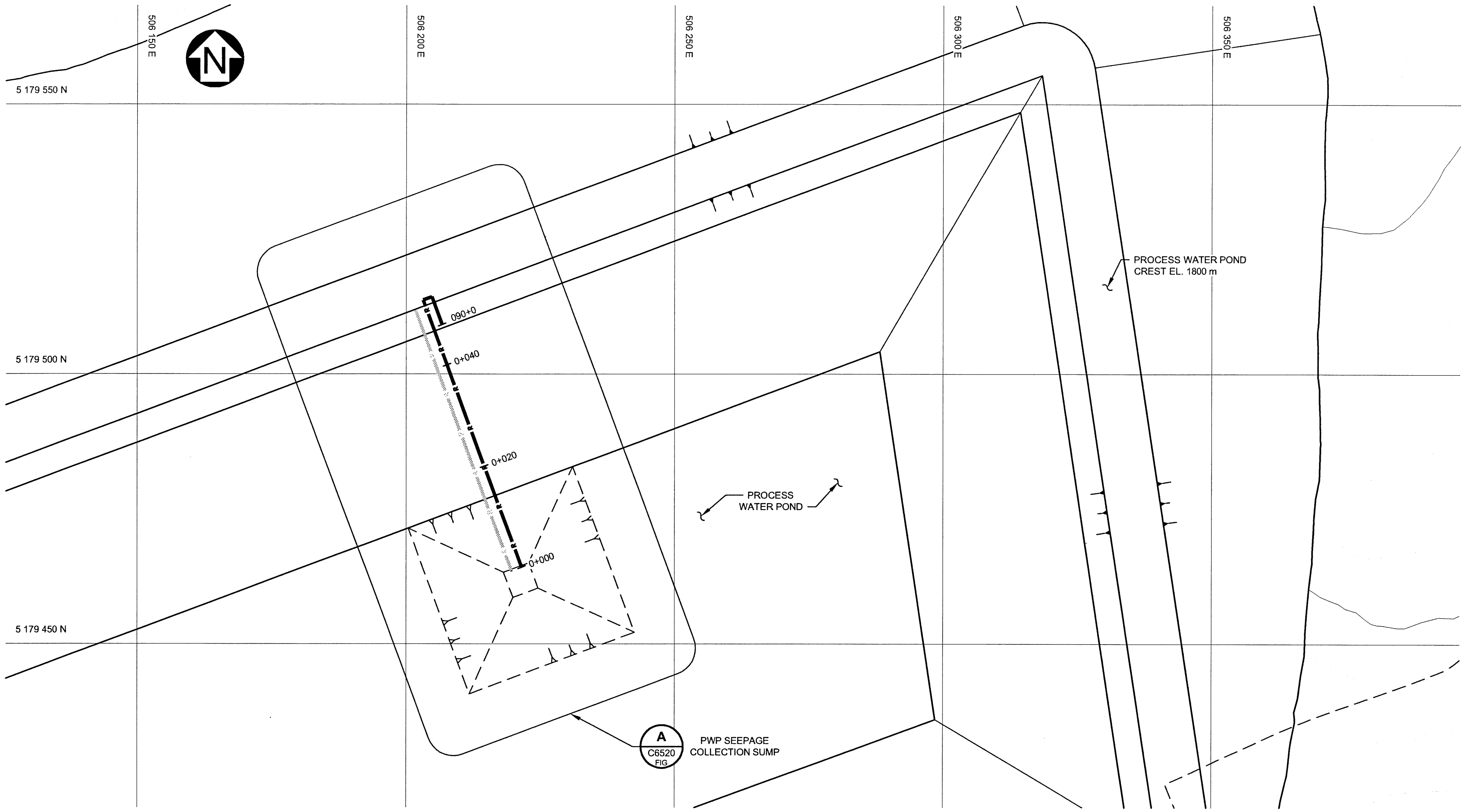
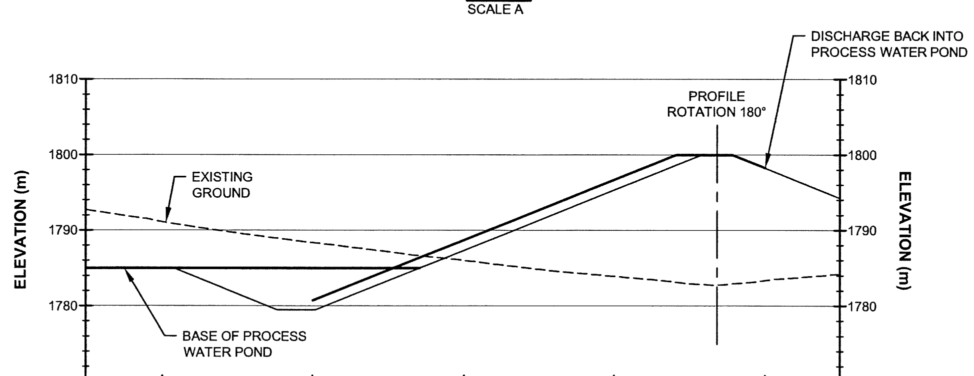


PLAN
SCALE A



STATION (m)	-0+030	-0+020	0+000	0+020	0+040	0+060	0+070
EXISTING GROUND ELEVATION	1792.72	1791.08	1788.35	1786.01	1783.90	1783.37	1784.21
PIPE INVERT ELEVATION				1788.69	1796.69	1798.25	
DESIGN PROFILE			SLOPE = 40%			0% -40%	
PIPE DATA			ND 80 mm HDPE DR21 LENGTH = 60 m				

PROFILE
SCALE A

LEGAND:

R RECLAIM WATER PIPELINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 12.
2. CONTOUR INTERVAL IS 1 METER.
3. DIMENSIONS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

SCALE A 10 5 0 10 20 30 40 50 m

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6300	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - P&ID
C6330	SEEPAGE COLLECTION AND PUMPBACK SYSTEM - TYPICAL SECTIONS

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM	K.	K.

REVISIONS

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PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6510	0

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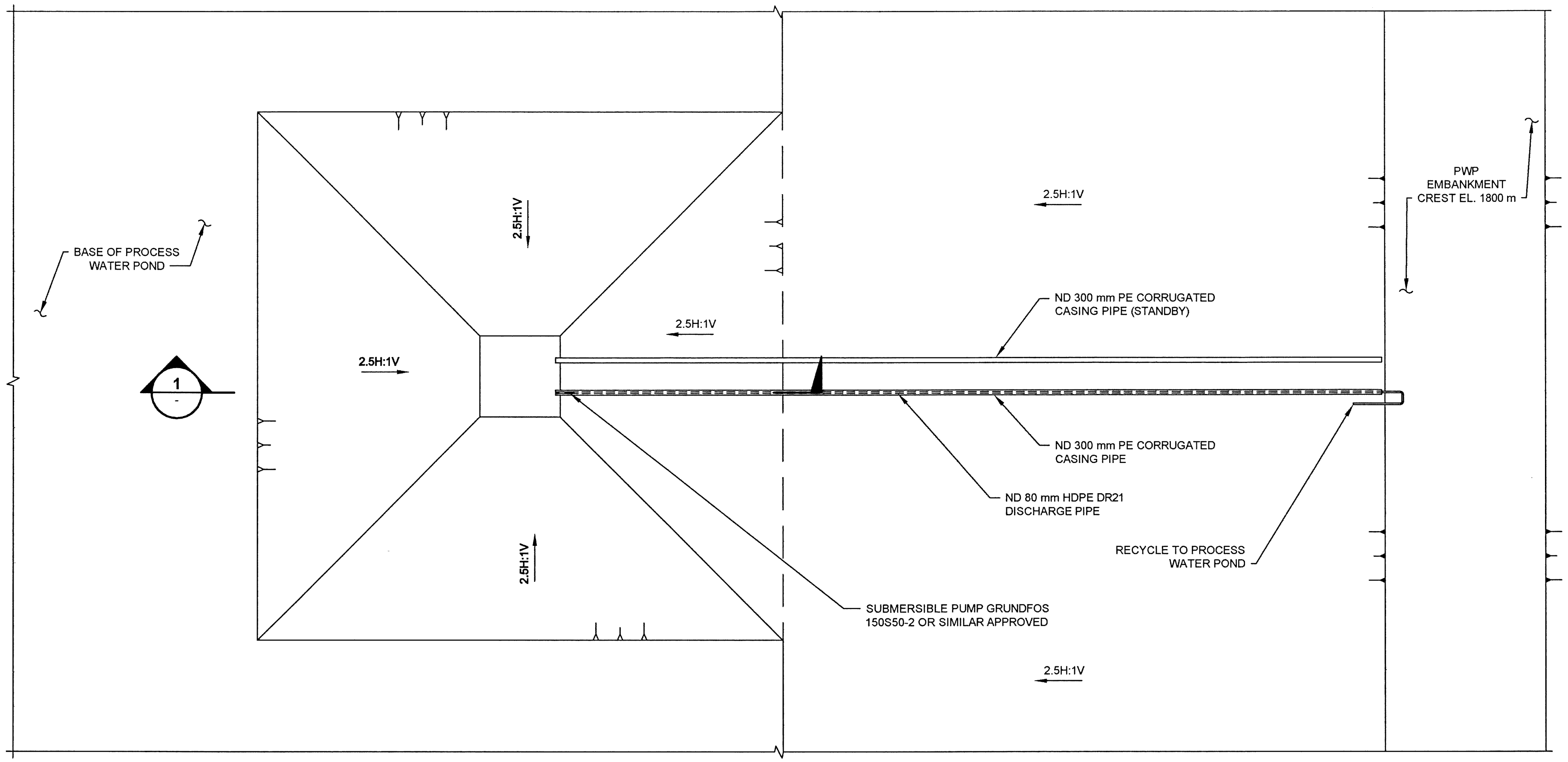
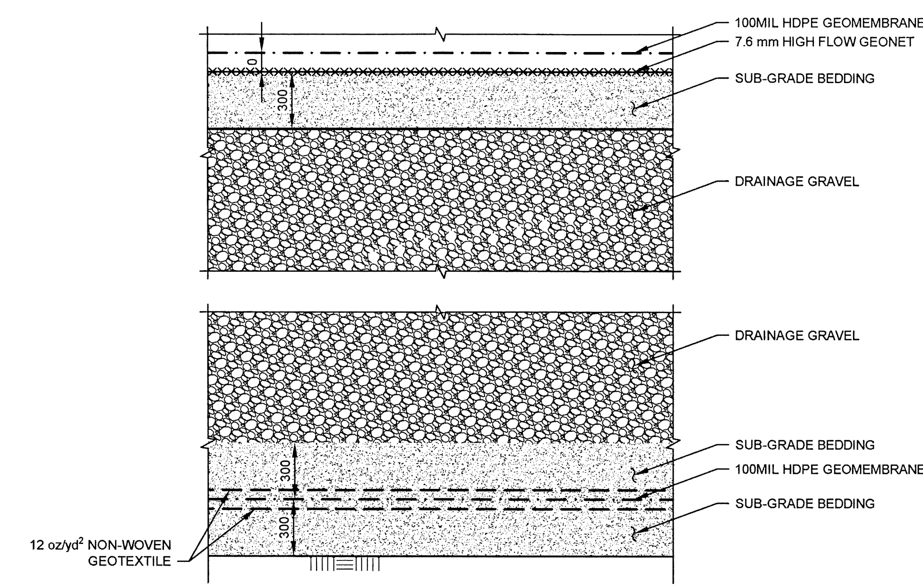
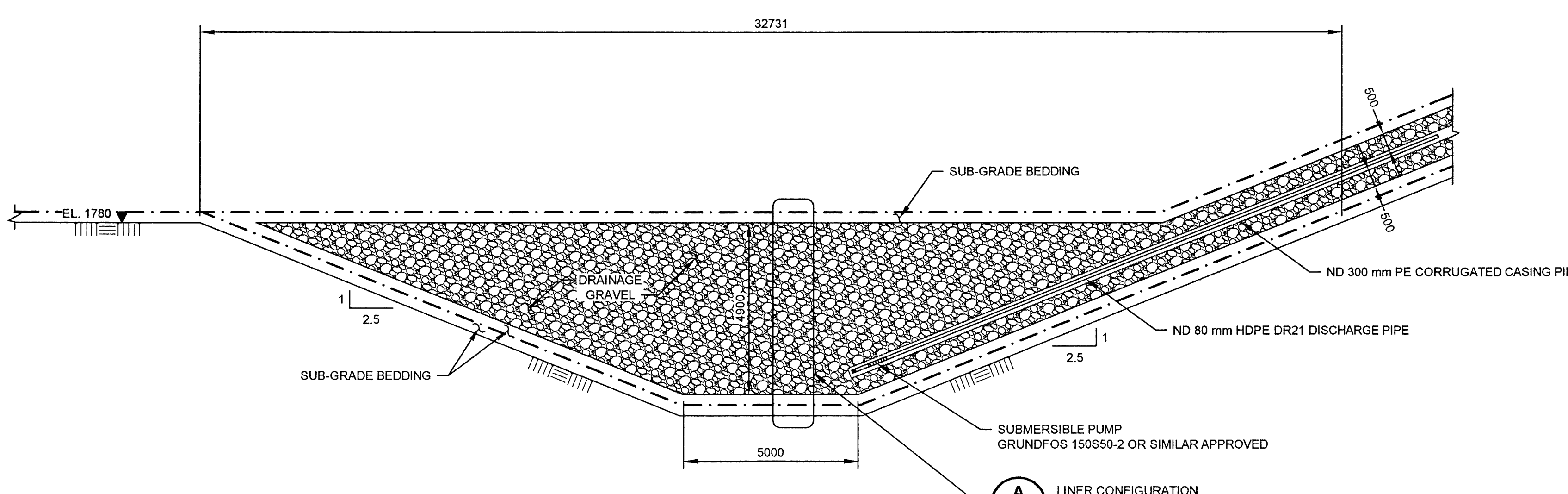
XREF FILE(S): Topo_1m; Facility_PWP; CTF_S2 IMAGE FILE(S):



A C6510 **DETAIL**
PWP SEEPAGE COLLECTION SUMP
SCALE A



A - **SECTION**
LINER CONFIGURATION
NTS



1 - **SECTION**
PWP SEEPAGE COLLECTION SUMP
SCALE A

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS, UNLESS NOTED OTHERWISE.

SCALE A 4 2 0 4 8 12 16 20 m
SCALE B 2 1 0 2 4 6 8 10 m

FOR INFORMATION ONLY

DRG. NO.	DESCRIPTION
C6220	CTF - WATER MANAGEMENT SYSTEMS - TYPICAL SECTIONS - 1 OF 2
C6210	CEMENTED TAILINGS FACILITY TO PROCESS WATER POND - PLAN & PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16OCT'15	ISSUED FOR MOP APPLICATION	RSS	KJM		

REVISIONS

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PROCESS WATER POND SEEPAGE COLLECTION AND RECYCLE SYSTEM TYPICAL SECTIONS

P/A NO.	DRAWING NO.	REVISION
VA101-460/3	C6520	0

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XREF FILE(S): IMAGE FILE(S):

APPENDIX J

REPORT ON QUATERNARY FAULTING POTENTIAL

(Pages J1 to J20)

WHITEHALL GEOGROUP, Inc.

107 Whitetail Road, Whitehall, Montana 59759 USA
whgeol@gmail.com
Telephone: 406-287-5408

June 22, 2017

Mr. Jerry Zieg, Senior Vice President
Tintina, Montana Inc.
17 East Main Street
(P.O. Box 431)
White Sulphur Springs, MT 59645

Dear Mr. Zieg:

The attached report was done to determine if there are Quaternary faults in the general area of a planned cement tailings facility at the proposed Black Butte Copper Mine. Previous workers have mapped faults in this area that offset Mesoproterozoic to earliest Eocene rocks, but the youngest documented activity on these faults occurred during the late Cretaceous and early Eocene. Geologic mapping done by others and in this study indicates that there is no evidence of these older faults or any new faults being active during the Quaternary. This conclusion is supported by geologic field evidence of the area's Cenozoic deposits which demonstrates that these deposits are not disrupted by faulting. It is also supported by LiDAR data from which a hillshade image was generated. Northeast-trending features can be identified on the hillshade image, but these features do not offset mapped Quaternary deposits. Additionally, no other fault-like features were observed cutting through Cenozoic units on the hillshade image.

Sincerely,

Digitally signed by Debra L Hanneman
DN: cn=Debra L Hanneman, o=Whitehall Geogroup, Inc., ou=President, email=whgeol@gmail.com, c=US

Debra L. Hanneman, Ph.D.
President, Whitehall Geogroup, Inc.
State of Wyoming Licensed
Professional Geologist #PG-28

EXECUTIVE SUMMARY

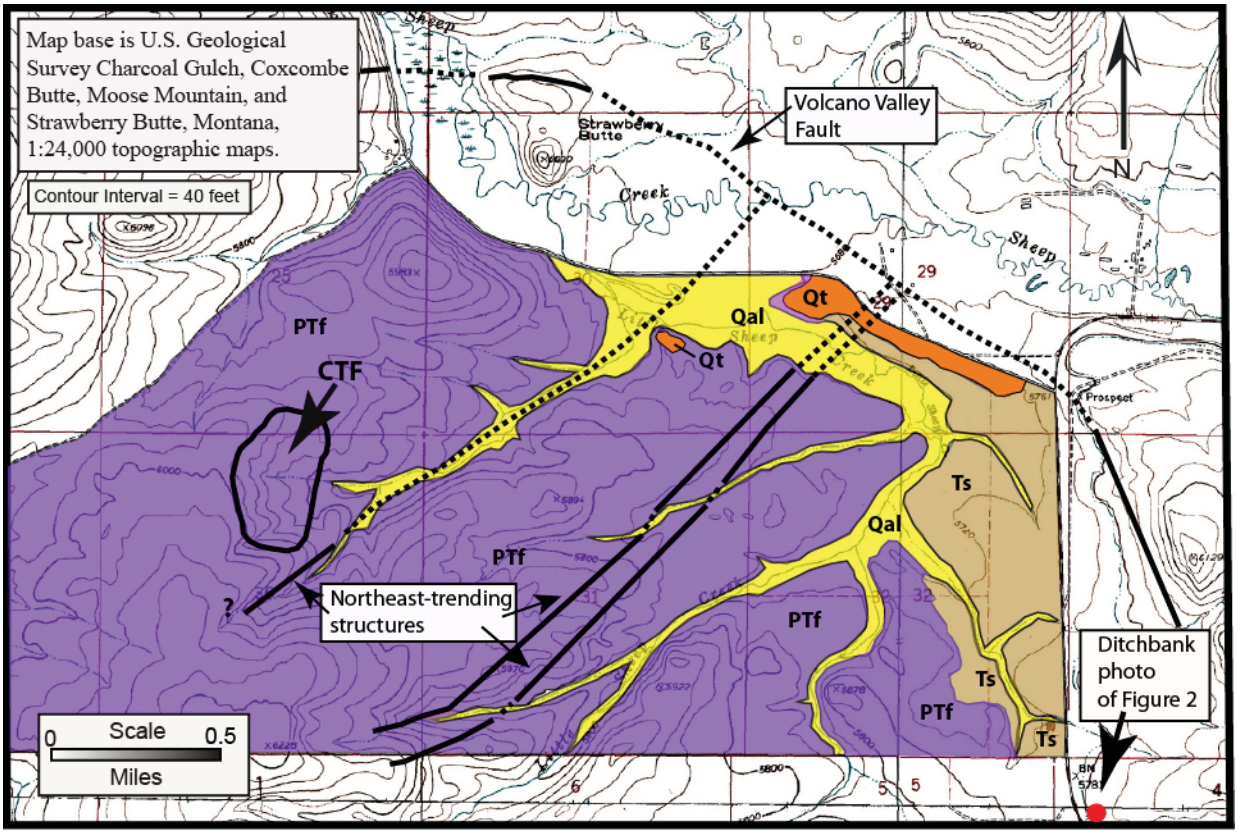
This project was done to determine if there is Quaternary faulting activity in the general area of the cement tailings facility at the proposed Black Butte Copper Mine. Previous workers have mapped faults in this area that offset Mesoproterozoic to earliest Eocene rocks, but the youngest documented activity on these faults occurred during the late Cretaceous and early Eocene. Geologic mapping done by others and in this study indicates that there is no evidence of these older faults or any new faults being active during the Quaternary. This conclusion is supported by geologic field evidence of Cenozoic deposits which demonstrates that these deposits are not disrupted by faulting. It is also supported by LiDAR data from which a hillshade image was generated. Northeast-trending features can be seen on the hillshade image, but these features do not offset mapped Quaternary deposits. Additionally, no other fault-like features crossing the Cenozoic units were identified on the hillshade image.

INTRODUCTION

This project is focused on the question of whether Quaternary faulting is present in the area of the cement tailings facility (CTF) location that will be part of the proposed Black Butte Copper Mine. The CTF's planned location is in section 36, T12N, R6E (Figure 1), atop Mesoproterozoic bedrock of the Newland Formation. Additionally, Eocene age intrusive rocks mapped as biotite-hornblende dacite (Reynolds and Brandt, 2007) cut the Newland Formation in the area of the proposed CTF.

Geologic structures that fault pre-Quaternary deposits mapped in the general vicinity of the proposed CTF include the Volcano Valley fault (Reynolds and Brandt, 2007) and three northeast-trending faults (Tintina Resources, 2016 Geologic Map) (Figure 1). The Volcano Valley fault lies about 1.5 miles north of the proposed CTF, and is a reverse fault with its south side up. The reverse fault movement is Late Cretaceous-pre Eocene in age. The only documented younger activity on this fault is that it is intruded by a hornblende biotite dacite body that has a $^{40}Ar/^{39}Ar$ isotopic age of 54.4±0.2 Ma, which places these rocks in the earliest Eocene. This intruded part of the Volcano Valley fault lies approximately 8 miles west of the CTF (Reynolds and Brandt, 2005).

The three north-east-trending faults that are mapped approximately 0.08 to 0.8 miles to the southeast and east of the CTF (Figure 1) offset Mesoproterozoic and earliest Eocene intrusive rocks that occur as sills and larger intrusive bodies (Tintina



Map Legend for the Geology in the Area of the Proposed Cement Tailings Facility

Qal	Qal - Quaternary alluvium
Qt	Qt - Quaternary terrace deposit
Ts	Ts - Tertiary strata
PTf	PTf - Pre-Tertiary fill (this unit includes rocks from Mesoproterozoic to 54.2 Ma in age)
	Fault, dotted where concealed
CTF	Outline of cement tailings facility

Figure 1. Geology in the area of the proposed cement tailings facility (mapped geology based on Reynolds and Brandt, 2007; Tintina Resources, 2016 Geologic Map; and mapping by D.L. Hanneman, 6/14/2017-6/16/2017).

Resources, 2016 Geologic Map). The compositions of the intrusive rocks in this area are hornblende biotite dacite, and as such, I assume them to have an age similar to the 54.4±0.2 Ma hornblende biotite dacite that intruded the Volcano Valley fault.

DO QUATERNARY FAULTS EXIST NEAR THE CTF?

Based on the geologic structural setting and previous geologic mapping outlined above, the determination of whether Quaternary faulting exists near the CTF should be made by initially examining where already identified faults project through Quaternary deposits. These faults are of particular interest because they are zones of previous weakness and could therefore reactivate through time. Both the mapped Volcano Valley fault trace and the northeast-trending fault traces can be projected into an area that, using available previous geologic mapping and my geologic mapping done for this project, contains Cenozoic deposits (Reynolds and Brandt, 2007;Tintina Resources, 2016 Geologic Map; Hanneman, 6/14/2017-6/15/2017) (Figure 1). This area is located approximately 1.5 miles north and northwest of the CTF, mainly in sections 29, 30, and 32, T12N, R7E. And finally, the CTF area was investigated during this project to determine if any unidentified faults offset the area's Cenozoic deposits.

Cenozoic Deposits Used For Age Constraints

In order to better age constrain the question of Quaternary faulting for this area, it is critical to age constrain the local Cenozoic deposits. The oldest unit in this area is Tertiary in age, and more specifically probably late Eocene to early Oligocene. The maximum age determination is based upon the strata containing hornblende biotite dacite clasts, and thus the strata are younger than earliest Eocene, specifically younger than 54.4±0.2 Ma. The minimum age constraint is based upon mapped Tertiary strata north of the proposed mine site being overlain by basalt flows that have whole rock $^{40}Ar/^{39}Ar$ isotopic ages ranging from 32.8 to 30.4 Ma (Reynolds and others, 2002). The lithologies present in the late Eocene to early Oligocene unit include smectitic mudstone, sandstone, conglomerate, and volcanic tuff beds (based upon my geologic field work and core samples provided by Tintina Resources, 6/14/2017-6/16/2017). The age range and lithologies of this Tertiary unit are consistent with those described for the Beaver Creek area by Runkel (1986) in his work on the Tertiary geology and vertebrate paleontology of the Smith River Valley.

The next younger geologic unit is an unconsolidated gravel deposit that caps the Tertiary strata. Reynolds and Brandt (2007) mapped this unit on the north side of Sheep Creek, immediately north of the proposed mine area, and labeled it a terrace gravel with a Pleistocene to Holocene age. I matched the gravel cap I found on the proposed mine property with what Reynolds and Brandt mapped as a terrace gravel and I believe they are the same unit. However, I disagree with the time range that those authors placed on the unit. The terrace gravel is likely only Pleistocene, and probably falls more into the 200,000 years old to 220,000 years old age range. This age designation is based upon the weathering rind thicknesses of basalt clasts that I sampled (sample number=67 clasts) from the gravel as compared with basalt clast weathering rind thicknesses from a study done by Coleman and Pierce (1981) in the western United States. I give an age range for the basalt clast weathering rinds on the proposed mine property because, unlike the Coleman and Pierce study samples that came from a soil B horizon, there is little to no soil B horizon in my sample area. I also measured the clast rind thickness in the field using a portable millimeter scaler. Hence, the basalt clast weathering rinds may indicate an inflated older age for the deposit, but even the minimum rind thickness suggests an age older than Holocene. The gravel unit includes unconsolidated rounded small boulders to pebbles of quartzite, fossiliferous limestone, basalt, dacite, and sandstone clasts. Clast bases have calcium carbonate coatings with some coatings (particularly on the limestone) up to three cm in thickness.

The current drainage system is incised into all older geologic units, including the Quaternary terrace gravel described above. The sediments associated with the current drainage system are unconsolidated and include clay to boulders that comprise the current floodplains and active channels of Sheep Creek and its tributaries. As these sediments are a part of the present drainage system, I have grouped them into Quaternary alluvium and into the one age unit of Holocene. A water well log from an adjoining property to the proposed mine ($SE_{1/4}SW_{1/4}NW_{1/4}$, section 28, T12N, R7E) indicates 17 feet of clay, sand, pebbles, and cobbles of what I interpret as Quaternary alluvium, so there may well be late Pleistocene sediment contained within this unit. But for the purposes of this project, Holocene is sufficient for an upper Quaternary age constraint.

Do Any Structures Offset the Cenozoic Deposits?

I assessed both geologic field evidence and airborne LiDAR (Light Detection and Ranging) data in determining if there is evidence for Quaternary faulting in and around the CTF. The field evidence is taken from the Cenozoic deposits on the proposed mine property and from Tertiary strata exposures in the Holstrom ditch walls located in section 4, T11N, R7E, approximately 0.5 miles southeast of proposed mine property.

Geologic Field Work Observations and Interpretations. The Quaternary terrace gravel provides a reasonable basis for determining if the surface in sections 29 and 30, T12N, R7E has been cut by Quaternary faulting. I walked the old terrace surface and found that where the clasts aren't disturbed by human-caused workings, the clasts are in their original positions with calcium carbonate coatings on the clasts' undersides (that calcium carbonate occurs on the undersides of clasts in semi-arid to arid areas is well documented: Machette, 1985; Pustovoytov, 2003; Scott and Moore, 2007). Thus, because clasts on the terrace surface (where not disturbed by human-caused workings) are undercoated by calcium carbonate, I interpret this occurrence to indicate that surface is not disrupted.

There is a noticeable gully developing in section 29, beneath the terrace gravels (Figure1 and Figure 3). My mapping of this area shows that the gully is the likely result of the boundary between softer Tertiary mudstone and much more resistant Mesoproterozoic Newland Formation rock. The lithologic boundary can be more readily explained as an erosional edge rather than as an older fault. This explanation arises because the overall Tertiary strata distribution mapped by myself and more extensively by Reynolds and Brandt (2007) appears to be that of a Tertiary erosional paleovalley such as those described for age-equivalent strata in the Laramie Range (Evanoff, 1990, 2016).

That this area represents a Tertiary erosional paleovalley is further supported by Tertiary exposures in the Holstrum ditch. Figure 2 shows a ditch bank where thin white layers at the ditch bank's top are horizontal. These thin white layers occur at the top of

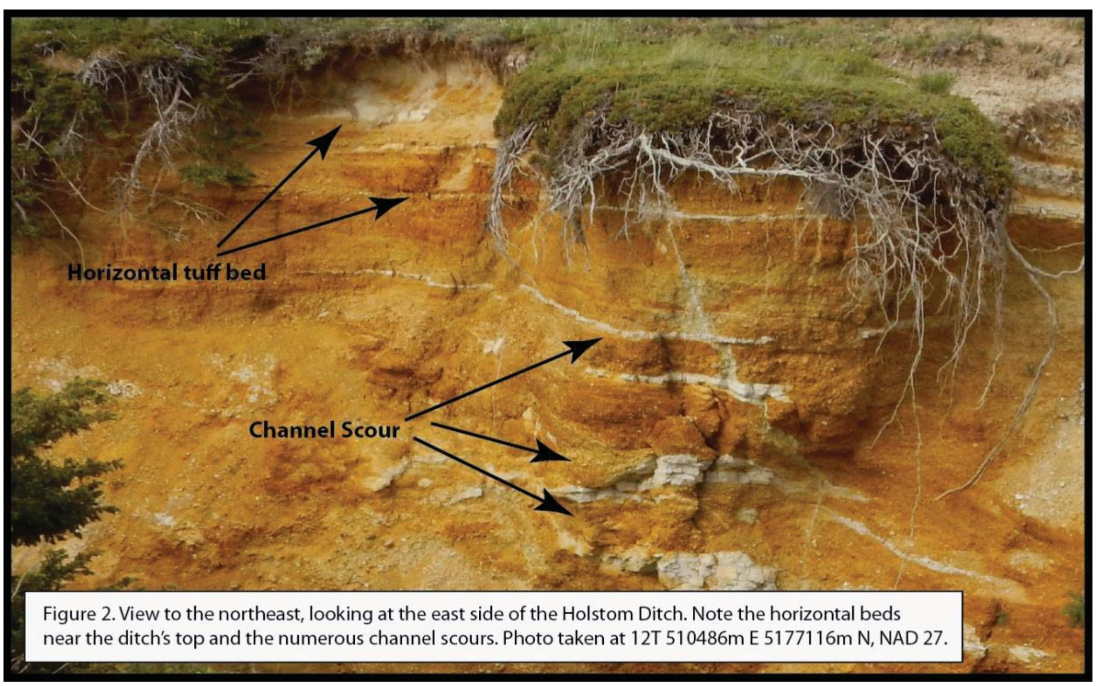


Figure 2. View to the northeast, looking at the east side of the Holstom Ditch. Note the horizontal beds near the ditch's top and the numerous channel scours. Photo taken at 12T 510486m E 5177116m N, NAD 27.

a cut-and-fill channel, and thus are within that part of the channel fill where original sedimentation events aggrade to form horizontal units. This ditch bank is approximately 0.5 miles west of the mapped Volcano Valley fault (Reynolds and Brandt, 2007). If the

Volcano Valley fault system was active during or after deposition of the channel fill and the contained thin white layers, the white layers should probably be tilted away from horizontal as a result of faulting activity.

LiDAR Data Observations. High resolution, 16 points/m2, airborne LiDAR flown by Sands Surveying, Kalispell, Montana (2012), was used to provide a detailed digital terrain model (DTM) of the proposed mine and CTF area. DTMs developed from airborne LiDAR surveys are increasingly used to identify and characterize surface faults (Haugerud et al., 2003; Hilley and Arrowsmith, 2008; Zielke and others, 2010; Stumpf and others, 2013; Tortini and others, 2015). The technique of hillshading was applied to the DTM that encompassed the proposed mine and CTF area using Golden Software Surfer version 12 (Figure 3). This technique illuminates the surface of the DTM from a

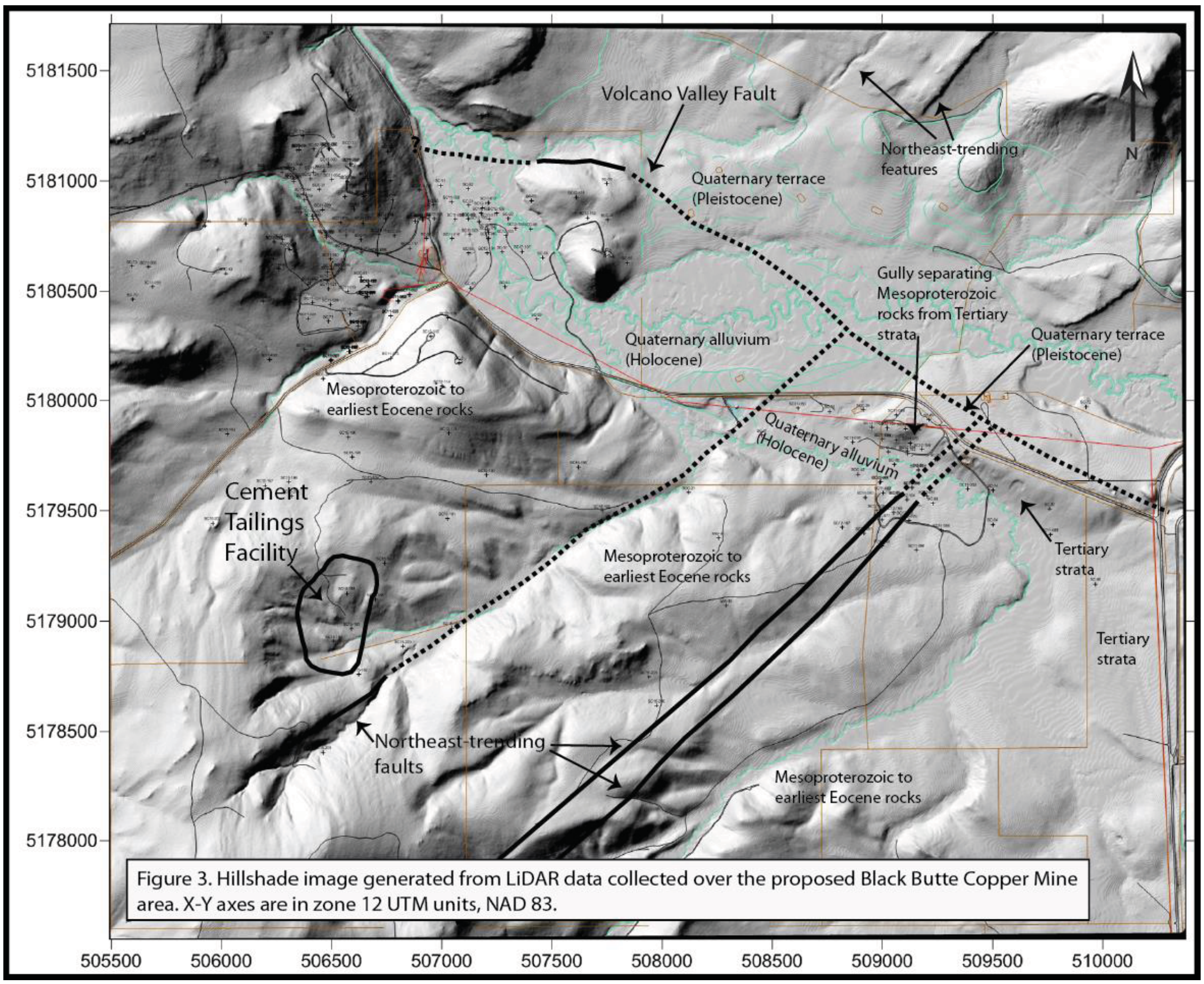


Figure 3. Hillshade image generated from LiDAR data collected over the proposed Black Butte Copper Mine area. X-Y axes are in zone 12 UTM units, NAD 83.

particular sun angle and has proven effective for visualizing surface faults (Ganas et al., 2005; Engelkemeir and Khan, 2008; Tortini and others, 2015; Morell and others, 2017).

As shown in the hillshade image of Figure 3, there are no obvious disruptions on the older Quaternary terrace surfaces or in the Quaternary alluvium of the current floodplains. The northeast-trending structures noted earlier in the *Introduction* section of this report and indicated by arrows in Figure 3 do not cut through Cenozoic deposits. The gully that is the boundary of Mesoproterozoic Newland Formation rocks and Tertiary strata can be seen in Figure 3, but again as discussed above, is more likely an erosional boundary. Furthermore, no other fault-like features that cut through Cenozoic units were observed on the hillshade image.

The present channels of Sheep Creek and its tributaries are also depicted on the hillshade image. None of the meanders in either Sheep Creek or Little Sheep Creek line up with projected northeast-trending faults. The non-alignment of channel segments suggests that there is no channel control by Quaternary faulting.

As depicted in both Figures 1 and 3, the tributary of Little Sheep Creek immediately east-southeast of the CTF appears to conform to topography rather than follow a northeast trend where it merges with the main Little Sheep Creek drainage. The uppermost channel of Little Sheep Creek also appears to be curving to the northwest in response to butting up against the older Tertiary strata that are flanked by Cambrian rock. Both these geomorphic features lead me to believe that they are also not controlled by Quaternary faulting, but rather they are controlled by topographic features of the landscape.

DISCUSSION

Prior to the late Eocene, faulting did occur in the general area of the CFT. However, there is no geologic evidence found by previous mapping in this area and in the geologic mapping done for this project that indicates Quaternary faulting activity.

The geological field work that I did for this project supports a conclusion that the surface covered by an older Quaternary terrace deposit is not disrupted by faulting. The in-situ position of clasts within the terrace gravel, with calcium carbonate coatings on their undersides, is the main basis for this deduction. This deposit also matches up with other Quaternary terrace deposits mapped by Reynolds and Brandt (2007) on the north side of Sheep Creek that are not cut by northeast-trending lineaments which can be readily observed in the hillshade image of Figure 3. It should also be noted that Reynolds and Brandt (2007) show the faulting that they mapped in this same area as concealed beneath Cenozoic deposits, thus also indicating that there is no evidence for Quaternary faulting.

The Tertiary deposits in the proposed mine area appear to be deposits within erosional paleovalleys rather than fault controlled depocenters. Topographic relief was considerable in the northern Rockies during the Eocene (Constenius, 1996; Fan and others, 2017), and resulted in numerous Eocene-Oligocene paleovalleys that extended into the core of areal mountain ranges. As noted by Evanoff (1990) for the Eocene paleovalleys in the Laramie Mountains of Wyoming, "the local relief indicated by the paleovalleys was ample for erosion to provide coarse gravel for fluvial systems, without requiring episodes of repeated uplift" (p.446). Similarly, the sediments within the Tertiary units in and near the proposed mine site indicate local fluvial systems with very localized clast input. These same sediments also contain a high percentage of volcanic ash. The ash was probably originally an aeolian component to the depositional system, being derived from the nearby Helena Volcanic field which was active from about 39-36 Ma (Chadwick, 1985; Schmidt and others, 1994). Volcanic ash as an aeolian deposit is a common component of erosional paleovalleys, although in the area of the proposed mine, the volcanic ash appears to be mostly reworked by fluvial processes in cut-and-fill channels. However, the erosional paleovalley interpretation for the Tertiary deposits in the project area is a viable interpretation for the Tertiary fill and is supported by the Tertiary deposits extending into the Little Belt Mountains (Reynolds and Brandt, 2007), horizontal bedding observed in Tertiary strata within a nearby irrigation ditch (Figure 2), and the documentation of high relief in the northern Rocky Mountain during the Eocene.

The hillshade image generated from LiDAR data shows no evidence for faults that cut Cenozoic deposits. Northeast-trending structures that can be clearly seen on the image do not cross either the older Quaternary terrace gravel surface or the current floodplain that contains Holocene sediment. Even the meander segments of Little Sheep Creek and Sheep Creek show no alignment with the projected trends of mapped area faults. Typically stream channels do reflect fault control by a change in their direction that parallels a fault's trend, but again this aspect of stream channel geomorphology cannot be seen on the LiDAR hillshade image in Figure 3.

The present drainage system within the area of the proposed Black Butte Copper Mine has down-cut into pre-existing rock, and this indicates a change in base level for the system. However, the down-cutting may have more to do with glacial melt-outs that affect the entire Smith River drainage system rather than local tectonism.

Lastly, the conclusion of no evidence for Quaternary faulting in the immediate area of the CTF is also supported by historical seismicity data. Wong and others (2005) place the area of the proposed mine in the Northern Great Plains, which is part of the stable continental U.S. interior. These authors state that "tectonism associated with plate boundary interactions probably ceased about 100 Ma, so zones of major recent deformation area generally absent (Dewey and others, 1989). Earthquake epicenters are scattered and form isolated clusters with no apparent spatial relationship to geologic structures" (p. 6). Indeed, in the very general area of the proposed mine, there are only two 1.5-2 magnitude earthquakes found in the historic seismicity data base for years 1809-2001. Wong and others work (2005) also indicates low probability for significant seismic events in this area over the next 5,000 years.

SUMMARY

Faults mapped in the area of the proposed Black Butte Copper Mine and its contained CTF offset Mesoproterozoic to earliest Eocene rocks. The youngest documented activity on these faults occurred during the late Cretaceous and early Eocene. Geologic mapping done by previous workers and in this study indicates that there is no evidence of these older faults or any new faults being active during the Quaternary. This conclusion is supported by geologic field evidence of Cenozoic deposits showing that these deposits are not disrupted by faulting. It is also supported by LiDAR data from which a hillshade image was generated. Northeast-trending features can be seen on the hillshade image, but these features do not offset mapped Quaternary deposits. Additionally, no other fault-like features within the Cenozoic units were observed on the hillshade image.

REFERENCES CITED

Chadwick, R.A., 1985, Overview of Cenozoic volcanism in the west central United States, in Flores, R. M., and Kaplan, S. S., eds., Cenozoic paleogeography of the west-central United States: Tulsa, Oklahoma, Society of Economic Paleontologists and Mineralogists, p. 359-382.

Colman, S.M., and Pierce, K.L., 1981, Weathering Rinds on Andesitic and Basaltic Stones as a Quaternary Age Indicator, Western United States: U.S. Geological Survey Professional Paper 1210, 56 p.

Constenius, K.N., 1996, Late Paleogene extensional collapse of the Cordilleran foreland fold and thrust belt: Geological Society of America Bulletin, v. 1 08, p. 20–39, doi: 10.11 30/0016-7606(1996) 108<0020:LPECOT>2.3.CO;2.

Dewey, J.W., Hill, D.P., Ellsworth, W.L., and Engdahl, E.R., 1989, Earthquakes, faults, and the seismotectonic framework of the contiguous United States: *In* Pakiser, L.C., and Mooney, W.D., eds., Geophysical Framework of the Continental United States, Geological Society of America Memoir 172, p. 541-576.

Engelkemeir ,R.M., and Khan, S.D., 2008, Lidar mapping of faults in Houston, Texas, USA: Geosphere, v. 4, p.170–182.doi:10.1130/GES00096.1.

Evanoff, E., 1990, Early Oligocene paleovalleys in southern and central Wyoming: Evidence of high local relief on the late Eocene unconformity: Geology, v. 18, p. 443-446, doi: 10.1130/0091-7613(1990)018<0443:EOPISA>2.3.CO.

Evanoff, E., 2016, Middle to late Cenozoic geology and geomorphology of the Laramie Mountains, Wyoming: 2016 GSA Annual Meeting in Denver, Colorado, USA, Session No. 426.

Fan, M., Constenius, K.N., and Dettman, D.L., 2017, Prolonged high relief in the northern Cordilleran orogenic front during middle and late Eocene extension based on stable isotope paleoaltimetry: Earth and Planetary Science Letters 457(2017)376–384.

Ganas, A., Pavlides, S., and Karastathis, V., 2005, DEM-based morphometry of range-front escarpments in Attica, central Greece, and its relation to faultslip rates. Geomorphology, v. 65, p. 301–319.doi:10.1016/j.geomorph.2004.09.006

Haugerud, R.A., Harding, D.J., Johnson, S.Y., Harless, J.L.,Weaver, C.S., and Sherrod, B.L., 2003, High-resolution Lidar topography of the Puget Lowland, Washington—a bonanza for Earth science. GSA Today 13, p. 4–10.doi: 10.1130/1052-5173(2003)13<0004:HLTOTP>2.0.CO;2.

Hilley, G.E., and Arrowsmith, J.R., 2008, Geomorphic response to uplift along the Dragon's Back pressure ridge, Carrizo Plain, California: Geology, v. 36, p. 367–370.doi:10.1130/G24517A.1.

Machette, M.N., 1985, Calcic Soils of the Southwestern United States: *In* Soils and Quaternary Geology of the Southwestern United States. D.L. Weide and M.L. Faber, eds., Special Paper Vol. 203, p. 1-21. Geological Society of America, Denver, CO.

Morell, K.D., Regalla, C., Leonard, L.J., Amos, C., and Levson, V., 2017: Quaternary Rupture of a Crustal Fault beneath Victoria, British Columbia, Canada: GSA Today, v. 27, p. 1-7, doi: 10.1130/GSATG291A.1

Pustovoytov, K., 2003, Growth rates of pedogenic carbonate coatings on coarse clasts: Quaternary International, v. 106–107, p. 131–140.

Reynolds, M.W., and Brandt, T.R., 2005, Geologic map of the Canyon Ferry Dam 30′ x 60′ quadrangle, west-central Montana: U.S. Geological Survey Scientific Investigations Map 2860, 32-p. pamphlet, 3 plates, scale 1:100,000.

Reynolds, M.W., and Brandt, T.R., 2007, Preliminary geologic map of the White Sulphur Springs 30' x 60' quadrangle, Montana: U.S. Geological Survey Open-File Report 2006-1329, scale 1:100,000.

Reynolds, M.W., Miggins, D.P., and Snee, L.W., 2002, Age and tectonics of middle Tertiary basaltic volcanism and effects on the landscape of west-central Montana: Geological Society of America Abstracts with Programs, v. 34, no. 6, p. 409.

Runkel, A.C., 1986, Geology and vertebrate paleontology of the Smith River basin, Montana: Missoula, Mont., University of Montana M.S. Thesis, 80 p.

Scott, G.R., and Moore, D.W., 2007, Pliocene and Quaternary deposits in the northern part of the San Juan Basin in southwestern Colorado and northwestern New Mexico: U.S. Geological Survey Scientific Investigations Report 2007–5006, 13 p.

Schmidt, R.G., Loen, J.S., and Wallace, C. A., 1994, Geology of the Elliston Region, Powell and Lewis and Clark Counties, Montana: U.S. Geological Bulletin 2045, 25 p.

Stumpf, A., Malet, J.-P., Kerle ,N., Niethammer, U.,and Rothmund, S., 2013, Image-based mapping of surface fissures for the investigation of landslide dynamics: Geomorphology, v.186, p. 12–27.doi:10.1016/j.geomorph.2012.12.010.

Tintina Resources, 2016, 2016 geologic map: Proprietary data.

Tortini, R., van Wyk de Vries, B. and Carn, S.A., 2015, Seeing the faults from the hummocks: tectonic or landslide fault discrimination with LiDAR at Mt Shasta, California: Front. Earth Sci, v. 3:48. doi: 10.3389/feart.2015.00048.

Wong, I., Olig, S., Dober, M., Wright, E.N., Lageson, D., Silva, W., Stickney, M., Lemieux, M., amd Anderson, L., 2005, Probabilistic earthquake hazards maps for the state of Montana: Montana Bureau of Mines and Geology, Special Publication 117, 72 p.

Zielke, O., Arrowsmith, J.R., Ludwig, L.G., and Akçiz, S.O., 2010, Slip in the 1857 and earlier large earthquakes along the Carrizo Plain, San Andreas Fault: Science, v. 327, p.1119–1122.doi:10.1126/science. 1182781.

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Education

1989 - Ph.D., Geology, University of Montana, Missoula, Montana; Study focus – Continental stratigraphy/sedimentology/paleontology.
1977 - MSc., Geology, University of Calgary, Calgary, Alberta; Study focus – Paleozoic invertebrate paleontology.
1975 - BS., Natural History, University of Toledo, Toledo, Ohio.

Professional Experience

1990 – present: President and Principal Owner, Whitehall GeoGroup, Inc.,

Whitehall, Montana.

- Consulting projects include:
  - Paleosol and Cenozoic basin development research.
  - GIS paleontological database developed for U.S. Bureau of Land Management, southwestern Montana lands.
  - Vertebrate fossil inventory for U.S. Bureau of Land Management lands acquisitions.
  - Webb Schools/Raymond A. Alf Museum of Cenozoic geologic history/paleontology fossil vertebrate research in Gravelly Range, southwest Montana.
  - Hydrogeological research for high-volume water wells.
  - Near-surface geophysical survey/interpretation for Cenozoic Florissant Fossil Beds National Monument, U.S. National Park Service.
  - Near-surface geophysical surveys/interpretations for groundwater contamination and industrial development projects.
  - Geologic mapping for geologic resources.
  - Keck Geology Consortium, Co-leader for Cenozoic basin geology and geophysics, southwestern Montana.
  - Gravity/seismic interpretation of Montana basins.
  - Adjunct Assistant Professor – Earth Science Department, Montana State University.

- Over 250 mineral assessments done for conservation easements throughout Montana, Idaho, and North Dakota.
- Geologic resource due diligence work for various law firms.
- Registered lobbyist for the Montana 63rd /2013 Session – lobbying focus on energy and eminent domain issues.
- CO2 offset in Borden Hotel Renovation –Jefferson County, Montana, Local Development Corporation.
- Southwestern Montana geology CD development, now marketed by AAPG and Earthmaps.

1986/1989: Assistant Professor, Earth Science Department, Montana State University, Bozeman, Montana.

- Instructed geology field camps

1983-1988: Instructor, Geological Engineering Department, Montana College of Mineral Science and Technology, Butte, Montana.

- Instructed undergraduate courses in physical, historical, and structural geology, hydrogeology, presentation media, and graduate level stratigraphy.

1982-1983: Hydrogeologist, Department of Natural Resources and Conservation, Water Resources Division, Helena, Montana.

- Researched Montana groundwater availability in numerous locales state-wide.

1979-1982: Geologist, U.S. Geological Survey, Geologic Division, Denver, Colorado.

- Collected data for mineral evaluations of proposed wilderness areas; conducted research on southwestern Montana Cenozoic basins.

1978: Geologist, U.S. Forest Service, Beaverhead National Forest, Wisdom, Montana.

- Evaluated Wisdom District mining claims.

1977: Instructor, Earth Sciences Department, Mount Royal University, Calgary, Alberta, Canada.

- Instructed undergraduate courses in historical geology and stratigraphy.

Professional Affiliations

Association of American Petroleum Geologists
Association for Women Geoscientists

- Board of Directors, Rocky Mountain delegate: 2007-2013
- International Member Liaison: 2010 – 2016
- Committees served on: Professional Excellence Award, the Sand Travel Grant Award, the Takken Travel Grant Award, and the Gaea Editorial Board

Geological Society of America
Montana Geological Society
SEPM - Society for Sedimentary Geology

Publications

Geologic Maps : Peer-Reviewed

1. O'Neill, J.M., Klepper, M.R., Smedes, H.W., **Hanneman, D.L.**, Frazer, G.D., and Mehnert, H.H., 1996, Geological map and cross sections of the central and southern Highland Mountains, southwestern Montana: U.S. Geological Survey Map I-2525.

2. **Hanneman, D.L.**, 1987, Geologic map of the Pintler Lake quadrangle, Beaverhead County, Montana: U.S. Geological Survey MF-1931.

3. **Hanneman, D.L**., 1987, Geologic map of the Pine Hill quadrangle,Beaverhead County, Montana: U.S. Geological Survey MF-1930.

4. **Hanneman, D.L**., 1984, Geologic map of the Mud Lake quadrangle, Beaverhead County, Montana: U.S. Geological Survey Map MF - 1696.

5. **Hanneman, D.L.**, 1984, Geologic map of the Wisdom quadrangle,Beaverhead County, Montana: U.S. Geological Survey Map MF - 1695.

Professional Papers: Peer-Reviewed

1. **Hanneman, D.L.**, and Wideman, C.J., 2009, Continental sequence stratigraphy and continental carbonates, Carbonates in Continental Settings: Processes, Facies and Applications, Alonso-Zarza, A.M., and Tanner, L.H., eds., Elsevier, p.215-273.

2. **Hanneman, D.L.**, and Wideman, C.J., 2006, Calcic paleosol stacks - regional sequence boundary indicators in Tertiary deposits of the Great Plains and Western USA:

Geological Society of America**,** Paleoenvironmental Record and Applications of Calcretes and Palustrine Carbonates, Special Paper 416, p.1-15.

3. Wang, X., Wideman, B.C., Nichols, R., and **Hanneman, D.L.**, 2004, A new species of Aelurodon (Carnivora, Canidae) from the Barstovian of Montana: Journal of Vertebrate Paleontology, v. 24, p.445-452.

4. **Hanneman, D.L.**, Cheney, E., and Wideman, C.J., 2003, Cenozoic sequence stratigraphy of northwestern USA; SEPM Cenozoic Systems of the Western United States, Raynolds, R.G. and Flores, R.M., eds., p.135-156.

5. **Hanneman, D.L.**, Wideman, C.J., and Halvorson, J., 1994, Calcic paleosols: their use in subsurface stratigraphy: American Association of Petroleum Geologists Bulletin, v. 78, p.1360-1371.

6. **Hanneman, D.L**., and Wideman, C.J., 1991, Sequence stratigraphy of Cenozoic continental rocks: Geological Society of America Bulletin, v.103, p.1335-1345.

7. **Hanneman, D.L.**, and Wideman, C.J., 1990, Paleosols: reflectors in continental sequences: Geophysics: The Leading Edge of Exploration, v.9, p.38-40.

8. Foxworthy, B., **Hanneman, D.L.**, Coffin, D.L., and Halstead, E.C., 1987, Hydrogeologic regions - Region 1, western mountain ranges: in Hydrogeology: Back, W., Rosenshein, J. S., and Seaber, P.R., eds., Decade of North American Geology, v. O-2., p.25-35.

9. O'Neill, J.M., Ferris, D.C., Schmidt, C.J., and **Hanneman, D.L.**, 1984, Recurrent movement along northwest trending faults, southern Highland Mountains, southwestern Montana: in A Guide to Belt Rocks: Roberts, Sheila, ed., Montana Bureau of Mines and Geology Special Publication 94, p.209-216.

Non-Journal Articles

1. **Hanneman, D.L.**, 2013, Journeying through Cuba’s geology and culture: Earth, v. 58, no. 8, p.42-51.

2. **Hanneman, D.L.**, 2008, Geological consulting and kids: An unpredictable balancing act?: Motherhood, The Elephant in the Laboratory, Monosson, E., ed., Cornell University Press, p.79-82.

Field Guides

1. Boggs, K.J.E., and **Hanneman, D.L.**, 2016, Tectonics, Climate Change, and Evolution: Southern Canadian Cordillera: Association for Women Geoscientists Annual Field Trip, 209 p.

Recent Abstracts – 2002 to Present Time

1. **Hanneman, D.L.**, and Lofgren, D., 2017, Vertebrate Paleontology and Geology of High Elevation Tertiary Deposits in the Gravelly Range, Southwestern Montana: Geological Society of America Abstracts with Programs. Vol. 49, No. 5 doi: 10.1130/abs/2017RM-293156.

2**. Hanneman, D.L.**, and Wideman, C.J., 2016, Cenozoic Stratigraphy in Western Montana: Current Status and A Way Forward, Geological Society of America Abstracts with Programs. Vol. 48, No. 7 doi: 10.1130/abs/2016AM-279878.

3. Wade, D., Nielsen, C., and **Hanneman, D.L.**, 2016, Age Constraints on Cenozoic Continental Deposits, Madison Bluffs, Southwestern Montana, Geological Society of America Abstracts with Programs. Vol. 48, No. 7 doi: 10.1130/abs/2016AM-282047.

4. Nielsen, C., Wade, D., and **Hanneman, D.L.**, 2016, Neogene Distributive Fluvial System Strata at the Anceney Fossil Vertebrate Locality, Southwestern Montana, Geological Society of America Abstracts with Programs. Vol. 48, No. 7 doi: 10.1130/abs/2016AM-281977.

5. **Hanneman, D.L.**, and Wideman, C.J., 2013, Cenozoic tectonic sequences and basin evolution in western Montana, Geological Society of America, Abstracts with Programs, Vol. 45, No. 7, p. 134.

6. **Hanneman, D.L.**, and Wideman, C.J., 2010, White River Group Equivalents in Montana: Geological Society of America, Abstracts, Rocky Mountain Sectional meeting, v. 42, no. 3, p.18.

7. **Hanneman, D.L.**, and Wideman, C.J., 2009, Continental sequence stratigraphy with emphasis on continental carbonates: Geological Society of America, Abstracts, national meeting, v. 41, no. 7, p.123.

8. **Hanneman D.L.**, and Wideman, C.J., 2006, Sequence Stratigraphy and Paleosols in Continental Rocks – Examples from Cenozoic Deposits of the Great Plains and Western USA: American Association of Petroleum Geologists, Abstracts, regional meeting.

9. **Hanneman D.L.**, and Wideman, C.J., 2005, Calcic pedocomplexes delineate sequence boundaries in Tertiary strata of the Great Plains and western USA: Geological Society of America, Abstracts, national meeting, v. 37, no. 7, p.139.

10. **Hanneman D.L.**, and Wideman, C.J., 2005, Calcic Paleosols - Regional sequence boundary indicators in Cenozoic strata of southwestern Montana: American Association of Petroleum Geologists, Abstracts, annual meeting, Calgary, Alberta, Canada.

11. **Hanneman, D.L.**, and Wideman, C.J., 2004, Ash fall tuff marker beds within Cenozoic basin-fill of Southwestern Montana: Geological Society of America, Abstracts, national meeting, p.72.

12. **Hanneman, D.L.**, Cheney, E., Wideman, C.J., 2002, Cenozoic synthems of the northwestern United States; Geological Society of America, Abstracts, national meeting, p.281.