APPENDIX 3-P FRESH WATER SUPPLY SYSTEM DESIGN REPORT

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VA101-457/33-13

BLACKWATER GOLD PROJECT
FRESH WATER SUPPLY SYSTEM DESIGN REPORT

Rev	Description	Date
0	Issued in Final	November 4, 2021
1	Issued in Final with Updated Seals	November 15, 2021

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ABBREVIATIONS

The Project	Blackwater Gold Project
Artemis	Artemis Gold Inc.
BC	British Columbia
Blackwater	Blackwater Gold Project
BW Gold	BW Gold Ltd.
CEA	Canadian Environmental Assessment
CPD	Certified Project Description
the Agency	Canadian Environmental Assessment Agency
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
ECD	Environmental Control Dam
EMLI	Ministry of Energy, Mines and Low Carbon Innovation
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FSR	Forest Service Road
FWR	Fresh Water Reservoir
FWSS	Fresh Water Supply System
HDD	Horizontal Directional Drilling
HDPE	high density polyethylene
HWL	high water level
IFN	Instream Flow Needs
kN	kilonewton
KP	Knight Piésold Ltd.
LiDAR	Light Detection and Ranging
LOM WB Model	Life of Mine Water Balance Model
LWL	low water level
m	metre
masl	metres above sea level
mbgs	metres below ground surface
MDE	Maximum Design Earthquake
mm	millimetre
Mtpa	million tonnes per annum
New Gold	New Gold Inc.
NPSHA	Available Net Positive Suction Head
PE	polyethylene
TFCC	Temperature and Flow Control Chamber
TSF	Tailings Storage Facility
UTM	Universal Transverse Mercator
WSL	Water Surface Level

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The Blackwater Gold Project (Blackwater / the Project) is a large gold-silver deposit located approximately 112 kilometres (km) southwest of Vanderhoof in central British Columbia (BC). The Project involves a conventional truck-shovel open pit mine and a gold processing plant with an initial throughput of approximately 5.5 million tonnes per annum (Mtpa), ramping up to a maximum throughput of approximately 20 Mtpa by Year 11 of operations. Ore will be processed in a plant by a combined gravity circuit and whole ore leaching to recover gold and silver into a gold-silver doré product.

The mine site is located within the traditional territories of Lhoosk'uz Dené Nation, Ulkatcho First Nation, Skin Tyee Nation and Tsilhqot'in Nation. Other components of the Project, including the existing Kluskus and Kluskus-Ootsa Forest Service Roads (FSRs) and transmission line, cross the traditional territories of Nadleh Whut'en First Nation, Saik'uz First Nation, and Stellat'en First Nation; collectively, the Carrier Sekani First Nations, as well as the traditional territories of the Nazko First Nation, Nee Tahi Buhn Band, Cheslatta Carrier Nation, and Yekooche First Nation.

1.2 PROJECT HISTORY

The Blackwater area was actively explored by Richfield Ventures Corp. (Richfield) beginning in 2009. The Blackwater property was obtained by New Gold Inc. (New Gold) through the acquisition of Richfield in June 2011. Knight Piésold Ltd. (KP) was retained by New Gold beginning in early 2011 to provide technical support of the Project and has been involved continuously since 2011 in various aspects of the Project. A series of preliminary mine development alternatives assessments for the Project were completed between 2011 and early 2012. A Preliminary Economic Assessment (PEA) of the Project was completed in the third quarter of 2012 followed by a Feasibility Study throughout 2013, which was filed in January 2014 (the 2014 FS). KP contributed to the design of the tailings storage facility (TSF) and associated water management facilities for the 2014 FS (KP, 2014). The Project underwent a coordinated provincial and federal environmental assessment that was initiated in 2012 and ended successfully in 2019 with the issuance of a provincial Environmental Assessment Certificate (EAC) and federal Decision Statement.

Artemis Gold Inc. (Artemis) entered into an asset purchase agreement in June 2020 to acquire Blackwater from New Gold. BW Gold Ltd. (BW Gold), a wholly owned subsidiary of Artemis, is the holding entity for the mineral claims and was party to the purchase agreement with New Gold. Artemis prepared a prefeasibility study during the third quarter of 2020 based on a revised approach to developing the Project. KP contributed the design of the TSF and associated water management facilities for the 2020 Prefeasibility Study (the 2020 PFS).

1.3 CONTEXT AND DESIGN OBJECTIVES

1.3.1 CONTEXT

Development of the Project will affect flows in Davidson Creek through the progressive changes to the contributing drainage area due to construction of the TSF and other project facilities within the upper Davidson Creek drainage basin. The amount of water required to support ore processing at the mine will also impact the availability of water to provide flows to Davidson Creek downstream of the mine. The design of the water management structures for the mine has taken into consideration the following objectives:

- Temporary and secure storage of water within the mine site area in engineered water storage facilities to meet mine water demands.
- Limit accumulation of surplus water within the TSF to the maximum practicable extent.
- Control, collect, and divert non-contact surface water flows not needed for mine operations.
- Control and collect and treat if necessary, contact surface water prior to use/release.
- Controlled release of surface water flows to Davidson Creek downstream of the mine meeting the defined Instream Flow Needs (IFN) to reduce the potential environmental impacts of the project to the extent reasonably practicable.

Drainage from the majority of the mine area flows by gravity into the TSF; which simplifies water management, spill control, and mine closure. Beyond the TSF, the specific water management structures included for the initial detailed design of the Project are described in the Water Management Structures Detailed Design Report (KP, 2021k) and include the following:

- Fresh Water Reservoir (FWR) to store water and provide flows to lower Davidson Creek to meet IFN downstream of the mine, and to provide water for mine operations when required. Outflows from the FWR will typically be through a series of discharge pipes or from the overflow spillway during times when the reservoir is at full capacity and inflows exceed outflows through the discharge pipes. The FWR will receive inflows from several sources as follows:
    - Direct precipitation on the FWR and runoff from contributing catchments.
    - Diverted flows from undisturbed areas upgradient of the TSF that will be conveyed around the TSF to the FWR. The Northern Diversion System is operational starting in Year 7 to divert non-contact runoff upslope of the TSF to the FWR.
    - Mine contact water suitable for release to the downstream receiving environment.
    - Freshwater from Tatelkuz Lake supplied by the Fresh Water Supply System (FWSS) in later phases of mine operations. The FWSS is the topic of this report and will be described in the sections that follow.
- A lined Water Management Pond (WMP) located downslope of the open pit and stockpiles area and within the ultimate footprint of the TSF to manage runoff from contributing areas and water pumped from collection points. The WMP will provide make-up water to support ore processing. Water not needed to support mine operations will be used to mitigate flow reductions in lower Davidson Creek. The engineering design basis and design details for the WMP are included in the TSF Stage 1 Detailed Design Report (KP, 2021f).
- Central Diversion System (CDS) to divert freshwater around the TSF to a tributary of Davidson Creek or to a water transfer pond where it can be pumped to the WMP.
- A WMP discharge system to route water from the WMP to the FWR. Water will be pumped to the FWR when required to limit accumulation of surplus water within the TSF and supply water to the FWR for release to Davidson Creek.

It is anticipated that at some stage of mine development the amount of available water from runoff to the FWR and flows conveyed to the FWR from the mine site area alone will be insufficient to meet the IFN in Davidson Creek. The FWSS would pump water from Tatelkuz Lake through a pipeline and into the FWR and/or directly into Davidson Creek at the FWR to provide additional water to address the shortfall.

An overall system flow diagram is presented on Drawing C5050 in Appendix D.

1.3.2 OVERALL OBJECTIVES

The principal design objective for the FWSS is to provide additional freshwater, drawn from Tatelkuz Lake and released at the FWR, as needed to supplement the water available for release to Davidson Creek or to provide make-up water to the mine when required. The design of the FWSS has taken into consideration the following requirements:

- Layout of the system components contained within the EAC Certified Project Description (CPD) boundary.
- Sufficient capacity to convey the currently recommended IFN for Davidson Creek as a minimum.
- Consideration for potential future adjustments to flow requirements if monitoring and adaptive management requires adjustment to flow provisions.
- Provide variable and controlled flow from Tatelkuz Lake and allow optimized use of both the FWR and the FWSS to meet IFN and temperature objectives.
- Tatelkuz Lake FWSS intake will be located at a depth that will produce temperatures appropriate for Davidson Creek.
- Limit environmental impacts of the FWSS itself, particularly at the Tatelkuz Lake intake site by minimizing the physical footprint of the intake structure on the shoreline of Tatelkuz Lake and using appropriate screens on the intake pipes.
- Include monitoring features to confirm performance goals are achieved and design criteria and assumptions are met.
- The FWSS must be operational year-round.

1.4 SCOPE OF REPORT

BW Gold is proposing to develop Blackwater and is in the process of preparing a *Mines Act* and *Environmental Management Act* Permit Application (the Permit Application), along with several *Water Sustainability Act* Permit Applications and *Fisheries Act* authorizations. This report describes the design of the FWSS. The purpose of the FWSS is to provide freshwater from Tatelkuz Lake to the FWR at the Blackwater mine site to supplement the flows released from the FWR to meet IFN. The FWSS will comprise of an intake structure and pumpstation at Tatelkuz Lake, a water supply pipeline, an outlet at the FWR, booster pumpstation(s), and connections to the FWR outlet works.

The design basis, outlining the basic criteria for the design, construction, and operation of the works, is included as Appendix A. A summary of the hydrometeorological characterization of the Project site is included in Appendix B. Appendix C comprises a summary of available geotechnical information related to the proposed works. The design drawings are presented in Appendix D.

This report includes a summary of:

- site conditions
- design criteria for the various facilities
- design details for the system, including plans and sections
- a summary of auxiliary components, including access roads
- a summary of additional requirements to support construction and operation of the works

This report should be read in conjunction with Water Management Structures Detailed Design Report (KP, 2021k), which describes the detailed design the FWR and other specific water management structures, including the CDS and WMP discharge system, required at the start of mine operations upstream and downstream of the TSF. The Life of Mine Water Balance Model Report (KP, 2021a) summarizes how the IFN in Davidson Creek are predicted to be met.

These structures are further discussed in the TSF Stage 1 Detailed Design Report (KP, 2021f) and other water management structures associated with later phases of mine development are described in the TSF Life of Mine Design Report (KP, 2021e).

1.4.1 BATTERY LIMITS

The battery limit for the content of this is report are elements for the FWSS between Tatelkuz Lake and the FWSS pipeline outfall to Davidson Creek.

Specifically excluded from this report but covered by KP in the Water Management Structures Detailed Design Report (KP, 2021k) are:

- The FWSS Pipeline Outfall to Davidson Creek
- FWR, outlet works, and temperature and flow control chambre
- Instream flow and temperature monitoring

The FWSS Pipeline Outfall to Davidson Creek is a component of the FWSS that will be constructed earlier in time in conjunction with the FWR and thus are not included herein.

Specifically excluded from this Report but covered by others:

- The FWSS power distribution line design

1.5 ADDITIONAL REFERENCE REPORTS

The following KP subject matter reports provide the latest background and supporting information relevant to this report and the Permit Application:

- Water Management Structures Design Report (KP, 2021k)
- TSF Stage 1 Detailed Design Report (KP, 2021f)
- TSF Life of Mine Design Report (KP, 2021e)
- Life of Mine Water Balance Model Report (KP, 2021a)
- 2020 Hydrometeorology Report (KP, 2021g)
- Seismic Hazard Assessment (KP, 2021j)
- Dam Site Characterization Report (KP, 2021i)
- Stockpiles Geotechnical and Water Management Design Report (KP, 2021m)

Data collected at the site that are relevant to the preparation of this report and the reports listed above are summarized in the following additional reference reports:

- 2020-2021 Site Investigation Report (KP, 2021h)
- 2019 Site Investigation Report (KP, 2021n)
- 2013 Site Investigation Report (KP, 2013d)
- 2012 Site Investigation Report (KP, 2013c)
- 2020 Baseline Climate Report (KP, 2021d)
- 2020 Hydrology and Water Temperature Baseline Report (KP, 2021c)
- Groundwater Baseline Report (KP, 2021b)

1.6 REGULATORY CONTEXT

1.6.1 ENVIRONMENTAL ASSESSMENT

The BC Environmental Assessment Office (EAO) and the Canadian Environmental Assessment Agency (the Agency) conducted a coordinated assessment of the Project, which included co-chairing working group meetings, hosting a joint public comment period, and jointly identifying and addressing technical issues. The coordinated provincial and federal environmental assessment was initiated in 2012 and ended successfully in 2019 with the issuance of a provincial Environmental Assessment Certificate and federal Decision Statement.

1.6.1.1 PROVINCIAL ENVIRONMENTAL ASSESSMENT CERTIFICATE

The Project issued EA Certificate included the Certified Project Description (Schedule A) and a Table of Conditions (Schedule B), on June 21, 2019. Schedule B of the provincial EA Certificate contains 43 conditions related to: transfer of Certificate or transfer of interest in the Project; mitigation, monitoring, and management plans; consultation; verification and compliance; and reporting.

1.6.1.2 FEDERAL DECISION STATEMENT

The federal Minister of Environment (now Minister of Environment and Climate Change) was responsible for making decisions on environmental effects referred to in Section 5(1) of CEAA 2012 (e.g., changes in fish and fish habitat as defined in the *Fisheries Act*; changes in aquatic species as defined in the *Species at Risk Act*; changes in migratory birds as defined in the *Migratory Birds Convention Act*; and any changes to the environment caused by the project on aboriginal peoples health and socio-economic conditions, physical and cultural heritage, current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance).

The Federal Decision Statement Conditions that relate to the FWSS are listed in Table 1.1.

Table 1.1 Federal Decision Statement Conditions that Relate to the FWSS

Number	Condition Description (Partial)
3	**Fish and Fish Habitat**
3.1	Implement measures to control erosion and sedimentation to avoid the deposit of deleterious substances in water frequented by fish. Submit these measures to the Agency and to Indigenous groups before implementing them.
3.2	Develop, prior to construction and in consultation with Indigenous groups and DFO, measures to protect fish and fish habitat when undertaking activities in or near water…a proposal to salvage and relocate fish prior to conducting any Designated Project activity requiring removal of fish habitat.
3.3	Design, install and operate the freshwater intakes for the freshwater supply system to avoid fish entry or reduce the incidental capture, death or injury of fish.
3.8	Develop, prior to construction, measures to maintain instream flow needs in Davidson Creek. The Proponent shall maintain instream flow needs in Davidson Creek during all phases of the Designated Project at a minimum within flow rates recommended by the Proponent in Appendix 5.1.2.6D of the Environmental Impact Statement, unless otherwise authorized by Fisheries and Oceans Canada.
3.9	Maintain water temperature in Davidson Creek, as described by the Proponent in Section 5 of Appendix A (Blackwater Gold Project – Assessment of Flows from the Water Treatment Plant and North and South Diversions on Davidson Creek Temperatures. Knight Piesold. Memorandum VA16-01038) of Appendix C-1 of the Environmental Impact Statement Supplemental Report Assessment of Effects Related to Project Changes (August 2016), unless otherwise authorized by Fisheries and Oceans Canada.
3.10	Mitigate effects to fish and fish habitat from water withdrawn from Tatelkuz Lake during operation, including by using mine water and water from the northern and southern diversions identified by the Proponent in Figure 3-1 of the Environmental Impact Statement Supplemental Report Assessment of Effects Related to Project Changes (August 2016) for the operation of the mill.
3.12	For any fish habitat offsetting measure(s) proposed in any offsetting plan(s) referred to in condition 3.11 that may cause adverse environmental effects not considered in the environmental assessment, develop and implement measures to mitigate those effects, including effects to Indigenous peoples' current use of lands and resources for traditional purposes.
3.16	Develop a follow-up program as it pertains to fish habitat in Tatelkuz Lake and Chedakuz Creek, including fish habitat quantity and quality surveys . Monitor the Tatelkuz Lake littoral zone, monitor water flows in Chedakuz Creek between Tatelkuz Lake and the confluence with Davidson Creek.
10	**Accidents and Malfunctions**
10.1	Take all reasonable measures to prevent accidents and malfunctions.

Note(s):

1. MOECCS, 2019.

1.6.2 PROVINCIAL REGULATORY CONTEXT

1.6.2.1 PROVINCIAL OVERSIGHT

The three regulatory agencies responsible for oversight of water management systems in BC associated with mine sites are the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI), the Ministry of Environment and Climate Change Strategy, and the B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). Through ongoing discussions with these regulatory agencies, it is KP's understanding that regulatory oversight of the designs, operation and the associated water licenses will be approved and regulated by FLNRORD.

1.6.2.2 WATER SUSTAINABILITY ACT

BW Gold is submitting a water licence permit application under the *Water Sustainability Act* (WSA) to FLNRORD, which will govern the removal of water from Tatelkuz Lake using the FWSS at the Project.

1.6.3 FEDERAL REGULATORY CONTEXT

1.6.3.1 FISHERIES AUTHORIZATION

The Project is primarily located within the Davidson Creek watershed which supports both rainbow trout (Oncorhynchus mykiss) and Kokanee salmon (Oncorhynchus nerka). Palmer Environmental Consulting Group (Palmer) has been retained by BW Gold to prepare a Fisheries Offsetting Plan, including the IFNs referenced in this report, that will be submitted for a *Fisheries Act* Section 35(2) authorization in support of developing the Project. The target IFN flows were developed by Palmer to limit the potential environmental impacts of the project by providing flows supportive of rainbow trout (Oncorhynchus mykiss) and Kokanee salmon (Oncorhynchus nerka) populations within Davidson Creek (Palmer, 2021).

2.0 SITE SETTING

2.1 PHYSIOGRAPHY AND MAJOR DRAINAGE SYSTEMS

The Project site is situated on the Nechako Plateau of British Columbia, part of the Interior Plateau east of the Coast Mountain Range. This is an area of moderate relief characterized by gently undulating, northwest-trending hills cut by small to medium-sized drainages. The elevation of the Blackwater property ranges from just over 1,000 m in low-lying areas northeast of the proposed mine site, to 1,800 m at the summit of Mt. Davidson on the southwest side of the property. The Blackwater deposit is located on the northern flanks of the mountain.

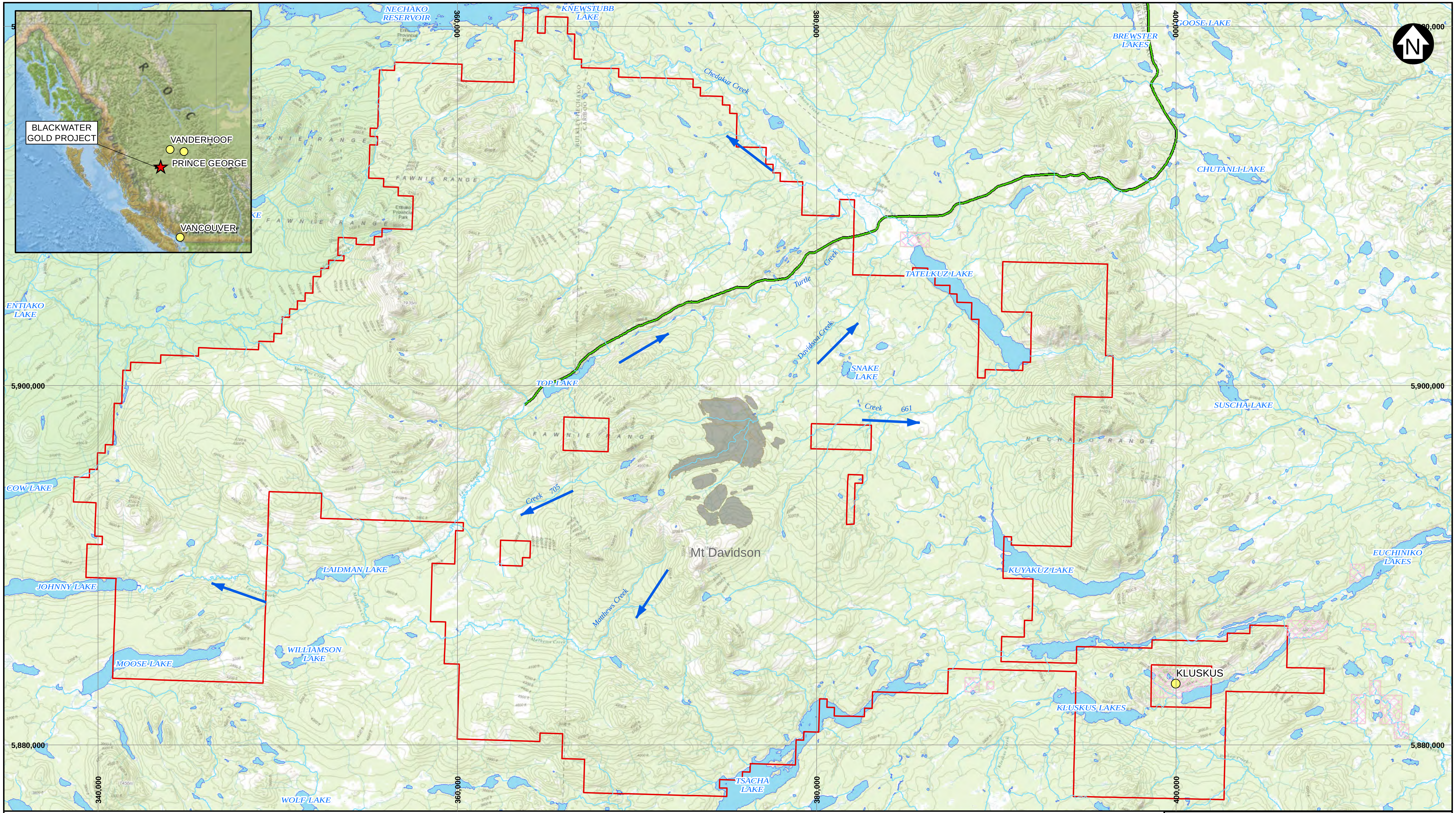
The Project facilities are situated primarily within the Davidson Creek watershed and the headwaters of the Creek 661 watershed. Mt. Davidson creates a drainage divide between northeast flowing Davidson Creek and Creek 661, southwest flowing Creek 705, and south flowing tributaries to the Blackwater River. Seeps and wetlands are common along the lower slopes of Mt. Davidson.

The project location along with the major drainage systems and flow direction in the Project area are shown on Figure 2.1.

The TSF and associated water management facilities are located in the upper reaches of the Davidson Creek catchment area. The proposed mine site facilities south of the TSF area include the open pit, plant site, and stockpile areas, which are located within a tributary catchment to Davidson Creek or in the upper reaches of a tributary (Creek 505659) that flows to Creek 661. The terrain within these areas is generally gently inclined, except along the incised portions of Davidson Creek, which are characterized by moderate to moderately steeply inclined slopes adjacent to the drainage.

2.2 PROPERTY, TENURES AND LAND USE

The FWSS is located on provincial Crown land partially within the mineral claim boundaries held by BW Gold. The Tatelkuz Lake intake is sited outside of this area. The Blackwater claim block comprises 75 mineral cell claims totaling 30,578 ha. All Blackwater claims are 100% held in the name of BW Gold. BW Gold holds both the recorded and beneficial interest in these claims. None of the Blackwater cell claims are known to overlap any legacy or Crown granted mineral claims, or no-staking reserves.



Legend

- CITY/TOWN
- FIRST NATIONS RESERVE
- PROPERTY BOUNDARY
- PROPOSED PROJECT FACILITIES
- KLUSKUS FSR
- FLOW DIRECTION

2 1 0 2 4 6 8 10 km

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE MAP.
2. COORDINATE GRID IS IN METRES/DEGREES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:200,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.
4. MINE INFRASTRUCTURE FOOTPRINT IS BASED ON 2021 FEASIBILITY STUDY DESIGN.

BW GOLD LTD.

BLACKWATER GOLD PROJECT

PROJECT LOCATION

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA101-457/33	13

FIGURE 2.1	REV 0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	10SEP'21	ISSUED WITH REPORT	BTW	KK	JGC

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2.3 HYDROMETEOROLOGY AND CLIMATE

Hydrological and meteorological data have been collected at the project site since early 2011. The site-specific data were correlated with available long-term regional data. The details of the hydrometeorology study are presented in the 2020 Hydrometeorology Report (KP, 2021g). The study indicated that the available site and regional datasets are adequate to provide a reasonable basis for describing and quantifying the hydrological and meteorological characteristics of the project area for the purpose of water balance modelling, engineering design, and environmental assessment. The key findings of the study are summarized in Appendix B.

2.4 REGIONAL GEOMORPHOLOGY

The geomorphic features of the region are largely the product of the last glaciation period (the Fraser Glaciation). The Cordilleran ice sheet covered the region to a maximum depth of approximately 300 m at the peak of the Fraser Glaciation approximately 19,000 years ago. At the peak of glaciation, the localized ice flow direction at the region was toward the northeast, as evidenced by drumlins, flutings, and other streamlined glacial landforms. Most of the mountain peaks in the region show rounded tops which is evidence to suggest that during the height of the Fraser Glaciation, the ice elevation exceeded 1,750 metres above sea level (masl), which is higher than most of the tallest peaks in the region. Most glacial cycles terminated with rapid climate warming where the periphery of the ice sheet was the first to become ice free. The Cordilleran Ice Sheet during the Fraser Glaciation developed over 10,000 – 15,000 years, but disappeared in less than 5,000 years (Clague, 1981; Clague et al., 1990; Clague, 2000). Additional details related to the characterization of the site are contained in the Dam Site Characterization Report (KP, 2021i).

2.5 REGIONAL GEOLOGY

The Project is underlain by the Stikine Terrane within the Intermontane Belt of the Canadian Cordillera and is located within a structurally uplifted block termed the Nechako uplift (Leslie, 2010). The Stikine Terrane in this area is represented by the Hazelton Group which consists of Carboniferous to Middle Jurassic Island arc volcanic rocks and sedimentary deposits. In the lower unit of the Hazelton Group, felsic tuffs and sediments are prominent which make up the Entiako Formation whereas the upper unit consists of felsic to mafic volcanic flows, volcaniclastics, and sedimentary rocks, called the Naglico Formation (Leslie, 2010).

With the continued subduction under the North American plate, post-accretionary stratigraphy deposited over the Stikine during the Middle Jurassic to Early Paleocene (Looby, 2015). Sedimentary basins developed in the Stikine and Cache Creek Terranes in the form of marine and non marine sediments of the Middle to Late Jurassic Bowser Lake Group (Looby, 2015). Locally, the sediments of the Middle to Late Jurassic Bowser Lake Group are interlayered with deposits of the Hazelton Group, and collectively, these groups are intruded by Late Cretaceous granitic to granodioritic plutons (Leslie, 2010).

Late Cretaceous stratigraphy overlaying the Hazelton and Bowser Lake groups consist of Powell Creek Group volcanic rocks and related sedimentary rocks of the Kasalka Group (Leslie, 2010). Young volcanism of the Stikine Terrance consists of widespread Eocene volcanic arc related extensional felsic volcanic rocks and minor sedimentary rocks of the Ootsa Lake Group (Leslie, 2010). Quaternary glacial deposits overlie most of central British Columbia making outcrops sparse.

2.6 REGIONAL SEISMICITY

The Project site is situated in a region within central BC where the level of recorded historical seismic activity has been low. The seismic hazard in the region is influenced by the seismically active region of coastal northwest BC, southwest Yukon territory and southeast Alaska. The coastal region has experienced many large earthquakes, including events in the range of Magnitude 7 to 8. The earthquakes located offshore and west of the project site is associated with the Queen Charlotte fault system, which runs underwater along the west coast of Haida Gwaii and defines the boundary between the Pacific and North American tectonic plates. The largest event instrumentally recorded in Canada is a Magnitude 8.0 earthquake that occurred along this fault in 1949, approximately 540 km west of the project site.

The level of seismicity in the interior of BC and the Rocky Mountains region drops off rapidly with distance from the west coast and to the north. The largest earthquake recorded in the southern Cordillera region was an event of about Magnitude 6.0 in 1918, located in the Valemount area of the Rocky Mountain trench. The maximum earthquake magnitude for northern BC is estimated to be Magnitude 7.0 to 7.5, with an upper bound estimate of Magnitude 7.7 for the Rocky Mountains region, based on historical earthquake data and the regional tectonics and fault systems (Halchuk, 2014). Similarly, there is the potential for large earthquakes of up to about Magnitude 7.5 along the coastal region of mainland western BC, including the Coast Mountains. Although these earthquakes have the potential to be as large as about Magnitude 7.5, they are too distant (approximately 400 km or more) to contribute significantly to the seismic hazard at the Project site. Additional details related to defining response spectrum are included in the Seismic Hazard Assessment (KP, 2021j).

2.7 LOCAL GEOLOGY

Deglaciation commenced approximately 16,000 years ago and progressed by frontal retreat to the west or southwest towards the Coast Mountains and progressively lowering of the ice sheet surface by down-wasting (Clague, 2018). The pattern of ice-marginal and subglacial meltwater channels indicates that areas of higher elevation in the vicinity of the mine site became ice-free before valley floors and other low-lying areas. Glacial ice appears to have stagnated in the Davidson Creek valley during late deglaciation producing ice-stagnation landforms such as eskers, kettles, and kames.

Geomorphic evidence indicates that the meltwater corridors evolved over the short period during which they were active. Downward-stepping terraces within some meltwater corridors show that active channel floors were progressively lowered by fluvial erosion as the ice melted. The lowest and youngest terraces may have formed in proglacial settings after the meltwater ceased to be confined by ice. Evidence also exists for shifts in meltwater discharge among the major meltwater corridors over this period. The oldest corridors lie somewhat higher than the Davidson Creek corridor and are truncated by it. The modern drainage system became established as soon as the area was fully deglaciated, probably around 13,000 years ago. Since then, there has been little geomorphic change in the study area (Clague, 2018).

The reconnaissance terrain and glacial landform map (KP, 2019) indicates an extensive cover of glacial till and glaciofluvial sands and gravels across the Project area. Massive lodgement glacial tills were deposited at the base of the ice sheet. Ablation tills were also deposited locally as the ice sheet retreated. Sediments deposited during de-glaciation of the area include glaciofluvial and glaciolacustrine sediments. Glaciofluvial sands and gravels are common in valley bottoms and along the valley flanks, occurring as kames, eskers, and terraces. A large amount of glacial meltwater was channeled along northeast oriented sub-glacial meltwater channels producing esker deposits that are broadly aligned with the modern Davidson Creek valley.

The topography today consists of typically rounded mountain tops, and bedrock exposure is rare and generally restricted to higher elevations. Bedrock is deepest along the Davidson Creek valley bottom where it is encountered at up to 107 meters depth. An extensive blanket of glacial debris covers the Project area with the thickest within the Davidson Creek watershed averaging over 60 metres. More recent glaciation resulted in the removal of older glacial deposits or cover by younger glacially derived deposits.

2.8 GEOTECHNICAL CONDITIONS

2.8.1 GENERAL

Site investigation programs conducted between 2012 and 2021 were generally located within the mine site area and extended downstream to the FWR with several test pits and drillholes located further downstream (northeast) of the FWR, approximately within 1 km. KP also completed a site visit in July 2013 at the proposed Tatelkuz Lake Intake and Booster Stations to inspect and record the topography, near surface geology, hydrology, and vegetation within the proposed footprint for the major components.

Bedrock exposure in the Project area is rare and restricted to higher elevations. Bedrock is deepest along the Davidson Creek valley bottom where it is encountered at up to 110 meters depth. The characterization of the surface material and bedrock units are summarized in the following below.

2.8.2 SURFICIAL MATERIALS

- Topsoil: Thickness ranging from 0 to 0.3 m with an average of 0.1 m based on the test pits. Topsoil may be locally thicker in wetland areas and creek bottoms where investigation work was not performed.
- Glacial Deposits: Most dominant surficial material. Glacial sequences identified range in thickness from 14 to 51 m with an average of 37 m based on the geotechnical drillholes. Lodgement and undifferentiated till occur below at depth with interval thickness ranging 2 to 44 m. The till is interbedded with glaciofluvial deposits and glaciolacustrine materials.
- Reworked Regolith: Less prevalent than the glacial deposits within the surficial material and is generally found at depth below the glacial deposits directly above the weathered bedrock.

2.8.3 BEDROCK UNITS

- Completely Weathered Bedrock: This unit was intercepted only in drillholes GT13-04 to GT13-06 with a thickness ranging from 22 to 36 m.
- Highly Weathered Bedrock: Intercepted in drillholes GT13-04 to GT13-06 at an elevation ranging from 1,095 to 1,063 masl.
- Intact Bedrock: Intercepted in drillholes GT13-04 to GT13-06 at an elevation ranging from 1,088 to 1,050 masl. The bedrock lithology at the FWR is predominantly Andesite which can be generally described as a strong rock with 'FAIR' Rock Mass Quality Rating. (Bieniawski, 1989).

Measured groundwater elevations within 1 km downstream of the FWR range from 1,144 to 1,130 masl. Descriptions of the geotechnical conditions for each FWSS component are included in the Appendix C. Foundation conditions at the FWR can be found in the Dam Site Characterization Report (KP, 2021i).

Additional ground truthing and geotechnical and hydrogeological investigations are recommended prior to final design to verify ground conditions at the intake structure, booster pumpstation, and along the water supply pipeline depending on final grading plans.

2.9 DAVIDSON CREEK

2.9.1 CONTEXT

The Davidson Creek valley is incised locally and flows northeast from the site toward Chedakuz Creek downstream of Tatelkuz Lake. The footprint area of the proposed TSF lies within the upper reaches of the Davidson Creek catchment area. The terrain within this footprint is predominantly gently inclined, except along the incised portions of Davidson Creek. The Project is located within the Davidson Creek watershed, which is 78 km^2 and supports both rainbow trout (*Oncorhynchus mykiss*) and Kokanee salmon (*Oncorhynchus nerka*). The Davidson Creek valley is incised locally and flows northeast from the site toward Chedakuz Creek downstream of Tatelkuz Lake. The footprint area of the proposed TSF lies within the upper reaches of the Davidson Creek catchment area. In the years of the Projects proposed development, the smallest area contributing flows into the FWR is composed of the Northern Diversion System and the FWR direct catchment area. A map of the contributing areas is presented in the Life of Mine Watershed Model Report (KP, 2021a). The contributing watershed area to Davidson Creek will be reduced from approximately 78 km^2 to an estimated 13 km^2 at the downstream extent of the TSF at the most stringent times of the Project development. A general arrangement of TSF, major catchment boundaries, and general surface water flow patterns for the site are shown on Figure 2.1.

The baseline hydrology and temperatures in Davidson Creek are included in the 2020 Hydrology and Temperature Baseline Report (KP, 2021c).

2.9.2 INSTREAM FLOW NEED

The Davidson Creek IFN is summarized in section 3.3.3.

2.9.3 EXPECTED TIMING OF SHORTFALL

IFN flows in Davidson Creek are expected to be met during all months in Operations and Closure as a result of water diverted around the mine, stored in the WMP and FWR, supplemented by the FWSS and other sources. Details of the assessment are included in the Life of Mine Water Balance Model Report (KP, 2021a).

Water diverted around the mine and pumped from the WMP is expected to be sufficient to meet IFN requirements under average or wetter than average conditions in the first phase of mining (Years 1 through 5). Under drier than average conditions (15 to 25% likelihood) a source of makeup water may be required during the first phase of mining to meet IFN criteria in non-freshet months. Meeting IFN criteria during those drier conditions could require an additional source of water of approximately 150 L/s based on the 90th percentile predicted rate. If allowances for streamflows lower than IFN are made during dry conditions, adding water at a rate of 20 to 50 L/s is predicted to increase streamflows in Davidson Creek to the baseline (pre-mining) flows.

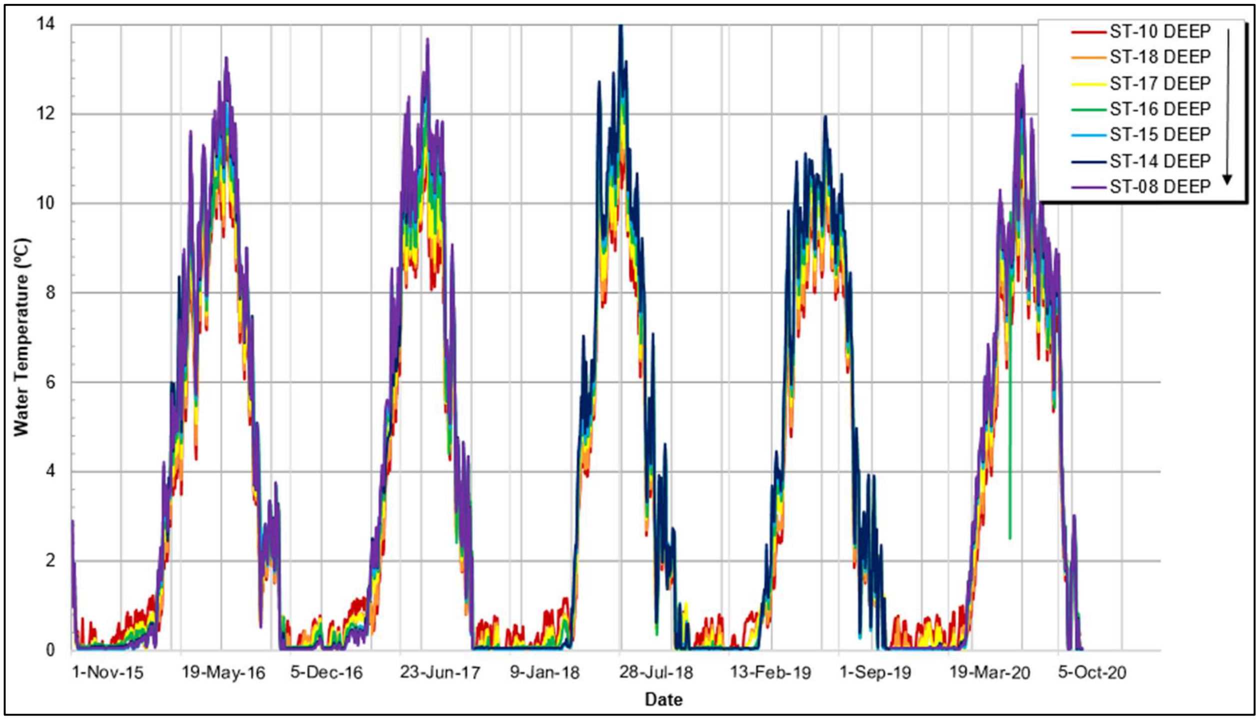
In later phases of mining, the FWSS is estimated to contribute 10% of the total annual IFN in Years 6 through 17 and 40% of the total annual IFN thereafter based on average climate conditions. The 5th and

95th percentile pumping rates from all 40 simulations in later years of mining are 0 and 540 L/s, respectively, which indicates that under very wet conditions water stored on or diverted around the mine could be sufficient to meet IFN criteria and under very dry conditions the FWSS may provide the full IFN flow.

2.9.4 BASELINE TEMPERATURE

The temperature records for Davidson Creek are typically characterised by near freezing temperatures prior to the spring freshet, followed by a gradual warming period until July and August, which are the warmest months. Temperatures then decrease steadily back to near freezing temperatures by November or December.

Spatial comparison of average daily water temperatures at dedicated water temperature stations along Davidson Creek, from 2015 to 2020, is shown on Figure 2.2 (extracted from KP, 2021c).



Note(s):

1. Water temperature stations are listed from upstream to downstream in the legend.

Figure 2.2 Spatial Comparison of Average Daily Temperatures in Davidson Creek

2.10 OTHER DRAINAGE CATCHMENTS

Creek 661 flows northeast from the project site into Chedakuz Creek upstream of Tatelkuz Lake. An unnamed catchment drains Snake Lake, which is located between the Davidson Creek and Creek 661 catchments. This area drains directly to Tatelkuz Lake. Chedakuz Creek drains Tatelkuz Lake before its confluence with Davidson Creek approximately 800 m downstream of the lake. Chedakuz Creek flows northwest passing under a bridge at the Kluskus Forest Service Road (FSR) approximately 2 km downstream from the lake. Turtle Creek, located to the north of Davidson Creek, drains another catchment area running parallel to Davidson Creek towards Chedakuz Creek. Turtle Creek flows closely to Davidson

Creek near the base, before flowing north under the Kluskus FSR to its confluence with Chedakuz Creek downstream of the Kluskus FSR. Chedakuz Creek flows northwest from this point for approximately 25 km to the Nechako Reservoir.

Matthews Creek and Creek 705 both flow west of the deposit area and combine with westward flowing Fawnie Creek to form a second predominant surface water flow pattern in the region. Fawnie Creek flows towards Laidman Lake and Johnny Lake, into Entiako Provincial Park, and ultimately forming a portion of the flow of the Entiako River into the Nechako Reservoir.

The catchment divide for the Blackwater River is south of the deposit area and constitutes the third major surface water flow pattern in the region. The Blackwater River is a tributary of the Fraser River and flows generally north-eastward across the Fraser Plateau in the Chilcotin region of central BC. Its confluence with the Fraser River is approximately 40 km northwest of Quesnel.

2.11 TATELKUZ LAKE

Tatelkuz Lake was identified as the most practical water source to supplement flow in Davidson Creek because it is the largest lake in the area. It is fed by a watershed with an area of approximately 395 km^2 so it provides the lowest risk source with regard to security of water supply. Tatelkuz Lake is a long narrow lake located approximately 15 km northeast of the proposed Project site. The lake is roughly 9 km long and 1 km wide. The Tatelkuz Lake Indian Reserve 28 (IR 28) is located on the northwest side of the lake. Chedakuz Creek drains the lake and flows towards the northwest through IR 28 towards the confluence with Davidson Creek further within the IR 28.

The average lake elevation is 927.0 masl. The lowest recorded historical lake elevation is 926.8 masl and the highest historical lake elevation is 929.0 masl. The lake levels are the highest during the freshet period from April to August, while they vary within a relatively narrow margin during the rest of the year. Tatelkuz Lake depth area capacity, anticipated water surface elevations and anticipated temperature are summarized and discussed in Appendix E. The Tatelkuz Lake water surface elevations as recorded at the streamflow monitoring station Tatelkuz Lake – L1, are shown on Figure 2.3. The design lake intake elevation is 918.8 masl.

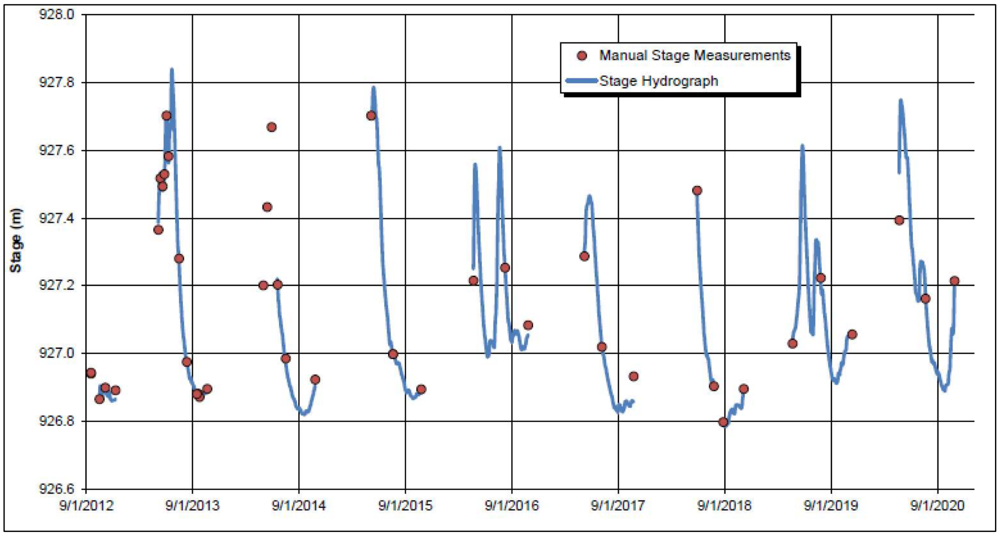


Figure 2.3 Tatelkuz Lake Station L1 Stage and Intake Elevation

Monthly thermal changes in Tatelkuz Lake are illustrated in Figure 2.4. Temperature variability decreases in the hypolimnion, with a thermocline occurring approximately between 2 m and 15 m below the water surface, depending on the season. Tatelkuz Lake starts undergoing fall turnover in September and October, and the thermocline deepens, with warmer epilimnion water mixing with cooler hypolimnion water. In October, Tatelkuz Lake would be fully mixed. The surface of the lake will freeze in the winter months. These values are important as they affect the elevation settings of the proposed intake structure as well as the depth at which water will be withdrawn from Tatelkuz Lake.

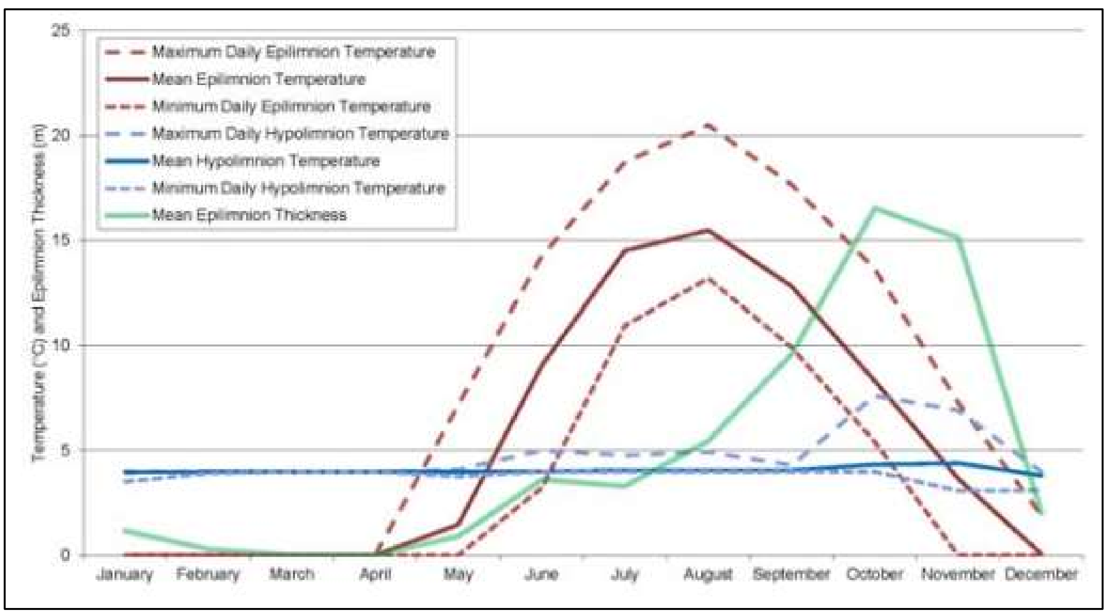


Figure 2.4 Range of Long-Term Epilimnion and Hypolimnion Temperatures in Tatelkuz Lake

Note(s):

1. KP, 2016A – VA16-00070 - Water Temperature Modelling of Tatelkuz Lake.

3.0 FRESH WATER SUPPLY SYSTEM

3.1 OBJECTIVE

The objective of the FWSS is to provide additional flows to Davidson Creek to support IFN. FWSS flows are required when upstream diversions and the proposed mine water management strategy are not able to meet IFN alone.

3.2 DESIGN FEATURES

The FWSS includes the following components which are detailed in the subsequent corresponding sections of this report:

- Tatelkuz Lake Intake and Pump Station
- Fresh Water Supply Pipeline
- Booster Pump Station
- Access
- Power distribution (by others)

In addition to the above components, the FWR is also discussed in the following sections to provide information supplemental to the design of the FWSS. FWSS component coordinates are provided in Table 3.1.

Table 3.1 FWSS Component Locations

Feature	Indicative Elevation	Latitude	Longitude	Easting (m)	Northing
Tatelkuz Lake Intake	918 masl	53°15'52.14"N	124°39'28.34"W	389 425	5 902 975
Tatelkuz Lake Pump Station	931 masl	53°15'49.65"N	124°39'33.10"W	389 335	5 902 900
Booster Pump Station	1,055 masl	53°15'35.84"N	124°45'4.78"W	383,180	5,902,620
Fresh Water Reservoir[1]	1,166 masl	53°13'38.70"N	124°49'32.64"W	378 125	5 899 125

Note(s):

1. Fresh Water Reservoir location is included for completeness but is not a component of the freshwater pumping system from Tatelkuz Lake.

3.3 DESIGN CRITERIA

A summary of pertinent design criteria is included as Appendix A.

3.3.1 DESIGN LIFE

The FWSS design life currently being considered is 50 years or less, as it is anticipated that the embankment dam impounding the FWR will be decommissioned during the transition from closure to post-closure (currently estimated to be Year 46 after the commencement of operations), when stream flows in

Davidson Creek are able to return to natural conditions without the water demands for mine operations or pit filling upstream.

3.3.2 DEVELOPMENT TIMING

A water balance model for the life of the Project was developed to support permitting and is presented in the Life of Mine Water Balance Model Report (KP, 2021a). The water balance model indicates that the FWSS will be required in approximately Year 5 of mine operations.

3.3.3 HAZARD LEVELS

The building classification for the FWSS structures (including the intake and booster pumpstation) is defined per the British Columbia Building Code (BCBC, 2018) as: Low hazard industrial occupancy, Group F, Division 3.)

The design basis event defines the limit of expected normal function and performance of facility – no major damage to facility but minor interruption may result in the case of seismic and flood event. The hazard events for the design basis are defined in Table 3.2.

Table 3.2 Design Level Hazard

Hazard	Tatelkuz Lake Water Intake, Pumpstation, Booster Station, Pipeline
Flood	24 hour, 1 in 200 year return period
Earthquake	1 in 2,475 year return period(1)
Wind	1.5 x 1 in 30 year return period
Terrain Hazards	Non-Applicable. Generally no steep terrain above features. To be confirmed.

Note(s):

1. 2018 British Columbia Building Code.

3.3.4 INSTREAM FLOW NEEDS

The design criteria related to minimum flow releases from the combined FWR / FWSS was defined by the IFN in Davidson Creek. Target IFN flows for Davidson Creek were developed by Palmer Environmental Consulting Group (Palmer) and are discussed in detail in the Fisheries Offsetting Plan (Palmer 2021). The target IFN flows were developed to limit the potential environmental impacts of the project by providing flows supportive of rainbow trout *(Oncorhynchus mykiss*) and Kokanee *(Oncorhynchus nerka)* populations within Davidson Creek. The design IFN criteria are presented in Table 3.3.

Table 3.3 Davidson Creek Instream Flow Needs

Period	IFN (m^3/s)	Days
January 1 to April 15	0.08	105-106
April 16 to May 10	0.15	25
May 11 to May 15 (Flushing Flows)	0.56	5
May 16 to June 30	0.56	46
July 1 to July 15	0.30	15
July 16 to August 31	0.15	47
September 1 to November 30	0.12	91
December 1 to December 31	0.08	31

Note(s):

1. Davidson Creek IFN values from the Blackwater Project Fisheries Offsetting Plan: Instream Flow Needs (Palmer, 2021).

The maximum IFN is 0.56 m^3/s during the spring period; however, it is recognized that the recommended flows may be subject to revision following observation and monitoring, and subject to revisions based on discussions with DFO.

3.4 ACCESS

3.4.1 GENERAL ACCESS

The Project site is accessed by vehicle via the Kluskus FSR, the Kluskus-Ootsa FSR and the exploration access road, which connects to the FSR near kilometre marker 146. A new 16 km long mine access road will be built to connect to the FSR near kilometre marker 124.5. The Kluskus FSR joins Highway 16 approximately 10 km west of Vanderhoof. Driving time from Vanderhoof to the mine site is about 2.5 hours.

3.4.2 FWSS ACCESS

Roads providing access to the FWSS components are to be all-weather roads, in place until the FWSS is decommissioned. The road alignments, culverts and diversion ditches within the project corridor will be designed, constructed, and maintained in accordance with the requirements of the British Columbia Forest Practices Code, and the appropriate recommendations of the Forest Road Engineering Guidebook and the Forest Service Bridge Design and Construction Manual. Hydraulic structures along the access roads will normally be designed for the 1:100-year return period flood flows. The majority of the FWSS access alignment follows the existing forestry road network.

A portion of new access will need to be developed and some existing roads modified for the construction and operation of the FWSS. The anticipated segment lengths are summarized in Table 3.4.

Table 3.4 FWSS Access Components

From	To	Category
Pumpstation Access Road Junction near Davidson Creek Bridge	Pumpstation Access Road Junction from Service Road	Service Road to be refurbished and utilized for life of facility. To be developed in conjunction with the water conveyance system and transmission line.
Pumpstation Access Road Junction from Service Road	Pumpstation	New Road to be developed in conjunction with the water conveyance system and transmission line.
Pumpstation Access Road Junction near Davidson Creek Bridge	FWR Junction	Mine Access Road to include an allowance for the water conveyance system and transmission line.
FWR Junction	FWR	Short new road segments to access the FWR.

3.4.3 NEW ACCESS CONSIDERATIONS

New construction includes right-of-way clearing and grubbing, topsoil stripping, stump removal, log decking, and construction of sub-grade, ditches and drainage structures. The locations of the new roads are based on topographic features and surface material, and the control point of where that road is accessing. Where feasible, road grades will be constructed flatter than 12% to allow for easier access during construction and reduce the costs of long-term maintenance. The new access roads, where possible, will be located to aid in the construction of the water conveyance line.

Sub-grade construction consists of using local material to construct a stable surface to form the base of the road. The roads are planned to be constructed using a cut-and-fill technique. Material is cut from the uphill side of the road and is placed as fill on the downhill side of the road. The material is then packed using the tracks of the excavator or bulldozer. If suitable stabilizing material is unavailable on-site, material may need to be hauled from a suitable borrow area. If the on-site material is not suitable for a road-running surface, off-site material may need to be hauled to cap the road.

3.4.4 CROSS DRAIN CULVERTS

Cross drain culverts are used to carry ditch water from one side of the road to the other and spaced at intervals necessary to minimize erosion of the roadside ditch line. Cross-drain culverts will be designed and constructed following the BC Forest Service Road code.

3.5 TATELKUZ LAKE INTAKE AND PUMP STATION

3.5.1 OVERVIEW

The intake of water from Tatelkuz Lake will be conducted via a permanent, land-based concrete wet-well structure. The structure will consist of horizontal screened intake pipes, a cast-in place concrete wet-well, vertical turbine pumps, and a pre-fabricated steel superstructure to house the associated mechanical and electrical infrastructure. These components are described in detail in the following sections.

The wet-well structure configuration was selected as the preferred option, versus a submersible pump unit or a floating barge structure, for the following reasons:

- The lake level variation was determined to operate within a relatively small and manageable range
- The land-based wet-well was considered to be preferable for year-round maintenance access

- A land-based system was considered to have less of an impact on the riparian zone and to be more aesthetically pleasing since the intake screens and intake pipelines would not be visible
- The land-based wet-well was estimated to be less expensive (KP, 2013e)

The Tatelkuz Lake Intake and Pump Station is shown on Drawings C5300, C5310, and M5060 in Appendix D.

3.5.2 SCREENED INTAKE PIPES

The FWSS will draw water from Tatelkuz Lake through two pipes, each approximately 110 m long and equipped with cylindrical screens at the intake end of the pipes. The pipes will passively convey water from the lake to the concrete wet well. The upstream end of the screened intake pipes will be located at a depth that allows for water to be drawn from the lake hypolimnion as frequently as practicable. This depth was found to be eight meters below the anticipated Tatelkuz Lake low water level (LWL) based on the assessment summarized in Appendix E.

There will be two sections of intake pipe, both constructed of nominal diameter (ND) 900 mm DR17 high density polyethylene (HDPE). The first section of pipe will be anchored on the lake bottom as required to keep it in place. The second section of pipe will be installed underground through the lake bank (between the lake and wet-well) and constructed either via horizontal drilling or jacking, or other means deemed appropriate upon collection and review of additional geotechnical data. This configuration makes it possible to limit the depth of the pumpstation wet-well while allowing the intake to draw water from a greater depth, more easily achieving water intake from the hypolimnion.

Two pipes, as opposed to one, allows for redundancy and for maintenance/modifications to take place as required. For example, it allows for the potential modification to one of the conveyance pipes to a greater or shallower depth in Tatelkuz Lake if it were ever shown to be beneficial.

The Intake Screen design basis assumptions are as follows, and a typical screen configuration is indicated on Figure 3.1:

- 0.67 m^3/s intake capacity for each screen (2 screens for redundancy)
- 0.15 m/s approach velocity
- stainless material screens (no coating to minimize bio-fowling)
- 5 mm slot opening
- The total pressure drop through the Tee assembly and conveyance shall not exceed 0.5 m

Screen cleaning will have to be completed manually using divers should it ever be required. No screen cleaning mechanism was included. Screened intake pipe details are shown on drawing C5310.

Figure 3.1 Picture of Tee Type Cylindrical Screen

Note(s):
1. Image from Elgin Separation Solutions.

3.5.3 WET-WELL

The wet-well will be constructed as a cast-in-place concrete structure and will serve to provide a basin from which the pumps can draw water to be delivered to the FWR. The wet-well will be rectangular in shape with a minimum internal elevation of 922 masl and will rise to the pump house floor at elevation 930.83 masl. The boundary of the extents of excavation required for construction of the well are set back from the high-water level extents, by a minimum of five meters. The pump station and wet-well (within the extents of the required excavation) are set back an additional approximately 5 to 10 metres.

The high and low water levels are expected to be 928.8 masl and 926.8 masl respectively.

3.5.4 PUMP STATION – CIVIL INFRASTRUCTURE

The pump station structure will include an installed crane of suitable capacity/design for the required loads, and removable roof hatches for pump installation, removal, and maintenance.

The pumphouse foundation slabs will be designed to accommodate and support the superstructure and pumping equipment as well as to resist roto-dynamic forces and vibrations caused by the equipment.

Foundation preparation will consist of removing all unsuitable foundation material and backfilling up to foundation level with engineered fill.

3.5.4.1 SUPER STRUCTURE

The pumphouse will comprise a reinforced concrete substructure with structural steel metal clad superstructure. The structural design of the superstructure will be provided by a pre-engineered building supplier retained by BW Gold, with cladding and roof details provided by the building supplier.

Final dimensions of the pumphouse layout, with sufficient space to contain the pumps, all mechanical and electrical building services, adequate space for access to items that require maintenance (such as filters, coils and drain pans, and strainers, etc.) will be established together with the relevant equipment suppliers.

3.5.4.2 CONSTRUCTION STAGING

The foundation and wet-well excavation will occur on shore.

Horizontal directional drilling (HDD), excavation and backfill, or other means as deemed most appropriate based on geotechnical conditions, will connect the wet-well to the lake once the foundation of the wet well is complete. HDD is a trenchless construction process where pipe is installed along a bore path, which is created by a drilling rig. Excavation and backfill consists of removing material to allow for pipe placement at the required elevation, and replacing the excavated material to secure the pipe in place.

The second conveyance section and screen foundation can be sunk from the lake surface then tied to the pipe endings.

3.5.4.3 BUFFER

A 5 m access buffer will be allowed around the structure for staging and access, and a 15 m buffer will be allowed in front of the structure.

3.5.5 PUMP STATION – MECHANICAL AND ELECTRICAL INFRASTRUCTURE

The Intake Pumpstation will initially be outfitted with three vertical turbine pumps: two operating, and one on standby (100% standby capacity – may be reviewed during subsequent stages of design). The pumps are designed to provide a total maximum flowrate of 0.67 m^3/s (2,400 m^3/h) to meet the design flowrates. The pumps will be housed inside a prefabricated steel structure and will draw water from the wet-well chamber, approximately 9 m below the pump house floor. Each pump will provide the required Total Design Head (TDH) at a maximum flowrate of 335 L/s (1,150 m^3/h) to meet the total design flowrate of 670 L/s. Each of the pumps will be equipped with a variable frequency drive (VFD) and motor to allow for controlled start-up and shutdown, as well as to accommodate variable flow demand.

The pumps do not require insulation or heat tracing, as they are located within the steel superstructure at the pump station. The structure will provide sufficient weather protection to prevent temperature or exposure-related damage to any equipment contained within.

The flow of liquid into any pump should be uniform, steady, and free from swirl and entrained air. Lack of uniformity through inlet connection can result in pumps not operating to optimum design condition and at a lower hydraulic efficiency.

3.6 FRESH WATER SUPPLY PIPELINE

3.6.1 OVERVIEW

Water will be conveyed via a pipeline from Tatelkuz Lake to the FWR. The pipeline will be constructed using HDPE of various thickness/pressure ratings. Additional details for the pipeline are presented below in Table 3.5.

Table 3.5 FWSS Pipeline Summary

	Elevations
Minimum Tatelkuz Lake Intake Pit WSL	926.3 masl
Booster Station	1,055.3 masl
High Point Above Fresh Water Reservoir	1,170.0 masl
FWSS Outlet at the FWR	1,066.0 masl
	Length
Pumpstation to Booster Station	6,550 m
Booster Station to High Point	7,190 m
Total	13,740 m
Diameter and Material	**ND750 mm DR9/DR11/DR17 HDPE**
Overall System Head Loss at Design Flow	70 m

3.6.2 ALIGNMENT

The pipe alignment will be routed along existing access roads as much as practicable. This design reduces potential environmental impacts, saves construction access costs as well as future maintenance costs, and facilitates visual inspection and monitoring. In some cases, the pipeline alignment is routed along the best accessible route since no existing access roads exist between the proposed intake location and the FWR location; new access roads need to be constructed for this purpose.

The FWSS pipeline was laid out within the boundaries of the CPD, which is a defined boundary identified in the EAC. It should be noted more optimal alignments may be possible outside of the CPD boundary but would require an amendment to the approved boundaries. Additional refinements may be made to limit excavation quantities and limit the reliance on air release valves where possible during detailed design, by keeping the alignment on a constant uphill slope to the extent practicable.

3.6.3 MATERIAL SELECTION AND PRESSURE SPECIFICATIONS

The water conveyance pipeline will comprise approximately five discernible sections along the pipeline alignment between the intake pump station, booster pump station, and the FWR:

1. a high-pressure section (DR9 HDPE) from the main pump station to approximately Station 0+950
2. a lower pressure section (DR17 HDPE) from Station 0+950 to the booster station
3. another high-pressure section (DR9 and DR11 HDPE) from the booster station to approximately Station 8+000
4. a lower pressure section from approximately Station 8+000 to the point of maximum elevation along the pipeline alignment at approximately Station 13+625
5. a final outfall section will descend to either the FWR or the temperature and flow control chamber at the FWR outlet

The pipeline was sized to result in flow velocities that would maintain relatively low pressures and a reliable system design (standard components), while also balancing initial and sustaining/operating costs. The pipeline design consists of butt-fused ND 750 mm PE4710 pipe, with dimension ratios ranging from DR9 in the high-pressure sections, to DR 11 and DR 17 as pressures reduce with increased elevation and distance from the respective pump stations.

HDPE pipe was selected as the preferred material as it meets the required operating pressure specifications while contributing to the system's reliability due to the desirable material properties such as strong corrosion and erosion resistance. HDPE is also a cost-effective solution for this application and is suitable for field-installation to meet system requirements.

3.6.4 WEATHER/ENVIRONMENTAL PROTECTION

Multiple factors were considered when determining the most appropriate pipeline alignment and profile, including the following:

- freezing conditions
- thermal expansion/contraction
- wildfires
- falling debris
- vandalism
- pipe thrust due to internal flow/pressure
- vehicle interaction

All of these risks/factors can be adequately mitigated by burying the pipe. Burying the pipe also serves to provide support as the trench backfill material gives the pipeline additional stiffness, enhances its resistance to sub-atmospheric pressures, and protects against ultraviolet radiation. The extent to which the pipe must be buried to achieve full mitigation of each risk varies. The most restricting factor in terms of burial depth in this case, is mitigation of the risk of freezing due to extreme cold weather.

The frost depth in the Project region was estimated to be approximately three (3) metres below ground surface (mbgs). The pipe would therefore have to be buried with at least three metres of cover above the crown of the pipe to fully mitigate the risk of freezing during periods of extreme cold weather under full pipe and no flow conditions. Although this is a technically feasible solution, there are financial, reliability, and environmental implications of burying pipes at such depths.

Additional engineering solutions that could mitigate the risk factors listed above are available with reduced burial depths and warrant consideration in future design stages. These options are described below and will be considered in more detail to optimize the design prior to final design and construction. Refer to Drawings C5420, C5421, and C5422 for pipe burial option details.

- Pipe Insulation and Electric Heat Tracing – the depth of cover (burial depth) may be reduced to a nominal amount while mitigating the risks/factors listed above, with the exception of the risk of freezing. The pipe could be equipped with insulation and electric heat tracing to maintain water temperatures high enough to prevent freezing and maintain system operability during periods of cold weather. This is a technically feasible solution. This option requires additional energy consumption and therefore introduces additional environmental and financial implications; however, the time expected to require protection from freezing temperatures is expected to be limited.
- Pipe Insulation – The depth of cover (burial depth) may be reduced to some extent while mitigating the risks/factors listed above by placing insulation over the crown of the pipe. This approach passively contributes to the insulating effect provided by the burial material and would reduce the burial depth required to prevent freezing, but is a less conventional solution. The reduction in burial depth may not be significant from a cost perspective.

- Operational Controls/Alignment Optimization – reduction of the burial depth to a nominal amount while mitigating all risks/factors listed above may be possible by optimizing the pipeline alignment and implementing additional operational controls. If localized low points could be eliminated to provide a naturally free-draining pipeline, it would be possible to operate the system such that during periods of cold temperatures, freezing of the water within the pipeline is prevented by maintaining an adequately high flow velocity that the water cannot freeze, or by draining the pipeline when continuous flow is not required. A variation of this option would be to install a secondary smaller pipeline adjacent to the nominally buried main pipeline, in which adequate velocities could be maintained to prevent freezing if lower flowrates from Tatelkuz Lake are required during periods of extreme freezing temperatures.

3.6.5 ROAD AND WATER CROSSINGS

Where the pipeline is to be routed underneath or directly adjacent trafficked areas, the pipeline will be designed for such vehicle loads. Other pipe protection measures may be used which might include sleeve pipes and concrete slab protection. Water crossings will be designed to allow water to go over or under the pipeline depending on the anticipated flow and existing drainage.

3.6.6 AIR/VACUUM RELEASE VALVES AND DRAIN POINTS

Air/vacuum combination release valves and drain points will be appropriately located along the pipeline alignment to release entrapped air and allow for draining of the FWSS as necessary. Exact locations of air/vacuum combination release valves have not yet been confirmed, and the requirement/location of these components will be evaluated in greater detail as the exact alignment/profile of the pipeline is confirmed.

Pipes, fittings, and valves will be equipped with adequate weather protection where pipes are exposed for the inclusion of air/vacuum combination release valves and drain points.

3.7 BOOSTER PUMPSTATION

3.7.1 DESCRIPTION

A booster pumpstation is included in the design of the FWSS to limit the size and head of the individual pump systems. Additional booster stations may be considered during subsequent design stages to optimize the system where practicable. Inclusion of a booster pumpstation also reduces system pressures in general to allow for use of HDPE pipe and low-pressure piping components, which results in greater cost reduction, ease of installation, and system reliability.

The pump station is located at approximately station 6+500 along the length of the FWSS pipeline, at an elevation of 1,055 masl as indicated on drawing M5050. The location was selected to minimize localized high and low points downstream of the pumps, as well as to balance system operating pressures and pump/pipeline pressure specifications at each of the two pump stations in the FWSS.

The booster pumpstation will comprise a structural steel skid complete with a building equipped with all necessary access, insulation, heating, ventilation, and lighting. The skid will contain the pumps, piping, and valves in one room, and the electrical infrastructure in a separate room. The pump station will be equipped with three horizontal pumps: two operating, and one on standby (100% standby capacity – may be reviewed during subsequent stages of design). The pumps will be equipped with VFDs and will be fed directly from the main FWSS pipeline.

Each horizontal pump will provide 155 m TDH at a flowrate of approximately 1,206 m^3/h, and be equipped with motors rated to 1,250 HP. The system will be controlled via input from pressure indicators and a flowmeter on the discharge of the pumps, all located within the enclosed skid. Discharge piping will be carbon steel prior to the connection to the main HDPE FWSS pipeline, which will convey water from the booster station to the FWR.

Details of the booster pump station are shown on Drawing M5070.

3.8 POWER DISTRIBUTION

Access to low-cost hydroelectric power is available at the Glennanan BC Hydro Sub-station and will require the construction of a 135 km transmission line (not covered herein).

An additional power distribution line will be required to supply power to the pumpstation at Tatelkuz Lake and Booster Pumpstation. The design basis and description will be provided by others.

A clearance allowance from the pipeline centerline should be made adjacent to the proposed water conveyance line to accommodate any transmission requirement.

3.9 MISC. EQUIPMENT FOR BUILDINGS (PUMPHOUSE AND BOOSTER STATION)

3.9.1 ELECTRICAL POWER SUPPLY AND CONTROLS

Permanent power supply will be provided by a 25 kV line, fed from the mine substation. Backup power supply will be provided from the same site distribution line from the site temporary generator to allow the control system and equipment to continue running after electrical power supply interruption. The FWSS design includes the power supply infrastructure from a battery limit at stepdown from the pole of the 25 kV site distribution line.

Communication will consist of a local motor control centre (MCC) and control panels with remote input and output (I/O) at each project component. The main programmable logic controller (PLC) for the system will be located at the Booster Station. The PLCs will be capable of running each system independently in the event of communication failure.

3.9.2 HEATING AND VENTILATION SYSTEM

The structures will be equipped with a ventilation system that will either be mechanically forced or convection induced. Heating and ventilation system will be provided to maintain a constant temperature inside within a minimum of 10°C to a maximum of 30°C.

3.9.3 SECURITY SYSTEM

The structures will be fenced and equipped with a security alarm system to deter and prevent vandalism or tampering. The security alarm will detect intrusion. The security system will be amalgamated as part of the communication and control system. The Owner will develop a security protection plan.

3.9.4 FIRE DETECTION AND PROTECTION SYSTEM

The structures will be equipped with a fire alarm system. The principal firefighting equipment will be portable chemical fire extinguishers. Fire suppression equipment will not be provided.

4.0 REFERENCES

ASCE 1996. D.W.Smith, Cold Regions Utilities Monograph (Third Edition.)

BCBC, 2018. British Columbia Building Code. BC Office of Housing and Construction Standards, National Research Council of Canada, 2018.

Canadian Environmental Assessment Agency (CEAA), 2019. Blackwater Gold Project Environmental Assessment Report. April 15, 2019.

Clague, J.J. (1981). Late Quaternary Geology and Geochronology of British Columbia. Part 2: Summary and Discussion of Radiocarbon-Dated Quaternary History. Geological Survey of Canada, Paper 80. 35 - 41. Ottawa, ON.

Clague, J.J. 2000. (2000). Recognizing Order in Chaotic Sequences of Quaternary Sediments in the Canadian Cordillera. Quaternary International., 29-38.

Clague, D. J. (2018). Deglacial Geology of the Blackwater Mine Study Area.

Department of Fisheries and Oceans Canada (DFO), Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater (https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html)

FLake (http://www.flake.igb-berlin.de/)

Halchuk, S., Allen, T.I., Adams, J., and Rogers, G.C. (2014). Fifth Generation Seismic Hazard Model Input Files as Proposed to Produce Values for the 2015 National Building Code of Canada. Geological Survey of Canada, Open File 7576. doi:10.4095/293907.

Katopodis Chis., (Katopodis, 1992) Department of Fisheries and Oceans Canada (DFO) Fish Screening for Water Intakes dated February 1992

Katopodis, C. 1992. Fish Screening for Water Intakes. Department of Fisheries and Oceans Canada (DFO). February 1992.

Knight Pièsold Ltd. (KP, 2019). Revised Landform and Terrain Maps. Vancouver, BC. Ref. No. VA101-457/26, Letter VA19-01017. July 9, 2019.

Knight Piésold, (KP, 2021a), Blackwater Gold Project – Life of Mine Water Balance Model Report. Vancouver, BC. Ref. No. VA101-457/33-1, Rev D. September 16, 2021.

Knight Piésold Ltd. (KP, 2021b). Blackwater Gold Project – Groundwater Baseline Report. Vancouver, BC. Ref. No. VA101-457/33-2, Rev. B. September 13, 2021.

Knight Piésold (KP, 2021c). Blackwater Gold Project – 2020 Hydrology and Water Temperature Baseline Report. Vancouver, BC. Ref. No. VA101-457/33-3, Rev. 1. May 17, 2021.

Knight Piésold, (KP, 2021d), Blackwater Gold Project – 2020 Baseline Climate Report. Vancouver, BC. Ref. No. VA101-457/33-4, Rev 0. January 14, 2021.

Knight Piésold Ltd., (KP, 2021e). Blackwater Gold Project – Tailings Storage Facility – Life of Mine Design Report. Vancouver, BC. Ref. No. VA101-457/33-5, Rev. C, dated September 10, 2021.

Knight Piésold Ltd. (KP, 2021f). Blackwater Gold Project – TSF Stage 1 Detailed Design Report. Vancouver, BC. Ref. No. VA101457/33-6, Rev. C. September 10, 2021.

Knight Piésold Ltd. (KP 2021g). Blackwater Gold Project – 2020 Hydrometeorology Report. Vancouver, BC. Ref. No. VA101-457/33-8, Rev. 1. May 17, 2021.

Knight Piésold Ltd. (KP, 2021h). Blackwater Gold Project – 2020-2021 Geotechnical Site Investigation Data Report. Vancouver, BC. Ref. No. VA101-457/33-9, Rev. 0. June 7, 2021.

Knight Piésold Ltd. (KP, 2021i). Blackwater Gold Project – Dam Site Characterization Report. Vancouver, BC. Ref. No. VA101-457/33-10, Rev. C. September 10, 2021.

Knight Piésold Ltd. (KP, 2021j). Blackwater Gold Project – Seismic Hazard Assessment. Vancouver, BC. Ref. No. VA101-457/33-12, Rev. 0. March 18, 2021.

Knight Piésold Ltd. (KP, 2021k). Blackwater Gold Project – Water Management Structures Detailed Design Report. Vancouver, BC. Ref. No. VA101-457/33-14, Rev. 0. October 29, 2021.

Knight Piésold Ltd. (KP, 2021l). Blackwater Gold Project – 2020 Mine Waste and Water Management PFS. Vancouver, BC. Ref. No. VA101 457/32-1, Rev. 0. February 26, 2021.

Knight Piésold Ltd. (KP, 2021m). Blackwater Gold Project – Stockpiles Geotechnical and Water Management Design Report. Vancouver, BC. Ref. No. VA101 457/33-22, Rev. C. October 27, 2021.

Knight Piésold Ltd. (KP, 2021n). Blackwater Gold Project – 2019 Geotechnical Site Investigation Data Report. Vancouver, BC. Ref. No. VA101-457/31-1, Rev. 0. May 19, 2021.Knight Piésold, (KP, 2016a). Blackwater Gold Project: Water Temperature Modelling of Tatelkuz Lake, VA16-00070. January 2016.

Knight Piésold, (KP, 2016b). Blackwater Gold Project: Water Temperature Modelling in the Fresh Water Supply System Pipeline, VA16-00140. February 2016.

Knight Piésold, (KP, 2016c). Blackwater Gold Project: Water Temperature Modelling of Fresh Water Reservoir, VA16-00069, January, 2016.

Knight Piésold, (KP, 2016d). Blackwater Gold Project: Water Temperature Modelling of Davidson Creek, VA16-00154, February, 2016.

Knight Piésold, (KP, 2016e). Temperature Assessment of the Fresh Water Supply System for the Blackwater Project, VA16-00094, March 22, 2016.

Knight Piésold, (KP, 2016f). Blackwater Gold Project – Assessment of Flows from the Water Treatment Plant and Northern and Southern Diversions on Davidson Creek Temperatures, VA16-01038, August 8, 2016.

Knight Piésold Ltd. (KP, 2014). Mine Waste and Water Management Design Report, KP Ref. No. VA101-457/6-11 Rev. 2, dated September 12, 2014.

Knight Piésold Ltd. (KP, 2013a). Revised Baseline Tatelkuz Lake Levels. KP Ref. No. VA13-01604, dated July 22, 2013.

Knight Piésold Ltd. (KP, 2013b). Geotechnical Characterization Report, KP Ref. No. VA101-457/6-8 Rev. 0, dated November 29, 2013.

Knight Piésold Ltd. (KP, 2013c). 2012 Site Investigation Report, KP Ref. No. VA101-457/6-1 Rev. 0, dated September 23, 2013.

Knight Piésold Ltd. (KP, 2013d). 2013 Site Investigation Report, KP Ref. No. VA101-457/6-4 Rev. 0, dated November 7, 2013.

Knight Piésold Ltd. (KP, 2013e). Blackwater Gold Project – Fresh Water Supply System Design, KP Ref. VA13-01189, dated July 17, 2013.

Leslie, C.D. (2010). Assessment Report on 2009 Diamond Drilling Report on the Blackwater Gold Project. B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 31650.

Looby, E.L. (2015). The Timing and Genesis of the Blackwater Gold-Silver Deposit, Central British Columbia: Constraints from Geology, Geochronology and Stable Isotopes. Master of Science. The University of British Columbia.

Minister of the Environment. 2019 (MOE, 2019). Decision Statement Issued under Section 54 of the Canadian Environmental Assessment Act, 2012. Issued to New Gold Inc. for the Blackwater Gold Project. April 15, 2019.

Minister of Environment and Climate Change Strategy and Minister of Energy, Mines and Petroleum Resources. (MoECCS, 2019). Environmental Assessment Certificate # M19-01. In the matter of the Environmental Assessment Act S.B.C. 2002, c. 43 (the Act) and in the matter of an Application for an Environmental Assessment Certificate (Application) by New Gold Inc. (Proponent) for the Blackwater Gold Project. June 21, 2019. Including Schedule A – Certified Project Description and Schedule B - Table Of Conditions for an Environmental Assessment Certificate. National Oceanic and Atmospheric Administration (NOAA), 1997. Fish Screening Criteria for Anadromous Salmonids. January 2007.

Natural Resources Conservation Service (NRCS, 2007) - United States Department of Agriculture, National Engineering Handbook Technical - Supplement 14N: Fish Passage and Screening Design Part 654 (210–VI–NEH, August 2007.) Issued August 2007.

Palmer Environmental Consulting Group (Palmer, 2021). Memorandum – Blackwater Fisheries Offsetting Plan: Instream Flow Needs. File No. 2006501. Dated April 8, 2021

Shamsher Prakash and Vijay K. Puri. Foundations for Vibrating Machines. Special Issue, April-May 2006, of the Journal of Structural Engineering, SERC, Madras. INDIA

Shewan, Alana, Akkerman, Anna and Martin, Violeta (Shewan, 2017), Deterministic Lake and Stream Temperature Modelling: Maintaining Optimal Water Temperature for Kokanee and Rainbow Trout Through Informed Design. CSCE. June 3, 2017.

United States Fish and Wildlife Service (USFWS), 2019. Fish Passage Engineering Design Criteria. Northeast Region.

5.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

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APPENDIX A

Design Criteria

(Pages A-1 to A-4)

APPENDIX A
DESIGN CRITERIA – FRESH WATER SUPPLY SYSTEM DESIGN REPORT

1.0 DESIGN CRITERIA

ABBREVIATIONS							
A	Assumed Data	I	Industry Standard	BWG	BW Gold Ltd.	TBD	To be Determined
C	Calculation	KP	Knight Piésold	T	Testwork Data	V	Vendor Data/ Info
D	Drawings / Archived Data	MMTS	Moose Mountain Technical Services	TBA	To be Advised	EA	Environmental Assessment
E	Engineering Calculation			TBC	To be Confirmed		

CRITERIA DESCRIPTION	UNITS	VALUE	BASIS	DETAILS & COMMENTS
1.0 SITE DATA				
Project Data				
Project Location	-	112 km SW of Vanderhoof	BWG	2020 NI 43-101 Report
Tatelkuz Lake Pump Station				
Site Coordinates	m	5 902 900 N 389 335 E	KP	UTM Zone 10U, NAD83
Site Elevation	masl	930.8	KP	
Booster Pump Station				
Site Coordinates	m	5,902,620 N 383,180 E	KP	UTM Zone 10U, NAD83
Site Elevation	masl	1,055.0	KP	
Design Life and Hazard Level				
Design Life	Years	50	A	
Flood Return Period	Years	1 in 200	KP	
Earthquake Return Period	Years	1 in 2,475	I	
Wind Return Period	Years	1.5 x 30 year values	I	
Climate Conditions				
Mean Annual Precipitation	mm	595	KP	KP 2020 Hydrometeorology Report VA101-457/33-8 Rev. 1
Long-term Actual Evaporation	mm	332 - 443	KP	
Design Minimum Temperature	°C	-20	BWG	TBC
Design Maximum Temperature	°C	32.8	KP	KP 2020 Climate Baseline Report VA101-457/33-4 Rev. 0
Duration of Freezing Period	days	200	A	
2.0 DESIGN FLOWS				
Overall				
Design Flowrate	m^3/s	0.67	KP	EA Application, Maximum IFN + 20%
IFN				

CRITERIA DESCRIPTION	UNITS	VALUE	BASIS	DETAILS & COMMENTS
Dec 1 – Apr 15	m^3/s	0.08	Palmer	Palmer April 2021, Blackwater Fisheries Offsetting Plan Draft: Instream flow needs for Davidson Creek.
Apr 16 – May 10	m^3/s	0.15		
May 11 – Jun 30	m^3/s	0.56		
Jul 1 – Jul 15	m^3/s	0.30		
Jul 16 – Aug 31	m^3/s	0.15		
Sep 1 – Nov 30	m^3/s	0.12		
Flushing Flows				
Operating (May 11 – May 15)	m^3/s	Not Applicable as IFN sufficient	Palmer	Palmer April 2021
Flushing Flow Design	m^3/s	1.12	A	EA
Flow Ramping Objectives				
Flows less or equal to 0.15 m^3/s	$m^3/s/h$	0.030	Palmer	Palmer April 2021
Flows are greater than 0.15 m^3/s	$m^3/s/h$	0.040		
3.0 INTAKE STRUCTURE AND PUMP STATION				
Tatelkuz Lake				
L.W.L. @ Station L1	masl	926.80	KP	2013 Letter VA13-01604 – Revised Baseline Tatelkuz Lake Levels.
H.W.L. @ Station L1	masl	928.83	KP	
Lake Fetch Length	m	8,500	A	Google Earth
Lake Width	m	1,000	A	Google Earth
Setup (Wind Tide) at Intake	m	0.0	A	WSL gage is across from the proposed Intake Location.
Wind Speed Correction Factor	-	0.3	E	Smith, 1995
Wave Design Wind	m/s	15	A	Blackwater Low (Maximum 2011-2020)
Wave Height	m	0.6	E	Smith, 1995
Max Ice Thickness	m	3.0	KP	Based on January Epilimnion Thickness VA16-00070
Freeboard	m	2.0	A	
Dry Shore Elevation	masl	930.8	A	Parking/Pumphouse El.
Intake				
Design Flow	m^3/s	0.67 x 2	KP	Two intake lines – 100% redundancy for maintenance activities.
Submergence of Intake Pipe to Satisfy Temp. Requirements	m	8.00	A	
Minimum Submergence	m	2 x Pipe Diameter	E	Not Governing
Maximum Velocity	m/s	High (governed by pipe material)	KP	
Minimum Velocity	m/s	0	KP	Velocity > 2 m/s on occasion may be required to avoid deposition of fine material in the lake intake line.

CRITERIA DESCRIPTION	UNITS	VALUE	BASIS	DETAILS & COMMENTS
Max Headloss through Intake and Conveyance to Pumping Pit	m	0.6	A	To be included in screen performance specifications to when provided to vendor during procurement.
Footing Elevation	masl	917.00	KP	Approximate
Lake Side Valve or Gate	-	None	KP	
Pumpstation Side Valve or Gate	-	Yes	KP	
Lake Access Boat Ramp	-	TBD	A	May be required for initial installation and/or maintenance.
Intake Screen				
Selected Screen Size Spacing	mm	5	A	Requires Confirmation. 1997 US guideline for salmonids. If fry are present the screen opening size is 2.38 mm. If it's for larger fish (fingerlings) the screen opening size is 6.38 mm. Rainbow trout/kokanee in Tatelkuz Lake are likely fingerlings or larger.
Maximum Velocity	m/s	0.15	I	Based on $V = 0.02\ L^{0.56}$ from Katapodis (1990.) The fingerling criteria from NOAA 1997 is 0.8 ft./s (0.25 m/s), while the fry criteris ain 0.33 ft./s (0.1 m/s).
Antifouling coating	Y/N	N	A	Assumes no invasive species present (zebra mussel and quagga mussel).
Screen Cleaning Method	-	NA	A	
Pumpstation Elevation Settings				
Minimum Pump Submergence	m	TBC	KP	To be confirmed based on exact pump selected during subsequent design phases. Vortex plates may be used to supplement depth of submergence requirements.
Wet Well Sump Elevation	masl	917.0	KP	
Pumps				
Configuration	-	Vertical Turbine Pumps	KP	
TDH	m	160		Maximum per-pump value. Operating value is dependent on flowrate.
Maximum Flow Rate	m^3/h	1,210 m^3/h	A	Maximum per-pump value.
Number of Pumps	#	3	A	

CRITERIA DESCRIPTION	UNITS	VALUE	BASIS	DETAILS & COMMENTS
Standby Capacity	%	50	A	One installed standby unit.
4.0 WATER CONVEYANCE PIPLINE				
General Pipeline Specifications				
Pipe Material	-	HDPE PE4710, or steel where required due to high pressures.	KP	
Pipeline Pressure Rating	-	HDPE – Min. DR21	KP	
Alignment	-	Follow existing road alignments where possible, remain within CPD boundary.	KP	Optimization of alignment may be further investigated.
Anchoring	-	Burial to mitigate resultant thrust forces	KP	
Air/Vacuum Combination Release Valves	-	Required at all high points and a maximum spacing of 600 m	KP	Variations may be acceptable depending on pipeline grading and flow velocities.
Drain Points	-	Required at all low points	KP	
Minimum Bend Radius	-	20 x OD	I	
Joints	-	Butt fusion preferred	A	
Water Flow, Velocity, and Temperature Specifications				
Pipeline Design Flow	m^3/s	0.67	KP	Referenced from Section 2.0 Design Flows
Max Design Velocity	m/s	3	KP	Best practice to balance CAPEX and OPEX/Sustaining Costs.
Minimum Water Operating Temperature	°C	4	KP	Expected temperature of liquid water in Tatelkuz Lake – Figure 2.5.
Burial Depth				
Depth of Frost Penetration	m	3.0	E	CFEM 4th ed eq. 13.3
Minimum Burial Depth	m	0.6 – 3.0	KP	Burial depth to be confirmed based on analysis of most suitable risk mitigation measures as described in report VA101-457/33-13.

2.0 REFERENCES

Knight Pièsold Ltd., 2020. *2020 Hydrology and Water Temperature Baseline Report*, Report No. VA101-457/33-3, Rev 1. May 17, 2021.

Knight Pièsold Ltd., 2013. *Revised Baseline Tatelkuz Lake Levels*, Ref. No. VA13-01604. July 22, 2013.

Knight Pièsold Ltd., 2021. *Water Management Structures Detailed Design Report*, Report No. VA101-457/33-14, Rev D. September 10, 2021.

Knight Pièsold Ltd., 2021. 2020 *Hydrometeorology Report*, Report No. VA101-457/33-8, Rev 1. May 17, 2021.

Knight Pièsold Ltd., 2021. *2020 Baseline Climate Report*, Report No. VA101-457/33-4, Rev 0. January 14, 2021.

APPENDIX B

Hydrometerological Conditions

(Pages B-1 to B-7)

APPENDIX B
HYDROMETEOROLOGICAL CONDITIONS – FRESH WATER SUPPLY SYSTEM DESIGN REPORT

1.0 GENERAL

Hydrological and meteorological data have been collected at the Blackwater Gold Project (the Project) site since 2011. These data have been used, along with regional data, to conduct a hydrometeorology study as presented in the 2020 Hydrometeorology Report (KP, 2021c). The study indicates that the available site and regional datasets are adequate to provide a reasonable basis for describing and quantifying the hydrological and meteorological characteristics of the project area for the purpose of water balance modelling, engineering design, and environmental assessment. The key findings of the study have been summarized in the following sections.

2.0 MONITORING LOCATIONS

Hydrometric data are currently being collected at 12 hydrology monitoring stations in the Project area to support hydrometric characterization of the mine site area and are identified as H1, H2, H2B, H4B, H5, H6, H7, H10, H11, H12, L1 and L1-Outlet. Meteorological data are being collected at two climate stations, which are identified as Blackwater High and Blackwater Low. Data collected at the Blackwater High station is considered to be most representative of the Project area due to its proximity to the majority of the proposed Project facilities. There are also three snow survey stations (SS1, SS2 and SS3), which have been used to collect snowpack data. The monitoring locations are shown on Figure 2.1.

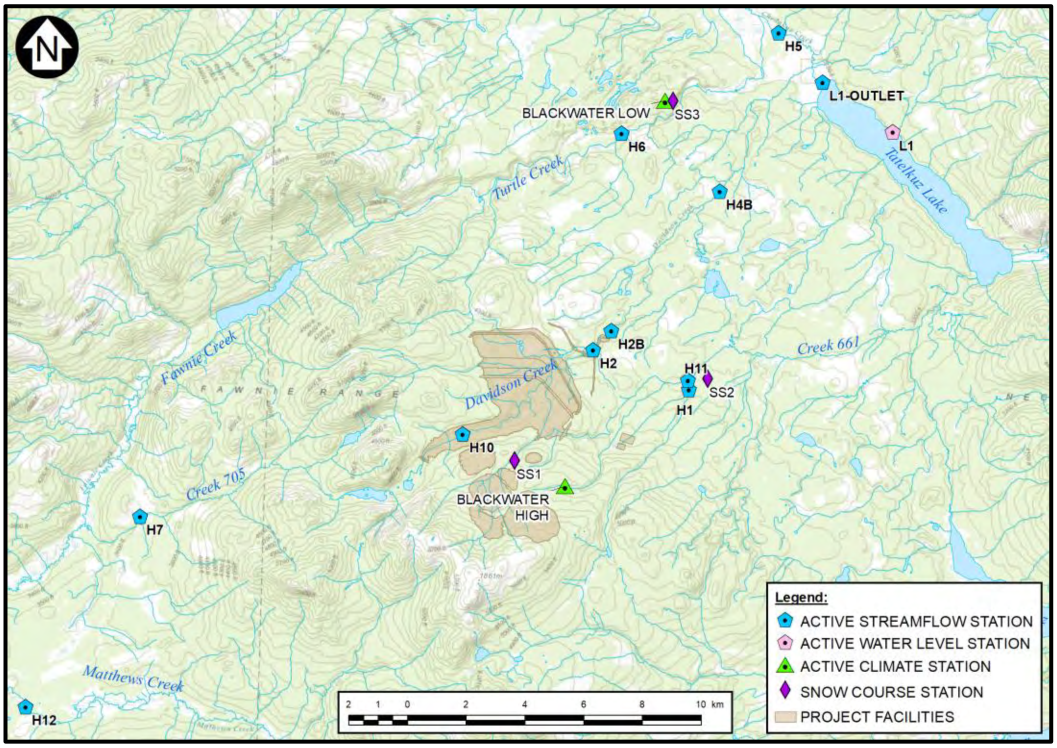


Figure 2.1 Project Monitoring Stations

3.0 SITE CONDITIONS SUMMARY

3.1 LONG-TERM MONTHLY AIR TEMPERATURE

The long-term mean annual temperature (MAT) at the Project is estimated to be 2.0 °C, with minimum and maximum mean monthly temperatures estimated to be -7.3 °C in December and 11.0 °C in July, respectively.

3.2 LONG-TERM MONTHLY AND ANNUAL PRECIPITATION

The long-term mean annual precipitation (MAP) for the Project area is estimated to be 595 mm, at an elevation of approximately 1,470 m. This MAP is based on a long-term precipitation synthetic record that contains a minor upward correction in the winter months (Nov – March) to account for under catch at the Project climate station, as determined by calibration of the Baseline Watershed Model (KP, 2021d).

3.3 DISTRIBUTION OF RAINFALL AND SNOWFALL

The mean monthly rainfall and snowfall values for the Project are presented in Table 3.1. Approximately 60% of precipitation is estimated to fall as rain, with the majority occurring between April and October.

Table 3.1 Estimated Distribution of Rainfall and Snowfall for Blackwater High (1980-2020)

Month	Mean Rainfall (mm)	Mean Snowfall (mm)	Ratio of Rainfall (%)	Ratio of Snowfall (%)
January	3	48	6%	94%
February	3	32	8%	92%
March	7	23	24%	76%
April	24	9	72%	28%
May	43	1	98%	2%
June	68	0	100%	0%
July	63	0	100%	0%
August	52	0	100%	0%
September	50	2	97%	3%
October	47	15	76%	24%
November	14	42	24%	76%
December	2	46	5%	95%
Annual	**376**	**217**	**59%**	**41%**

Note(s):

1. The mean monthly values describe the average total precipitation for each complete month on record.
2. The annual values describe the average annual precipitation for each full year on record. Years with one or more months with fewer than 20 days of record are not used when estimating annual averages.
3. The total precipitation of 593 mm is less than the map of 595 mm because of rounding in individual months.

3.4 EVAPORATION AND SUBLIMATION

Long-term mean annual potential evapotranspiration (PET) is estimated to be 554 mm for the Project. Long-term mean annual actual evapotranspiration (AET) is estimated to be in the range of 330 mm to 440 mm for Project climate station, assuming a typical 60% to 80% AET/PET ratio for the coniferous vegetation that is native to the Project area.

3.5 SOLAR RADIATION

The maximum solar radiation measured at the low and high elevation climate stations was 1,033 W/m^2 and 997 W/m^2, respectively, and both occur in July.

3.6 DAVIDSON CREEK LONG-TERM DISCHARGE AND UNIT RUNOFF

The proposed Tailings Storage Facility (TSF) is located within the Davidson Creek watershed. There are four hydrology stations located on Davidson Creek; H10, H2, H2B, and H4B, which have a corresponding drainage areas of 7.1, 44.0, 46.1, and 61.4 km^2 respectively.

The long-term mean annul unit discharge (MAUD) at the Davidson Creek stations ranges from 11.2 L/s/km^2 (353 mm) at H10 to 6.8 L/s/km^2 (215 mm) at H4B and is dependent on the effects due to differences in catchment size, elevation, surface cover, surficial geology, and the locations of the stations within Davidson Creek. The monthly unit discharge distribution for Davidson Creek is shown on Figure 3.1. The highest mean monthly unit discharge occurs in May, corresponding with Freshet, while the lowest occurs in February.

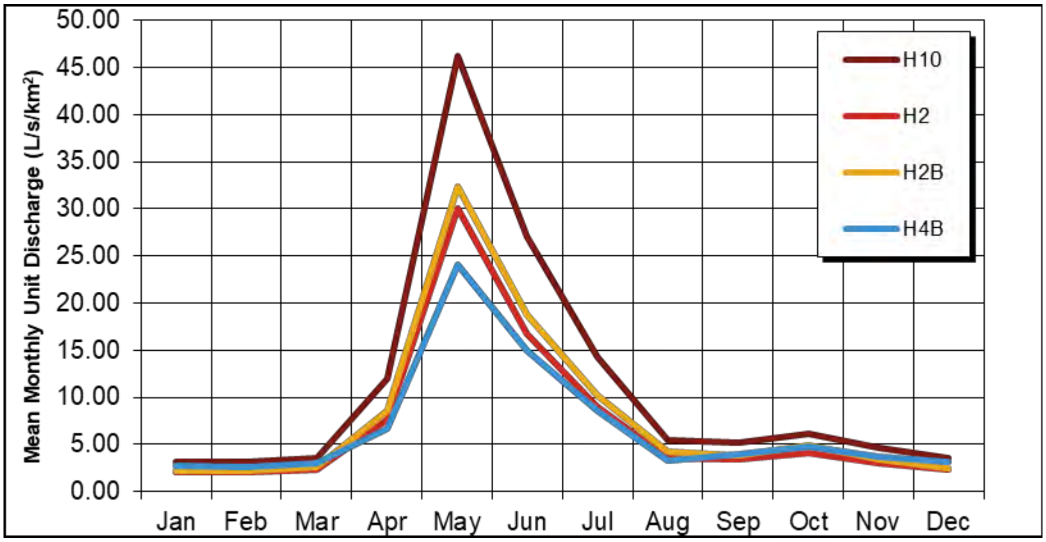


Figure 3.1 Long-Term Synthetic Time Series Mean Monthly Unit Discharge at Davidson Creek

3.7 RETURN PERIOD EXTREME PRECIPITATION

3.7.1 24 HOUR EXTREME PRECIPITATION ESTIMATES

Estimated 24-hour extreme rainfall values were prepared for various return periods and for the probable maximum precipitation (PMP) to support the design of the Project and are summarized in Table 3.2.

Table 3.2 Extreme Precipitation Return Period Values

Return Period (years)	24-Hour Extreme Rainfall (mm)
2	32
5	47
10	56
15	62
20	65
25	68
50	77
100	86
200	95
500	106
1,000	115
PMP	288

3.7.2 RETURN PERIOD SNOWPACK

Extreme snow water equivalent (SWE) values were estimated for the Project site by using a frequency factor approach and are presented in Table 3.3. The 100-year return period snowpack SWE is estimated to be 406 mm, and the probable maximum snow accumulation (PMSA) is estimated to be 665 mm.

Table 3.3 Return Period Snowpack Estimates for Blackwater High

Mean Annual Maximum SWE (mm) =	178.0
Standard Deviation (mm) =	62.4
Sample Size =	30
Return Period (years)	**Peak Snowpack SWE (mm)**
2	166
5	232
10	274
15	298
20	314
25	327
50	367
100	406
200	444
500	496
1,000	535
10,000 (PMSA)	665

Note(s):

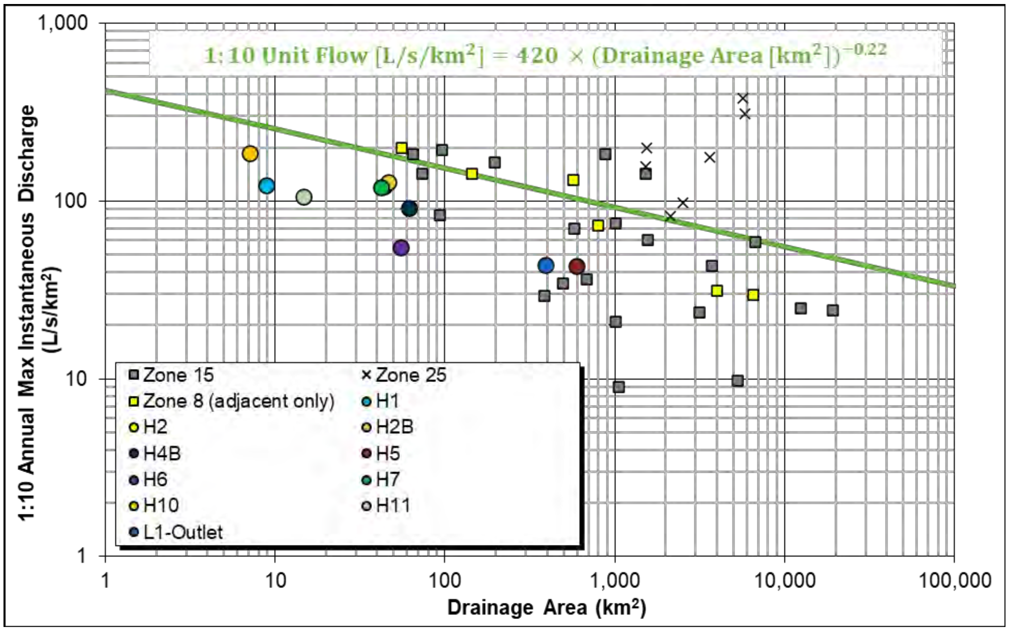
1. PMSA is estimated to be the 1 in 10,000 year return period snowpack.

3.8 RETURN PERIOD STREAMFLOW

Peak flows are relevant to pipeline water crossings and areas where the pipeline will be adjacent to water bodies. Peak flows for the Project area occur almost exclusively during the spring freshet period. These flows result from snowmelt events, or rainfall combined with snowmelt events. The envelope curve shown on Figure 3.2 is based on instantaneous regional peak flows scaling and is recommended to be used as the basis for generating Project design flows for undisturbed areas.

The curve should be used to estimate the 1 in 10-year design peak flows, while higher return period peak discharge values should be estimated using the conversion ratios provided in Table 3.4. For structures with a reasonably long design life (e.g. 20 years or more), a 15% uplift should be applied in determining peak design flow values as suggested by EGBC guideline on mitigating effects of possible future change in water input from precipitation (EGBC, 2018).

The 1-in-10 year peak flows are a product of the peak unit flows calculated above and the associated drainage area. The resultant values are used to calculate peak flows for alternate return periods using the conversion ratios provided in Table 3.4 extracted from the *British Columbia Inventory of Streamflow Reports* (Ahmed, 2015 and 2017) for several regional sites whose 1-in-10 year values lie close to those estimated for the Project.



Note(s):

1. Regional relations from Ahmed (2017) for Zone 15 and 25 and from Ahmed (2015) for Zone 8 (only stations adjacent to project area are shown).

Figure 3.2 Blackwater Project Peak Instantaneous Flows Compared to BC Streamflow Inventory Reports Peak Instantaneous Flows

Table 3.4 1 in 10 Year Unit Flow Conversion Ratios

Return Period (Years)	1:10 Conversion Ratio
2	0.58
5	0.82
20	1.19
50	1.46
100	1.69
200	1.93
500 (extrapolated)	2.21
1000 (extrapolated)	2.44

Note(s):

1. The conversion ratios are applied to 1 in 10-year unit flows determined by the envelope curve presented on figure 3.2.
2. 500-year and 1,000-year ratios were linearly extrapolated using a log-scale based on the ratios for the 20-, 50-, 100-, and 200-year return periods.

3.9 WIND SPEED AND DIRECTION

Recorded monthly mean annual windspeed from the Climate Report data (KP, 2021b) indicates Annual Mean Hourly Wind Speeds of:

- Blackwater Low: 2.2 m/s (7.9 km/hr)
- Backwater High: 3.0 m/s (10.8 km/hr)

Monthly recorded averages are summarized in Table 3.5.

Table 3.5 Recorded Monthly and Annual Mean Hourly Wind Speeds (m/s)

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
Blackwater Low	1.9	2.1	2.3	2.5	2.3	2.4	2.2	2.2	2.1	2.0	2.0	1.9	2.2
Blackwater High	3.7	3.3	3.2	3.2	2.4	2.6	2.5	2.6	2.8	3.2	3.5	3.6	3.0

Note(s):

1. Source: KP, 2021a – 2020 Baseline Climate Report.

4.0 REFERENCES

Ahmed, A., 2015. *Inventory of Streamflow in the Omineca and Northeast Regions*. Knowledge Management Branch, Ministry of Environment and Climate Change Strategy. Available at: http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=48460

Ahmed, A., 2017. *Inventory of Streamflow in the Cariboo Region*. Knowledge Management Branch, Ministry of Environment and Climate Change Strategy. Available at: http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=52707

Engineers and Geoscientists British Columbia (EGBC), 2018, *Professional Practice Guidelines: Legislated Flood Assessments in a Changing Climate in BC Version 2.1*

Knight Piésold Ltd. (KP), 2021a. Blackwater Gold Project – 2020 Hydrology and Water Temperature Baseline Report (KP Reference No. VA101-457/33-3 Rev 1), May 17, 2021.

Knight Piésold Ltd. (KP), 2021b. Blackwater Gold Project – 2020 Baseline Climate Report (KP Reference No. VA101-457/33-4 Rev 0), dated January 14, 2021.

Knight Piésold Ltd. (KP), 2021c. Blackwater Gold Project – 2020 Hydrometeorology Report, KP Ref. No. VA101-457/33-8 Rev 1. May 17, 2021.

Knight Piésold Ltd. (KP), 2021d. Letter to: Sachi DeSouza, Artemis Gold Inc. *Re: Blackwater Gold Project – 2020 Baseline Watershed Model Report*. September 7, 2021. Vancouver, BC. Ref. No. VA21-00074, (VA101-457/33).

APPENDIX C

Geotechnical Information

(Pages C-1 to C-5)

APPENDIX C
GEOTECHNICAL CONDITIONS – FRESH WATER SUPPLY SYSTEM DESIGN REPORT

1.0 GENERAL

The Fresh Water Supply System (FWSS) was designed to provide fresh water from Tatelkuz Lake to the Fresh Water Reservoir (FWR) at the Blackwater mine site to provide additional make-up water to the FWR. The FWSS will comprise an intake structure and pump station at Tatelkuz Lake, water supply pipeline and outlet at the FWR, booster pump station(s), and connections to the FWR outlet works.

The geotechnical conditions at the FWSS features are described in this appendix. A plan map showing FWSS features is shown on Figure 1.1.

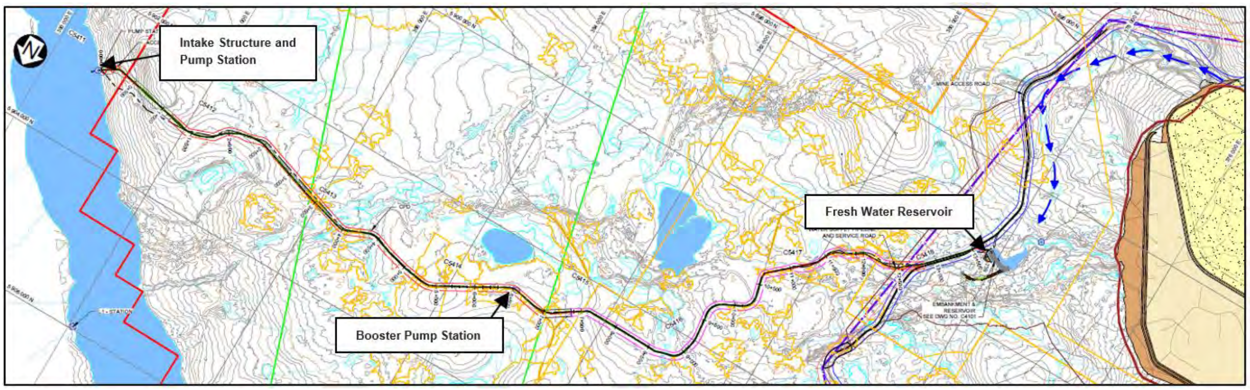


Figure 1.1 Fresh Water Supply System Plan Map

2.0 SUMMARY OF DATA SOURCES

2.1 SITE VISIT AND INVESTIGATION PROGRAMS

Geotechnical and hydrogeological investigation programs were conducted across the Project area between 2012 and 2021 which mainly focused on the proposed tailings storage facility and water management structures. The site investigation programs extent was limited to the FWR with a several test pits and drillholes located further downstream (northeast) of the FWR, approximately within 1 km. The foundation conditions at the FWR are not described in this appendix and can be found in the Dam Site Characterization Report (KP, 2021).

KP also completed a site visit in July 2013 at the Tatelkuz Lake Intake and Booster Stations to inspect and record the topography, near surface geology, hydrology, and vegetation of the proposed footprint for the major components. Site photos were collected, and several hand-dug test pits were excavated to investigate the near surface stratigraphy. Details of the site inspection is summarized below.

Tatelkuz Lake Intake Structure

The topography at the proposed Intake location was noted to be gently sloping shoreline with increasing elevation to the southwest at approximately 5% gradient. No bedrock outcrops were identified within a 200 m radius of the site. One hand-dug test pit was excavated and resulted in the following stratigraphy:

- 0 - 0.3 m: ***Peat/topsoil***, some silt and sand, trace gravel, subangular to subrounded, fine, non plastic, dark brown, spongy, fibrous, moist to wet
- 0.3 - 0.5 m: ***Sand and Gravel***, trace becoming some silt, subangular to subrounded, fine to coarse, well graded, non plastic, brown, loose to compact, massive, moist to dry

Photos of the site and the test pit is included in Figure 2.1 below.

Figure 2.1 Photos at the Tatelkuz Intake Structure (July 2013 Site Visit)

Booster Station

The topography at the proposed Booster Station was observed to be very gradual sloping at approximately 2% gradient to the south-southwest. One hand-dug test pit was excavated and resulted in the following stratigraphy:

- 0 - 0.9 m: ***Sand***, some silt, trace gravel and cobbles, subangular to subrounded, fine to coarse, non-plastic, well graded, light brown to yellow, loose, massive, dry

No surface water was identified in the area. Vegetation in the area comprises a pine nursery with an average tree trunk diameter of 100 mm. The trees are moderately spaced in a 2-3 m grid with fallen dead wood and some standing stumps in the area.

Photos of the site and the test pit is included in Figure 2.2 below.

Figure 2.2 Photos at Booster Station Site (July 2013 Site Visit)

2.2 DESKTOP STUDY AND REVIEW

A desktop study was carried out to review available records on surficial geology, geomorphology, bedrock geology, and structural geology at the FWSS. The following documents were reviewed as part of the desktop study:

- Recognizing order in chaotic sequences of Quaternary sediments in the Canadian Cordillera (Clague and James, 2002)
- Pleistocene Glaciation of British Columbia (Clague and Ward, 2011)
- Surficial Geology, Nechako River, BC - Map 2067A (Plouffe, A., Leveson, V.M, and Mate, D.J., 2004)
- Bedrock Geology, Trek Project Area, Northern Interior Plateau, Central BC (GBC, 2017)
- Deglacial Geology of the Blackwater Mine Study Area (Clague, 2018)
- Revised Landform and Terrain Maps (KP, 2019)

3.0 FOUNDATION CONDITIONS

The surficial geology maps indicate that the surficial material along the FWSS is extensively ice contact glaciofluvial deposits (mainly sand and gravel) and glacial till deposits (undifferentiated) which are typically greater than 3 m thick. Massive lodgement glacial tills were deposited at the base of the ice sheet. Ablation tills were also deposited locally as the ice sheet retreated. Sediments deposited during de-glaciation of the area include glaciofluvial and glaciolacustrine sediments. Glaciofluvial sands and gravels are common in valley bottoms and along the valley flanks, occurring as kames, eskers, and terraces. A large amount of glacial meltwater was channeled along northeast oriented sub-glacial meltwater channels producing esker deposits that are broadly aligned with the modern creek valleys. There are also localized organic deposits (peat) located within abandoned meltwater channels that are typically 2 to 3 m thick.

The deglaciation model map (Clague, 2018) and the terrain and landform maps (KP, 2019) indicate that the surficial material within 1 km downstream of the FWR is predominantly alluvium material and glaciofluvial sands and gravels along the modern Davidson Creek drainage and glacial till (ablation and lodgement) south of Davidson Creek.

Bedrock exposure in the FWSS area is rare and restricted to higher elevations. Bedrock is deepest along the Davidson Creek valley bottom where it is encountered at up to 110 meters depth.

Information from 14 machine dug test pits, 2 hand-dug test pits, and 5 geotechnical drillholes completed within 1 km downstream of FWR were used to partly characterize the geotechnical and hydrogeological conditions of the FWSS section. Additional ground truthing and geotechnical and hydrogeological investigations are recommended prior to final design to verify ground conditions at the intake structure, booster pumpstation, and along the water supply pipeline depending on final grading plans.

The associated drillhole and test pit sites are summarized in Table 3.1.

Table 3.1 FWSS Drillhole and Test Pit Summary

FWSS Feature Name	Drillhole Sites	Test Pit Sites
North of Davidson Creek (Within 1 km Downstream of FWR)	TW13-03, GT13-04 to GT13-06, MW12-09S/D	TP12-159, TP12-160, TP13-178 to TP13-183
North of Davidson Creek (Within 1 km Downstream of FWR)	None	TP13-192 to TP13-197
Tatelkuz Intake Structure	None	TP-1 (hand-dug in 2013)
Pipeline Corridor	None	None
Booster Station	None	TP-2 (hand-dug in 2013)

The interpreted stratigraphy and foundation conditions at the vicinity of the FWSS features based on available information are described below:

- **Topsoil:** Thickness ranging from 0 to 0.3 m with an average of 0.1 m based on the test pits.
- **Glacial Deposits:** Glacial sequences identified range in thickness from 14 to 51 m with an average of 37 m based on the geotechnical drillholes. Lodgement and undifferentiated till occur below at depth with interval thickness ranging 2 to 44 m. The till is interbedded with glaciofluvial deposits (mainly kame) with thickness ranging from 5 too 9 m and glaciolacustrine materials with interval thickness ranging from 3 to 11 m.
- **Reworked Regolith:** This unit was intercepted at one drillhole GT13-05 with thickness of 5 m.
- **Completely Weathered Bedrock:** This unit was intercepted only in drillholes GT13-04 to GT13-06 with a thickness ranging from 22 to 36 m.
- **Highly Weathered Bedrock:** Intercepted in drillholes GT13-04 to GT13-06 at an elevation ranging from 1,095 to 1,063 masl.
- **Intact Bedrock:** Intercepted in drillholes GT13-04 to GT13-06 at an elevation ranging from 1,088 to 1,050 masl. The bedrock lithology at the FWR is predominantly Andesite which can be generally described as a strong rock with ‘FAIR’ Rock Mass Quality Rating. (Bieniawski, 1989).
- **Groundwater Conditions:** Measured groundwater elevations within 1 km downstream of the FWR range from 1,144 to 1,130 masl.

4.0 REFERENCES

Clague J.J., James, T.S. (2002). History and Isostatic Effects of the Last Ice Sheet in Southern British Columbia. Quaternary Science Review, Rev. 21, 71-87.

Clague, D. J. (2018). Deglacial Geology of the Blackwater Mine Study Area.

Clague, J.J., Ward, B. (2011). Pleistocene Glaciation of British Columbia. Developments in Quaternary Science, Vol. 15. 563-573.

Geoscience BC. (2017). Bedrock Geology, TREK Project Area, Northern Interior Plateau, Central BC. (Released – August 17, 2017; supersedes GBC Report 2015-10). Map 2017-06-01/MDRU Map 12-2017.

Knight Piesold Ltd. (KP, 2019). Revised Landform and Terrain Maps, dated July 9, 2019. Ref. No. VA101-457/26 Letter VA19-01017. . Vancouver.

Knight Piésold Ltd. (KP, 2021). Blackwater Gold Project – Dam Site Characterization Report, KP Ref. No. VA101-457/33-10 Rev. C, dated September 10, 2021.

Plouffe, A., Levson, V.M., and Mate, D.J. (2004). Surficial geology, Nechako River, British Columbia. Geological Survey of Canada, Map 2067A, 1:250,000 scale.

APPENDIX D

Select Drawings

G0001 Rev 0	C5411 Rev 0	C5420 Rev 0
G0005 Rev 0	C5412 Rev 0	C5421 Rev 0
G0006 Rev 0	C5413 Rev 0	C5422 Rev 0
G0040 Rev 0	C5414 Rev 0	M5005 Rev 0
C5050 Rev 0	C5415 Rev 0	M5050 Rev 0
C5300 Rev 0	C5416 Rev 0	M5060 Rev 0
C5310 Rev 0	C5417 Rev 0	M5070 Rev 0
C5410 Rev 0	C5418 Rev 0	

Knight Piésold CONSULTING

TABLE D.1

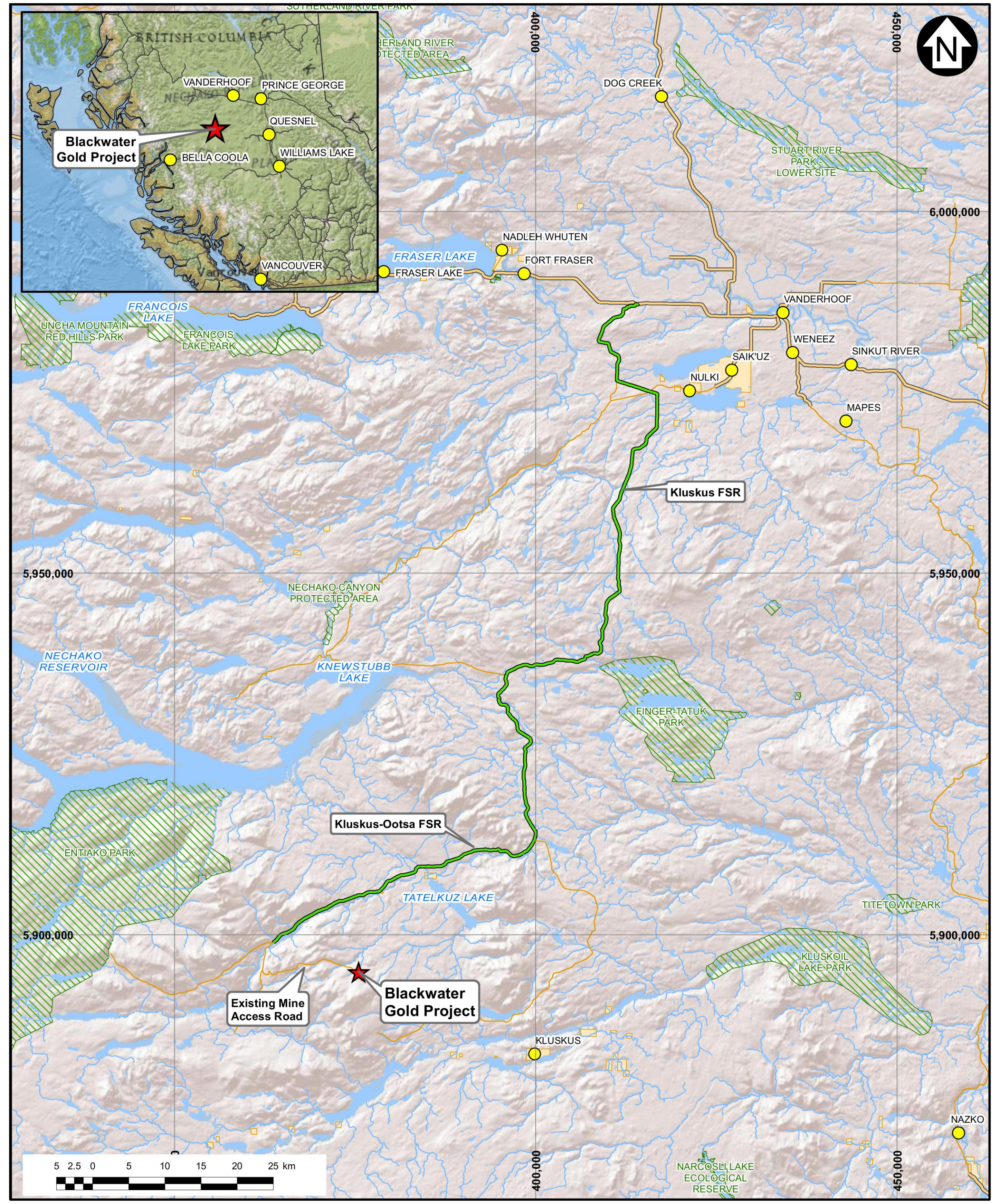
BW GOLD LTD.
BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM DESIGN REPORT
DRAWING LIST

KP DWG No.	Rev.	Revision Date	Package	Drawing Title
G0001	0	29OCT'21	FWSS	Title Sheet
G0005	0	29OCT'21	FWSS	Legend, Symbols, and Abbreviations
G0006	0	29OCT'21	FWSS	Civil General Notes
G0040	0	29OCT'21	FWSS	Construction Material Gradations
C5050	0	04NOV'21	FWSS	Fresh Water Supply System - Flow Diagram
C5300	0	04NOV'21	FWSS	Fresh Water Supply System - Intake Structure - Overview
C5310	0	04NOV'21	FWSS	Fresh Water Supply System - Intake Structure - Plan and Section
C5410	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile
C5411	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 1 of 8)
C5412	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 2 of 8)
C5413	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 3 of 8)
C5414	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 4 of 8)
C5415	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 5 of 8)
C5416	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 6 of 8)
C5417	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 7 of 8)
C5418	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance - Plan and Profile (Sheet 8 of 8)
C5420	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance Pipeline - Alternative Sections for Frost Protection - 1 of 3
C5421	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance Pipeline - Alternative Sections for Frost Protection - 2 of 3
C5422	0	04NOV'21	FWSS	Fresh Water Supply System - Water Conveyance Pipeline - Alternative Sections for Frost Protection - 3 of 3
M5005	0	04NOV'21	FWSS	Fresh Water Supply System - Piping and Instrumentation Diagram
M5050	0	04NOV'21	FWSS	Fresh Water Supply System - Pipeline - Plan and Profile
M5060	0	04NOV'21	FWSS	Fresh Water Supply System - Water Pump Station - Plan and Section
M5070	0	04NOV'21	FWSS	Fresh Water Supply System - Booster Station - Plan

BW GOLD LTD.

BLACKWATER GOLD PROJECT
PERMITTING LEVEL DESIGN
DRAWING PACKAGE



LEGEND:

- PROJECT LOCATION
- CITY/TOWN
- KLUSKUS FSR
- PAVED ROAD
- GRAVEL ROAD
- RIVER/CREEK
- LAKE
- FIRST NATION RESERVE

NOTES:

1. COORDINATE GRID IS NAD 1983 UTM ZONE 10N
2. BASE MAP: ESRI ARCGIS ONLINE SHADED RELIEF MAPPING.

DETAILED DESIGN

NOT FOR CONSTRUCTION

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

TITLE SHEET

PROFESSIONAL PROVINCE OF C. B. NIAMIR # 41576 BRITISH COLUMBIA ENGINEER

2021-11-15

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	G0001	0

DRG. NO.	DESCRIPTION
-	-

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29OCT'21	ISSUED FOR PERMITTING	CBN	SKC	DDF	DDF

REVISIONS

SAVED: M:\1\01\00457\33\A\Acad\DWGS\G0001\G0001, 10/29/2021 11:03:08 AM , ANASIRI PRINTED: 10/29/2021 11:05:18 AM, G0001, ANASIRI ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): IMAGE FILE(S):

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

OR,

WHEN SECTION IS OBVIOUS AND/OR SPACE IS LIMITED

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

DETAIL REFERENCE

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.

50000 — DIMENSIONS IN MILLIMETRES

℄ — CENTERLINE ON SECTION

N — NORTH SYMBOL

SYMBOLS

- FOUNDATION TREATMENT
- OVERBURDEN
- APPROX. (OR ASSUMED) ROCK SURFACE
- LIMIT OF GEOSYNTHETIC FACING
- FILL SLOPE SYMBOL
- CUT SLOPE SYMBOL
- SLOPE - CONCRETE FACE
- OPENING OR BLOCKOUT
- FLOW DIRECTION
- EL. XXX — ELEVATION ON PLAN
- EL. XXX — ELEVATION ON SECTION
- W.L. XXX — WATER LEVEL
- INFERRED GROUNDWATER LEVEL.
- SLOPE 1 — SLOPE ON SECTION
- #H:1V — SLOPE (ARROW POINTS DOWN SLOPE)
- #% — GRADE (ARROW POINTS DOWN SLOPE)
- PIPE END
- TUBULAR SECTION ON END
- MATCH LINE — MATCHLINE
- INDICATE AN AREA ON PLAN VIEW (CREST EL. 273.5)
- SCP — SEDIMENT CONTROL POND
- SB — SEDIMENT BASIN
- ED — ENERGY DISSIPATER
- DS — DIVERSION STRUCTURE
- SR — SLOPE ROUGHENING
- TEST PIT
- DRILLHOLE
- GEOTECHNICAL ROTARY DRILLHOLE WITH PIEZOMETER
- MONITORING WELL
- WP01 — WORK POINT
- PUMPSTATION
- VIBRATING WIRE PIEZOMETER
- SURFACE MOVEMENT MONUMENT
- READOUT PANEL BOX IN PLAN
- SLOPE INCLINOMETER
- RECLAIM SYSTEM
- READOUT PANEL BOX IN SECTION
- TOTAL STATION
- SURVEY PRISM
- SUMP

ABBREVIATIONS

UNO	UNLESS NOTED OTHERWISE
C/C	CENTER TO CENTER
EL.	ELEVATION IN METRES
EQ.	EQUAL
SP	SPACING
NTS	NOT TO SCALE
DN	DOWN
OPN'G	OPENING
REQ'D	REQUIRED
OD	OUTSIDE DIAMETER
ID	INSIDE DIAMETER
DIA. OR Ø	DIAMETER
R	RADIUS
m	METRE
mm	MILLIMETRE
CTR	CENTER
EA.	EACH
EMBK.	EMBANKMENT
CJ	CONSTRUCTION JOINT
CONTR. JT.	CONTRACTION JOINT
EXP. JT.	EXPANSION JOINT
APPROX.	APPROXIMATE
TYP.	TYPICAL
W/S	WATERSTOP
W/	WITH
BTW	BETWEEN
CONC.	CONCRETE
COL.	COLUMN
BM	BEAM
SOL	SETTING OUT LINE
NA	NOT APPLICABLE
CSP	CORRUGATED STEEL PIPE
SR	SHORT RADIUS
XXS	STEEL PIPE WEIGHT
TSF	TAILING STORAGE FACILITY
GW	GROUND WATER
STA.	STATION
EOH	END OF HOLE
DWG	DRAWING
E	EAST
N	NORTH
masl	METERS ABOVE SEA LEVEL
WP	WORK POINT
BLDG	BUILDING
CHK	CHECKED
CL	CENTERLINE
EG	EXISTING GROUND
FG	FINISHED GROUND
IE	INVERT ELEVATION
HORIZ, H	HORIZONTAL
VERT, V	VERTICAL
NO	NUMBER
NTS	NOT TO SCALE
REV	REVISION
TOC	TOP OF CONCRETE
TYP	TYPICAL

LEGEND:

- DIVERSION AREA
- MINE WATER
- FRESH WATER
- UPLAND BEACH
- BOG / WETLAND AREA
- EMERGENT VEGETATION WETLAND
- UPLAND SLOPE
- TAILINGS BEACH
- EMBANKMENT FILL
- NAG WASTE ROCK / OVERBURDEN
- PAG WASTE ROCK
- ORE STOCKPILE
- TOPSOIL
- OVERBURDEN
- BORROW AREA (ZONES S AND C)
- ESKER BORROW AREA (ZONES C, F, T AND E)
- ROCK SLOPES
- FILL AREAS
- CUT AREAS
- ORGANICS / TOPSOIL
- SANDY/GRAVELLY SILT OR SILT
- SILT AND CLAY
- SILT AND SAND
- REGOLITH
- INTACT BEDROCK
- 1ST STAGE CONCRETE
- 2ND STAGE CONCRETE
- TAILINGS
- PAG WASTE ROCK
- WEARING COURSE
- HDPE LINER ON PLAN
- CONCRETE
- ZONE C (SHELL ZONE)
- DRAIN ROCK / ZONE D
- ENGINEERED FILL / ZONE E
- SAND / ZONE F (FILTER ZONE)
- GLACIAL TILL / ZONE S (SEAL ZONE)
- GRAVEL / ZONE T (TRANSITION ZONE)
- RIPRAP
- RIPRAP BEDDING (ZONE RB)

LINE TYPES

- SILT FENCE
- SPILLWAY
- DIVERSION CHANNEL
- COLLECTION CHANNEL
- MINIMUM EXCAVATION LINE
- EXISTING GROUND
- FINISHED GROUND
- GEOTEXTILE
- HDPE LINER
- GEONET
- CONSTRUCTION ROAD
- ACCESS ROAD
- EXISTING ACCESS TRAILS
- CATCHMENT BOUNDARIES
- SEEPAGE / WATER SUPPLY PIPELINES
- WATER DIVERSION PIPELINE
- WATER RECLAIM PIPELINE
- TRANSMISSION LINE
- PROPERTY BOUNDARY
- TAILINGS PIPELINE
- TAILINGS DEPOSIT
- INFERRED LPS DEPTH
- CUT-OFF TRENCH BOTTOM
- POTENTIAL LPS DEEP TARGET
- PIEZOMETER LEAD
- FOUNDATION DRAIN
- SEEPAGE COLLECTION DRAIN
- EMBANKMENT OUTLET DRAIN
- CHIMNEY DRAIN

DETAILED DESIGN

NOT FOR CONSTRUCTION

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA ENGINEER C. B. NIAMIR # 41576
2021-11-15

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

LEGEND, SYMBOLS, AND ABBREVIATIONS

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	G0005	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29OCT'21	ISSUED FOR PERMITTING	CBN	ABN	DDF	DDF

SAVED: M:\1\01\00457\33\A\Acad\DWGS\G0005\G0005, 10/29/2021 1:27:17 PM , ANASIRI PRINTED: 10/29/2021 1:38:33 PM, G0005, ANASIRI ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): IMAGE FILE(S):

GENERAL:

1. COORDINATE GRID IS UTM NAD 83 ZONE 10U.
2. GROUND TOPOGRAPHY BASED ON INFORMATION PROVIDED BY EAGLE MAPPING ON AUGUST 8 AND 9, 2011.
3. ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES, UNLESS NOTED OTHERWISE.
4. DRAWINGS WILL BE READ IN CONJUNCTION WITH THE PROJECT TECHNICAL SPECIFICATIONS. THE DRAWINGS WILL TAKE PRECEDENCE IN THE CASE OF A DISCREPANCY.
5. CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER UPON ANY DISCOVERY OF DISCREPANCIES BETWEEN THE ISSUED DRAWING SET AND/OR CONSTRUCTED WORKS.
6. CONTRACTOR SHALL BE RESPONSIBLE TO MAINTAIN SURVEY CONTROL ON ALL ASPECTS OF THE WORKS. THE CONTRACTOR SHALL VERIFY ALL LINES, GRADES, LOCATIONS AND TIE-IN POINTS PRIOR TO COMMENCEMENT OF THE WORKS AND SHALL NOTIFY THE ENGINEER IMMEDIATELY OF ANY DISCREPANCY.
7. PIPELINE ALIGNMENTS TO BE CONFIRMED BY THE CONTRACTOR IN THE FIELD TO ENSURE PIPELINE INSTALLATION AND OPERATION DO NOT INTERFERE WITH OTHER INFRASTRUCTURE/OPERATING ACTIVITIES.
8. CONTRACTOR TO CONFIRM THE LOCATION OF ALL HIGH AND LOW POINTS ALONG THE PIPELINE ALIGNMENT, FOR THE INSTALLATION OF COMBINATION AIR/VACUUM RELEASE VALVES AND DRAIN POINTS, RESPECTIVELY.
9. PIPE FOUNDATION SHALL BE INSPECTED BY THE ENGINEER PRIOR TO LAYING OF THE PIPE. ANY SOFT OR HARD SPOTS, SUCH AS A ROCK OUTCROPS NOT EXPECTED, SHALL BE SURVEYED AND REPORTED TO THE ENGINEER FOR CHECKING AND INSTRUCTIONS.
10. CONTRACTOR TO CONFIRM THE LOCATION OF ALL ROAD AND PIPE CROSSINGS.
11. ALL MATERIALS USED WILL BE THE BEST SUITED FOR THE APPLICATION BASED ON SUPPLIER SPECIFICATIONS.

DESIGN CHANGE MANAGEMENT:

1. MATERIALS OR PRODUCTS USED WILL BE AS SPECIFIED ON THE DESIGN DRAWINGS OR EQUIVALENT AS APPROVED BY THE ENGINEER.

INSTRUMENTATION:

1. ALL WATER LEVEL, PORE PRESSURE, SURFACE AND SUBSURFACE DEFORMATION INSTRUMENTATION ARE TO BE INSTALLED WITH WIRELESS CAPABILITIES TO AUTOMATICALLY COLLECT AND TRANSMIT DATA.
2. FLOW MONITORING INSTRUMENTATION SHALL BE SURVEILLED AUTOMATICALLY OR MANUALLY DEPENDING ON THE LOCATION AND MONITORING SETUP, AS DETERMINED BY THE ENGINEER. FLOW MONITORING INSTRUMENTATION SHALL BE COMPRISED OF THE FOLLOWING:
- V-NOTCH WEIRS AT THE END OF PERMANENT INLET AND OUTLET PIPES OR
- FLOW METERS ON PERMANENT PUMPS.
3. DATA LOGGERS WITH CELLULAR TRANSMITTING CAPABILITIES ARE TO BE INSTALLED AT THE TOE OF MAIN DAM C AT EACH INSTRUMENTATION SECTION.
4. DAM CREST SURFACE DISPLACEMENT TO BE AUTOMATICALLY MONITORED BY TOTAL STATION AND SURVEY PRISMS.
5. SURVEY PRISMS INSTALLED AT 100 METER INTERVALS ON MAIN DAM C CREST.
6. AUTOMATIC TOTAL STATIONS TO SCAN SURVEY PRISMS AT A MINIMUM ONCE DAILY. AUTOMATIC MONITORING TO COMMENCE AT SUBSTANTIAL COMPLETION.

FOUNDATIONS:

1. THE FOUNDATION LEVELS GIVEN ON THE DRAWINGS ARE ANTICIPATED LEVELS. THE FINAL FOUNDATION LEVELS WILL BE DETERMINED BY THE ENGINEER BASED ON ACTUAL SITE CONDITIONS.
2. EXCAVATIONS WITH SIGNIFICANT WATER SEEPAGE MAY REQUIRE REDUCED EXCAVATION SLOPES THAN WHAT IS SHOWN ON THE EXCAVATION DRAWINGS AND WILL REQUIRE DEWATERING. CONTRACTOR TO ALLOW FOR SUCH DEWATERING SYSTEM.
3. BLINDING CONCRETE / LEAN MIX CONCRETE MUDSLAB MAY BE REQUIRED IN THE BOTTOM OF SOME FOUNDATION EXCAVATIONS. MINIMUM THICKNESS OF BLINDING CONCRETE SHALL BE 50 mm WITH A MAXIMUM NOMINAL THICKNESS OF 200 mm. THE BLINDING CONCRETE SHALL NOT BE THICKER THAN 400 mm AT DEEP INFILL AREAS SUCH AS ROCK EXCAVATION OVER-BREAK.
4. BLINDING CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF AT LEAST 15 MPa AT 28 DAYS.
5. FOR BLINDING LAYER CONCRETE THICKER THAN NOMINAL 200 mm USE CONVENTIONAL TYPE C25 CONCRETE UP TO DESIGN GRADE AND ELEVATION, FROM WHERE THE SPECIFIED CONCRETE STRENGTH FOR THE STRUCTURAL MEMBER SHOULD BE USED.
6. PRIOR TO PLACING BLINDING CONCRETE, REMOVE AND REPLACE ALL AREAS OF LOOSE OR SOFT MATERIAL OR COMPACT SUB GRADE SOILS AS SPECIFIED.
7. FREEZING OF BLINDING LAYER CONCRETE AND/OR EXPOSED FOUNDATION MATERIAL SHALL NOT BE ALLOWED AND WILL BE REJECTED BY THE ENGINEER.
8. ALL EXCAVATIONS AND FOUNDATION MATERIAL ARE TO BE INSPECTED AND ACCEPTED BY THE ENGINEER PRIOR TO PLACING BLINDING CONCRETE, FORMWORK OR ANY REINFORCEMENT. HOLD EXCAVATION FOR INSPECTION AND APPROVAL BY ENGINEER.
9. ALL EXCAVATIONS SHALL BE KEPT FREE OF STANDING WATER AT ALL TIMES.

TEMPORARY STRUCTURES:

1. THE CONTRACTOR SHALL DESIGN AND DETAIL ALL TEMPORARY STRUCTURES USED FOR THE CONSTRUCTION OF THE PERMANENT WORKS.
2. MAINTAIN ALL STRUCTURES IN A STABLE CONDITION DURING CONSTRUCTION AND ENSURE AT ALL TIMES THAT NO PART OF THE STRUCTURE IS OVER STRESSED DUE TO THE CONSTRUCTION ACTIVITIES.
3. PERMANENT WORKS SHALL NOT BE ALLOWED TO BE UNDERCUT OR UNDERMINED BY ANY CONSTRUCTION ACTIVITIES.

FORMWORK:

1. DESIGN
   - 1.1. ALL FORMWORK AND FALSEWORK SHALL COMPLY WITH CAN/CSA S269.1 AND CAN/CSA S269.3 OR ACI 347. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DESIGN OF FORMWORK. FORMWORK AND FALSEWORK SHALL BE DESIGNED BY A PROFESSIONAL ENGINEER.
2. FORMED FINISHED SURFACES
   - 2.1. FINISH F1: FORMS BUILT OF STANDARD FORM PLY WITH A MINIMUM AMOUNT OF REFINEMENT.
   - 2.2. FINISH F2: FORMS FOR GENERAL APPLICATION FOR SURFACES EXPOSED TO VIEW WITHOUT STRINGENT AESTHETIC REQUIREMENTS; OF PLYWOOD, STEEL OR FORM LINER OF PRE-APPROVED MATERIAL.
   - 2.3. FINISH F3: FORMS FOR SURFACES WHERE AESTHETIC OR MECHANICAL PERFORMANCE REQUIRES A HIGH QUALITY FINISH; OF PLYWOOD, STEEL OR FORM LINER OF PRE-APPROVED MATERIAL. PATTERN FROM THE FORMS LEFT IN THE CONCRETE SURFACE MUST HARMONIZE WITH THE STRUCTURE AND ITS FUNCTION. ALL JOINTS SHALL BE HORIZONTAL OR VERTICAL.
   - 2.4. FINISH F4: SEVERE TOLERANCE LIMIT; OF SMOOTH SANDED UNLINED AND UNCOATED PLYWOOD.
3. UNFORMED FINISHES
   - 3.1. FINISH U1: EVEN, UNIFORM FINISH; CONSOLIDATED, LEVEL AND SCREEDED.
   - 3.2. FINISH U2: WOOD FLOAT FINISH.
   - 3.3. FINISH U3: STEEL TOWELLED FINISH.
   - 3.4. FINISH U4: HARD, STEEL TOWELLED FINISH - BURNISHED.
   - 3.5. FINISH U5: BROOM FINISH.
   - 3.6. FINISH U6: HARDENED FINISH; APPLY FLOOR HARDENER PER MANUFACTURER'S INSTRUCTIONS.
4. CHAMFERS
   - 4.1. FORM ALL EXPOSED CONCRETE CORNERS AND EDGES WITH 20 mm or 25 mm CHAMFER. ALL CONCRETE CORNERS SHALL HAVE A 25 mm CHAMFER TO PREVENT CONCRETE CHIPPING.
5. SPECIFIED CONCRETE FINISH FOR PARTICULAR APPLICATION/EXPOSURE
   - 5.1. SURFACES EXPOSED TO VIEW (EXTERIOR) - F2, U2
   - 5.2. SURFACES EXPOSED TO VIEW (INTERIOR) - F3, U3
   - 5.3. SURFACES AGAINST BACKFILL - F1, U1
   - 5.4. SURFACES EXPOSED TO WATER OR WATER PASSAGE - F4, U3

STEEL REINFORCEMENT:

1. MATERIALS
   - 1.1. REINFORCEMENT STEEL SHALL BE DEFORMED BAR REINFORCEMENT FOR STRUCTURAL CONCRETE IN ACCORDANCE TO CSA G30.18 - GRADE 400 R (OR GRADE 400 W WHERE SPECIFIED).
   - 1.2. WELDED WIRE FABRIC SHALL BE IN ACCORDANCE WITH CSA G30.15M.
   - 1.3. MINIMUM YIELD STRENGTHS FOR REINFORCEMENT:
     - 1.3.1. DEFORMED BAR FY = 400 MPA
     - 1.3.2. WELDED WIRE FABRIC FY = 280 MPA
2. MINIMUM CONCRETE COVER TO REINFORCEMENT
   - 2.1. EXTERNAL FACES CAST ON/AGAINST SOIL, ROCK OR CONCRETE BLINDING - 75 mm
   - 2.2. EXTERNAL FACES EXPOSED TO FLOWING WATER:
     - 2.2.1. PRIMARY REINFORCEMENT - 75 mm
     - 2.2.2. STIRRUPS, TIES AND SPIRALS - 60 mm
   - 2.3. EXTERNAL FACES EXPOSED TO WEATHER, STANDING WATER & SOIL BACKFILL:
     - 2.3.1. PRIMARY REINFORCEMENT - 50 mm
     - 2.3.2. STIRRUPS, TIES AND SPIRALS - 40 mm
   - 2.4. INTERNAL FACES EXPOSED TO FLOWING WATER:
     - 2.4.1. PRIMARY REINFORCEMENT - 75 mm
     - 2.4.2. STIRRUPS, TIES AND SPIRALS - 60 mm
   - 2.5. INTERNAL FACES EXPOSED TO AIR & STANDING WATER:
     - 2.5.1. PRIMARY REINFORCEMENT - 40 mm
     - 2.5.2. STIRRUPS, TIES AND SPIRALS - 30 mm
   - 2.6. EXTERNAL SLAB SURFACES EXPOSED TO TRAFFIC - 50 mm
   - 2.7. INTERNAL SLAB SURFACES EXPOSED TO TRAFFIC - 40 mm
3. EXPOSURE CLASS
   - 3.1. ALL CONCRETE SHALL BE REGARDED TO HAVE AN EXPOSURE CLASS OF F-2 IN ACCORDANCE WITH CSA A23.3, EXCEPT CONCRETE EXPOSED TO WATER.
   - 3.2. ALL CONCRETE SURFACES IN CONTACT WITH WATER SHALL BE REGARDED TO HAVE AND EXPOSURE CLASS F-1 IN ACCORDANCE TO CASE A23.3.
4. TOLERANCES
   - 4.1. ON COVER- -0 mm, +10 mm
   - 4.2. ON EFFECTIVE DEPTH (FROM FACE OPPOSITE REBAR) - -10 mm, +10 mm
   - 4.3. ON EMBEDMENT AND LAP LENGTHS- -0 mm, NO UPPER LIMIT
   - 4.4. ON STANDARD HOOK DIMENSIONS- -0 mm, NO UPPER LIMIT
   - 4.5. ON LOCATION OF INSERTS, OPENINGS & EMBEDS- -5 mm, +5 mm
   - 4.6. ON LATERAL SPACING OF REBAR- -15 mm, +15 mm
   - 4.7. ON REBAR DIMENSION LENGTHS- -25 mm, +25 mm
   - 4.8. ON OVERALL TIE BAR AND STIRRUP DIMENSIONS- -5 mm, +5 mm
5. SPLICES
   - 5.1. ALL SPLICE LENGTHS NOT INDICATED EXPLICITLY ON DRAWINGS ARE CLASS B, AS DEFINED BY CLAUSE 12.15.1 OF CSA A23.3.
   - 5.2. LOCATE STEEL REINFORCEMENT SPLICES ONLY WHERE SHOWN ON THE DRAWINGS. ALTERNATE REINFORCEMENT SPLICES IN SLABS AND WALLS WHERE POSSIBLE TO AVOID SINGLE SPLICE LOCATION LINE THROUGH COMPONENTS. NO SUPPLEMENTARY SPLICES ARE ALLOWED WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.
   - 5.3. WELDING OF OR TO STEEL REINFORCEMENT IS NOT PERMITTED FOR ANY PURPOSE EXCEPT, IF EXPLICITLY SHOWN ON THE DRAWINGS OR WITH WRITTEN APPROVAL BY THE ENGINEER.
6. FABRICATION AND DETAILING
   - 6.1. FABRICATE BENDS AND HOOKS OF BARS TO CLAUSE 12.2 OF A23.1 UNLESS OTHERWISE DIMENSIONED ON THE DRAWINGS.
   - 6.2. ALL STEEL REINFORCEMENT SHALL NOT BE BENT COLD. THE MINIMUM BAR BEND DIAMETER SHALL NOT BE LESS THAN THE VALUES PROVIDED IN CSA A23.1 - TABLE 16.
7. GENERAL REINFORCEMENT DRAWING SYMBOLS
   - 7.1. STANDARD 90° HOOK:

     ELEVATION PLAN
   - 7.2 STANDARD 90° HOOK:
   - 7.3 LAPPED SPLICE

     OR
   - 7.4 TOP AND NEAR FACE BARS
   - 7.5 BOTTOM OR FAR FACE BAR

STEEL REINFORCEMENT (CONT'D):

8. REINFORCEMENT SPACING
   - 8.1. UNLESS OTHERWISE SHOWN, THE FIRST AND LAST BARS IN SLABS AND WALLS, STIRRUPS IN BEAMS, AND TIES IN COLUMNS SHALL BE PLACED AT A MAXIMUM OF HALF THE SPECIFIED SPACING OF ADJACENT BARS FROM THE ENDS OF THE MEMBER. THE MINIMUM CLEAR DISTANCE BETWEEN PARALLEL BARS, OTHER THAN AT SPLICES, SHALL BE THE NOMINAL DIAMETER OF THE BARS IN BEAMS OR ONE AND ONE-HALF TIMES THE NOMINAL DIAMETER IN COLUMNS; BUT IN NO CASE LESS THAN 1.5 X THE MAXIMUM COARSE AGGREGATE SIZE OF 25 mm IN BEAMS OR 40 mm IN COLUMNS.
9. TYPICAL REINFORCEMENT BAR DESIGNATION

   NUMBER REQUIRED — (SEE SECTION 4)

   12 - 20M AT 150 (EF)

   BAR SIZE — CENTRE TO CENTRE (SPACING)
10. REINFORCEMENT DOWELS
    - 10.1. THE MINIMUM PROJECTION AND EMBEDMENT OF ALL DOWELS SHALL COMPLY WITH THE MINIMUM SPECIFIED SPLICE AND EMBEDMENT LENGTHS RESPECTIVELY, UNLESS NOTED OTHERWISE ON THE REINFORCEMENT DRAWINGS. DOWEL PROJECTION INTO CONSECUTIVE CONCRETE POURS SHALL NOT BE LESS THAN 50 X BAR DIAMETER.
11. WELDING TO REINFORCEMENT
    - 11.1. WELDING OF REINFORCEMENT SHALL NOT BE PERMITTED EXCEPT WHERE REQUIRED FOR SPECIAL END ANCHORAGE OR OTHER REQUIREMENTS AS SHOWN ON THE DRAWINGS OR AS DIRECTED BY THE ENGINEER. GRADE 400W REINFORCEMENT STEEL SHALL BE USED AT THESE LOCATIONS. TACK WELDING OF BARS INTO CAGES SHALL NOT BE PERMITTED. TACK-WELDING OF REINFORCEMENT IN LIEU OF WIRE TYING OR FOR ATTACHING EMBEDDED ITEMS TO REINFORCEMENT SHALL NOT BE PERMITTED. ADDITIONAL NON-STRUCTURAL ERECTION BARS OR FRAMES SHALL BE PROVIDED FOR SUCH ELEMENT REQUIRING WELDING OR EMBEDDED ELEMENTS, TO ENSURE THAT NO ACCIDENTAL WELDING OCCURS TO ANY STRUCTURAL REINFORCEMENT STEEL.
    - 11.2. CAD WELDING OF EMBEDDED COPPER ELEMENTS FOR GROUNDING GRID TO REINFORCEMENT IN VARIOUS CONCRETE STRUCTURES, MAY BE REQUIRED TO FORM AN ELECTRICAL GRID, AS INDICATED ON DRAWINGS. WELDING OF REINFORCING BARS SHALL CONFORM TO CSA STANDARD W186.
12. REINFORCEMENT PLACEMENT
    - 12.1. REINFORCEMENT MAY BE RELOCATED BY UP TO 50 mm TO CLEAR PIPES, SEALS, WATERSTOPS, RECESSES, EMBEDDED METALWORK AND CONDUITS, EXCEPT AS NOTED BELOW. WHERE POSSIBLE, A MINIMUM CLEARANCE OF AT LEAST 25 mm SHALL BE MAINTAINED BETWEEN REINFORCEMENT AND EMBEDDED MATERIALS.
    - 12.2. THE MINIMUM CLEARANCE BETWEEN REINFORCEMENT AND POWER CONDUITS SHALL BE 100 mm.
    - 12.3. THE MINIMUM CLEARANCE BETWEEN REINFORCEMENT AND ANY PART OF EMBEDDED STEEL PENSTOCK COMPONENTS SHALL BE 100 mm. THE ELECTRICAL ISOLATION & CONDUCTIVITY OF PENSTOCK COMPONENTS SHALL BE TESTED PRIOR TO CONCRETING OF SUCH COMPONENTS.
    - 12.4. UNDER NO CIRCUMSTANCES SHALL LONGITUDINAL REINFORCEMENT FOR HEAVILY REINFORCED BEAMS AND COLUMNS BE DISPLACED TO CLEAR EMBEDDED MATERIALS. IN SUCH CASES, SUBJECT TO THE APPROVAL OF THE ENGINEER, EMBEDDED MATERIALS SHALL BE DISPLACED. TENSION BARS SHALL NOT BE BENT INTO SHARP OFFSETS WITH SLOPES OF MORE THAN 1 LATERAL ON 6 LONGITUDINAL TO CLEAR OBSTRUCTIONS.
    - 12.5 . REINFORCEMENT SHALL BE ACCURATELY PLACED IN ACCORDANCE WITH THE DRAWINGS AND SHALL BE ADEQUATELY SECURED AGAINST DISPLACEMENT BY USING ANNEALED IRON WIRE TIES OR SUITABLE CLIPS AT INTERSECTIONS AND SHALL BE SUPPORTED BY CONCRETE OR PLASTIC SPACERS.
13. CUTTING OF STEEL REINFORCEMENT
    - 13.1. UNDER NO CIRCUMSTANCES SHALL DOWELS AND OTHER STEEL REINFORCEMENT BE TERMINATED OR CUT WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER. DOWEL BARS THAT ARE CUT WITHOUT THE ENGINEER'S APPROVAL SHALL BE REPLACED BY THE CONTRACTOR.

CONCRETE:

1. MATERIALS
   - 1.1. CEMENT - IN ACCORDANCE WITH CSA A5 TYPE 10.
   - 1.2. AGGREGATES - IN ACCORDANCE WITH CSA A23.1
   - 1.3. ADMIXTURES - IN ACCORDANCE WITH CSA A23.1
     - 1.3.1. AIR-ENTRAINING ADMIXTURES WITH ASTM C260
     - 1.3.2. CHEMICAL ADMIXTURES TO ASTM C494 AND ASTM C1017.
     - 1.3.3. CALCIUM CHLORIDE ADMIXTURES ARE NOT PERMITTED
2. SPECIFIED CONCRETE COMPRESSIVE STRENGTH
   - 2.1. C50 - 50 MPa
   - 2.2. C40 - 40 MPa
   - 2.3. C35 - 35 MPa
   - 2.4. C30 - 30 MPa
   - 2.5. C25 - 25 MPa
   - 2.6. C15 - 15 MPa
3. GROUTS
   - 3.1. NON-SHRINK GROUT: CEMENTITIOUS PREMIXED GROUT, 40 MPa SPECIFIED 28 DAY COMPRESSIVE STRENGTH.
   - 3.2. EPOXY GROUT: HILTI HIT HY150, RE500, HILTI HSE 2421 OR AS INDICATED ON THE DRAWINGS.
4. CONCRETE MIXING, PREPARATION AND PLACEMENT
   - 4.1. DO NOT ADD ADDITIONAL WATER TO THE CONCRETE AFTER BATCHING AND MIXING IN ACCORDANCE WITH THE MIX DESIGN. THE ENGINEER MAY REJECT ANY CONCRETE TO WHICH ADDITIONAL WATER WAS ADDED WITHOUT FURTHER CAUSE.
   - 4.2. CONCRETE SHALL NOT BE PLACED IN FORMWORK THAT HAS GOT ICE/SNOW INSIDE OF IT. CONCRETE MAY ONLY BE PLACED AFTER THE INSIDE OF FORMWORK AND EXISTING CONCRETE COMPONENTS IN CONTACT WITH NEW FRESH CONCRETE HAS BEEN CONTINUOUSLY PRE-HEATED FOR 24 HOURS ABOVE 5° CELSIUS DURING COLD WEATHER CONCRETE PLACEMENT.
   - 4.3. CONCRETE SHALL NOT BE PLACED WITHOUT PRIOR INSPECTION AND ACCEPTANCE OF STEEL REINFORCEMENT, COVER AND FORMWORK BY THE ENGINEER.
   - 4.4. LOCATE CONSTRUCTION JOINTS AS SHOWN ON THE DRAWINGS. DO NOT MAKE ADDITIONAL CONSTRUCTION JOINTS WITHOUT THE PRIOR WRITTEN APPROVAL OF THE ENGINEER.
   - 4.5. THE INSIDE OF FORMWORK SHALL BE CLEANED OUT OF ALL DEBRIS, LOOSE TIE WIRES, WATER AND ICE PRIOR TO THE PLACEMENT OF CONCRETE.
   - 4.6. ROUGHEN ALL VERTICAL AND HORIZONTAL CONSTRUCTION JOINTS TO MINIMUM 5 mm AMPLITUDE BY MEANS OF AIR/WATER JET BLASTING OR BUSH-HAMERING TO REMOVE LAITANCE AND EXPOSE COARSE AGGREGATE. ROUGHENING OF FRESHLY CAST-IN-PLACE CONCRETE SURFACE IS NOT ADEQUATE.
   - 4.7. DISCHARGE CONCRETE INTO CONCRETE FORMS WITHIN 1 HOUR AFTER CEMENT WAS INTRODUCED INTO THE MIX OR PRIOR TO 300 REVOLUTIONS OF THE TRUCK DRUM. THE ENGINEER MAY ALTER THESE REQUIREMENTS DEPENDING ON CONTRACTOR'S QUALITY CONTROL AND FAVOURABLE CONCRETE STRENGTH RESULTS.
5. FORMWORK REMOVAL AND CURING
   - 5.1. DO NOT REMOVE WALL FORMWORK BEFORE THE CONCRETE HAS REACHED AT LEAST 40% OF THE REQUIRED 28 DAY COMPRESSIVE STRENGTH IN ORDER TO SUPPORT ITSELF. FORMWORK SHALL REMAIN IN PLACE FOR A MINIMUM PERIOD OF 48 HOURS.
   - 5.2. SOFFIT/SUPPORTING FORMWORK/FALSEWORK SHALL REMAIN IN PLACE UNTIL THE CONCRETE HAS REACHED AT LEAST 70% OF THE TARGETED COMPRESSIVE STRENGTH. SUSPENDED SLAB COMPONENTS SHALL BE PROPED/SUPPORTED UNTIL THE CONCRETE HAS REACH 100% OF THE TARGET COMPRESSIVE STRENGTH. THE ENGINEER MAY ALLOW DEVIATION FROM THIS REQUIREMENT, FROM CASE TO CASE.
   - 5.4. COMMENCE WITH CURING OF ALL SURFACES IMMEDIATELY FOLLOWING PLACEMENT AND AFTER STRIPPING OF FORMWORK. THE MINIMUM BASIC CURING PERIOD SHALL BE 7 CONSECUTIVE DAYS FOLLOWING PLACEMENT. CURING METHODS SHALL BE IN ACCORDANCE TO CSA A23.1 SECTION 7.4 AND ANNEX I. CONCRETE SHALL AT ALL TIMES DURING THE SPECIFIED CURING PERIOD BE PROTECTED AGAINST FREEZING AND DRYING OUT OF ALL SURFACES.
   - 5.5. TEMPERATURE RECORDS SHALL BE KEPT FOR ALL STRUCTURAL CONCRETE COMPONENTS.THE MAXIMUM TEMPERATURE DIFFERENTIAL SHALL NOT EXCEED 20°C FOR ANY STRUCTURAL COMPONENT, AS SPECIFIED IN CSA A23.1 SECTION 7.4 IN ORDER TO REDUCE POTENTIAL THERMAL STRESS CRACKING.

DETAILED DESIGN

NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — C. B. NIAMIR # 41576

2021-11-15

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CIVIL GENERAL NOTES

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	G0006	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
-	-

REVISIONS

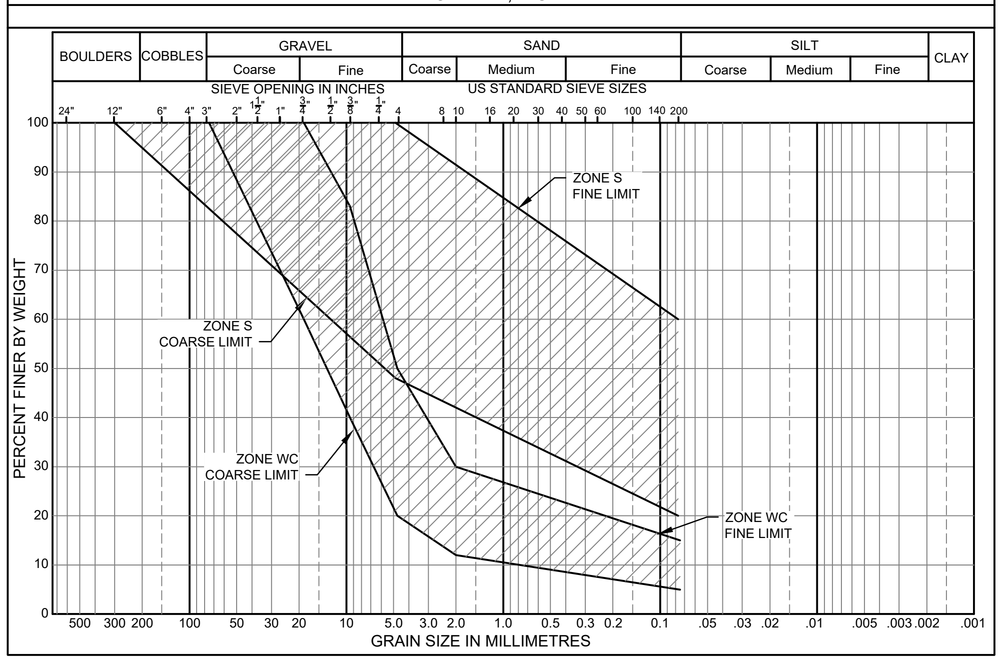
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29OCT'21	ISSUED FOR PERMITTING	CBN	SKC	DDF	DDF

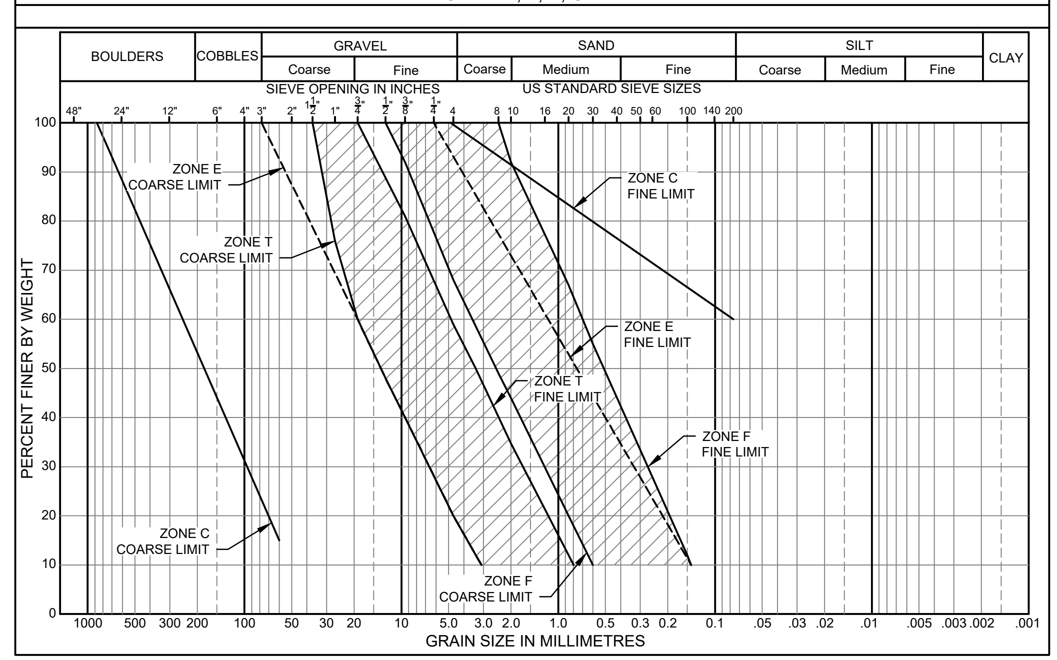
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - S, WC



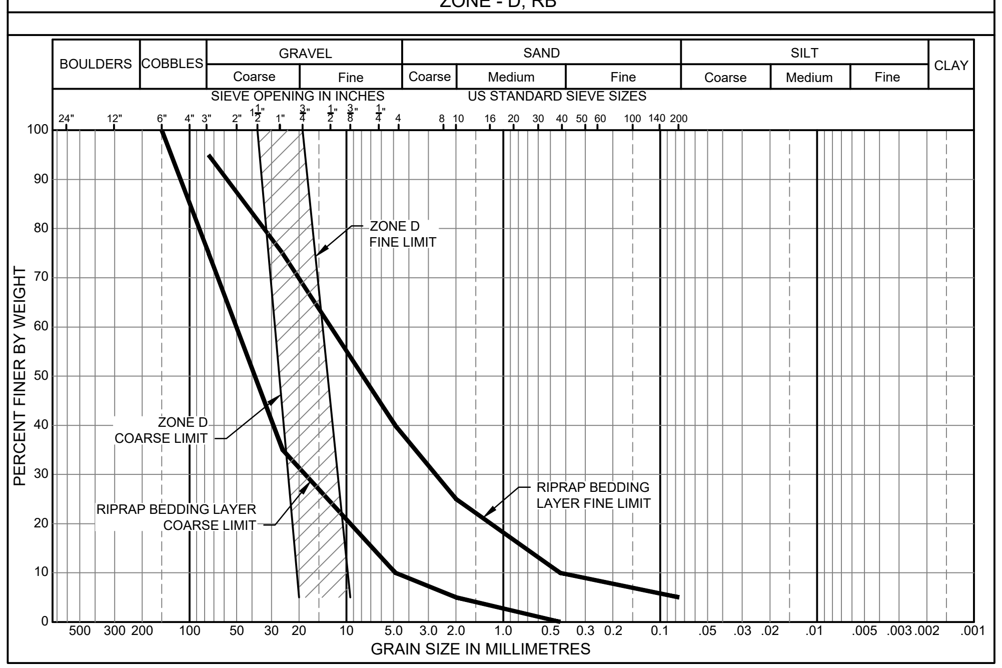
UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - F, T, E, C



UNIFIED SOIL CLASSIFICATION SYSTEM

ZONE - D, RB



MATERIAL PLACEMENT AND COMPACTION REQUIREMENTS

ZONE	MATERIAL TYPE	LOCATIONS	PLACING AND COMPACTION REQUIREMENTS
S	GLACIAL TILL	SEAL ZONE	PLACED, MOISTURE CONDITIONED AND SPREAD IN MAXIMUM 300 mm THICK LAYERS (AFTER COMPACTION). VIBRATORY COMPACTION TO 95% OF STANDARD PROCTOR MAXIMUM DRY DENSITY OR AS APPROVED BY THE ENGINEER
F	SAND	FILTER ZONE	PLACED AND SPREAD IN MAXIMUM 600 mm THICK LAYERS AND COMPACTED WITH MINIMUM 4 TO 6 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER
T	GRAVEL	TRANSITION ZONE	PLACED AND SPREAD IN MAXIMUM 600 mm THICK LAYERS AND COMPACTED WITH MINIMUM 4 TO 6 PASSES OF 10 TON SMOOTH DRUM VIBRATORY ROLLER, OR AS APPROVED BY THE ENGINEER.
E	ENGINEERED FILL	FOUNDATIONS	PLACED AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. VIBRATORY COMPACTED TO 100% OF STANDARD PROCTOR MAXIMUM DRY DENSITY OR AS APPROVED BY THE ENGINEER.
C	WASTE ROCK OVER BURDEN	SHELL ZONE	PLACE AND SPREAD IN MAXIMUM 1000 mm THICK LAYERS. UNIFORMLY COMPACTED BY SELECTIVE ROUTING OF HAUL TRUCK TRAFFIC ON MAIN FILL AND BY 10 TON SMOOTH DRUM VIBRATORY ROLLER ON THE FILL EDGES.
D	DRAIN ROCK	DRAINS	PLACED AROUND DRAINAGE PIPES AND WRAPPED WITH GEOTEXTILE.
R	RIPRAP	RIPRAP	PLACED WITH EXCAVATOR BUCKET IN INTERLOCKING FASHION WITH MINIMAL COMPACTIVE EFFORT.
RB	RIPRAP BEDDING	RIPRAP	PLACE AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. UNIFORMLY COMPACTED BY BUCKET TAMPING.
WC	WEARING COURSE	ROADS	PLACE AND SPREAD IN MAXIMUM 150 mm THICK LAYERS. EACH LAYER SHALL BE COMPACTED BY A MINIMUM OF 4 PASSES OVER THE ENTIRE SURFACE WITH 10 TON SMOOTH DRUM VIBRATORY ROLLER.

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006.
2. RIPRAP TO BE HARD, DENSE AND DURABLE TO WITHSTAND LONG EXPOSURE TO WEATHERING.
3. RIPRAP STONES SHALL BE ANGULAR IN SHAPE. NO STONE SHALL EXCEED A LENGTH TO BREADTH OR THICKNESS OF 3.
4. SELECTED BC MINISTRY OF TRANSPORTATION RIPRAP CLASSES AND DIMENSIONS SHOWN IN TABLE 1 AND TABLE 2. RIPRAP D50 AND THICKNESS SPECIFIED ON DRAWING G0060.
5. SEE PROJECT TECHNICAL SPECIFICATIONS FOR ADDITIONAL MATERIAL REQUIREMENTS.

GRADATION OF ROCK SIZES IN EACH CLASS OF RIPRAP

CLASS OF RIPRAP (kg)	D50 (mm)	ROCK GRADATION PERCENTAGE SMALLER THAN GIVEN ROCK MASS (kg)		
		15%	50%	85%
5	150	0.5	5	15
50	330	5	50	150
250	565	25	250	750
1000	900	100	1000	3000
2000	1130	200	2000	6000

APPROXIMATE AVERAGE DIMENSION OF EACH SPECIFIED ROCK CLASS MASS (mm) (SG = 2.64)

CLASS OF RIPRAP (kg)	D50 (mm)	APPROXIMATE AVERAGE DIMENSION (mm)		
		15%	50%	85%
5	150	70	150	215
50	330	155	330	475
250	565	260	565	815
1000	900	415	900	1295
2000	1130	525	1130	1630

DETAILED DESIGN

NOT FOR CONSTRUCTION

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

CONSTRUCTION MATERIAL GRADATIONS

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA ENGINEER C. B. NIAMIR # 41576

2021-11-15

DDF DDF

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	G0040	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	29OCT'21	ISSUED FOR PERMITTING	CBN	SKC		

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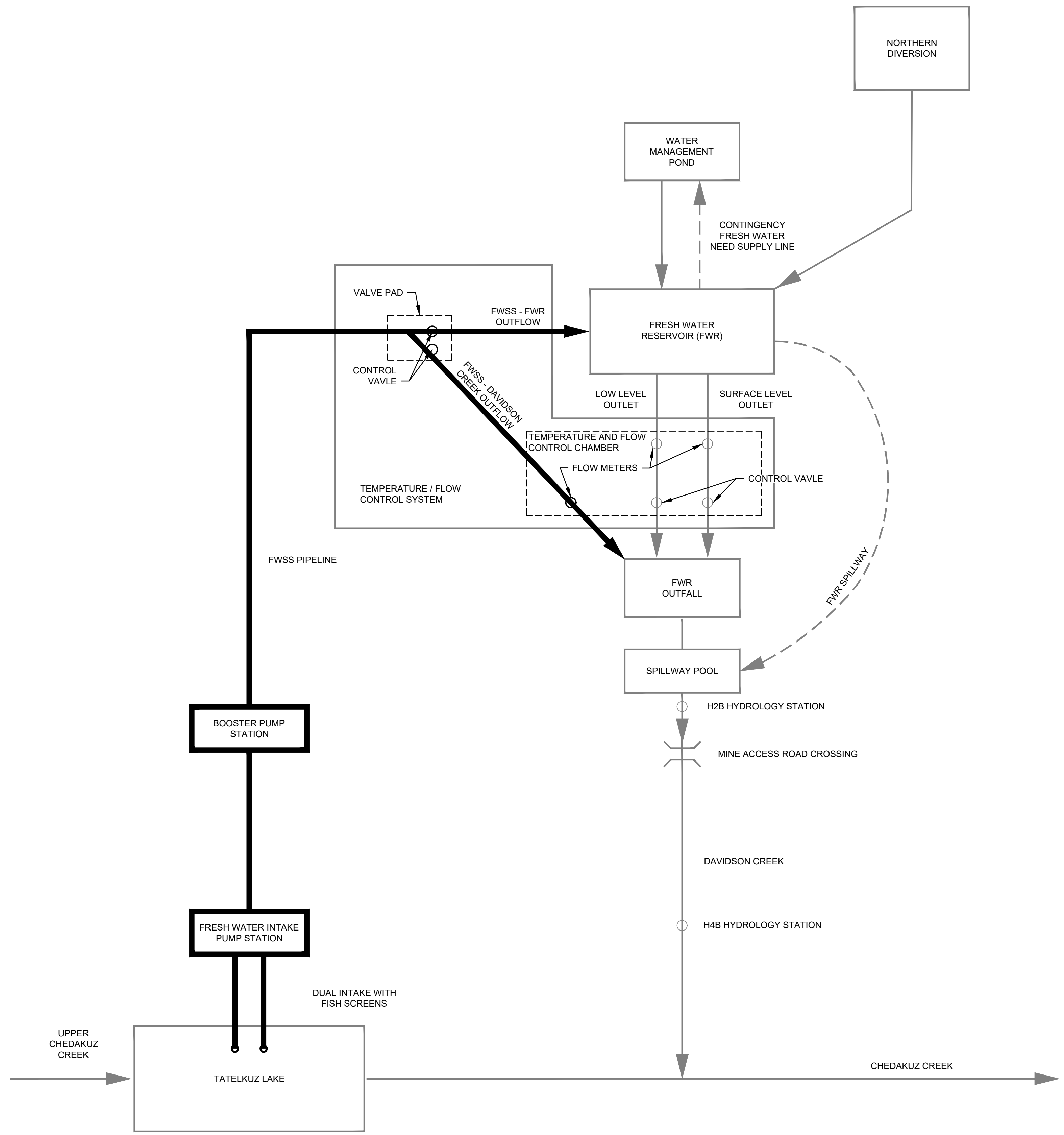

NOTES:

1. SOLID LINE TYPES INDICATE NORMAL OPERATING CONDITIONS.
2. DASHED LINE TYPES INDICATE ALTERNATIVE OPERATING CONDITIONS
3. BOLD LINE TYPES INDICATE FRESH WATER SUPPLY SYSTEM COMPONENTS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

DDF DDF

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM FLOW DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5050	0

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC		

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

DRG. NO.	DESCRIPTION

REFERENCE DRAWINGS

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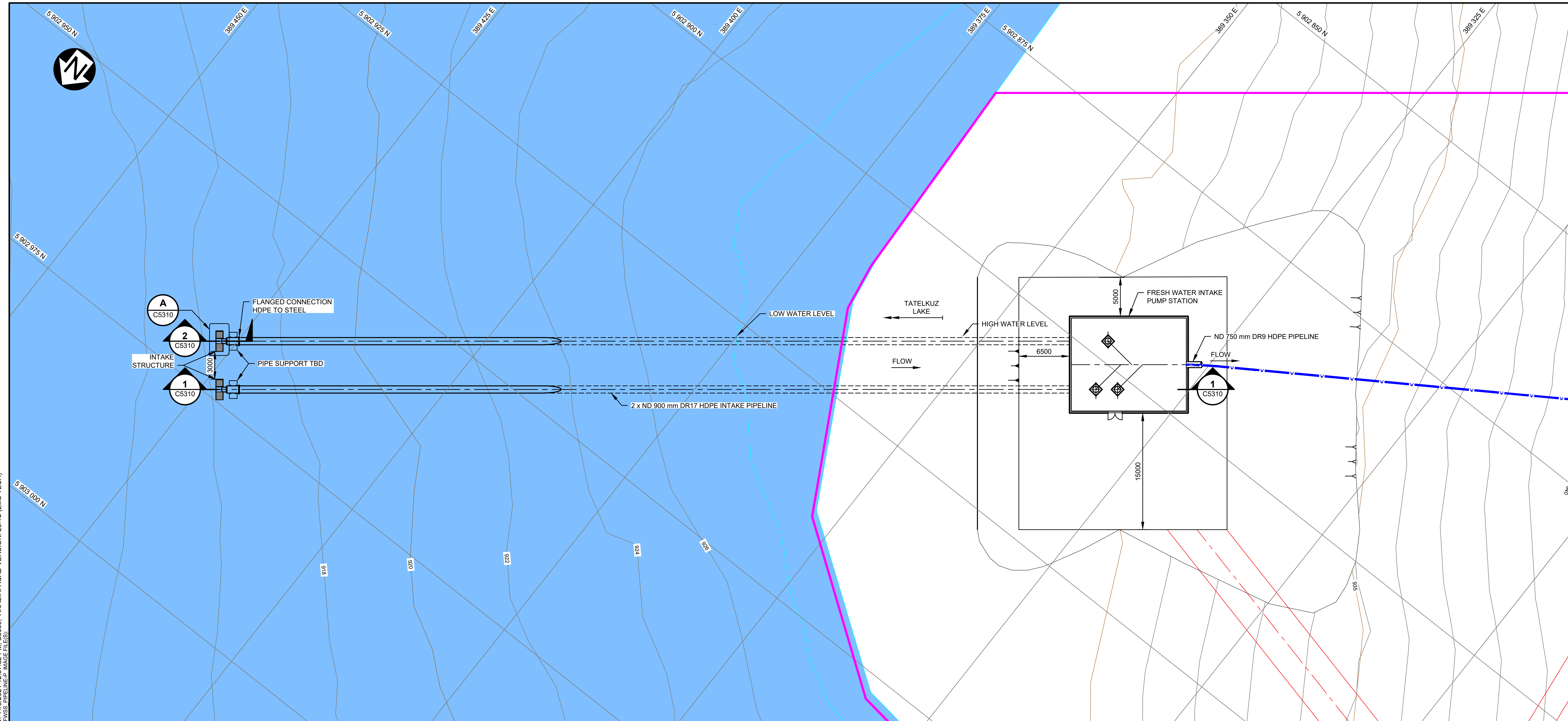

PLAN
SCALE A

SCALE A 5 2.5 0 5 10 15 20 25 m

LEGEND:

- WATER CONVEYANCE PIPELINE
- FWSS PIPELINE ACCESS ROAD
- CERTIFIED PROJECT DESCRIPTION BOUNDARY

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.

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PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
INTAKE STRUCTURE
OVERVIEW

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5300	0

DRG. NO.	DESCRIPTION
C5310	FRESH WATER SUPPLY SYSTEM - INTAKE STRUCTURE - PLAN AND SECTION

REFERENCE DRAWINGS

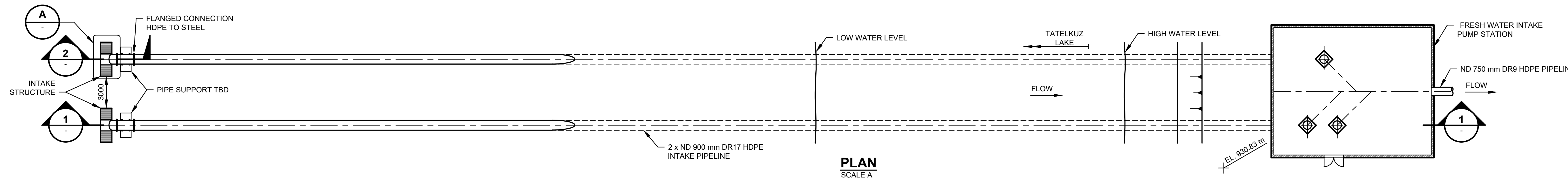
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

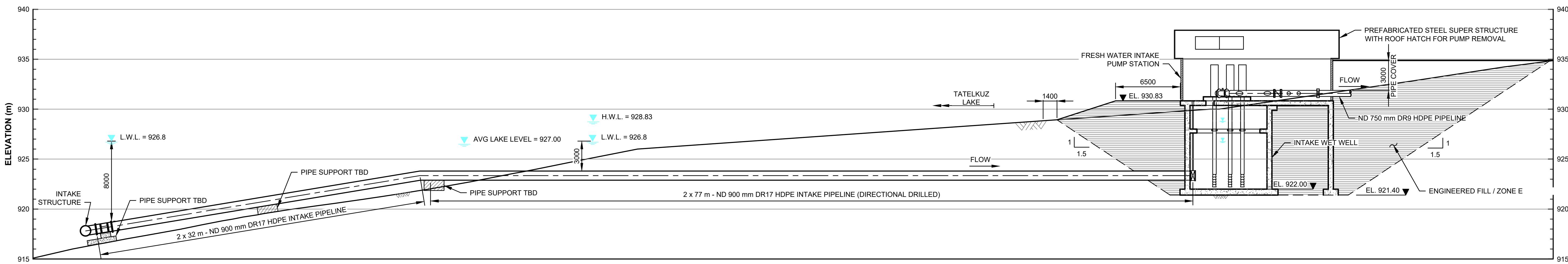
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC	DDF	DDF

REVISIONS

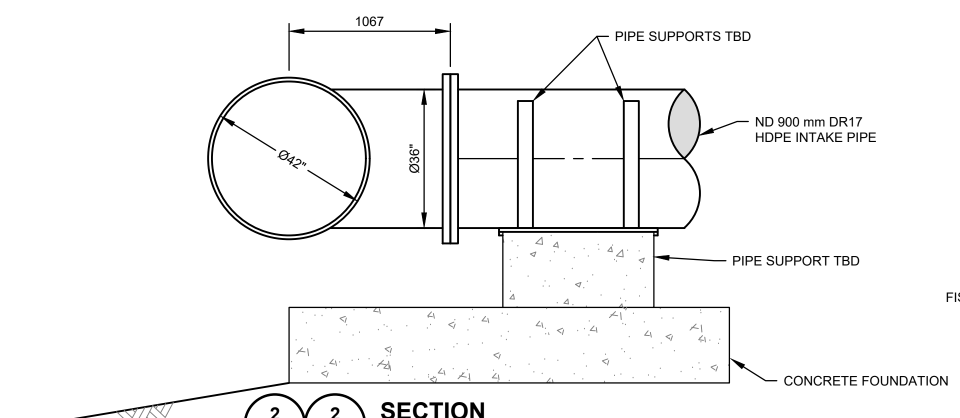
SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5300\C5300, 11/5/2021 12:33:58 PM , ANASIRI PRINTED: 11/5/2021 12:37:52 PM, C5300, ANASIRI ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): Tatelkuz Bathymetry, Whole LiDAR_1m, PropertyBoundary, Hydro Existing Roads & Trails 2020, 762MM_DIA_FWSS PIPELINE-P IMAGE FILE(S):



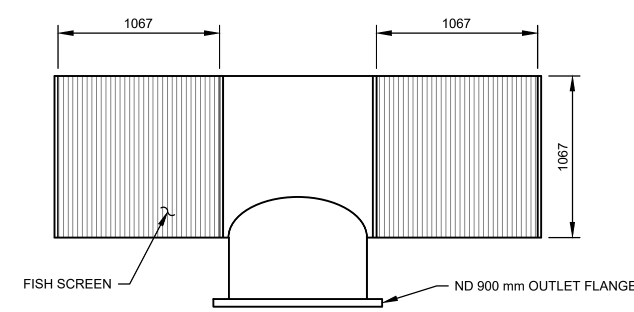
PLAN
SCALE A



1 C5300 1 - SECTION
SCALE A



2 C5300 2 - SECTION
INTAKE STRUCTURE
SCALE B



A C5300 A - DETAIL
INTAKE STRUCTURE - PLAN
SCALE B

LEGEND:

- REINFORCED CONCRETE
- ENGINEERED FILL / ZONE E

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006
2. EXCAVATION SLOPE TO BE ADJUSTED BASED ON ENCOUNTERED SOIL AND GROUNDWATER CONDITIONS.
3. FOR FILL MATERIAL SPECIFICATIONS SEE DRAWING G0040.
4. EXCAVATION INVERT ELEVATION MAY BE MODIFIED DEPENDING ON GROUND CONDITIONS ENCOUNTERED.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE B 0.5 0.25 0 0.5 1.0 1.5 2.0 2.5 m
SCALE A 4 2 0 4 8 12 16 20 m

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA B. S. FICHOT # 30575
2021-11-05

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
INTAKE STRUCTURE
PLAN AND SECTION

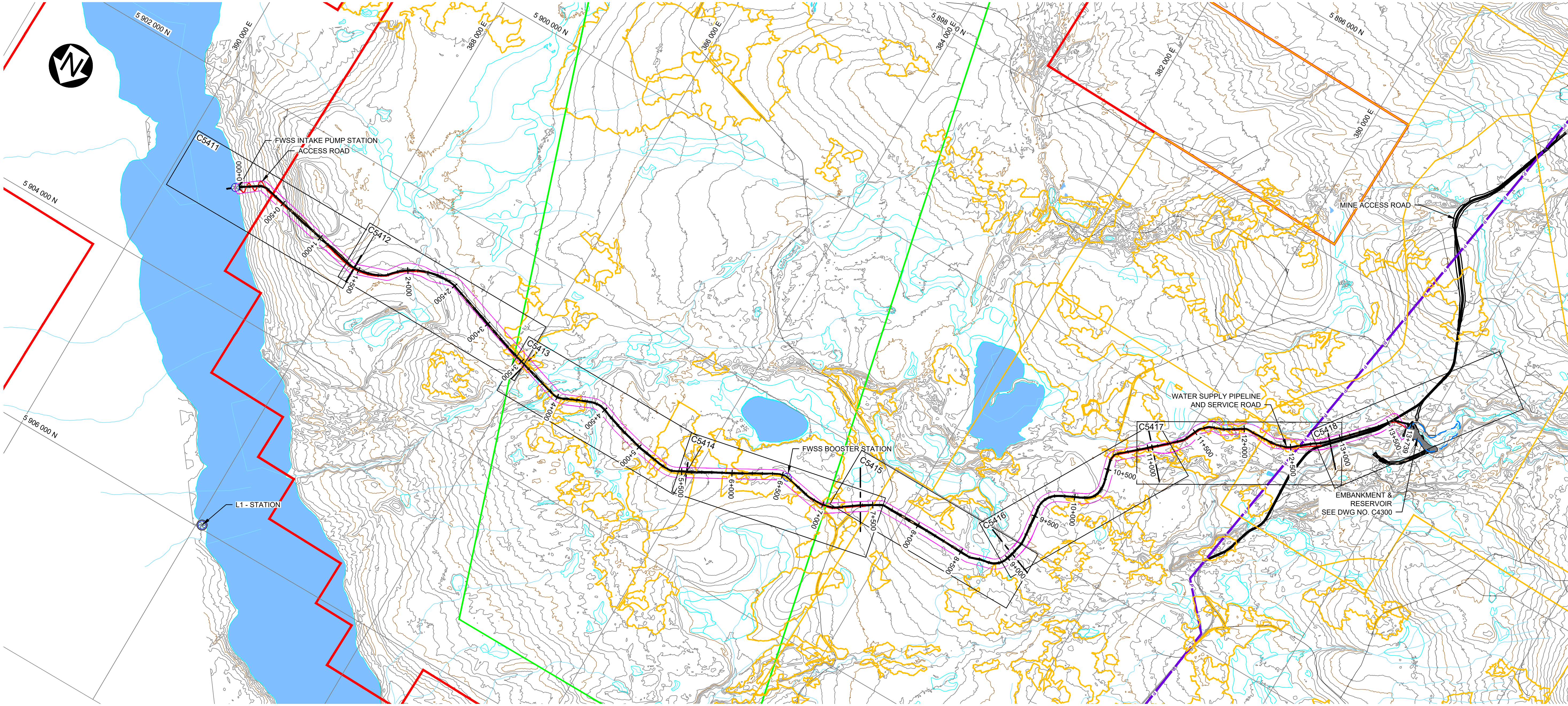
P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5310	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
G0040	CONSTRUCTION MATERIAL GRADATIONS
G0060	CIVIL GENERAL NOTES
C5300	FRESH WATER SUPPLY SYSTEM - INTAKE STRUCTURE - OVERVIEW

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC	DDF	DDF



PLAN
SCALE A

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5410\C5410, 11/5/2021 1:56:31 PM , ELEE PRINTED: 11/5/2021 2:05:17 PM, C5410, ELEE ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): Hydro; Topo 5m Contours; Site C Embankment - YEAR 23 YR23 Mine Objects; Mine Access Road; Fresh Water Reservoir; PropertyBoundary; Site D Embankment and PAG in Stages CPD Polygons; Existing Roads & Trails 2020; 762MM DIA FWSS PIPELINE-P; Fresh Water Reservoir Berm Spillway IMAGE FILE(S):

DRG. NO.	DESCRIPTION
C5418	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 8 OF 8)
C5417	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 7 OF 8)
C5416	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 6 OF 8)
C5415	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 5 OF 8)
C5414	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 4 OF 8)
C5413	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 3 OF 8)
C5412	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 2 OF 8)
C5411	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - PLAN & PROFILE (SHEET 1 OF 8)
C4300	FRESH WATER RESERVOIR - EMBANKMENT - PLAN
G0006	CIVIL GENERAL NOTES
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

LEGEND:

- PUMP STATION
- MINE ACCESS ROAD
- TRANSMISSION LINE
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE SPECIFICATIONS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 400 200 0 400 800 1200 1600 2000 m

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

REVISIONS

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\# 30575
2021-11-05

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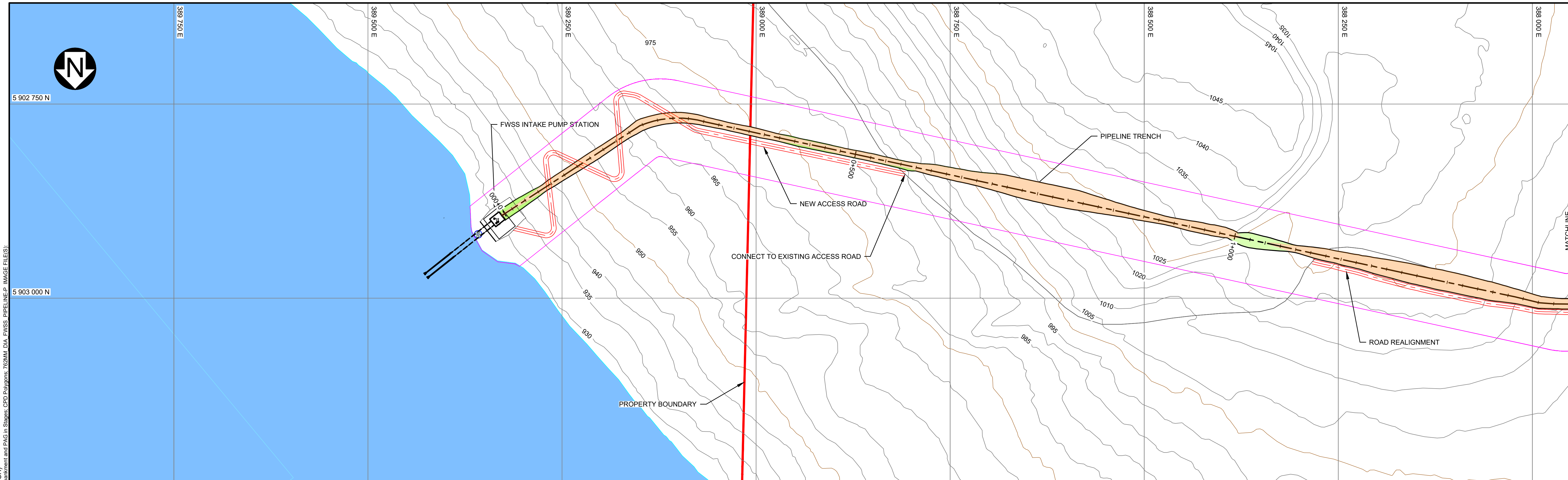
BLACKWATER GOLD PROJECT

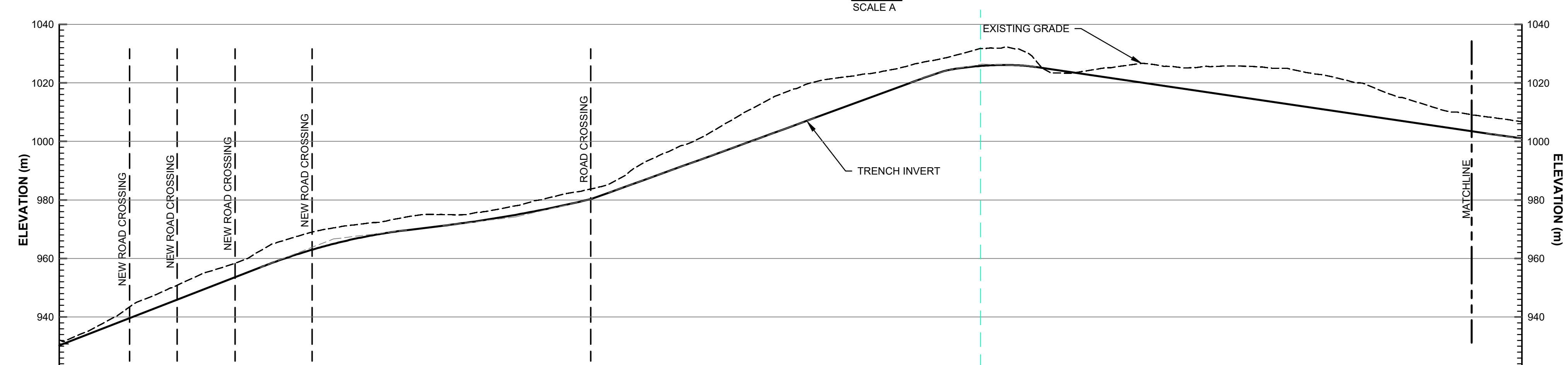
FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
GENERAL ARRANGEMENT

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5410	0



PLAN

SCALE A



EXISTING GRADE (masl)	932.18	980.55	1028.13	1006.70
TRENCH INVERT (masl)	930.30	976.95	1025.46	1001.00
STATION (m)	0+000	0+500	1+000	1+500
PIPE SPECIFICATION	ND 750 mm DR9 HDPE (SEE NOTE 2)		ND 750 mm DR17 HDPE (SEE NOTE 2)	

PROFILE

HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:

- FILL AREAS
- CUT AREAS
- PUMP STATION
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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30575
2021-11-05

ODF ODF

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 1 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5411	0

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

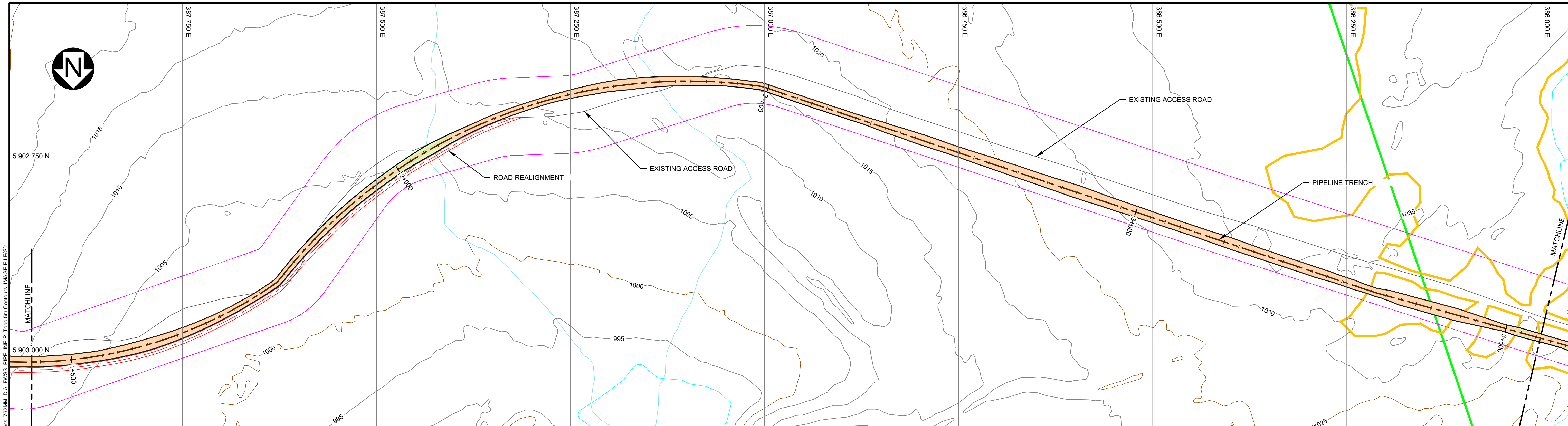
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

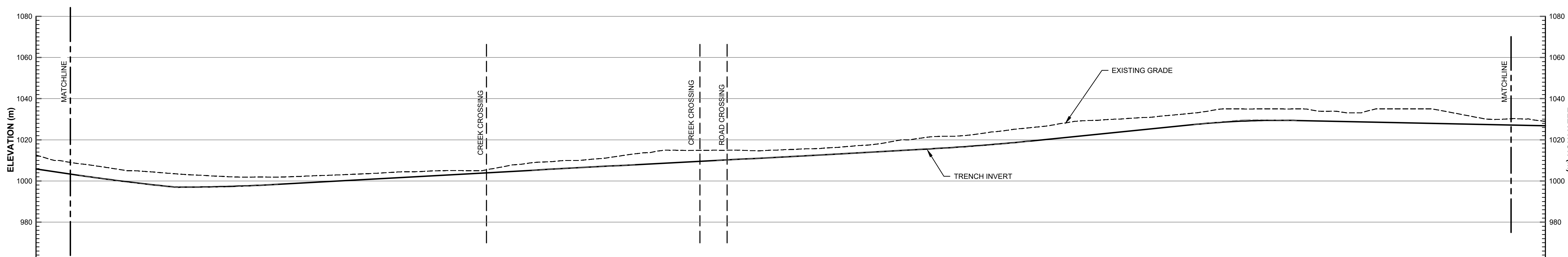
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS		

REVISIONS



PLAN
SCALE A



EXISTING GRADE (masl)	1012.62	1006.70	1005.02	1015.28	1030.55	1030.91	1029.07
TRENCH INVERT (masl)	1005.83	1001.00	1002.92	1011.87	1024.45	1027.51	1026.80
STATION (m)	1+400	1+500	2+000	2+500	3+000	3+500	3+600
PIPE SPECIFICATION	ND 750 mm DR17 HDPE (SEE NOTE 2)						

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:
- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:
1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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2021-11-05

DDF DDF

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 2 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5412	0

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

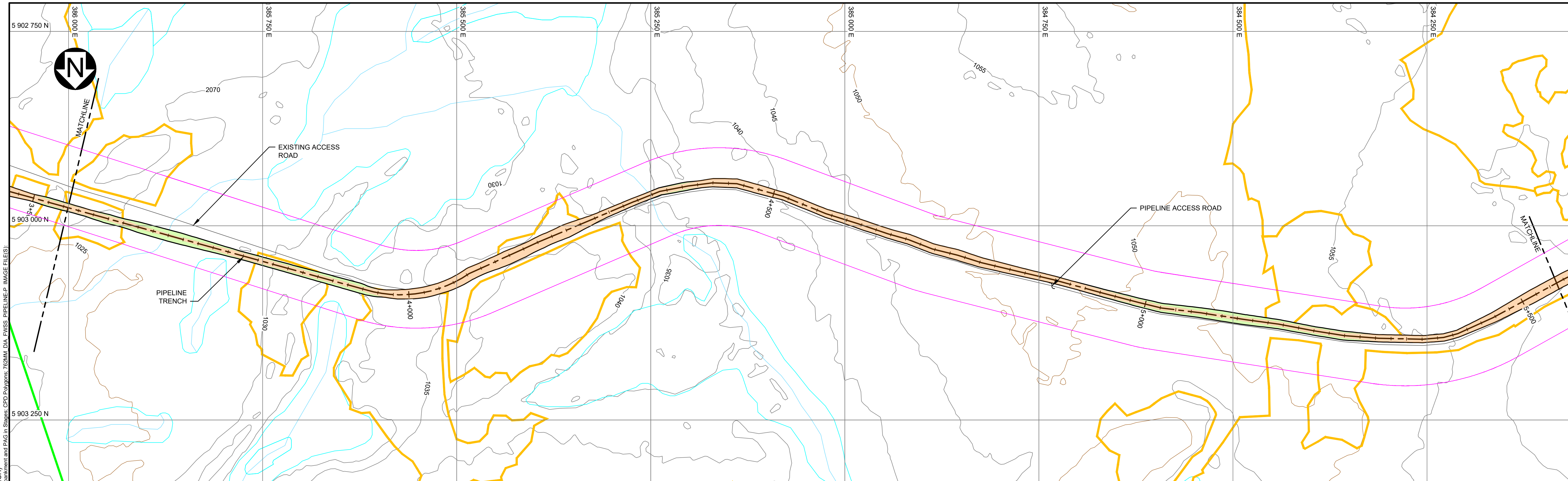
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

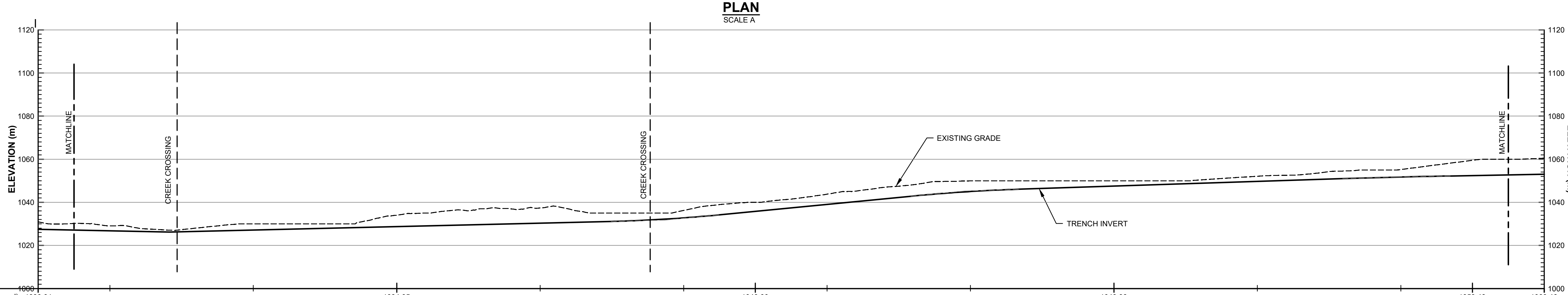
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

REVISIONS

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5412\C5412, 11/5/2021 12:11:21 PM , SCAMMAYO PRINTED: 11/5/2021 12:14:54 PM, C5412, SCAMMAYO ACAD VERSION: 23.1S (LMS TECH)



PLAN
SCALE A



EXISTING GRADE (masl)	1030.91	1034.05	1040.00	1049.98	1059.48	1060.46
TRENCH INVERT (masl)	1027.51	1028.74	1035.81	1047.50	1052.40	1052.99
STATION (m)	3+500	4+000	4+500	5+000	5+500	5+600
PIPE SPECIFICATION	ND 750 mm DR 17 HDPE (SEE NOTE 2)					

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:
- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:
1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

REVISIONS

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PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

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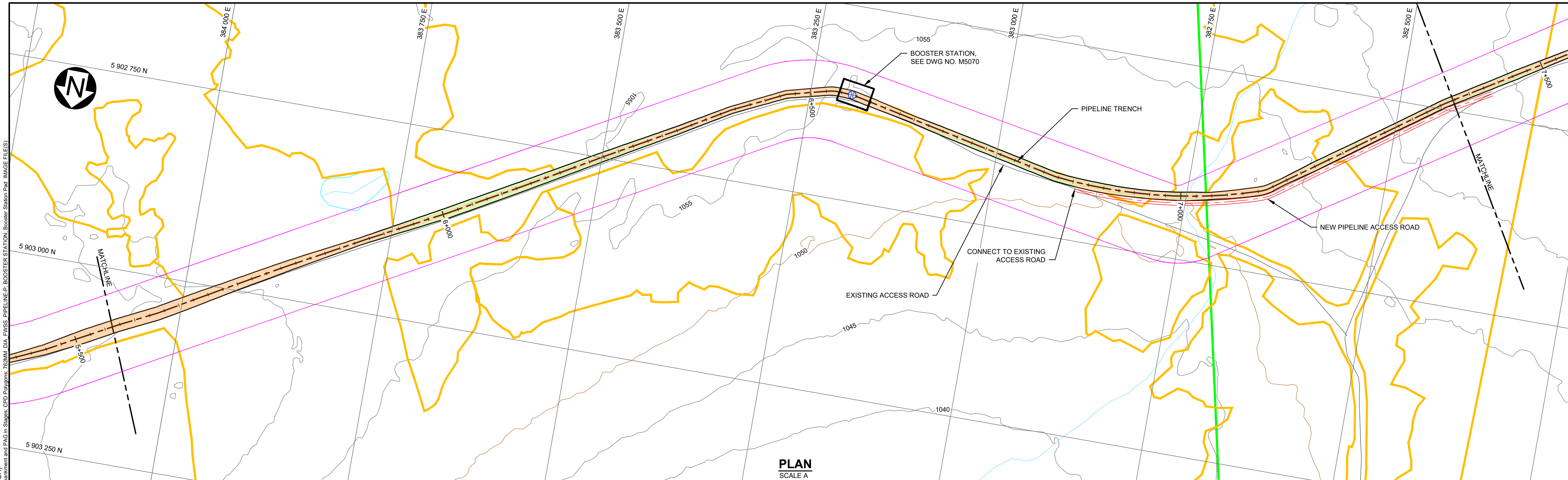
BW GOLD LTD.

BLACKWATER GOLD PROJECT

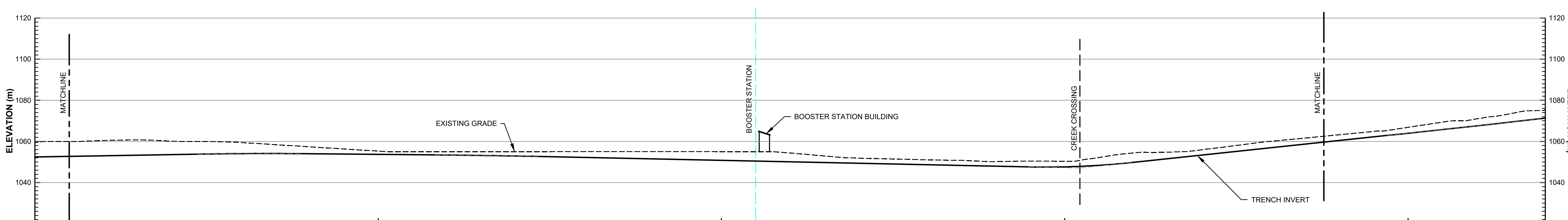
FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 3 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5413	0

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5413\C5413, 11/5/2021 8:24:15 AM , MFLYNN PRINTED: 11/5/2021 9:30:16 AM, C5413, SCAMMAYO ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): Hydro, Topo 5m Contours; Site C Embankment - YEAR 23; YR23 Mine Objects; Mine Access Road; Fresh Water Reservoir; Intake Structure Option B; PropertyBoundary; Existing Roads & Trails 2020; Site D Embankment and PAG in Stages; CPD Polygons; 762MM DIA FWSS PIPELINE-P IMAGE FILE(S):



PLAN
SCALE A



EXISTING GRADE (masl)	1059.48	1055.26	1055.01	1050.31	1066.84	1075.29
TRENCH INVERT (masl)	1052.40	1053.68	1050.77	1047.61	1063.97	1071.29
STATION (m)	5+500	6+000	6+500	7+000	7+500	7+700
PIPE SPECIFICATION	ND 750 mm DR17 HDPE (SEE NOTE 2)			ND 750 mm DR9 HDPE (SEE NOTE 2)		

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:
- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD
- PUMP STATION

NOTES:
1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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DDF DDF
2021-11-05

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 4 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5414	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE
M5070	FRESH WATER SUPPLY SYSTEM - BOOSTER STATION - PLAN

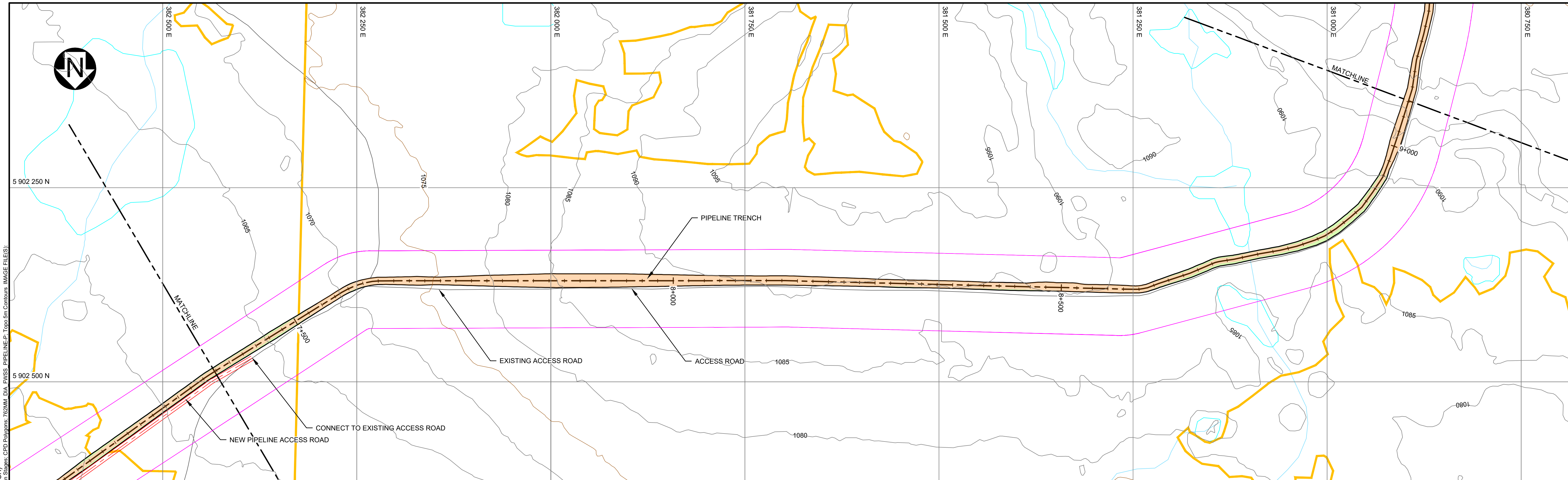
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

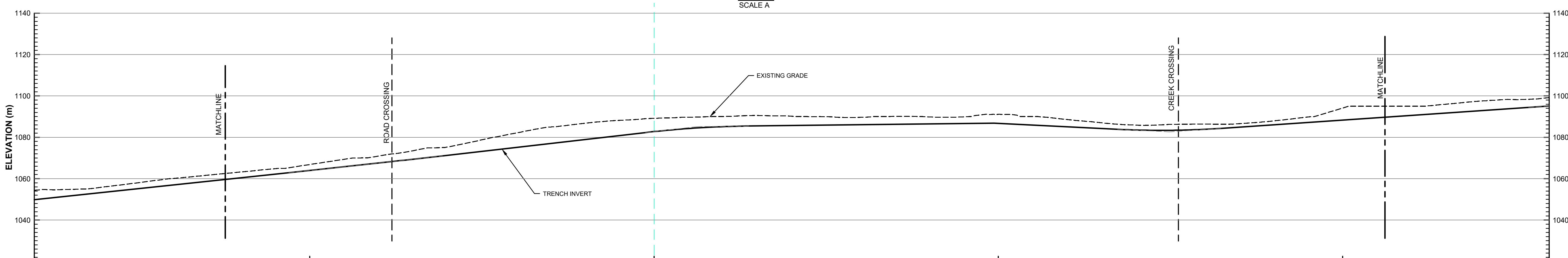
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS		

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5414\C5414, 11/5/2021 8:24:54 AM , MFLYNN PRINTED: 11/5/2021 9:36:02 AM, C5414, SCAMMAYO ACAD VERSION: 23.1S (LMS TECH)



PLAN
SCALE A



EXISTING GRADE (masl)	1054.38	1066.84	1089.16	1091.11	1094.12	1099.19
TRENCH INVERT (masl)	1049.80	1063.97	1082.75	1086.72	1088.32	1095.13
STATION (m)	7+100	7+500	8+000	8+500	9+000	9+300
PIPE SPECIFICATION	ND 750 mm DR9 HDPE (SEE NOTE 2)			ND 750 mm DR11 HDPE (SEE NOTE 2)		

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:
- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:
1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS.

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SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

DOF DOF

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS		

REVISIONS

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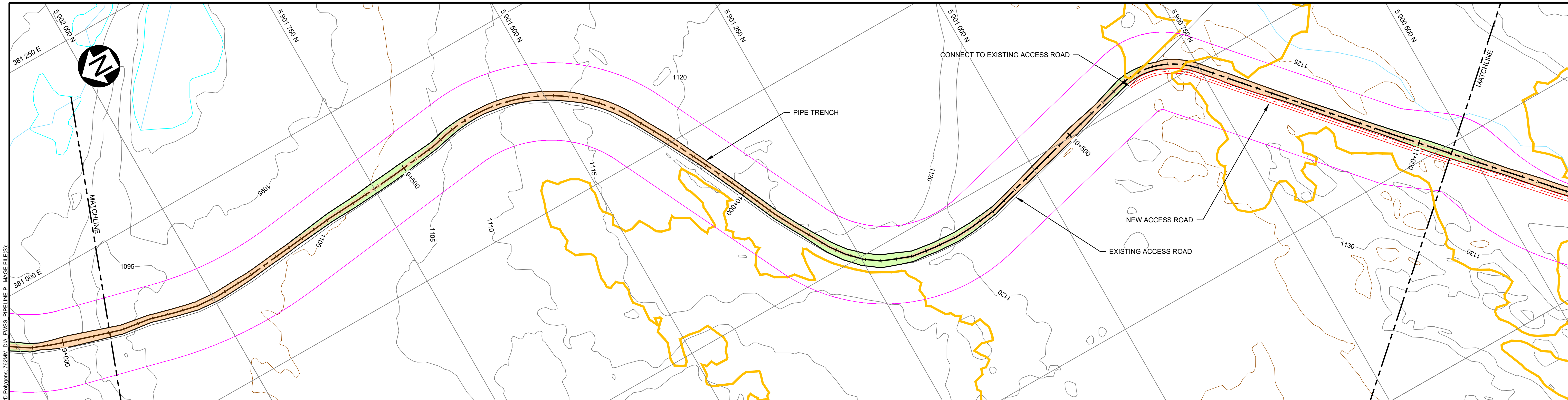
BLACKWATER GOLD PROJECT

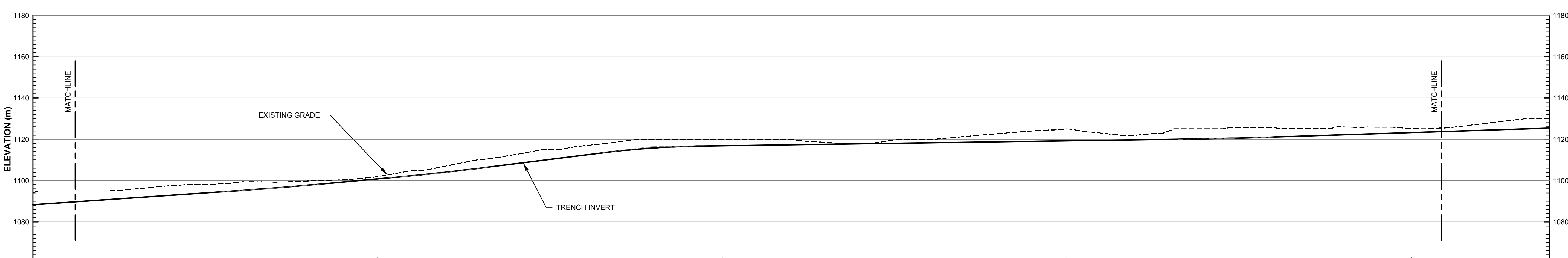
FRESH WATER SUPPLY SYSTEM WATER CONVEYANCE PLAN AND PROFILE (SHEET 5 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5415	0

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5415\C5415, 11/5/2021 8:25:24 AM , MFLYNN PRINTED: 11/5/2021 9:37:18 AM, C5415, SCAMMAYO ACAD VERSION: 23.1S (LMS TECH)



PLAN
SCALE A



EXISTING GRADE (masl)	1094.12	1101.93	1120.00	1124.98	1125.09	1129.88
TRENCH INVERT (masl)	1088.32	1100.80	1116.89	1119.27	1123.24	1125.41
STATION (m)	9+000	9+500	10+000	10+500	11+000	11+200
PIPE SPECIFICATION	ND 750 mm DR11 HDPE SEE NOTE 2)		ND 750 mm DR17 HDPE (SEE NOTE 2)			

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:

- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE DETAILS.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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PROFESSIONAL PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
ENGINEER
2021-11-05

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
G5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

REVISIONS

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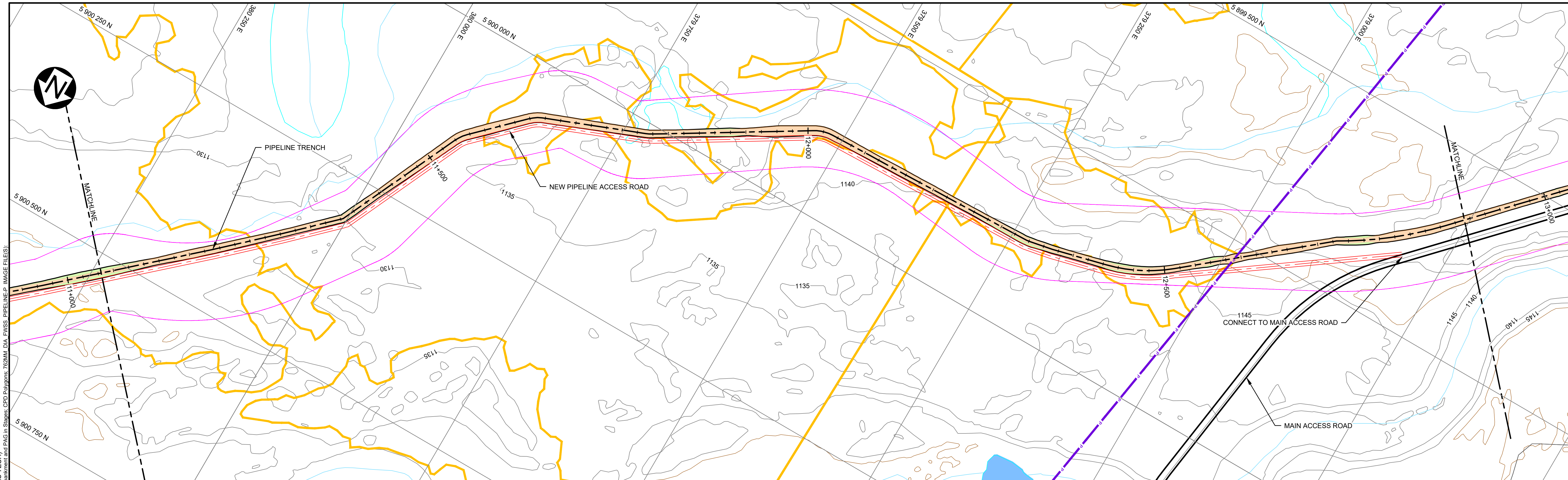
BLACKWATER GOLD PROJECT

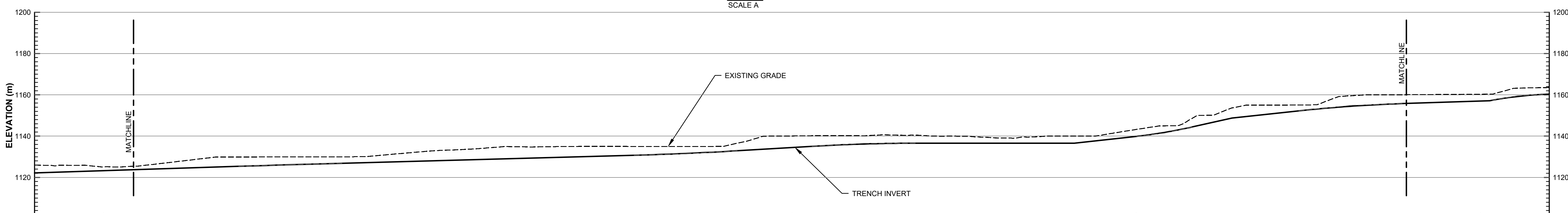
FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 6 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5416	0

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5416\C5416, 11/5/2021 11:27:10 AM , SCAMMAYO PRINTED: 11/5/2021 11:29:38 AM, C5416, SCAMMAYO ACAD VERSION: 23.1S (LMS TECH)



PLAN
SCALE A



EXISTING GRADE (masl)	1125.99	1125.09	1133.21	1140.08	1143.24	1160.30	1163.64
TRENCH INVERT (masl)	1122.16	1123.24	1128.26	1134.48	1139.89	1157.00	1160.37
STATION (m)	10+900	11+000	11+500	12+000	12+500	13+000	13+100
PIPE SPECIFICATION	ND 750 mm DR17 HDPE (SEE NOTE 2)						

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:

- FILL AREAS
- CUT AREAS
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD
- TRANSMISSION LINE

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE PROFILE.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

REVISIONS

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PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

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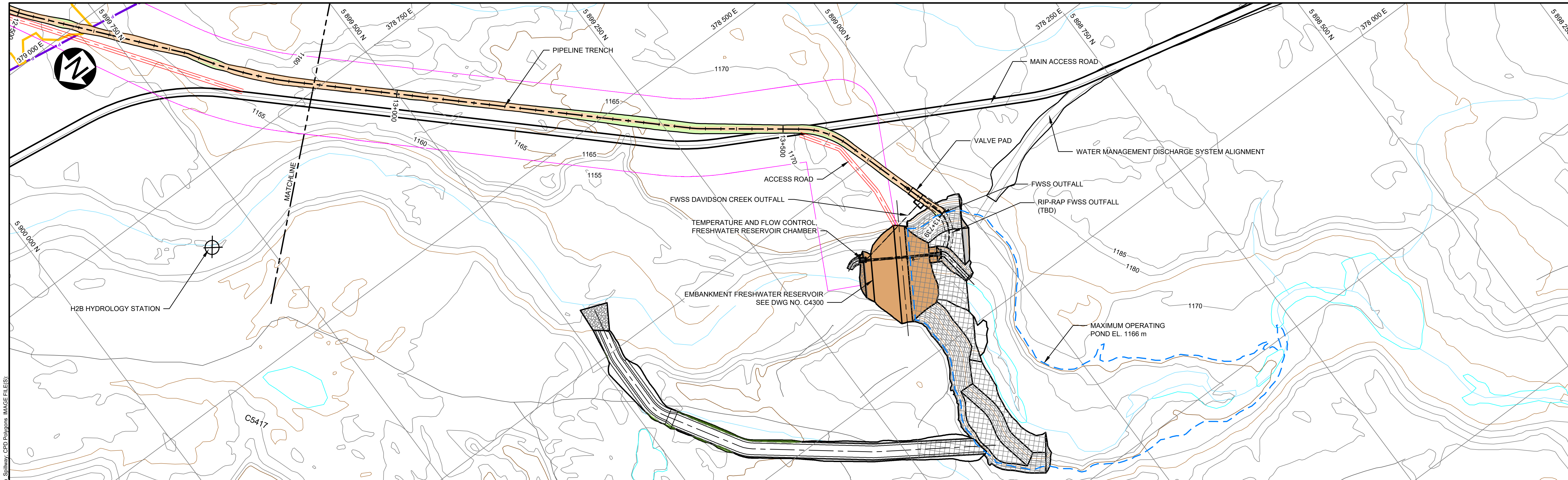
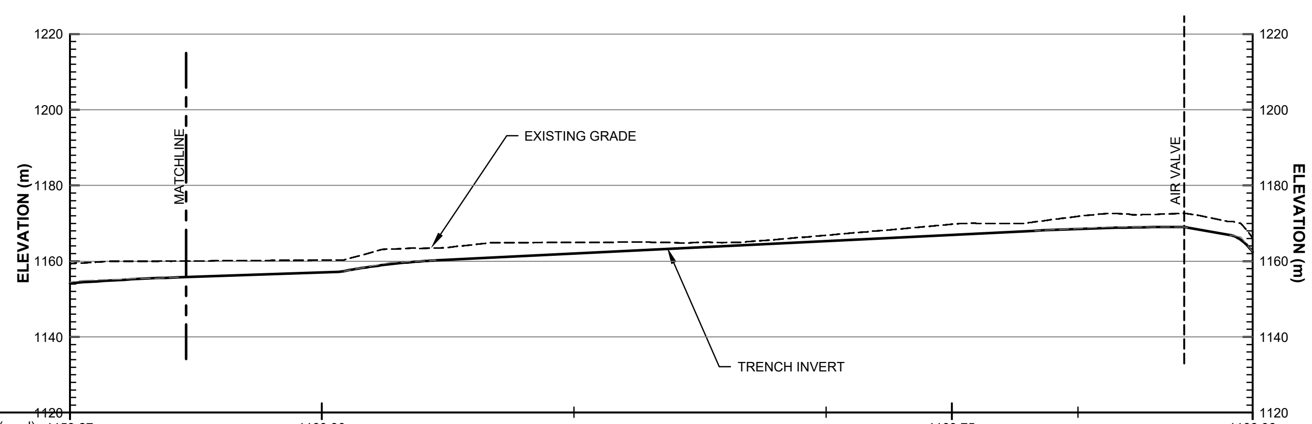
BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 7 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5417	0



PLAN
SCALE A



EXISTING GRADE (masl)	1159.27	1160.30	1169.75	1166.06
TRENCH INVERT (masl)	1154.18	1157.00	1166.97	1162.47
STATION (m)	12+800	13+000	13+500	13+739
PIPE SPECIFICATION	ND 750 mm DR17 HDPE (SEE NOTE 2)			

PROFILE
HORIZONTAL: SCALE B
VERTICAL: SCALE C

LEGEND:

- FILL AREAS
- CUT AREAS
- HDPE LINER
- EXISTING ACCESS TRAILS
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- FOREST TENURES
- SUNFIELD ENERGY INVESTIGATIVE LICENSE
- FWSS PIPELINE ACCESS ROAD

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. REFER TO DRAWING M5050 FOR PIPELINE PROFILE

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE C: 20 10 0 20 40 60 80 100 m
SCALE B: 60 30 0 100 200 300 m
SCALE A: 50 25 0 50 100 150 200 250 m

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PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE
PLAN AND PROFILE (SHEET 8 OF 8)

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5418	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
C4300	FRESH WATER RESERVOIR - EMBANKMENT - PLAN
M5050	FRESH WATER RESERVOIR - PIPELINE - PLAN AND PROFILE

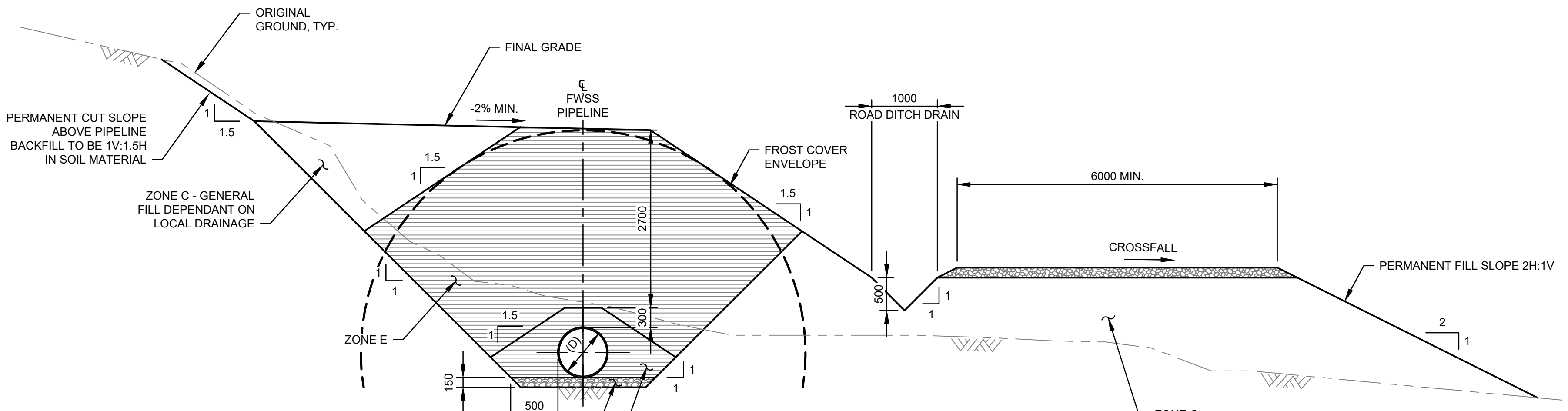
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

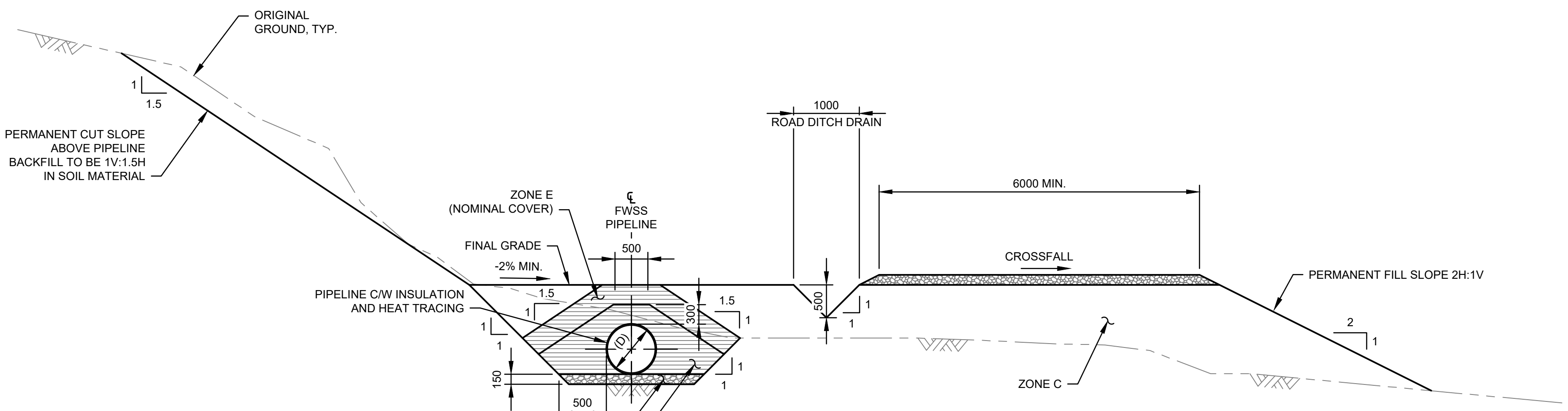
REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	BRS	DDF	DDF

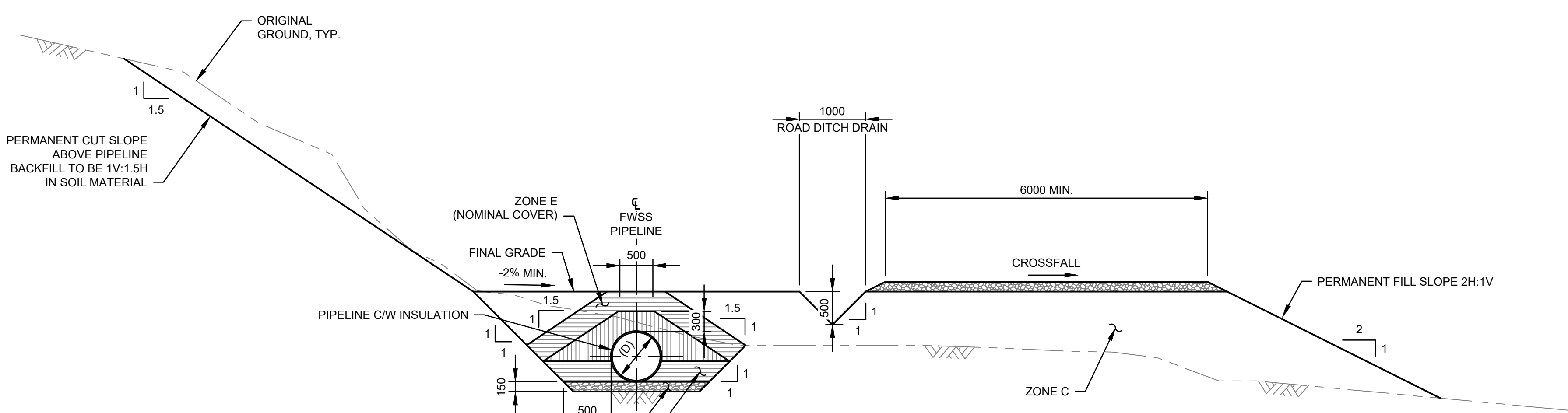
SAVED: M:\1\01\00457\33\A\Acad\DWGS\C5418\C5418, 11/5/2021 2:03:09 PM , ELEE PRINTED: 11/5/2021 2:03:44 PM, C5418, ELEE ACAD VERSION: 23.1S (LMS TECH)
XREF FILE(S): Hydro, Topo 5m Contours, Mine Access Road, Fresh Water Reservoir, Intake Structure Option B, PropertyBoundary, Existing Roads & Trails 2020, 762MM DIA FWSS PIPELINE-P, Fresh Water Reservoir Berm Spillway, CPD Polygons IMAGE FILE(S):



OPTION 1 - 3 m BURIAL DEPTH
PIPE CUT SLOPE ADJACENT TO ROAD
SCALE A



OPTION 2 - PIPE INSULATION AND HEAT TRACING
PIPE CUT SLOPE ADJACENT TO ROAD
SCALE A



OPTION 3 - PIPE INSULATION AND LOW CONDUCTIVITY BACKFILL
PIPE CUT SLOPE ADJACENT TO ROAD
SCALE A

LEGEND:

- ZONE C
- ZONE D
- ZONE E
- LOW CONDUCTIVITY / INSULATING MATERIAL
- WEARING COURSE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006..
2. FOR FILL MATERIAL SPECIFICATIONS SEE DRAWING G0040.
3. WHERE THE DOWNSLOPE SIDE OF THE PIPE IS NOT IN TRENCH, THE PROFILE SHALL BE MADE UP OF ENGINEERED FILL.
4. EROSION PROTECTION OF ALL FILL SLOPES WILL BE REQUIRED TO THE SATISFACTION OF THE ENGINEER.
5. TRANSVERSE DRAINAGE, CONSISTING OF ND100 NON-PERFORATED CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE AT 2% GRADE, TO BE PROVIDED AT LOCATIONS.
6. OPTION 4 - ALIGNMENT OPTIMIZATION WITH OPTION 2 BACKFILL AND OPERATIONAL CONTROLS TO ALLOW AUTOMATED DRAINING OF THE PIPELINE.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 1 0.5 0 1 2 3 4 5 m

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PROFESSIONAL ENGINEER – PROVINCE OF BRITISH COLUMBIA – B. S. FICHOT # 30575
2021-11-05
DDF DDF

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BW GOLD LTD.

BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE PIPELINE
ALTERNATIVE SECTIONS FOR FROST PROTECTION
1 OF 3

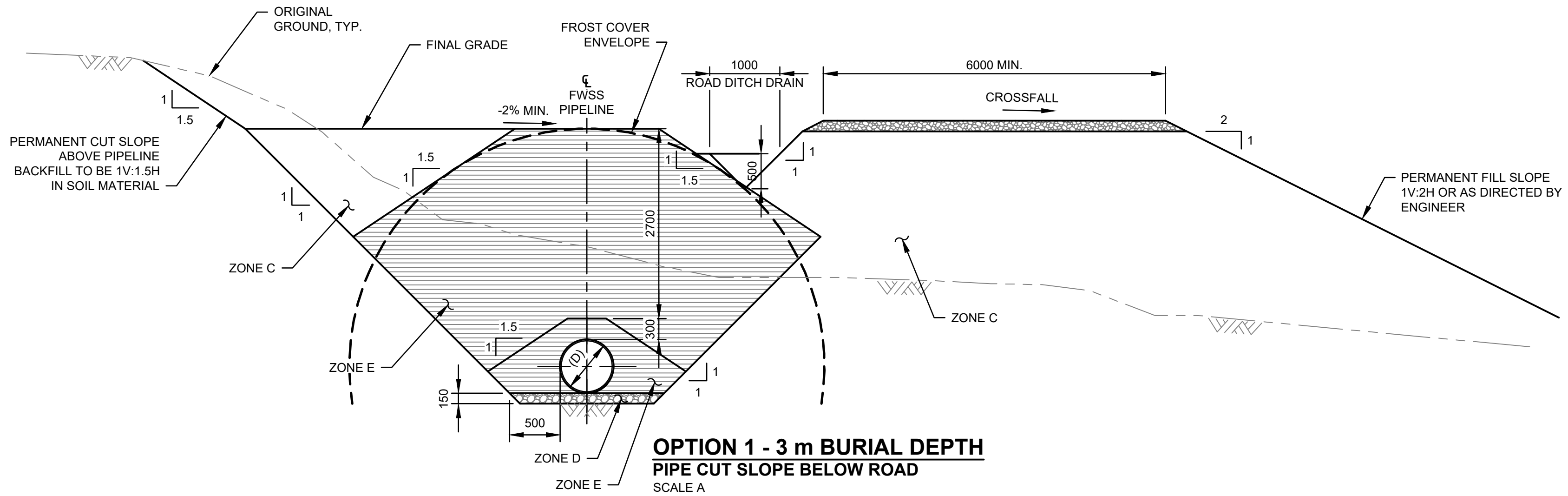
P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5420	0

REFERENCE DRAWINGS

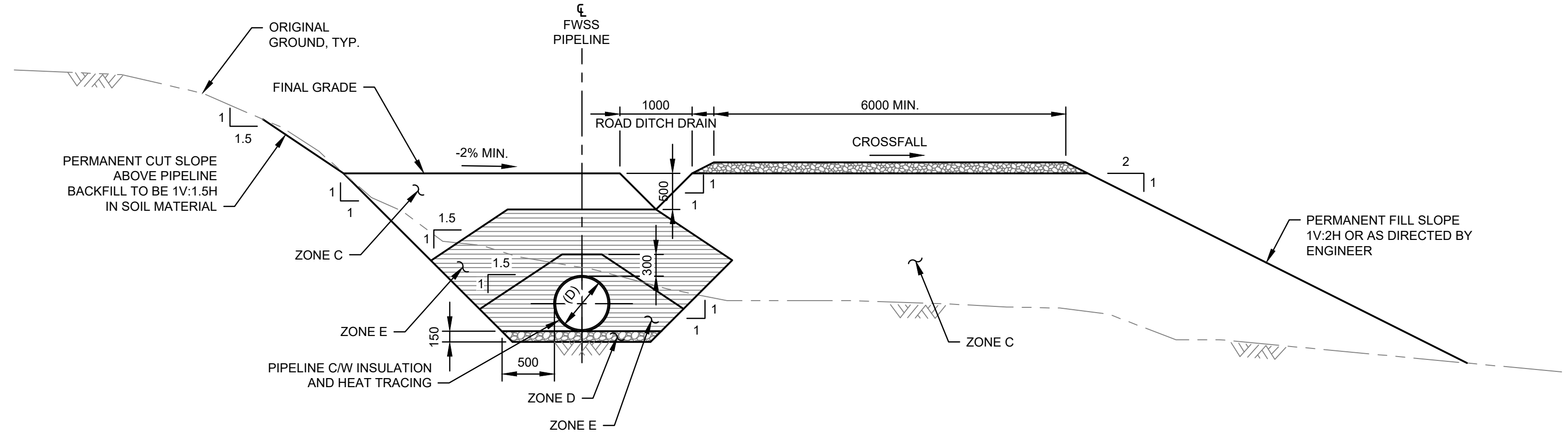
DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
G0040	CONSTRUCTION MATERIAL GRADATIONS

REVISIONS

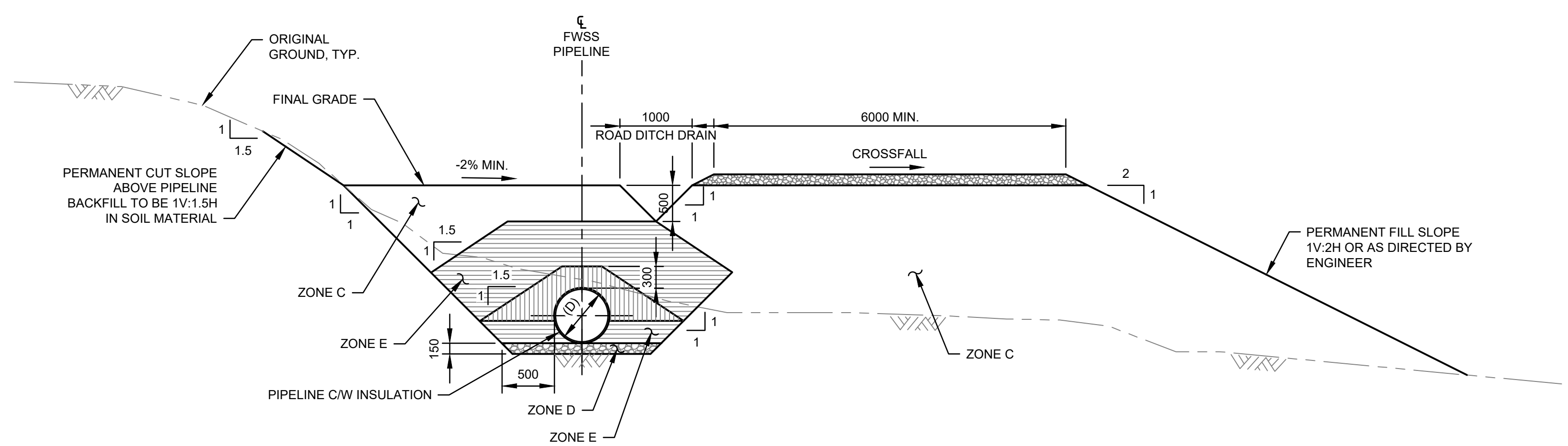
REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC		



OPTION 1 - 3 m BURIAL DEPTH
PIPE CUT SLOPE BELOW ROAD
SCALE A



OPTION 2 - PIPE INSULATION AND HEAT TRACING
PIPE CUT SLOPE BELOW ROAD
SCALE A



OPTION 3 - PIPE INSULATION AND LOW CONDUCTIVITY BACKFILL
PIPE CUT SLOPE BELOW ROAD
SCALE A

LEGEND:

- ZONE C
- ZONE D
- ZONE E
- LOW CONDUCTIVITY / INSULATING MATERIAL
- WEARING COURSE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006..
2. FOR FILL MATERIAL SPECIFICATIONS SEE DRAWING G0040.
3. WHERE THE DOWNSLOPE SIDE OF THE PIPE IS NOT IN TRENCH, THE PROFILE SHALL BE MADE UP OF ENGINEERED FILL.
4. EROSION PROTECTION OF ALL FILL SLOPES WILL BE REQUIRED TO THE SATISFACTION OF THE ENGINEER.
5. TRANSVERSE DRAINAGE, CONSISTING OF ND100 NON-PERFORATED CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE AT 2% GRADE, TO BE PROVIDED AT LOCATIONS.
6. OPTION 4 - ALIGNMENT OPTIMIZATION WITH OPTION 2 BACKFILL AND OPERATIONAL CONTROLS TO ALLOW AUTOMATED DRAINING OF THE PIPELINE.

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SCALE A 1 0.5 0 1 2 3 4 5 m

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PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
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2021-11-05

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE PIPELINE
ALTERNATIVE SECTIONS FOR FROST PROTECTION
2 OF 3

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5421	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
G0040	CONSTRUCTION MATERIAL GRADATIONS

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC		

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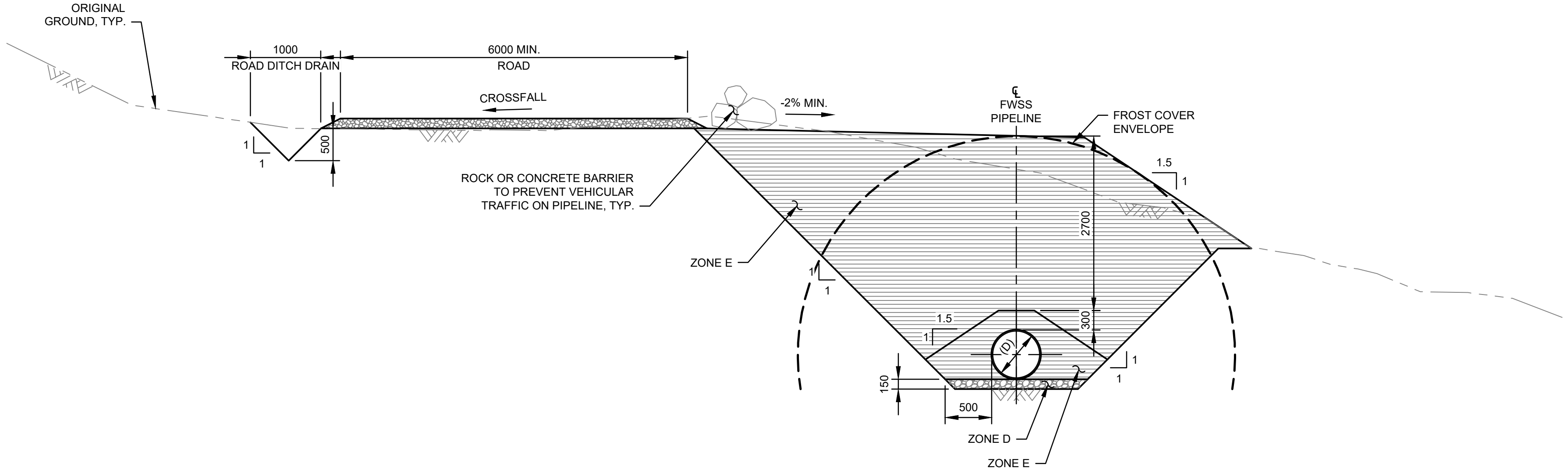
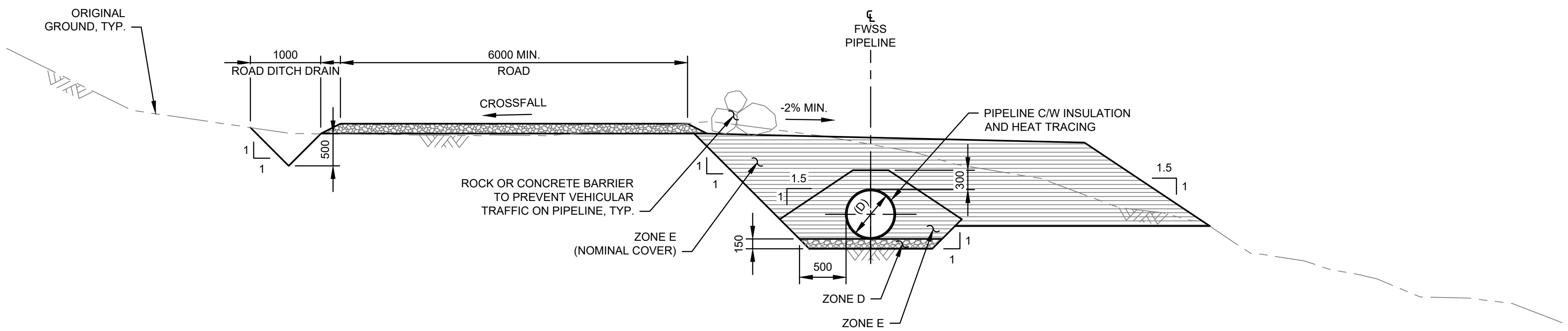


OPTION 1 - 3 m BURIAL DEPTH

ROAD ON UPSLOPE SIDE OF PIPELINE

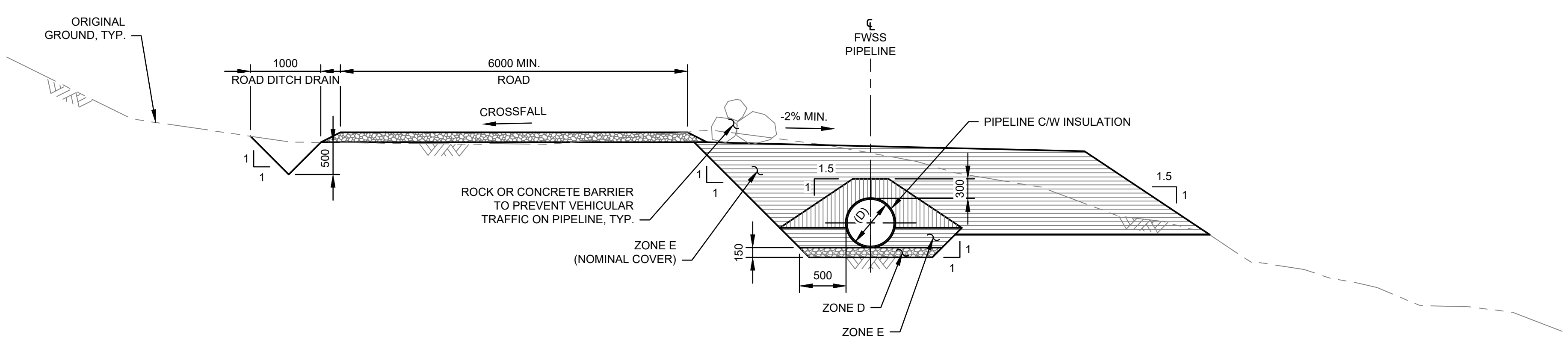
SCALE A



OPTION 2 - PIPELINE INSULATION AND HEAT TRACING

ROAD ON UPSLOPE SIDE OF PIPELINE

SCALE A



OPTION 3 - PIPE INSULATION AND LOW CONDUCTIVITY BACKFILL

ROAD ON UPSLOPE SIDE OF PIPELINE

SCALE A

LEGEND:

- ZONE C
- ZONE D
- ZONE E
- LOW CONDUCTIVITY / INSULATING MATERIAL
- WEARING COURSE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006..
2. FOR FILL MATERIAL SPECIFICATIONS SEE DRAWING G0040.
3. WHERE THE DOWNSLOPE SIDE OF THE PIPE IS NOT IN TRENCH, THE PROFILE SHALL BE MADE UP OF ENGINEERED FILL.
4. EROSION PROTECTION OF ALL FILL SLOPES WILL BE REQUIRED TO THE SATISFACTION OF THE ENGINEER.
5. TRANSVERSE DRAINAGE, CONSISTING OF ND100 NON-PERFORATED CORRUGATED HIGH DENSITY POLYETHYLENE (HDPE) PIPE AT 2% GRADE, TO BE PROVIDED AT LOCATIONS.
6. OPTION 4 - ALIGNMENT OPTIMIZATION WITH OPTION 2 BACKFILL AND OPERATIONAL CONTROLS TO ALLOW AUTOMATED DRAINING OF THE PIPELINE.

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

SCALE A 1 0.5 0 1 2 3 4 5 m

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
B. S. FICHOT
30575
2021-11-05

DDF DDF

Knight Piésold CONSULTING

BW GOLD LTD.

BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
WATER CONVEYANCE PIPELINE
ALTERNATIVE SECTIONS FOR FROST PROTECTION
3 OF 3

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C5422	0

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
G0040	CONSTRUCTION MATERIAL GRADATIONS

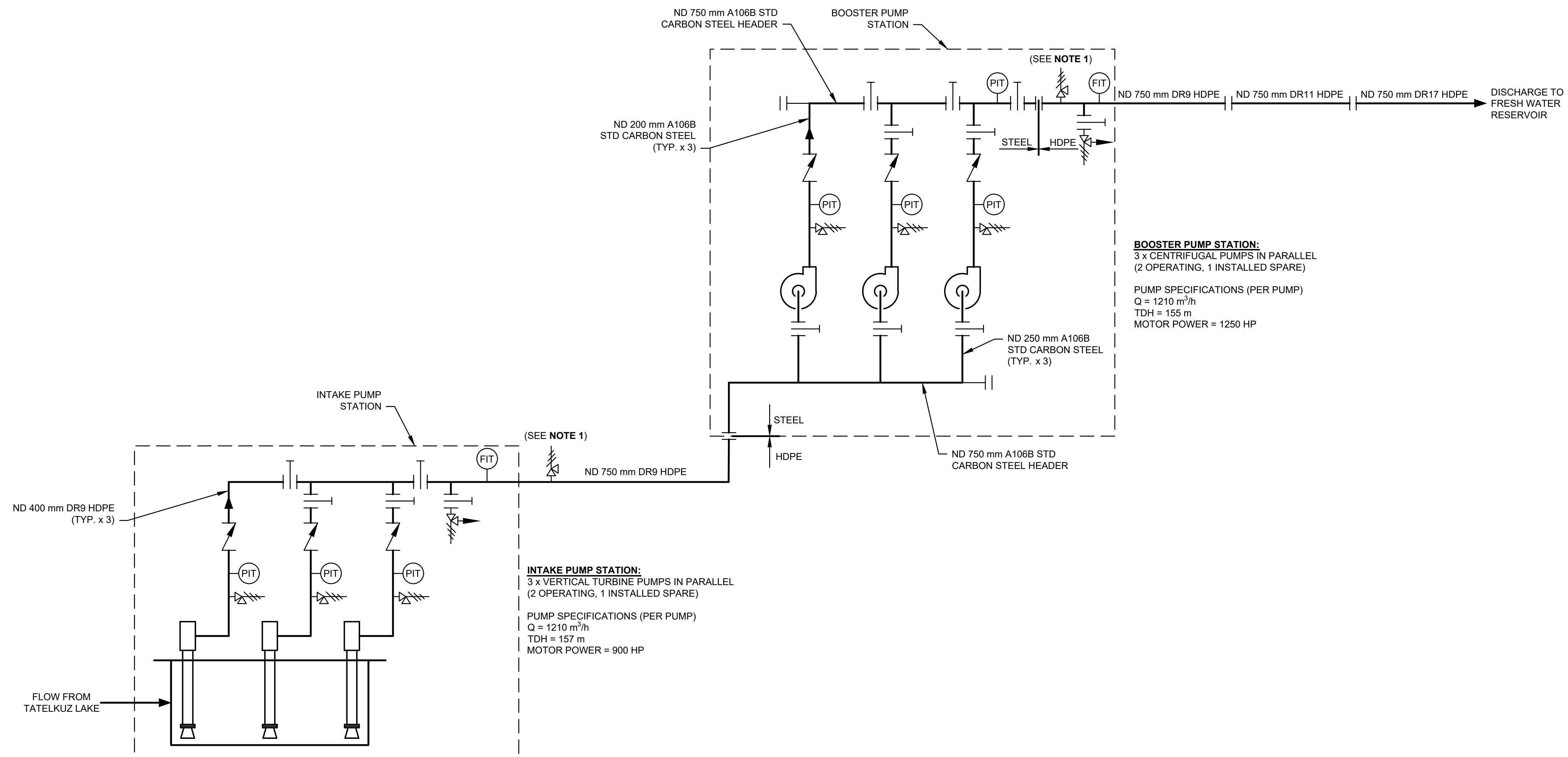
REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	BXF	SKC		

REVISIONS



BOOSTER PUMP STATION:
3 x CENTRIFUGAL PUMPS IN PARALLEL
(2 OPERATING, 1 INSTALLED SPARE)

PUMP SPECIFICATIONS (PER PUMP)
Q = 1210 m^3/h
TDH = 155 m
MOTOR POWER = 1250 HP

INTAKE PUMP STATION:
3 x VERTICAL TURBINE PUMPS IN PARALLEL
(2 OPERATING, 1 INSTALLED SPARE)

PUMP SPECIFICATIONS (PER PUMP)
Q = 1210 m^3/h
TDH = 157 m
MOTOR POWER = 900 HP

LEGEND:

- PIPE FLOW
- FLOW DIRECTION
- FLANGED CONNECTION
- BLIND FLANGE
- GATE VALVE
- AIR VALVE / VACUUM RELIEF COMBINATION VALVE
- PRESSURE RELIEF VALVE
- CHECK GATE VALVE
- PIT — PRESSURE INDICATOR / TRANSMITTER
- FIT — FLOW INDICATOR / TRANSMITTER
- CENTRIFUGAL PUMP
- VERTICAL TURBINE PUMP

BY OTHERS
BATTERY LIMIT
KNIGHT PIÉSOLD SCOPE OF WORK

NOTES:

1. NOT ALL AIR/VACUUM RELIEF AND DRAIN VALVES ARE SHOWN ALONG PIPELINE INFRASTRUCTURE. REFER TO PIPELINE ALIGNMENT AND PROFILE DRAWING M5050 FOR ADDITIONAL PIPELINE ALIGNMENT DETAILS.
2. HEAT TRACING AND INSULATION OR OTHER SUITABLE WEATHER PROTECTION SUCH AS AN INSULATED AND HEATED ENCLOSURE IS REQUIRED ON ALL PUMP STATION EQUIPMENT, COMBINATION AIR/VACUUM RELEASE VALVES, AND DRAIN POINTS.

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XREF FILE(S): IMAGE FILE(S):

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2021-11-15

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
PIPING AND INSTRUMENTATION DIAGRAM

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	M5005	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
M5070	FRESH WATER SUPPLY SYSTEM - BOOSTER STATION - PLAN
M5060	FRESH WATER SUPPLY SYSTEM - INTAKE PUMP STATION - PLAN AND SECTION
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND PROFILE

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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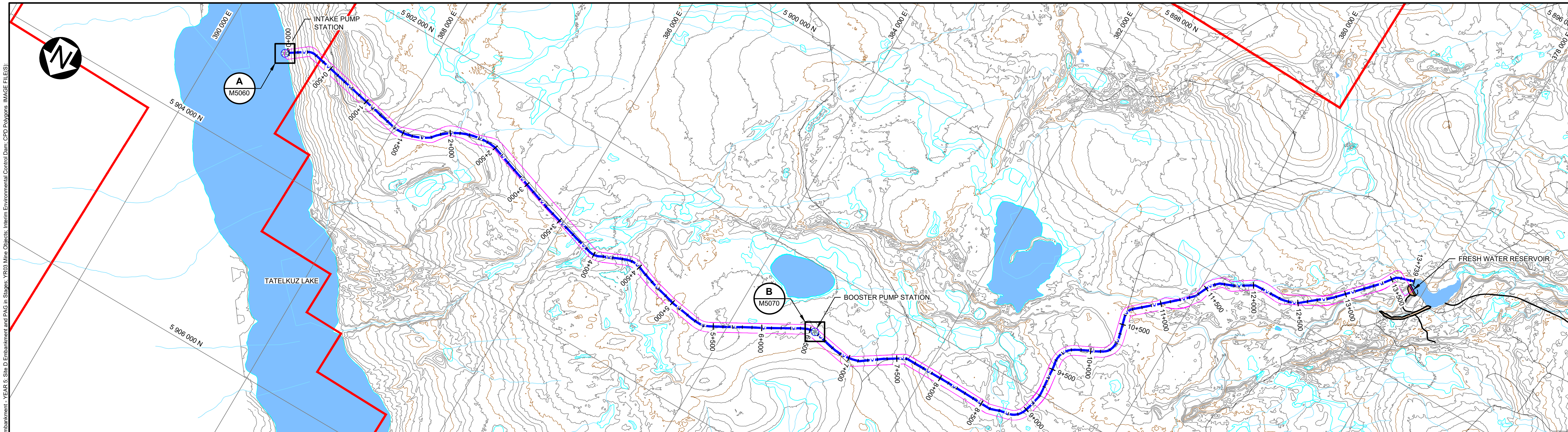
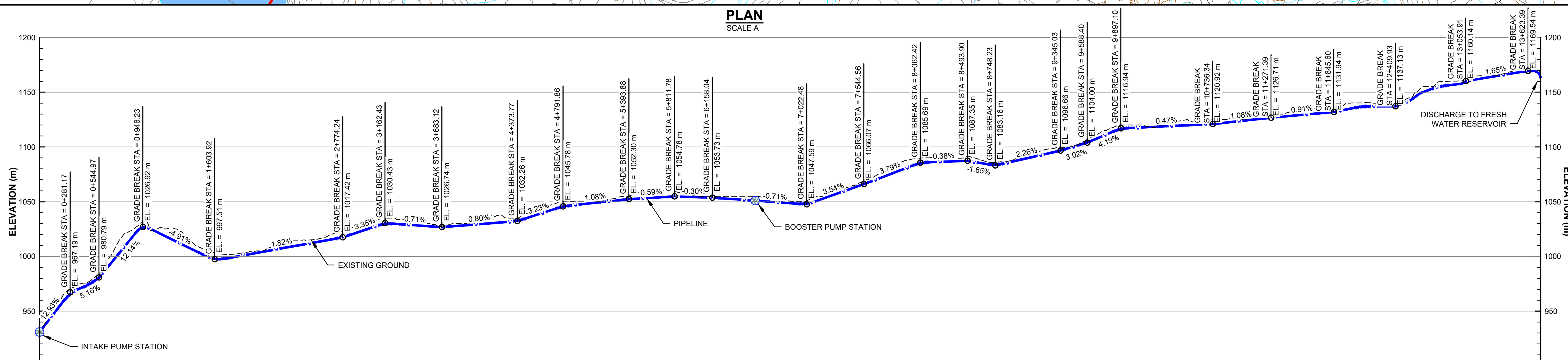


PLAN
SCALE A



STATION (m)	0+000	0+500	1+000	1+500	2+000	2+500	3+000	3+500	4+000	4+500	5+000	5+500	6+000	6+500	7+000
GROUND ELEVATION (m)	932.18	980.55	1028.13	1006.70	1005.02	1015.28	1030.55	1030.91	1034.05	1040.00	1049.98	1059.48	1055.26	1055.01	1050.31
PIPE INVERT ELEVATION (m)	930.83	977.48	1025.99	1001.53	1003.45	1012.40	1024.98	1028.04	1029.27	1036.34	1048.03	1052.93	1054.21	1051.30	1048.14

STATION (m)	7+500	8+000	8+500	9+000	9+500	10+000	10+500	11+000	11+500	12+000	12+500	13+000	13+500	13+739
GROUND ELEVATION (m)	1066.84	1089.16	1091.11	1094.12	1101.93	1120.00	1124.98	1125.09	1133.21	1140.08	1143.24	1160.30	1169.75	1166.06
PIPE INVERT ELEVATION (m)	1064.50	1083.28	1087.25	1088.85	1101.34	1117.43	1119.80	1123.77	1128.79	1135.01	1140.42	1157.53	1167.50	1163.00

PIPE SPECIFICATION: ND 750 mm DR9 HDPE | ND 750 mm DR17 HDPE | ND 750 mm DR9 HDPE | ND 750 mm DR11 HDPE | ND 750 mm DR17 HDPE

LEGEND:

- FRESH WATER
- EMBANKMENT FILL
- EXISTING ACCESS TRAILS
- ACCESS ROAD
- CONSTRUCTION ROAD
- PROPERTY BOUNDARY
- CERTIFIED PROJECT DESCRIPTION BOUNDARY
- WATER CONVEYANCE PIPELINE
- PUMP STATION

NOTES:

1. INSTRUMENTATION DEVICES ARE NOT SHOWN AT THIS STAGE OF DESIGN.
2. LOCATION OF ALL AIR / VACUUM RELIEF VALVES NOT SHOWN. AIR / VACUUM RELIEF VALVES TO BE LOCATED AT ALL HIGH / LOW POINTS OR AT A MAXIMUM SPACING OF 600 m.
3. FOR GENERAL NOTES SEE DRAWING G0006.
4. FOR THE FWSS PIPING AND INSTRUMENTATION DIAGRAM REFER TO DRAWING M5005.
5. PIPELINE ALIGNMENT RELATIVE TO ACCESS ROAD ALIGNMENT IS PRESENTED ON DRAWING C5410

PROFILE
FRESH WATER SUPPLY SYSTEM PIPELINE
HORIZONTAL: SCALE A
VERTICAL: SCALE B

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SCALE B: 80 40 0 100 200 300 400 m
SCALE A: 400 200 0 400 800 1200 1600 2000 m

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2021-11-15

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM PIPELINE PLAN AND PROFILE

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	M5050	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C5410	FRESH WATER SUPPLY SYSTEM - WATER CONVEYANCE - GENERAL ARRANGEMENT
G0006	CIVIL GENERAL NOTES
M5005	FRESH WATER SUPPLY SYSTEM - PIPING AND INSTRUMENTAL DIAGRAM
M5060	FRESH WATER SUPPLY SYSTEM - WATER PUMP STATION - PLAN AND SECTION
M5070	FRESH WATER SUPPLY SYSTEM - BOOSTER STATION - PLAN

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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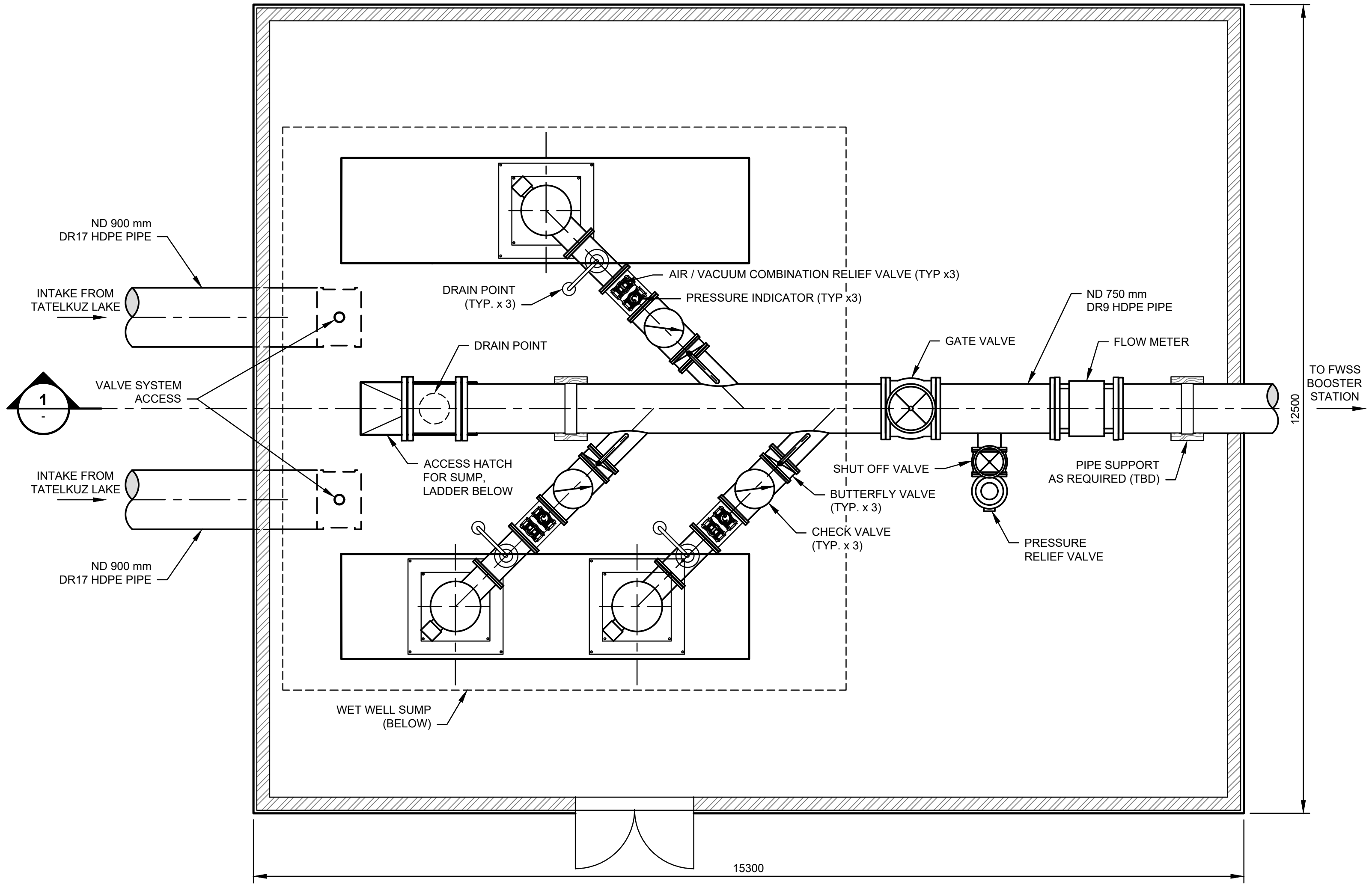
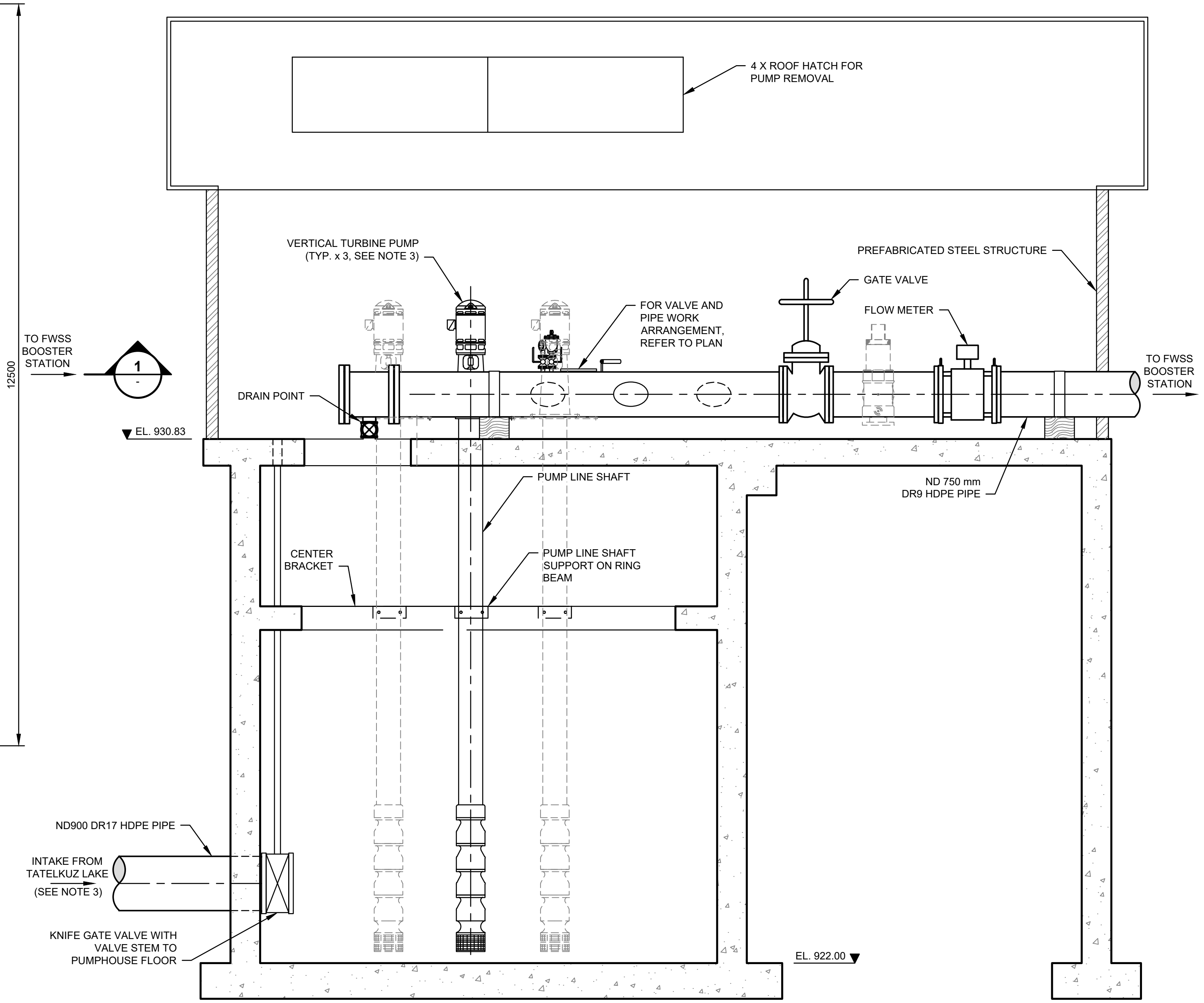


PLAN
SCALE A



SECTION
PUMP STATION
SCALE A

FOR INFORMATION ONLY
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SCALE A 1 0.5 0 1 2 3 4 5 m

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006.
2. REFER TO DRAWING C5300 AND C5310 FOR WATER STRUCTURE CIVIL DESIGN DETAILS.
3. REFER TO DRAWING M5005 FOR PUMP PERFORMANCE SPECIFICATIONS.

DRG. NO.	DESCRIPTION
C5300	FRESH WATER SUPPLY SYSTEM - INTAKE STRUCTURE - OVERVIEW
C5310	FRESH WATER SUPPLY SYSTEM - INTAKE STRUCTURE - PLAN AND SECTION
G0006	CIVIL GENERAL NOTES
M5005	FRESH WATER SUPPLY SYSTEM - PIPING AND INSTRUMENTAL DIAGRAM
M5050	FRESH WATER SUPPLY SYSTEM - PIPELINE - PLAN AND SECTION
C5310	FRESH WATER SUPPLY SYSTEM - INTAKE STRUCTURE - PLAN AND SECTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
INTAKE PUMP STATION
PLAN AND SECTION

P/A NO.	DRAWING NO.	REVISION
VA101-457-33	M5060	0

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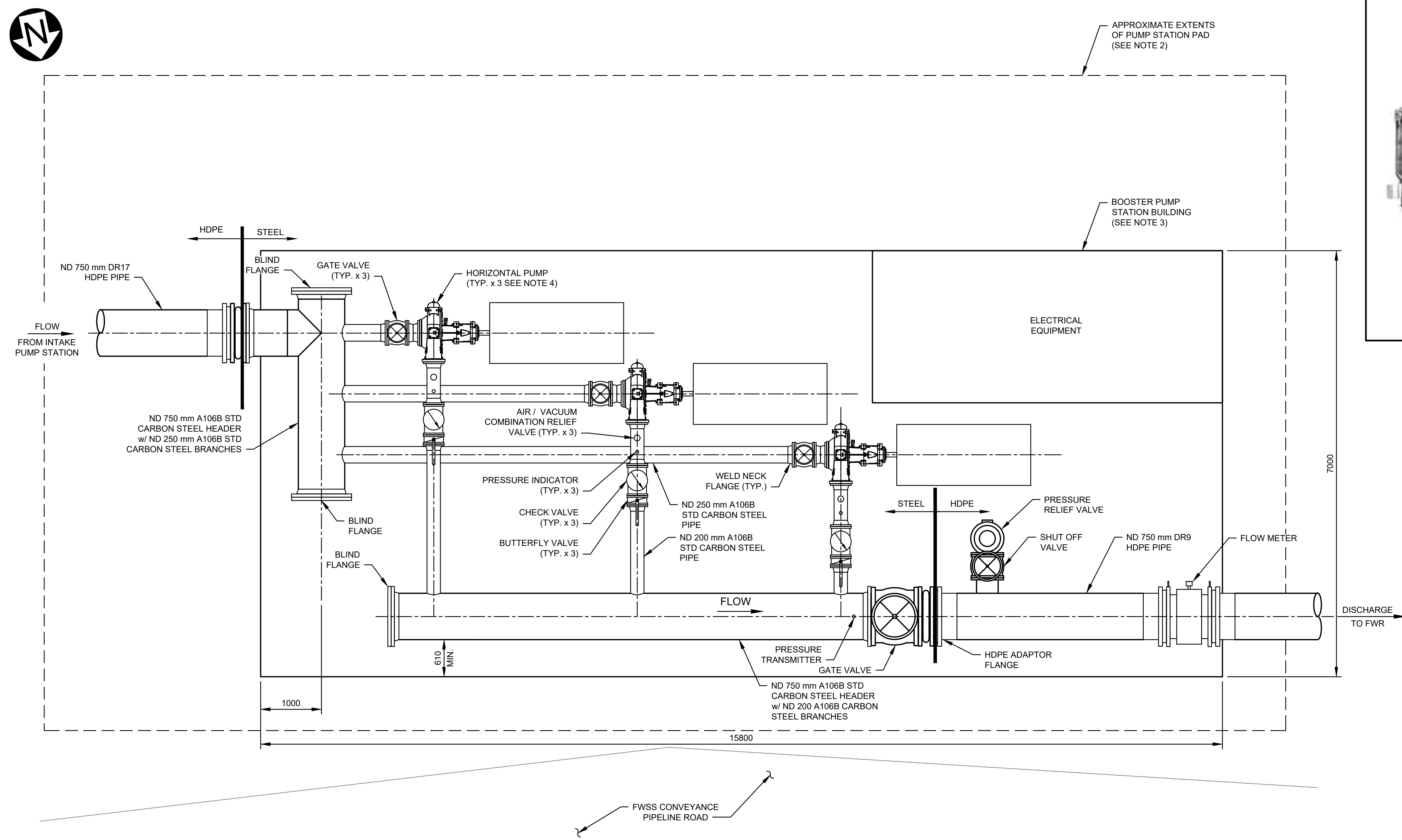
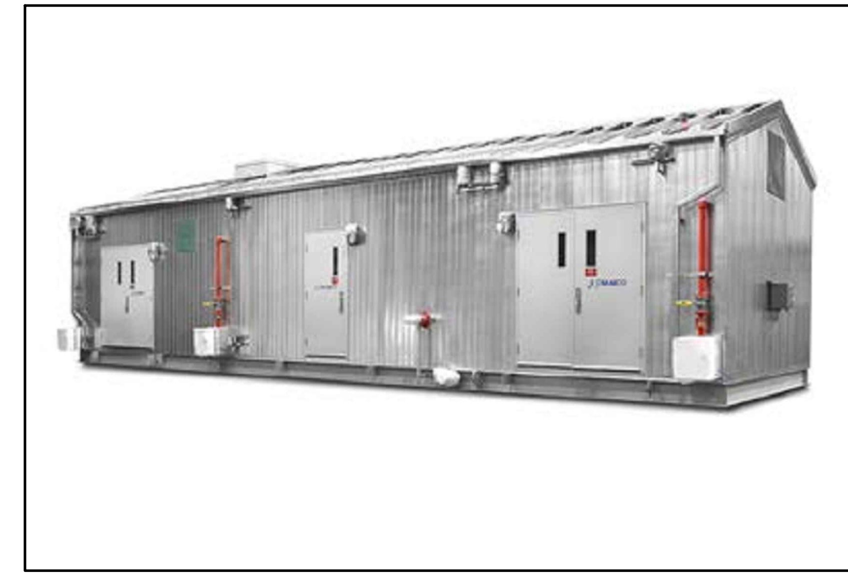


B
M5050
PLAN
BOOSTER PUMP STATION
SCALE A



TYPICAL PUMP SKID BUILDING
FOR ILLUSTRATION PURPOSES ONLY
(SEE NOTE 3)

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. PUMP STATION PAD TO BE CLEARED / COMPACTED TO PROVIDE COMPETENT SURFACE FOR PUMP STATION SEACAN, AS REQUIRED. PAD DETAILS TO BE CONFIRMED DURING SUBSEQUENT DESIGN PHASES.
3. PUMP STATION CONFIGURATION AS PER PUMP SUPPLIER RECOMMENDATIONS, EXACT PUMP / EQUIPMENT LAYOUT AND BUILDING DETAILS TO BE CONFIRMED DURING SUBSEQUENT DESIGN PHASES, IN CONJUNCTION WITH THE EQUIPMENT SUPPLIER.
4. REFER TO DRAWING M5005 FOR PUMP PERFORMANCE SPECIFICATIONS.

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0.8 0.4 0 1 2 3 4 mm
SCALE A

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
M5005	FRESH WATER SUPPLY SYSTEM - PIPING AND INSTRUMENTAL DIAGRAM
M5050	FRESH WATER SUPPLY SYSTEM - PLAN AND SECTION

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	04NOV'21	ISSUED FOR PERMITTING	MRF	EL		

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BLACKWATER GOLD PROJECT

FRESH WATER SUPPLY SYSTEM
BOOSTER STATION
PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	M5070	0

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XREF FILE(S): CPD Polygons Existing Roads & Trails 2020, Whole LIDAR_tm: Booster Station Pad IMAGE FILE(S):

APPENDIX E

Tatelkuz Lake Information

(Pages E-1 to E-6)

APPENDIX E
TATELKUZ LAKE INFORMATION – FRESH WATER SUPPLY SYSTEM DESIGN REPORT

1.0 GENERAL

Tatelkuz Lake is a long narrow lake located approximately 15 km northeast of the proposed Project site. The Tatelkuz Lake Indian Reserve 28 (IR 28) is located on the northwest side of the lake. Chedakuz Creek drains the lake and flows towards the northwest through IR 28 towards the confluence with Davidson Creek further within the reservoir.

2.0 TATELKUZ LAKE DEPTH AREA CAPACITY CURVE

The Tatelkuz Lake area and capacity relationships are shown in the Elevation-Area-Capacity curves on Figure 2.1. The relationships are based on the bathymetric survey with 2 m contour resolution that was performed on Tatelkuz Lake by AMEC on June 9, 2013.

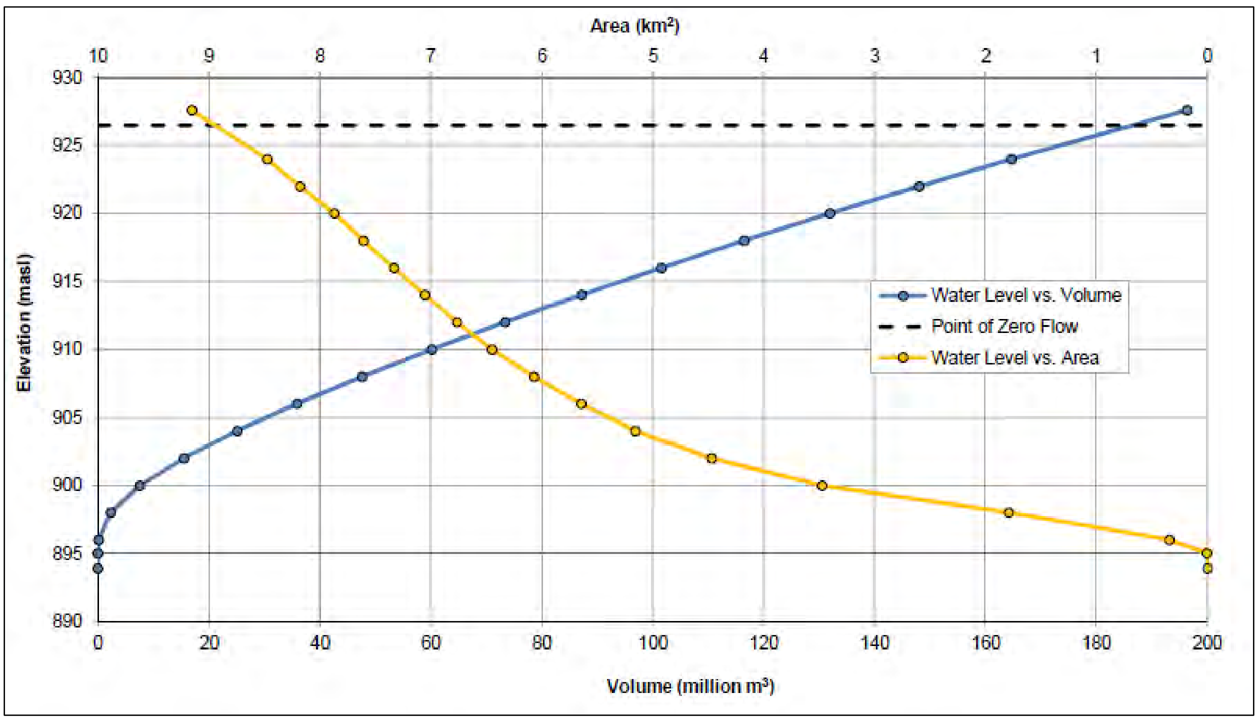

Figure 2.1 Tatelkuz Lake Depth Area Capacity Curve

Note(s):

1. KP, 2013a.

3.0 TATELKUZ LAKE WATER LEVELS

Streamflow monitoring stations and water level monitoring stations are operated within the Tatelkuz Lake watershed. Recorded water surface elevations are shown in Figure 3.1. Tatelkuz Lake – L1 was installed in April 2012 to monitor lake levels and remains active. The station is located on Tatelkuz Lake. Outlet of Tatelkuz Lake – L1-Outlet was installed in May 2012 to monitor streamflow and remains active. The station is located at the outlet of Tatelkuz Lake.

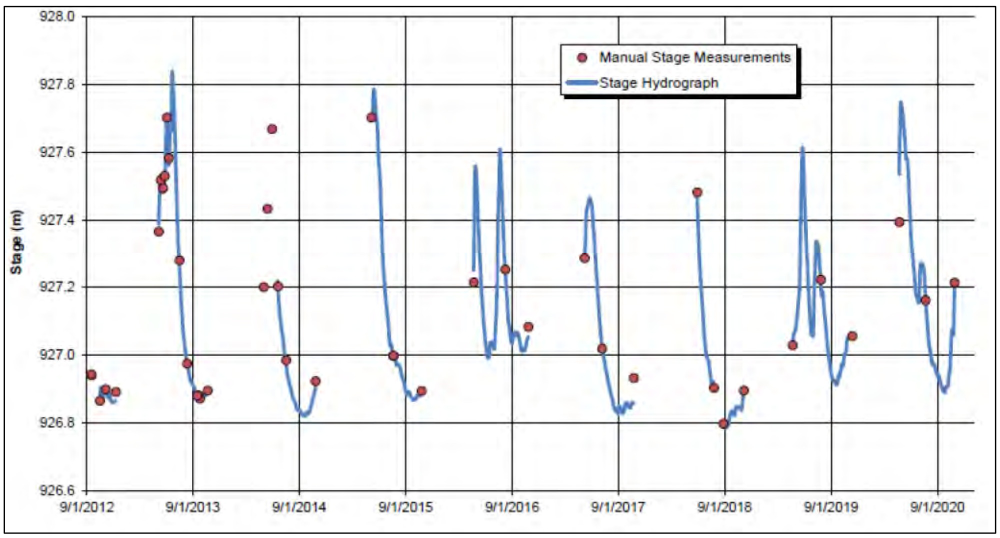

Figure 3.1 Tatelkuz Lake Station L1 Stage

Note(s):

1. KP, 2021c.

KP completed an analysis of the lake level changes at Tatelkuz Lake in 2013 letter (KP, 2013a). The estimated lake levels were based on measured lake levels and estimated discharges at the outlet to Chedakuz Creek. The resultant Long Term Synthetic Stage Series Tatelkuz Lake is shown in Figure 3.2. and the associated Long Term Stage Series Scatter Plot in Figure 3.3.

The resulting estimated long-term water surface levels inform the design of the FWSS. The results indicated that the maximum lake level fluctuation was on the order of approximately 2 m during the period of record, while on average the lake level fluctuates within approximately 0.8 m annually. The lake levels are the highest during the freshet period from April to August, while they vary within a relatively narrow margin during the rest of the year.

As a result of the 2013 analysis, for the purpose of design it will be assumed:

- Point of zero outflow: 926.5 masl
- The lowest historical lake elevation: 926.8 masl
- The highest historical lake elevation: 929.0 masl

These elevations are not currently associated with a specific return period and will need to be further evaluated considering the return period of the design flood during future design stages.

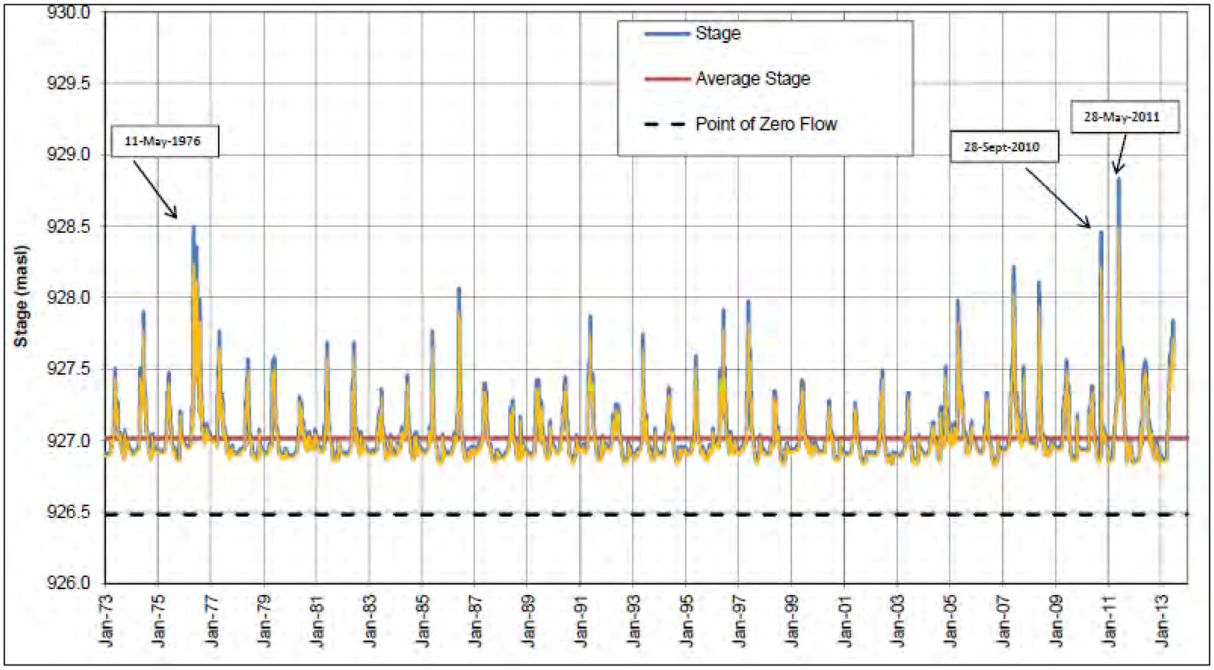

Figure 3.2 Tatelkuz Lake Long Term Synthetic Stage Series

Note(s):

1. KP 2013a.

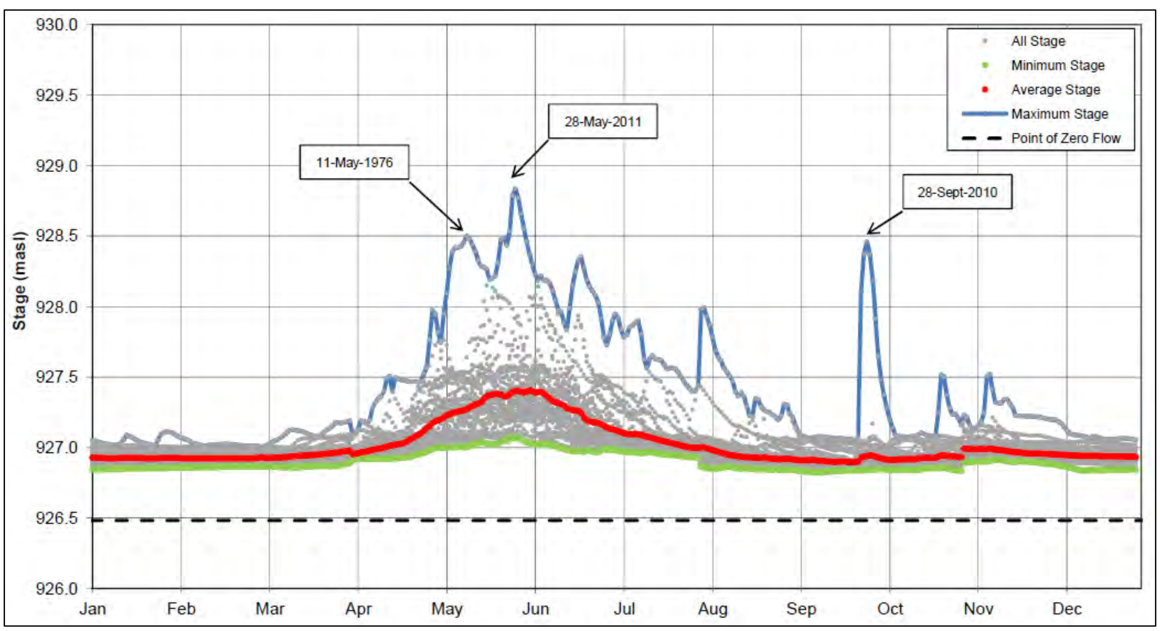

Figure 3.3 Tatelkuz Lake Long Term Stage Series Scatter Plot

Note(s):

1. KP, 2013a.
2. Synthetic stage series is based on the combined measured and synthetic discharge series for the lake outlet developed for the period Jan 1973 - May 2013.

4.0 TATELKUZ LAKE WATER TEMPERATURE

In 2016, KP estimated daily and monthly thermal changes in Tatelkuz Lake using a freshwater lake model called FLake (KP, 2016a). FLake can estimate the vertical temperature structure and mixing conditions in lakes overtime. The model was developed for use as a lake parameterization scheme in numerical weather predictions and climate modeling, but it has also been used as a stand-alone lake model.

Long-term epilimnion and hypolimnion temperatures, as well as epilimnion thickness values were calculated using the calibrated model. The results are shown in Table 4.1 below. The thermocline is a thin but distinct layer in a large body of water in which temperature changes more drastically with depth than it does in the layers above or below. Temperature variability decreases in the hypolimnion, with a thermocline occurring approximately between 2 m and 10 m below the water surface, depending on the season.

Table 4.1 Modeled Long-Term Temperature and Epilimnion Thickness for Tatelkuz Lake

Parameter		Units	January	February	March	April	May	June	July	August	September	October	November	December
Epilimnion Temperature	Minimum Daily	°C	0.0	0.0	0.0	0.0	0.0	3.2	11.0	13.2	9.9	5.4	0.0	0.0
	Mean	°C	0.0	0.0	0.0	0.0	1.5	9.1	14.5	15.5	12.8	8.3	3.7	0.1
	Maximum Daily	°C	0.0	0.0	0.0	0.0	7.2	14.3	18.7	20.5	17.6	13.6	7.3	1.9
Hypolimnion Temperature	Minimum Daily	°C	3.5	3.9	4.0	4.0	3.8	4.0	4.0	4.0	4.0	4.0	3.1	3.1
	Mean	°C	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.1	4.0	4.3	4.4	3.8
	Maximum Daily	°C	4.0	4.0	4.0	4.0	4.1	5.0	4.8	4.9	4.3	7.6	6.9	4.0
Epilimnion Thickness	Minimum Daily	m	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.3	6.3	11.0	0.0	0.0
	Mean	m	1.2	0.3	0.0	0.0	0.9	3.6	3.3	5.5	9.6	16.5	15.1	2.0
	Maximum Daily	m	3.3	2.2	0.6	0.0	21.4	19.5	6.9	10.5	16.4	21.4	21.4	5.0

Note(s):

1. KP, 2016a.

Tatelkuz Lake starts undergoing fall turnover in September and October, and the thermocline deepens, with warmer epilimnion water mixing with cooler hypolimnion water. The temperature variability Tatelkuz Lake is expected to be limited in October as a result of mixing.

Seasonal temperature and epilimnion thickness frequency duration curves (presented in KP 2016a) indicate that water of nearly constant hypolimnion temperature would be withdrawn for most of the year if the FWSS intake was placed 8 m or more below the Tatelkuz Lake water surface. The epilimnion thickness is 8 m or less approximately 93% of the time in the winter, and approximately 95% of the time in the summer, while it varies during the overturn periods in the spring and fall. An epilimnion thickness of 0.0 m or 21.4 m, which is equivalent to the average lake depth, indicates the lake would have limited temperature variability due to mixing. The mean lake temperatures in the spring and fall, when the lake is mixed, are below approximately 10°C and 13°C, respectively.

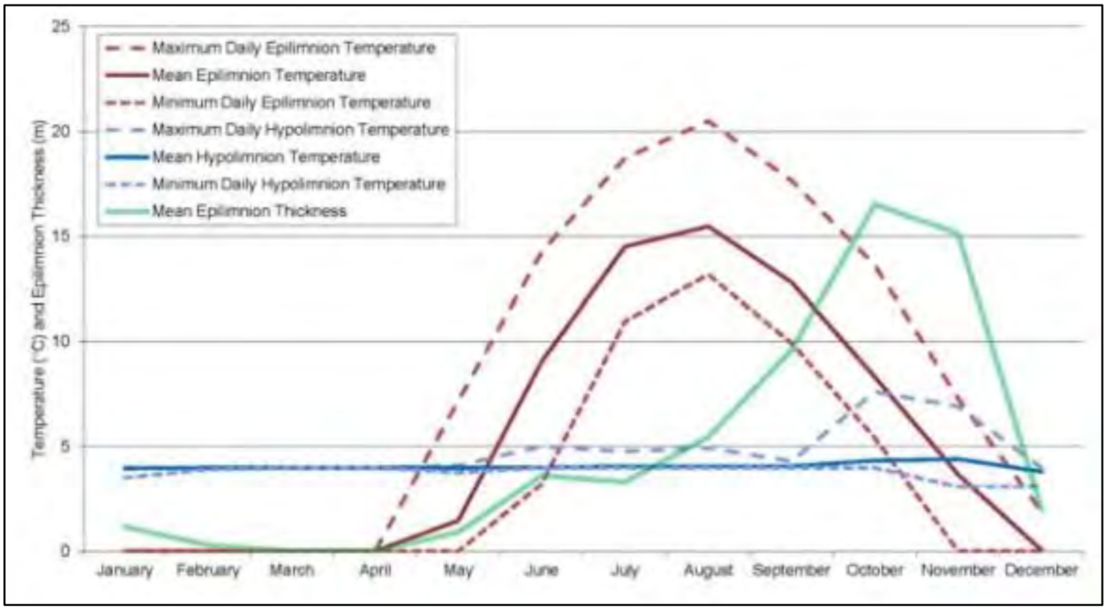

Figure 4.1 Range of Long-Term Epilimnion and Hypolimnion Temperatures in Tatelkuz Lake

Note(s):

1. KP, 2016a.

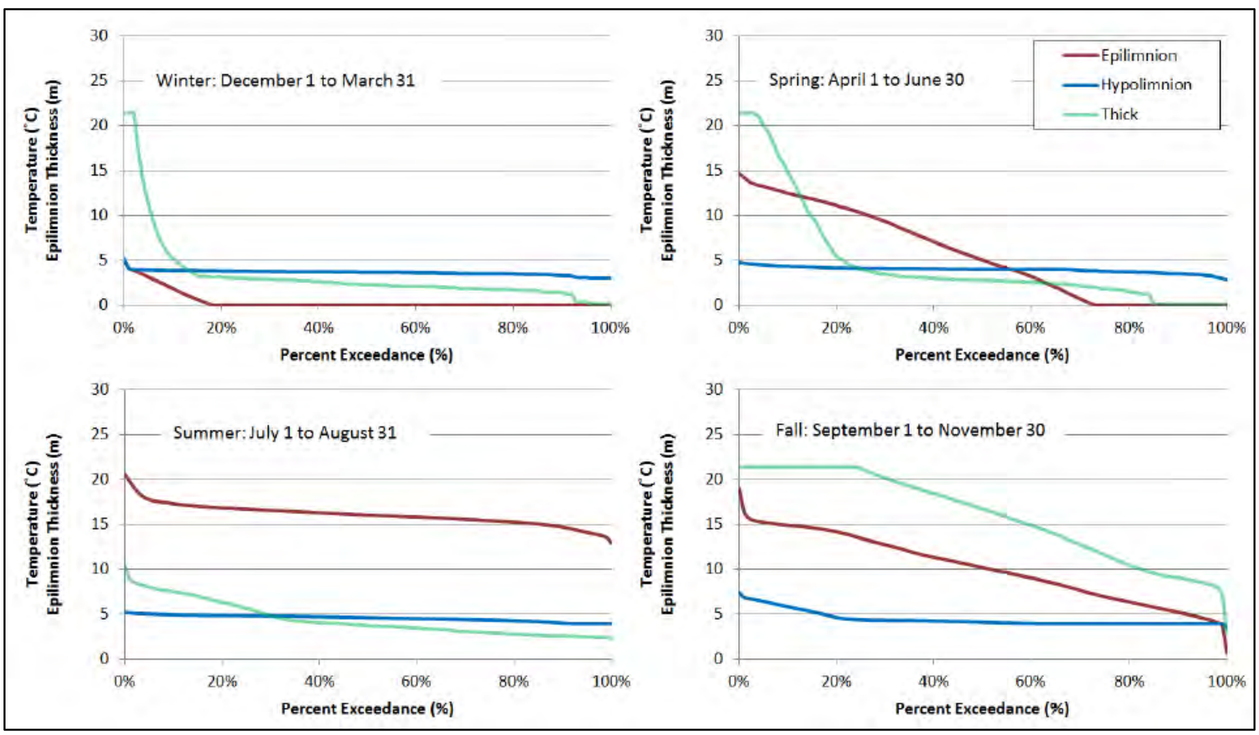

Figure 4.2 Tatelkuz Lake - Seasonal Lake Temp. and Epilimnion Thickness Duration Curves

Note(s):

1. KP, 2016a.

4.1 LAKE ICE

Typically, the surface of the lake may freeze in the winter months (January to March). The duration of ice cover can vary depending on prevailing climate conditions. The design will utilize the results of the January epilimnion thickness calculated in the previous analysis.

5.0 REFERENCES

Knight Piésold (KP, 2021c). Blackwater Gold Project – 2020 Hydrology and Water Temperature Baseline Report Rev 1. Ref. No. VA101-457/33-3. May 17, 2021.

Knight Piésold, (KP, 2021d), Blackwater Gold Project – 2020 Baseline Climate Report, VA101-457/33-4. Jan 14, 2021.

Knight Piésold, (KP, 2016a). Blackwater Gold Project: Water Temperature Modelling of Tatelkuz Lake, VA16-00070. January 2016.

Knight Piésold Ltd. (KP, 2013a). Revised Baseline Tatelkuz Lake Levels. KP Ref. No. VA13-01604, dated July 22, 2013.