BW GOLD LTD
a subsidiary company of Artemis Gold Inc

Blackwater Gold Project

Mine Site Water and Discharge Monitoring and Management Plan

March 2022

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ACRONYMS AND ABBREVIATIONS

AEMP	Aquatic Effects Monitoring Program
Application	Joint Application for *Mines Act/Environmental Management Act* Permits Application
Artemis	Artemis Gold Inc.
ARD	Acid rock drainage
BC	British Columbia
Blackwater	Blackwater Gold Project
BW Gold	BW Gold LTD.
CALA	Canadian Association of Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CDS	Central Diversion System
CEA Agency	Canadian Environmental Assessment Agency
CEO	Chief Operating Officer
CM	Construction Management
COO	Chief Operating Officer
DAF	Dissolved aeration flotation
DS	Decision Statement
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EC	Environment Canada
ECD	Environmental Control Dam
EMLI	Ministry of Energy, Mines and Low Carbon Innovation
EMP	Environmental Management Plan
EMPR	Ministry of Energy, Mines and Petroleum Resources
EMS	Environmental Management System
ENV	Ministry of Environment and Climate Change Strategy
EPCM	Engineering, Procurement, and Construction Management
ERM	ERM Environmental Consultants Canada Ltd.
FSR	Forest Service Road
FWR	Freshwater Reservoir

FWSS	Freshwater Supply System
GM	General Manager
HC	Health Canada
IECD	Interim Environmental Control Dam
IFN	Instream flow needs
Km	kilometre
KP	Knight Piésold Ltd.
LDN	Lhoosk'uz Dené Nation
LGO	Low grade ore
LoM	Life of Mine
M	metre
masl	Metres above sea level
MBBR	Moving bed biofilm reactor
MELP	Ministry of Environment, Lands and Parks
MEM	Ministry of Energy and Mines
MELP	Ministry of Environment, Lands and Parks
MEMPR	Ministry of Energy, Mines and Petroleum Resources
MERP	Mine Emergency Response Plan
MOE	Ministry of Environment
MWLAP	Ministry of Water, Land and Air Protection
ML	Metal leaching
MPs	management plans
MSDP	Mine Site Water and Discharge Monitoring and Management Plan
Mtpa	Million tonnes per annum
NAG	Non acid generating
NF	Nanofiltration
NFN	Nazko First Nation
NWFN	Nadleh Whut'en First Nation
OMS	Operations Maintenance and Surveillance
ORP	oxidation-reduction potential

PAG	Potentially Acid Generating
POCs	Parameters of Concern
POPCs	Parameters of Potential Concern
Project	Blackwater Gold Project
QA/QC	Quality Assurance / Quality Control
QP	Qualified Professional
RISC	Resources Information Standards Committee
RO	Reverse osmosis
SBEBs	Science-Based Environmental Benchmark
SCP	Sediment Control Pond
SFN	Saik'uz First Nation
SOPs	Standard Operating Procedures
StFN	Stellat'en First Nation
T	tonnes
TDS	total dissolved solids
TKN	Total Kjeldahl Nitrogen
TRP	Trigger Response Plan
TSF	Tailings Storage Facility
TSS	total suspended solids
UFN	Ulkatcho First Nation
VP	Vice President
WAD	Weak Acid Dissociable
WBM	Water Balance Model
WMP	Water Management Pond
WQG	Water quality guidelines
WQM	Water Quality Model
WTP	Water Treatment Plant
YDWL	Yinka Dene Water Law

1. PROJECT OVERVIEW

The Blackwater Gold Project (the Project) is a gold and silver Open Pit mine located in central British Columbia (BC), approximately 112 kilometres (km) southwest of Vanderhoof, 160 km southwest of Prince George, and 446 km northeast of Vancouver.

The Project is presently accessed via the Kluskus Forest Service Road (FSR), the Kluskus-Ootsa FSR and an exploration access road, which connects to the Kluskus-Ootsa FSR near kilometre (km) marker 142. The Kluskus FSR joins Highway 16 approximately 10 km west of Vanderhoof. A new, approximately 13.8 km road (Mine Access Road) will be built to replace the existing exploration access road and will connect to the Kluskus-Ootsa FSR at approximately km marker 124.5. Driving time from Vanderhoof to the mine site is about 2.5 hours.

Major mine components include a Tailings Storage Facility (TSF), ore processing facilities, waste rock and overburden stockpiles, topsoil stockpiles, borrow areas and quarries, Low Grade Ore (LGO) stockpile, water management infrastructure, water treatment plants (WTPs), accommodation camps and ancillary facilities. The mine site facilities planned to be constructed by the end of active Open Pit mining in Year +18 are shown on Figure 1-1. The gold and silver will be recovered into a gold-silver doré product and shipped by air and/or transported by road. Electrical power will be supplied by a new approximately 135 km, 230 kilovolt overland transmission line that will connect to the BC Hydro grid at the Glenannan substation located near the Endako mine, 65 km west of Vanderhoof.

The Blackwater mine site is located within the traditional territories of Lhoosk’uz Dené Nation (LDN), Ulkatcho First Nation (UFN), Skin Tyee Nation and Tsilhqot'in Nation. The Kluskus and Kluskus-Ootsa FSRs and Project transmission line cross the traditional territories of Nadleh Whut’en First Nation (NWFN), Saik’uz First Nation (SFN), and Stellat’en First Nation (StFN); collectively, the Carrier Sekani First Nations, as well as the traditional territory of the Nazko First Nation (NFN), Nee-Tahi-Buhn Band, Cheslatta Carrier Nation and Yekooche First Nation (EAO 2019a and 2019b).

Project construction is anticipated to take approximately two years. Mine development will be phased with an initial mill throughout of approximately 15,000 tonnes per day (t/d) or 5.5 million tonnes per annum (Mtpa) for the first five years of operations. After the first five years, the milling capacity will increase to approximately 33,000 t/d or 12 Mtpa for the next five years, and to approximately 55,000 t/d or 20 Mtpa in Year +11 until the end of the 23-year mine life. The Closure phase is Year +24 to approximately Year +45, ending when the Open Pit has filled and the TSF is allowed to passively discharge to Davidson Creek, and the Post-Closure phase is 46 years.

New Gold Inc. (New Gold) received Environmental Assessment Certificate #M19-01 (EAC) on June 21, 2019 under the *2002 Environmental Assessment Act* (EAO 2019c) and a Decision Statement (DS) on April 15, 2019 under the *Canadian Environmental Assessment Act, 2012* (CEA Agency 2019). In August 2020, Artemis Gold Inc. (Artemis) acquired the mineral tenures, assets and rights in the Blackwater Project that were previously held by New Gold Inc. On August 7, 2020, the Certificate was transferred to BW Gold LTD. (BW Gold), a wholly-owned subsidiary of Artemis, under the 2018 *Environmental Assessment Act*.
The Impact Assessment Agency of Canada notified BW Gold on September 25, 2020 to verify that written notice had been provided within 30 days of the change of proponent as required in Condition 2.16 of the DS, and that a process had been initiated to amend the DS.

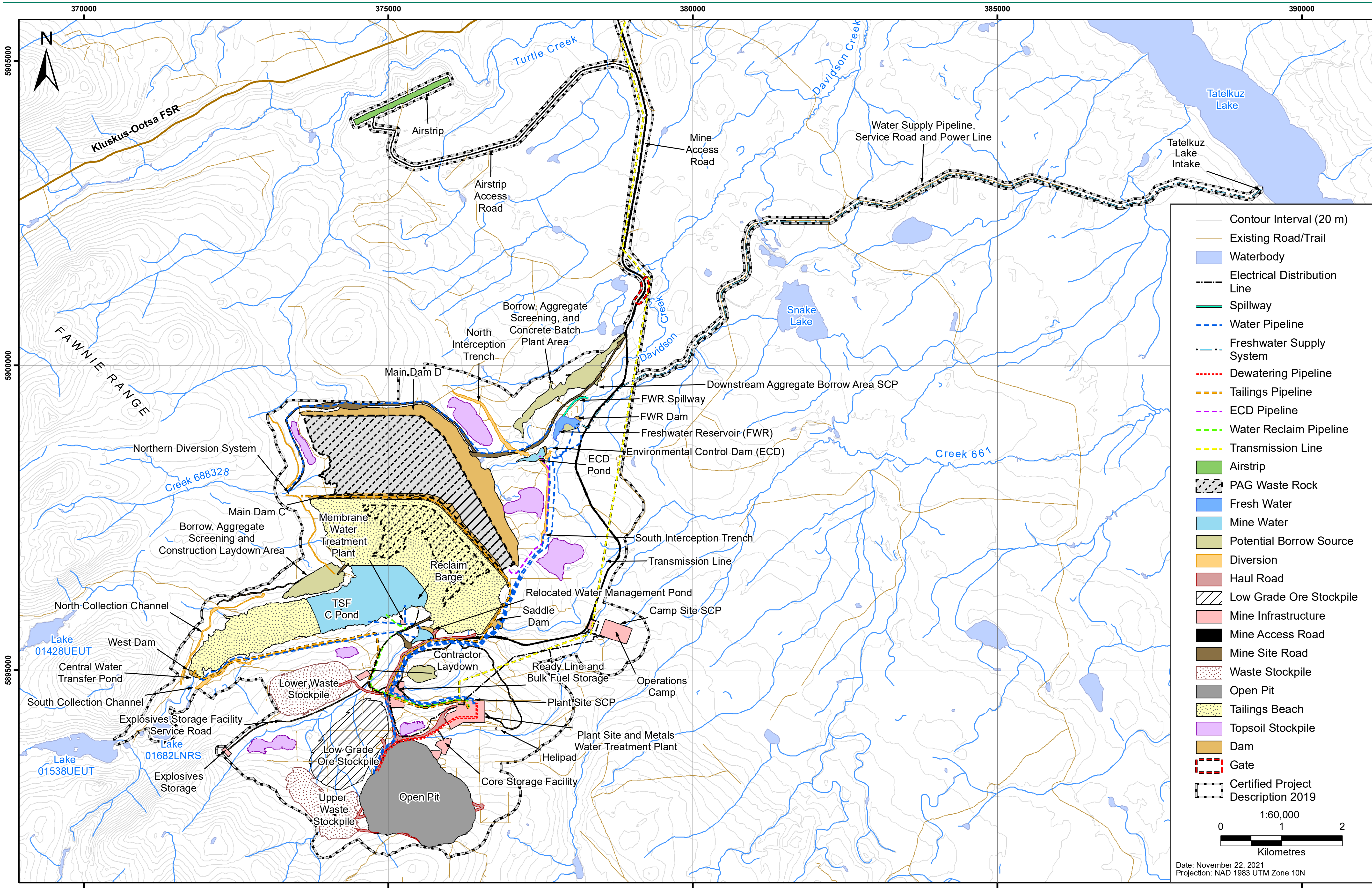


Figure 1-1: Mine Site General Arrangement (Year +18)

2. PURPOSE AND OBJECTIVES

The purpose of the Mine Site Water and Discharge Monitoring and Management Plan (MSDP or plan) is to:

- Provide operational management and monitoring procedures for each life of mine (LoM) phase, as well as contingency measures, for the effective interception, conveyance, diversion, storage, and discharge of contact and non-contact water on the mine site.
- Provide a comprehensive monitoring program for surface water, groundwater, and seepage water quantity and quality within the proposed permitted area and discharge points over the LoM.

The plan is designed to provide an early detection system and identify trends in surface water and groundwater quality so that potential impacts to the receiving environment can be investigated, mitigated, and avoided. In addition, ongoing monitoring will be used to evaluate predictions, calibrate models, and update models and mitigation options throughout the LoM.

Mine site water will be discharged to the environment from the following site infrastructure:

- Freshwater Reservoir (FWR);
- Sediment control ponds (SCPs);
  - TSF Stage 1 SCP (Year -2 only);
  - Downstream Aggregate Borrow Area SCP;
  - Camp Site SCP;
  - Plant Site SCP (Up to Year -2 only);
- Membrane WTP (Post-Closure phase only);
- TSF Spillway (Post-Closure phase only); and
- Groundwater seepage.

The plan integrates baseline information and modelling study results provided in the Joint *Mines Act / Environmental Management Act* Permits Application (the Application) as follows: meteorology and climate studies (Chapter 2.2), water quantity (Chapter 2.6) and quality (Chapter 2.7) baseline studies, site-wide water balance model (Appendix 5-B), surface water quality model (WQM; Appendix 5-D), numerical groundwater model (Appendix 5-F), and treatment requirements (Section 5.6, Appendix 5-G [Metals WTP], Appendix 5-H [Membrane WTP], Appendix 3-F [lime neutralization]), and takes into account discharge requirements (Chapter 5.8) and the mine plan (Chapter 3).

This MSDP is intended to be implemented in conjunction with other management and monitoring plans pertinent to the protection of the aquatic receiving environment, including the following:

- Environment Monitoring Programs (Chapter 7);
- Aquatic Effects Monitoring Program (AEMP) Plan (Appendix 7-A);
- Surface Erosion Prevention and Sediment Control Plan (Appendix 9-A); and
- Metal Leaching/Acid Rock Drainage Management Plan (Appendix 9-D).

3. ROLES AND RESPONSIBILITIES

BW Gold has the obligation of ensuring that all commitments are met and that all relevant obligations are made known to mine personnel and site contractors during all phases of the mine life. A clear understanding of the roles, responsibilities, and level of authority that employees and contractors have when working at the mine site is essential to meet Environmental Management System (EMS) objectives.

Table 3-1 provides an overview of general environmental management responsibilities during all phases of the mine life for key positions that will be involved in environmental management. Other positions not specifically listed in Table 3-1 but who will provide supporting roles include independent environmental monitors, an Engineer of Record (EOR) for each tailings storage facility and dam, an Independent Tailings Review Board (ITRB), TSF qualified person, geochemistry qualified professional, and other qualified persons and qualified professionals.

Table 3-1: BW Gold Roles and Responsibilities

Role	Responsibility
Chief Executive Officer (CEO)	The CEO is responsible for overall Project governance. Reports to the Board.
Chief Operating Officer (COO)	The COO is responsible for engineering and Project development and coordinates with the Mine Manager to ensure overall Project objectives are being managed. Reports to CEO.
Vice President (VP) Environment & Social Responsibility	The VP is responsible for championing the Environmental Policy Statement and EMS, establishing environmental performance targets, and overseeing permitting. Reports to COO.
General Manager (GM) Development	The GM Development is responsible for managing project permitting, the Project's administration services and external entities, and delivering systems and programs that ensure Artemis's values are embraced and supported: Putting People First, Outstanding Corporate Citizenship, High Performance Culture, Rigorous Project Management and Financial Discipline. Reports to COO.
Mine Manager	The Mine Manager, as defined in the *Mines Act*, has overall responsibility for mine operations, including the health and safety of workers and the public, EMS implementation, overall environmental performance and protection, and permit compliance. The Mine Manager may delegate some of their responsibilities to other qualified personnel. Reports to GM.
Construction Manager (CM)	The CM is accountable for ensuring environmental and regulatory commitments and obligations are being met during the construction phase. Reports to GM.
Environmental Manager (EM)	The EM is responsible for the day-to-day management of the Project's environmental programs and compliance with environmental permits, updating EMS and MPs. The EM or designate will be responsible for reporting non-compliance to the CM, and Engineering, Procurement and Construction Management (EPCM) contractor, other contractors, the Company and regulatory agencies, where required. Supports the CM and reports to Mine Manager.
Departmental Managers	Departmental Managers are responsible for implementation of the EMS relevant to their areas. Reports to Mine Manager.
Indigenous Relations Manager	Indigenous Relations Manager is responsible for Indigenous engagement throughout the life of mine. Also responsible for day-to-day management and communications with Indigenous groups. Reports to VP Environment & Social Responsibility.
Community Relations Advisor	Community Relations Advisor is responsible for managing the Community Liaison Committee and Community Feedback Mechanism. Reports to Indigenous Relations Manager.

Role	Responsibility
Environmental Monitors	Environmental Monitors (includes Environmental Specialists and Technicians) are responsible for tracking and reporting on environmental permit obligations through field-based monitoring programs. Report to EM.
Aboriginal Monitors	Aboriginal Monitors are required under EAC condition 17 and will be responsible for monitoring for potential effects from the Project on the Indigenous interests. Indigenous Monitors will be involved in the adaptive management and follow-up monitoring programs. Report to EM.
Employees and Contractors	Employees and contractors are responsible for being aware of permit requirements specific to their roles and responsibilities. Report to Departmental Managers.
Qualified Professionals and Qualified Persons	Qualified Professionals (QPs) and qualified persons will be retained to review objectives and conduct various aspects of environmental and social monitoring as specified in EMPs and social MPs.

BW Gold will employ a qualified person as an EM who will ensure that the EMS requirements are established, implemented and maintained, and that environmental performance is reported to management for review and action. The EM is responsible for retaining the services of qualified persons or qualified professionals with specific scientific or engineering expertise to provide direction and management advice in their areas of specialization. The EM will be supported by a staff of Environmental Monitors that will include Environmental Specialists and Technicians and by a consulting team of subject matter experts in the fields of environmental science and engineering.

During the Construction phase, BW Gold will be entering into multiple EPC contracts, likely for the Transmission Line, Process Plant, Tailings and Reclaim System, and 25kV Power Distribution. Each engineer/contractor will have their own CM and there will be a BW Gold responsible PM and/or Superintendent who ultimately reports to the GM Development. Some of the scope, such as the TSF and Water Management Structures will be self-performed by BW Gold, likely using hired equipment. Other smaller scope packages may be in the form of EPCM contracts. The EPCM contractors will report to the CMs who will ultimately be responsible for ensuring that impacts are minimized, and environmental obligations are met during the Construction phase. For non-EPCM contractors, who will perform some of the minor works on site, the same reporting structure, requirements, and responsibilities will be established as outlined above. BW Gold will maintain overall responsibility for management of the construction and operation of the mine site and will therefore be responsible for establishing employment and contract agreements, communicating environmental requirements, and conducting periodic reviews of performance against stated requirements.

The CM is accountable for ensuring that environmental and regulatory commitments/obligations are being met during the construction phase. The EM will be responsible for ensuring that construction activities are proceeding in accordance with the objectives of the EMS and associated MPs. The EM or designate will be responsible for reporting non-compliance to the CM and EPCM contractor, other contractors, and regulatory agencies, where required. The EM or designate will have the authority to stop any construction activity that is deemed to pose a risk to the environment; work will only proceed when the identified risk and concern have been addressed and rectified.

Environmental management during operation of the Project will be integrated under the direction of the EM, who will liaise closely with departmental managers and will report directly to the Mine Manager. The EM will be supported by the VP of Environment and Social Responsibility in order to provide an effective and integrated approach to environmental management and ensure adherence to corporate environmental standards. The EM will be accountable for implementing the approved MPs and reviewing them periodically for effectiveness. Departmental area managers (e.g., mining, milling, and plant/site services) will be directly responsible for implementation of the EMS and EMPs relevant to their areas. All employees and contractors are responsible for daily implementation of the practices and policies contained in the EMS.

During closure and post-closure staffing levels will be reduced to align with the level of activity associated with these phases. Prior to initiating closure activities, BW Gold will revisit environmental and health and safety roles and responsibilities to ensure the site is adequately resourced to meet permit monitoring and reporting. The Mine Manager will maintain overall responsibility for management of Closure and Post-closure activities.

Pursuant to Condition 19 of the Project's EAC M#19-01, BW Gold has established an Environmental Monitoring Committee to facilitate information sharing and provide advice on the development and operation of the Project, and the implementation of EAC conditions, in a coordinated and collaborative manner. Committee members include representatives of the Environmental Assessment Office (EAO), UFN, LDN, NWFN, StFN, SFN, NFN, Ministry of Energy, Mines and Low Carbon Innovation (EMLI), Ministry of Environment and Climate Change Strategy (ENV), and Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Pursuant to Condition 17 of the EAC, Aboriginal Group Monitor and Monitoring Plan, BW Gold will retain or provide funding to retain a monitor for each Aboriginal Group prior to commencing construction and through all phases of the mine life. The general scope of the monitor's activities will be related to monitoring for potential effects from the Project on the Aboriginal Group's Aboriginal interests.

4. COMPLIANCE OBLIGATIONS, GUIDANCE, AND BEST MANAGEMENT PRACTICES

4.1 Legislation

Federal legislation pertinent to water management includes:

- *Canadian Environmental Protection Act, 1999;*
- *Fisheries Act;*
  - *Metal and Diamond Mining Effluent Regulations;*
- *Impact Assessment Act*; and
- *United Nations Declaration on the Rights of Indigenous Peoples Act*.

Provincial legislation pertinent to water management includes:

- *Declaration on the Rights of Indigenous Peoples Act;*
- *Drinking Water Protection Act;*
- *Environmental Assessment Act;*
- *Environmental Management Act;*
  - *BC Contaminated Sites Regulation;*
- *Mines Act;*
  - Health, Safety and Reclamation Code for Mines in British Columbia (Code); and
- *Water Sustainability Act.*

4.2 Environmental Assessment Certificate and Federal Decision Statement Conditions

Condition 33 of the Project's Environmental Assessment Certificate (EAC) #M019-01 requires the holder to develop a Mine Waste and Water Management Plan, in consultation with Aboriginal Groups, Ministry of Energy, Mines and Low Carbon Innovation (EMLI) and ENV. The draft plan must be provided to EMLI, ENV, Aboriginal Groups and the EAO for review a minimum of 60 days prior to the commencement of construction. BW Gold will develop a separate plan to address Condition 33 requirements.

Conditions in the federal DS pertaining to water management include:

> *Condition 3.7: The Proponent shall, from operation through post-closure phase, collect and treat seepage from the tailings storage facility and any other contact water, in accordance with the requirements of the Metal and Diamond Mining Effluent Regulations and the* Fisheries Act*, before it is deposited into the receiving environment. When treating contact water and seepage, the Proponent shall take into account the water quality thresholds in British Columbia's Water Quality Guidelines for the Protection of Aquatic Life and any water quality standards established under the Yinka Dene 'Uza'hné Surface Water Management Policy and the Yinka Dene 'Uza'hné Guide to Surface Water Quality Standards, for Davidson Creek, Chedakuz Creek, and Tatelkuz Lake, respectively class as class III, class II and class I surface waterbodies under the Yinka Dene 'Uza'hné Surface Water Management Policy.*

> *Condition 3.8: The Proponent shall 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.

4.3 Existing Permits

BW Gold received *Mines Act* Permit M-246 on June 22, 2021 and *Environmental Management Act* Permit 110602 on June 24, 2021 in relation to the early works program. Part D (Reclamation and Closure Program) Condition C.4 of the *Mines Act* permit pertains to surface water management and monitoring. Permit 110602 authorizes the discharge of treated effluent from the Plant Site construction area SCP.

The Project has a Northern Health approval for groundwater supply well 3 (ID 31679) for a potable water supply without treatment (May 28, 2012).

4.4 Guidelines and Best Management Practices

Federal and provincial guidelines related to water management include:

- Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (BC MEM 1998a);
- Policy for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia (BC MEM & BC MELP 1998b);
- Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (MEND 2009);
- Metal Mining Technical Guidance Document for Environmental Effects Monitoring (EC 2012);
- Guidelines for Groundwater Modelling to Assess Impacts of Proposed Natural Development Activities (Wels et al. 2012);
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016b);
- Technical Guidance 4. *Environmental Management Act* Authorizations. Annual Reporting Under the *Environmental Management Act*. A Guide for Mines in British Columbia (BC MOE 2016a);
- Manual of British Columbia Hydrometric Standards (RISC Committee 2018);
- British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture Summary Report (ENV 2019);
- Parameters of Concern Fact Sheet: Defining Parameters of Concern for Mine Effluent Discharge Authorization Applications (ENV 2019);
- Guidelines for Canadian Drinking Water Quality Summary Table (HC 2020);
- Source Drinking Water Quality Guidelines (ENV 2020a);
- British Columbia Environmental Laboratory Manual (ENV 2020b);
- Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life (CCME 2021);
- British Columbia Working Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture (ENV 2021); and
- BC Field Sampling Manual (Province of British Columbia 2021).

5. ADAPTIVE MANAGEMENT FRAMEWORK

The MSDP is a living document with the expectation that the plan will evolve and be updated in response to the results of the mine site and discharge monitoring program, changing conditions or development at the site, updates to scientific methods, and through consultation and discussions with Indigenous Groups and other stakeholders. The plan incorporates adaptive management as follows:

- **Plan:** Planned mitigation measures and monitoring programs are identified in Chapter 5 of the Application.
- **Do:** Implementing the mitigation measures described in Chapter 5.
- **Monitor:** Conducting monitoring programs as described below in Section 7.3 and 8.3.
- **Adjust:** Reviewing qualitative and quantitative triggers for upset conditions to determine whether mitigation measures related to the failure of any component needs to be altered or additional measures implemented. Table 11-1 identifies adaptive management actions.

Adaptive management is intended to address the circumstances that will require implementation of alternate or additional mitigation measures to address effects of the Project if the monitoring shows that those effects are approaching the triggers identified in the MSDP.

6. SITE OVERVIEW

This section provides an overview of the Project site's surface drainage and baseline environmental conditions in relation to meteorology and climate, water quantity and water quality. Information in this section is summarized from Chapter 2, Baseline Information.

6.1 Surface Drainage

Proposed mine facilities are primarily located in the Davidson Creek catchment. Davidson Creek flows northeast from the mine site into lower Chedakuz Creek downstream of Tatelkuz Lake. The TSF, waste stockpiles, low-grade ore stockpile, and most mine site infrastructure areas lie within the upper Davidson Creek watershed.

The footprints of the TSF closure spillway, Plant Site, camp, and a portion of the Open Pit are located in the Creek 661 catchment. Creek 661 flows northeast from the Project site into upper Chedakuz Creek, which flows into the southeast end of Tatelkuz Lake.

Tatelkuz Lake is located at the outlet of Creek 661 and discharges to lower Chedakuz Creek. Water from Tatelkuz Lake will be used to meet in-stream flow needs (IFN) along Davidson Creek.

Chedakuz Creek flows northwest into the Nechako Reservoir, discharging into the Chedakuz Arm of Knewstubb Lake.

To the west of the Davidson Creek watershed, Creek 705 flows southwest into Fawnie Creek. As part of the fish habitat offsetting plan, the western-most extent of the Davidson Creek watershed (Lake 01682LNRS, upstream of the TSF) will be redirected to flow westward to Lake 01538UEUT within the Fawnie Creek watershed. Furthermore, there may be times during the Operations, Closure and Post-closure phases when the flows are too great for the pumping systems at the Central Water Transfer Pond, resulting in release of water to Lake 01538UEUT and through the Fawnie Creek Watershed.

The Project footprint and watershed drainages are presented on Figure 6.1-1.

Adjacent watersheds not predicted to be impacted by the project include Snake Lake and Turtle Creek. Snake Lake is located between the Davidson Creek and Creek 661 watersheds and flows in a northeast direction into Tatelkuz Lake. The Turtle Creek watershed is north of the Davidson Creek watershed. The creek flows north and east before discharging to Chedakuz Creek downstream of the confluence of Davidson Creek and Chedakuz Creek.

6.2 Meteorology and Climate

Climate baseline data has been collected at the Project site since 2011. A baseline climate report summarizing data collected from 2011 to November 2020 is provided in Appendix 2-A (KP 2021d). Meteorological and hydrological characterizations for the Project, presented in terms of expected long-term climatic and hydrologic conditions at the mine site, are provided in a hydrometeorology baseline report provided in Appendix 2-B (KP 2021g).

Two climate stations were installed at the Project site, one at an elevation of 1,050 metres above sea level (masl) in 2011 ('Blackwater Low') and one at an elevation of 1,470 masl in 2012 ('Blackwater High'). In addition, three snow survey stations were established in 2012 between the elevations of 1,051 masl and 1,412 masl. The stations are described further in the 2020 Baseline Climate Report (KP 2021d).

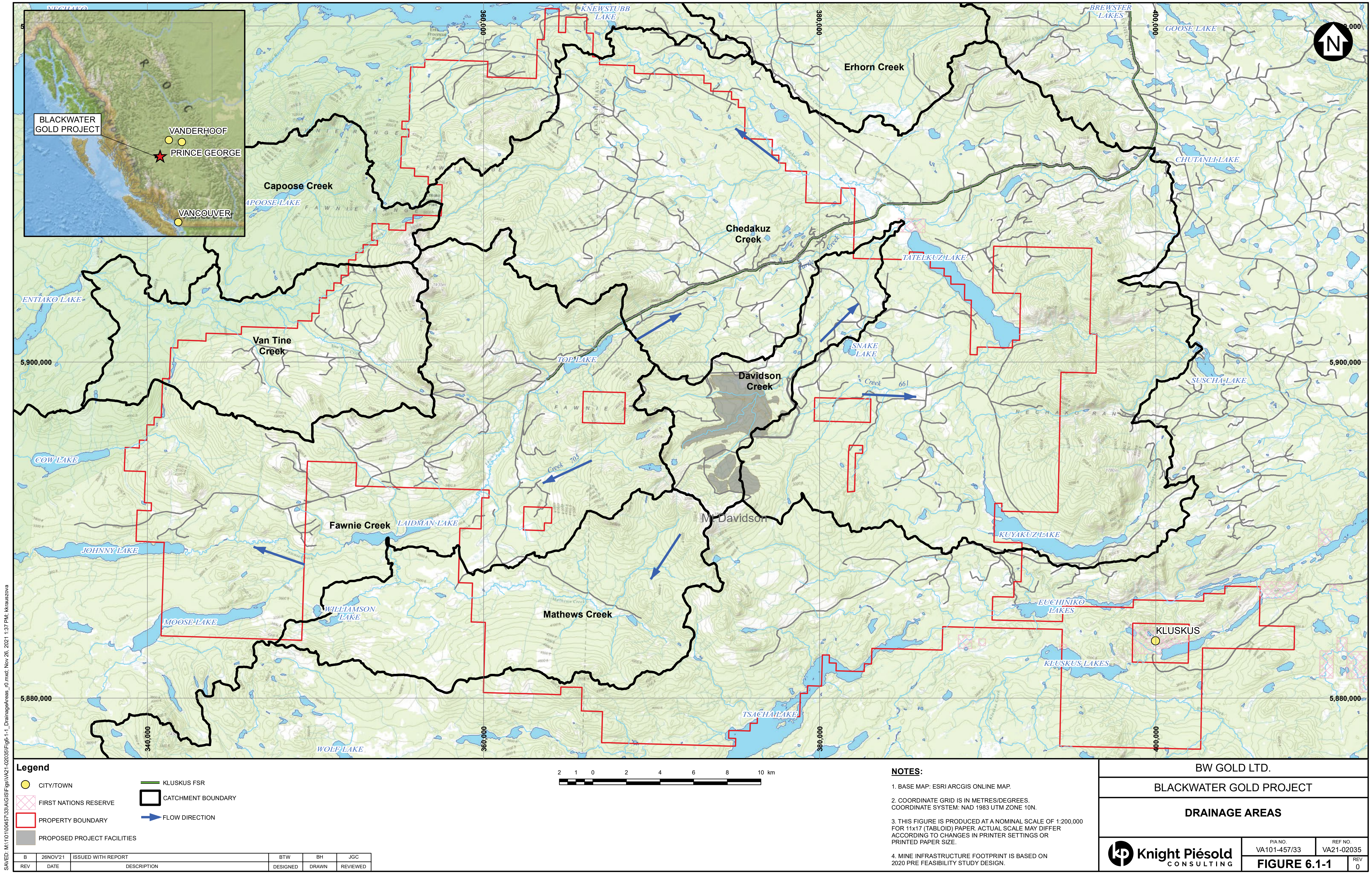


Figure 6.1-1: Project Watershed Areas

Source: Knight Piésold Consulting (2021).

The Project is at a similar elevation to the Blackwater High climate station. Mean annual data for the Blackwater High station for the measured parameters are:

- Air Temperature: 2.0°C
- Wind speed: 3.0 m/s
- Relative Humidity: 70%
- Solar radiation: 3.1 kWh/m^2
- Net radiation: 0.5 kWh/m^2
- Precipitation: 595 mm

The long-term mean monthly air temperature for the Blackwater High climate station is presented on Figure 6.2-1, and the estimated long-term mean monthly precipitation for the Blackwater High climate station is presented on Figure 6.2-2.

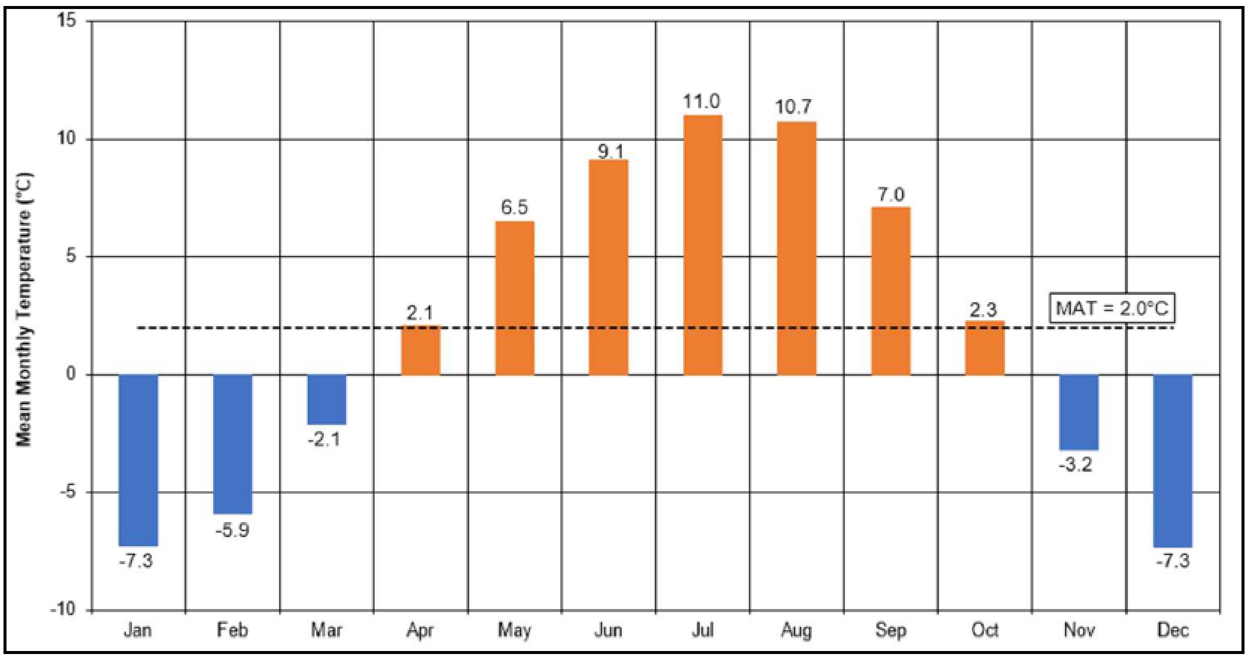


Figure 6.2-1: Blackwater High – Long-Term Mean Monthly Air Temperature

The snow survey station data are used to assess snow accumulation, snow density, and snowmelt patterns. Snow water equivalent values for the winter snowpack are estimated to be generally highest in late March/early April, with the average snowpack melt pattern (snowmelt timing) estimated to be 5% in March, 65% in April, and the remaining 30% in May.

Precipitation at the Project site is split between rain and snow with approximately 41% of precipitation estimated to fall as snow on an average annual basis.

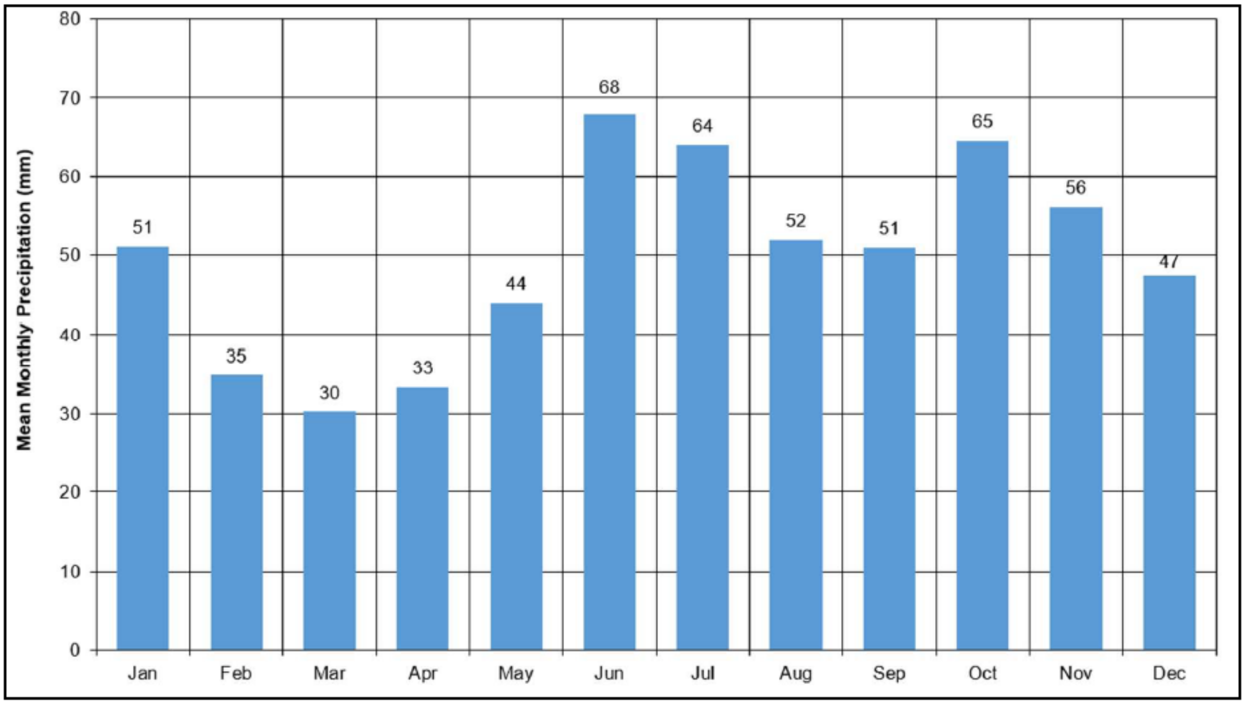


Figure 6.2-2: Blackwater High – Estimated Long-Term Mean Monthly Precipitation

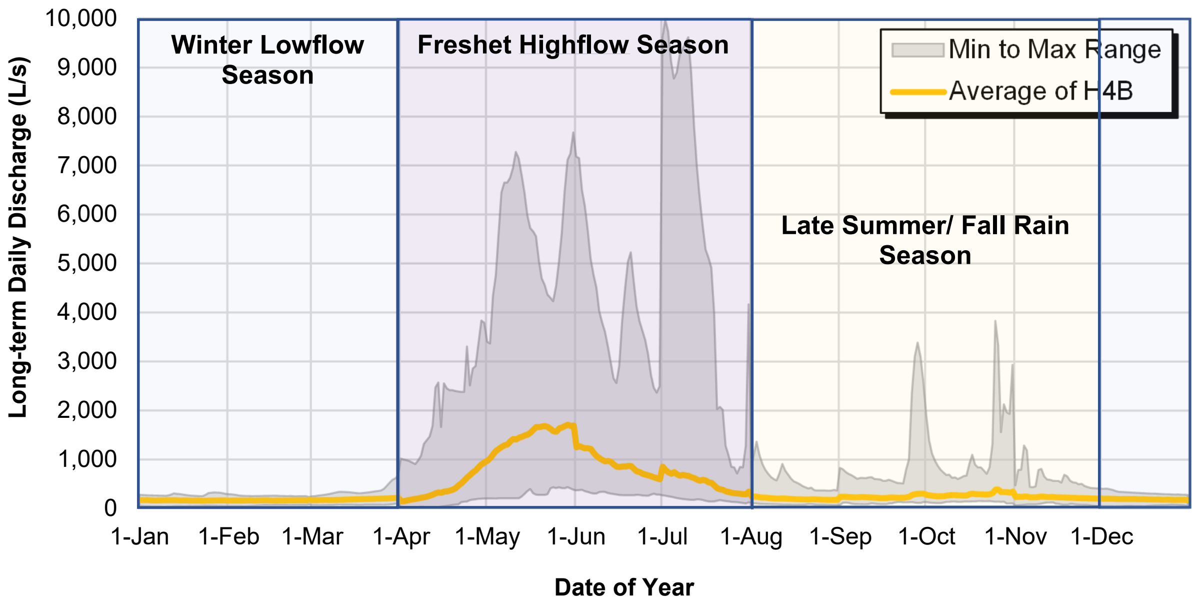
6.3 Water Quantity

6.3.1 Surface Water Hydrology

There are 12 active hydrology stations (11 streamflow and 1 lake level) in the Project area. The station history, rating curves, and discharge hydrographs for each hydrology station are presented in the 2020 Hydrology and Water Temperature Baseline Report (KP 2021c). The hydrological assessment of conditions in the Project area is based on data from 10 of the active 11 streamflow stations.

Stream flow records collected at the Project were correlated with long-term regional records to develop an estimate of the range of possible hydrologic conditions in the Project area for use in engineering design and the assessment of long-term hydrologic impacts due to mine operations. Long-term daily discharge series specific to the Project were developed using frequency paired regression analysis to correlate site and regional flow data. Methodology and results are presented in the 2020 Hydrometeorology Report (KP 2021g).

An example of the hydrograph (average and range) at the hydrology station H4B on Davidson Creek is provided on Figure 6.3-1. Station H4B is approximately 6 km downstream of the FWR. The greatest streamflow variability occurs during the spring freshet period of high flows, and the lowest variability occurs during the low flow summer and winter months. There are two low flow periods evident in the Project data: a late summer period, generally between August 1 and September 30, and a winter period, generally between November 1 and March 31. The summer low flow period is a result of warm temperatures and low precipitation conditions occurring subsequent to the spring snowmelt period (freshet), while the winter low flow period is a result of precipitation being stored as ice and snowpack. During these low flow periods, stream flows are primarily due to baseflow (shallow groundwater discharge). Prolonged dry and/or freezing periods result in a reduction of groundwater recharge and corresponding groundwater discharge, therefore resulting in a reduction in the baseflows to streams.



Note: Long-term synthetic record for H4B based on the Dean River Water Survey of Canada Gauge (08FC003) for the period 1973-2020.

Figure 6.3-1: Davidson Creek Hydrograph (at station H4B)

Peak flows for the Project area occur almost exclusively during the spring and early summer freshet period, which typically occurs in May and June. These high flows result from snowmelt events or rainfall combined with snowmelt events.

6.3.2 Hydrogeology

Groundwater level data has been collected at the Project since 2012. The baseline water level dataset includes water levels recorded continuously using pressure transducers installed in 24 monitoring wells and 26 standpipe piezometers over various periods and by vibrating wire piezometers installed in 48 drillholes. Water levels have also been measured manually at more than 70 standpipe piezometers and test wells. A baseline groundwater report summarizing the physical groundwater data collected at the Project, such as water levels and permeability data, and an interpretation of groundwater flow is presented in Appendix 2-J (KP 2021b). The monitoring well, standpipe piezometer, and vibrating wire piezometer installation sites are summarized in Tables 3.1 to 3.3 of the baseline groundwater report (Appendix 2-J).

Groundwater flow at the Project is expected to occur primarily through glaciofluvial (channel and non-channelized) deposits, coarse grained glacial till, and highly weathered bedrock. Groundwater flow in overburden is expected to be restricted by the multiple glaciolacustrine units mapped across the catchment along with lower permeability zones of glacial till and the soil-like horizon of completely weathered bedrock. Groundwater flow in bedrock is expected to be conveyed primarily in the highly weathered bedrock, with lesser amounts of flow occurring as preferential flow through fractures in less weathered bedrock. The low permeability completely weathered bedrock horizon in Davidson Creek valley is expected to limit groundwater flow to deeper bedrock.

Groundwater elevations in the project area are topographically controlled and influenced locally by differences in permeability. Perched water within the shallow overburden is common on lower permeability zones of glacial till or on glaciolacustrine deposits. Water levels across the Project typically range from 3 to 20 m below ground surface (mbgs) but are as deep as 55 mbgs in upper Davidson Creek valley within the proposed TSF C basin and 85 mbgs in a zone of higher permeability identified in the deposit area. Downward hydraulic gradients are common in upper Davidson Creek valley upstream of the proposed TSF D Main Dam (Main Dam D) and upward hydraulic gradients exist further downstream near the proposed FWR. Artesian water levels are present at the downslope extent of the deposit, the base of Mount Davidson, and in valleys. Seasonal water level fluctuations are less than 1 m at many of the sites across the proposed TSF basin, indicating there is little variation in seasonal recharge rates. Water level fluctuations increase up to 7 m at sites hydraulically connected to drainages in Davidson Creek valley and over 10 m in the recharge zone of the deposit.

Depressed water levels are observed along Davidson Creek valley that may be related to a buried sand and gravel deposit. The presence of depressed water levels in these deeper sand and gravel deposits suggests the deposits are buried channels that are hydraulically connected to a downstream discharge location such as Davidson Creek or one of its tributaries. The main buried channel encountered parallel to Davidson Creek is interpreted to daylight near the toe of proposed Main Dam D on Davidson Creek based on existing drillhole data. Three buried channels are inferred to exist beneath Main Dam C and Main Dam D, one of which is interpreted to daylight near the proposed FWR on Davidson Creek.

Groundwater recharge at the Project occurs along topographic highs such as the deposit area on Mount Davidson and in the headwaters of Davidson Creek and Creek 661. The ability of groundwater to recharge the deeper overburden and bedrock is limited by the presence of low permeability strata or lenses consisting of glacial till, glaciolacustrine deposits, and completely weathered bedrock. Groundwater discharge is expected along the main drainages of Davidson Creek and Creek 661. These drainages flow year-round, which indicates groundwater discharge provides a source of water to sustain streamflow.

6.4 Water Quality

6.4.1 Surface Water Quality

A cumulative baseline surface water quality report is provided in Chapter 2 (Appendix 2-H of the Application; ERM 2020) and the pertinent information is summarized in this section. The surface water quality monitoring program was designed with consideration of provincial guidance documents, EAC conditions, and the Yinka Dene Water Law. Twenty-six stream and river sampling sites in the Creek 661, Davidson Creek, Turtle Creek, and Chedakuz Creek, Creek 705, Fawnie Creek, and the Blackwater River watersheds were monitored in the period from 2011 to 2020 as shown on Figure 6.4-1. Sampling sites were classified as near-field, mid-field, and far-field monitoring sites, or reference sites.

Sampling frequency ranged from weekly to annually. The frequency and location of sampling changed over the course of the baseline monitoring program to support updated Project designs, to meet specific Project objectives, and in consultation with regulators and Aboriginal Groups. Seventeen sites were sampled in 2020 at frequencies ranging from quarterly to monthly, and weekly during freshet (May/June) and summer low flow (August/September).

Sampling was performed in accordance with the BC Field Sampling Manual (BC Ministry of Water, Land and Air Protection, 2013). A single stream water quality grab sample was collected at each site. Duplicate samples were collected at approximately 10% of the sites during each sampling trip. Samples were collected in clean, pre-labelled bottles shipped from ALS Environmental Services in Burnaby, BC. Water quality results are compared to applicable BC or CCME water quality guidelines for freshwater aquatic life.

The most commonly observed guideline exceedances (BC or CCME) in Project streams were total and dissolved aluminum, total cadmium, total chromium, total and dissolved copper, and total and dissolved zinc. Guidelines exceedances for each of these parameters were observed in several of the Project watersheds. Other parameters observed above guidelines in the baseline dataset were nitrite, total arsenic, dissolved cadmium, total and dissolved iron, total mercury, and total silver. pH was observed below the BC lower guideline limit at one monitoring station in Upper Davidson Creek, but fell within the BC guideline range at all other Project sites.

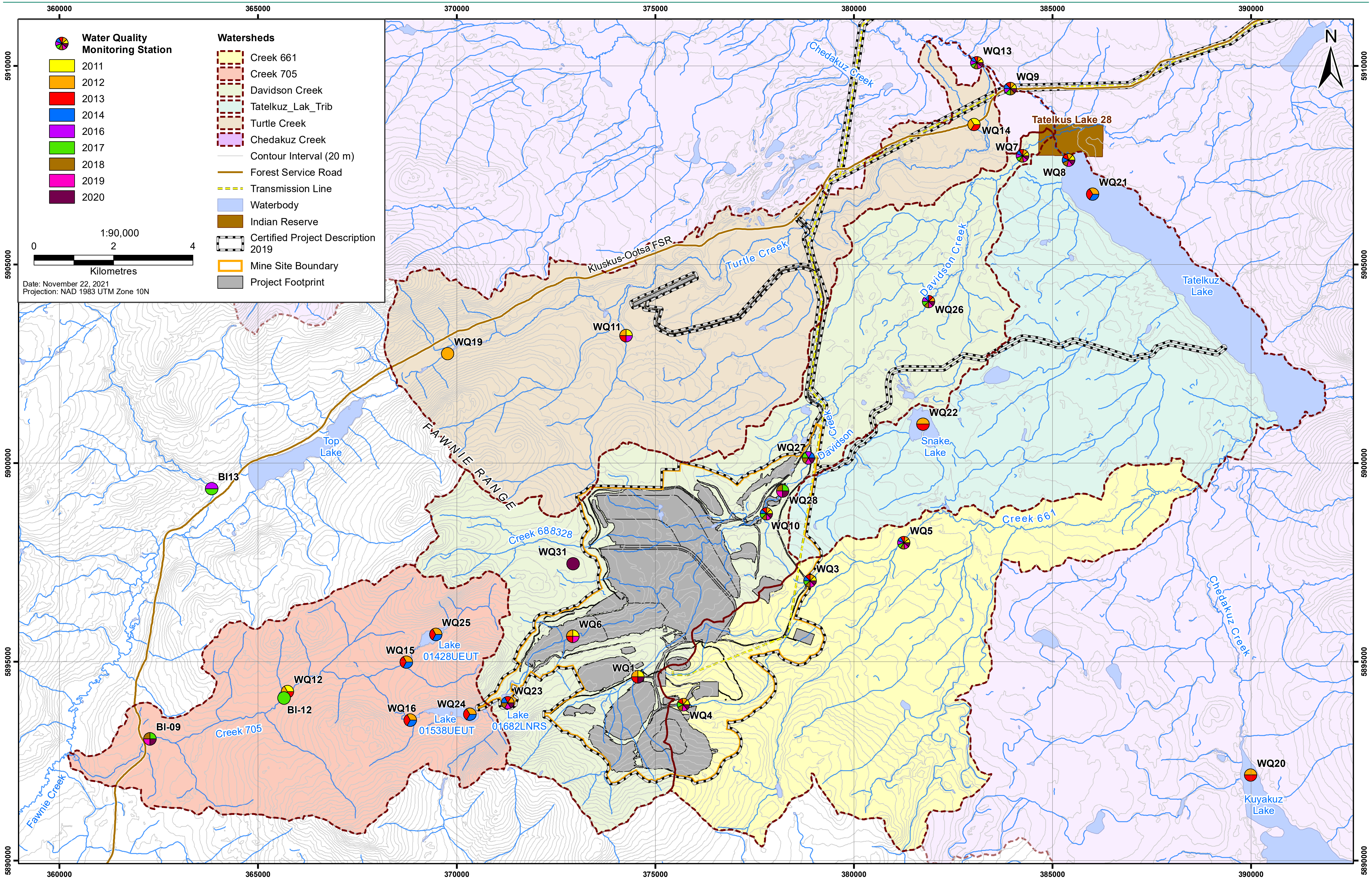


Figure 6.4-1: Surface Water Quality Sampling Locations 2011 - 2020

6.4.2 Groundwater Quality

The baseline groundwater quality data collected at the Project is presented in the baseline groundwater report in Appendix 2-J (KP 2021d). The baseline groundwater quality program was developed with consideration of the Water and Air Baseline Guidance Document for Mine Proponents and Operators developed by BC MOE (2012; 2016b). Sampling was performed in accordance with the BC Field Sampling Manual (BC Ministry of Water, Land and Air Protection 2013). Baseline groundwater data have been collected at the Project since 2012.

Thirty-one monitoring wells were installed in 17 locations. Groundwater samples were collected at 21 monitoring wells as part of the groundwater quality sampling network, including 18 monitoring wells installed in 2012 and two monitoring wells installed in 2019. The existing groundwater monitoring wells targeted locations that may be affected by mine development or provide valuable information with respect to water quality intercepted in mine facilities, such as the proposed Open Pit. Paired shallow and deep monitoring wells are typically installed at monitoring sites to characterize differences in water quality at different depths.

Groundwater sampling events were typically conducted three times per year from 2012 through 2020. Groundwater sampling events generally took place during the seasonal water level high (May/June), water level recession (September/October), and water level low (February/March) to characterize water quality during the most variable periods of the year

A quality assurance/quality control program was implemented at the start of the groundwater sampling program, which included the collection of duplicate, travel blank, and field blank samples. Samples were collected in clean, pre-labelled bottles shipped from ALS Environmental Services in Burnaby, BC. Analytical sampling results were assessed against pre-set data quality objectives to determine if the results were representative of background formation conditions.

Guideline exceedances were noted in groundwater quality samples for dissolved concentrations of aluminum, arsenic, cadmium, iron, manganese, and zinc concentrations. Concentrations of major anions (chloride, fluoride, and sulphate) did not exceed BC water quality guidelines in any groundwater samples. Total organic carbon exceeded BC source drinking water quality guidelines intermittently.

7. MINE SITE WATER MANAGEMENT AND MONITORING

7.1 Overview of Water Management

The goal of the water management system is to meet the Project's operational and potable water demands and requirements while limiting the amount of surplus water stored onsite and minimizing potential adverse effects to the receiving environment. Operational demands are driven by the process plant water needs and the waste management strategy to saturate potentially acid generating (PAG) and metal leaching (ML) waste materials.

Processing plant water demands are a function of the ore throughput rate as shown in Table 7.1-1.

Table 7.1-1: Processing Plant Water Requirements

Phase	Water Demand (Mm^3/month)	Throughput rate (million tonnes per annum (Mtpa))
Phase I (Year 1 to 5)	0.55	5.5.
Phase II (Year 6 to 10)	1.2	12
Phase III (Year 11 to 23)	2.0	20

Mine waste generated on site includes PAG and ML waste rock, tailings, as well as non-acid generating (NAG) waste rock and overburden. PAG and ML waste rock and tailings will be stored in the TSF in a saturated condition to limit the potential for acid rock drainage (ARD) and reduce ML. NAG waste rock and overburden will either be used for TSF embankment construction, used for site infrastructure (e.g., site roads), used for reclamation, and/or be permanently stored on surface in designated stockpiles.

LGO will be stockpiled for processing later in mine life. LGO is expected to be PAG and will therefore be stored on a lined base with design measures to enhance capture of surface and sub-surface contact water in a collection pond so that it can be directed to the lime neutralization system at the processing plant. The neutralized runoff will be directed to the TSF along with the tailings slurry.

Water management objectives relating to the receiving environment include meeting IFN and water quality guidelines or approved Science-Based Environmental Benchmark (SBEBs) in Davidson Creek and Creek 661. Condition 26 (Water Quality Management) of the Project's EAC requires SBEBs be developed in consultation with Aboriginal Groups and ENV considering the Yinka Dena Water Law for Davidson Creek, and any other water policies from Aboriginal Groups for Davidson Creek and/or Creek 661 that are made available to BW Gold.

To balance the goals above, BW Gold will recycle water within the Project areas to the maximum extent practicable to reduce consumptive uses from other freshwater sources. The plan is that 90% of process water will come from recycling water from the TSF. The remaining 10% of mill water demands are from other sources, prioritized as follows:

1. Open pit dewatering system (from within the pit sumps and pit depressurization wells)
2. Mine site treated water and upstream diversion water stored within the WMP
3. Upstream diversion water and Tatelkuz Lake water, stored within the FWR

BW Gold will treat surplus water as needed before discharging water to Davidson Creek. Discharging treated water during the life of mine helps mitigate flow losses in Davidson Creek and reduces the volume of surplus water stored onsite.

Details of the water management system are described in the LoM Water Balance Model (WBM) in Chapter 5 of this Application. The LoM WBM explicitly considers flows associated with the following key mine facilities and processes:

- Plant Site;
- Open Pit and Pit Lake;
- TSF C and TSF D, including the ponds and water stored in the tailings and waste rock;
- Main Dam D, Main Dam C, West Dam, Saddle Dam;
- Upper and Lower Waste Stockpiles;
- LGO Stockpile;
- Water treatment (Metals WTP, Membrane WTP and lime neutralization system);
- WMP;
- FWR;
- Surface water diversions (e.g., ditches, diversions, and channels);
- SCPs;
- Environmental control dams (i.e., the Interim ECD and ECD);
- Seepage collection and interception systems;
- Site water transfers (e.g., potable water, pipelines, water pumped from one location to another); and
- Freshwater Supply System (FWSS).

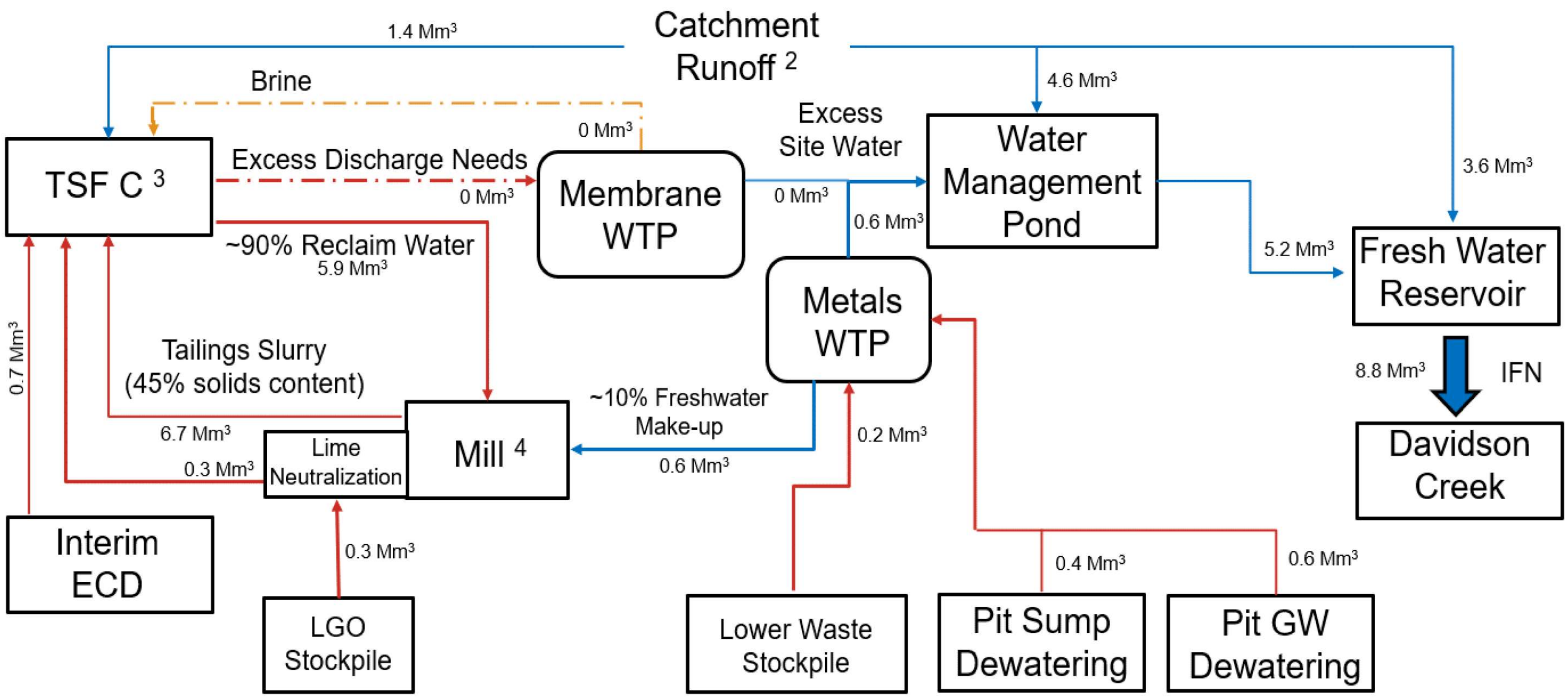
The water supply sources for the Project are:

- Runoff from catchment areas upstream of the TSF;
- Precipitation onto the TSF and runoff from the mine site facilities;
- Water recycle from the TSF supernatant pond;
- Groundwater and runoff from Open Pit dewatering and depressurization wells;
- Water extracted from two wells east of the camp area (potable and firewater use); and
- Freshwater from Tatelkuz Lake (primarily to offset flow reductions in Davidson Creek in later phases of mine operations) through the FWSS.

Water losses from the Project are:

- Discharge from the FWR;
- Evaporation;
- Water retained in the tailings and waste rock interstitial space (voids) in the TSF;
- Groundwater seepage;
- Discharge from the TSF Stage 1 SCP (during Year -2), Plant Site SCP (until Year -1), Downstream Aggregate Borrow Area SCP, and Camp Site SCP; and
- Entrainment of water in ice during the winter period.

Simplified and detailed flow schematics are provided in Appendix 5-B (KP 2021a). The simplified schematics are reproduced on Figures 7.1-1 through 7.1-6. The water management plan schedule is shown in Table 7.1-2.



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 5 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR.
3. PROCESSES INTERNAL TO THE TAILINGS STORAGE FACILITY (TSF) ARE NOT PRESENTED SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS AND RETURNED FROM CONSOLIDATION SEEPAGE.
4. MILL WATER BALANCE ALSO INCLUDES 0.2 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
5. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 1 TO 6

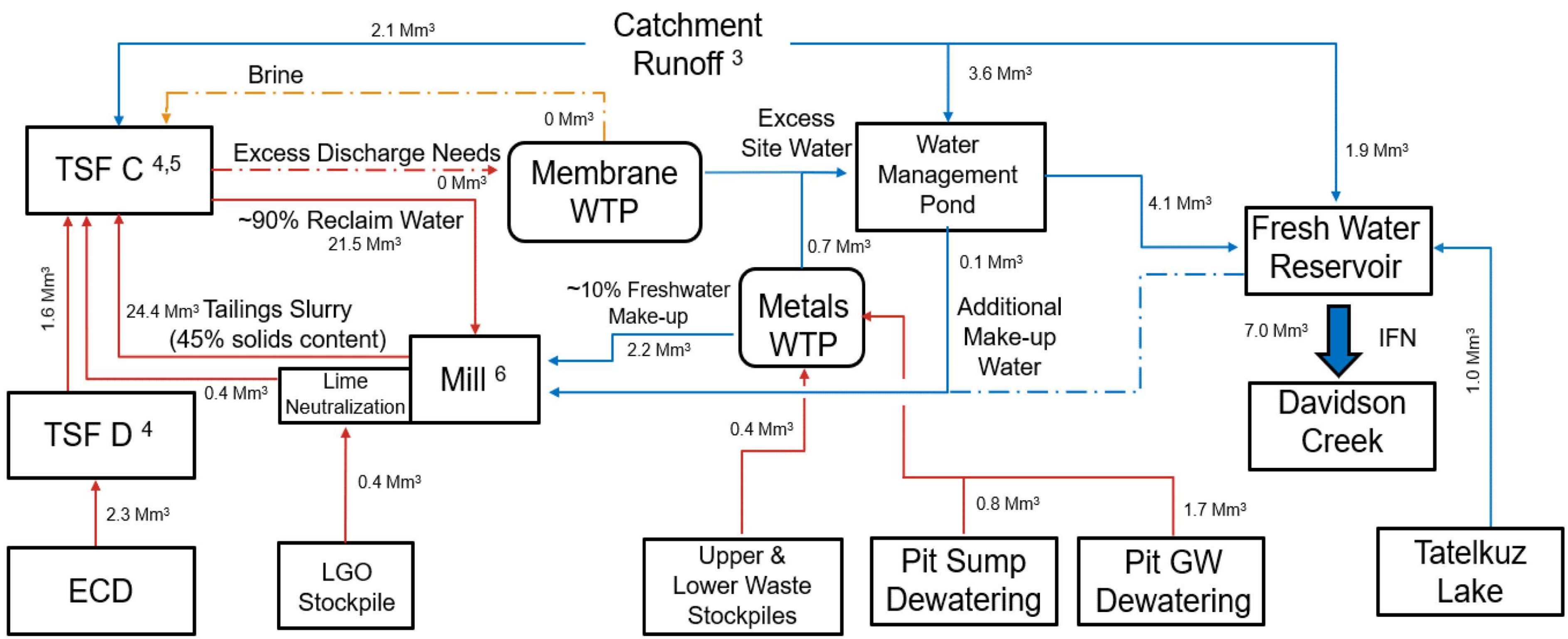
Knight Piésold CONSULTING

P/A NO. VA/101-457/33

REF. NO. VA22-00034

FIGURE 7.1-1

REV 1



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 17 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. MATERIAL STARTS TO BE PLACED IN THE UPPER WASTE STOCKPILE IN YEAR 11.
3. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.0 Mm³ (NOT SHOWN).
4. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
5. TSF C RECEIVES 0.2 Mm³ OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 17.
6. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm³ INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 7 TO 17

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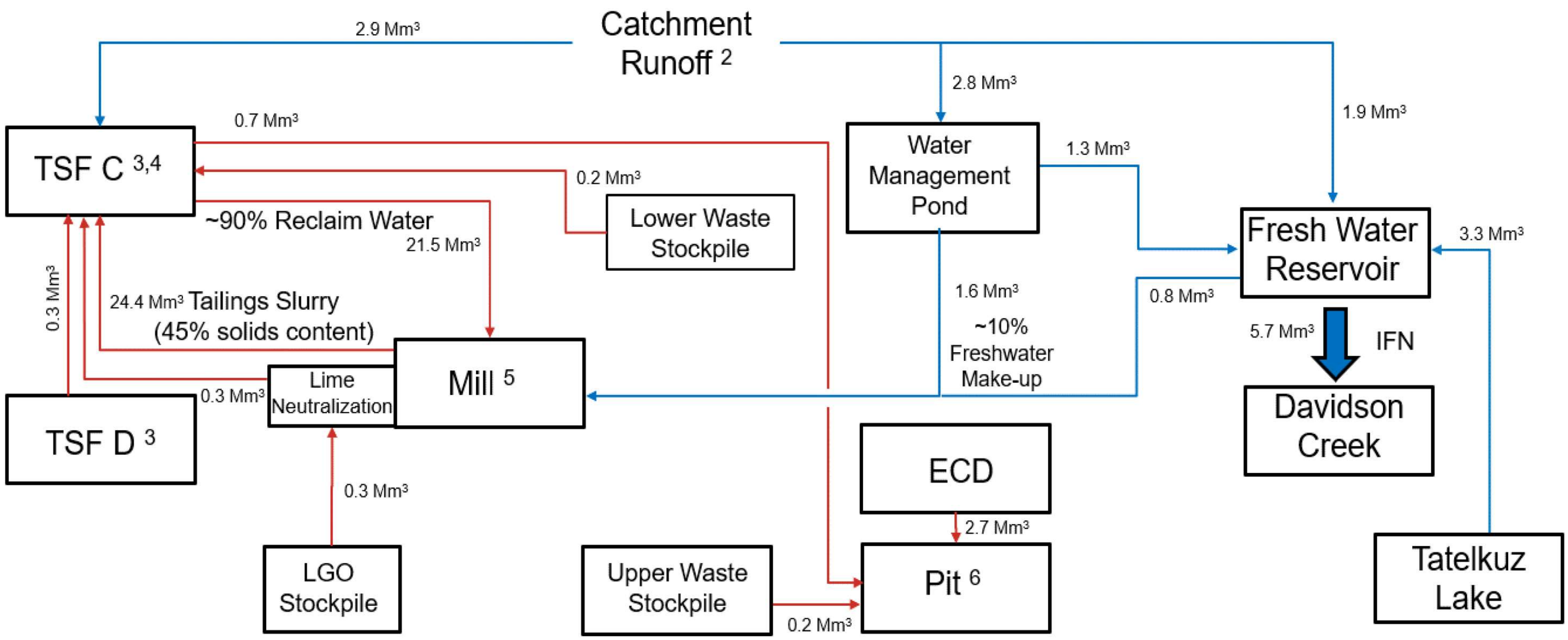
P/A NO. VA/101-457/33

REF. NO. VA22-00034

FIGURE 7.1-2

REV 1



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 20 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.0 Mm³.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 0.3 Mm³ OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 20.
5. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm³ INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
6. PIT LAKE VOLUME INCREASES 4.6 Mm³ IN YEAR 20. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1.1 Mm³.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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BLACKWATER GOLD PROJECT

**SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 18 TO 20**

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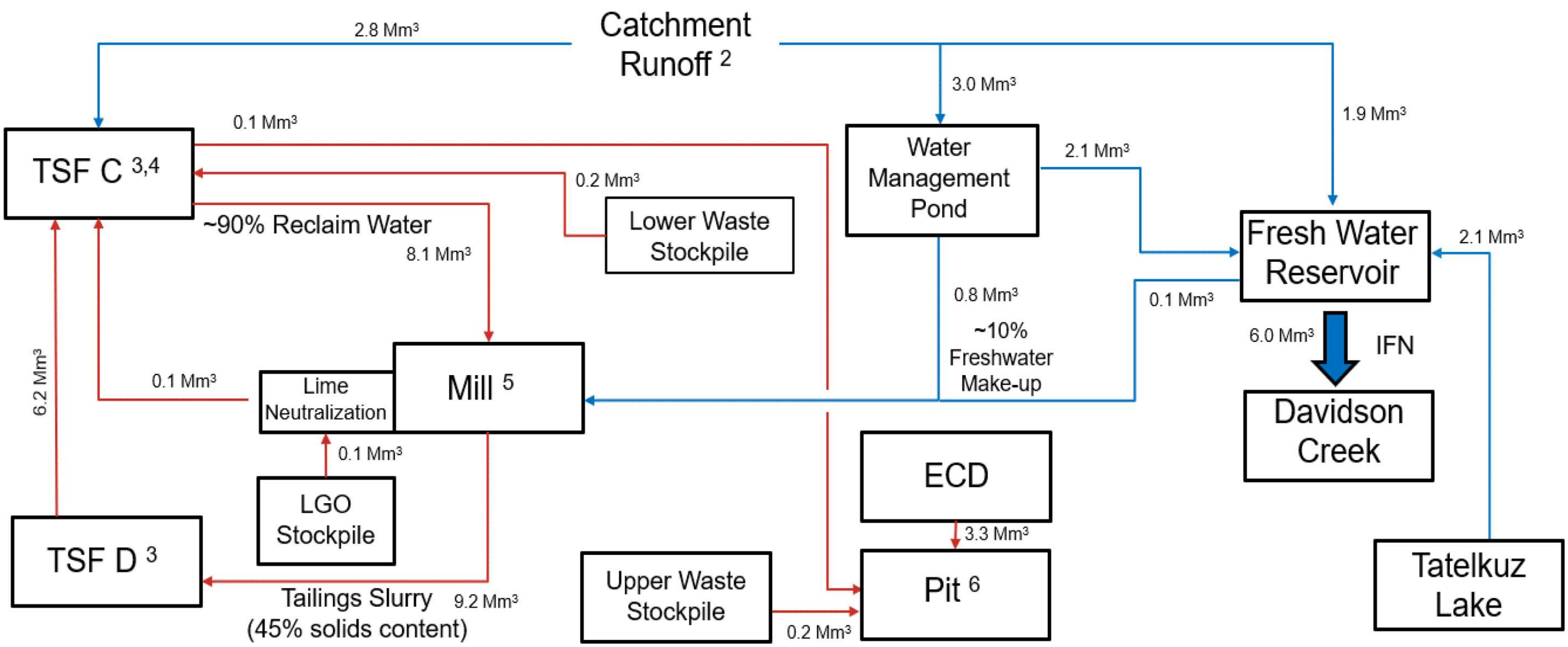
P/A NO. VA/101-457/33

REF. NO. VA22-00034

FIGURE 7.1-3

REV 1



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 23 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 1.4 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER LOST TO TAILINGS AND WASTE ROCK VOIDS, WATER RETURNED FROM CONSOLIDATION SEEPAGE, AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 0.2 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 23.
5. MILL WATER BALANCE ALSO INCLUDES 0.6 Mm^3 INFLOW AS WATER CONTAINED IN ORE (NOT SHOWN).
6. PIT LAKE VOLUME INCREASES 4.7 Mm^3 IN YEAR 23. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1.1 Mm^3.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, MILL, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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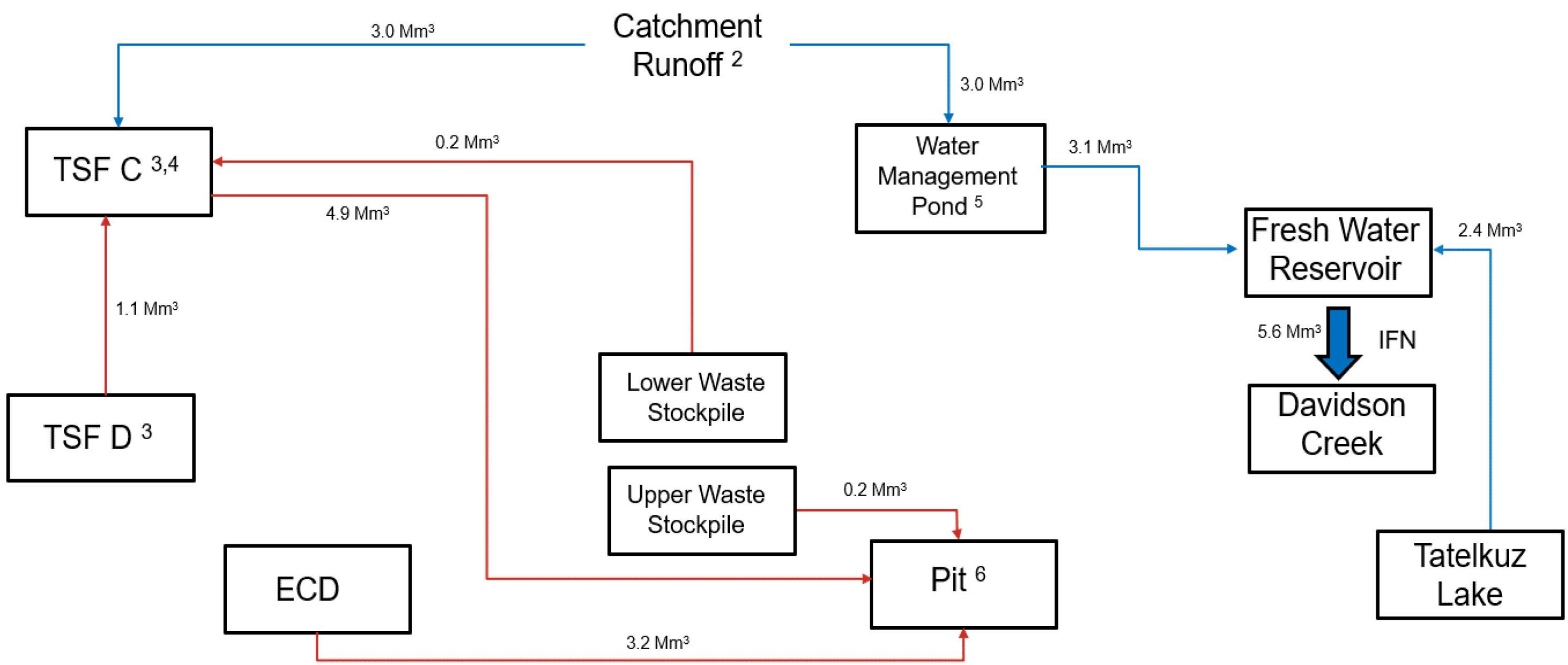
BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC
OPERATIONS YEAR 21 TO 23

Knight Piésold CONSULTING

P/A NO.	REF. NO.
VA/101-457/33	VA22-00034

FIGURE 7.1-4 REV 1



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 25 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 3.1 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITIES DOES NOT PRESENT INTERNAL PROCESSES SUCH AS WATER RETURNED FROM CONSOLIDATION SEEPAGE AND THE CHANGE IN POND VOLUME.
4. TSF C RECEIVES 0.2 Mm^3 OF WATER FROM THE WEST DAM SEEPAGE SUMP PUMPBACK SYSTEM IN YEAR 25.
5. INFLOWS TO THE WATER MANAGEMENT POND INCLUDE 0.05 Mm^3 SEEPAGE FROM CONTACT SOURCES.
6. PIT LAKE VOLUME INCREASES 9.2 Mm^3 IN YEAR 25. ADDITIONAL INPUTS TO THE PIT FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE 1 Mm^3.
7. DETAILED TABLES SUMMARIZING ALL WATER BALANCE COMPONENTS OF THE TSF, WATER MANAGEMENT POND, AND FRESH WATER RESERVOIR ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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SIMPLIFIED FLOW SCHEMATIC CLOSURE

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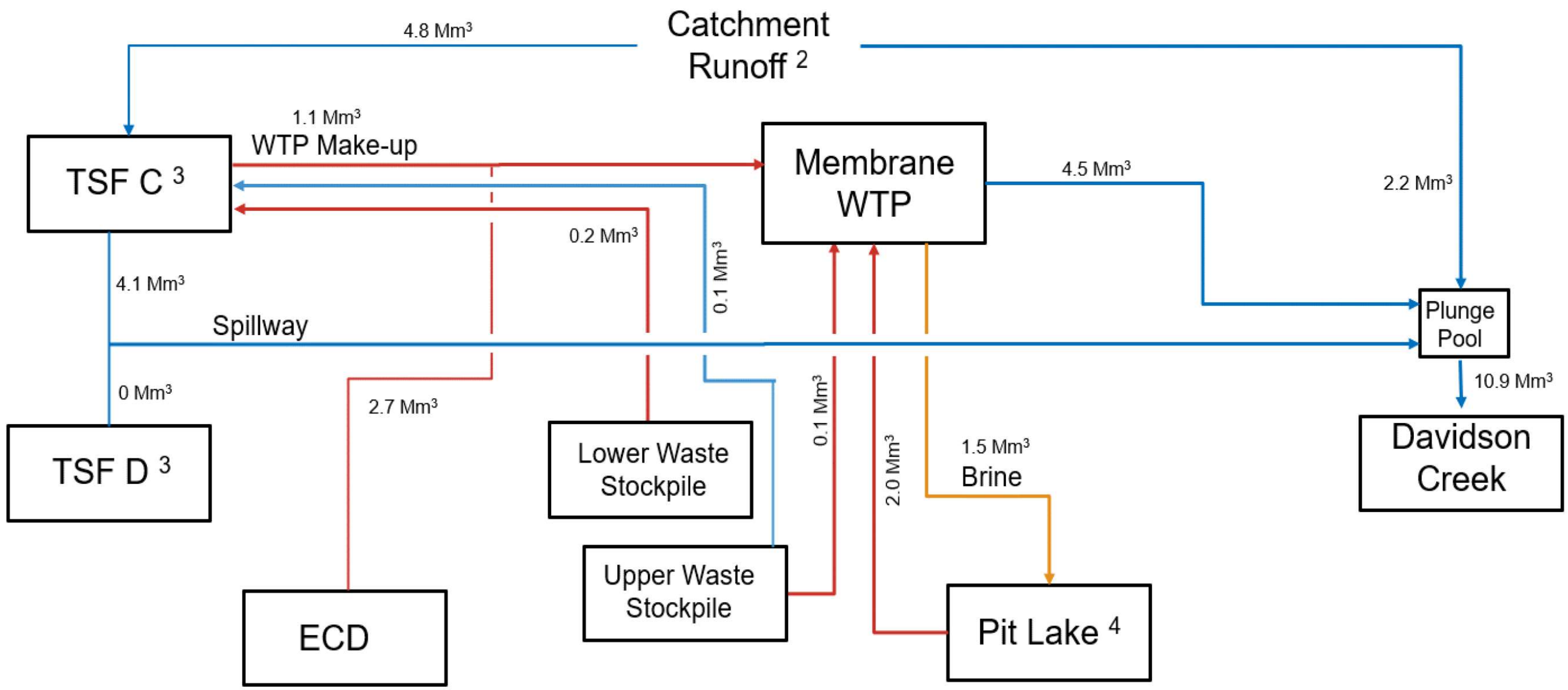
P/A NO.	REF. NO.
VA/101-457/33	VA22-00034

FIGURE 7.1-5 REV 1



NOTES:

1. FLOWS ARE PRESENTED FOR YEAR 55 OF THE LIFE OF MINE WATER BALANCE MODEL WITH AVERAGE CLIMATE INPUT.
2. CATCHMENT RUNOFF INCLUDES RUNOFF FROM CONTRIBUTING CATCHMENT AND DIRECT PRECIPITATION TO POND / RESERVOIR MINUS EVAPORATIVE LOSSES FROM POND / RESERVOIR. CATCHMENT RUNOFF TO TSF D IS 2.1 Mm^3.
3. SIMPLIFIED WATER BALANCE OF TAILINGS STORAGE FACILITY (TSF) DOES NOT PRESENT INTERNAL PROCESSES SUCH AS SEEPAGE. TABLES SUMMARIZING ALL COMPONENTS OF THE TSF WATER BALANCE ARE PRESENTED IN APPENDIX E5 OF THE SITE WIDE WATER BALANCE MODEL REPORT IN APPENDIX 5-B.
4. CONTRIBUTIONS TO THE PIT LAKE FROM NET PRECIPITATION, GROUNDWATER INFLOWS, AND SURFACE RUNOFF ARE AN ADDITIONAL 0.5 Mm^3.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
1	12JAN'22	ISSUED WITH TRANSMITTAL	MCW	CAS

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BLACKWATER GOLD PROJECT

SIMPLIFIED FLOW SCHEMATIC POST-CLOSURE

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P/A NO. VA/101-457/33

REF. NO. VA22-00034

FIGURE 7.1-6

REV 1

Table 7.1-2: LoM WBM Timeline of Water Management Plan

Mine Process and Water Management Activity	Construction	Operations (Mine Year)																							Closure	Post-Closure[1]
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
Mill																										
Mill Throughput (Mtpa)[2]		4.5	5.5	5.5	5.5	5.5	12	12	12	12	12	20	20	20	20	20	20	20	20	20	20	20	20	7.5	-	-
TSF C																										
Tailings Deposition																										
Waste Rock placed in TSF C																										
TSF C Pond pumped to Mill																										
TSF C Pond pumped to Pit Lake																										
TSF C Pond surplus pumped to Membrane WTP (if required)																										
TSF C Pond discharges via Closure Spillway																										
TSF D																										
Tailings Deposition																										
Waste Rock placed in TSF D																										
TSF D Pond pumped to TSF C																										
TSF D Pond discharges via Closure Spillway																										
Open Pit																										
Open Pit sump and dewatering wells to Metals WTP																										
Pit Lake filling to target elevation																										
Pit Lake pumped to Membrane WTP																										
LGO																										
LGO deposited in stockpiles																										
LGO processed from stockpiles																										
Water collected from LGO Stockpiles to TSF C																										
Water collected from LGO Stockpiles to Lime Neutralization																										
Upper Waste Stockpile																										
Water collected from Stockpile to Metals WTP																										
Water collected from Stockpile to Open Pit																										
Runoff from Stockpile to TSF C and Toe Discharge Collected to Membrane WTP																										
Lower Waste Stockpile																										
Water collected from Stockpile to Metals WTP																										
Runoff from Stockpile to TSF C																										
Interim ECD																										
Interim ECD collect seepage from TSF C & Pumpback to TSF C																										

Mine Process and Water Management Activity	Construction	Operations (Mine Year)																							Closure	Post-Closure[1]
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23		
ECD																										
ECD and Seepage Collection System collects seepage from TSF																										
ECD pumped to TSF D																										
ECD pumped to Pit Lake																										
ECD pumped to Membrane WTP																										
WMP																										
Water Management Pond surplus contributes to Mill freshwater																										
Water Management Pond surplus pumped to FWR																										
FWR																										
Fresh Water Reservoir discharges to Davidson Creek																										
FWSS																										
Pumps water from Tatelkuz Lake																										
Diversions																										
Central Diversion Area directed to WMP																										
Central Diversion Area directed to Plunge Pool																										
Northern Diversion Area directed to FWR (and TSF as required)																										

https://theermgroup.sharepoint.com/sites/ec-blackwater-project/bw-gold/Shared Documents/01 Permitting/Major Works/Chapter 9 - Management Plans/Appendix 9-E Mine Site and Water Monitoring/Tables/KP Table 7.1-2/[Table 3.1 – Timeline_rE.xlsm]Table – Timeline

Notes:

[1] Post-closure begins when the Pit Lake reaches its target elevation and water discharges from the TSF via the closure spillway.

[2] Mtpa = millions tonnes per annum.

7.2 Water Management Infrastructure

7.2.1 Open Pit and Pit Lake

Excavation of the Open Pit begins in Year -1 and continues through Year +17, with the maximum disturbed area reached by the end of Year +13. Pit dewatering designs are provided in Appendix 3-B, and changes to groundwater due to the mine development are presented in Appendix 5-F.

From Year -1 until approximately the end of Year +17, pit dewatering will be achieved by pumping surface water that collects in the pit sump and groundwater from dewatering and depressurization wells to the Metals WTP. Water from the pit dewatering system will be treated for metals and sent to the mill to meet the freshwater reclaim requirement and treated water in excess of the mill freshwater requirement will be sent to the WMP. Open Pit groundwater dewatering rates are predicted to increase from 10 L/s in early mining to 65 L/s as the Open Pit is advanced (Appendix 3-B) and are predicted to meet the mill freshwater demand in early mining. A zone of groundwater drawdown is predicted to extend outward from the Open Pit perimeter affecting groundwater levels within a radial distance of up to 2 km (Appendix 5-F).

Starting in Year +18, when mining from the Open Pit ceases and the LGO is being processed through the mill, a Pit Lake will form from natural groundwater inflows, surface water runoff and precipitation, and surplus water pumped from TSF C and the ECD to accelerate filling. In post-closure, the surface water elevation of the Pit Lake will be maintained below the pit rim through water withdrawal and conveyance to the Membrane WTP, as required, prior to discharge to the downstream receiving environment. Seepage from the Pit Lake is predicted to report to TSF C, Creek 505659 (a tributary of Creek 661), the TSF Closure Spillway channel, and Davidson Creek. The Pit Lake Seepage Collection System is predicted to capture 85% of the seepage that discharges to the southern tributary of Creek 505659 and convey it to the Membrane WTP.

7.2.2 Tailings Storage Facility

The TSF is designed to permanently store thickened slurry/tailings, PAG and ML waste rock, provide water for ore processing, and support mine site water balance management. The TSF comprises two adjacent sites, TSF C and TSF D, which in total are designed to hold 469 Mm^3 of tailings and waste rock material and up to 12 Mm^3 of pond storage. Additional freeboard allowances are included in the design to manage seasonal inflows and provide protection for severe natural flooding. The annual filling schedule for the TSF is presented in Table 7.2-1.

Construction of the TSF will commence in Year -2 with the diversion of Davidson Creek and construction of the TSF C Diversion Berm, TSF C Stage 1 SCP, and the Interim Environmental Control Dam (IECD) and pond. The Stage 1 TSF embankment will be constructed using locally borrowed overburden materials and NAG waste materials from the Open Pit; subsequent embankment raises will continue to use NAG waste materials. The final raise for the TSF will occur in approximately Year +20 to contain tailings to the end of operations in Year +23. The LoM development plan for the TSF is further described in the TSF Life of Mine Design Report (KP 2021f), which is included as Appendix 3-K. The detailed design of the Stage 1 TSF is presented in the TSF Stage 1 Detailed Design Report (KP 2021g), which is included as Appendix 3-J.

The nominal TSF C and TSF D pond volumes are presented in Table 7.2-2. Nominal pond volumes for TSF C vary over the LoM, as this is the primary water source for the mill, and is based on approximately four months of processing plant water demands. The nominal pond volume for TSF D is 2 Mm^3 from Year 23 forward.

Table 7.2-1: TSF Annual Filling Schedule

Mine Period	Year	Cumulative Tailings (Mm^3)		Cumulative WR (Mm^3)		Supernatant Pond Allowance (Mm^3)	
		TSF C	TSF D	TSF C	TSF D	TSF C	TSF D
1	-2	0	0	0.05	0	0	0
2	-1	0	0	0.6	0	1	0
3	1	3	0	5	0	2	0
4	2	8	0	9	0	2	0
5	3	12	0	12	0	2	0
6	4	16	0	19	0	2	0
7	5	20	0	26	0	2	0
8	6	30	0	32	6	5	0
9	7	39	0	32	17	5	0
10	8	48	0	32	33	5	0
11	9	57	0	32	53	5	0
12	10	67	0	32	75	5	0
13	11	82	0	32	93	10	0
14	12	97	0	32	105	10	0
15	13	113	0	32	122	10	0
16	14	128	0	32	143	10	0
17	15	143	0	32	161	10	0
18	16	159	0	32	174	10	0
19	17	174	0	32	180	10	0
20	18	190	0	32	180	10	0
21	19	205	0	32	180	10	0
22	20	220	0	32	180	10	0
23	21	232	4	32	180	10	2
24	22	232	19	32	180	10	2
25	23	232	25	32	180	10	2

Table 7.2-2: Nominal Pond Volumes

Mine Years	TSF – C Nominal Pond Volume (Mm^3)	TSF – D Nominal Pond Volume (Mm^3)
Year 1	1	-
Year 2 and 3	2 (ramping up in Year 2)	-
Year 4 to 6	5 (ramping up in Years 4 and 5)	-
Year 7 to 10	5	<0.1
Year 11 to 20	10 (ramping up in Year 11)	<0.1
Year 21 to 23	10	2
Year 24 onwards	2	2

The nominal TSF C pond volume equates to approximately four months of processing plant water supply.
The nominal TSF D pond volume is set at 2 Mm^3once tailings discharge to TSF D begins.

Based on the filling schedule and water balance modelling, the time to saturate PAG waste rock within the TSF is predicted to be 12 months or less. This is aligned with the ML/ARD Management Plan (Appendix 9-D). The estimated time to saturate PAG waste rock placed in the TSF is presented in Table 7.2-3.

Table 7.2-3: Time to Saturate PAG Waste Rock Placed in TSF

Facility	Mine Year	Approximate time to Saturate (Months)
TSF C	-2 and -1	< 1
	1	1
	2	3
	3	6
	4+	12
TSF D	6	< 1
	>6	3

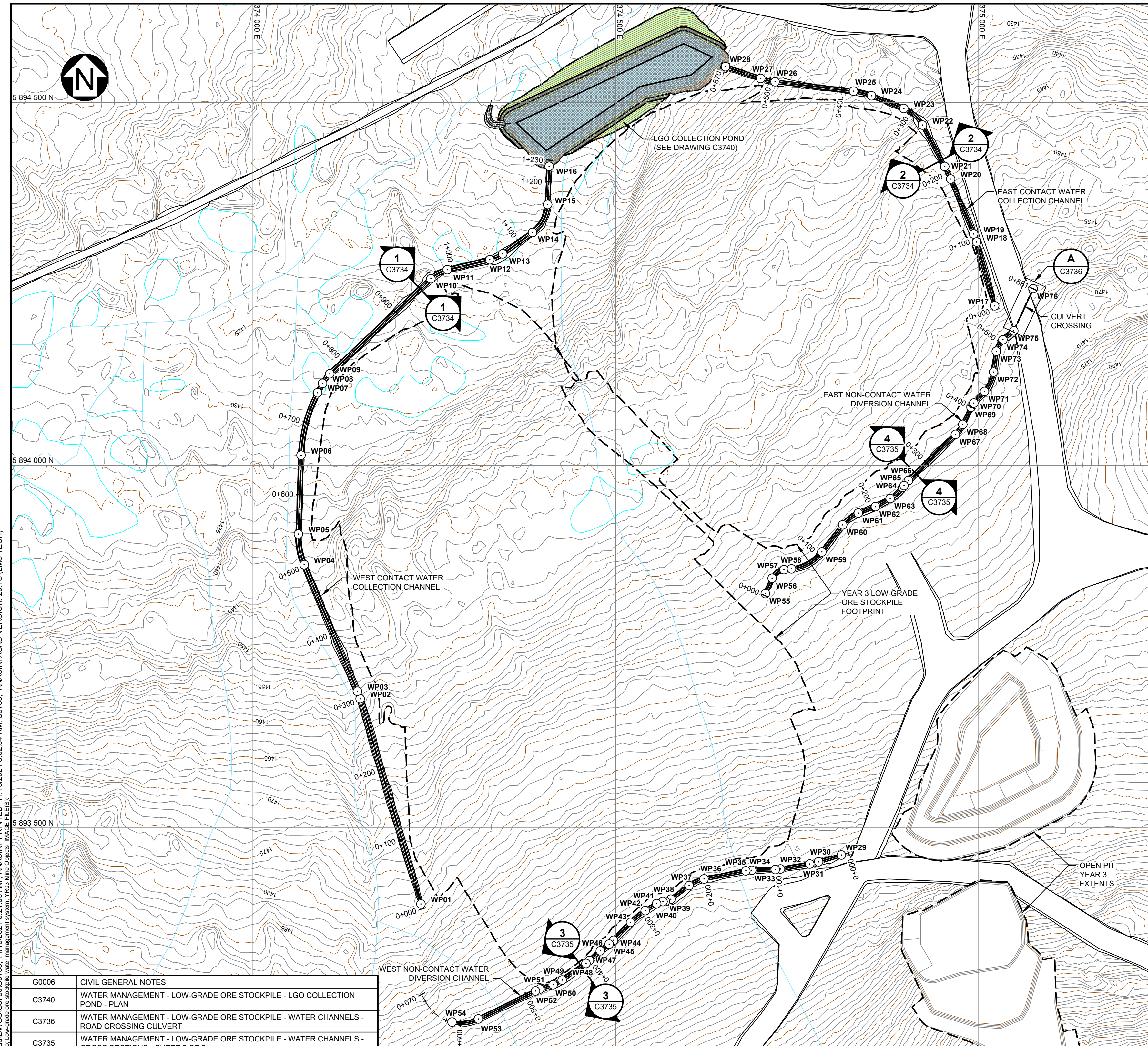
7.2.3 Low Grade Ore Stockpile

The LGO Stockpile will be located between the Open Pit and TSF C. Higher-grade LGO ore will be segregated and placed in the LGO Stockpile from Year +1 through Year +9, and then rehandled from the stockpile and processed from Year +9 to the end of Year +15. Lower-grade LGO will be placed in the LGO Stockpile from Year-1 through Year+17, and then rehandled and processed from Year +18 through Year +23. Drainage from the ore stockpile is expected to be acidic and contain elevated metals; therefore, the LGO stockpile design includes a liner system across the footprint area, a series of non-contact and contact water diversion channels, and foundation drains. All runoff and seepage from the LGO stockpile will be collected in a collection pond conveyed to the lime neutralization circuit at the process plant, and discharged to TSF C. The LGO Stockpile water management arrangement for Year -1 is shown on Figure 7.2-1 with additional details related to the LGO Stockpile seepage collection system shown on Figure 7.2-2. The general arrangement of the stockpiles area for Year+3 is shown on Figure 7.2-3. The LGO Stockpile water management systems required at the start of mine operations are further described in the Stockpiles Geotechnical and Water Management Design Report (KP 2021h), which is included as Appendix 3-N.

7.2.4 Lower and Upper Waste Stockpiles

Overburden and NAG waste rock with low ML potential will be stored in the Lower and Upper Waste Stockpiles. The Lower Waste Stockpile will consist of mostly overburden; it will be placed from Year -1 through Year +10. Overburden (1/3rd) and NAG waste rock(2/3rd) with low ML potential will be placed in the Upper Waste Stockpile beginning in approximately Year +11 and continuing to the end of operations. The Lower Waste Stockpile material will be used to support reclamation of the TSF and other infrastructure on the mine site. Any material remaining material will be fully reclaimed by the start of post-closure, at which time the collection pond will be reclaimed. The Upper Waste Stockpile will be progressively reclaimed during operations.

Runoff and toe discharge from the unreclaimed Lower Waste Stockpile will be directed to a collection pond during Operations and then to the TSF C starter pond prior to construction of the WMP; to the Metals WTP and then WMP in late Year-1 through Operations; and to the TSF C pond in Year+18 through Closure.



CONTACT WATER WEST CHANNEL WORK POINTS

POINT NO.	EASTING	NORTHING	ELEVATION (m)
WP01	374231.8	5893394.9	1478.6
WP02	374147.9	5893677.8	1454.2
WP03	374144.2	5893688.3	1453.3
WP04	374070.6	5893862.6	1440.3
WP05	374062.8	5893904.9	1437.8
WP06	374066.5	5894013.5	1431.8
WP07	374089.3	5894099.8	1427.9
WP08	374096.1	5894112.7	1427.3
WP09	374106.1	5894125.8	1426.6
WP10	374245.4	5894257.0	1421.4
WP11	374268.2	5894269.3	1420.1
WP12	374326.7	5894283.1	1418.8
WP13	374344.4	5894291.2	1418.6
WP14	374385.7	5894320.8	1417.8
WP15	374406.5	5894359.4	1414.9
WP16	374408.5	5894411.9	1411.6

CONTACT WATER EAST CHANNEL WORK POINTS

POINT NO.	EASTING	NORTHING	ELEVATION (m)
WP17	375023.0	5894219.5	1460.6
WP18	374997.9	5894307.4	1453.1
WP19	374994.0	5894318.6	1452.3
WP20	374962.2	5894394.4	1444.6
WP21	374954.1	5894411.6	1443.3
WP22	374923.4	5894468.8	1436.1
WP23	374897.6	5894491.8	1432.0
WP24	374852.9	5894509.3	1430.8
WP25	374828.3	5894515.5	1430.2
WP26	374720.2	5894528.6	1420.8
WP27	374700.3	5894533.1	1417.8
WP28	374652.0	5894549.3	1412.9

NON-CONTACT WATER WEST CHANNEL WORK POINTS

POINT NO.	EASTING	NORTHING	ELEVATION (m)
WP29	374811.7	5893462.5	1503.0
WP30	374780.2	5893452.9	1501.2
WP31	374767.9	5893450.0	1501.2
WP32	374727.5	5893443.0	1501.0
WP33	374720.4	5893442.3	1500.9
WP34	374688.0	5893441.4	1500.8
WP35	374679.8	5893440.5	1500.7
WP36	374622.1	5893429.4	1500.4
WP37	374601.5	5893420.2	1500.3
WP38	374576.5	5893401.5	1500.2
WP39	374568.7	5893398.5	1500.1
WP40	374565.6	5893398.3	1500.1
WP41	374556.8	5893395.4	1500.0
WP42	374541.0	5893385.7	1500.0
WP43	374520.9	5893369.5	1499.8
WP44	374497.3	5893344.8	1499.7
WP45	374491.4	5893339.6	1499.6
WP46	374479.1	5893330.2	1499.5
WP47	374464.3	5893316.8	1499.4
WP48	374459.3	5893312.8	1499.4
WP49	374426.5	5893290.0	1499.2
WP50	374414.0	5893283.7	1499.1
WP51	374395.7	5893277.4	1499.0
WP52	374389.7	5893275.0	1499.0
WP53	374311.1	5893236.3	1498.6
WP54	374274.8	5893232.0	1498.4

NON-CONTACT WATER EAST CHANNEL WORK POINTS

POINT NO.	EASTING	NORTHING	ELEVATION (m)
WP55	374706.8	5893822.8	1468.3
WP56	374716.0	5893844.0	1467.1
WP57	374732.4	5893855.9	1467.0
WP58	374742.9	5893857.0	1466.9
WP59	374784.6	5893880.2	1466.7
WP60	374813.3	5893917.6	1466.5
WP61	374835.1	5893933.8	1466.3
WP62	374858.5	5893942.8	1466.2
WP63	374878.9	5893953.8	1466.1
WP64	374896.2	5893969.2	1466.0
WP65	374898.0	5893971.8	1465.9
WP66	374904.0	5893978.8	1465.9
WP67	374968.9	5894042.4	1465.4
WP68	374978.9	5894056.1	1465.4
WP69	374990.4	5894079.7	1465.2
WP70	374994.3	5894085.5	1465.2
WP71	375008.9	5894101.6	1465.1
WP72	375021.3	5894128.2	1464.9
WP73	375025.3	5894156.9	1464.8
WP74	375034.3	5894172.9	1464.7
WP75	375049.3	5894185.1	1466.0
WP76	375076.0	5894243.2	1463.5

LEGEND:

- MINE WATER
- FILL AREAS
- CUT AREAS
- WP01 WORK POINT

NOTES:

1. FOR GENERAL NOTES SEE DWG. G0006.
2. FOR CONTACT WATER CHANNEL PROFILES SEE DWG. C3732.
3. FOR NON-CONTACT WATER CHANNEL PROFILES SEE DWG. C3733.

DETAILED DESIGN
NOT FOR CONSTRUCTION

SCALE A: 60 30 0 100 200 300 m

PLAN
WATER MANAGEMENT SYSTEM
SCALE A

DRG. NO.	DESCRIPTION
G0006	CIVIL GENERAL NOTES
C3740	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - LGO COLLECTION POND - PLAN
C3736	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - WATER CHANNELS - ROAD CROSSING CULVERT
C3735	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - WATER CHANNELS - CROSS SECTIONS - SHEET 2 OF 2
C3734	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - WATER CHANNELS - CROSS SECTIONS - SHEET 1 OF 2
C3733	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - NON-CONTACT WATER CHANNELS - PROFILES
C3732	WATER MANAGEMENT - LOW-GRADE ORE STOCKPILE - CONTACT WATER CHANNELS - PROFILES

REFERENCE DRAWINGS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED

REVISIONS

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED	APPROVED
0	16NOV'21	ISSUED FOR PERMITTING	KAB	ABN/RAF		

REVISIONS

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BW GOLD LTD.

BLACKWATER GOLD PROJECT

WATER MANAGEMENT
LOW-GRADE ORE STOCKPILE
PLAN
YEAR -1

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C3730	0

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C3730\C3730, 11/16/2021 8:21:00 AM, ANASIRI PRINTED: 11/16/2021 8:32:04 AM, C3730, ANASIRI ACAD VERSION: 23.1S (LMS TECH)

Figure 7.2-1: LGO Stockpile Water Management (Year -1)

Source: Knight Piésold Consulting (2021).

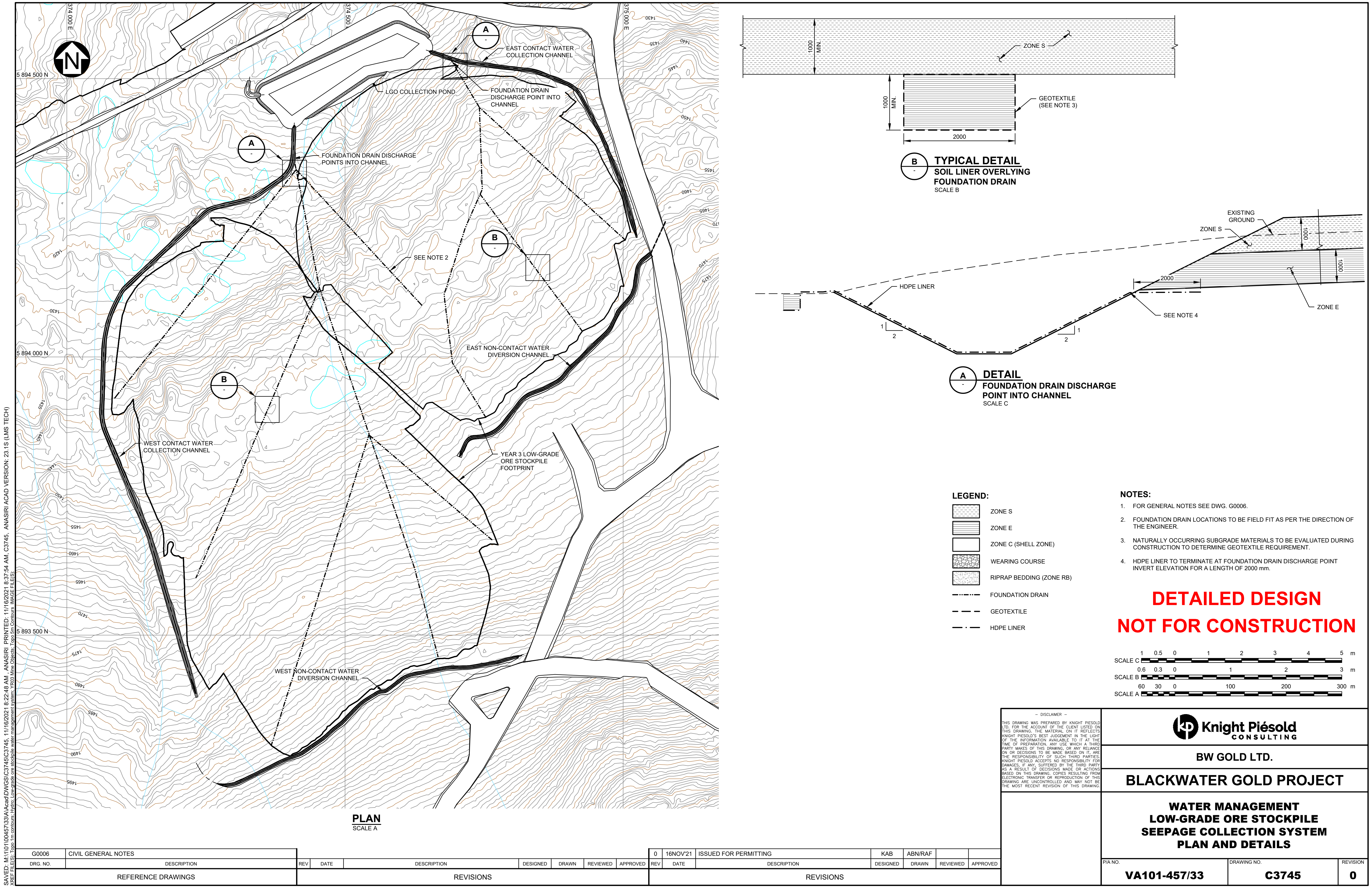


Figure 7.2-2: LGO Stockpile Seepage Collection System

Source: Knight Piésold Consulting (2021).

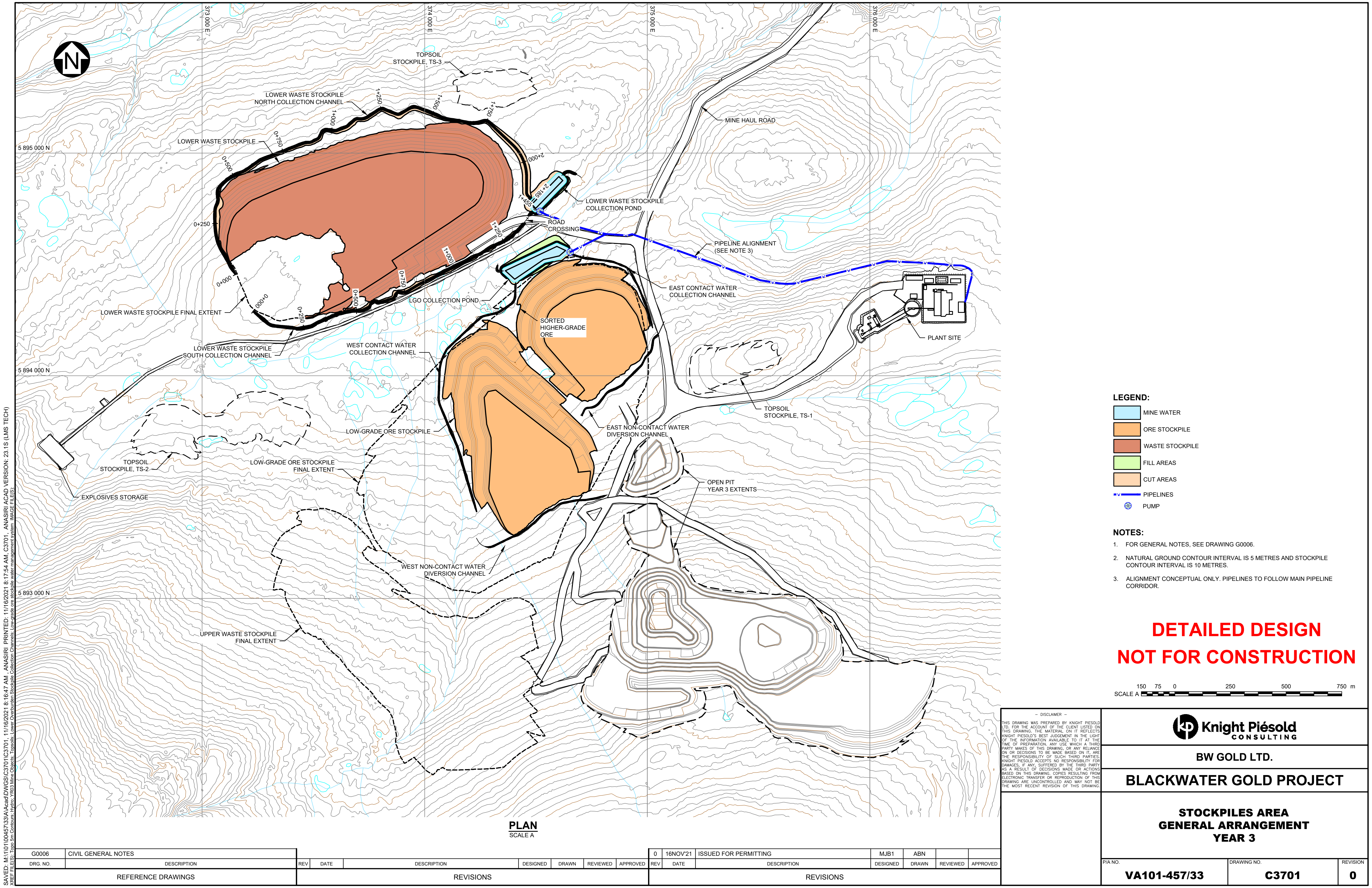


Figure 7.2-3: Stockpiles Area – General Arrangement – Year +3

Source: Knight Piésold Consulting (2021).

Groundwater seepage from the Lower Waste Stockpile footprint contributes to the TSF C Pond, Main Dam D drains, ECD, South Collection Channel, and the natural tributary contributing to the WMP.

Water from the Upper Waste Stockpile goes to a collection pond and from there to the Metals WTP beginning in Year+11 and continuing through Year+17, and to the Pit Lake from Year+18 through Closure. In post-closure, toe discharge from the Upper Waste Stockpile will continue to be collected in the collection pond and from there will be directed to the Membrane WTP, while runoff from the top of the stockpile will be directed to TSF C.

The waste stockpile water management systems required at the start of mine operations are further described in the Stockpiles Geotechnical and Water Management Design Report (KP 2021h), which is included as Appendix 3-N.

7.2.5 Water Management Pond

The WMP will be constructed in Year -2 downslope of the Open Pit and stockpiles area and within the ultimate footprint of TSF C to manage runoff from contributing areas. The primary function of the WMP is to provide fresh make-up water for ore processing at the mill. Excess water will be discharged via a pumping system and pipeline to the FWR. The discharge pumps have a total system flowrate of approximately 2,800 m^3/h. The WMP will have a capacity of approximately 825,000 m^3. The design of the WMP is described in the TSF Stage 1 Detailed Design Report (KP 2021f), included as Appendix 3-J.

The WMP will receive direct runoff from the mine area creek catchment, water pumped from other collection points and water management systems, treated effluent from the Metals WTP and Membrane WTP during Operations, and seepage from the Lower Waste Stockpile and Upper Waste Stockpile.

The WMP will be formed using natural topography enclosed by construction of three geomembrane-lined earthfill berms on the West, North, and East sides of the pond. The WMP is initially located in the southeastern portion of the TSF C footprint and is relocated upslope of the original location by the start of Year 11. The WMP will be decommissioned by the start of the Post-Closure phase.

7.2.6 Freshwater Reservoir

The FWR will be constructed downstream of the TSF and the associated seepage collection works, approximately 1,800 m downstream of the Main Dam D. The purpose of the FWR is to maintain a suitable source of fresh water to provide flows to lower Davidson Creek as required to reduce the potential environmental impacts of the project and to support mine operations when required. The design of the FWR is presented in the Water Management Structures Detailed Design Report (KP, 2021i), which is included as Appendix 3-O.

The FWR will be formed as an in-creek reservoir using natural topography enclosed by construction of an earthfill berm on the northeast side of the reservoir. The embankment will be approximately 125 m in length and will impound a total volume of around 370,000 m^3 from its foundation level to the spillway invert elevation.

The FWR will collect direct precipitation on the FWR and runoff from contributing catchments, diverted flows (non-contact) from the Northern Diversion System during Year+7 to Year+23, water pumped from the WMP, and Tatelkuz Lake water via the FWSS. The FWSS pumps water from Tatelkuz Lake to the FWR and will be installed and operational from Year+6 through Closure. Water discharged via the FWR outlets report directly to upper Davidson Creek.

The FWR will be constructed by the end of Year -1 prior to the start of ore processing and will be decommissioned near the end of closure. Towards the end of the active mine closure period, it is anticipated that the FWR will be drained and decommissioned, and the embankment dam will be breached.

Regulation of stream flows at the FWR will cease during closure to allow a natural flow regime to develop in Davidson Creek. Pumped flows from Tatelkuz Lake to the FWR via the FWSS will also cease.

Two sets of FWR outlet works (a surface level outlet and low-level outlet) will provide the flows necessary to meet design requirements. The outlet works consist of three identical pipes, each sized to individually provide the largest IFN. The low-level outlet contains twin pipes for redundancy, higher flow flushing capacity, and ease of maintenance. The surface level outlet will contain one pipe with the ability to provide the maximum IFN without the use of the low-level pipes. The design objectives of the two outlet works are:

- The IFN can be met at all times of year, with two outlet pipes out of service.
- Water can be drawn at the surface of the FWR or at depth in the FWR to adjust to seasonal temperature targets.
- Higher flushing flows or IFNs can be accommodated in the IFNs change in the future.

The design of the FWR was based on storing the equivalent of approximately seven days of IFN at the maximum rate in May and June of 0.56 m^3/s. The basis for and magnitude of these flows were developed by Palmer Environmental (Palmer 2021). The discharge requirements vary throughout the year from 0.08 m^3/s during winter baseline flow, to 0.12 m^3/s in the fall, to a maximum of 0.56 m^3/s for approximately seven weeks in May and June (Table 7.2-4). Releases from the FWR will be managed by at the Temperature and Flow Control Chamber located on the downstream side of the FWR embankment.

Table 7.2-4: Davidson Creek Instream Flow Needs

Period	IFN (m^3/s)	Days
January 1 to April 15	0.13	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	0.3	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

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

7.2.7 Surface Water Diversions

Surface water diversions are proposed to convey non-contact water around the TSF to the FWR for release to Davidson Creek or to the WMP for use by the mill. The major diversions are described below.

7.2.7.1 Central Diversion System

The Central Diversion System (CDS) will be constructed to divert freshwater around the TSF to a tributary of Davidson Creek or to a water transfer pond where the flows can be pumped to the WMP. The design of the CDS was separated into two phases, as the system components will need to be relocated in approximately Year +6 due to the expanding footprint of the TSF. Phase 1 of the CDS will be operational from Year -1 to Year +6, while Phase 2 will be operational from Year +7 to post-closure.

The design of the Phase 1 CDS is presented in the Water Management Structures Detailed Design Report (KP 2021i), included as Appendix 3-O. The Phase 2 CDS is presented in the TSF Life of Mine Design Report (KP 2021e), included as Appendix 3-K.

The primary components of the Phase 1 CDS during are:

- Diversion and collection channels;
- Water transfer pond; and
- Pipeline and pump system.

The Phase 1 Central Water Transfer Pond will be constructed upstream of the TSF within the Davidson Creek watershed in the general vicinity of the existing exploration access road and has a total contributing catchment area of approximately 8.6 km^2. Water collected in the Central Water Transfer Pond can be pumped to the WMP or overflow through a spillway to TSF C, as required

The primary components of the Phase 2 CDS are the same as in Phase 1; however, the components are located further upstream to accommodate construction of the West Dam for TSF C. Two collection channels will be constructed to route water around the TSF to the Phase 2 Central Water Transfer Pond. The Phase 2 Central Water Transfer Pond is created by impounding water upstream of the West Dam and will have a total contributing catchment area of approximately 5.5 km^2. The pond will receive inflows from Davidson Creek and the Phase 2 North and South Collection Channels.

Water will be pumped from the Central Water Transfer Pond to the WMP during the Operations and Closure phases, and into the TSF C spillway and directed to the plunge pool in Davidson Creek in post-closure.

7.2.7.2 Northern Diversion System

The Northern Diversion Channel of the CDS will become the Northern Diversion System (NDS) at the end of Year +6 to allow for diversion of upstream flows from the northwest around the TSF and provide water to the FWR. The design of the NDS is presented in the TSF Life of Mine Design Report (KP 2021e), included as Appendix 3-K.

The NDS comprises the following primary components:

- North and South Collection Channels to intercept freshwater prior to reaching TSF D and convey flows to the Northern Water Transfer Pond;
- Northern Water Transfer Pond: located on an unnamed tributary west of the TSF to capture water such that it can be conveyed to the FWR; and
- Northern Diversion System Pipeline: route water around the perimeter of the TSF D from the Northern Water Transfer Pond to the FWR using a gravity pipeline system.

The Northern Water Transfer Pond will be constructed upstream of the TSF within an unnamed watershed and has a total contributing catchment area of approximately 9.8 km^2. The pond has a design life of approximately 16 years and will receive inflows from the unnamed watershed and the North and South Collection Channels. Water from the pond will flow via gravity to the FWR using the Northern Diversion System Pipeline, which has a design flow of 300 L/s. Flows in excess of the pipeline capacity, leakage from the collection channels, and overflow from the diversion structure will contribute to TSF D. For closure and post-closure, this system will be decommissioned and the flows from this catchment will report to the TSF.

7.2.8 Sediment Control Ponds

Sediment control ponds are proposed for Stage 1 construction of Main Dam C (prior to construction of the IECD), Plant Site, aggregate borrow areas, and camp. The SCP water will be conveyed as follows:

- The TSF Stage 1 SCP will be located downstream of the Main Dam C cut-off trench and will collect runoff from the Davidson Creek basin and Mine Area Creek basin, and discharge to Davidson Creek. The SCP will be constructed in Year -2 and decommissioned after construction of the IECD in Year -1.
- The Plant Site SCP (authorized by *Mines Act* M-246 [Early Works] will provide controlled discharge to ground through a rapid infiltration basin system during construction and to the mill during operations and to TSF C until the Plant Site is reclaimed and the SCP decommissioned.
- A downstream aggregate borrow area SCP will discharge to Davidson Creek during Construction and Operations. The downstream aggregate borrow area SCP will be in place from Year-1 through to Closure, when it will be decommissioned.
- An upstream aggregate screening area SCP will discharge to the TSF C pond or to the TSF Stage 1 SCP prior to water being held behind Main Dam C.
- The Camp Site SCP will discharge to Creek 505659 in Upper Creek 661. From This SCP will operate from Year -2 until the end of Closure, at which point it will be decommissioned.

7.2.9 Environmental Control Dams

There are two environmental control dams (ECD): an interim IECD downstream of TSF C, which will be functional from Year -1 until Year +6, and the final ECD, which will be constructed downstream of TSF D and functional from Year +7 through post-closure. The design of the IECD is presented in the TSF Stage 1 Detailed Design Report (KP 2021g), which is Appendix 3-J of the Application. The design of the ECD is presented in the TSF Life of Mine Design Report (KP 2021f), which is included as Appendix 3-K.

Seepage from Main Dam C, groundwater discharge, and surface water runoff will be collected at the IECD, located approximately 500 m downstream of Main Dam C at a topographic low point in Davidson Creek. The IECD will utilize a pumpback system to convey the recovered flows to the TSF C pond. The dam will be maintained in a dewatered condition to the maximum extent practical. Seepage through the IECD will be captured in a foundation drain system and sump. The IECD will be fully constructed prior to the start of operations and was designed to manage seepage and runoff until the construction of Main Dam D beginning in approximately Year +5. The IECD is designed with a maximum storage capacity of approximately 58,000 m^3.

The IECD pumpback system comprises shore-mounted, end-suction, centrifugal pumps equipped with variable frequency drives capable of providing up to 130 m total design head at a design flowrate of 280 m^3/hr. The pump system intake will be located within the IECD pond and will discharge into TSF C with erosion protection as required. The design flowrate was selected to provide capacity to dewater the 1 in 100-year, 24-hour storm event volume, within a period of 14 days while continuously managing seepage inflows.

The ECD will be constructed approximately 1,000 m downstream of Main Dam D and upstream of the FWR at a topographic low point in Davidson Creek. The ECD will be constructed in Year +6 prior to PAG/NAG3 waste rock placement in TSF D. Two seepage interception trenches (north and south of Davidson Creek) will be excavated through the surficial sand and gravel terraces downstream of the Main Dam D and will report to the ECD pond. The trenches will be excavated into low-permeability subgrade soils and will each extend approximately 1.6 km north and south of the ECD. The dam will be maintained in a dewatered condition to the maximum extent practical. The ECD has a capacity of approximately 194,000 m^3. The ECD pumpback system comprises shore-mounted, end-suction, centrifugal pumps. The pump system intake will be located within the ECD pond and the pipeline will discharge into TSF D with erosion protection as required. The design flowrate was selected to provide capacity to dewater the 1 in 100-year, 24-hour storm event volume, within a period of 14 days while continuously managing seepage inflows.

7.2.10 Water Treatment

Two WTPs (the Metals WTP and Membrane WTP) are proposed to treat mine site water, and one domestic sewage treatment plant (STP) is proposed to treat domestic sewage on site. In addition, lime will be used to neutralize LGO Stockpile runoff and seepage.

A Metals WTP will treat groundwater inflow and surface water runoff from the Open Pit and surface runoff from the Lower and Upper Waste Stockpiles from Year -1 to Year +17. McCue Engineering Contractors (McCue) developed the detailed design for the Metals WTP (McCue 2021; Appendix 5-G).

A Membrane WTP is proposed to treat supernatant pond water from TSF C during operations and primarily ECD water (i.e., TSF seepage water) in post-closure. During operations, water treatment is required to reduce the water storage inventory in the TSF during wet periods. The design for the Membrane WTPs was developed by BQE Water (2021; Appendix 5-H). Membrane WTPs are designed to remove sulphate, nitrogen (N)-species, and trace heavy metals in mine contact water: a reverse osmosis (RO) WTP will be used in Operations and a nanofiltration (NF) WTP will be used in post-closure. Treated water will be directed to the WMP during operations and the brine by-product from the membrane filtration unit will be recycled to the TSF. Treated water will be discharged directly to Davidson Creek in post-closure, with the brine by-product conveyed to the Pit Lake.

The proposed water treatment systems are summarized in Table 7.2-5.

Table 7.2-5: Summary of Project Water Treatment

Water Treatment	Phase	Influent Sources	Discharge Location
Metals WTP	Operations	Pit Sump; Pit GW dewatering; Upper and Lower Waste Stockpiles runoff	Water Management Pond
Lime neutralization	Operations	LGO Stockpile runoff and seepage	TSF C or D Pond
Membrane (RO) WTP	Operations	TSF C Pond	Water Management Pond
Membrane (NF) WTP	Post-closure	ECD; Pit Lake; TSF C Pond	Plunge Pool
Domestic sewage WTP	Operations	Process Plant	TSF C or D Pond

Notes:

LGO – low grade ore; RO – reverse osmosis; NF – nano-filtration

The treatment design targets for all WTPs are equal to BC water quality guidelines for the protection of aquatic life, with the exception of total suspended solids (TSS), for which design targets were set equal to MDMER effluent concentration limits (Table 7.2-6). The treatment design targets for the Membrane and Metals WTPs were also set to support adherence to Yinka Dene Water Law (YDWL) Class III water quality standards, which are considered to apply to Davidson Creek and Creek 661. The YDWL Class III standards are equal to BC and CCME water quality guidelines. Calculated guidelines were based on the baseline dataset for WQ28 for hardness, chloride, pH, temperature, and dissolved organic carbon.

A lime neutralization system will neutralize water that comes in contact with the LGO Stockpile (Ausenco 2021; Appendix 3-F). The lime neutralization system will operate from Year +1 through Year +23.

This plan also includes domestic wastewater discharge from the Plant Site, which will be generated from facilities at the process plant, truck shop and wash, and mine dry/office, including kitchen, washroom, showering and laundry. The Plant Site will be built during Year -2 and -1 during the Construction phase and it is expected that all of the facilities generating domestic wastewater will be operational by Year +1.

Table 7.2-6: Design Targets for Membrane and Metals WTP Treated Effluent

Parameter	Unit	Design Target	
		Monthly Average	Instantaneous Maximum
TSS	mg/L	15	30
pH	-		6.5 to 9.0
Ammonia	mg-N/L	1.53	7.97
Nitrate	mg-N/L	3	32.8
Nitrite	mg-N/L	0.02	0.06
Sulphate	mg/L	128	
Chloride	mg/L	150	600
Fluoride	mg/L		0.514
Cyanide (Weak Acid Dissociable)	mg/L		0.01
T-Ag	mg/L	0.00005	0.0001
T-As	mg/L		0.005
T-B	mg/L	1.2	
T-Be	mg/L	0.00013	
T-Co	mg/L	0.004	0.11
T-Cr	mg/L	0.001	
T-Fe	mg/L		1
T-Hg	mg/L	0.00002	
T-Mn	mg/L	0.53	0.546
T-Mo	mg/L	1	2
T-Ni	mg/L	0.025	
T-Pb	mg/L	0.0035	0.0061
T-Sb	mg/L	0.009	
T-Se	mg/L	0.002	
T-Tl	mg/L	0.0008	
T-U	mg/L	0.0085	
T-Zn	mg/L	0.0075	0.033
D-Al	mg/L	0.05	0.1
D-Cd	mg/L	0.000047	0.000072
D-Cu	mg/L	0.0006	0.0036
D-Fe	mg/L		0.35

Notes:

D = dissolved; T = total

The design for the conveyance system from the Lower Waste Stockpile Collection Pond to the Metals WTP can be found in Appendix 3-N, and the design for the conveyance system from the metals WTP at the Plant Site to the WMP is included in Appendix 3-O. The WTPs are described in Chapter 5.6 and 5.7 of the Application and summarized in the following sub-sections.

7.2.10.1 Metals WTP

The Metals WTP will operate from Year -1 through Year +17). The Metals WTP will treat Open Pit groundwater inflow, surface water runoff to the open pit, and surface water runoff from the Upper and Lower Waste Stockpiles. Treatment of water for all the sources is not required after Year +17.

Water treatment capacity will be phased as follows:

- Phase 1 (Year -1 to +4): two WTP trains (WTP A and B) will be designed with a total capacity of 105 L/s, and sequentially brought online to handle the maximum flow. Each train will be designed with flexibility to handle the lower flow rates expected in the winter months.
- Phase 2 (Year +5 to +8): an additional train (WTP C) with a design flow rate of 50 L/s will be brought online to treat the increased flow from the expanding Open Pit.
- Phase 3 (Year +9 to +17): a fourth train (WTP D) with a design flow rate of 50 L/s will be brought online in Year 9 to handle the increased flow rate.

Treatment of water for all the sources is not required after Year +17. Each train will be designed with flexibility to work at half the design capacity to account for winter and summer flow rate variations. The maximum flow rate in summer is estimated to range from 21 L/s in Year -1 to 203 L/s in Year +17, while in winter the maximum flow rate is estimated to range from 21 L/s in Year -1 to 79 L/s in Year +17, as it is expected that inflow from the pit sump will not occur during winter.

A metals treatment pond is proposed upstream of the Metals WTP to collect water from all the sources and temporarily store them before being pumped to the Metals WTP. Since the flow from the pit sump is estimated based on the average annual climate inputs, the metals treatment pond has the capacity to contain short term increases in peak precipitation flows. Two ponds are proposed: Pond 1 (4,600 m^3 volume) will handle predicted flow during Phase 1 and Pond 2 (4,400 m^3 volume) will handle the increased flow during Phase 2 and Phase 3. In the event that the metals treatment pond reaches its maximum capacity, water would be contained in the pit sump.

An influent pump with a variable frequency drive will be installed to pump water from the metals treatment pond to the Metals WTP. The flow rate, pH, and turbidity of the influent water will be monitored with instruments on the inlet line.

The treated water will be directed into the combined effluent tank for final pH monitoring and adjustment. Final monitoring of effluent quantity and quality will be performed with an inline flow meter, pH meter, and turbidity meter. If the pH is within the discharge range the water will be discharged to the WMP, otherwise the water will be recycled to the metals treatment pond.

7.2.10.2 Membrane WTP

The operations Membrane WTP will use a reverse osmosis (RO) membrane to treat TSF supernatant pond water for sulphate and nitrogen species and discharge treated water into the WMP. The brine by-product (retentate) stream from the membrane filtration unit will be recycled to the TSF. The treatment is only predicted during wet periods (as identified by the variable climate scenarios in the LoM WBM) to reduce the water storage inventory in the TSF. The design basis assumes an inflow of 72 L/s and treated discharge to the environment of 54 L/s, with 18 L/s of retentate to the TSF. The system will be designed to operate from April through October (seven months). Treatment is specified in the LoM WBM to occur when the TSF C Pond volume in Operations exceeds a minimum threshold volume specified for modelling purposes, which is approximately of three to four times the monthly mill reclaim requirement.

The post-closure a Membrane WTP will treat water from the ECD as a priority and top up with flow from the Pit Lake and TSF C up to a maximum of 190 L/s. The system will be designed to operate year-round.

The WTP effluent discharge and recycle lines will be outfitted with automatic valves linked to pH and conductivity measurements to ensure automatic switch-over to recycle should effluent parameters go outside of limits. Off-specification plant effluent will be pumped back to the TSF. An operator will manually switch the process back to discharge mode after confirming that all parameters are within limits.

7.2.10.3 Lime Neutralization System

Runoff and infiltration into the LGO stockpile will be collected and conveyed to the process plant where it will be neutralized with lime before being discharged to the TSF. The capacity of the neutralization system is based on the predicted runoff from the LGO stockpile and will vary according to the operations phase of the processing plant: from Year +1 to Year +5 the water treatment capacity will be 57 m^3/hr, increasing to approximately 108 m^3/hr from Year +6 through Year +23.

LGO Stockpile runoff water will be pumped to two agitated neutralization tanks operating in series, and lime will be added to the first neutralization tank in the form of calcium hydroxide slurry until pH 10.0 is reached. Neutralized water will then overflow into the second neutralization tank and then pumped to the final tailings pumpbox. The pH of influent and effluent will be measured using pH probes and this information will be used to automate dosing of lime slurry and discharge of effluent to the tailings pumpbox. Water that meets the pH criteria for discharge will be by gravity to the TSF, while water that does not meet the pH criteria for discharge will be recirculated within the neutralization tanks.
Lime neutralization does not affect the water balance.

7.2.10.4 Domestic Water/Sewage Treatment

Domestic wastewater from the Plant Site will be treated and directed to the TSF via the tailings line. Water in the TSF will be reused for mining operations. Domestic wastewater from the Plant Site will be treated in a mechanical treatment plant using a moving bed biofilm reactor (MBBR) followed by dissolved aeration flotation (DAF) and ultraviolet treatment. The majority of the coagulant and flocculent will stay in the sludge phase and will not be discharged to the TSF. Sludge will be dewatered via a dewatering bag system, then collected and trucked off site to an approved disposal facility. The filtrate from this system will be collected and pumped back into the MBBR/DAF system. Other domestic sewage systems for the camp and other buildings are not captured through this application and therefore are not described in this plan.

7.3 Mine Site Water Monitoring

Mine site water monitoring, for quantity and quality, is described below. The intent of monitoring on site is to provide an early detection system and identify trends in surface water and groundwater quality so that potential impacts to the receiving environment can be investigated, mitigated, and avoided. In addition, ongoing monitoring will be used to evaluate predictions, calibrate and update models, and update mitigation options as needed throughout the LoM. The monitoring outlined is intended to comply with relevant legislation and to reduce the likelihood of a potential non-compliance event as a result of mining operations.

7.3.1 Mine Site Surface Water Quality Monitoring

7.3.1.1 Monitoring Methods

The monitoring program will follow QA/QC procedures specified in the following documents:

- BC Field Sampling Manual (BC Ministry of Water, Land and Air Protection 2013);
- BC Environmental Laboratory Manual (BC Ministry of Environment and Climate Change Strategy, 2020b); and

- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC MOE 2016b).

The QA/QC components of the mine surface water monitoring program will include:

- Equipment checks and calibration;
- Duplicate sampling;
- Blank sampling;
- Use of certified laboratories for analysis, and
- Data quality evaluation, including the assessment of ion balance (where applicable), total versus dissolved metal concentrations, and assessment of the influence of suspended solids on dissolved concentrations in groundwater samples, and flagging of outlier data points that could indicate sample contamination.

Field sampling protocols will follow guidance presented in BC MWLAP (2013), BCMOE (2016b) and MDMER and involve the procurement and preparation of appropriate equipment and materials, including:

- A field meter and appropriate calibration and maintenance materials,
- Pre-labeled, clean bottles and associated materials (e.g., gloves, labels, preservatives, filters, ice packs, coolers, travel blanks) provided by the analytical laboratory,
- A camera,
- Record-keeping materials,
- Appropriate Health and Safety equipment and general field gear.

It is assumed the analytical laboratory will provide five to nine bottles (plastic and/or glass) for each sample, depending on the final parameter list and laboratory analytical method. Field water quality measurements will be recorded using a calibrated water quality meter. New, clean gloves will be used for analytical water collections at each station, and replaced as appropriate. The sampling sites must conform to WorkSafeBC, the Code and other applicable safety requirements, and be accessible under expected weather and flow conditions.

Samples will be collected at the mid-point of the mine water flow path (if relevant), slightly below the water surface, to minimize potential contamination from disturbed sediments or air-borne particulates. To collect the samples that do not require filtration (and are not pre-charged with the preservatives), the clean sample bottle will be plunged beneath the water surface with the opening facing directly down, fully submerged below the water surface if depth allows, to minimize entrainment of surface debris. Samples that will be analysed for dissolved parameters will be filtered into the appropriate bottle in the field using syringes and approved 0.45 µm filters provided by the analytical laboratory or supplied by BW Gold Ltd. Preservatives will be added to the bottles that require preservation (if the bottles are not pre-charged) in the field and immediately capped. All samples will be kept cool and in dark conditions until shipment in secured coolers with ice packs, chain of custody forms, and appropriate packing to the analytical laboratory. Every reasonable effort will be made to ensure the samples arrive at the laboratory within recommended hold times. Detailed SOPs will be developed prior to the onset of the Construction phase.

7.3.1.2 Monitoring Locations

The mine site water monitoring locations and the water source at each point (contact water and non-contact water) are summarized in Table 7.3-1 and shown on Figures 7.3-1 (end of Year -1) through 7.3-5 (post-closure). The water quality monitoring locations have been selected to enable ongoing evaluation of the quality of contact water and non-contact water that has been diverted around the mine site or captured for use in the mill process. Discharge monitoring locations are discussed in Section 8 and are therefore not included in Table 7.3-1.

7.3.1.3 Monitoring Frequency

Mine site process and clean water diversion surface water quality monitoring will be conducted monthly. WTP influent and effluent will be at a higher frequency relative to other mine site surface water quality monitoring stations and is discussed further in Section 7.3.3.

7.3.1.4 Parameters and Analysis

The parameters to be measured in mine site water (Table 7.3-2) will be a continuation from the baseline program and will include those constituents recommended by the BC MOE (2016b) as well as parameters identified as Parameters of Concern (POCs) and Parameters of Potential Concern (POPCs) in the Project Conceptual Site Model (CSM; Section 5.10). The same parameter set will be monitored in discharged waters (Section 8.3). Data analysis will include an evaluation of concentration trends and comparison to BC and/or CCME guidelines (as appropriate) and trigger levels, as relevant (Section 11). Influent and effluent waters for treatment systems will be subject to additional analyses (e.g., instantaneous in-line comparison to established benchmarks, parameter concentration ranges and central tendencies, flow vs. concentration relationships) per the operator specifications, to inform treatment operations.

Field (*in situ*) measurements will be recorded for:

- Temperature;
- Dissolved oxygen;
- Conductivity;
- Salinity;
- pH; and
- ORP.

Field measurements will be collected using a regularly calibrated multi-parameter water quality meter.

7.3.2 Mine Site Surface Water Flow Monitoring

Mine site flow monitoring is required to support the on-going evaluation and refinement of the predictions of the water balance model and the surface and groundwater water quality model. Flow monitoring is also required to manage the on-site water that will be needed for ore processing at the Plant Site, and to determine when water from the TSF C pond exceeds a threshold volume that will trigger treatment of TSF C pond water via the Membrane WTP. Table 7.3-3 provides a summary of the proposed surface water flow monitoring locations – flow monitoring sites will be co-located with the mine site surface water quality monitoring locations shown on Figures 7.3-1 through 7.3-5. Monitoring details for each of the components are provided in the sections below.

Water level measurements and flow monitoring will typically occur at all water retaining ponds to monitor water levels and compliance with freeboard requirements and to measure outflows from the ponds.

Flow monitoring at effluent discharge points to the environment is discussed in Section 8.

Table 7.3-1: Mine Site Process and Clean Water Diversion Water Quality Monitoring Locations

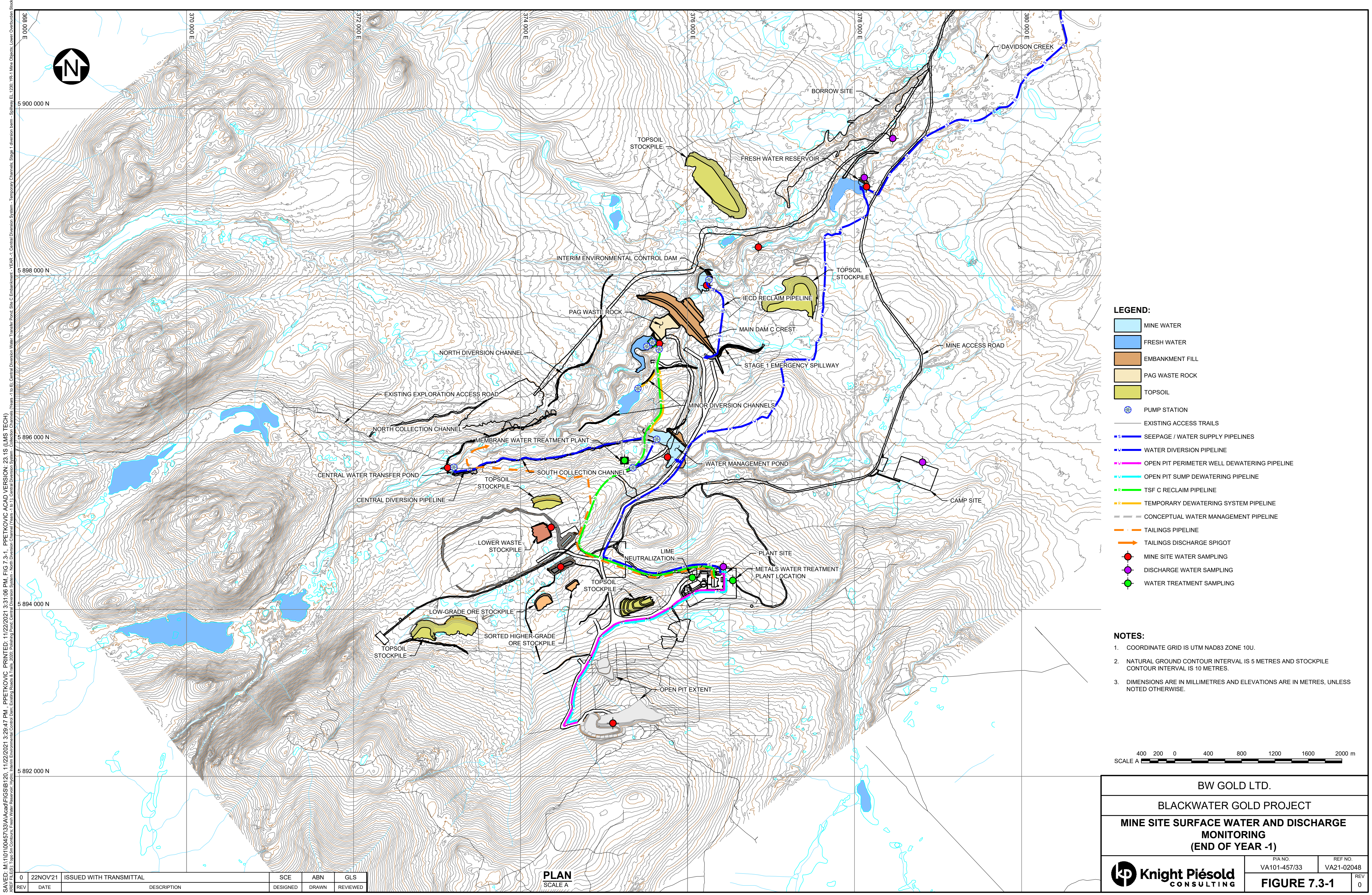
Facility	Coordinates	Mine Phase	Water Source	Water Pumped to
Upper Waste Stockpile Collection Pond	TBD	Operations, Closure	Stockpile runoff and toe discharge	Metals WTP in operations, and Pit Lake in closure.
Lower Waste Stockpile Collection Pond	5894712N, 374470E	Construction, Operations, Closure	Stockpile runoff and toe discharge	Metals WTP in construction and operations, and TSF C Pond in closure.
LGO Stockpile Collection Pond	5894510N, 374534E	Operations	Stockpile runoff and toe discharge; groundwater collected in the foundation drains.	Lime neutralization system in operations.
Open Pit Sump	5893300N, 375369E (lowest point of ultimate pit design)	Construction, Operations	Groundwater inflow and surface water from upgradient catchment; Upper Waste Stockpile seepage; precipitation on pit walls	Metals WTP in Years -1 to +17.
Pit Lake	5893091N, 375322E (centre of pit lake)	Operations (starting Year +18), Closure, Post-Closure	Groundwater and surface water from upgradient catchment; Upper Waste Stockpile seepage; runoff from the Upper Waste Stockpile (closure and post-closure); precipitation on pit walls; TSF C Pond (late operations and closure only); ECD pump back (late operations and closure only); Membrane WTP brine (post-closure only).	Membrane WTP in post-closure.
TSF C pond	5895923N, 374950E	All	Precipitation; water drained from waste rock voids; TSF C beach runoff and infiltration; consolidation seepage from tailings; tailings slurry water; runoff and toe discharge from Main Dam C; IECD pumpback; water pumped from TSF D pond; West Dam seepage pumpback; sewage effluent; Lower and Upper Waste Stockpiles seepage; WMP overflow; lime neutralization system effluent; Membrane WTP brine (operations only); groundwater and surface water from upgradient catchment; Central Diversion System North and South Collection Channels overflow and leakage.	Reclaim water pumped to mill in operations; surplus water pumped to Membrane WTP in operations; water pumped to Pit Lake in closure; flow via spillway in post-closure.
West Dam Seepage Sump	5894906N, 371817E	Operations, Closure, Post-Closure	West Dam runoff; West Dam toe discharge; seepage from TSF C; groundwater discharge.	TSF C or Phase 2 Central Water Transfer Pond.

Facility	Coordinates	Mine Phase	Water Source	Water Pumped to
TSF D pond	5898029N, 374089E	Operations, Closure, Post-Closure	Tailings slurry water; TSF D beach runoff and infiltration; precipitation; water drained from waste rock voids; ECD pumpback; consolidation seepage; Open Pit seepage in post-closure (portion not captured by seepage collection system for treatment); runoff and toe discharge from Main Dam D; runoff and toe discharge from Main Dam C; seepage from TSF C pond; groundwater and surface water from upgradient catchment Northern Diversion System flows in excess of pipeline capacity, leakage from collection channels, and diversion structure overflow.	TSF C in operations and closure; flow via spillway in post-closure.
Water Management Pond	5895553N, 375576E	Construction (Year -1), Operations, Closure	Effluent from Metals WTP; effluent from Membrane WTP; Upper Waste Stockpile seepage; surface water from upgradient catchment; pumped flows from the Central Diversion System.	Mill to meet processing requirements and surplus to the FWR. Flow in excess of the WMP discharge pipeline capacity overflows to TSF C Pond via the WMP pipe outlet and/or spillway.
IECD pond	5897905N, 376173E	Construction (Year -1), Operations (Year +1 to Year +6).	Seepage from TSF C; Main Dam C runoff and toe discharge; Lower Waste Stockpile seepage; groundwater and surface water from upgradient catchment.	TSF C
Downstream of IECD	5898337N, 376856E	Construction (Year -1), Operations (Year +1 to Year +6).	Seepage pathways through TSF C prior to construction of ECD	IECD
ECD pond	5898484N, 377431E	Operations, Closure, Post-Closure	Seepage from TSF C, TSF D, Main Dam D, Lower Waste Stockpile, Pit Lake, contact runoff, and non-contact surface and subsurface flows.	TSF D in operations, Pit Lake in closure, and Membrane WTP in Post-Closure.
FWSS	5899042N, 378139E	Operations, Closure	Non-contact water pumped from Tatelkuz Lake.	FWR
Central Diversion System Water Transfer Pond	5894821N, 371795E	Construction, Operations, Closure, Post-Closure	Non-contact water upgradient of TSF until Year +6. Pond re-located west of West Dam in Year +7.	WMP, overflow via spillway to TSF C to Year +6; During high flow events may spill to Lake 16 from Year +7 onwards.

Facility	Coordinates	Mine Phase	Water Source	Water Pumped to
Northern Diversion System Water Transfer Pond	5897923N, 373347E	Operations (Year +7 onwards), Closure	Non-contact water upgradient of TSF.	FWR, overflow via spillway to TSF D.

Note: Coordinates are approximate, all station locations and coordinates will be verified upon station commissioning. Water sources may vary with mining phase.

TBD: Coordinates to be determined at a future date. The Upper Waste Stockpile Collection Pond will be designed (and coordinates identified) some time prior to Year 11.



Note: Monitoring locations will be finalized during Construction.

Figure 7.3-1: Mine Site Surface Water and Discharge Monitoring (End of Year -1)

Source: Knight Piésold Consulting (2021).

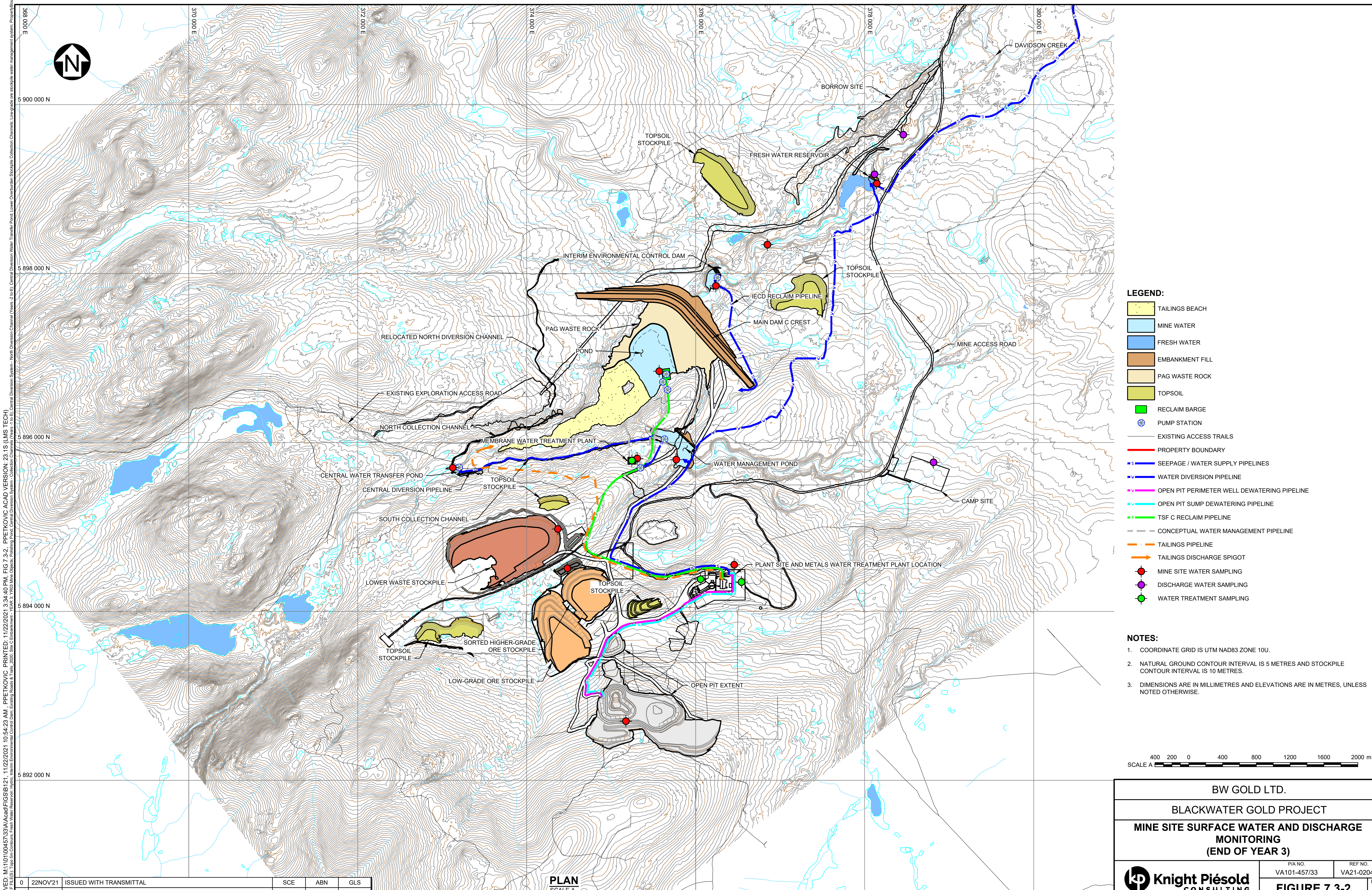
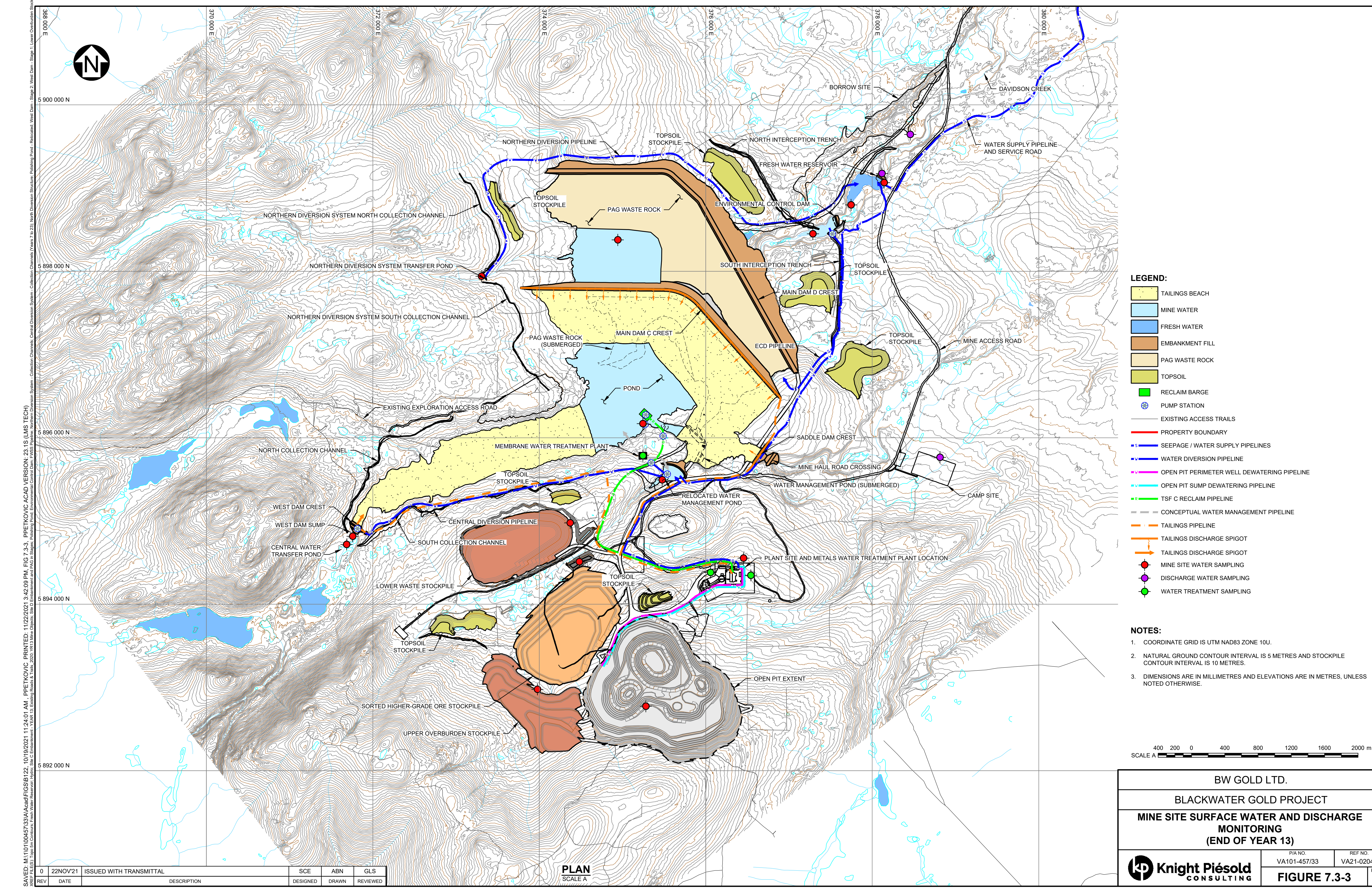


Figure 7.3-2: Mine Site Surface Water and Discharge Monitoring (End of Year +3)

Note: Monitoring locations will be finalized during Construction.

Source: Knight Piésold Consulting (2021).



Note: Monitoring locations will be finalized during Construction.

Figure 7.3-3: Mine Site Surface Water and Discharge Monitoring (End of Year +13)

Source: Knight Piésold Consulting (2021).

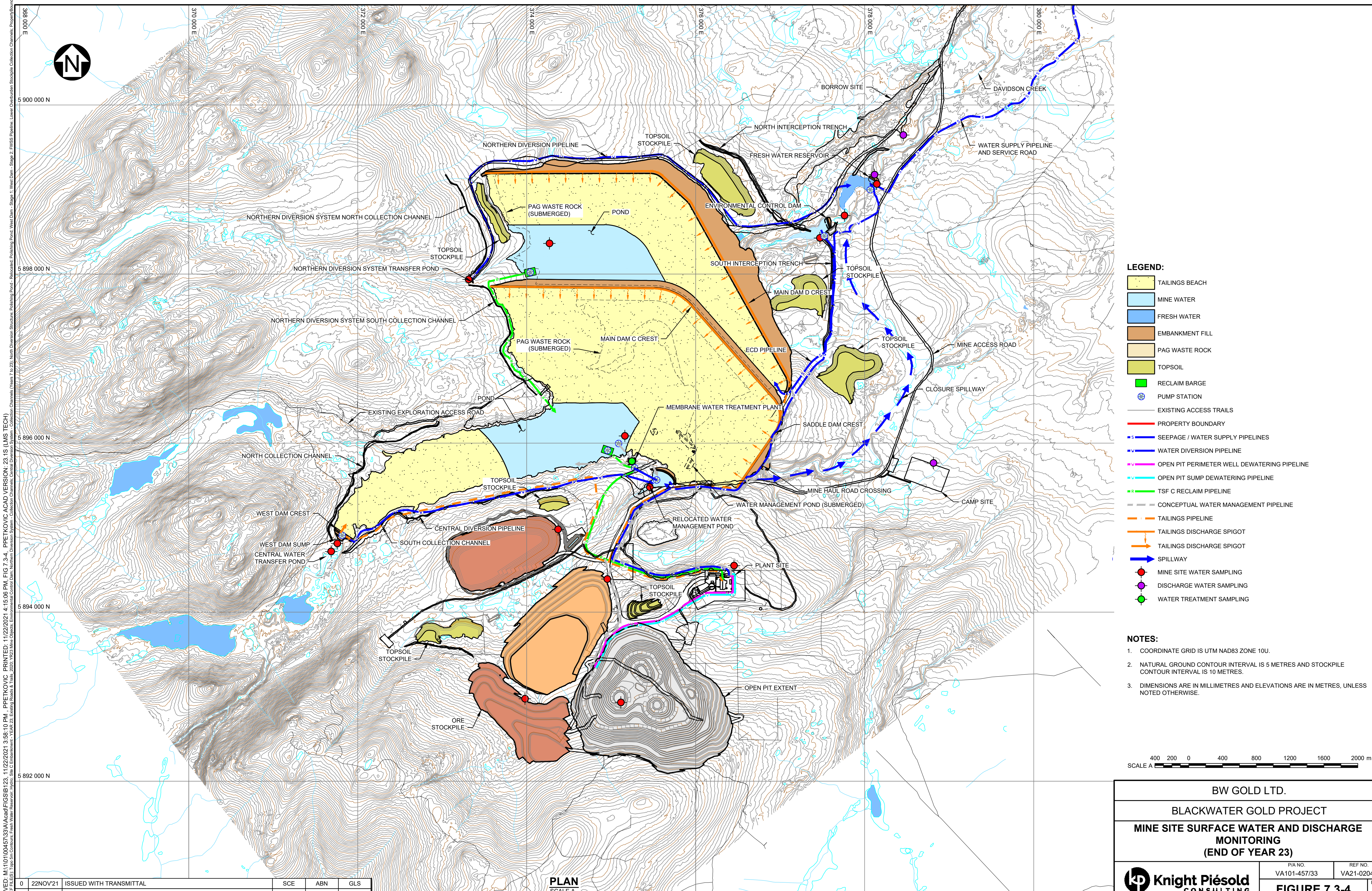


Figure 7.3-4: Mine Site Surface Water and Discharge Monitoring (End of Year +23)

Note: Monitoring locations will be finalized during Construction.

Source: Knight Piésold Consulting (2021).

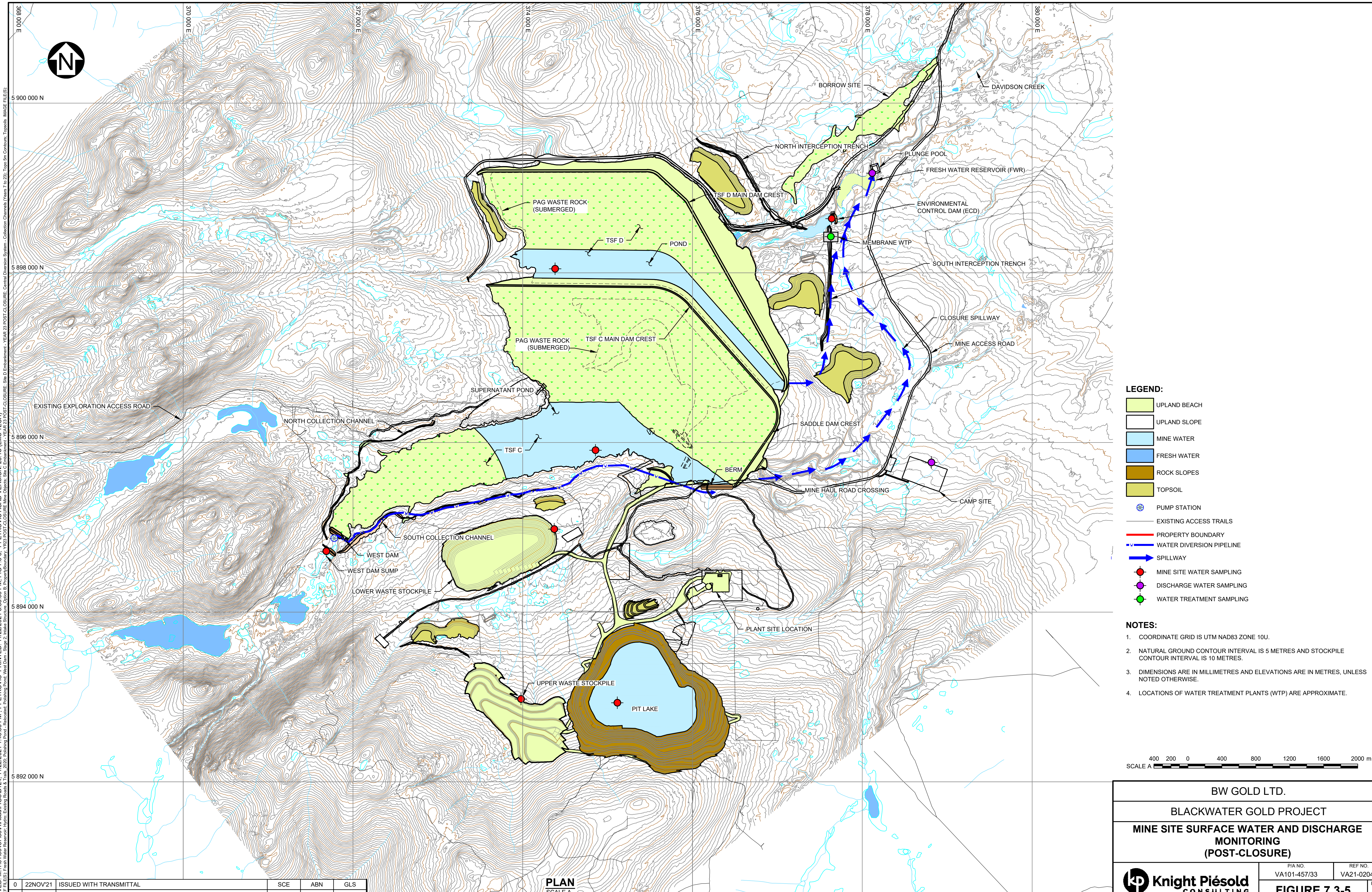


Figure 7.3-5: Mine Site Surface Water and Discharge Monitoring (Post-closure)

Note: Monitoring locations will be finalized during Construction.

Source: Knight Piésold Consulting (2021).

Table 7.3-2: Chemistry Parameters and Detection Limits

Parameter	Detection Limit	Parameter	Detection Limit
Physical Parameters		**Major Anions**	
pH	0.01	Alkalinity – Total	1 mg/L
Specific Conductivity	2 µS/cm	Acidity	2 mg/L
Hardness as $CaCO_3$ (Dissolved)	1 mg/L	Chloride	0.5 mg/L
Total Dissolved Solids	10 mg/L	Fluoride	0.02 mg/L
Total Suspended Solids	2 mg/L	Bromide	0.05 mg/L
Turbidity	0.1 NTU	Sulphate	0.5 mg/L
Colour	5 CU	**Organics**	
Nutrients		Total Organic Carbon	0.5 mg/L
Nitrate Nitrogen	0.005 mg/L	Dissolved Organic Carbon	0.5 mg/L
Nitrite Nitrogen	0.005 mg/L	**Cyanide**	
Nitrogen – Total	0.05 mg/L	Total Cyanide	0.001 mg/L
Ammonia Nitrogen	0.02 mg/L	Weak Acid Dissociable (WAD) Cyanide	0.001 mg/L
Ortho phosphorus – dissolved	0.005 mg/L		
Phosphorous – Total	0.005 mg/L		
Total and Dissolved Metals		**Total and Dissolved Metals**	
Aluminum	0.001 mg/L	Manganese	0.0002 mg/L
Antimony	0.0001 mg/L	Mercury	0.00001 mg/L
Arsenic	0.0002 mg/L	Molybdenum	0.0001 mg/L
Barium	0.0001 mg/L	Nickel	0.0005 mg/L
Beryllium	0.0001 mg/L	Potassium	0.1 mg/L
Bismuth	0.0005 mg/L	Selenium	0.0003 mg/L
Boron	0.01 mg/L	Silicon	0.05 mg/L
Cadmium	0.0001 mg/L	Silver	0.00001 mg/L
Calcium	0.05 mg/L	Sodium	0.1 mg/L
Chromium	0.0005 mg/L	Strontium	0.0002 mg/L
Cobalt	0.0001 mg/L	Thallium	0.00001 mg/L
Copper	0.0002 mg/L	Tin	0.0002 mg/L
Iron	0.01 mg/L	Titanium	0.01 mg/L
Lead	0.0001 mg/L	Uranium	0.00001 mg/L
Lithium	0.001 mg/L	Vanadium	0.001 mg/L
Magnesium	0.1 mg/L	Zinc	0.001 mg/L

Table 7.3-3: Mine Site Surface Water Flow Monitoring Locations

Facility	Mine Phase	Monitoring Instruments Proposed	Rationale
TSF C supernatant pond – water level	Construction, Operations, Closure, Post-Closure	Pressure transducers and/or lookdown water level sensors, combined with manual survey	To determine when supernatant will be sent to the Membrane WTP and confirm adequate freeboard. To inform on-going water balance model calibration.
TSF D supernatant pond – water level	Operations, Closure, Post-Closure	Pressure transducers and/or lookdown water level sensors, combined with manual survey	To confirm adequate freeboard. To inform on-going water balance model calibration.
Central diversion system	Operations, Closure, Post-Closure	Pressure transducers at pond, flowmeters at pumpstation, new surface flow monitoring station downstream, if required	Improve understanding of inflows and outflows, diversion efficiency, and inform on-going water balance model calibration
Northern diversion system	Operations, Closure	Pressure transducers at pond, flowmeters at outlet pipe, new surface flow monitoring station downstream, as required	Improve understanding of inflows and outflows, diversion efficiency, and inform on-going water balance model calibration
WMP	Construction (Year -1), Operations, Closure.	Pressure transducers and/or lookdown water level sensors, combined with manual survey. Flowmeters at pumpstations, v-notch weir or other surface flow monitoring technique a primary overflow outlet	Improve understanding of inflows and outflows, diversion efficiency, and inform on-going water balance model calibration.
IECD	Construction (Year -1), Operations (Year +1 To Year +6).	Pressure transducers at pond combined with manual survey. Flowmeters at pumpstation.	Improve understanding of inflows and outflows, and inform on-going water balance model calibration
ECD	Operations, Closure, Post-Closure	Pressure transducers at pond combined with manual survey. Flowmeters at pumpstation.	Improve understanding of inflows and outflows, and inform on-going water balance model calibration

7.3.2.1 TSF Supernatant Ponds

The design of the TSF includes water storage allowances for the supernatant pond to provide a continuous source of process water for mill operations and to manage seasonal inflows, the Environmental Design Flood, and the Inflow Design Flood (Appendix 3-K, 3-J). The LoM WBM predicts that the TSF C pond volume will fluctuate between 1 (Year+1) and 10 Mm^3 (Year+11 to Year+23), as shown in Table 7.2-2. The pond volume of TSF C in Closure is maintained near 2 Mm^3 by pumping water to the Pit Lake. The TSF D Pond is maintained at a minimum volume prior to discharge of tailings into the facility and has a nominal operating water storage allowance of 2 Mm^3 after tailings discharge begins.

The volume of water in the TSF ponds will be estimated using a combination of pond water level measurements and bathymetric surveys. Water levels will be regularly monitored, using a combination of water level monitoring instrumentation and manual survey techniques, at the TSF C supernatant pond and later at the TSF D supernatant pond, to compare current water levels with freeboard requirements. A bathymetric survey of the supernatant ponds will occur at least twice (spring and fall) per year initially to develop a good understanding the rate of TSF filling. The frequency of bathymetric surveys may be decreased to annual measurements once the TSF filling relationship is well understood. Bathymetric measurements help calibrate the understanding of the depth/area/capacity relationship of each TSF pond. A combination of frequent water level measurements and bathymetric survey data will be used to regularly estimate the volume of water in the TSF.

If the supernatant pond exceeds the nominal operating volume (Table 7.2-2), membrane water treatment of the TSF C pond will be initiated. An Operations Maintenance and Surveillance (OMS) Manual will be prepared following initial construction and prior to commissioning of the TSF to provide comprehensive operating instructions and monitoring frequencies and will identify how and when water will be pumped to the Membrane WTP. Conceptually, the Membrane WTP operating instructions described in the OMS Manual will be a tier-based system, similar to a trigger action response plan, that will link treatment instructions with data from the available monitoring equipment and surveillance techniques.

7.3.2.2 Central Diversion System Water Transfer Pond

Water level monitoring within the water transfer pond is required to inform the operation of the pumping system and document when the pond has reached capacity and flow into the TSF is occurring.

The quantity of water pumped from the Phase 1 and Phase 2 Central Water Transfer Pond outlets will be monitored using flow meters installed downstream of the centrifugal pumps. In addition, during Year -1 to Year +6, a surface water flow monitoring station downstream of the Central Water Transfer Pond may be required to measure the quantity of water spilling from the facility and contributing to the TSF. The surface flow monitoring station will consist of a pressure transducer and data logger system to measure continuous water level, and frequent discharge measurements at varying flows to develop a stage-discharge rating curve. Baseline monitoring station H10 is located downstream of the Central Water Transfer Pond and may be used for instream flow monitoring until the tailings encroaches upon it; after this a new station will be established further upstream. The design concept for Year+7 to the end of operations and through Post-Closure does not involve excess flow being routed to the TSF, therefore a surface water flow monitoring station will not be required.

Water levels will be monitored using a pressure transducer with an appropriate depth range.
All monitoring instrumentation will incorporate a radio or telemetry system to facilitate automated data collection and to allow accessed to monitoring data in real time, if required.

In the event of winter ice conditions, the automated water level transducers can malfunction. In this case pond elevations will be monitored visually by means of calibrated lines marked on the banks of the facility or manual survey techniques until the automated system regains functionality.

7.3.2.3 Northern Diversion System Water Transfer Pond

Water level monitoring within the North Diversion System Water Transfer Pond is required to provide information regarding how much storage is available. Water levels will be monitored using a pressure transducer with an appropriate depth range.

Flow through the outlet of the North Diversion System Water Transfer Pond will be monitored using ultrasonic flow meters installed within the outlet pipe. In addition, a surface flow monitoring station downstream of the water transfer pond may be required to measure the of water volume spilling from the facility and contributing to the TSF. If required, the surface flow monitoring station will consist of a pressure transducer and data logger system and will require the development of a stable water level/discharge rating curve.

All monitoring instrumentation will incorporate a radio or telemetry system to facilitate automated data collection and allow accessed to monitoring data in real time, if required.

In the event of winter ice conditions, the automated water level transducers can malfunction. In this case pond elevations will be monitored visually by means of calibrated lines marked on the banks of the facility or using manual survey techniques until the automated system regains functionality.

7.3.2.4 Water Management Pond

A WMP Discharge Pipeline will route water from the WMP to the FWR. Water will be pumped to the FWR when not needed to support mill operations.

Water pumped from the WMP will be monitored using a flow meter installed downstream of the centrifugal pumps. The pumps will be controlled by a floating level control system in the WMP and equipped with variable frequency drives to balance the total system head from the individual units.

A culvert on the West Berm will provide supplemental outflow capacity to the TSF supernatant pond during periods of elevated runoff, and an emergency spillway will be constructed along the left abutment of the North Berm, terminating at a stilling basin in the Mine Area Creek catchment below the North Berm and upstream of Main Dam C.

7.3.2.5 Interim ECD and ECD Ponds

The IECD water will be pumped to TSF C from Year -1 through Year +6. The ECD pumpback system is required to convey water from the ECD to TSF D beginning at the end of Year +6. Water pumped from the IECD and ECD will be monitored using flow meters installed downstream of the pumps. The pumps will be controlled by a floating level control system in the IECD and ECD and equipped with variable frequency drives.

7.3.3 Water Treatment Monitoring

Water treatment plant operations and treatment efficiencies will be monitored by WTP operators as part of internal protocols and Standard Operating Procedures (SOPs) (Appendix 5-G and Appendix 5-H). This monitoring will include inline recordings at various treatment stages, field test kids (HACH or equivalent) for key parameters, and analytical samples submitted to a Canadian Association of Laboratory Accreditation (CALA) certified laboratory, specific to each treatment system.

The key performance indicators that will be monitored at the Membrane WTPs to determine if effluent is meeting specifications are (BQE 2021; Appendix 5-H of the Application) are as follows:

- For metal precipitation: pH and the residual oxidation-reduction potential (ORP) measurement. Maintaining pH on target and a slightly negative ORP ensures that treatment targets are being achieved; and
- For membrane filtration: permeate conductivity. Permeate water quality targets are achieved when the conductivity is maintained below a pre-determined setpoint.

Final monitoring of effluent quantity and quality at the Metals WTP will be performed with an inline flow meter, pH meter, and turbidity meter (McCue 2021; Appendix 5-G of the Application).

Monitoring will also be conducted by BW Gold at WTP influent and effluent points to support the evaluation of treatment efficiency and inform ML/ARD monitoring and mine water management (Table 7.3-4). WTP influent and effluent operational monitoring weekly samples will be collected during WTP operations and analyzed for the suite of parameters. The frequency of WTP sampling may be reduced following commissioning and a period of routine operation of each system once a consistent, long-term trend in effluent quality is demonstrated. The parameters to be measured will be a continuation from the baseline program and may include but not be limited to those analytes recommended by the BC MOE (2016b), summarized in Table 7.3-2.

Table 7.3-4: Summary of Water Treatment Monitoring Locations

Facility	Coordinates	Mine Phase	Description	
Metals WTP	5894248N, 376487E	Operations	Influent	Monitored at Metals Treatment Pond. Pond for temporary storage of inlet water to Metals WTP
			WTP	Operational plant monitoring. Treats pit sump water, and Upper and Lower Waste Stockpile runoff
			Effluent	Effluent stream (treated water)
Lime Neutralization System	5894395N, 376250E	Operations	Influent	Monitored at LGO stockpile toe
			WTP	Operational plant monitoring. Treats runoff and seepage from LGO stockpiles
			Effluent	Outflow stream of lime-adjusted water
Membrane (RO) WTP	5895780N, 375246E	Operations	Influent	Monitored at TSF C
			WTP	Operational plant monitoring. Treats TSF C pond overflow
			Effluent	Effluent stream (treated water)
Membrane (NF) WTP	5895780N, 375246E	Post-Closure	Influent	Influent stream to WTP
			WTP	Operational plant monitoring. Treats ECD water, TSF C overflow, Pit Lake water and collected Pit Lake seepage
			Effluent	Effluent stream (treated water)
Plant Site Sewage Treatment Facility	5894427N, 376420E	Construction, Operations, Closure	Influent	Influent stream to facility
			Effluent	Effluent stream (treated water)

Note: Coordinates are approximate, all station locations and coordinates will be verified upon station commissioning.

For the lime neutralization system, the influent and effluent flow and pH will be continuously monitored in the process plant control room and data will be recorded by the control system. Grab samples will be collected weekly immediately upstream and downstream of the neutralization tanks. The pH of the grab samples will be analyzed by a lab to confirm calibration of the pH probes in the lime neutralization system.

As described in Section 7.2.11.4, the current Application also considers the authorization of a sewage treatment facility at the Plant Site. This facility will treat domestic wastewater discharge generated from facilities at the processing plant, truck shop and wash, and mine dry/office, including kitchen, washroom, showering, and laundry. The facilities at the Plant Site will be built during Year -2 and Year -1 of the Construction phase with facilities generating domestic wastewater by the start of Year +1. Domestic wastewater from the Plant Site will be treated and directed to the TSF C Pond via the tailings line. Further information is presented in Section 3.5.11.12 (Waste Management Facilities) and Section 5.7 (Domestic Water/Sewage Treatment) of the Application.

7.3.4 Mine Site Groundwater Quality and Flow

Mining activities that may impact groundwater quality during construction and operations include stockpiling of ore and tailings and waste rock management. In closure and the long-term, seepage from the Pit Lake may also impact groundwater quality.

Mining activities that will impact groundwater flow include Open Pit dewatering, construction of the TSF, and to a lesser extent waste rock, overburden, and LGO stockpiling. The most significant impact to baseline groundwater flow is expected to be associated with Open Pit dewatering.

7.3.4.1 Groundwater Quality

Monitoring Methods

Groundwater quality samples will be collected using methods that are in accordance with the well purging and sampling procedures from the following documents:

- British Columbia Field Sampling Manual. Part E Groundwater (Draft). Edition. Province of British Columbia. 2021; and
- Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. 1996. United States Environmental Protection Agency. Puls, R.W., and M.J. Barcelona. EPA/540/S-95/504 (EPA 1996).

To collect representative groundwater samples, stagnant water present in the monitoring well will be purged prior to sampling. The purging and sampling methods employed will be dictated by the conditions of each individual monitoring well. Two approaches will be applied to the groundwater wells, depending on whether the wells recover very quickly and a minimum drawdown can be maintained while purging, or whether the wells are very slow to recover and a minimum drawdown cannot be maintained despite very low pumping rates.

Monitoring Frequency

Monitoring of groundwater quality will be quarterly at the majority of sites. Annual sampling is proposed at a few background sites (MW12-05S/D and MW12-13S) that already have a water quality record several years long.

Installation of proposed monitoring wells will proceed such that baseline conditions in the new wells can be established based on a minimum of one year of seasonal data collection prior to breaking significant ground in the vicinity, if possible.

Quality Parameters and Analyses

Baseline groundwater quality monitoring to date has included the following:

- In situ parameters (specific conductivity, temperature, pH, dissolved oxygen, turbidity);
- Physical parameters (pH, specific conductance, TSS, total dissolved solids (TDS), hardness, acidity, and alkalinity), turbidity;
- Anions (bromide, chloride, fluoride, and sulphate);
- Nutrients (ammonia, nitrate, nitrite, total and dissolved phosphorus, dissolved orthophosphate, Total Kjeldahl Nitrogen (TKN), and total nitrogen);
- Cyanide; cyanate, thiocyanate;
- Dissolved and total metals (standard full suite with mercury, chromium III, and chromium VI); and
- Total Organic Carbon and Dissolved Organic Carbon.

The same parameters will be monitored during construction and operations. Samples collected for QA/QC purposes (such as duplicates, field and trip blanks) will be analysed for the standard full suite of each parameter group. Dissolved and total metals analyses will be completed to low-level detection limits. Future analyses, mitigation measures, or permits may require additional parameters to be analysed.

Groundwater quality results will be reviewed in a timely manner and evaluated with QA/QC procedures such as anion-cation balance and measured to calculated TDS ratio. Analyses of potential impacts to groundwater quality will be conducted by comparing data against the background baseline dataset. Interpretations for potential impacts to groundwater quality will be made in conjunction with surface water studies.

7.3.4.2 Groundwater Flow

Monitoring Methods

Changes to groundwater recharge or discharge locations will manifest through changes in water levels and flow paths. This groundwater level monitoring program has been developed to effectively capture changes to groundwater recharge and discharge locations. Groundwater levels will be monitored using pressure transducers and vibrating wire piezometers (VWPs). The pressure transducers will be downloaded when the monitoring wells are sampled. Manual water level measurements will be taken at every site visit and compared to pressure transducer readings on-site to ensure equipment is functioning correctly. If non-vented pressure transducers are used, a separate pressure transducer will be deployed to record barometric pressure. In order to capture impacts to both the shallow and deeper groundwater systems, a range of screened intervals will be monitored.

Monitoring Frequency

Water levels will be measured manually on a quarterly basis at each monitoring well and standpipe piezometer. Pressure transducers will be installed at all groundwater monitoring stations to provide a complete data set and verification for interim compliance. Transducer readings will be set to record at three-hour intervals.

Parameters and Analyses

Groundwater flow analyses will consider impacts to groundwater levels as well as changes to groundwater flow paths. Groundwater levels during construction and operations will be compared against reference groundwater levels established prior to breaking ground to assess the potential for impacts to surface water or changes in groundwater flow pathways. Groundwater levels are expected to decrease surrounding the Open Pit; analyses will include comparison against predicted water level drawdowns. Groundwater levels downstream of the TSF could increase associated with potential seepage from the facility; water levels downstream of the TSF will be compared against background water levels.

Interpretations for potential impacts will be made in conjunction with any surface water studies.

7.3.4.3 Groundwater Monitoring Locations

Monitoring is proposed at 29 locations for groundwater quality and at 40 locations for groundwater flow. The groundwater monitoring locations are listed in Table 7.3-5 (groundwater quality) and Table 7.3-6 (groundwater flow) and shown on Figures 7.3-6 through 7.3-9. The rationales for the locations are described below based on the proposed mine infrastructure. Long-term monitoring well locations were selected based on the following criteria:

- They are screened within potential groundwater flow pathways;
- They are reasonably spaced around the down-gradient area; and

- The screen depths are reasonably distributed to capture impacts to both the shallow and deeper groundwater systems.

The plan includes monitoring background conditions. Monitoring background conditions is an important component of impact assessment and effective quality assurance. Four monitoring locations (MW12-05S/D, MW-A, MW12-01D/S, MW12-13S) are proposed for monitoring background conditions during construction and operations. Background data will be used to distinguish between impacts due to project activities and variation due to natural conditions such as climate change.

Existing wells no longer needed will be decommissioned in accordance with requirements under the *Water Sustainability Act*, *Groundwater Protection Regulation* (Parts 12, 12.1-12.2). In accordance with the Regulation, all wells will be deactivated as soon as practicable if unused for five years. Deactivation requirements include:

- Water supply and dewatering wells: shut off power supply to pump or remove or disconnect manual pump handle;
- Flowing artesian well: prevent backflow into well, stop artesian flow through casing, and prevent leakage of artesian flow at surface or into another aquifer; and
- Monitoring well: remove any instruments used for water level monitoring.

Open Pit

The most significant impact to baseline groundwater flow is expected to be associated with Open Pit dewatering. The measured volumes of mine water pumped from the dewatering wells will be compared to the predicted values, and the model will be updated if required, to reflect these differences and improve understanding of the groundwater regime. The predicted propagation of the cone of depression will be compared against measured groundwater levels in monitoring wells. Groundwater drawdown associated with Open Pit dewatering will recover following closure of the mine and the development of a Pit Lake. As a result, these impacts to groundwater flow are not permanent and mitigation is not required in the long-term. Proposed water level monitoring sites include existing wells (MW12-03D, MW12-10D, MW12-11D/S, and MW-05) and a new site to monitor water level drawdown toward the Blackwater River catchment (GT-A). Groundwater sampling is proposed to be continued down-gradient of the Open Pit at MW12-03D.

The proposed water level monitoring sites listed above exclude and are in addition to sites surrounding the Open Pit where water level monitoring will be conducted to evaluate pit slope depressurization for Open Pit stability analyses.

TSF and ECD

Seepage collected by the TSF C and TSF D embankment drains and inflows to the IECD and ECD will be monitored and compared to predicted values. Monitoring wells located down-gradient of TSF C and TSF D will be used to monitor for potential unrecoverable seepage by monitoring water levels and water quality. Buried glaciofluvial sand and gravel channels and the weathered bedrock horizons are potential preferential groundwater flow pathways that may convey seepage down-gradient of the TSF. An increase in groundwater level downgradient of the TSF in these deeper subsurface horizons could indicate a hydraulic connection and potential for subsurface seepage flow.

Water quality of seepage collected by TSF C and TSF D embankment drains and inflows to the IECD and ECD will be monitored and compared to predicted values. Seepage from the TSF will report rapidly to the embankment drains and its quality can be assessed to predict the quality of potentially unrecoverable foundation seepage that would have a much longer travel time. Monitoring wells down-gradient of Main Dam C, Main Dam D, TSF C Saddle Dam, IECD, and the ECD will be used to monitor for indications of unrecoverable seepage.

Table 7.3-5: Mine Site Groundwater Quality Monitoring Locations – Construction and Operations

Facility	ID	Coordinates	Screen Zone (mbgs)	Frequency	Screen Zone Depth Rationale	Description
Background Well	MW12-01D/S	01D: 5899360N.374655E	36.6 – 39.6	Quarterly (MW12-01D only)	Shallow: Shallowest permeable horizon (weathered bedrock).	Existing wells north of TSF. Decommissioned prior to construction of Main Dam D.
		01S: 5899360N.374658E	9.1 – 12.2		Deep: Competent bedrock well.	
Background Well	MW12-05D/S	05D: 5896210N.371310E	23.2 – 26.2	Annual	MW12-05S: Overburden well.	Existing upgradient reference sites located in Davidson Creek headwater.
		05S: 5896210N.371309E	7.6 – 10.7		MW12-05D: Shallow bedrock well.	
	MW12-13S	13S: 5893830N.370808E	10 – 13.1		MW12-13S: Shallowest permeable horizon (glaciofluvial deposits).	
Background Well	MW-A (S/D)	TBD	TBD	Quarterly	Shallowest and deeper water bearing zone.	Proposed upgradient reference site. Install in Construction.
LGO and Ore Stockpiles	MW12-02S	5894670N.374704E	8.2 – 9.8	Quarterly	Shallowest water bearing zone (glacial till).	Existing wells down-gradient of ore stockpiles and LGO Stockpile Collection Pond.
LGO, Ore and Waste Stockpiles	MW-B (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed wells down-gradient of ore and waste stockpiles. Install in Construction.
	MW-C (S/D)					
	MW-R (S/D)					
	MW-S (S/D)					
Open Pit	MW12-03D	5893860N.376013E	33.5 – 36.6	Quarterly	Shallowest water bearing zone (glacial till).	Existing wells down-gradient of deposit.
Plant Site	MW-E (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed wells down-gradient of Plant Site. Install in Construction phase.
IECD	GT20-04	5898081N.376215E	22.17 – 27.94	Quarterly	Water bearing zone above bedrock (glacial till).	Existing wells downs-gradient of IECD. Decommissioned in Year +5.

Facility	ID	Coordinates	Screen Zone (mbgs)	Frequency	Screen Zone Depth Rationale	Description
TSF C / Main Dam C	MW-D (S/D) MW-P (S/D) MW-Q (S/D)	TBD	TBD	Quarterly	MW-D: screens target the inferred buried glaciofluvial unit and an underlying permeable horizon. MW-P and MW-Q: screens target horizons that could be potential seepage pathways from the facilities (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed wells down-gradient of Main Dam C South Abutment. Install in Construction and Decommission in Year +5.
TSF C / Main Dam C	MW-K (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till and/or weathered bedrock).	Proposed wells down-gradient of Main Dam C. Install prior to Year +10.
TSF D / Main Dam D	MW-F (S/D) MW-G (S/D) MW-H (S/D) MW-I (S/D) MW-J (S/D) MW-L (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed wells down-gradient of Main Dam D. Install in Year +5.
TSF D / Main Dam D	MW12-07D/S	07D: 5899440N.376395E 07S: 5899440N.376399E	35.4 – 38.6 19.8 – 22.9	Quarterly	Shallowest and deeper water bearing zones (glaciofluvial deposits).	Existing well north of TSF. Decommission prior to construction of the North Interception Trench.
Downgradient of Aggregate Source	MW-M (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed site. Install in Construction.
FWR	MW12-08D/S	08D: 5899260N.377911E 08S: 5899260N.377911E	32.6 – 35.6 16.2 – 19.3	Quarterly	Shallowest (glaciofluvial deposits) and deeper (glacial till) water bearing zones.	Existing wells down-gradient of ECD/North of FWR.
FWR	MW12-09D	5899688N.378334E	30.5 – 33.6	Quarterly	Water bearing zone (glacial till).	Existing wells down-gradient of FWR.

Facility	ID	Coordinates	Screen Zone (mbgs)	Frequency	Screen Zone Depth Rationale	Description
TSF Closure Spillway	MW-O (S/D)	TBD	TBD	Quarterly	Shallowest and deeper water bearing zones (glaciofluvial deposits).	Proposed wells down-gradient of Saddle Dam. Install prior to Year +10.
Camp Site	MW12-12D/S	12D: 5896250N.378490E	31.2 – 34.2	Quarterly	Shallowest (glaciofluvial deposits) and deeper (glacial till) water bearing zones.	Existing wells down-gradient of Camp Site and TSF Spillway in Closure.
		12S: 5896250N.378490E	11.2 – 14.2			
Saddle Dam	MW-N (S/D)	TBD	TBD	Quarterly	Well screens to be installed in horizons that could be potential seepage pathways (i.e., glacial till, glaciofluvial, and/or weathered bedrock).	Proposed wells down-gradient of Saddle Dam. Install prior to Year +10.

Notes:

Coordinates presented in UTM Zone 10U NAD 83.

Screen zone is metres below ground surface.

TBD – to be determined.

Table 7.3-6: Mine Site Groundwater Flow Monitoring Locations

Facility	ID	Description
Background Well	MW12-01D/S	Existing wells north of TSF. Decommissioned prior to construction of Main Dam D.
	MW12-05D/S MW12-13S	Existing upgradient reference sites located in Davidson Creek headwater.
	MW-A (S/D)	Proposed upgradient reference site. Install in Construction.
Ore Stockpiles	MW12-02S	Existing wells down-gradient of ore stockpiles and LGO Collection Pond.
Ore and Waste Stockpiles	MW-B (S/D) MW-C (S/D) MW-R (S/D) MW-S (S/D)	Proposed wells down-gradient of ore and waste stockpiles. Install in Construction.
Open Pit	MW12-10D MW12-11D/S	Existing wells within Open Pit extent. Decommissioned/lost in Year +13.
	MW12-03D	Existing wells down-gradient of deposit.

Facility	ID	Description
Plant Site	MW-E (S/D)	Proposed wells down-gradient of Plant Site. Install in Construction phase.
IECD	GT20-04 GT21-03D/S	Existing wells downs-gradient of IECD. Decommissioned in Year +5.
TSF C / Main Dam C	GT12-01 GT12-02 GT12-09 GT12-10 GT12-11 GT13-19 GT13-20 GT13-21	Existing wells down-gradient of Main Dam C. Decommissioned prior to construction of Main Dam D.
	MW-D (S/D) MW-P (S/D) MW-Q (S/D)	Proposed wells down-gradient of Main Dam C. Install in Construction and Decommission in Year +5.
	MW-K (S/D)	Proposed wells down-gradient of Main Dam C. Install prior to Year +10.
TSF D / Main Dam D	MW-F (S/D) MW-G (S/D) MW-H (S/D) MW-I (S/D) MW-J (S/D) MW-L (S/D)	Proposed wells down-gradient of Main Dam D. Install in Year +5.
	MW12-07D/S	Existing well north of TSF. Decommission prior to construction of the North Interception Trench.
Downgradient of Aggregate Source	MW-M (S/D)	Proposed site. Install in Construction.
FWR	MW12-08D/S	Existing wells down-gradient of ECD/North of FWR.
	MW12-09D/S	Existing wells down-gradient of FWR.
TSF Closure Spillway	MW-O (S/D)	Proposed wells down-gradient of closure spillway. Install prior Year +10.
Camp Site	MW12-12D/S	Existing wells down-gradient of Camp Site and TSF Spillway in Closure.
Saddle Dam	MW-N (S/D)	Proposed wells down-gradient of Saddle Dam. Install prior to Year +10.

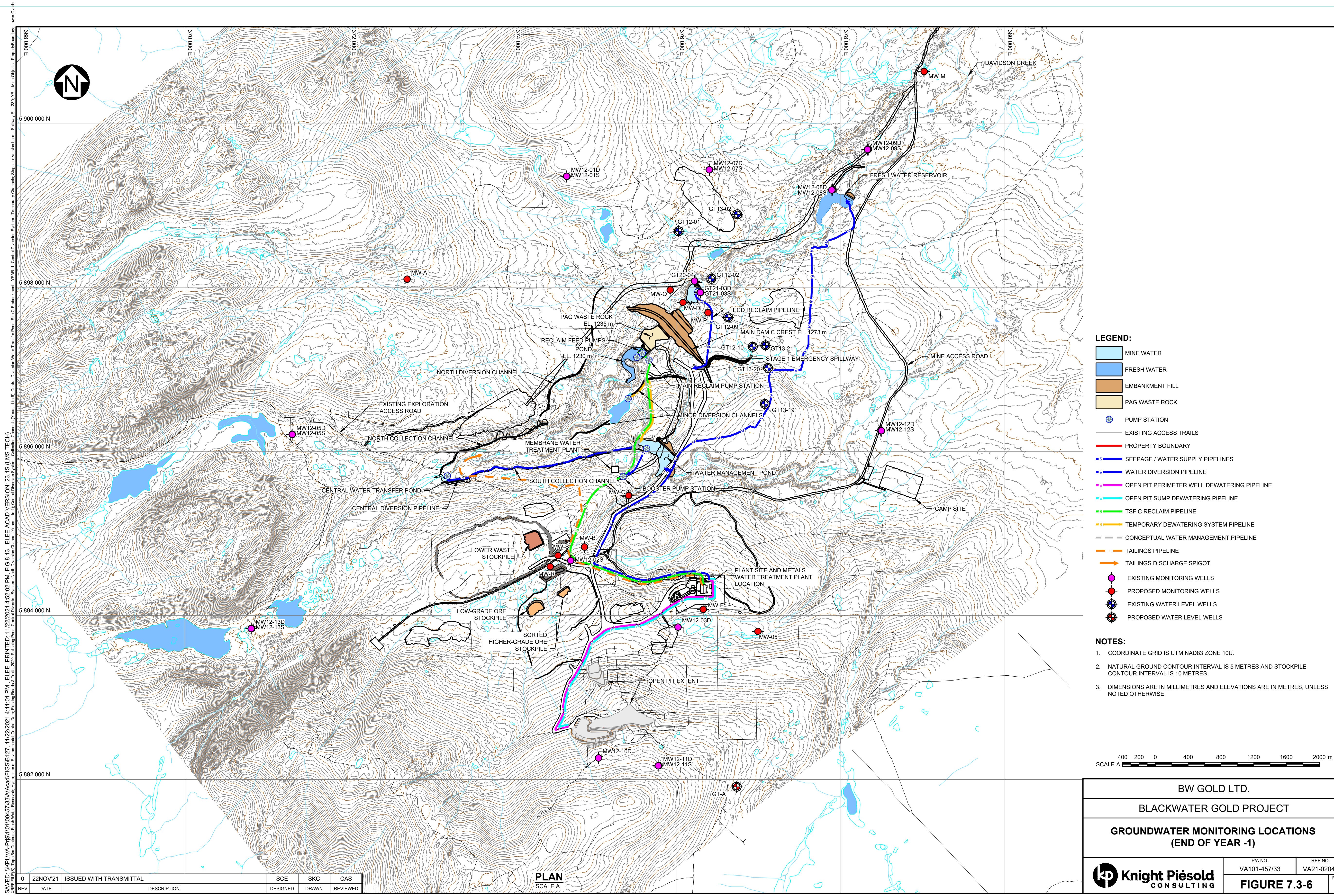


Figure 7.3-6: Groundwater Monitoring Locations (End of Year -1)

Source: Knight Piésold Consulting (2021).

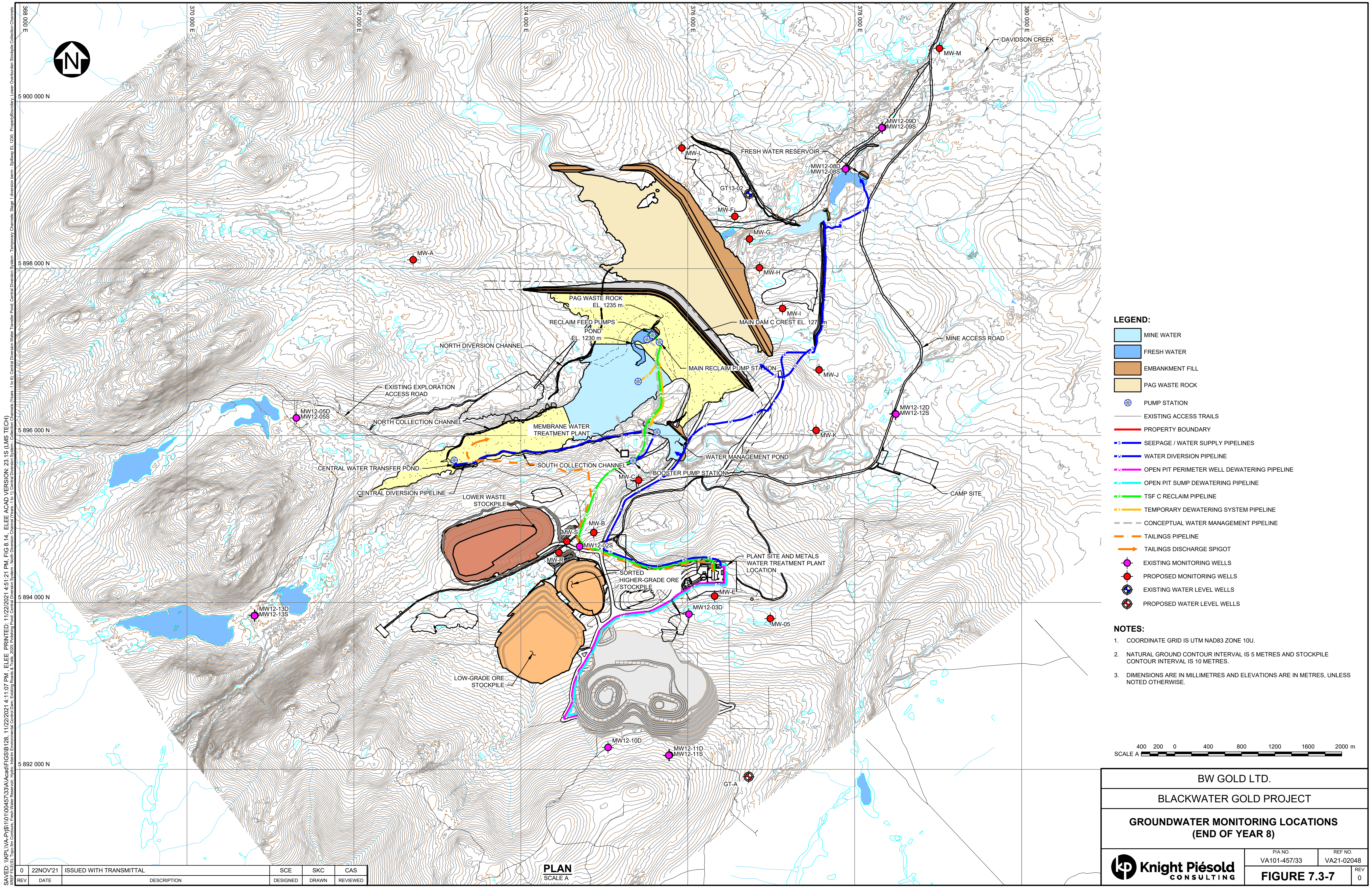


Figure 7.3.7: Groundwater Monitoring Locations (End of Year +8)

Source: Knight Piésold Consulting (2021).

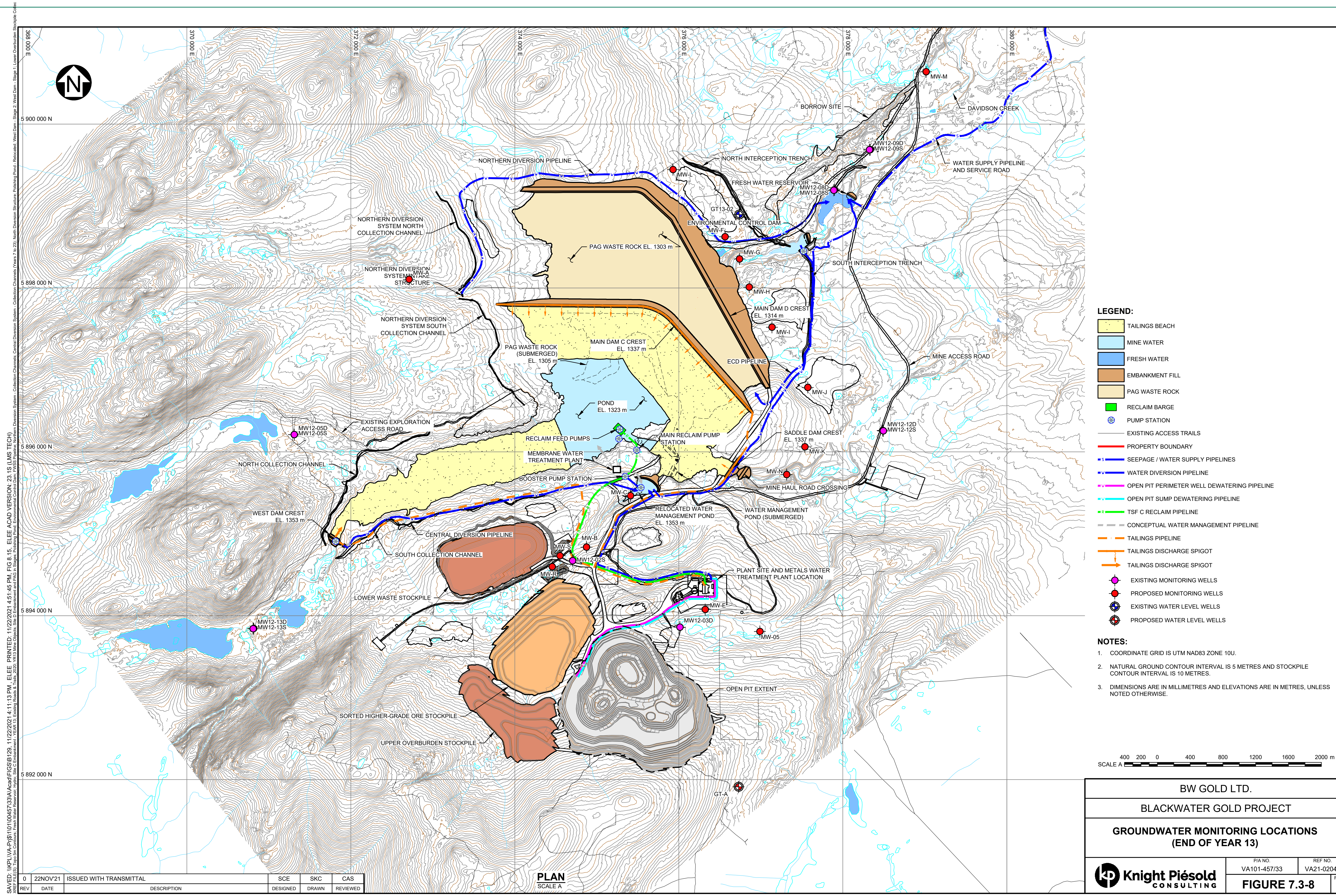


Figure 7.3-8: Groundwater Monitoring Locations (End of Year +13)

Source: Knight Piésold Consulting (2021).

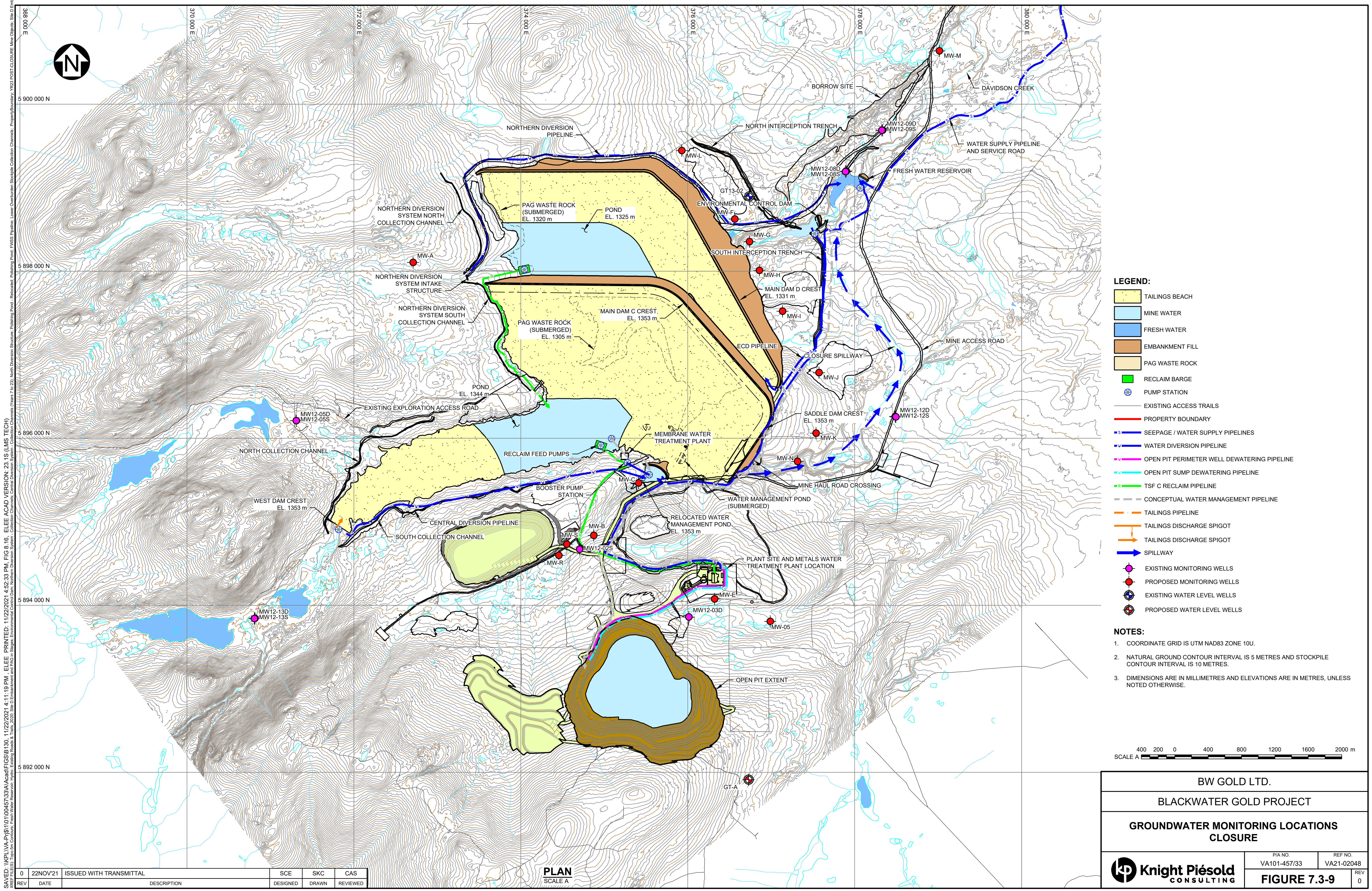


Figure 7.3-9: Groundwater Monitoring Locations (Closure)

Source: Knight Piésold Consulting (2021).

Several existing monitoring wells and new monitoring sites will be used to monitor water quality and water level to assess the potential for seepage from the TSF to bypass seepage collection measures. Sentinel wells will be established upgradient of the IECD and ECD and seepage collection trenches (MW-D, MW-F through MW-I, and MW-L, MW-N, MW-P and MW-Q) to evaluate seepage flow paths and depths and potential for seepage to bypass the collection systems. Long-term monitoring wells are already established in Davidson Creek at and downstream of the FWR (MW12-08S/D and MW12-09S/D) and downgradient of the TSF and the Closure Spillway in the Creek 661 catchment (MW12-12D/S).

LGO Stockpile and Upper and Lower Waste Stockpiles

Monitoring wells will be located down-gradient of the LGO stockpile and Upper and Lower Waste Stockpiles to provide early warning of possible seepage quantity or quality concerns. One existing monitoring well (MW12-02S) and four new monitoring sites (MW-B and MW-C) will monitor groundwater quality downgradient of all stockpiles. Proposed monitoring well MW-R will monitor groundwater down-gradient of the LGO stockpile and associated collection pond and proposed monitoring well MW-S will monitor groundwater down-gradient of the Lower Waste Stockpile.

Plant Site

Monitoring wells will be located down-gradient of the Plant Site to provide early warning of possible seepage quantity or quality concerns. One new monitoring site (MW-E) is proposed to monitor groundwater quality downgradient (south) of the Plant Site.

7.3.4.4 Seeps

Monitoring of water levels and water quality at groundwater discharge points will assist in characterizing potential for impacts to surface water from groundwater. Groundwater discharge quality monitoring will consist of a seep mapping and sampling program. Seep surveys are aimed at enhancing the understanding of groundwater flow in the project area and specifically down-gradient of the TSF, stockpiles, and Pit Lake, and to identify potential pathways for seepage from these facilities.
Seep monitoring will include descriptions of seeps and waterbodies encountered during mapping, their frequency and location, elevation, and water quality. Where sufficient flow exists, water quality samples of the seep will be collected following the same QA/QC procedures established for surface water sampling.

Seep surveys will be conducted during construction and operations. Results of each seep survey will be compared against results of earlier surveys to assess potential groundwater flow pathways from the mine to the receiving environment and potential for impacts to surface water from groundwater.

Seep mapping will be conducted annually during dry periods, when seeps can be more accurately distinguished from surface runoff.

8. DISCHARGE MANAGEMENT AND MONITORING

8.1 Overview

The goal of the discharge management system is to release diverted and site water to the receiving environment in a manner that minimizes the potential for adverse effects to downstream receptors (flow and water quality), while contributing to the objective of maintaining site water balance requirements. The goal of the discharge monitoring program is to evaluate and record the quantity and quality of mine-related water released to the receiving environment. This information is subsequently used to:

1. Evaluate compliance with regards to applicable regulatory requirements;
2. Evaluate the performance of mine water management, adaptive management, and relevant mine and environmental management plans;
3. Support WB/WQM updates as appropriate; and
4. Facilitate environmental planning through the LoM.

All anticipated discharges for the Project area are summarized in Table 8.1-1. A description of each discharge is presented in further detail in Section 5.8 (Effluent Discharge) of the Application.
The management of water associated with each discharge is presented in this document in Section 8.2 and corresponding monitoring methods are described in Section 8.3.

Table 8.1-1: Discharge from the Project Area by Phase

Location	Coordinates	Phase	Nature of Discharge	Receiving Catchment
Fresh Water Reservoir (FWR)	5899167N, 377870E	Construction, Operations, Closure	Surface	Davidson Creek
TSF Stage 1 SCP	5897749N, 376200E	Construction (first year of construction only)	Surface	Davidson Creek
Plant Site SCP	5894512N, 376428E	Construction	Surface	Creek 661
Downstream Aggregate Borrow Area SCP	5899644N, 378457E	Construction, Operations	Surface	Davidson Creek
Camp Site SCP	5895765N, 378813E	Construction, Operations, Closure	Surface	Creek 661
Membrane WTP	5898478N, 377546E	Post-Closure	Surface	Davidson Creek
TSF Spillway	5898467N, 377801E	Post-Closure	Surface	Davidson Creek
Non-point source discharges	n/a	Construction, Operations, Closure, Post-Closure	Groundwater	Davidson Creek, Creek 661

Note: Coordinates are approximate, all station locations and coordinates will be verified upon station commissioning.

In addition to surface mine water discharge via the surface outflows described above, non-point discharges from the mine site are anticipated to report to Davidson Creek and Creek 661 through subsurface flow paths. Management and monitoring of these flows within the mine site footprint are addressed in Section 7.3. Monitoring the influence of mine-related groundwater flows that enter the receiving environment beyond the mine site footprint is incorporated as part of the AEMP (Appendix 7-A).

8.2 Discharge Management

8.2.1 Freshwater Reservoir

Mine surface contact water will be discharged to the receiving environment via the FWR outlet during the Construction, Operation, and Closure phases. The FWR receives: 1) direct precipitation on the FWR and non-contact runoff from contributing catchments 2) water pumped from the WMP, which includes both contact water and diverted non-contact water, 3) diverted non-contact water via the Northern Diversion System, and 4) Tatelkuz Lake water via the FWSS. Water discharged via the FWR outlet reports directly to Davidson Creek, which in turn enters Chedakuz Creek downstream of Tatelkuz Lake.

The management of Project discharges via the FWR outlet will be primarily dependent on:

1. Management and treatment of surface contact water that reports to the WMP and is subsequently conveyed via a pump system and pipeline to the FWR; and
2. Management of non-contact waters that are diverted to the WMP and FWR to fulfill mill make-up needs as well as satisfy IFN for Davidson Creek.

Water releases from the FWR will be managed using the primary outlet works with an overflow spillway designed to maintain dam safety. The outlet design considers a maximum release of up to 1.68 m^3/s (1.12 m^3/s through the low-level outlet and 0.56 m^3/s through the surface-level outlet), providing some system redundancy at the planned flowrates and flexibility for adaptive management if IFN are adjusted in the future based on the results of environmental monitoring programs. Water pumped from Tatelkuz Lake via the FWSS in later years of mine operations will typically be routed to the FWR to provide an additional source of water to maintain discharges to Davidson Creek, but can also be directed to Davidson Creek via connection to the Temperature and Flow Control Chamber if required due to FWR maintenance or to meet discharge temperature targets.

Each outlet pipe from the FWR will be fitted with a main valve and a maintenance valve with the ability to regulate flows according to water surface levels, mill needs, and IFN requirements. The FWR general arrangement is show on Figure 8.2-1. The outlet works are shown on Figure 8.2-2. The outlet pipes will feed into the Temperature and Flow Control Chamber, which will provide further flow regulation.

The required characteristics of FWR discharges are summarized in Table 8.2-1. Mine site water management will be optimized to achieve water quality that meets BC water quality guidelines (WQGs) or approved SBEBs at the FWR outlet in the Construction and Operation phases under a range of climate conditions. The quality of water discharged via the FWR is largely dependent on the quality of mine contact waters that report to the WMP. Water treatment is a primary mitigation strategy to maintain the quality of FWR discharge and to protect water quality in Davidson Creek. As such, a Trigger Response Plan (TRP) will be developed to support the management of FWR discharge and will integrate triggers associated with WTP discharge and operator actions as appropriate.

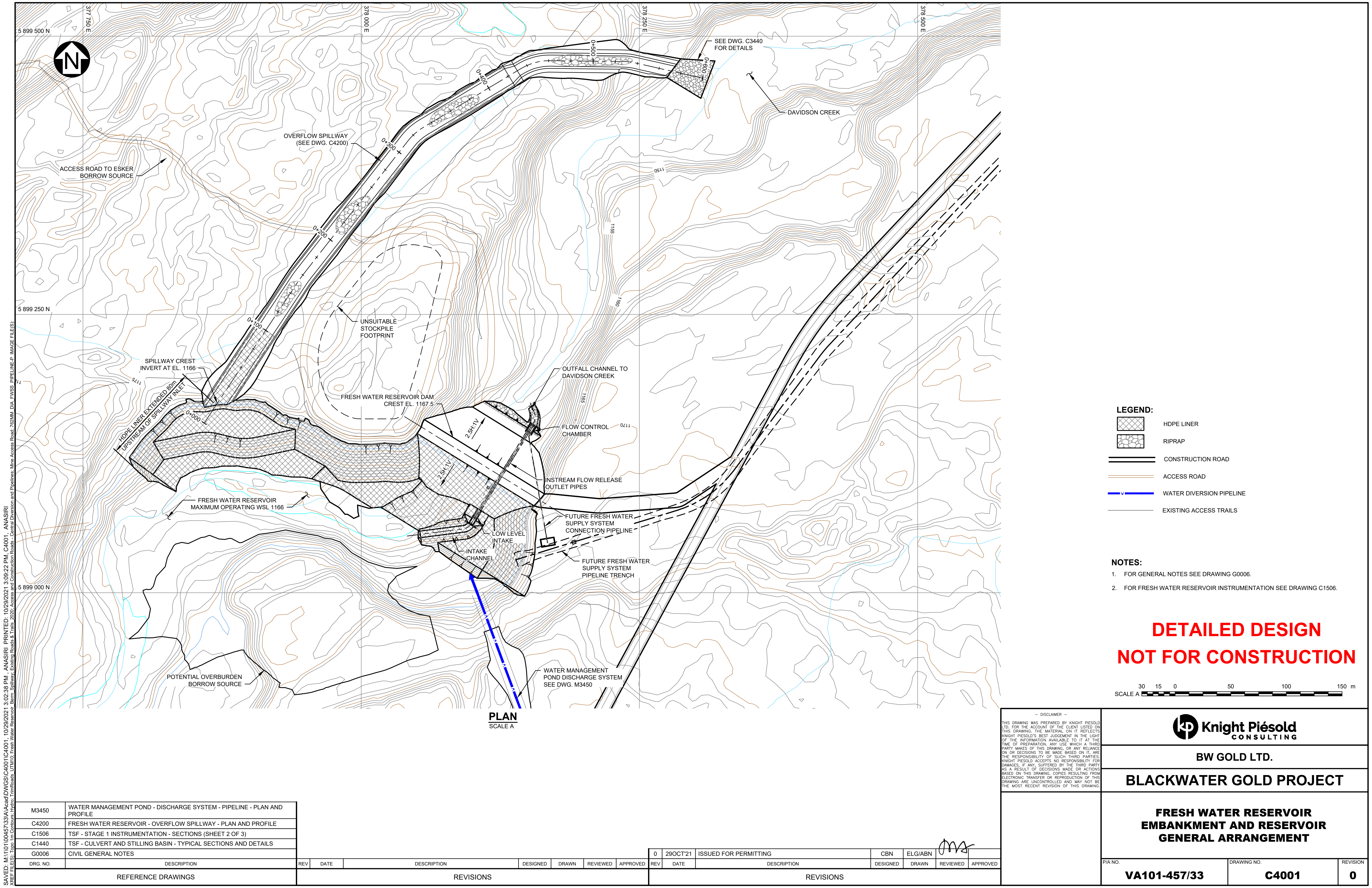
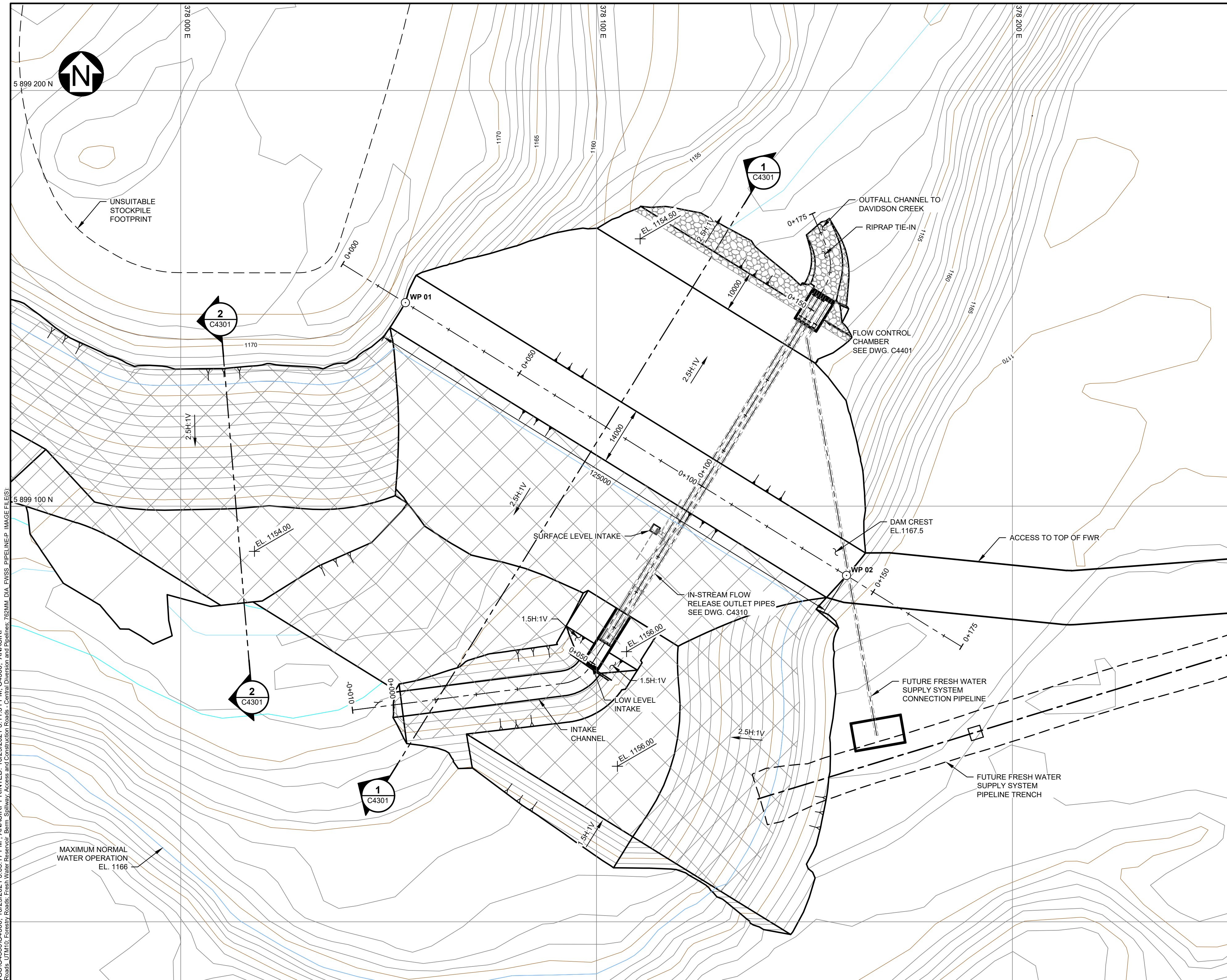


Figure 8.2-1: Freshwater Reservoir Embankment and Spillway General Arrangement

Source: Knight Piésold Consulting (2021).



PLAN
SCALE A

EMBANKMENT WORK POINTS TABLE			
WORK POINT NO.	EASTING	NORTHING	ELEVATION (m)
WP 01	378054.0	5899148.9	1,167.5
WP 02	378160.1	5899083.3	1,167.5

KEY STATIONS OF OUTLET PIPES CENTERLINE			
STATIONS	EASTING	NORTHING	DESCRIPTION
-0+010	378,041.3	5,899,050.9	BEGINNING OF CENTERLINE ALIGNMENT
0+000	378,051.2	5,899,052.2	BEGINNING OF INTAKE CHANNEL
0+041.1	378,092.0	5,899,057.4	BEGINNING OF CURVE
0+049.1	378,098.6	5,899,061.7	END OF CURVE
0+049.2	378,098.6	5,899,061.7	BEGINNING OF HEADWALL STRUCTURE
0+056.0	378,102.2	5,899,067.4	END OF HEADWALL STRUCTURE
0+146.0	378,149.5	5,899,144.0	BEGINNING OF CHAMBER
0+154.0	378,153.7	5,899,150.8	END OF CHAMBER
0+154.5	378,154.0	5,899,151.2	PIPE OUTLET
0+155.71	378,154.6	5,899,152.2	BEGINNING OF CURVE
0+166.29	378,155.4	5,899,162.4	END OF CURVE
0+175	378,151.9	5,899,170.4	END OF CENTERLINE ALIGNMENT

LEGEND:

- HDPE LINER
- RIPRAP
- CONSTRUCTION ROAD
- ACCESS ROAD

NOTES:

1. FOR GENERAL NOTES SEE DRAWING G0006.

DETAILED DESIGN

NOT FOR CONSTRUCTION

SCALE A 10 5 0 10 20 30 40 50 m

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BLACKWATER GOLD PROJECT

FRESH WATER RESERVOIR EMBANKMENT PLAN

P/A NO.	DRAWING NO.	REVISION
VA101-457/33	C4300	0

REFERENCE DRAWINGS

DRG. NO.	DESCRIPTION
C4401	FRESH WATER RESERVOIR - FLOW CONTROL CHAMBER - PLAN, SECTION AND DETAIL
C4310	FRESH WATER RESERVOIR - EMBANKMENT OUTLET PIPES - PROFILE AND SECTION
C4301	FRESH WATER RESERVOIR - EMBANKMENT - PROFILE AND SECTION
G0006	CIVIL GENERAL NOTES

REVISIONS

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

SAVED: M:\1\01\00457\33\A\Acad\DWGS\C4300\C4300, 10/29/2021 3:05:17 PM , ANASIRI PRINTED: 10/29/2021 3:11:31 PM, C4300, ANASIRI

Figure 8.2-2: Freshwater Reservoir Outlet Works

Source: Knight Piésold Consulting (2021).

Table 8.2-1: Proposed Flow, Water Quality and Toxicity Targets for Freshwater Reservoir Discharge

Parameter	Requirement	Units
Flow Monitoring		
Discharge rate	Continuous; rate dependent on IFN (up to 1.68 m^3/s)	m^3/s
Field Measurement		
pH	6.5 to 9.0	pH units
Analytical Chemistry		
Total suspended solids	Maximum: 30 Monthly mean: 15[1]	mg/L
Nitrite	BC WQG[2]	mg/L
Sulphate	BC WQG[3]	mg/L
Total Chromium	BC WQG[4]	mg/L
Dissolved Aluminum	SBEB concentrations – January, February, March – BC WQG of 0.05 mg/L April to July – 0.26 mg/L August to December – 0.11 mg/L	mg/L
Acute Toxicity		
Rainbow trout acute lethality[2]	Minimum 50% survival in 100% concentration effluent	
Daphnia magna acute lethality[3]	Minimum 50% survival in 100% concentration effluent	

Notes:

IFN: Instream flow needs

BC WQG: British Columbia Water Quality Guideline for the protection of aquatic life

SBEB: Science-Based Environmental Benchmark

[1] *Calculation of monthly mean TSS concentration is the same as required for Suspended Solids under the* Metal and Diamond Mines Effluent Regulation *(SOR/2002-222).*

[2] *BC WQG is dependent on chloride concentration.*

[3] *BC WQG is hardness dependent.*

[4] *BC WQG is dependent on speciation.*

[5] *Reference method for determining acute lethality of effluents to rainbow trout (EPS 1/RM/13, second edition, December 2000).*

[3] *Reference method for determining acute lethality of effluents to* Daphnia magna *(EPS 1/RM/14, second edition, December 2000 with February 2016 amendments).*

8.2.2 Sediment Control Ponds

Surface discharge will occur from four SCPs:

- TSF Stage 1 SCP (Construction only);
- Plant Site SCP (Construction only);
- Downstream Aggregate Borrow Area SCP (Construction through Closure); and
- Camp Site SCP (Construction through Closure).

Sediment control ponds will be designed following the Ministry of Environment (2015) guidance document on sizing and operation. The ponds will be designed to accommodate a live storage equal to an established storm event with freeboard; storage will depend on the size of the runoff area and the life of the structure.

The minimum design flow for removal of suspended solids in sediment ponds will correspond to the 10-year, 24-hour runoff flow (Ministry of Environment 2015). The ponds will be designed with spillways to convey larger storm events to maintain a minimum 0.5 m freeboard on the embankment during the structural design run-off event (minimum 1-in-200 years) (Ministry of Environment 2015).

Particle size analyses (the fraction of minus 2 and minus 10 micron particles) in representative soil samples will be determined, along with settling analysis required for effective sediment pond design. The potential need for and use of flocculant, or other Best Management Practices associated with erosion prevention and sediment control, will follow methods described in Appendix 9-A (Surface Erosion Prevention and Sediment Control Plan). Discharge associated with each pond is described below.

8.2.2.1 TSF Stage 1 Sediment Control Pond

The TSF Stage 1 SCP will be located downstream of the Main Dam C cut-off trench. This pond will capture background surface runoff, background groundwater, and runoff from the Davidson Creek basin and Mine Area Creek basin, and discharge to Davidson Creek. The SCP will be constructed in Year -2 and is planned to be decommissioned shortly after construction of the IECD in Year -1.

The proposed targets for the TSF Stage 1 SCP discharge are summarized in Table 8.2-2. Discharge targets for pH, TSS, and toxicity testing reflect effluent quality requirements under MDMER. The discharge target for Cr was set based on water quality model output (Base Case, 95th percentile) screening against 80% BC WQGs, which identified Cr as a POPC for which regulatory effluent discharge limits may be warranted. The maximum predicted T-Cr concentration is above 80% BC WQG but remains below the 100% BC working WQG for Cr (VI); as such, the discharge target was proposed as equal to BC WQG. Refer to Application Section 5.4 (Water Quality Model) and Section 5.8 (Effluent Discharge) for further detail.

Table 8.2-2: Proposed Flow, Water Quality and Toxicity Targets for TSF Stage 1 Sediment Control Pond Discharge

Parameter	Requirement	Units
Flow Monitoring		
Discharge rate	Continuous	m^3/s
Field Measurement		
pH	6.5 to 9.0	pH units
Analytical Chemistry		
Total suspended solids	Maximum: 30 Monthly mean: 15[1]	mg/L mg/L
Total Cr	BC WQG	mg/L
Acute Toxicity		
Rainbow trout acute lethality[2]	Minimum 50% survival in 100% concentration effluent	
Daphnia magna acute lethality[3]	Minimum 50% survival in 100% concentration effluent	

Notes:

BC WQG: British Columbia Water Quality Guideline for the protection of aquatic life

[1] *Calculation of monthly mean TSS concentration is the same as required for Suspended Solids under the* Metal and Diamond Mines Effluent Regulation *(SOR/2002-222).*

[2] *Reference method for determining acute lethality of effluents to rainbow trout (EPS 1/RM/13, second edition, December 2000).*

[3] *Reference method for determining acute lethality of effluents to* Daphnia magna *(EPS 1/RM/14, second edition, December 2000 with February 2016 amendments).*

8.2.2.2 Plant Site Sediment Control Pond

Discharge from the Plant Site SCP to a tributary of Creek 661 occurs during the Construction phase (Year -2 and Year -1). The Plant Site SCP incorporates the design criteria in the Ministry of Environment (ENV, 2015) guidance document. Proposed discharge targets for this SCP are equivalent to those proposed for the Camp Site SCP (Table 8.2-3).

Table 8.2-3: Proposed Flow, Water Quality and Toxicity Targets for Camp Site and Plant Site Sediment Control Pond Discharge

Parameter	Requirement	Units
Flow Monitoring		
Discharge rate	Continuous	m^3/s
Field Measurement		
pH	6.5 to 9.0	pH units
Analytical Chemistry		
Total suspended solids	Maximum: 30 Monthly mean: 15[1]	mg/L mg/L
Nitrate-N	*5.3	mg/L
Nitrite-N	*0.055	mg/L
Total Arsenic	*0.057	mg/L
Total Cobalt	*0.0080	
Total Chromium	BC WQG	mg/L
Total Manganese	*3.8	mg/L
Total Antimony	*0.014	mg/L
Total Zinc	*0.086	mg/L
Dissolved Cadmium	*0.0013	mg/L
Dissolved Copper	*0.0058	mg/L
Acute Toxicity		
Rainbow trout acute lethality[2]	Minimum 50% survival in 100% concentration effluent	
Daphnia magna acute lethality[3]	Minimum 50% survival in 100% concentration effluent	

Notes:

** Value based on Upper Case water quality prediction.*

BC WQG: British Columbia Water Quality Guideline for the protection of aquatic life.

[1] *Calculation of monthly mean TSS concentration is the same as required for Suspended Solids under the* Metal and Diamond Mines Effluent Regulation *(SOR/2002-222).*

[2] *Reference method for determining acute lethality of effluents to rainbow trout (EPS 1/RM/13, second edition, December 2000).*

[3] *Reference method for determining acute lethality of effluents to* Daphnia magna *(EPS 1/RM/14, second edition, December 2000 with February 2016 amendments).*

8.2.2.3 Downstream Aggregate Borrow Area Sediment Control Pond

The Downstream Aggregate Borrow Area SCP will be located downstream of the TSF footprint, on the north-western bank of Davidson Creek. This pond will capture surface runoff within the Borrow Area catchment from Construction phase through to the Closure phase. It is not anticipated that NAG waste rock or overburden will be stored in this catchment, and therefore the potential for water quality alterations will be limited to water interactions with borrow sources (e.g., cut and fill surfaces). Accordingly, water quality in this pond is expected to largely reflect a background water signature, with the exception of elevated TSS associated with local earthworks. Discharge from the Downstream Aggregate Borrow Area SCP will be directed to Davidson Creek between monitoring stations WQ27 and WQ26.

The proposed targets for this SCP discharge are summarized in Table 8.2-4. Discharge targets for pH, TSS, and toxicity testing reflect effluent quality requirements under MDMER. Discharge targets for total Ag, total As, total Zn, dissolved Cd, and dissolved Cu reflect Upper Case predictions used to represent the Downstream Aggregate Borrow Area SCP discharge that exceed 80% BC WQGs. These parameters were identified as POPCs for discharged pond effluent for which regulatory effluent discharge limits may be warranted. Refer to Application Section 5.4 (Water Quality Model) and Section 5.8 (Effluent Discharge) for further detail.

Table 8.2-4: Proposed Flow, Water Quality and Toxicity Targets for Downstream Aggregate Borrow Area Sediment Control Pond Discharge

Parameter	Requirement	Units
Flow Monitoring		
Discharge rate	Continuous	m^3/s
Field Measurement		
pH	6.5 to 9.0	pH units
Analytical Chemistry		
Total suspended solids	Maximum: 30 Monthly mean: 15[1]	mg/L mg/L
Total Silver	*0.000054	mg/L
Total Arsenic	*0.0093	mg/L
Total Zinc	*0.033	mg/L
Dissolved Cadmium	*0.00049	mg/L
Dissolved Copper	*0.0030	mg/L
Acute Toxicity		
Rainbow trout acute lethality[2]	Minimum 50% survival in 100% concentration effluent	
Daphnia magna acute lethality[3]	Minimum 50% survival in 100% concentration effluent	

***Notes**:*

**Value based on Upper Case water quality prediction*

[1] *Calculation of monthly mean TSS concentration is the same as required for Suspended Solids under the* Metal and Diamond Mines Effluent Regulation *(SOR/2002-222).*

[2] *Reference method for determining acute lethality of effluents to rainbow trout (EPS 1/RM/13, second edition, December 2000).*

[3] *Reference method for determining acute lethality of effluents to* Daphnia magna *(EPS 1/RM/14, second edition, December 2000 with February 2016 amendments).*

8.2.2.4 Camp Site Sediment Control Pond

The Camp Site SCP will be located downgradient of the camp footprint within the Creek 661 catchment. This pond will capture surface runoff associated with camp area construction and operation. Water in this area may show a minor mine-related signature associated with the materials used to construct the camp pad (e.g., overburden and possibly NAG5 waste rock), in addition to disturbance-related suspended sediments. Discharge from the Camp Site SCP will be directed to Creek 505659, an upper tributary of Creek 661.

Proposed discharge targets for the Camp Site SCP are presented in Table 8.2-3. Discharge targets for pH, TSS, and toxicity testing reflect effluent quality requirements under MDMER. Discharge targets for nitrate-N, nitrite-N, total As, total Co, total Cr, total Mn, total Sb, total Zn, dissolved Cd, and dissolved Cu reflect Upper Case predictions used to represent Camp Site SCP discharge that exceed 80% BC WQGs. These parameters were identified as POPCs for discharged pond effluent for which regulatory effluent discharge limits may be warranted. Refer to Application Section 5.4 (Water Quality Model) and Section 5.8 (Effluent Discharge) for further detail.

8.2.3 Membrane NF Water Treatment Plant

During the Post-Closure phase, a Membrane NF WTP will treat TSF seepage water collected at the ECD up to a maximum rate of approximately 190 L/s. To maintain a constant inflow rate, water from the Pit Lake and TSF Pond will provide make up water to the Membrane NF WTP. Treated water from this WTP will be discharged directly to Davidson Creek. Therefore, the Membrane NF WTP outlet is anticipated to represent a final point of discharge in the Post-Closure phase.

The Membrane NF WTP has been developed using the same effluent concentration design targets identified for Operation phase WTPs, including British Columbia water quality guidelines for the protection of aquatic life and MDMER effluent concentration limits for TSS (Table 7.2-6). The Membrane NF WTP discharge will be managed based on automated inline monitoring, field (HACH or equivalent) test kits and laboratory analysis of grab samples. Should parameter concentrations in the Membrane NF WTP treatment stages or discharge exceed acceptable concentrations, discharge of WTP effluent to Davidson Creek will cease. Specifically, water will be recycled within the WTP and re-routed for temporary storage on site, per the operator’s standard operating procedure, until WTP discharge is demonstrated to meet required discharge characteristics. Discharge limits for the Membrane WTP for the post-closure period will be proposed in subsequent regulatory applications.

8.2.4 TSF Spillway

In post-closure, a pond will remain in both TSF C and TSF D areas. Ponds have been sized to minimize geotechnical risks while optimizing the degree to which tailings and waste rock will remain saturated. In this manner, the ponds serve as a mitigation measure to minimize ARD/ML from the PAG tailings and PAG and ML waste rock in the long-term. Surface drainage will be conveyed to the ponds, and if the water quality is suitable to discharge, it will be released to Davidson Creek via the TSF Spillway. Therefore, the TSF Spillway is anticipated to represent a final point of discharge in the Post-Closure phase. If water quality is not suitable for direct discharge to Davidson Creek, it will be pumped to the Membrane NF WTP for treatment prior to discharge to Davidson Creek. Discharge limits for the TSF Spillway for the Post-Closure period will be proposed in subsequent regulatory applications.

8.3 Discharge Monitoring

Sampling methods for surface discharges will follow best practices as outlined in the BC Field Sampling Manual, Part E Water and Wastewater Sampling (BC MWLAP 2013) and MDMER requirements. The sampling sites must conform to the *Mines Act*/HSRC, WorkSafeBC and other applicable safety requirements, and be accessible under expected weather and flow conditions. Monitoring methods will be detailed in SOPs following the submission of this Application. The following sections present the monitoring for discharge quantity and quality by discharge location. The discharge monitoring locations are presented on Figures 7.3-1 through 7.3-5.

8.3.1 Discharge Quantity

Discharge rates for all final discharge points will be monitored on a continuous basis. Flow monitoring associated with each final discharge point for the Project is described below. The monitoring described herein is designed to be consistent with, and facilitate adherence to, the requirements for effluent monitoring under the MDMER and the BC *Environmental Management Act*, and to align with monitoring components and objectives of the AEMP.

8.3.1.1 FWR

Water from the reservoir released through the outlets will be monitored using ultrasonic flow meters installed at each of the discharge outlets for compliance reporting requirements. The general arrangement of the outlet works and flow monitoring chamber location are provided on Figure 8.2-2.

In addition, an in-stream flow monitoring station downstream of the FWR within Davidson Creek may be required as a back-up station to confirm the IFN release, should the flowmeters require maintenance or in the event that they are damaged. Baseline monitoring station H2B is located in Davidson Creek between the FWR pipe outlets and the FWR spillway outlet. Monitoring at H2B and a spillway monitoring device could be used in combination to determine the total flow from the FWR. If additional precision is required, a more permanent structure such as a weir could be installed in place of hydrometric station H2B or further downstream below where the FWR spillway re-enters Davidson Creek, so that the contributing flow includes the overflow spillway and water released through the FWR pipe outlets.

In addition to flow monitoring, water level monitoring within the reservoir is also required to inform the operation of the outlets. Water level monitoring will also provide information related to how much storage is available within the reservoir and will also be used to indicate when the reservoir capacity has been reached and flow through the spillway is occurring. Water levels will be monitored using a pressure transducer with an appropriate depth range.

8.3.1.2 Sediment Control Ponds

Surface discharge rates from the TSF Stage 1 SCP, Plant Site SCP, Camp Site SCP, and Downstream Aggregate Borrow Area SCP will be monitored continuously using ultrasonic or inline flow meters on outlet pipes or other monitoring devices, such as a v-notch weir with a lookdown sensor depending on the discharge arrangement. It is noted these ponds are intended to primarily capture surface runoff; as such, surface discharge from these locations is expected to occur only in certain months of the year.

8.3.1.3 Membrane NF WTP

Discharge monitoring for the Membrane WTP through the Post-Closure phase will continue following similar methods outlined for the Operations phase. Monitoring of Membrane NF WTP discharge will follow high-frequency operational requirements, per the operator’s standard procedures, that include automated flow readings at a number of stages within the plant to guide the automatic operation of the WTP, provide key input for process and safety interlocks, and provide operations personnel with key insights on plant performance. As part of this flow monitoring and management system, the flow rate of treated effluent generated by the Membrane NF WTP will be monitored continuously.

8.3.1.4 TSF Spillway

It is anticipated a continuous flow logger will be used to record discharge released from the Project via the TSF Spillway in the Post-Closure phase. The location, design, and implementation of flow monitoring equipment for the TSF Spillway will be detailed in parallel with the final spillway design.

8.3.2 Discharge Quality

This section summarizes the discharge quality monitoring program for final discharge points. This plan is designed to be consistent with the requirements for effluent monitoring under the MDMER, the *Environmental Management Act*, and to align with monitoring components and objectives of the AEMP. Further detail on the predicted quality of mine water discharge is presented in Chapter 5 (Modelling, Mitigation, and Discharge, Section 5.8 Effluent Discharge).

An overview of monitoring components and frequencies for final discharge points is presented in Table 8.3-1. A detailed list of mine water and discharge monitoring locations, components, frequencies, and their rationale is presented in Table 9-1. During the Construction, Operation, and Closure phases, discharge quality will be monitored via field parameters measured in situ, grab samples, and toxicity testing. Analytical samples for discharge quality will be collected following methods outlined in Section 7.3.1.1. Field measurements will be collected at the same time as analytical sample collection. Similarly, water aliquots collected for acute and sublethal toxicity testing will be collected at the same time as field measurements and analytical sample collection. Monitoring of discharge quality in the Post-Closure phase will continue following similar methods and frequencies described for the Construction, Operation, and Closure phases, but parameters and/or sampling frequencies may be reduced as appropriate.

Table 8.3-1: Discharge Quality Monitoring Program Overview

Monitoring Component	Description	Sampling Frequency
Field measurement	Turbidity, pH, conductivity, temperature, DO*	Weekly
Analytical chemistry	▪ Physical parameters ▪ Nutrients, organics, and cyanide species ▪ Major anions ▪ Total and dissolved metals	Weekly
Acute toxicity	▪ Rainbow trout acute lethality test (EPS 1/RM/13, second edition, December 2000) ▪ *Daphnia magna* acute lethality test (EPS 1/RM/14, second edition, December 2000 with February 2016 amendments)	Monthly
Sublethal toxicity (conducted at final discharge point that has potentially the most adverse impact**)	▪ Fish species (early life stage rainbow trout Reference Method EPS 1/RM/28) ▪ Invertebrate (*Ceriodaphnia dubia* Report EPS 1/RM/21) ▪ Plant (*Lemna minor* Reference Method EPS 1/RM/37) ▪ Alga (*Pseudokirchneriella subcapitata* Report EPS 1/RM/25)	Twice per year***

** Certain parameters may be monitored at a higher frequency depending on discharge works design and associated infrastructure.*

*** For the purpose of this Application, sublethal toxicity testing is assumed to occur on FWR discharge. The sublethal toxify testing location may be adjusted as appropriate, per MDMER.*

**** Test frequency and species will be adjusted as appropriate, per MDMER.*

Analytical water quality samples will be submitted to ALS Environmental, or another CALA-certified analytical laboratory, as appropriate, and analyzed at a minimum for the suite of parameters and corresponding detection limits presented in Table 8.3-2. Analytical testing procedures will vary with parameters.

The parameters measured in mine discharge will include those prescribed under MDMER, the baseline surface water monitoring program (per BC MOE, 2016b), and parameters identified as Parameters of Concern (POCs) and Parameters of Potential Concern (POPCs) for aquatic life in the Project Conceptual Site Model (CSM; Section 5.10). Routine analysis of discharge monitoring data will include a comparison to discharge limits prescribed in the EMA effluent permit, BC and/or CCME water quality guidelines (as appropriate), and MDMER maximum authorized concentrations, as appropriate. Water quality data results may compared to WB/WQM predictions to ensure predicted concentrations are reasonable, and may be used to update the surface water quality model as appropriate.

Table 8.3-2: Discharge Quality Monitoring Parameters and Detection Limits

Parameter	Detection Limit	Parameter	Detection Limit
Physical Parameters		**Major Anions**	
pH	0.01	Alkalinity – Total	1 mg/L
Specific Conductivity	2 µS/cm	Acidity	2 mg/L
Hardness as $CaCO_3$ (Dissolved)	1 mg/L	Chloride	0.5 mg/L
Total Dissolved Solids	10 mg/L	Fluoride	0.02 mg/L
Total Suspended Solids	2 mg/L	Bromide	0.05 mg/L
Turbidity	0.1 NTU	Sulphate	0.5 mg/L
Colour	5 CU	**Organics**	
Nutrients		Total Organic Carbon	0.5 mg/L
Nitrate Nitrogen	0.005 mg/L	Dissolved Organic Carbon	0.5 mg/L
Nitrite Nitrogen	0.005 mg/L	**Cyanide**	
Nitrogen – Total	0.05 mg/L	Total Cyanide	0.001 mg/L
Ammonia Nitrogen	0.02 mg/L	Weak Acid Dissociable (WAD) Cyanide	0.001 mg/L
Ortho phosphorus – dissolved	0.005 mg/L		
Phosphorous – Total	0.005 mg/L		
Total and Dissolved Metals		**Total and Dissolved Metals**	
Aluminum	0.001 mg/L	Mercury	0.00001 mg/L
Antimony	0.0001 mg/L	Molybdenum	0.0001 mg/L
Arsenic	0.0002 mg/L	Nickel	0.0005 mg/L
Barium	0.0001 mg/L	Potassium	0.1 mg/L
Beryllium	0.0001 mg/L	Selenium	0.0003 mg/L
Bismuth	0.0005 mg/L	Silicon	0.05 mg/L
Boron	0.01 mg/L	Silver	0.00001 mg/L
Cadmium	0.0001 mg/L	Sodium	0.1 mg/L
Calcium	0.05 mg/L	Strontium	0.0002 mg/L
Chromium	0.0005 mg/L	Thallium	0.00001 mg/L
Cobalt	0.0001 mg/L	Tin	0.0002 mg/L
Copper	0.0002 mg/L	Titanium	0.01 mg/L
Iron	0.01 mg/L	Uranium	0.00001 mg/L
Lead	0.0001 mg/L	Vanadium	0.001 mg/L
Lithium	0.001 mg/L	Zinc	0.001 mg/L
Magnesium	0.1 mg/L	Radium 226	0.01 Bq/L
Manganese	0.0002 mg/L		

Data analysis will further include evaluations of concentration trends, QA/QC analysis as described in Section 7.3.1.1, and data evaluation as required for MDMER reporting (Section 12.1.1), EMA annual reporting (Section 12.1.2), and annual reclamation reporting (Section 12.1.3).

Field parameters will be collected at the time of each grab sample collection, and will include at minimum:

- Temperature;
- Turbidity;
- Dissolved oxygen;
- Conductivity;
- pH; and
- ORP.

The monitoring program will follow QA/QC procedures specified in the following documents:

- BC Field Sampling Manual (BC Ministry of Water, Land and Air Protection 2013);
- BC Environmental Laboratory Manual (BC Ministry of Environment and Climate Change Strategy, 2020b);
- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators (BC Ministry of Environment 2016b); and
- MDMER.

The QA/QC components of discharge quality monitoring will include:

- Equipment checks and calibration;
- Use of appropriate detection limits for analytical samples;
- Field replicate sampling and data evaluation;
- Field and trip blank sampling and data evaluation; and
- Sample data evaluation, including the assessment of total *versus* dissolved metal concentrations, suspended sediment concentrations and their potential influence on reported metal concentrations, and potential outlier data points.

In addition to the above surface point discharges, non-point discharges from the Project are expected to report via groundwater to Davidson Creek and Creek 661. Monitoring of such sub-surface discharges is integrated with the monitoring program outlined in Section 7.3.4 and the AEMP (Appendix 7-A) for Davidson Creek and Creek 661. The programs include routine surface water quality and hydrology (water level, flow, as appropriate) monitoring at various locations.

9. MONITORING SUMMARY

A comprehensive list of the monitoring locations, monitoring type, and sampling frequency discussed in previous sections is presented in Table 9-1. This table includes all monitoring locations required for the purpose of mine process water, clean water diversion, and effluent discharge management. It also includes water monitoring prescribed under the ML/ARD Management Plan, monitoring for the WTP and treatment system efficiency, and for ongoing water balance analysis and verification. Supplemental to monitoring stations identified here, additional stations may be required within the mine site or as part of the AEMP as mine infrastructure design and discharge works are refined.

Table 9-1: Summary of All Mine Water and Discharge Monitoring Locations

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Effluent Discharge					
FWR outlet		Flow	Continuous using ultrasonic flow meters	Final discharge point to Davidson Creek: construction, operations, closure.	Federal and provincial regulatory requirement.
		Temperature	Continuous		
		Field	Weekly		
		Chemistry	Weekly		
		Acute toxicity	Monthly		
		Sublethal toxicity**	Twice per year		
Membrane NF WTP Effluent		Flow	Continuous	Final discharge point to Davidson Creek: post-closure.	Federal and provincial regulatory requirement.
		Field	Weekly***		
		Chemistry	Weekly***		
		Acute toxicity	Monthly		
		Sublethal toxicity**	Twice per year		
TSF Spillway		Flow	Continuous	Final discharge point to Davidson Creek: post-closure. TSF C is anticipated to release water via the spillway on a monthly basis throughout post-closure under average climate conditions. TSF D is anticipated to discharge via the spillway in post-closure during freshet months in average climate conditions and during additional months under wet climate conditions, depending on the amount of flow diverted to Davidson Creek via the Northern Diversion System. Detail on the discharge regime of the TSF ponds in post-closure will be refined during detailed Closure planning.	Federal and provincial regulatory requirement.
		Temperature	Continuous		
		Field	Weekly***		
		Chemistry	Weekly***		
		Acute toxicity	Monthly		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Effluent Discharge *(cont'd)*					
Plant Site SCP	EMS: E324811	Flow	Continuous, when discharging	Final discharge point to Creek 661: Construction. Receives flow from Plant Site SCP, which collects surface runoff from Plant Site construction area. This water is pumped to the mill during operations and is directed to TSF C after completion of ore processing until it is reclaimed in Closure.	Federal and provincial regulatory requirement.
		Chemistry	Weekly, when discharging		
		Turbidity	Continuous, when discharging		
		Field	Weekly, when discharging		
		Acute toxicity	Monthly, when discharging		
TSF Stage 1 SCP		Flow	Continuous, when discharging	Final discharge point to Davidson Creek: Construction (Year -2 only). Located approximately 300 m downstream of the TSF Stage 1 Main Dam C centreline. Constructed prior to the start of Main Dam C construction. This pond will be decommissioned following construction of the Interim ECD (Year -1) and FWR. Once decommissioned, the FWR will be the final discharge point.	Federal and provincial regulatory requirement.
		Chemistry	Weekly, when discharging		
		Turbidity	Continuous, when discharging		
		Field	Weekly, when discharging		
		Acute toxicity	Monthly, when discharging		
Camp Site SCP		Flow	Continuous, when discharging	Final discharge point to Creek 661: construction, operations, closure.	Federal and provincial regulatory requirement.
		Turbidity	Continuous, when discharging		
		Field	Weekly, when discharging		
		Chemistry	Weekly, when discharging		
		Acute toxicity	Monthly, when discharging		
Downstream Aggregate Borrow Area SCP		Flow	Continuous, when discharging	Final discharge point to Davidson Creek: construction, operations, closure. Pond captures run-off from aggregate/ esker borrow area and concrete batch plant.	Federal and provincial regulatory requirement.
		Turbidity	Continuous, when discharging		
		Field	Weekly, when discharging		
		Chemistry	Weekly, when discharging		
		Acute toxicity	Monthly, when discharging		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Surface Water					
Upper Waste Stockpile Collection Pond		Field	Monthly	Collection pond for stockpile runoff and toe discharge: construction, operations, closure. Flows routed to TSF C pond prior to construction of WMP in Construction phase, Metals WTP in Operations phase, and Pit Lake in Closure phase.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous, when discharging		
Lower Waste Stockpile Collection Pond		Field	Monthly	Collection pond for stockpile runoff and toe discharge: operations, closure. Flows routed to Metals WTP in Operations phase and TSF C Pond in Closure phase.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous, when discharging		
Open Pit Sump		Field	Monthly	Sump within Open Pit that collects non-contact and contact waters: construction, operations. Water pumped to Metals WTP in Years -1 to +17.	Water balance and geochemical monitoring; inform adaptive management, as appropriate. Track volume sent to mill and to the Metals WTP. Determine if process water will need to be sourced from the WMP.
		Analytical chemistry	Monthly		
		Flow	Continuous, when pumping		
Pit Lake (multiple depths)		Field	Monthly	In-Pit Lake that forms at cessation of mining: operations (starting Year +18), closure, post-closure. Approximately 2 Mm^3 water pumped annually to the Membrane WTP in post-closure.	Geochemical and lake dynamics (e.g., stratification) monitoring.
		Analytical chemistry	Monthly		
Tailings supernatant		Field	Five samples per quarter	Tailings slurry collected at outlet pipe to TSF in a bucket and allowed to settle before siphoning off the supernatant for sampling: operations.	Geochemical monitoring.
		Analytical chemistry	Five samples per quarter		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Surface Water *(cont'd)*					
TSF C		Field	Monthly	Supernatant pond representative of various inputs (e.g., tailings slurry, water released from tailings voids, contact and non-contact surface and ground waters): operations ,closure, post-closure. Sample collected from reclaim barge. Reclaim water pumped to mill in operations; surplus water pumped to Membrane WTP in operations; water pumped to Pit Lake in Closure phase.	Geochemical monitoring. Water level monitoring and bathymetry required to determine when supernatant will be sent to the Membrane WTP. Water level monitoring to confirm adequate freeboard available.
		Analytical chemistry	Monthly		
		Water level / Bathymetry	Continuous / Twice per year		
		Flow	Continuous, when pumping		
West Dam Seepage Sump		Field	Monthly	Collection pond for seepage emanating from West dam, seepage from TSF C, and surface runoff: operations, closure, post-closure. Seepage pumped to TSF C.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous, when pumping		
TSF D		Field	Monthly	Supernatant pond representative of various inputs (e.g., tailings slurry, contact and non-contact surface and ground waters, pumpback from ECD) directed to TSF: operations (from Year +7), closure, post-closure. Sample collected from reclaim barge. Water pumped to TSF C in operations and closure.	Water balance and geochemical monitoring; inform adaptive management, as appropriate. Water level monitoring to confirm adequate freeboard available.
		Analytical chemistry	Monthly		
		Water level / Bathymetry	Water level / Twice per year		
		Flow	Continuous, when pumping		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Surface Water *(cont'd)*					
Water Management Pond		Field	Monthly	Water storage and management pond for treated WTP effluent, contact seepage, non-contact runoff and diverted non-contact water: construction (Year -1), operations, closure. Water pumped to mill to meet processing requirements and surplus to the FWR monitored with inline flow meters. Flow exceeding pump operation rates overflows to TSF C Pond when WMP is full via the pipe overflow outlet or emergency spillway.	Key mine water management feature, discharges directly to FWR; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous using inline flow meters		
IECD Pond		Field	Monthly	Temporary collection pond for seepage from TSF C, Lower Waste Stockpile seepage, contact runoff, and non-contact surface and subsurface flows: construction (Year -1), operations (Year +1 to Year +6). Water pumped back to TSF C.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous using inline flow meters		
ECD pond		Field	Monthly	Collection pond for seepage from TSF C, TSF D, Main Dam D, Upper and Lower Waste Stockpiles, and the Pit Lake, contact runoff, and non-contact surface and subsurface flows: operations, closure, post-closure. Flows pumped to TSF D in operations, Pit Lake in closure, and Membrane WTP or Pit Lake in post-closure.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly		
		Flow	Continuous using inline flow meters		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Surface Water *(cont'd)*					
Davidson Creek Downstream of IECD Pond		Field Analytical	Monthly	Davidson Creek monitoring site downstream of the IECD to monitor seepage from TSF C.	Inform adaptive management, as appropriate.
		Chemistry			
Seeps to surface		Field	Monthly, when flow observed	Seepage surveys will be carried out regularly to identify seep locations, per ML/ARD Management Plan: construction, operations, closure.	Water balance and geochemical monitoring; inform adaptive management, as appropriate.
		Analytical chemistry	Monthly, when flow observed		
Water Treatment Plants					
Metals Treatment Pond		Field	Weekly	Pond for temporary storage of inlet water to Metals WTP: operations. Represents Metals WTP influent.	Treatment efficiency monitoring.
		Analytical chemistry	Weekly		
Metals WTP		In-line (flow, pH, turbidity, level)	Continuous	Treatment plant operations during the Operations phase. In-line monitoring occurs at different stages of water treatment, including treated effluent.	Operational plant monitoring.
Metals WTP Effluent		Field	Weekly	Metals WTP effluent stream (treated water): operations.	Operational plant monitoring; key mine water management feature.
		Analytical chemistry	Weekly		
Lime Neutralization System		In-line (flow, pH)	Continuous	System operations during the Operations phase. In-line flow and pH monitoring occurs at influent and effluent stages.	Operational plant monitoring.
		Analytical chemistry – pH only	Weekly		
		Analytical chemistry	Monthly		
Lime Neutralization System Effluent		Field	Monthly	Outflow stream of lime-adjusted water stream: operations. Influent to lime treatment system is monitored at LGO toe.	Operational plant monitoring.
		Analytical chemistry	Monthly		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Water Treatment Plants *(cont'd)*					
Membrane RO WTP		In-line (flow, level, pressure, pH, ORP, conductivity, turbidity)	Continuous	Treatment plant operations: operations. In-line monitoring occurs at different stages of water treatment, including treated effluent, and is automatically logged into a data historian. HACH kit analysis and analytical chemistry samples will be collected by operators using water collected at different stages of water treatment throughout plant.	Operational plant monitoring.
		HACH kit or equivalent (sulphate and/or ammonia)	Daily		
		Analytical chemistry****	Monthly		
Membrane RO WTP Effluent		Field	Weekly	Membrane WTP effluent stream (treated water): operations. Influent to WTP is monitored at TSF C.	Operational plant monitoring; key mine water management feature.
		Analytical chemistry	Weekly		
		HACH kit (alkalinity, ammonia, sulphate, zinc)****	Daily		
Membrane NF WTP Influent		Field	Weekly	Membrane WTP influent stream: post-closure. Includes TSF C overflow, ECD water, Pit Lake water, collected Pit Lake seepage. Effluent from WTP is monitored as post-closure final discharge point.	Operational plant monitoring.
		Analytical chemistry	Weekly		
Membrane NF WTP		In-line (flow, level, pressure, pH, ORP, conductivity, turbidity)	Continuous	Treatment plant operations: post-closure. In-line monitoring is automatically logged into a data historian. Silt density index test will be conducted by operators, and is conducted on water directed to NF membrane. HACH kit analysis and analytical chemistry samples will be collected by operators using water collected at different stages of WTP.	Operational plant monitoring.
		Silt density index	Daily		
		HACH kit (sulphate and/or ammonia)	Daily		
		Analytical chemistry****	Monthly		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Water Treatment Plants *(cont'd)*					
Plant Site Sewage Treatment Facility Influent		Visual inspection	Daily	Sewage treatment facility influent; represents domestic water collected from the mill, truckshop, and administrative areas.	Operational plant monitoring.
		Five day biological oxygen demand, TSS,	Monthly		
Plant Site Sewage Treatment Facility Effluent		Visual inspection	Daily	Treated effluent is directed to the TSF.	Operational plant monitoring.
		Five day biological oxygen demand, TSS, faecal coliform, turbidity, total nitrogen, nitrate	Monthly		
		Flow	Continuous		
Non-Contact Mine Surface Waters					
FWSS		Field	Monthly, when pumped to FWR	Non-contact water pumped from Tatelkuz Lake to support IFN or to the FWR to provide make up water for the mill: Operations, closure.	Monitor quality and quantity of background/non-contact water directed to FWR.
		Analytical chemistry	Monthly, when pumped to FWR		
		Flow	Continuous using inline flow meters		
Central Diversion System Water Transfer Pond		Field	Monthly	Collection and storage pond for diverted, non-contact water: operations, closure, post-closure. Water pumped to WMP or flows over weir to TSF C (Year -1 to Year +6). Pond relocated in Year+7 west of West Dam. Water level monitored using pressure transducer; water pumped from pond monitored using inline flow meters. Manual discharge measurements downstream of pond when spilling into TSF C.	Monitor quality and quantity of background/non-contact water diverted to WMP (or bypass to FWR if WMP is at capacity). Water level monitoring within the water transfer pond required to inform the operation of the pumping system and document when flow into TSF C is occurring.
		Analytical chemistry	Monthly		
		Flow	Continuous		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Non-Contact Mine Surface Waters *(cont'd)*					
Central Diversion System Water Transfer Pond *(cont'd)*				From Year+7 onward, during high flow events, when the storage capacity of the pond and outlet pump are exceeded, emergency discharge to Lake 16 could occur	
Northern Diversion System Water Transfer Pond		Field	Monthly	Collection and storage pond for diverted, non-contact water: operations (Year +7 onwards), closure. Water conveyed to FWR by pipeline, flows in excess of pipeline capacity and overflow via spillway contribute to TSF D pond. Water level monitored using pressure transducer; water pumped from pond monitored using inline flow meters. Manual discharge measurements downstream of pond when spilling into TSF C.	Monitor quality and quantity of background/non-contact water diverted to FWR. Water level monitoring within the water transfer pond required to inform the operation of the pumping system and document when flow into TSF D is occurring.
		Analytical chemistry	Monthly		
		Flow	Continuous		
Mine Site Groundwater					
Background Well	MW12-01D/S	Field	Quarterly (MW12-01D only)	Water level will be monitored using a pressure transducer.	Monitor quality and groundwater level to inform the environmental monitoring program. The site is a background monitoring station prior to construction of Main Dam D.
		Analytical chemistry	Quarterly (MW12-01D only)		
		Water Level	Continuous		
	MW12-05D/S	Field	Annual	Water level will be monitored using a pressure transducer	Upgradient reference site located in Davidson Creek Headwater
		Analytical chemistry	Annual		
		Water Level	Continuous		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Groundwater *(cont'd)*					
Background Well *(cont'd)*	MW-A (S/D)	Field	Quarterly	Proposed site. Install in Construction.	Upgradient reference site. Monitor quality and groundwater level
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
	MW12-13D/S	Field	Annual (MW12-13S)	Water level will be monitored using a pressure transducer	Headwater divide between Creek 705 and Davidson Creek. Upgradient reference site. Monitor quality and groundwater level.
		Analytical chemistry	Annual (MW12-13S)		
		Water Level	Continuous		
Downgradient of LGO and ore stockpiles	MW12-02S	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of LGO, ore, and Waste Stockpiles	MW-B (S/D) MW-C (S/D) MW-R (S/D) MW-S (S/D)	Field	Quarterly	Proposed site. Install in Construction.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Upgradient of Open Pit	MW12-10D	Water Level	Continuous	Water level will be monitored using a pressure transducer	Within Open Pit extent. Monitor to collect information to support hydrogeologic characterization in the vicinity of the Open Pit.
	MW12-11D/S	Water Level	Continuous	Water level will be monitored using a pressure transducer Wells will be lost in Year 13 when the pit reaches its maximum extent	Within Open Pit extent. Monitor to collect information to support hydrogeologic characterization in the vicinity of the Open Pit.

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Groundwater *(cont'd)*					
Downgradient of Open Pit	MW12-03D	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of Plant Site	MW-E (S/D)	Field	Quarterly	Proposed site. Install in Construction.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
IECD	GT20-04	Field	Annual	Water level will be monitored using a pressure transducer. Decommissioned prior to construction of Main Dam D.	Monitor quality and groundwater level to inform adaptive management, as appropriate.
		Analytical chemistry	Annual		
		Water Level	Continuous		
	GT21-03D/S	Water Level	Continuous	Water level will be monitored using a pressure transducer. Decommissioned prior to construction of Main Dam D.	Monitor groundwater level to inform adaptive management, as appropriate
Downgradient of TSF C Main Dam	GT12-01 GT12 -02	Water Level	Continuous	Water level monitored using a pressure transducer and a VWP. Decommissioned prior to construction of Main Dam D.	Monitor quality and groundwater level to inform adaptive management, as appropriate
Downgradient of TSF C Main Dam	GT12-09	Water Level	Continuous	Water level will be monitored using a pressure transducer. Decommissioned prior to construction of Main Dam D.	Monitor quality and groundwater level to inform adaptive management, as appropriate
	GT12-10				
	GT12-11				
	GT13-19				
	GT13-20				
	GT13-21				

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Groundwater *(cont'd)*					
Downgradient of TSF C Main Dam	MW-D (S/D) MW-P (S/D) MW-Q (S/D)	Field	Quarterly	Proposed site. Install in Construction. Decommissioned prior to filling Main Dam D.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of TSF C Main Dam	MW-K (S/D)	Field	Quarterly	Proposed site. Install prior to Year 10.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of TSF D Main Dam	MW -F (S/D)	Field	Quarterly	Proposed sites. Install in Year 5	Monitor quality and groundwater level to inform adaptive management, as appropriate
	MW-G (S/D)	Analytical chemistry	Quarterly		
	MW-H (S/D)	Water Level	Continuous		
	MW-I (S/D)				
	MW-J (S/D)				
	MW- (S/D)				
Downgradient of Aggregate Source	MW-M (S/D)	Field	Quarterly	Proposed site. Install in Construction.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of TSF D	MW12-07D/S	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform adaptive management, as appropriate Decommissioned prior to construction of ECD North Interception Trench.
		Analytical chemistry	Quarterly		
		Water Level	Continuous		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Mine Site Groundwater *(cont'd)*					
Downgradient of ECD/North of FWR	MW12-08D/S	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform the environmental monitoring program
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of FWR	MW12-09D/S	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of TSF Spillway	MW-O (S/D)	Field	Quarterly	Proposed site. Install prior to Year 10	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient TSF Saddle Dam and Camp	MW12-12D/S	Field	Quarterly	Water level will be monitored using a pressure transducer	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		
Downgradient of Saddle Dam	MW-N (S/D)	Field	Quarterly	Proposed site. Install prior to Year 10.	Monitor quality and groundwater level to inform adaptive management, as appropriate
		Analytical chemistry	Quarterly		
		Water Level	Continuous		

Facility	ID	Monitoring Type*	Frequency	Description	Rationale
Seep Survey Locations					
Seep survey locations	Seeps downgradient of the Open Pit and TSF, and along the drainage contributing to the WMP	Seep mapping Field Analytical chemistry	Annually	Where sufficient flow exists, water quality samples of the seep will be collected following the same QA/QC procedures established for surface water sampling	To collect information on potential changes to water quality and flow at groundwater discharge points.

Notes:

**Monitoring type and parameters include:*

***Field** = pH, conductivity, turbidity, oxidation-reduction potential, temperature, measured using an appropriate, calibrated field meter.*

***Analytical chemistry** = Includes physical parameters (pH, hardness, specific conductance, total suspended solids, total dissolved solids, turbidity), nutrients (ammonia-N, nitrite-N, nitrate-N, total N, total P, dissolved P, orthophosphate, total organic carbon, dissolved organic carbon), major anions (alkalinity, acidity, chloride, fluoride, bromide, sulfate, cyanide species), total and dissolved metals (multi-elemental ICP/ICPMS).*

***Flow – Continuous** = waters pumped from ponds will be monitored using ultrasonic or inline flow meters on outlet pipes.*

***Flow – Weekly** = water level in open channels will be monitored using pressure transducer with discharge measured manually to develop stage-discharge curves.*

***Water level – Quarterly** = water levels in groundwater wells will be measured as metres below ground surface; sub-set of wells will be monitored continuously using pressure transducers.*

***Acute toxicity** = Rainbow trout acute lethality test (EPS 1/RM/13, second edition, December 2000) and* Daphnia magna *acute lethality test (EPS 1/RM/14, second edition, December 2000 with February 2016 amendments). Test frequency will be adjusted as appropriate, per MDMER.*

***Sublethal toxicity** = Sublethal toxicity tests using a fish species (early life stage rainbow trout Reference Method EPS 1/RM/28), an invertebrate (*Ceriodaphnia dubia *Report EPS 1/RM/21), a plant (*Lemna minor *Reference Method EPS 1/RM/37), and an alga (*Pseudokirchneriella subcapitata *Report EPS 1/RM/25). Test frequency and species will be adjusted as appropriate, per MDMER.*

***Assumes monitoring location represents mine's final discharge point that has potentially the most adverse environmental impact on the environment.*

****Assumes sampling frequency is transitioned to monthly once operating trends are established.*

*****Monitoring frequency and/or parameter suite may vary during trouble shooting.*

10. NONCONFORMITY AND CORRECTIVE ACTIONS

This section summarizes potential nonconformities and corresponding corrective actions (i.e., mitigation measures) associated with mine site discharges. The present plan and the information provided below are intended to form the foundation of a detailed TRP that will be developed prior to the Operations phase.

Because groundwater seepage that reports to the Project receiving environment will represent a non-point source discharge, discharge quality and quantity limits (and corrective actions in the event of a limit exceedance) are not proposed. Instead, regulation, mitigations and adaptive management of this discharge type will occur through mine site groundwater management and monitoring and the AEMP (Appendix 7-A of the Application).

In support of the Application, BW Gold has committed to a wide range of mitigations that minimize potential effects of the Project to the downstream receiving environment, including source control of ML/ARD, management control, and containment (Section 5.4 of the Application). BW Gold has further committed to the operation of two active WTPs during the Operations phase (one metals removal system and one membrane reverse osmosis system), as well as one active WTP during the Post-Closure phase, as a result of a rigorous and comprehensive best achievable technology evaluation (Section 5.4 of the Application). The above mitigations yield a comprehensive water management strategy for the Project that affords flexibility and is supported by contingency options. This strategy has been scrutinized and validated in the LoM WB/WQM using a variable climate case. In the event that mine waters do not meet acceptability thresholds for discharge, contingencies identified in Table 10-1 may be implemented.
In most cases, the initial response to a non-conformity event constitutes immediate confirmatory or supplemental sampling. This is conducted in parallel with the implementation of mine site water management options to minimize the quantity of non-conforming water discharged to the environment until the water is shown to be suitable for discharge.

Reclamation research is also proposed to both address potential uncertainties in discharge conformity with regulatory limits and investigate opportunities to improve the Reclamation and Closure Plan.
The intent of the research is to support a post-closure landscape that reflects the end land use objectives. Potential areas of research include the use of wetlands to treat water, and Pit Lake amendments to reduce concentrations of POPCs in the water column. These research options and others are discussed in further in Chapter 4 of the Application.

Table 10-1: Effluent Discharge Non-Conformities and Corrective Actions

Facility	Event	Response
FWR outlet	Flow less than IFN	See Trigger Action Response Plan defined in the Aquatic Effects Monitoring Plan (AEMP) Appendix 7-A.
	Temperature not within proposed targets	See Trigger Action Response Plan defined in the AEMP Appendix 7-A.
	Discharge quality does not meet required characteristics	■ Confirmatory discharge quality sampling (including toxicity testing, as appropriate) will be conducted and an investigation will be launched to identify the cause of FWR discharge quality exceedance and to identify appropriate remedial actions, per the TRP. ■ Management of water in the FWR will be initiated to minimize discharge to Davidson Creek and mitigate potential effects until FWR water is confirmed suitable for discharge. Management actions may include: ○ Construct additional measures to route non-contact diversion water around the WMP to the FWR; ○ Discontinue pumping water from the WMP if it is identified as a source of water affecting FWR water suitability; ○ Temporary containment of normal inflow sources to the FWR within TSF C or TSF D to limit flows to the FWR; ○ Implementing additional sediment and erosion controls; ○ Implementing localized pH-adjustment; ○ Increasing the treatment rate at the Metals WTP during winter months (when the Metals WTP is not operating at its design hydraulic capacity); ○ Initiating Membrane WTP during winter months (e.g., November through March); and ○ Increasing the WTP capacity.
Membrane NF WTP Effluent (Post-closure only)	WTP effluent concentration exceeds design targets	■ Discharge from the WTP will be cycled per the operator standard operating procedure. An investigation of WTP operations will be conducted by the WTP operator to identify the cause of and rectify the non-conformity (Application Appendices 5-H (Membrane WTP Design Report)). ■ Response steps in the event of higher than predicted WTP influent concentrations are discussed under adaptive management (Section 11).
TSF Spillway (post-closure only)	Discharge quality does not meet required characteristics	■ Confirmatory discharge quality sampling (including toxicity testing, as appropriate) will be conducted and an investigation will be launched to identify the cause. ■ Management will be initiated to minimize discharge to Davidson Creek and mitigate potential effects until water is confirmed suitable for discharge. Management actions may include: ○ Routing water to Pit Lake, TSF C or TSF D for temporary containment; ○ Increasing WTP capacity; ○ Implementing additional sediment and erosion controls; and ○ Implementing localized pH-adjustment.

Facility	Event	Response
TSF Stage 1 SCP (construction only)	Discharge quality does not meet required characteristics	▪ Confirmatory discharge quality sampling will be conducted and an investigation will be launched to identify the cause. ▪ Management will be initiated to minimize discharge to Davidson Creek and mitigate potential effects until water is confirmed suitable for discharge. Management actions may include: ○ Implementing additional sediment and erosion controls; ○ Implementing localized pH-adjustment; and ○ Adding flocculant or other settling aids.
Plant Site SCP (construction only)	Discharge quality does not meet required characteristics	▪ Confirmatory discharge quality sampling will be conducted and an investigation will be launched to identify the cause. ▪ Management will be initiated to minimize discharge to Creek 661 and mitigate potential effects until water is confirmed suitable for discharge. Management actions may include: ○ Implementing additional sediment and erosion controls; ○ Implementing localized pH-adjustment; ○ Routing water to the WMP for temporary containment; and ▪ Adding flocculant or other settling aids.
Downstream Aggregate Borrow Area SCP	Discharge quality does not meet required characteristics	▪ Confirmatory discharge quality sampling will be conducted and an investigation will be launched to identify the cause. ▪ Management will be initiated to minimize discharge to Davidson Creek and mitigate potential effects until water is confirmed suitable for discharge. Management actions may include: ○ Implementing additional sediment and erosion controls; ○ Routing water to the WMP, TSF C or TSF D for temporary containment; ○ Implementing localized pH-adjustment; and ▪ Adding flocculant or other settling aids.
Camp Site SCP	Discharge quality does not meet required characteristics	▪ Confirmatory discharge quality sampling will be conducted and an investigation will be launched to identify the cause ▪ Management will be initiated to minimize discharge to Creek 661 and mitigate potential effects until water is confirmed suitable for discharge. Management actions may include: ○ Implementing additional sediment and erosion controls; ○ Treating water at the metals WTP; ○ Implementing localized pH-adjustment; ○ Adding flocculant or other settling aids; and ○ Routing water to the WMP, TSF C or TSF D for temporary containment.

11. ADAPTIVE MANAGEMENT

BW Gold is committed to continual improvement of its environmental management and performance. The MSDP will be reviewed annually to verify implementation and the continued suitability, adequacy and effectiveness, in conjunction with annual (or more frequent, as needed) review of monitoring data.

The MSDP is a “living” document, therefore updates to the plan may be required periodically. Circumstances that trigger an update to the MSDP may include changes to:

- Infrastructure or processes;
- The mine plan and schedule;
- Other relevant management plans;
- Response requirements;
- Regulations; and
- Incidents.

Preliminary triggers for additional mitigation, management and/or monitoring are described in Table 11-1. Triggers identified for mine site water quality are heavily focused on ML/ARD management within the mine site due to the potential magnitude of effect to mine water and discharge quality associated with ML/ARD processes. Quantitative thresholds will be developed as part of future regulatory submissions. The effectiveness of the mitigation strategies implemented as part of the adaptive management response will be monitored and evaluated. The mitigation strategies may be subsequently altered or additional mitigation measures considered depending on the results of the monitoring program, as appropriate.

The primary focus of mine site surface water quality monitoring in support of adaptive management will be the TSF ponds and pit water, as these are dominant loading sources for the Project where variability in water chemistry has the potential to impact downstream water quality. In addition, TSF D pond water quality has the potential to have a long-term impact on groundwater quality through seepage flow paths. Due to the predicted rapid onset of ARD for PAG mine rock, a portion of the PAG mine rock placed within the TSF basin may become acid generating prior to flooding. The proposed trigger for changes in pH in the TSF ponds will be a pH reading below pH 6.5.

Regarding groundwater, pumping rates, seepage flows, monitoring well piezometric levels, and groundwater chemistry will be compared against model predictions to assess requirements for adaptive management and implementation of contingencies. Reference datums (“triggers”) will be defined for monitored groundwater levels and groundwater quality. Generally, triggers related to groundwater quantity will include piezometric elevations in monitoring wells and standpipe piezometers. Groundwater quantity triggers will also consider groundwater and seepage quality indicators, since changes in quality may be indications of increased seepage rates. Final triggers will be calculated on a station-by-station basis and criteria will be established to indicate when a follow-up investigation is warranted.

A comprehensive list of triggers will be developed in support of a TRP prior to the onset of the Operations phase.

Table 11-1: Mine Site Water Adaptive Management Actions

Facility	Event	Response
Upper and Lower Waste Stockpile Collection Ponds	Concentrations meet BC aquatic life guidelines	Discharge water directly to the WMP (bypass treatment at the Metals WTP).
	Concentrations exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and increasing monitoring frequency. Investigation of material source will be triggered and may require reactive management strategies. Investigation to confirm Metals WTP will be able to accommodate the change and adjust the treatment if necessary.
	Surface flow rate exceeds predictions	Investigation to confirm Metals WTP will be able to accommodate the change and adjust the treatment if necessary.
Groundwater wells downstream of waste stockpiles	Concentrations approach or exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and increasing monitoring frequency, including additional sampling downgradient. Evaluate construction of seepage cut off walls or interception trenches, installation of groundwater pumping wells, directing tributaries downgradient of seepage paths to seepage collection works. Consider additional groundwater contingencies described in Section 11.1
LGO Stockpile Collection Pond	pH lower than anticipated	Follow-up investigation will be initiated to confirm and characterize pH measurements, which may include additional sampling, comparison of laboratory and field measurements, and increasing monitoring frequency. If appropriate, lime addition in the lime neutralization system will be increased within the lime neutralization system.
	Runoff volumes / flow rates exceed the capacity of the lime neutralization system	Capacity of the lime neutralization system will be increased, as needed. Pumping capacity of the LGO collection pond system will be increased, as needed. Evaluate if water could be directed to the Metals WTP.
Groundwater wells downstream of LGO stockpile	Parameter concentrations exceed predictions	Groundwater conceptual model will be revisited to improve the understanding of groundwater conditions. Conduct additional monitoring and sampling downgradient. Consider additional groundwater contingencies described in Section 11.1, as well as the following: ■ Design and implement a monitoring program for each component of the liner system, including the ability to monitor for flow and water quality in the foundation drains, contact water collection channels and LGO collection pond. ■ Evaluate the liner system design based on monitoring results from the liner system and adjust the design for future expansion of the LGO footprint as required to improve collection efficiency. ■ Consider revisions to the collection systems downstream of the stockpile based on the updated groundwater model that is informed by additional site characterization, as well as operational monitoring data.

Facility	Event	Response
Open Pit Sump	Concentrations meet BC aquatic life guidelines	Bypass treatment at the Metals WTP.
	Concentrations exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and increasing monitoring frequency. Investigation to confirm that Metals WTP will be able to accommodate the change and adjust the treatment if necessary. Pit wall mine rock exposures (e.g., PAG1, PAG2, NAG3, etc.) will be reviewed relative to expected mine rock types used in source term development. Results will be evaluated to determine if an update to the water quality model is required.
	Dewatering rates are lower than predicted	Source additional mill freshwater from the WMP
	Dewatering rates are greater than predicted	Optimize rates to align with WTP capacity needs and increase capacity of the WTP if necessary
	Drawdown surrounding the Open Pit is greater than predicted	Monitor tributaries to Creek 661 to evaluate potential impacts to streamflows and consider implementing additional groundwater contingencies, such as diverting water to Creek 661 in the event that groundwater drawdown is reducing streamflow.
	Concentrations exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and monitoring downgradient.
Pit Lake (multiple depths)	Concentrations exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and increasing monitoring frequency. Pit wall mine rock exposures (e.g., PAG1, PAG2, NAG3, etc.) will be reviewed relative to expected mine rock types used in source term development. Results will be evaluated to determine if an update to the water quality model is required. Feasibility of Pit Lake amendment options identified in Reclamation and Closure plan areas of research (Section 4.2.5, Reclamation Research) will be investigated. Such amendments could include: (1) nutrients (e.g., phosphorus) to enhance algal production and metal removal; and/or (2) chemical reagents (e.g., lime, ferric sulphate) to enhance metal removal.

Facility	Event	Response
TSF C and D Ponds	pH instability (i.e., pH < 6.5)	Follow-up investigation will be initiated to confirm and characterize measured values, which may include additional sampling, comparison of laboratory and field measurements, and an increased monitoring frequency. As appropriate, management actions will be initiated and may include: ■ Consider lime dosing in the mill; ■ Adjusting the waste rock flooding schedule; and ■ Temporary lime addition to re-establish neutral pH conditions in the pond environment. PAG quantities will be reviewed relative to expected PAG quantities used in source term development. If a higher proportion of waste rock is PAG, mine rock classification will be revisited and management strategies will be adjusted. Results will be evaluated to determine if an update to the water quality model is required.
	Concentrations approach or exceed predictions	Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and increasing monitoring frequency. Confirm Membrane WTP will be able to accommodate the change and adjust the treatment if necessary. The material source will be investigated. Depending on the material type or condition causing the increased metal mobility, reactive management strategies may be imposed. Results will be evaluated to determine if an update to the water quality model is required. Subsequent management actions may include: ■ Adjusting the waste rock flooding schedule; ■ Consider lime dosing in mill; ■ Optimizing spigot placement and discharge plans for the TSF to limit tailings beaches exposure time; and ■ Implementing WTP actions described below.
	Pond volume exceeds the nominal volume needed to support mine operations	■ Follow latest tier-based operational instructions in OMS Manual providing threshold values and associated response plans. ■ Convey surplus water to the Membrane WTP before discharge to the WMP.
Wells downgradient of TSF C and D	Concentrations approach or exceed predictions	■ Groundwater conceptual model will be revisited to improve the understanding of groundwater conditions and the potential for seepage bypassing the seepage collection works (IECD and ECD) will be reassessed. ■ Groundwater pathways will be investigated to develop appropriate mitigations as required, which could include constructing seepage interception trenches, installing groundwater pumping wells, directing tributaries downgradient of seepage paths to seepage collection works such as the IECD or ECD, or altering planned timelines forward for construction of Main Dam D or the ECD. ■ Consider additional groundwater contingencies described in Section 11.1.

Facility	Event	Response
WMP	Concentrations exceed predictions and water is not suitable for conveyance to the FWR	■ Follow-up investigation will be initiated to confirm and characterize measured concentrations, which may include additional sampling and an increased monitoring frequency at locations upstream. Pathways to investigate will include: ○ Membrane WTP and Metal WTP effluent; ○ Groundwater quality at wells upgradient of the WMP; and ○ Other potential flow paths to the WMP. ■ As appropriate, management actions may be initiated, including: ○ Temporary lime addition to re-establish neutral pH conditions in the pond environment; ○ Implementing WTP influent and effluent actions described below; ○ Directing water to TSF C; and ○ Treating water before discharge to the FWR.
	Water level	■ Water will be pumped to the FWR and/or to support ore processing when required to limit accumulation of surplus water. Additional WMP outlets are available to passively manage water levels include pipe overflow outlet and emergency spillway.
ECD and IECD Pond	Concentrations exceed predictions	■ No actions are proposed for the IECD and ECD since the water will remain on-site and directly impacts the water quality in TSF C and D. Potential actions are described under TSF C and D. The IECD and ECD will be monitored to support the understanding of water on site, and implications for long-term treatment.
	Pond volume is greater than expected	■ Increase pumping rates to decrease water volumes. ■ Provide additional pumping capacity to meet demand.
Wells downgradient of ECD and IECD	Concentrations approach or exceed predictions	■ Groundwater conceptual model will be revisited to improve the understanding of groundwater conditions and the potential for seepage bypassing the ECD will be reassessed. ■ Collect additional samples from the FWR to assess if the seepage is reporting to the FWR or downstream environment. ■ Groundwater pathways will be investigated to develop appropriate mitigations as required. ■ Consider additional groundwater contingencies described in Section 11.1.
Well downgradient of the Plant Site	Concentrations exceed predictions	■ Groundwater conceptual model will be revisited to improve the understanding of groundwater conditions. ■ Collect additional water quality samples from Creek 661 to assess if the seepage is reporting to the creek. ■ Groundwater pathways will be investigated to develop appropriate mitigations as required. ■ Consider additional groundwater contingencies described in Section 11.1.
Wells downgradient of the Aggregate Source	Concentrations approach or exceed predictions	■ Groundwater conceptual model will be revisited to improve the understanding of groundwater conditions. ■ Collect additional samples from Davidson Creek to assess if the seepage is reporting to the creek. ■ Groundwater pathways will be investigated to develop appropriate mitigations as required. ■ Consider additional groundwater contingencies described in Section 11.1.

Facility	Event	Response
Water Treatment Plants		
WTP influent	Concentrations approach or exceed predictions	Follow-up investigation will be conducted to explore potential sources of the exceedance and potential implications on treatment, including re-sampling of WTP influent and effluent. Additional monitoring will be initiated at relevant upstream and downstream stations as appropriate to characterize sources. Results of the follow-up investigation will be used to determine if mitigation measures are required. Investigation will be conducted with the objective of confirming that WTP can accommodate increased influent concentrations. Additional management options that may be considered (dependent on parameter(s) showing elevated concentrations) include: ▪ Adjustments in the mill process; ▪ Modifications to the WTP systems (e.g., increased reagent concentration, new reagents, new processes); ▪ Changing blasting practices; and ▪ Evaluation of the cyanide destruction process. Additional monitoring will be implemented to determine the effectiveness of mitigation measures. If long-term changes to WTP influent are identified, the water quality model and WTP treatment requirements will be evaluated as needed.
WTP effluent	WTP effluent exceeds its design target	Discharge from the WTP will be cycled per the operator standard operating procedure. An investigation of WTP operations will be conducted by the WTP operator to identify the cause of and rectify the non-conformity (Application Appendices 5-H (Water Treatment Plant for Sulphate Control), 5-G (Detailed Design for Blackwater Gold Water Treatment Plant)). In the event that treatment rates or efficiency are insufficient, the treatment capacity may be increased or system adjusted.
Lime neutralization system effluent	pH exceeds or falls below target	An investigation of treatment system operations will be conducted by the operator to identify the cause of and rectify the non-conformity. Reagent dosing and/or hydraulic residence time may be modified.

11.1 Groundwater Adaptive Management and Contingency Actions

Adaptive management strategies that could be implemented for groundwater quality include:

- Implementing additional groundwater interception such as pumping wells, well points, relief wells, or interception trenches.
- Implementing groundwater barriers to flow, such as cut-off walls and hydraulic barriers. Cut-off walls could be used in conjunction with pumping wells or trenches to increase seepage containment.
- In post-closure, groundwater-related contingencies may include:
  - Lowering the Pit Lake level in post-closure so that some or all of the Pit Lake seepage and some of the Upper Waste Stockpile seepage flows towards the pit rather than to downstream sites; and
  - Installing thicker engineered covers on the Upper and Lower Waste Stockpiles and on the TSF beaches and embankments to reduce infiltration and seepage.

12. REPORTING AND RECORD KEEPING

12.1 Reporting

Federal and provincial reporting requirements related to surface and groundwater water and water management are described below. Reporting requirements related to water management will also be informed by the *Mines Act* and *Environmental Management Act* permits issued for the Project. In addition to reporting requirements, the Code (Part 10, section 10.4.1) requires after commencement of operations, the water balance and water management plans under section 10.1.12 (Permit Application) of the Code be reconciled annually and updated as required.

Monitoring reports will be submitted as required by the federal or provincial regulations, guidance or permit and hard and electronic copies provided to Aboriginal Groups. Where required, monitoring data will be uploaded to government databases.

12.1.1 Metal and Diamond Mining Effluent Regulations *Reporting*

Environmental effects monitoring reporting is required by the *Metal and Diamond Mining Effluent Regulations* (MDMER). Division 2 of the MDMER sets out effluent monitoring conditions and monitoring reporting requirements are set out in section 21. Annual reporting requirements set out in section 22 (Division 2 of the MDMER; EC 2012).

12.1.2 Environmental Management Act *Annual Reporting*

Routine (monthly) and annual reporting is required for permits issued under the *Environmental Management Act*. These reports are public documents and prepared by QPs. Separate reports or sections of the annual report are expected for air, refuse and water/receiving environment. In some cases, a separate biological effects report or water quality report may be required (BC MOE 2016a). Reporting requirements are described in Technical Guidance 4 (BC MOE 2016a).

12.1.3 Annual Reclamation Reporting

The Project's annual reclamation report will describe the Environmental Protection Program over the past year, next year, and projected over the 5 years (in summary) and will include the following (EMLI 2021b):

Environmental Management Systems/Plans/Audits

- Summarize the environmental management plans implemented.
- Summarize the audit undertaken to review the EMS, EMPs, and SOPs.
- Document and provide a schedule for the revisions necessary to address the audit findings.

Surface Water Quality and Quantity

- Summarize the drainage monitoring program, including flows and water quality at monitoring locations both on and off of the mine property.
- Include data range and central tendencies for data summaries.
- Include maps depicting hydrologic features and monitoring locations.
- Include figures illustrating time series of parameters including pH, sulphate, alkalinity, acidity, base cations, major metals, trace elements, and major nutrients.
- Identify any water quality trends or issues and any actions that have or will be undertaken to address.

Groundwater Quality and Quantity

As above under Surface Water Quality and Quantity.

Water Quality Prediction, Mitigation, and Treatment

- Include a comparison of predicted water quality versus measured water quality, including key source terms used in predictions.
- Summarize and assess effectiveness of water quality protection and mitigation measures for the mine, including ML/ARD.
- Identify any issues encountered or expected and actions that have been or will be undertaken to address.

Water Management

- Describe and map pre-mining drainages/watersheds.
- Describe and map the current configuration of water management conveyance features and infrastructure, and changes to natural drainages/watersheds.

12.2 Record Keeping

The EM is responsible for data management and reporting related to water management. The data management system will include conducting routine inspections and monitoring, and providing these results to appropriate parties as required. The EM will also report key results of waste management monitoring and related environmental, health and safety incidents to the Blackwater Environment Committee and Aboriginal Groups during routine meetings.

Monitoring data will be entered into a secure, electronic database and have quality control checks completed upon receipt of results. Data will be entered into a standard format that allows for data reporting and analyses. Data and data comparisons will be stored in a single file format for each type of survey or monitoring activity. Monitoring data will be stored for the LoM and will be made available for review upon request.

13. PLAN REVISION

BW Gold will conduct an annual (or as necessary) evaluation of the efficacy of mitigation and monitoring activities. This Plan may be updated annually, as required, based on interpretation of ongoing monitoring results, BW Gold recommendations or based on changes to provincial or federal regulations or requests made by regulators and Aboriginal Groups.

14. QUALIFIED PROFESSIONALS

Note: This form of QP signoff may be replaced by the Professional Reliance forms and placement may be at the front or end of the Management Plan

This management plan has been prepared and reviewed by the following QPs:

Prepared by:

Stephanie Eagen, B.Sc. R.P.Bio.
Senior Environmental Scientist

Reviewed by:

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Senior Toxicologist

Reviewed by:

Alan Martin, M.Sc., R.P.Bio., P.Geo.
Principal, Senior Geochemist/Biologist

15. REFERENCES

Definitions of the acronyms and abbreviations used in this reference list can be found in the Acronyms and Abbreviations section.

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