Water Management Plan

Palmer Advanced Exploration Project
Haines, Alaska

MHT Upland Mining Lease No. 9100759

Prepared for:
Alaska Department of Environmental Conservation
Alaska Mental Health Trust Land Office

Prepared by:
Constantine Mining
800 West Pender Street; Suite 320
Vancouver, BC, Canada V6C 2V6

March 2019, Revised April 2022

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Summary

This updated Water Management Plan describes how Constantine Mining LLC (Constantine) will manage water at the Palmer Project site during their underground exploration program scheduled to begin in 2023. Constantine will manage two categories of water: 1) storm water, and 2) underground seepage water.

Storm water includes all the natural runoff (from rain or snowmelt) coming from disturbed surfaces (roads, pads, stockpiles, etc.). Constantine is currently managing storm water in accordance with Alaska Construction General Permit (CGP) AKR 100000. The CGP authorizes the discharge of storm water associated with construction activity to waters of the U.S., in accordance with the conditions and requirements set forth in the permit. Permit authorization is required from the "commencement of construction activities" until "final stabilization" as defined in Appendix C of the CGP. Constantine will be transitioning over to the Multi-Sector General Permit (MSGP) for stormwater at the completion of surface construction and then operate under the MSGP for the duration of the underground exploration program.

Underground seepage water includes natural inflows to the underground exploration ramp, tentatively schedule for construction starting in 2023. The seepage water will be collected underground and discharged to the environment, at the surface, under an approved land application disposal (LAD) system design and authorized under Waste Management Permit 2019DB0001.

Routinely, the underground seepage water will be continuously discharged through the LAD diffuser. The LAD diffuser is located upslope of the access road northeast east of Hangover Creek as illustrated in Figure 1.

Constantine has completed several hydrogeology and groundwater geochemical studies in the field and computer modeling as a means of characterizing groundwater and estimating potential seepage flow rates into the proposed underground ramp and for the water quality of this seepage. Constantine has estimated the anticipated volume of underground seepage but there remains a degree of uncertainty about the seepage rate. This is typically the case in predicting groundwater inflows prior to initiating development of any underground development. To allow for this uncertainty Constantine has incorporated conservative estimates into the design of its LAD system and has an adaptive water management strategy that includes probing for zones with high inflow rates in advance of the ramp development, in anticipation for the need to employ pressure grouting as a means of stemming the flow in these zones.

Constantine will also adhere to a list of explosives management BMP's with the objectives of avoiding the overuse of explosives and minimizing contact between water and explosives residue.

The objective of this Water Management Plan is to describe how Constantine will manage water on the site while meeting all regulatory requirements and minimizing the risk of any unauthorized discharges to the environment.

Constantine has completed a variety of environmental monitoring and characterization studies which include Acid Base Accounting, Aquatic Biology, Cultural Resources, Geology, Geotechnical, Water Quality, Groundwater Hydrology, Meteorology, Snow and Avalanche, Wetlands, Wildlife and Wildlife Habitat to characterize the natural environment in the Palmer Project area. Information derived from these studies was integrated into the project designs and into this Water Management Plan with the intent of preventing undue degradation to the environment.

1.0 WATER MANAGEMENT

Constantine will manage two categories of water during the underground advanced exploration project including: 1) stormwater, and 2) underground seepage water.

Constantine will also consume a small volume of water to meet underground drilling, water treatment, grouting and dust mitigation needs.

Stormwater includes all the natural runoff (from rain or snowmelt) coming from disturbed surfaces (roads, pads, stockpiles, etc.). Constantine manages storm water under authority of the Alaska Construction General Permit (CGP) AKR 100000. The CGP authorizes the discharge of storm water associated with construction activity to waters of the U.S., in accordance with the conditions and requirements set forth in the permit. Permit authorization is required from the “commencement of construction activities” until “final stabilization” as defined in Appendix C of the CGP. For the 2022 construction season, Constantine will migrate to the Multi-Sector General Permit (AKR060000) for stormwater and the permit will cover storm water management on the portion of the access road on Mental health trust lands where heavy truck traffic will be ongoing during the development of the underground exploration ramp.

Underground seepage water includes natural groundwater inflows into the underground exploration ramp. This is generally in the form of relatively small seeps associated with fractures and faults in the wallrock. The underground seepage water will be treated and conveyed to the LAD diffuser and discharged to the environment under authorization of Waste Management Permit 2019DB0001. Approval of Waste Management Permit includes a formal review of the LAD engineering drawings (as designed by KCB, 2022a and Veolia, 2022).

Routinely, the seepage water will be discharged through the buried LAD diffuser. The LAD diffuser is located east of Hangover Creek (Figure 1). The entire system, including active water treatment (discussed below) is referred to as the LAD system and its design is subject to review by ADEC prior to construction.

Underground seepage water will be directed to the portal area where active water treatment will remove solids and then the water will be directed the LAD diffuser. For the ADEC LAD review process the LAD includes all components of the water treatment and discharge system starting with the water treatment plant at the portal and ending at the diffuser. The settling ponds, also part of the LAD system, are intended for surplus water treatment (settleable solids) and settled solids management. Solids removal in the water treatment plant and/or the settling ponds will minimize the clogging of the LAD diffuser and subsurface receiving environment down-gradient of the diffusers, prolonging the useful life of the LAD system.

The LAD system (water treatment plant, settling ponds, diffuser) is designed to receive up to 900 gpm. In the unlikely event that there are water volumes that would exceed the freeboard in the settling ponds, then water would discharge over the emergency spillway constructed in the ponds, which has been designed to protect the structural integrity of the ponds.

The physical components of Constantine's LAD system are illustrated in Figure 1 and described below. They include:

- A water treatment plant near the portal designed to settle suspended solids from underground seepage water.
- A pair of treatment ponds for settling solids or storage of settled solids.
- Buried diffuser consisting of two parallel perforated HDPE pipes with valves to create zones.
- Piping to convey water from the portal to the LAD diffuser by gravity feed.
- Piping to convey water by gravity feed from the portal to the sediment control ponds (as contingency).
- A pump and pump house adjacent to the settling ponds capable of pumping water from the settling ponds up to the water treatment plant or directly to the LAD diffuser.
- Valves at the portal to control flows to either diffuser or the settling ponds.
- Totalizer(s) to record flows from the portal to the LAD diffuser and settling ponds.

In the original 2018 design (BGC 2018), the settling ponds were sized to provide sufficient settling time for settleable solids before that water was conveyed to the lower diffuser. However, with the addition of active water treatment at the portal, the seepage ponds are not required for primary settling of solids. In this updated Water Management Plan, the overall design of the ponds is unchanged, but they have been repurposed. One pond will be available as a settling pond should an unanticipated high volume of seepage overwhelm the water treatment plant, or for temporary use when the treatment plant may be inoperative (i.e., routine maintenance). The second pond will be used to manage settled solids, a byproduct of the active water treatment. Each pond holds approximately 358,500 gallons (1.1 acre-feet). The conceptual design for the impoundments that create the ponds has previously been submitted to ADNR Dam Safety Unit for jurisdictional review, and on July 12, 2018, ADNR dam safety concluded that the impoundments are not under jurisdiction of the Alaska Dam Safety Program.

Constantine has completed several hydrogeology site investigations in the field and computer modeling as a means of characterizing groundwater and estimating potential flow rates into the future underground ramp. The site investigations are described by KCB (2022b). Constantine has also been collecting groundwater samples from wells and surface seeps as part of an effort to predict the water quality of seepage water inflows into the ramp. pHase Geochemistry has developed a prediction of the water quality of the discharge from the underground ramp (updated in 2022).

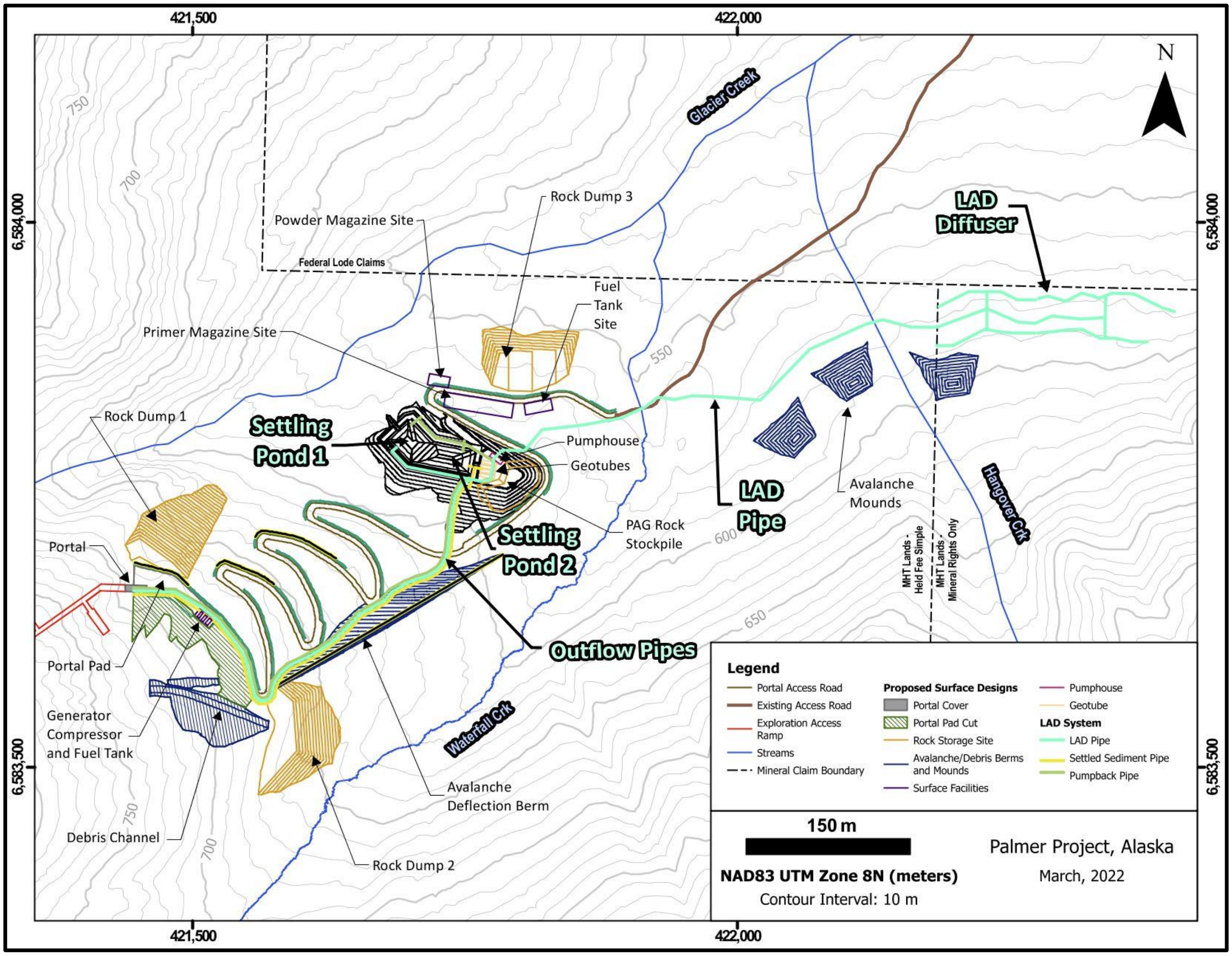

Figure 1. Major Components of Land Application Disposal System for Underground Seepage Water

Constantine has estimated the anticipated volume of underground seepage (Tundra, 2022) but there remains a degree of uncertainty about the total volume of seepage which is always the case in predicting groundwater flows prior initiating development of any underground development. As a result of this uncertainty Constantine has incorporated conservative estimates into the design of its LAD and has an adaptive water management strategy that includes probing for zones with high inflow rates in advance of the ramp development and employing pressure grouting as a means of stemming the flow in these zones prior to passing through them with the ramp. These are all described in more detail below in Section 1.3.

1.1 STORM WATER

Storm water on the Palmer Project site is regulated by ADEC under the APDES Program, delegated to the State by the EPA. Storm water management for the project is currently managed under the terms of the Construction General Permit (CGP, Permit No. AKR100000) for storm water discharges associated with Industrial Activity. The CGP authorizes, and sets conditions on, the discharge of pollutants from certain industrial activities to waters of the United States. To ensure protection of water quality and human health, the permit establishes control measures and best management practices (BMP's) that must be used to control the types and amounts of pollutants that can be discharged. This general permit is intended to regulate storm water (rain and snowmelt) runoff which encounters industrial activities and materials which have the potential to cause contamination.

To obtain authorization to operate under the CGP the permittee must develop a Storm Water Pollution Prevention Plan (SWPPP) according to the requirements of permit Part 5 and submit the SWPPP to ADEC. Further, the permittee must select, design, install and maintain control measures (BMP's) to meet effluent limits. To begin coverage under the CGP, the permittee must submit a complete Notice of Intent (NOI) to operate under the CGP to ADEC and pay the general permit authorization fee in accordance with 18 AAC 72.

Constantine has been operating under the CGP since 2014 has maintained a SWPPP and installed BMP's to meet the pollution minimization requirements of the CGP along the segments of the Glacier Creek access road as they were constructed, including the last segment ending at the portal pad. As outlined in the SWPPP, storm water is collected along ditches along the portal access road and other disturbed areas and conveyed to discharge points in uplands or to tributaries of Glacier Creek. BMP's, including energy dissipaters, stilling ponds, relief culverts, and sediment basins are being constructed, where required, to encourage settling of suspended solids from storm water and reduce the resulting discharge of pollutants.

Constantine is doing requisite storm water monitoring (inspections) currently under the CGP. The inspection location and scope are defined in Section 6.4 of the CGP. Inspections are performed on a weekly schedule (excluding winter shut-down periods) as required by section 6.1 of the CGP that applies to sites where the mean annual precipitation exceeds 40 inches. An inspection report is completed for each inspection in accordance with CGP section 6.7. Constantine will likely be transitioning over to the Multi-Sector General Permit (AKR060000) for stormwater prior to the 2022 construction season. The MSGP will authorize storm water management for continued heavy traffic on the road on Mental Health Trust Lands for the duration of the underground ramp development while development rock is hauled to the surface and repurposed for a variety of construction purposes or disposed of in designated dump sites.

Constantine will continue to manage stormwater as described in the SWPPP until the site is deemed to meet the "final stabilization" definition under the MSGP.

1.2 UNDERGROUND SEEPAGE WATER

Natural groundwater is anticipated to seep into the underground ramp as the ramp progresses. Inflows are modeled to increase as the ramp gets longer; the highest flows are anticipated in the Kudo fault area. Constantine has a plan to manage this water, including discharging it to the environment, as the ramp is developed and maintained during exploration activities.

Tundra Consulting (2022) estimates base seepage inflows to the exploration adit of 360 gpm with most of the seepage water coming from into the ramp where it will pass through the Kudo Fault zone, situated approximately 1,250 m (4,100 ft) from the portal. Sensitivity analyses using a range of conservative assumptions (i.e., higher K) predict ramp seepage water inflows up to 500 gpm (possible) to 700 gpm (unlikely).

Water quality sample data and constituent loading studies completed by pHase (2022) indicate the seepage inflows will be generally good quality. The water will also pick up some nitrate compounds as a result of interaction with the ramp system and blasting residues therein.

Constantine has used these base-case parameters to design this water management plan and the components parts of the LAD system but has also incorporated a significant degree of conservatism and adaptive management to reduce the risks associated with water management in general. For example, the discharge capacity of the lower diffuser is 900 gpm (KCB, 2022a) when the base flow is anticipated to average approximately 360 gpm with some seasonal variation (Tundra, 2022).

Constantine has designed the LAD, consisting of active water treatment, two settling ponds, pumps, valves, buried LAD diffuser and the piping required to convey water from the portal through the system with several operational options for controlling flows.

Constantine will collect all underground seepage in a series of underground sumps, direct it to active treatment at the portal before conveying it by pipe directly to the LAD diffuser or to one of the settling ponds and then to the LAD diffuser.

The LAD redesign engineering report (KCB 2022a), water treatment plans (Veolia, 2022), and this Water Management Plan are being submitted to ADEC as appendices to Constantine's Revised Application for Waste Management Permit for the Palmer Phase II Exploration Project (Revision date April 2022). Constantine is submitting this information as part of a formal LAD design review, with the objective of receiving "Approval to Construct" from ADEC prior to construction.

To evaluate the volume of underground seepage inflows, Constantine will use an adaptive management strategy to managing seepage water in effort to identify zones of high flow rates and optionally pressure-grout them to reduce flows. The adaptive management strategy is discussed further in Section 1.3 of this Water Management Plan.

1.2.1 Underground Seepage Water Quantity

Between 2014 and 2021, Constantine completed field studies including packer testing, shut-in/flow measurements, water level monitoring (in drillholes), and computer modeling to estimate seepage rate for underground inflows. That work was managed by Tundra Consulting (2016 – 2022).

The proposed underground ramp design includes an inclined, 1,612 m ramp and a more gently inclined 400 m exploration drilling drift. The first 1,250 m of the ramp is projected to pass through Jasper Mountain Basalt, a competent unit with few faults and low anticipated seepage rates. The ramp then progresses through a transitional unit consisting of a mix of basalt and argillite, the Kudo Fault, a major sub-vertical fault zone with higher anticipated flow rates, and finally terminating in the Hanging Wall Basalt.

Hydraulic conductivity is dominantly controlled by faults and fracture zones with variable K values, while the competent rock is characterized by low K. Six principal hydrogeologic units were defined in the project area by Tundra (2022) including: 1) Kudo Fault, 2) Kudo Fault Damage Zone – Jasper Mountain, 3) Kudo Fault Damage Zone – South Wall, 4) Slide Block, 5) Shallow Country Rock, and 6) Country Rock. Work in 2021 indicates that the Kudo fault has very low permeability (hydraulic conductivity, K, of 6.1 x 10-5 m/day) due to fault gouge, and that there are wide damage zones on either side of the fault with higher K (2.7 x 10-3 m/day and 2.1 x 10-2 m/day).

Tundra (2022) applied a numeric groundwater model to estimate flow into the proposed ramp. The method incrementally estimates flow as the ramp is advanced. The analysis is most sensitive to K and pressure head above the ramp (i.e., saturated thickness above the ramp) and is less sensitive to the storage capacity of the rocks and the ramp radius. Enough data are available to estimate flows for the entire exploration ramp. The base case estimate of flow from the entire ramp is 360 gpm. Flows as high as 500 gpm are possible but less likely and flows as high 700 gpm are possible but highly unlikely (Figure 2; Scenario 6 is the most conservative model with the base case being the most likely). These flow rates do not account for Adaptive Strategies during operations (described in Section 1.3)

1.2.1 Underground Seepage Water Quality

Constantine's prediction of the seepage water quality is based on an analysis by consultant pHase Geochemistry completed in 2019 and updated in 2022 (final report pending). PHase started with background groundwater geochemistry from site P29 (groundwater monitoring site) and scaled those concentrations for each constituent using the leachate results from the humidity cell and field barrel samples. The resultant predicted concentrations for a list of constituents, including explosive residues, are included in Table 1 with a comparison to Alaska acute and chronic water quality standards (AWQS). The table illustrates that the predicted water chemistry from the underground ramp will meet AWQS except for Mn

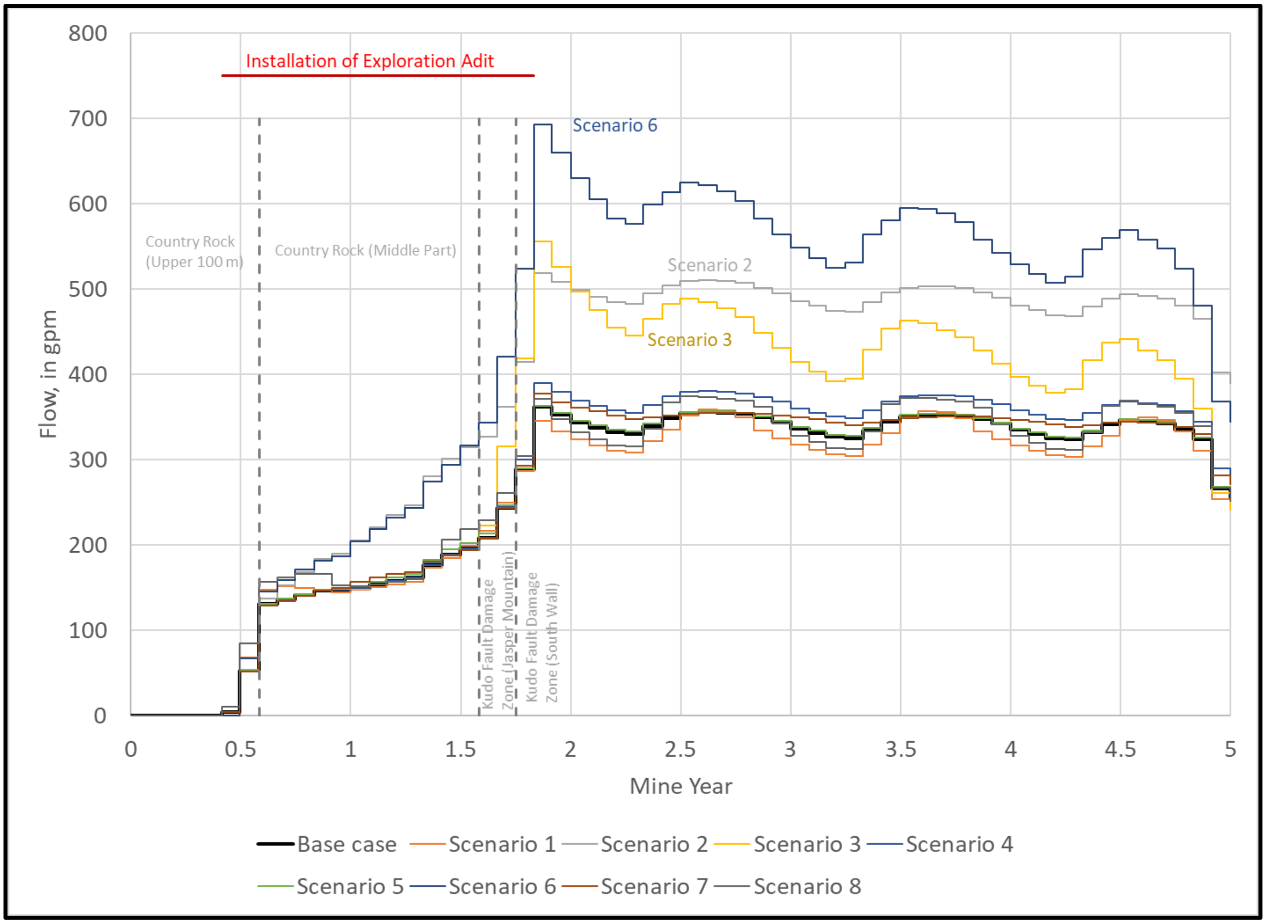

Figure 2. Predicted Underground Seepage Quantity

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1.2.2 Underground Seepage Water Management and Disposal

Owing to the inclination of the underground ramp, all seepage inflows will flow, by gravity, toward the portal. Initially, seepage will report to the water ditch parallel to the driving surface in the ramp and flow toward a sump down-ramp, where it will accumulate. As sumps fill and then overflow, the overflow water will flow down-ramp, in the ditch, to the next sump, and so on through the series of sumps. Eventually flows will report to sumps 1 & 2, closest to the portal. Sumps 1 & 2 are configured such that water will be allowed to settle in sump 2 and overflow to sump 1, where it will be conveyed to the water treatment plant and then discharged to the environment through the LAD diffuser.

Constantine will dispose of water through the LAD diffuser. Constantine will monitor flow volumes from the portal area using a totalizer(s). This is the best measure of seepage water inflows. Constantine will also monitor water quality at several monitoring wells in accordance with their monitoring plan as a means of detecting any significant changes to background water quality after the LAD system is in operation. Early in the ramp, development when inflows are initially low, seepage water may be directed to one of the settling ponds for solids settling until seepage inflows increase to point where operation of the water treatment plant can be sustained. The water treatment plant is designed to operate at a minimum flow of 125 gpm but can be operated at a lower flow rate than that by recycling treated water, with the effect of maintaining plant throughput at least 125 gpm (Veolia, 2022).

Table 1. Predicted Underground Seepage Water Quality

		Alaska WQ Guidelines				**Seepage Discharge Wastewater Chemistry (Predicted)**		
Parameter	as	**Acute Guideline (mg/L)**	**Chronic Guideline (mg/L)**	***as***	**Background Groundwater (GW) at Station P29**	**GW + Scaled Humidity Cell Concentration**	**GW + Field Barrel Concentration**	**Conservative Predicted Discharge Wastewater Chemistry**
Hard as CaCO^3	t	—	—	—	255	907	258	907
pH	-	—	—	—	8.6	7.9	8	7.9
NH^3 as N	t	8.4	—	t	0.027	n.d.	n.d.	0.79
NO^3 as N	t	10*	—	t	0.005	n.d.	n.d.	1.1
NO^2 as N	t	1*	—	t	0.001	n.d.	n.d.	0.08
Al	d	0.75	0.75	t	0.0039	0.00024	0.0039	0.0039
As	d	0.34	0.15	d	0.00019	0.0034	0.00019	0.003
Cd	d	0.00299	0.00033	d	0.0000065	0.00015	0.0000065	0.00015
Cr-III	d	0.7942	0.1033	d	0.0002	0.0076	0.0002	0.0076
Cr-IV	d	0.0160	0.0110	d	0.0002	0.0076	0.0002	0.0076
Cu	d	0.0197	0.0127	d	0.0005	0.0079	0.0005	0.0079
Fe	d	—	1	t	0.24	0.24	0.24	0.24
Pb	d	0.10013	0.00390	d	0.000058	0.0008	0.000058	0.0008
Mn	d	0.05**	—	t	0.076	0.33	0.076	0.33
Hg	d	0.001400	0.000770	d	0.000017	0.0001	0.000017	0.0001
Ni	d	0.6598	0.0733	d	0.0005	0.0079	0.0005	0.0079
Se	d	—	0.0046	d	0.00005	0.0028	0.00005	0.0028
Ag	d	0.00646	—	d	0.00001	0.00016	0.00001	0.00016
V	d	0.1***	—	t	0.0005	0.11	0.0005	0.11
Zn	d	0.1652	0.1666	d	0.00087	0.045	0.00087	0.045
Notes:		Note: Data is presented as dissolved metals (d) or total metals (t) in mg/L						
		n.d. is non detectable						
		Guidelines were taken from: *Alaska Water Quality Criteria Manual for Toxic And Other Deleterious Organic and Inorganic Substances (DEC, 2008)* ; guidelines for dissolved metals are presented						
		Acute and Chronic guidelines for Freshwater Aquatic Life are presented, unless more stringent guidelines were available; * = drinking water; ** = human health for the consumption of water and aquatic organisms; *** = irrigation water						
		If parameters of interest are not presented, no exceedance was observed						
		For calculation of hardness-dependent guidelines, an assumed hardness of 150 mg/L as CaCO3 was used; pH was assumed to be ≥8						

1.2.3 Explosive Management Source Control Best Management Practices.

This section describes the best management practices, protocols and procedures that will be implemented to ensure the optimal use and minimal loss of explosive products. Strategies that reduce the amount of explosives required to accomplish mining objectives will directly correlate to a reduction in the risk of nitrogen-related impacts to the receiving environment, including water, and the types of management strategies necessary to meet environmental protection goals. All the following factors can play a role in optimal explosive use and minimizing the quantity of nitrogen released to the environment.

Strategies are provided for each of the following as described below:

- **Explosive product selection**
  - Constantine has chosen to use packaged emulsion as the primary blasting agent for the program.
- **Powder factor optimization**
  - With drifting rounds, once the contractor finds a drill/blast pattern that works well in the rock they are drifting in, they will use it routinely. In the interest of drilling efficiency, they will keep the number of holes to a minimum, which means the powder usage will also be efficient.
- **Practices for explosive storage (preventing contact with water/moisture)**
  - Packaged emulsion will be stored in weatherproof magazines separate from blasting caps to prevent contact with water and for safety. The magazines will be provided by the explosives vendor, thus the magazine size is not currently known. After the development contract has been awarded, the contractor will inform Constantine of the number of magazines and the magazine storage capacity. At that time safety berms will be designed to comply with Bureau of Alcohol, Tobacco, and Firearms (BATF) regulations and to provide avalanche protection.
- **Practices to prevent water contacting explosive in blast holes (i.e., blast hole liners, bench dewatering)**
  - Grades in the underground ramp access at the Palmer Project vary from +2.5% to +12%. Ground water and drill water will drain away from the face, thus there will be no ponding at the face. Holes will be blown clean of debris and water before loading.
- **Drill pattern optimization**
  - Drill pattern density and drillhole depth will be optimized to attain the desired break using the minimum amount of explosive.
- **Explosive loading**

    - The blasts at Palmer will be small (5m x 5m x ~3m), so the explosives loading process will be fast. Excess explosives brought to the face, but not used, will be returned to the magazines.
- **Spill response/reporting**
    - This would apply to bulk loaded explosives, which will not be used at Palmer. Any sticks of emulsion that are dropped will be picked up and used or returned to storage.
- **Incident management/investigation**
    - Incidents will be investigated by the Contractor (who will hold the BATF license) and Constantine. Reports will be made to the proper authorities (BATF and/or MSHA).
- **Training and inspection**
    - Only trained personnel will be allowed to handle, load, and detonate explosives. All shipments of explosives will be inspected and inventoried upon arrival.
- **Dealing with misfires**
    - After blasting and after mucking, the face will be inspected for misfires. Misfires will be detonated by inserting a new cap and firing after the face has been safely cleared of personnel.
- **Handling and disposal waste explosive products**
    - Defective or excess explosive products will be returned to the vendor.

1.3 ADAPTIVE STRATEGIES

There is typically a degree of uncertainty, or a lack of precision, in the prediction of seepage rates of groundwater into any underground excavation, including the exploration ramp system proposed by Constantine.

To address this uncertainty Constantine has thoroughly considered a range of options for managing water, including options for managing the unlikelihood of very high unanticipated seepage volumes. Constantine anticipates a base flow of 360 gpm but has incorporated flows as high as 700 gpm (very unlikely). The LAD system is designed to treat and discharge 700 gpm continuously and although this is unlikely to occur Constantine added and additional 200 gpm, for a total of 900 gpm into the design of the LAD.

In addition to this conservative design criteria Constantine also has a number of adaptive management options it can incorporate to manage seepage rates underground as discussed below.

Constantine will use an adaptive management strategy for managing seepage inflows.

Constantine may implement one or more of the following adaptive strategies in response to conditions underground.

- Discharge seepage water through the LAD diffuser.
- Redirect water in excess of the water treatment capacity directly to one of the settling ponds for treatment prior to conveying it to the LAD diffuser.
- The water treatment facility is capable of treating flows up to 900 gpm (base case expected to be 360 gpm).
- Drill probe holes in front of the advancing ramp to identify fracture zones, perform hydrogeology testing, and define seepage rates in advance of intersecting them with the ramp.
- Suspend ramp development in response to any evidence of exceptional seepage inflows detected by probe-drilling.
- Use pressure grouting techniques to create a grout curtain around the ramp to minimize the seepage inflows prior to intersecting them with the ramp.
- Plug, cement or install valves in all underground exploration drill holes to reduce seepage water inflows.
- Install pressure transducers in underground artesian drillholes or perform other hydrogeologic tests underground to contribute to the understanding and characterization of the groundwater in the area.
- Discharge flows that exceed the capacity of the water treatment plant can be directed to one of the settling ponds for treatment and/or temporary storage.

1.4 Water Consumption

Water will be used for excavating the development ramp and for underground exploratory core drilling. This water will consist of seepage water sourced from one of the underground sumps or from one or more artesian underground drill holes. Constantine will apply for authorization for all consumptive water use under a Temporary Water Use Authorization (TWUA) from ADNR. Constantine will also apply for a TWUA to convey the seepage water to the diffuser. In addition, the water treatment plant will consume small quantities of water in gland seals and similar. There are currently no current plans to use any site water for domestic uses.

1.5 REFERENCES

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