Contents

1. PURPOSE

This document addresses the requirements of the Northern Star (Pogo) LLC Pogo Mine Waste Management Permit 2018DB0001, the solid waste regulations 18 AAC 60.800 – 860, the Alaska Pollutant Discharge Elimination System (APDES) permit (AK-0054334-1) and addresses the requirements of the Potable Water System Operation Approval for PWSID: 372643 (Pogo Lower Camp) and PWSID 372685 (Pogo Permanent Camp) as well as the State of Alaska Drinking Water Regulations, 18 ACC 80.

2. SCOPE

The Pogo Mine Monitoring Plan includes the following components:

- Visual monitoring plan, including the Drystack Tailings Facility (DSTF)
- Fluid management plan including the Recycle Tailings Pond (RTP);
- Geochemical monitoring plan;
- Surface water monitoring plan;
- Groundwater monitoring plan;
- Effluent monitoring plan;
- Drinking water monitoring plan;
- Appendix A: Pogo Facilities Map and Monitoring Locations;
- Appendix B: Invasive Weed Control;
- Appendix C: Baseline Data Summary for Groundwater Monitoring Locations

The geotechnical monitoring plan for the drystack tailings facility is described in the Pogo Mine Drystack Tailings Facility Construction and Maintenance Plan, which is attached to Pogo's Plan of Operations as Appendix F.

3. DEFINITIONS AND ACRONYMS

Acronym	Definition
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish & Game
ADNR	Alaska Department of Natural Resources
APDES	Alaska Pollutant Discharge Elimination System
ARD	Acid Rock Drainage
BMP	Best Management Practices
CIP	Carbon-in-Pulp
DMR	Discharge Monitoring Report
DSTF	Drystack Tailing Facility
EDMS	Environmental Data Management System
GWUDISW	Ground Water Under the Influence of Surface Water
MDMR	Multi Sector General Permit Discharge Monitoring Report
MSGP	Multi Sector General Permit (Stormwater)
MWTP	Mine Water Treatment Plant
ORTW	Off-River Treatment Work
PWSID	Public Water System Identification
PWTP	Potable Water Treatment Plant

QAPP	Quality Assurance Project Plan
RTP	Recycle Tailing Pond
SWP	Safe Work Procedure
SWPPP	Stormwater Pollution Prevention Plan
TWUP	Temporary Water Use Permit
USGS	United States Geological Survey
WAD	Weak Acid Dissociable
WET	Whole Effluent Toxicity
XRF	X-Ray Fluorescence Spectrometer

4. PERMIT MANAGEMENT

Implementation of the Waste Management Permit falls under the Environmental Department Manager who has direct reporting responsibilities to the Pogo General Manager.

Permit compliance and sampling and reporting activities are tracked by the Environmental Manager. All monitoring and inspection data are managed using the Environmental Data Management System (EDMS) or the online INX data management software.

5. VISUAL MONITORING PLAN

The visual monitoring program includes daily, weekly and annual inspections of the project facilities comprising the waste management system. These facilities are described in the Plan of Operations and shown schematically in plan view on Pogo Facilities Map and Monitoring Locations (Appendix A). Copies of the RTP Dam & Drystack Weekly Inspection Form are shown in the RTP O&M Manual (Refer to PGO-ENV-008-MAN).

5.1 Drystack Tailings Facility (DSTF)

The physical characteristics of the drystack are visually inspected by equipment operators on days when tailings are being placed. As part of their regular daily inspections, operations personnel look for unusual cracks, bulging, and signs of settlement, seepage and erosion on the drystack.

5.2 Incindental, Non-hazardous Waste Disposal within the DSTF

Incidental, non-hazardous, waste is placed within the mineralized rock layer in accordance to Waste Management Permit 2018DB0001. Incidental waste is encapsulated with drystack tailings in the same manner as mineralized. It is placed at least 50 feet from the drystack margins and contained in six-foot-thick lift of compacted mineralized rock, then covered with at least a two-foot-thick lift of compacted tailings. Filter cake from the Mine Water Treatment Plant, is placed on compacted tailings and covered with more compacted tailings. Operations personnel are trained to place and cover inert, incidental waste so as to prevent blowing debris. Records are kept of the volume and description of the incidental non-hazardous waste placed in the DSTF and are reported in the Pogo Mine Annual Monitoring Report.

5.3 Monitoring Wells

An environmental department individual observes the monitoring wells at least once per quarter for physical damage and maintains a record of observations in the online INX data management software.

5.4 Wildlife

Operations personnel monitor wildlife interactions with the surface waste disposal facilities in order to evaluate impacts that operations may have on wildlife. Documentation of wildlife interactions observed during the visual site inspections are recorded in the Surface Operations Dry Stack Log. The drystack operating personnel are trained to record observations of wildlife interaction at the DSTF and the RTP reservoir. Any wildlife mortalities that are observed are recorded in a log maintained at the project site and the Environmental Manager or designate will contact the Alaska Department of Fish & Game (ADF&G) to report wildlife mortalities.

5.5 Invasive Weed Control

Environmental personnel monitor revegetated sites and growth media stockpiles for the presence of invasive weeds. Areas monitored include:

- reclaimed exploration drill sites accessible along roadways,
- reclaimed exploration roads,
- growth media stockpiles; and
- any concurrent reclamation on Pogo mine site.

Exploration drill sites and reclaimed exploration roads that require helicopter access are at lower risk for invasive weeds and are therefore excluded from this monitoring program. Growth media stockpiles are included to reduce the buildup of the invasive weed seed-bank that may impact future reclamation.

An initial invasive weed inventory was performed in 2018. Following this, inspections will be performed periodically. When invasive weeds are identified, timely removal is initiated. Generally, invasive weeds are removed by hand (preferably before seeds are disseminated), contained in plastic bags to prevent the spread of seed, or other propagules, and disposed of offsite. Large infestations may require chemical management and will be planned in conjunction with the ADNR Invasive Weeds and Agricultural Pest Coordinator.

Invasive weed inventories, inspections, and eradication efforts are reported externally (e.g. state agencies) in the *Pogo Mine Annual Activity and Monitoring Report* and submitted annually to:

Invasive Weeds and Agricultural Pest Coordinator
Dan Coleman
daniel.coleman@alaska.gov
1-907-745-8721

Invasive weed discoveries that require external reporting are listed in the Alaska Administrative Code 11AAC 34.020 Prohibited and Restricted Noxious Weeds:

- Bindweed, field (Convolvulus arvensis)
- Fieldcress, Austrian (Rorippa austriaca)
- Galensoga (Galensoga parviflora)
- Hempnettle (Galopsis tetrahit)
- Knapweed, Russian (Centaurea repens)
- Lettuce, blue–flowering (Lactuca puichella)
- Quackgrass (Agropyron repens)
- Sowthistle, pereninial (Sonchus arvensis)
- Spurge, leafy (Euphorbia esula)
- Thistle, Canada (Cirsium arvense)
- Whitetops and its varieties (Cardaria drabe, C. pubescens, Lepidium latifolium)

Appendix B includes:

1. Site maps of all revegetated areas and growth media stockpiles that are part of the monitoring program.
2. Prohibited & Restricted Noxious Weeds, ADNR Department of Agriculture, used for identification.

6. FLUID MANAGEMENT PLAN

6.1 Recycle Tailings Pond (RTP) Dam

The Environmental Department conducts an inspection of the RTP dam weekly. Inspections are recorded in INX and the department maintains a record of their observations. The visual observations include looking for unusual cracks, bulging, settling, seepage and erosion on the RTP dam. A complete checklist was developed as part of the "RTP Dam Operation and Maintenance Manual".

Once every three years, as required by permit, a formal Periodic Safety Inspection (PSI) is completed by a professional engineer and the results shared with the State Dam Safety official.

6.2 Water Balance Management

Process water is managed by the mill for water discharged into and withdrawn from the RTP, as well as RTP water recycled to the mill and water treated and discharged to the Off-River Treatment Works (ORTW). A site-wide water balance is completed by the Mill monthly.

In periods where precipitation inflows are inadequate, makeup fresh water may be taken from the gravel ponds and pumped into MWTP#3 and the RTP.

In the case of an emergency underground (e.g. potential flooding situations), treated water may be pumped to the RTP for storage.

Water flowrate and quantity are measured using the following:

- Flow meters for pumped water
- Meteorological station for precipitation, monitored daily during summer months
- Annual snow survey in the first quarter for the drystack and RTP watersheds
- Flumes for water flow in Liese Creek, monitored bi-monthly through visual observation and a datalogger when water is flowing and after large rain events (>0.5 in)

A monthly water balance is determined from data provided by the monitoring schedule presented in Table 6.1.

Table 6-1: Fluid Management Monitoring Schedule

Fluid Stream	Measurement Type	Units	Frequency
Recycle Tailing Pond	Water Level	Gallons	Continuous
Precipitation	Met Stations / Rain Gauge	Inches	Recording / Daily Reading
Snow Survey	Depth and Density	Inches	Annual
Seepage Collection Wells	Flow Meter	Gallons	Continuous
Gravel Pond Water to MWTP	Flow Meter	Gallons	Continuous
Flume #1	Flow	Gallons	Bi-Monthly
RTP Water to Mill, Mine or MWTP	Flow Meter	Gallons	Continuous
Mine Water to Mill or MWTP	Flow Meter	Gallons	Continuous
Outfall 011 Discharge to ORTW	Flow Meter	Gallons	Continuous

6.3 Hydrology Characterization

Flumes and piezometers were installed along Liese Creek as part of ongoing hydrology data collection. Four flumes were installed to help determine surface flows. Flumes are visually inspected bi-monthly during the summer months and during heavy rainfall events. Flume inspections are completed during routine SWPPP, heavy rainfall events and routine sampling. Data is downloaded at least monthly when water is flowing. Flume #1 is located below the toe of the DSTF, collects water from the DSTF under drain, potential seepage from within the Drystack and any potential rainwater that has migrated through the Diversion Ditch. Flume #2 is located at the toe of the RTP Dam. It measures rainwater from the South Diversion Ditch, surface flow form Liese Creek, and potential seepage from the RTP. Flume #3 is located between Flume #2 and the 1875 Portal and receives flow from Flume #2 and from the North Diversion Ditch. Flume #4 is located near the Liese Creek Bridge.

Nests of piezometers are installed in three locations within the DSTF to monitor water pressure, hydraulic head and temperature. They are inspected and data downloaded quarterly. Piezometer RR-1 is located at the upper end of the DSTF where the red rock is being placed. It has three piezometers set as follows: RR-1-P3-S (shallow), RR-1-P4-M (mid-depth) and RR-1-P4-D (deep). GP-1 is located in the general placement area of the DSTF in front of the starter dam. It has two piezometers set as follows: GP1-P1-S (shallow) and GP-1-P2-D (deep). SB-1 is located within DSTF Shell 1. It has two piezometers set as follows: SB-1-P1-S (shallow) and SB-1-P2-D (deep).

Table 6-2: Hydrology Characterization Monitoring Schedule

Equipment Type	Measurement Type	Units	Frequency
Flume #2	Flow	gallons	Bi-Monthly
Flume #3	Flow	gallons	Bi-Monthly
Flume #4	Flow	gallons	Bi-Monthly
GP1-P1-Shallow	Piezometer	PSI & temperature (^{0}F)	Quarterly
GP1-P2-Deep	Piezometer	PSI & temperature (^{0}F)	Quarterly
RR-1-P3-Shallow	Piezometer	PSI & temperature (^{0}F)	Quarterly
RR-1-P4-Deep	Piezometer	PSI & temperature (^{0}F)	Quarterly
RR-1-P5-Mid	Piezometer	PSI & temperature (^{0}F)	Quarterly
SB1-P1-Shallow	Piezometer	PSI & temperature (^{0}F)	Quarterly
SB1-P2-Deep	Piezometer	PSI & temperature (^{0}F)	Quarterly

6.4 Water Rights and Temporary Water Use Authorizations

Pogo has a number of Permits to Appropriate Water (LAS designations) and Temporary Water Use Permits (TWUP designations), granted by ADNR. Table 6.3 lists permits and associated water sources and water quantity limits. These water sources are monitored, and gallons pumped are reported annually to ADNR. Table 6.4 lists Temporary Water Use Permits, associated water sources, and water quantity limits.

Table 6.3: Permits to Appropriate Water & Water Quantity Limits

Permit	Location	Measurement Type	Water Quantity Limits		
			Acre-feet per Year	Gallons per Year	Gallons Per Minute
LAS 24611	Drinking Water Wells DW02 & DW03	Flow Meter	81.77	26.6 Million	NA
LAS 24612	Gravel Pit Pond	Flow Meter	241.95	78.8 Million	NA
LAS 24613	Goodpaster River ORTW Influent	Flow Meter	24195.11	7,879 Million	15,000
LAS 24614	2 wells proposed upstream of ORTW	NA	3226.01	1,051 Million	NA
LAS 24615	4 wells proposed at headwaters of Liese Creek	NA	322.6	105.0 Million	NA
LAS 24616/ LAS 32225	Surface Water collected in RTP	Flow Meter	580.68	189.2 Million	NA
LAS 24617/ LAS 32229	Underground Mine Dewatering	Flow Meter	1,604.81	522.9 Million	NA
LAS 32228	RTP Seepage Collection System	Flow Meters	600	195.4 Million	NA
LAS 32032	Caribou Creek – Dust Control	NA	32.7	10.7 Million	200
LAS 32033	Shaw Creek – Dust Control	NA	32.7	10.7 Million	200
LAS 34034	Gilles Creek – Dust Control	NA	32.7	10.7 Million	200

Table 6.4: Temporary Water Use Permits & Water Quantity Limits

Permit	Location	Measurement Type	Water Quantity Limits
TWUP F2016-109	Drystack Tailings Facility Diversion Ditches	Calculated	163 cubic feet a second in South Ditch 41 cubic feet a second in North Ditch Combine 1,460.0 acre-feet per year

7. GEOCHEMISTRY

7.1 Drystack

The purpose of the geochemical monitoring program is to track trends in the tailings geochemistry and to compare the geochemical nature of the tailings material to the test work and assumptions used for the drystack design. It is applied to the materials placed on the general placement area.

A sampling schedule for Flotation Tailings, Flotation Interstitial Water and Mineralized Development Rock is shown in Table 7.1. Quarterly composites of monthly tailings samples collected from the process plant are submitted for geochemical analysis. Monthly Mineralized Development Rock samples are composited into a quarterly sample for analysis. The solid samples are analyzed for acid-base accounting using procedures generally recommended (Sobek et al, (1978)[1]) - see Table 11.1.3 in the Quality Assurance Project Plan (QAPP) (Document Control #PGO-ENV-039-PLA) – and reported in the quarterly monitoring reports. The Target Range of greater than 1.4 for the Neutralization Potential/Acid Potential ratio was developed from average flotation tailings test material characteristics shown in Table 8 of the SRK 3 Kinetic Report. The solid samples are also analyzed for 48 element-ICP metals (plus mercury) monitoring parameters for flotation tailings and mineralized development rock placed in the Drystack - see Table 7.2. Interstitial process water is extracted from the tailings and analyzed for the parameters indicated in Table 7.3. A target range was established using actual operating data taking the mean plus or minus two standard deviations to cover the range of measured data. In many cases, the standard deviation is greater than the mean, making the lower range zero.

[1] The Sobek method is the most commonly used Acid Base Accounting method – Sobek A.A., W.A. Schuller, J.R. Freeman and R.M. Smith, 1978, "Field and Laboratory Methods Applicable to Overburdens and Minesoils", prepared for U.S. Environmental Protection Agency, EPA-600/2-78-054, Cincinnati, Ohio.

Table 7-1: Drystack Sampling Schedule

Sample ID	Sample	Location	Frequency	Sample Type
PC003-solids	Flotation Tailing Solids	Mill Filter Building	Quarterly composite of Monthly samples	Grab
PC003	Flotation Tailing Interstitial Water	Mill Filter Building	Quarterly	Grab
PC002	Development Rock	Drystack, Active Area Mineralized Rock	Quarterly composite of Monthly samples	Grab

Table 7-2: Flotation Tailing and Mineralized Development Whole Rock Chemistry

Parameters[1]		
Aluminum	Indium	Strontium
Antimony	Lanthanum	Silver
Arsenic	Lead	Sulfur
Barium	Lithium	Tantalum
Beryllium	Magnesium	Tellurium
Bismuth	Manganese	Thallium
Calcium	Mercury	Thorium

Parameters[1]		
Cadmium	Molybdenum	Titanium
Cerium	Niobium	Tin
Cobalt	Nickel	Tungsten
Chromium	Phosphorus	Uranium
Cesium	Potassium	Vanadium
Copper	Rubidium	Yttrium
Iron	Rhenium	Zinc
Gallium	Scandium	Zirconium
Germanium	Selenium	------
Hafnium	Sodium	-------

[1]Arsenic and sulfur are the only metals required by permit to be monitored, the other metals are for informational purposes.

Table 7-3: Flotation Tailing Interstitial Water Chemistry and Operating Target Ranges

Parameter	Units	Original Target[1]	Operating Target Range[2]	Average[2]	Standard Deviation[2]
Total Dissolved Solids	mg/L	3,000	1094 to 5040	3588	726
Chloride, total	mg/L	34	26 to 230	128	51
Sulfate, total	mg/L	2,000	528 to 2740	1634	553
Ammonia as TKN	mg/L	17.8	0 to 70.1	33.3	18.4
Nitrate	mg/L	4	8 to 236	122	57
Cyanide, WAD	µg/L	Not Calculated	0 to 29.1	12.3	8.4
Arsenic	µg/L	5,100	0 to 2335	569	883
Cadmium	µg/L	5	0 to 1.13	0.374	0.378
Chromium	µg/L	14	0 to 4.145	0.681	1.732
Copper	µg/L	34	0 to 20.97	5.29	7.84
Iron	µg/L	29,600	0 to 103.1	35.9	33.6
Lead	µg/L	5	0 to 5.972	0.67	2.651
Mercury	µg/L	2	0.001 to 0.0014	0.001	0.0002
Manganese	µg/L	4,750	0 to 650	226	212
Nickel	µg/L	240	0 to 18.2	7.6	5.3
Selenium	µg/L	130	0 to 190	60	65
Silver	µg/L	2	0 to 0.276	0.08	0.098
Zinc	µg/L	700	0 to 48.4	13	17.7

1Original Target based on the geochemical characterization of tailings produced as a result of pre-mine metallurgical tests.

2Operating Target Range based on mean plus or minus two standard deviations of data from 2006 through June 2010 while operating.

3Analysis method in Table 12.1.2 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

The tailings geochemical results are used to detect trends in tailings composition. Further investigation to determine an appropriate plan of action will be instituted with the appropriate agencies in the event that the interstitial water chemistry exceeds the operating target range for four consecutive quarters.

7.1.1 Development Rock Segregation and Storage

During development and operations, all rock from underground is handled as "mineralized" unless otherwise analyzed and segregated on a round-by-round basis in accordance with the rock segregation procedures identified in the Waste Rock Characterization Safe Work Procedure (SWP). This document is located on SharePoint and can be found using the SharePoint ID# PGO-ENV-042-SWP - Waste Rock Characterization.

Table 7.4 presents development rock segregation parameters for non-mineralized and mineralized development rock.

Table 7-4: Development Rock Segregation Parameters

Parameter	Units	Method	Non-mineralized Action Limit	Mineralized Rock Action Limit
Sulfur	%	XRF Spectrometer	Less than 0.5	Greater than 0.5
Arsenic	mg/kg	XRF Spectrometer	Less than 600	Greater than 600

7.2 Cyanide Detox of Carbon-In-Pulp (CIP) Tailings Prior to Paste Backfill

Prior to disposal as part of the paste backfill tailings, the CIP tailings are subjected to cyanide detoxification using the SO2/air process or other suitable cyanide detoxification process approved by ADEC. Samples of the CIP tailings interstitial water are taken by mill operators before each paste pour (see Table 7.5). At least 90% of the samples shall contain less than ten ppm WAD cyanide and 100% of the samples shall contain less than 20 ppm WAD cyanide, based on analysis by Picric Acid Method of the interstitial water entrained in the CIP tailings prior to placement in the paste backfill (see Table 7.6). All CIP tailings are disposed in the underground mine workings.

Table 7-5: CIP Tailing Sampling Schedule

Sample ID	Sample	Location	Frequency	Sample Type
PC001	CIP Stock Tank	Mill Complex	Before Every Paste Pour	Grab

The CIP tailing sample is collected from the CIP Stock Tank and analyzed by the Pogo on-site Assay Lab.

Table 7-6: CIP Tailing Analysis Profile

Parameter	Units	Method	Permit Limit	
			90% of samples	100% of samples
Cyanide-WAD	ppm	Picric Acid Method	10	20

Samples are collected by Mill Operators.

8. SURFACE WATER MONITORING PLAN

The surface water quality monitoring program is designed to detect potential impacts to the surface water quality in the Goodpaster River. Six stations are used to monitor surface water quality (refer Figure 1 in Appendix A for location map).

Surface water monitoring is undertaken to fulfill the requirements of the Alaska APDES permit (AK-005334-1) and the ADEC Waste Management Permit (2018DB0012).

The APDES permit requires receiving water monitoring:

- To monitor any biological impacts to the Goodpaster River;
- To monitor changes that may occur as a result of activities associated with the discharges from the facility;
- To compare upstream and downstream monitoring results (to show any differences) and to compare monitoring results for each station over time, to show any trends; and
- To assure that state water quality standards are met and to provide information for future permitting actions.

The ADEC Waste Management Permit requires surface water monitoring:

- For parameters at frequencies and locations, which will ensure that sample results are representative and statistically valid; and
- To detect a violation of a water quality standard.

The objective of the surface water monitoring program is to detect any adverse biological impacts and any exceedance of a water quality standard.

The surface water sampling schedule during active mining operations, Phase II, is shown in Table 8.1 and in Table 15.1.2 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA). Surface water parameters collected are shown in Table 8.2.

Whole fish samples of juvenile Chinook salmon are collected annually from the Goodpaster River just before freeze up. A minimum of ten fish are collected upstream from Pogo Mine at site SW01 and ten fish downstream of Pogo Mine at site SW12. Samples are collected to show comparisons in metals accumulation in fish tissue between the upstream and downstream locations. The sampling schedule for fish tissue during active mining operations, Phase II, are shown in Table 8.1 and fish tissue sampling parameters are located in Table 8.3.

Table 8-1: CIP Phase II Active Mining Operations Surface Water Sampling Schedule

Station ID	Sample Location	GPS Coordinates	Sample Frequency	Sample Type
SW01	Above the project site, between Stingray and Otter Creeks	N 64.47991, W 144.83316	6/year- Late February to mid-March, mid-May, mid-June, early August, late September (including fish tissue samples), December	Grab
SW41	Below the ridge line that divides Liese Creek and Pogo Creek	N 64.45775, W 144.94559	6/year- Late February to mid-March, mid-May, mid-June, early August, late September, December	Grab
SW42	Near Outfall 002 (Sewage Treatment Plant Discharge)	N 64.44325, W 144.9425	6/year- Late February to mid-March, mid-May, mid-June, early August, late September, December	Grab
SW15	Below the project site	N 64.43730, W 144.93835	6/year- Late February to mid-March, mid-May, mid-June, early August, late September, December	Grab
SW12	Furthest downstream sampling point	N 64.36833, W 144.96143	Annually Late September (including fish tissue samples)	Grab
SW49	Above (upstream) all project facilities. Closer to mine site than SW01. More easily accessible if higher sampling frequency is deemed useful for internal monitoring.	N 64.47693, W 144.91136	6/year- Late February to mid-March, mid-May, mid-June, early August, late September, December, and as required for internal monitoring.	Grab
DRYTOE	Dry Stack Toe	N 64.44788, W 144.88642	12/year – Monthly when water is present	Grab

Table 8-2: Surface Water Analytical Parameters Profile 13s and Water Quality Standards

Surface Water Parameters	Units	Water Quality Standards
Alkalinity, as CaCO3	mg/L	NA
Antimony, Total	µg/L	6[1]
Arsenic, Total	µg/L	10[1]

Surface Water Parameters	Units	Water Quality Standards
Cadmium, Total	µg/L	0.094 to 0.64[2]
Conductivity, Field	µS/cm	NA
Copper, Total	µg/L	2.7 to 29[2]
Cyanide, WAD	µg/L	5.2[4]
Dissolved Oxygen, Field	mg/L	NA
Hardness, as CaCO3	mg/L	NA
Iron, Total	µg/L	1000[3]
Lead, Total	µg/L	0.54 to 11[2]
Manganese, Total	µg/L	50[5]
Mercury, Total	µg/L	0.05[5]
Nickel, Total	µg/L	16 to 168[2]
Nitrate-Nitrite as Nitrogen	mg/L	10[1]
pH, Field	s.u.	6.5 to 8.5[6]
Selenium, Total	µg/L	4.6[3]
Silver, Total	µg/L	0.30 to 379.30[7]
Sulfate	mg/L	250[6]
Temperature, Field	C	NA
Total Dissolved Solids	mg/L	500[6]
Turbidity, Field	NTU	NA
Zinc, Total	µg/L	36 to 379[7]

[1] Drinking water primary maximum contaminant levels.
[2] Chronic aquatic life fresh water. These criteria are hardness dependent. The range is shown for hardness of 25 to 400 mg/l CaCO3.
[3] Chronic aquatic life fresh water.
[4] APDES Permit # AK0053341 specifies a site-specific ML of 20 µg/L for WAD Cyanide.
[5] Human Health criteria for non-carcinogens.
[6] WQS for fresh water uses.
[7] Acute aquatic life fresh water.
[8]Analysis method in Table 15.2.2 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 8-3: Fish Tissue Analytical Methods and Action Limits (Fish Tissue Matrix)

Fish Tissue Parameters	Units	Action Limits
Length	mm	NA
Weight	grams	NA
Antimony	mg/kg	NA
Arsenic (inorganic)	mg/kg	NA
Cadmium	mg/kg	NA
Copper	mg/kg	NA
Lead	mg/kg	NA
Mercury, Total	mg/kg	NA
Nickel	mg/kg	NA

Fish Tissue Parameters	Units	Action Limits
Selenium	mg/kg	NA
Silver	mg/kg	NA

[1]Analysis method in Table 16.1.1.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 8.4 and Table 8.5 represent the sampling schedule for Phase III and Phase IV Closure Operations and Phase V Post Closure. Refer to Pogo's Reclamation and Closure Plan for more details about the phases of closure.

Table 8-4: Phase III and IV Closure Operations Surface Water Sampling Schedule

Station ID	Sample Location	Sample Frequency	Sample Type
SW01	Above the project site, between Stingray and Otter Creeks	Monthly for 10 years during closure operations	Grab
SW15	Below the project site	Monthly for 10 years during closure operations	Grab
DRYTOE	Dry Stack Toe	Monthly for 10 years during closure operations	Grab

Table 8-5: Phase V Post Closure Surface Water Sampling Schedule

Station ID	Sample Location	Sample Frequency	Sample Type
SW01	Above the project site, between Stingray and Otter Creeks	Annual sampling on years 1, 2,5,10, 15, 20, and 30	Grab
SW15	Below the project site	Annual sampling on years 1, 2,5,10, 15, 20, and 30.	Grab
DRYTOE	Dry Stack Toe	Annual sampling on years 1, 2,5,10, 15, 20, and 30	Grab

8.1 Storm Water Pollution Prevetion Plan and Best Management Practices Plan

The Pogo Mine Storm Water Pollution Prevention Plan and the Best Management Practices Plan (SWPPP & BMP) sets forth monitoring and inspection guidelines to prevent storm water pollution. It addresses the requirements of the APDES Multi-sector General Permits for Storm Water Permit AKR060000 (Pogo Permit Tracking Number AKR06AC58). The SWPPP & BMP can be found on SharePoint using the SharePoint ID# PGO-ENV-020-PLA. A summary of sampling locations and monitoring requirements is below in Table 8.6.

Table 8-6: Storm Water Sampling Locations

Station ID	Sample Location	Sample Frequency	Sample Type
SW21	Sediment pond, downstream of culvert outlet	Periodic	Grab

Periodic visual exams are performed using the Pogo Mine Storm Water Pollution Prevention Plan Monitoring Report form, which can be found in the SWPPP & BMP. A summary of visual quality parameters is below in Table 8.7.

Table 8-7: Storm Water Quarterly Visual Quality Sampling

Visual Quality Parameters	
Color	Odor
Clarity	Floating Solids
Settleable Solids	Suspended Solids

Foam	Oil Sheen
Other Obvious Indicators of Storm Water Pollution	Duration of Storm Event
Estimate of Total Gallons of Discharge	Flow Description

Storm water quality inspections are required at least quarterly or more frequently between spring break up and winter freeze up, as appropriate. Storm water inspections are also required after every 0.5-inch rain event. Any deficiencies must be corrected as soon as possible, but not later than 14 days after the inspection. These inspections are performed using the SWPPP Routine Mine Site Inspection form found in the SWPPP & BMP.

An ADEC Multi-Sector General Permit, MSGP Annual Reporting Form, in conjunction with a comprehensive site inspection, is required and usually takes place in June/July. It includes a review of the SWPPP & BMP, a visual inspection of the site (using the Annual SWPPP Mine Site Inspection form) and any recommended revisions. The results are summarized into an annual report, submitted to the ADEC and filed in the SWPPP & BMP. Corrective action must be made within 14 days, implementation of any SWPPP & BMP changes must occur within 12 weeks of annual inspection. The MSGP Annual Reporting Form is required to be submitted to ADEC by February 15th of the following year (both forms are in Pogo's SWPPP & BMP).

The Pogo Mine Storm Water Pollution Prevention Plan and the Best Management Practices Plan are updated annually or as changes occur. The Best Management Practices Plan (BMP) is reviewed annually by the BMP committee, which also serves as the Storm Water Pollution Prevention Team, and by the Pogo Mine General Manager and the BMP Committee Chairperson. Notice of BMP Certification must be submitted to the Alaska Department of Environmental Conservation as part of the APDES requirements by January 31 of the following year. Table 8.8 shows Storm Water Inspections and Reporting Requirements.

Table 8-8: Storm Water Inspections and Reporting Requirements

Inspection / Reporting	Frequency	Deadline
Storm Water Quality Inspections	Quarterly, and/or whenever a 0.5" rain event occurs	NA
Annual Comprehensive Site Evaluation	Usually occurs in June	June 31
ADEC MSGP Annual Report	Yearly	Due by Feb 15th of the following year
Quarterly Benchmark Sampling	Second and Third Quarters of 2022 and 2023	June 30 and September 30 of 2022 and 2023
ADEC MDMR	Quarterly	Due by the 15th day of the following month after receiving all lab results for that quarter or by the 15th of the month following the end of the quarter.
SWPPP & BMP Review	Updated annually, or as changes occur	NA
BMP Certification	Annually	January 31 of the following year

9. GROUNDWATER MONITORING PLAN

The groundwater monitoring program is designed to detect potential impacts to groundwater around the mine as per Pogo's ADEC Waste Management Permit (2018DB0001). It consists of:

- Monitoring wells MW12-500, MW12-501, MW12-502 (refer to **Table 9.1**),
- Monitoring wells MW18-001, MW18-002, MW18-003A, MW18-003B,
- Monitoring well MW11-216, and
- Monitoring wells MW11-001A and MW11-001B below the toe of the Drystack and above the RTP.

Monitoring wells MW18-001, MW18-002, MW18-003A, and MW18-003B were all constructed in 2018 to monitor water quality in Liese Creek Valley. Monitoring well MW18-001 is located approximately 300 feet downstream of the RTP Dam toe and monitors the shallow alluvial water in this area (Figure 1 Appendix A). Three additional monitoring wells are located approximately 450 feet downstream of the RTP Dam toe. The original wells MW03-500, MW03-501, and MW03-502 (bedrock exploration core holes converted to monitoring wells) were plugged and abandoned and replaced with MW12-500, MW12-501 and MW12-502 in 2012. These wells are sampled and compared with baseline conditions and Permit limits. MW18-003A and MW18-003B were placed as a nested pair downstream of Flume 4. MW18-003B was designed to replace MW04-213 and has a stronger relationship to the groundwater associated with underground workings. MW04-13 was last sampled in the third quarter, 2019, and is no longer sampled. **Table 9.1** represents the sampling schedule for groundwater monitoring during active mining operation phase.

Table 9-1: Phase II Active Operations Groundwater Sampling Schedule

Sample Class	Sample Location	Sample Frequency	Sample Type
Monitoring Wells	MW11-216	Semi-Annually	Grab
	MW12-500	Quarterly	
	MW12-501	Quarterly	
	MW12-502	Quarterly	
	MW11-001A	Quarterly	
	MW11-001B	Quarterly	
	MW18-001	Monthly	
	MW18-002	Quarterly	
	MW18-003A	Quarterly	
	MW18-003B	Quarterly	
Measurement	LT99-009	Quarterly	Static Groundwater Level
	MW99-216	Quarterly	

The objectives of the groundwater monitoring program are (1) to detect an exceedance of a water quality standard; for those parameters that have a natural condition exceeding the water quality standards, detect an increase in concentration above the natural condition; and (2) to detect a statistically significant increase above background in water quality. Groundwater background water quality summaries are shown in Appendix C.

A list of groundwater parameters sampled is located in Table 9.2.

Table 9-2: Groundwater Analytical Parameters Profile 13g and Water Quality Standards

Groundwater Parameters	Units	Water Quality Standards
Alkalinity, as CaCO3	mg/L	NA
Alkalinity, Total	mg/L	NA
Ammonia, as TKN	mg/L	pH and temperature dependent
Antimony, Dissolved	µg/L	6[1]
Arsenic, Dissolved	µg/L	10[1]
Cadmium, Dissolved	µg/L	0.094 to 0.64[2]
Calcium, Dissolved	mg/L	NA
Chloride	mg/L	230[3]
Chromium, Dissolved	µg/L	100

Groundwater Parameters	Units	Water Quality Standards
Conductivity, Field	µS/cm	NA
Copper, Dissolved	µg/L	2.7 to 29[2]
Cyanide, WAD	µg/L	5.2
Dissolved Oxygen, Field	mg/L	NA
Fluoride	mg/L	NA
Hardness, as CaCO3	mg/L	NA
Iron, Dissolved	µg/L	1000[3]
Lead, Dissolved	µg/L	0.54 to 11[2]
Magnesium, Dissolved	mg/L	NA
Manganese, Dissolved	µg/L	50[4]
Mercury, Dissolved	µg/L	0.05[3]
Nickel, Dissolved	µg/L	16 to 168[2]
Nitrate-Nitrite as Nitrogen	mg/L	10[1]
pH, Field	s.u.	6.5-8.5[5]
Potassium, Dissolved	mg/L	NA
Selenium, Dissolved	µg/L	4.6[3]
Silver, Dissolved	µg/L	0.30 to 379.30[6]
Sodium, Dissolved	mg/L	NA
Sulfate	mg/L	250[6]
Temperature, Field	C	NA
Total Dissolved Solids	mg/L	500[6]
Zinc, Dissolved	µg/L	36 to 379[6]

[1] Drinking water primary maximum contaminant levels.
[2] Chronic aquatic life fresh water. These criteria are hardness dependent. The range is shown for hardness of 25 to 400 mg/l CaCO3.
[3] Chronic aquatic life fresh water.
[4] Human Health criteria for non-carcinogens.
[5] WQS for fresh water uses.
[6] Acute aquatic life fresh water.
[7]Analysis method in Table 17.1.5 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Groundwater monitoring wells MW18-001, MW18-002, MW12-500 and MW12-501 and MW12-502 monitor potential seepage from the RTP, which is a zero-discharge facility. Exceedance of any value in Table 9.3 triggers corrective action.

Table 9-3: Upper Tolerance Limit Triggering Corrective Actions

Parameter	Units	Location		
		MW12-500 (MW03-500)	MW12-501 (MW03-501)	MW12-502 (MW03-502)
Antimony, Dissolved	µg/L	0.36	0.35	0.35
Arsenic, Dissolved	µg/L	47.8	47.6	45.0
Chloride	mg/L	0.79	1.23	1.06

Cyanide, WAD	µg/L	5.2	5.2	5.2
Nitrate as Nitrogen	mg/L	1.28	2.66	2.39
Potassium, Dissolved	mg/L	3.18	3.69	3.27
Selenium, Dissolved	µg/L	1.35	0.99	0.64
Sodium, Dissolved	mg/L	5.41	5.27	3.90

Tables 9.4 and 9.5 present the sampling schedule for groundwater monitoring during Phase III and IV Closure Operations and Phase V Post Closure. Refer to Pogo's Reclamation and Closure Plan for more details about phases of closure.

Table 9-4: Phase III & IV Closure Groundwater Sampling Schedule

Sample Class	Sample Location	Sample Frequency	Sample Type
Monitoring Wells	MW11-216	Semi-annually for 10 years during closure operations.	Grab
	MW12-500	Quarterly for 10 years during closure operations	
	MW12-501		
	MW12-502		
	MW11-001A		
	MW11-001B		
	MW18-001	Not specified in closure documents.	
	MW18-002		
	MW18-003A		
	MW18-003B		

Table 9-5: Phase V Post Closure Groundwater Sampling Schedule

Sample Class	Sample Location	Sample Frequency	Sample Type
Monitoring Wells	MW11-216	Sample Year 1, 2, 5, 10, 15, 20, and 30 at post-closure years during care and maintenance.	Grab
	MW12-500		
	MW12-501		
	MW12-502		
	MW11-001A		
	MW11-001B		
	MW18-001		
	MW18-002		
	MW18-003A		
	MW18-003B		

9.1 Hydrology Characterization Test Wells

Two test wells, MW12-001A (alluvial) and MW12-001B (bedrock) were installed near Pogo's Airstrip in order to conduct a pump test for the East Deep Hydrology Study in 2012. Both wells are sampled quarterly. Table 9.6 shows the Hydrology Characterization Sampling Schedule.

Table 9-6: Hydrology Characterization Sampling Schedule

Sample Class	Sample Location	Sample Frequency	Sample Type
Monitoring Wells	MW12-001A	Quarterly	Grab
	MW12-001B		

10. EFFLUENT MONITORING PLAN

Effluent monitoring is required by the APDES permit (AK-0053341).

The APDES permit requires effluent monitoring:

- To monitor the limits placed on the types and amounts of pollutants that are discharged to ensure protection of water quality and human health.

The objective of the effluent monitoring program is to detect an exceedance of an effluent limitation or an adverse biological impact.

The facility discharges to the Goodpaster River through two outfalls. Outfall 001 is the discharge point for treated mine drainage and excess precipitation. Outfall 002 is the discharge point for treated domestic wastewater. The outfalls and additional monitoring stations are shown on Figure 1 in Appendix A and described below in Table 10.1.

Table 10-1: Effluent Monitoring Outfall Locations

Station ID	Location	Purpose
Outfall 001	Mine water effluent stream after the last treatment unit prior to discharge into the receiving waters.	To monitor the effluent quality before discharge into the receiving waters.
Outfall 011	At the Mine Water Treatment Plant (MWTP) near the 1525 Portal.	To monitor the MWTP performance.
NPDES 001B	Influent pond (Pond 1), upstream inlet of the Goodpaster River prior to any mine influence.	To establish the natural condition concurrent with the discharge.
Outfall 002	Sewage effluent stream after the last treatment unit prior to discharge into the receiving waters.	To monitor the effluent quality before discharge into the receiving waters.
STP 002	Influent to the Sewage Treatment Plant (STP).	To monitor the STP performance.

The effluent monitoring schedules can be found in **Table 10.2**.

Table 10-2: Effluent Monitoring Schedule

Station ID	Frequency	Sample Type
Outfall 001	Weekly, Monthly, and Annual (prior to August 1)	Grab
NPDES 001B	Weekly, Monthly	Grab
Outfall 011	Weekly & Quarterly	Grab
Outfall 002	Monthly & Quarterly	Grab
STP 002	Quarterly	Grab

Stream Gauging is necessary to determine whether there is sufficient water flowing in the Goodpaster River to allow water withdrawal from NPDES001B. If the flow drops below 20 cfs, withdrawal is not allowed. The USGS maintains a stream flow gauge on the Goodpaster River near the Goodpaster Bridge and the data is made available to Pogo. During winter months USGS continues to monitor river flow on site at approximately quarterly intervals, or as needed if river water flow approaches 20cfs. Pogo may also perform stream gauging to determine river flow as needed. Water withdrawal from the Goodpaster River is limited to 15,000 gpm.

A list of weekly, monthly and annual parameters sampled at Outfall 001 is included in Table 10.3, Table 10.4, and Table 10.5.

Table 10-3: Outfall 001 Weekly Analytical Parameters Profile 10a and Effluent Limits

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Copper, Total Recoverable	µg/L	6.4	2.8
Cyanide, WAD	µg/L	8.9[1]	4.0[1]

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Lead, Total Recoverable	µg/L	1.4	0.4
Manganese, Total Recoverable	µg/L	108	49
pH	s.u.	6.5 to 8.5	6.5 to 8.5
Outfall Flow	gpm	16,000	NA
Temperature	°C	NA	NA
Floating Solids	Presence/Absence	Trace Amounts	Trace Amounts
Visible Foam	Presence/Absence	Trace Amounts	Trace Amounts

[1]APDES Permit #AK0053341 specifies a site-specific ML of 20 ug/L for WAD cyanide

[2]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 10-4: Outfall 001 Monthly Analytical Parameters Profile 10b and Effluent Limits

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Cadmium, Total Recoverable	µg/L	0.2	0.1
Mercury, Total	µg/L	0.02	0.01
Zinc, Total Recoverable	µg/L	59	19
Hardness, as CaCO3	mg/L	NA	NA
Turbidity, effluent	NTU	NA	5[1]
Turbidity, natural condition (Station NPDES001B)	NTU	NA	NA

[1]Difference in turbidity between Outfall 001 and NPDES001B cannot be greater than 5 NTU

[2]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 10-5: Outfall 001 Annual Whole Effluent Toxicity (WET) Testing and Target Level

Effluent Parameter	Units	APDES Target Level
Whole Effluent Toxicity, chronic	TU_c	2

[1]Analysis method in Table 19.1.3 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

A list of weekly and quarterly parameters sampled at Outfall 011 is included in Table 10.6 and Table 10.7.

Table 10-6: Outfall 011 Weekly Analytical Parameters Profile 11a and Effluent Limits

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Cyanide, WAD	µg/L	NA	NA
pH	s.u.	6.0 to 9.0	NA

[1]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 10-7: Outfall 011 Quarterly Analytical Parameters Profile 11b and Effluent Limits

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Arsenic, Total Recoverable	µg/L	NA	NA
Cadmium, Total Recoverable	µg/L	100	50
Copper, Total Recoverable	µg/L	300	150

Effluent Parameters	Units	APDES Effluent Limit	
		Daily Maximum	Monthly Average
Iron, Total Recoverable	µg/L	1,639	817
Lead, Total Recoverable	µg/L	600	300
Manganese, Total Recoverable	µg/L	NA	NA
Mercury, Total	µg/L	2	1
Selenium, Total Recoverable	µg/L	NA	NA
Zinc, Total Recoverable	µg/L	1,500	750
Hardness, as $CaCO_3$	mg/L	NA	NA
Outfall Flow	gpm	1,000	NA
Sulfates	mg/L	NA	NA
Total Dissolved Solids	mg/L	NA	NA
Total Suspended Solids	mg/L	30	20

[1]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

A list of monthly and quarterly parameters sampled at Outfall 002 is included in Table 10.8 and Table 10.9.

Table 10-8: Monthly Effluent Sewage Treatment Plant Outfall 002 Analytical Parameters Profile 12a and Effluent Limits

Effluent Parameters	Units	APDES Effluent Limit		
		Daily Maximum	Monthly Average	Weekly Average
Biochemical Oxygen Demand (BOD_5)	mg/L	60	30	45
Temperature	°C	NA	NA	NA
Dissolved Oxygen	mg/L	> 2	NA	NA
Fecal Coliform	#/100 mL	400	200	NA
Floating Solids	Presence/ Absence	Trace Amounts	NA	NA
Foam	Presence/ Absence	Trace	NA	NA
Nitrate-Nitrite as Nitrogen	mg/L	160	80	NA
Oily Wastes (Sheen on Receiving Water Surface)	Presence/ Absence	Absent	NA	NA
Outfall Flow	gpd	72,000	NA	NA
pH	s.u.	6.0 to 9.0	NA	NA
Total Suspended Solids	mg/L	60	30	45
Arsenic, Total Recoverable	µg/L	NA	NA	NA
Cadmium, Total Recoverable	µg/L	NA	NA	NA
Copper, Total Recoverable	µg/L	NA	NA	NA
Lead, Total Recoverable	µg/L	NA	NA	NA
Manganese, Total Recoverable	µg/L	NA	NA	NA
Mercury, Total	µg/L	NA	NA	NA
Zinc, Total Recoverable	µg/L	NA	NA	NA

[1]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Table 10-9: Quarterly Influent Sewage Treatment Plant (STP002) Analytical Parameters Profile 12b and Effluent Limits

Influent Parameters	Units	APDES Effluent Limit (% Removal)
Biochemical Oxygen Demand (BOD_5)	mg/L	85
Total Suspended Solids	mg/L	85

[1]Analysis method in Table 18.1.7.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

11. DRINKING WATER MONITORING PLAN

The Drinking Water Monitoring fulfills the requirements of the Potable Water System Operation Approval for PWSID: 372643 (Pogo Lower Camp) and PWSID 372685 (Pogo Permanent Camp) as well as the State of Alaska Drinking Water Regulations, 18 ACC 80. Both water systems are classified as Type: Non-Transient, Non-Community (Class A) Source: GWUDISW (Ground Water Under the Influence of Surface Water).

The drinking water monitoring program consists of:

- Water quality detection monitoring at entry points Potable Water Treatment 3 (PWT3) Lower Camp and Potable Water Treatment 2 (PWT2) Permanent Camp, and designated locations throughout the distribution system.

Tables 11.1 and 11.2 represent the sampling schedule for drinking water monitoring during active mining operating and Table 11.3 shows the drinking water parameters and ADEC maximum contaminant limits.

Table 11-1: Drinking Water Monitoring Schedule for Pogo Lower Camp PWSID: 372643

Drinking Water Parameter	Sample Location	Frequency	Sample Type
Arsenic	Entry Point of Distribution System Next sampling event between 2029 and 2037	1 sample/ 9 year cycle	Grab
Asbestos	Distribution System, Waiver granted until 2014, no renewal required unless new piping installed.	NA	NA
Bromate	Entry Point of Distribution System	Quarterly	Grab
Chlorine Residual, End Points	Rotating Throughout the Distribution System associated with Total Coliform Bacteria Sampling	Monthly	Grab
Disinfection Residual (Chlorine) at Entry Point	Entry Point of Distribution System	Daily	Grab
Lead and Copper	Designated Sites Throughout Distribution System Next Sampling Event in 2023	5 samples every 3 years	Grab
Inorganics	Entry Point of Distribution System Next sampling event between 2029 and 2037	1 sample/ 9 year cycle	Grab
Nitrate	Entry Point of Distribution System	Annual	Grab
Pesticides & Other Organics SOC/OOC	Waiver, renew by 9/30/23, 9/30/2026, 9/30/2029	Waiver renew every 3 years	NA
Total Coliform Bacteria	Rotating Throughout the Distribution System	Monthly	Grab
TTHM & HAA5	End of Distribution System	Annual	Grab
Sanitary Survey	Entire Potable Water System, next survey due in 2027	Every 5 Years	NA
Turbidity	After Filters	Daily	Grab

Drinking Water Parameter	Sample Location	Frequency	Sample Type
Volatile Organic Compounds	Entry Point of Distribution System	Annual	Grab
Emergency Response Plan/Priority Measures Plan	Plan update due 12/31/2021, 12/31/23, 12/31/2026	Biennial Update	NA

Table 11-2: Drinking Water Monitoring Schedule for Pogo Permanent Camp PWSID: 372685

Drinking Water Parameter	Sample Location	Frequency	Sample Type
Arsenic	Entry Point of Distribution System Next sampling event between 2029 and 2037	1 sample/ 9 year cycle	Grab
Asbestos	Distribution System, Waiver granted until 2014, no renewal required.	NA	NA
Bromate	Entry Point of Distribution System	Quarterly	Grab
Chlorine Residual, End Points	Rotating Throughout the Distribution System associated with Total Coliform Bacteria Sampling	Monthly	Grab
Disinfection Residual (Chlorine) at Entry Point	Entry Point of Distribution System	Daily	Grab
Lead and Copper	Designated Sites Throughout Distribution System Next Sampling Event 2025	5 samples every 3 years,	Grab
Inorganics	Entry Point of Distribution System - Next sampling event between 2029 and 2037	1 sample/ 9 year cycle	Grab
Nitrate	Entry Point of Distribution System	Annual	Grab
Pesticides & Other Organics SOC/OOC	Waiver, renew by 9/30/2023, 9/30/2026, 9/30/2029	Waiver renew every 3 years	NA
Sanitary Survey	Entire Potable Water System, next survey due in 2026	Every 5 Years	NA
Total Coliform Bacteria	Rotating Throughout the Distribution System	Monthly	Grab
TTHM & HAA5	End of Distribution System	Annual	Grab
Turbidity	After Filters	Daily	Grab
Volatile Organic Compounds	Entry Point of Distribution System	Annual	Grab
Emergency Response Plan/Priority Measures Plan	Plan update due, 12/31/2023, 12/31/2025, 12/31/2027	Biennial Update	NA

Table 11-3: Drinking Water Sampling Parameters for Pogo Lower Camp PWSID: 372643 and Pogo Permanent Camp PWSID: 372685 and Maximum Contaminant Limits

Drinking Water Parameters	Units	ADEC Drinking Water Maximum Contaminant Limit
Arsenic	µg/L	10
Bromate	µg/L	10
Chlorine Residual, End Points	mg/L	At Least Detectable
Disinfection Residual (Chlorine) at Entry Point	mg/L	Greater Than 0.2

Drinking Water Parameters	Units	ADEC Drinking Water Maximum Contaminant Limit
Copper	µg/L	1300
HAA5	µg/L	60
Lead	µg/L	15
Inorganics	various	various
Nitrate	mg/L	10
E. Coli	#/100ml	1
Total Coliform Bacteria	#/100ml	1
E. Coli (LT2)	MPN/100ml	1
Total Coliform Bacteria (LT2)	MPN/100ml	1
TTHM	µg/L	80
Volatile Organic Compounds	µg/L	various
UV Transmittance	cm-1	NA

[1]Analysis method in Table 20.1.5.1 of the Pogo Mine QAPP (Document Control #PGO-ENV-039-PLA)

Pogo drinking water treatment plants operate in compliance with the Public Water System Final Operation Approval. Tables 11.4 and 11.5 represent the Operation Approval parameter limits for drinking water monitoring during active mining operating.

Table 11-4: Drinking Water Operation Approval Limits for Pogo Lower Camp PWSID: 372643

Water Quality Parameter	Units	Limit
UV Transmittance (at inlet to UV reactor)	%	≥ 75%[1]
UV Intensity "Lamp" Sensor	%	≥ 63% or 0.5 mV
UV Intensity "Water" Sensor (labeled Net UVT)	%	≥ 75%
Treatment Plant Flow Rate	gpm	≤ 20[2]
Percent of monthly water volume treated that is within UV reactor validated conditions (i.e. within specification)	%	≥ 95%
Turbidity – 95 percentile of readings	NTU	≤ 1.49
Turbidity - maximum	NTU	≥ 5 NTU
Distribution entry – point chlorine residual		≥ 0.2 mg/L[3]
Orthophosphate dose	mg/L	≤ 15

[1] Collected during interim operational phase
[2] Record flow rate daily during peak WTP flow and submit with monthly operating report.
[3] Chlorine residual may need to be higher to meet disinfection CT requirements.

Table 11-5: Drinking Water Operation Approval Limits for Pogo Permanent Camp PWSID: 372685

Water Quality Parameter	Units	Limit
Ozone Residual (at outlet of first contactor)	mg/L	≥ 0.3
Water Temperature entering ozone contactor	C	≥ 5
Turbidity (after filtration but before orthophosphate and chlorine addition)	NTU	≤ 1.49[1]

Treatment Plant Flow Rate	gpm	≤ 28[2]
Orthophosphate dose	mg/L	≤ 15

[1] 95% of monthly reported reading must be less than limit; no spikes greater than 5 NTU.

[2] Record flow rate daily during peak WTP flow and submit with monthly operating report.

12. RELATED DOCUMENTS

Document Name	Document Number
Pogo Mine Plan of Operations	PGO-ENV-001-PLA
Waste Rock Characterization SWP	PGO-ENV-042-SWP
Pogo Recycled Tailings Pond Operating and Maintenance Manual	PGO-ENV-008-MAN
Storm Water Pollution Prevention Plan and Best Management Practices Plan	PGO-ENV-020-PLA

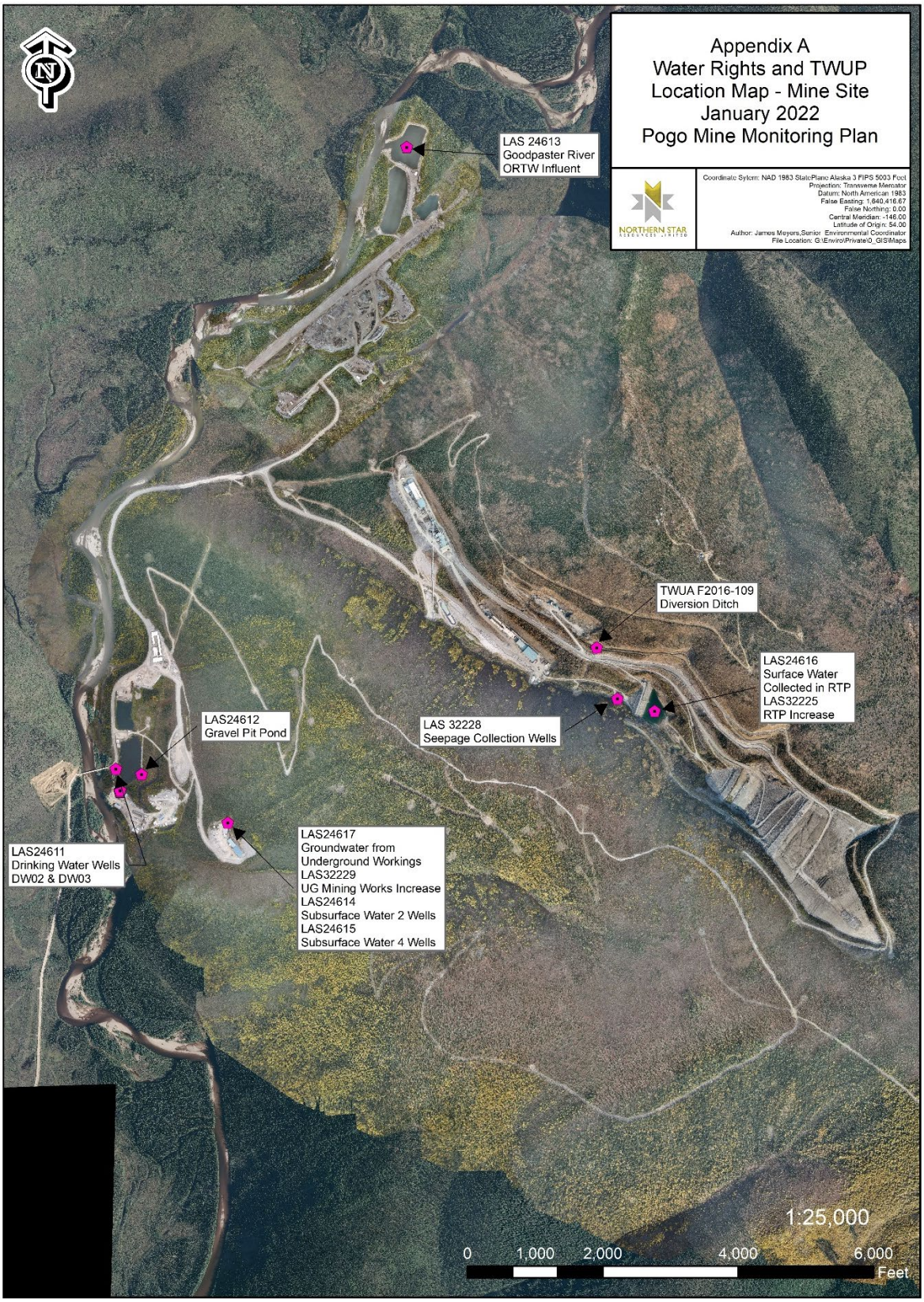
13. APPENDICES

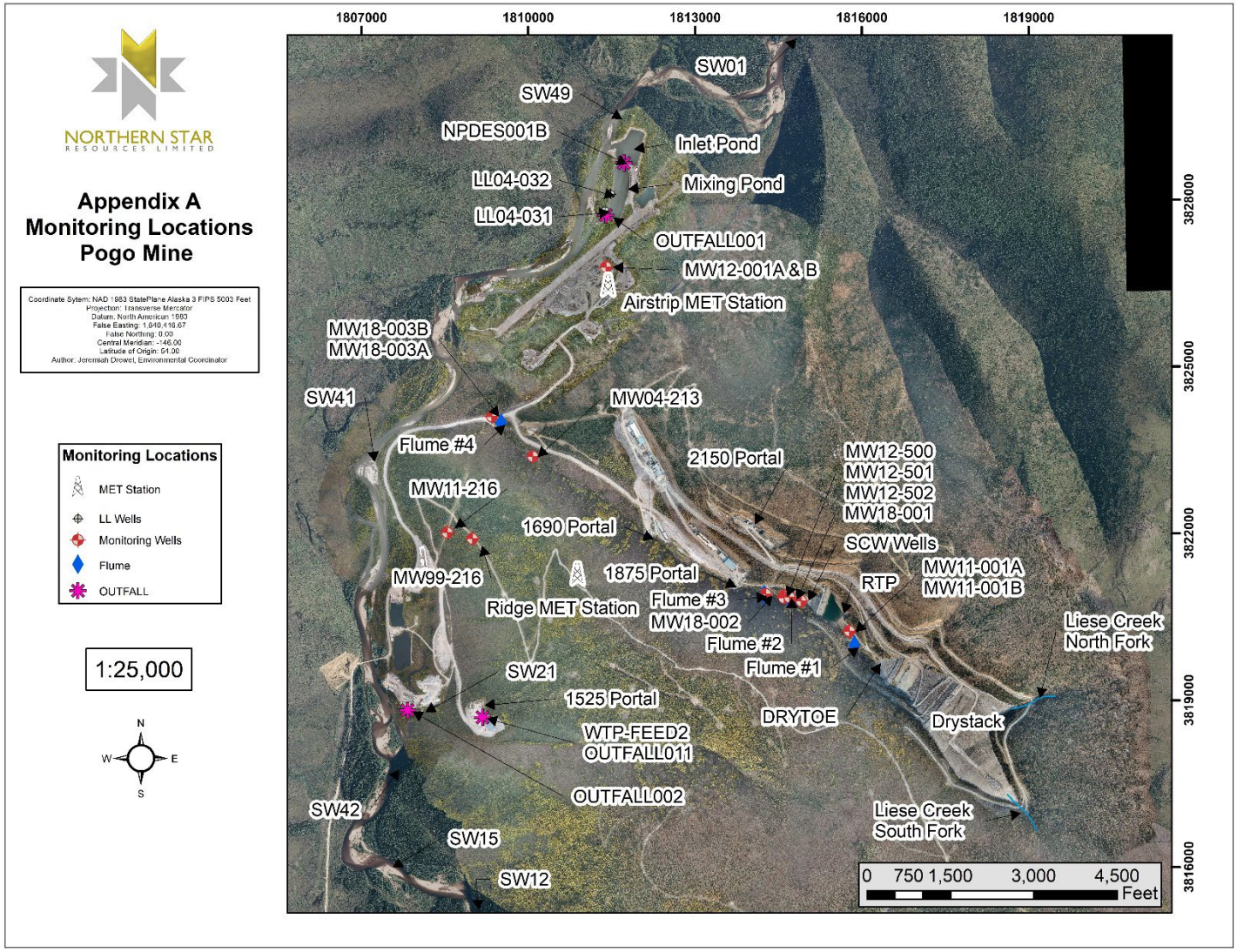
APPENDIX A - Figures: Monitoring Locations and Water Rights Locations

APPENDIX B - Invasive Weed Control

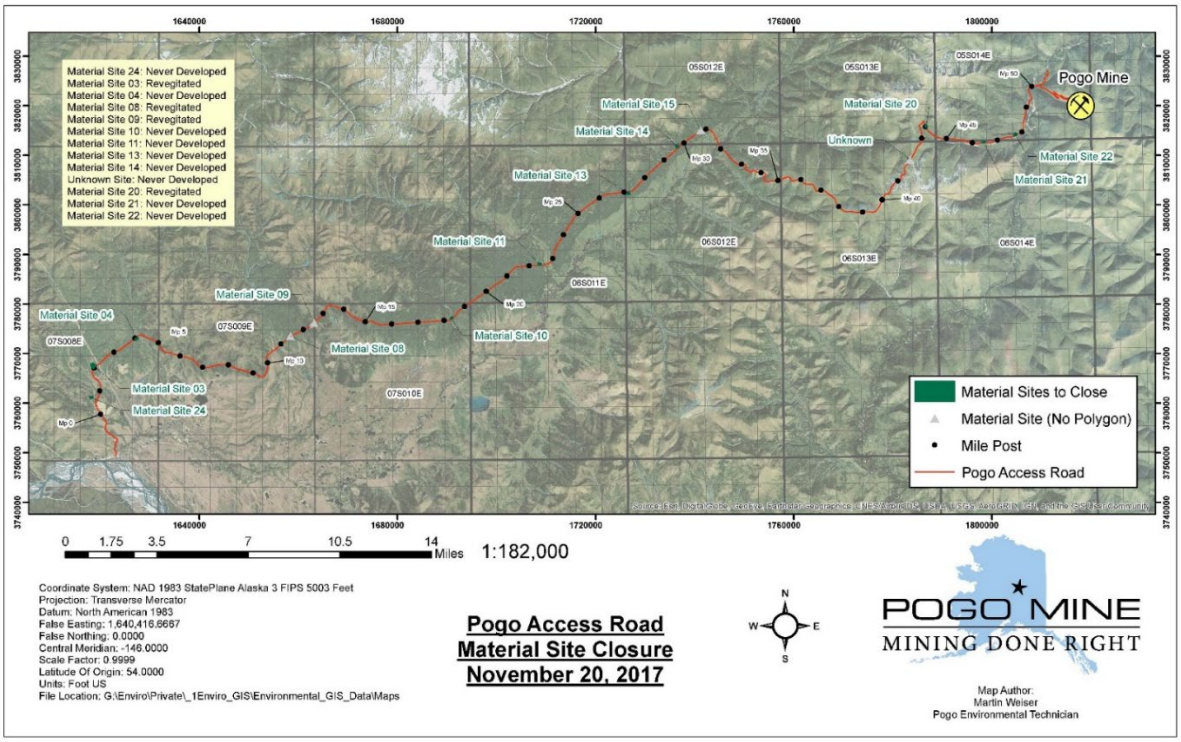
APPENDIX C - Baseline Data Summary for Groundwater Monitoring Locations

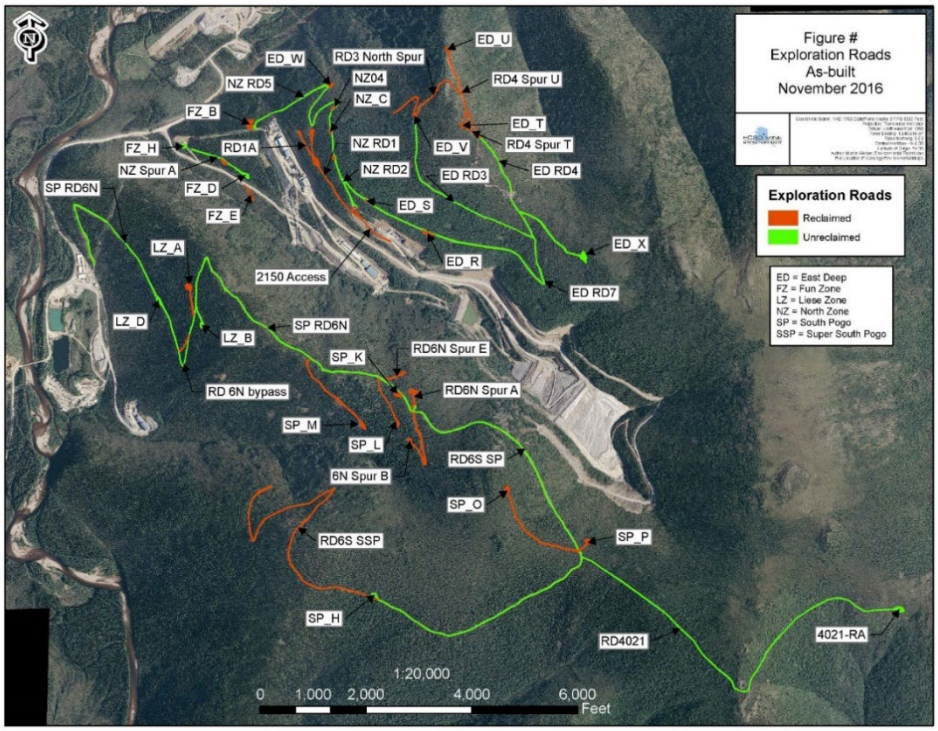
13.1 APPENDIX A - Figures: Monitoring Locations and Water Rights Locations

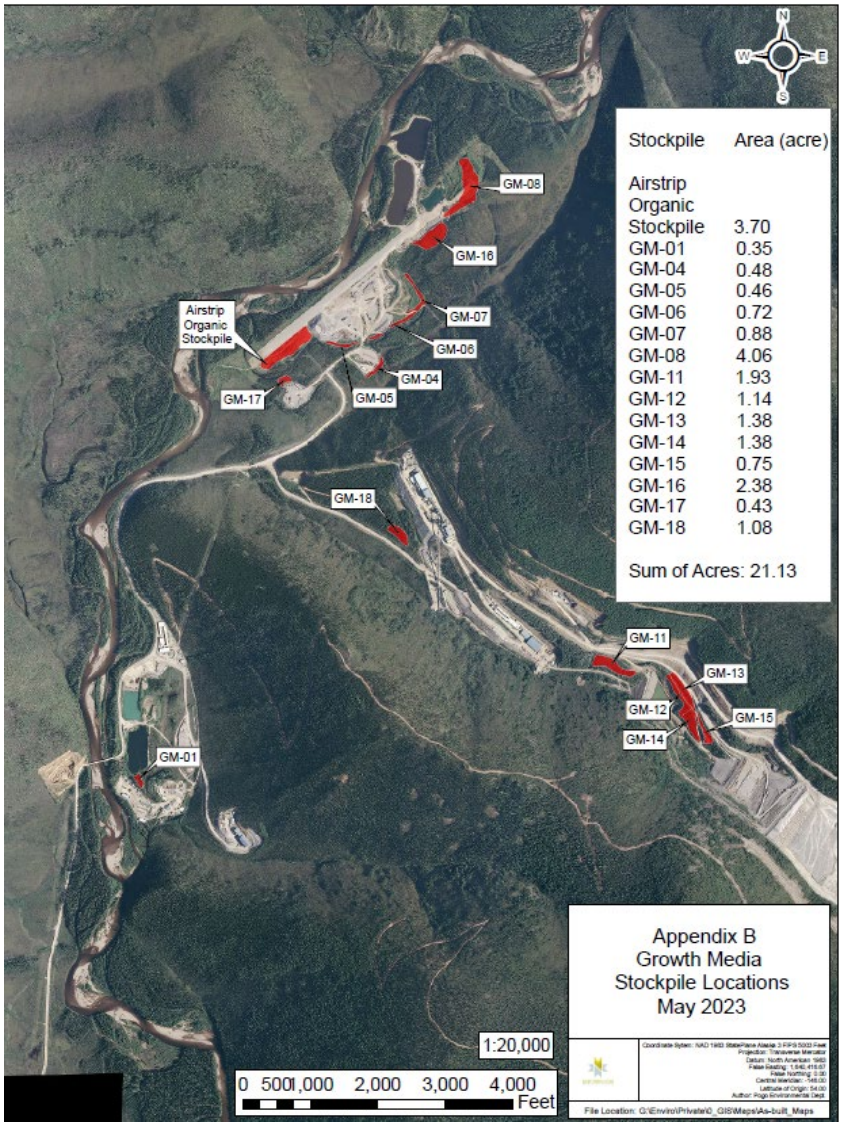



NORTHERN STAR
RESOURCES LIMITED
Appendix A
Monitoring Locations
Pogo Mine
Coordinate System: NAD 1983 StatePlane Alaska 3 FIPS 5003 Feet
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 1,640,416.67
False Northing: 0.00
Central Meridian: -146.00
Latitude of Origin: 54.00
Author: Jeremiah Drewel, Environmental Coordinator
Monitoring Locations
MET Station
LL Wells
Monitoring Wells
Flume
OUTFALL
1:25,000
N
W
E
S
1807000
1810000
1813000
1816000
1819000
3828000
3825000
3822000
3819000
3816000
SW01
SW49
NPDES001B
Inlet Pond
LL04-032
Mixing Pond
LL04-031
OUTFALL001
MW12-001A & B
Airstrip MET Station
MW18-003B
MW18-003A
SW41
MW04-213
Flume #4
2150 Portal
MW12-500
MW12-501
MW12-502
MW18-001
MW11-216
1690 Portal
SCW Wells
MW11-001A
MW11-001B
MW99-216
1875 Portal
RTP
Ridge MET Station
Flume #3
MW18-002
Liese Creek
North Fork
Flume #2
Flume #1
SW21
1525 Portal
DRYTOE
Drystack
WTP-FEED2
OUTFALL011
OUTFALL002
SW42
Liese Creek
South Fork
SW15
SW12
0 750 1,500 3,000 4,500
Feet

APPENDIX B - Invasive Weed Control






N
W
E
S
Stockpile Area (acre)
Airstrip Organic Stockpile 3.70
GM-01 0.35
GM-04 0.48
GM-05 0.46
GM-06 0.72
GM-07 0.88
GM-08 4.06
GM-11 1.93
GM-12 1.14
GM-13 1.38
GM-14 1.38
GM-15 0.75
GM-16 2.38
GM-17 0.43
GM-18 1.08
Sum of Acres: 21.13
GM-08
GM-16
Airstrip Organic Stockpile
GM-07
GM-06
GM-04
GM-17
GM-05
GM-18
GM-11
GM-13
GM-12
GM-15
GM-14
GM-01
Appendix B
Growth Media
Stockpile Locations
May 2023
1:20,000
0 500 1,000 2,000 3,000 4,000
Feet

Prohibited & Restricted Noxious Weeds

(A) The following are prohibited noxious weeds:

Field bindweed (*Convolvulus arvensis*)

Austrian fieldcress (*Rorippa austriaca*)

Galensoga (*Galensoga parviflora*)

Hempnettle (*Galeopsis tetrahit*)

Horsenettle (*Solanum carolinense*)

Russian Knapweed (*Acroptilon repens*)

Blue-flowering lettuce (*Lactuca pulchella*)

Quackgrass (*Elymus repens*)

Perennial sowthistle (*Sonchus arvensis*)

Leafy spurge (*Euphorbia esula*)

Canada thistle (*Cirsium arvense*)

Whitetops and its varieties (*Cardaria draba, C. pubescens, Lapidium latifolium*)

Purple loosestrife (*Lythrum salicaria*)

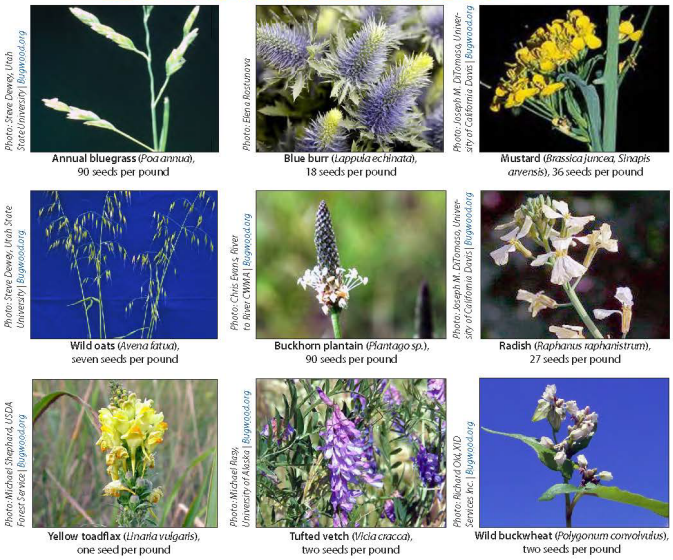
Orange hawkweed (*Hieraclum aurantiacum*)

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020

This list is available online, at:
plants.alaska.gov/invasives/pdf/noxious-weeds.pdf

Prohibited & Restricted Noxious Weeds

(B) The following are restricted noxious weeds, with their maximum allowable tolerances:



Annual bluegrass (*Poa annua*), 90 seeds per pound

Blue burr (*Lappula echinata*), 18 seeds per pound

Mustard (*Brassica juncea, Sinapis arvensis*), 36 seeds per pound

Wild oats (*Avena fatua*), seven seeds per pound

Buckhorn plantain (*Plantago sp.*), 90 seeds per pound

Radish (*Raphanus raphanistrum*), 27 seeds per pound

Yellow toadflax (*Linaria vulgaris*), one seed per pound

Tufted vetch (*Vicia cracca*), two seeds per pound

Wild buckwheat (*Polygonum convolvulus*), two seeds per pound

Statutory Authority:
AS 03.05 010
AS 03.05.030
AS 44.37.030
11AAC 34.020
(In effect before 7/28/59; am 3/2/78, Reg. 65; am 10/28/83, Reg. 88)

This list is available online, at:
plants.alaska.gov/invasives/pdf/noxious-weeds.pdf

13.2 APPENDIX C - Baseline Data Summary for Groundwater Monitoring Locations

Table 6.3: Baseline Data for MW11-001A

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Alkalinity, Total	mg/l	140	178	210	27.1	8	none
Antimony, Dissolved	ug/l	0.177	0.229	0.312	0.072	3	6
Antimony, Total	ug/l	0.161	0.267	0.425	0.098	5	none
Arsenic, Dissolved	ug/l	4.34	5.83	9.25	1.55	8	10
Cadmium, Dissolved	ug/l	<0.045	0.054	0.091	0.017	8	0.094
Calcium, Dissolved	mg/l	83	97	110	10.7	8	none
Chloride, Total	mg/l	0.94	1.75	2.45	0.52	8	230
Chromium, Dissolved	ug/l	0.94	1.15	1.26	0.18	3	100
Chromium, Total	ug/l	1.2	6.7	14.7	5.4	5	100
Copper, Dissolved	ug/l	3.9	5.9	9.3	1.9	8	2.7
Fluoride, Total	mg/l	<0.002	0.05	0.19	0.07	8	none
Hardness, Total	mg/l	270	328	370	39.2	8	none
Iron, Dissolved	ug/l	<2.7	117	700	240	8	1000
Lead, Dissolved	ug/l	<0.03	0.09	0.35	0.11	8	0.54
Magnesium, Dissolved	mg/l	15	20	24	3	8	none
Manganese, Dissolved	ug/l	1.3	5.9	15.8	5.1	8	50
Mercury, Dissolved	ug/l	0.001	0.002	0.003	0.001	5	0.05
Mercury, Total	ug/l	0.0028	0.0086	0.0191	0.0091	3	0.05
Nickel, Dissolved	ug/l	5.32	6.68	9.25	1.20	8	16
Nitrite plus Nitrate, Total	mg/l	10.3	19.1	34.6	7.8	8	10
Oxygen, Dissolved	mg/l	0.06	4.92	8.26	3.06	9	none
pH, Field	SU	6.4	6.6	6.8	7.1	9	6.5 - 8.5

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Potassium, Dissolved	mg/l	2.5	3.0	4.1	0.5	8	none
Selenium, Dissolved	ug/l	0.84	1.61	2.64	0.56	8	4.6
Silver, Dissolved	ug/l	<0.028	0.034	0.066	0.013	8	0.3
Sodium, Dissolved	mg/l	7.3	8.8	12.0	1.5	8	none
Specific Conductance, Field	Umhos/com	282	678	1479	400	9	none
Sulfate, Total	mg/l	85	103	126	14	8	250
Sum of Anions, Total	meq/l	6.5	6.5	6.5	0	1	none
Sum of Cations, Total	meq/l	9.2	9.2	9.2	0	1	none
TDS, Total	mg/l	310	437	530	66	8	500
Temperature, Water	° F	32.8	40.7	50.9	7.9	7	none
Total Nitrogen as N	mg/l	0.8	1.1	1.4	0.2	8	none
Water Temperature	° C	0.4	4.9	10.5	4.4	7	none
Weak Acid Dissociable Cyanide	ug/l	<1.2	2.3	<10	3.1	8	5.2
Zinc, Dissolved	ug/l	<0.08	1.96	6.32	2.36	8	36

Table 6.4: Baseline Data for MW11-001B

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Alkalinity, Total	mg/l	110	123	140	10	13	none
Antimony, Dissolved	ug/l	0.094	0.138	0.166	0.023	8	6
Antimony, Total	ug/l	0.122	0.161	<0.27	0.062	5	none
Arsenic, Dissolved	ug/l	2.77	3.91	4.43	0.44	13	10
Cadmium, Dissolved	ug/l	<0.045	0.050	0.083	0.012	13	0.094
Calcium, Dissolved	mg/l	53	81	130	22	13	none
Chloride, Total	mg/l	0.59	1.46	2.86	0.72	13	230
Chromium, Dissolved	ug/l	0.4	0.7	1.2	0.3	8	100
Chromium, Total	ug/l	0.45	1.11	2.42	0.77	5	100

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Copper, Dissolved	ug/l	0.81	1.26	2.26	0.41	13	2.7
Fluoride, Total	mg/l	<0.002	0.035	0.189	0.048	13	none
Hardness, Total	mg/l	180	264	410	68	13	none
Iron, Dissolved	ug/l	<2.7	25.4	150	55.3	13	1000
Lead, Dissolved	ug/l	<0.03	0.04	<0.07	0.02	13	0.54
Magnesium, Dissolved	mg/l	11	16	24	4	13	none
Manganese, Dissolved	ug/l	0.1	2.9	21.6	6.1	13	50
Mercury, Dissolved	ug/l	0.0002	0.0004	0.0007	0.0002	10	0.05
Mercury, Total	ug/l	0.0003	0.0005	0.0009	0.0004	3	0.05
Nickel, Dissolved	ug/l	2.26	3.93	5.52	1.06	13	16
Nitrite plus Nitrate, Total as N	mg/l	6.7	20.9	50.4	12.1	13	10
Oxygen, Dissolved	mg/l	0.11	8.08	18.05	4.97	13	none
pH, Field	SU	6.1	6.6	7.6	6.7	13	6.5 - 8.5
Potassium, Dissolved	mg/l	2.1	2.8	4	0.6	13	none
Selenium, Dissolved	ug/l	0.32	1.46	3.59	0.96	13	4.6
Silver, Dissolved	ug/l	<0.028	0.063	0.337	0.087	13	0.3
Sodium, Dissolved	mg/l	6.6	7.9	10.0	0.9	13	none
Specific Conductance, Field	Umhos /cm	287	570	1,232	316	13	none
Sulfate, Total	mg/l	58	91	137	25	13	250
TDS	mg/l	235	372	685	115	13	500
Temperature	° F	33.7	34.8	39.4	1.9	8	none
Total Nitrogen as N	mg/l	<0.05	0.44	0.88	0.24	13	none
Temperature	° C	0.97	1.57	4.09	1.05	8	none
Weak Acid Dissociable Cyanide	ug/l	<1.2	1.9	<10	2.4	13	5.2
Zinc, Dissolved	ug/l	<0.08	0.93	3.1	1.07	13	36

Table 6.5: Baseline Data for MW11-216

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Alkalinity, Total	mg/l	320	338	360	12	13	None
Antimony, Dissolved	ug/l	0.028	0.055	0.074	0.014	10	6
Antimony, Total	ug/l	0.047	0.053	0.060	0.006	3	none
Arsenic, Dissolved	ug/l	0.105	0.206	0.744	0.192	13	10
Cadmium, Dissolved	ug/l	<0.045	0.048	<0.066	0.007	13	0.094
Calcium, Dissolved	mg/l	73	79	84	3	13	none
Chloride, Total	mg/l	0.339	0.440	0.741	0.113	13	230
Chromium, Dissolved	ug/l	0.681	1.233	1.8	0.373	10	100
Chromium, Total	ug/l	1.06	1.43	1.82	0.38	3	100
Copper, Dissolved	ug/l	0.29	1.20	4.44	1.04	13	2.7
Fluoride, Total	mg/l	0.2	0.4	1.2	0.3	13	None
Hardness, Total	mg/l	430	465	480	15	13	None
Iron, Dissolved	ug/l	<2.7	2.7	<2.7	0	13	1000
Lead, Dissolved	ug/l	<0.03	0.04	<0.07	0.01	13	0.54
Magnesium, Dissolved	mg/l	60	65	69	3	13	none
Manganese, Dissolved	ug/l	0.44	1.63	3.54	0.79	13	50
Mercury, Dissolved	ug/l	<0.0001	0.0002	0.0004	0.0001	11	0.05
Mercury, Total	ug/l	<0.0001	0.0002	0.0004	0.0002	2	0.05
Nickel, Dissolved (ug/l as Ni)	ug/l	2.76	4.20	5.57	0.90	13	16
Nitrite plus Nitrate as N	mg/l	0.015	0.484	0.844	0.209	13	10
Oxygen, Dissolved	mg/l	2.38	10.88	20.57	5.51	13	none
pH, Field	SU	6.78	7.06	7.42	7.47	13	6.5 - 8.5
Potassium, Dissolved	mg/l	3.7	4.4	6.2	0.8	13	none
Selenium, Dissolved	ug/l	0.60	1.91	5.14	1.03	13	4.6
Silver, Dissolved	ug/l	<0.028	0.040	<0.086	0.0206	13	0.3
Sodium, Dissolved	mg/l	12	13	15	1	13	none
Specific Conductance, Field	umhos/cm	497	698	806	115	13	none
Sulfate, Total	mg/l	152	177	191	14	13	250

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Sum of Anions, Total	meq/l	10.149	10.149	10.149	0	1	none
Sum of Cations, Total	meq/l	10.534	10.534	10.534	0	1	none
TDS	mg/l	280	571	680	100	13	500
Temperature	° F	36.7	37.0	37.3	0.2	10	none
Total Nitrogen as N	mg/l	<0.1	0.2	<0.5	0.1	13	none
Temperature	° C	2.62	2.77	2.95	0.10	10	none
Weak Acid Dissociable Cyanide	ug/l	<1.1	1.9	<10	2.4	13	5.2
Zinc, Dissolved	ug/l	<0.08	1.95	8.85	2.30	13	36

Samples were collected semi-annually from MW04-213 (down gradient of the Ore Zone), from October of 2004 the beginning of gold production at Pogo on February 14, of 2006. This data was used to establish the minimum, maximum, mean, and standard deviations as baseline water quality parameters. Table 6.6 provides a summary of the baseline data.

Table 6.6: Baseline Data for MW04-213

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Alkalinity, Total	mg/l	132	142.5	153	14.8	2	none
Arsenic, Dissolved	ug/l	10.2	17.95	20.9	5.2	4	10
Cadmium, Dissolved	ug/l	<0.1	0.1	<0.1	0	5	0.094
Calcium, Dissolved	mg/l	50.7	55.8	61	7.3	2	none
Chloride, Total	mg/l	<0.5	0.54	0.66	0.06	5	230
Chromium, Dissolved	ug/l	<2	2	<2	0	3	100
Chromium, Total	ug/l	<1	1	<1	0	2	100
Copper, Dissolved	ug/l	0.275	1.159	2.52	0.823	5	2.7
Fluoride, Total	mg/l	<0.1	0.107	1.113	0.0092	2	None
Hardness, Total	mg/l	181	200	219	26.8	2	None
Iron, Dissolved	ug/l	48	76.34	138	38.5	5	1000
Lead, Dissolved	ug/l	<0.1	0.35	0.75	0.25	5	0.54
Magnesium, Dissolved	mg/l	13	15	16	2.2	2	none
Manganese, Dissolved	ug/l	582	639	693	48	5	50
Mercury, Dissolved	ug/l	<0.005	0.005	<0.005	0	5	0.05
Nickel, Dissolved (ug/l as Ni)	ug/l	0.72	1.91	2.85	0.76	5	16

Parameter Description	Units	Minimum Value	Mean Value	Maximum Value	Standard Deviation	Number of Samples	Groundwater Quality Standards
Nitrate, Total as N	mg/l	<0.1	0.1	0.1	0	5	10
Nitrite plus Nitrate as N	mg/l	0.029	0.077	0.173	0.083	3	10
Oxygen, Dissolved	mg/l	0.2	1.35	2.5	1.62	2	none
pH, Field	SU	6.87	7.22	7.54	7.3	4	6.5 - 8.5
Potassium, Dissolved	mg/l	1.58	1.59	1.61	0.02	2	none
Selenium, Dissolved	ug/l	<0.09	0.418	<0.5	0.183	5	4.6
Silver, Dissolved	ug/l	<0.1	0.1	<0.1	0	5	0.3
Sodium, Dissolved	mg/l	3.38	3.63	3.88	0.35	2	none
Specific Conductance, Field	umhos/cm	168	238	402	110	4	none
Sulfate, Total	mg/l	63	68	73	3.7	5	250
Sum of Anions, Total	meq/l	3.98	4.28	4.59	0.43	2	none
Sum of Cations, Total	meq/l	3.83	4.23	4.62	0.56	2	none
TDS	mg/l	226	260	271	19.5	5	500
Temperature	° F	36.7	37.0	37.3	0.2	10	none
Total Nitrogen as N	mg/l	<0.5	0.5	<0.5	0	5	none
Temperature	° C	0.1	1.3	2.9	1.2	4	none
Weak Acid Dissociable Cyanide	ug/l	<3	3	<3	0	5	5.2
Zinc, Dissolved	ug/l	5.4	11.2	13.5	3.5	5	36