NIBLACK EXPLORATION PROJECT

2016 Annual Report

Prepared for

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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollutant Discharge Elimination System Permit
BMP	best management practice
CBR	Committee Bay Resources Ltd.
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
LAD	land application/dispersion
MDL	method detection limit
MRL	method reporting limit
MS/MSD	matrix spike/matrix spike duplicate
NAG	non-acid-generating
NOAA	National Oceanic and Atmospheric Administration
NPLLC	Niblack Project LLC
NTU	nephelometric turbidity units
PAG	potentially acid-generating
PARCC	precision, accuracy, representativeness, completeness, and comparability
Permit	State of Alaska's Waste Management Permit 2013-DB0001
PQL	practical quantification limit
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
RPD	relative percent difference
SWPPP	stormwater pollution prevention plan
TDS	total dissolved solids
TSS	total suspended solids

1 INTRODUCTION

This report is submitted in accordance with annual reporting requirements for the Niblack Exploration Project. The Niblack Exploration Project is a copper-gold-zinc-silver prospect located off Moira Sound on southeastern Prince of Wales Island, approximately 30 miles southwest of the town of Ketchikan (Figure 1-1). The property is located at Section 34, T. 78 and 79 S., R. 88 E., Copper River Meridian; Latitude 55º 03′ 53″, Longitude -132º 08′ 48″. The property is composed of 17 patented claims, 298 staked federal lode claims, and 7 Alaska State tideland claims. All claims are owned 100 percent by Niblack Project LLC (NPLLC).

The Niblack area has been explored for minerals since the initial copper discovery at Niblack Anchorage in 1899. A detailed history of site ownership and project activities, including tons of ore produced and dates of operation, is presented in the *Niblack Underground Exploration Plan of Operations 2012 Post-Construction Update* (Integral 2013a). NPLLC acquired 100 percent ownership interest in the Niblack Exploration Project in early 2012. Modern day underground development on the Niblack Exploration Project was initiated by previous owners, Niblack Mining Corporation, on September 21, 2007, and was completed on July 12, 2008. The initial phase of underground drilling was completed on October 7, 2008, and the second phase of underground drilling was initiated on September 26, 2009.

The permits, plans, and approvals reported and referred to herein include the following:

- Alaska Department of Natural Resources Reclamation Plan Approval # J1122711 (ADNR 2012)
- Alaska Department of Environmental Conservation (ADEC) Waste Management Permit 2013-DB0001 (hereinafter Permit; ADEC 2013)
- Niblack Exploration Project Plans
  - *Niblack Project Underground Exploration Plan of Operations Post-Construction Update* (Integral 2013a)
  - *Niblack Reclamation and Closure Plan, Post-Construction Update* (Integral 2013b)
  - *Niblack Water Quality Monitoring Plan, Post-Construction Update* (Integral 2013c)
  - *Niblack Mining Corporation, Quality Assurance Project Plan* (QAPP; Integral 2013d)
  - Stormwater Pollution Prevention Plan (SWPPP; RTR 2006)
  - Water Quality Baseline and Site Monitoring Plan (Knight Piésold 2007b)
  - Operational Characterization Plan (Knight Piésold 2007a)

Permit 2013-DB0001, issued on March 13, 2013, is a renewal permit that replaced Permit 2006-DB0037. On September 1, 2015, ADEC issued APDES AK0053708 to NPLLC. This permit allows for the construction and operation of an outfall in the Niblack Anchorage within Moira Sound. The outfall will be used to discharge water from the settling ponds to the marine environment in lieu of discharge to the currently approved land application system (LAD). Easement for the outfall pipe was granted May 6, 2016. Construction of the outfall and associated works has not begun at the time of this report and the site continues to operate under Permit 2013-DB0001.

2 SUMMARY OF ACTIVITIES

Activities related to site development and maintenance, including climate information and reclamation, are presented in this section.

2.1 SURFACE DISTURBANCE

This section summarizes construction activities conducted since the Niblack Exploration Project was initiated on September 21, 2007. Underground construction and excavation commenced on September 21, 2007, and was completed on July 12, 2008. Placement of non-acid-generating (NAG) material at construction sites was completed shortly thereafter, as was the loading of the temporary potentially acid-generating (PAG) waste rock storage facility, in spring 2008. No additional expansion of the underground workings, or associated production of waste rock, is anticipated at this time. However, if future expansion does occur, the site design plans presented in the Permit (ADEC 2013) and the Underground Exploration Plan of Operations (Integral 2013a) will be followed.

Construction of the sediment ponds, and piping from the adit portal to the ponds, was complete prior to commencement of excavation activity in 2007. The water treatment plant and components of the land application/dispersion (LAD) water discharge system were completed in early 2008. Land application of effluent water from the settling ponds began in October 2007.

The total surface area cleared or disturbed at the project site is 13.5 acres. This total includes access roads and a historical land camp site constructed prior to 2007, which are not covered under the Niblack Underground Exploration Program permits. Photographs of site facilities are provided in Appendix A.

Surface disturbance is shown on the site-wide as-built maps (Figures 2-1 and 2-2) and includes the following:

- Access roads
- Ditches, culverts, and settling basins/sediment traps for stormwater management
- Construction of laydown areas for equipment/supply storage, including a fuel storage facility, magazine sites (currently decommissioned), portal area, shop area (old camp)
- Settling ponds and LAD water discharge system
- Barge landing and dock facilities
- Surface drilling landing
- Temporary PAG waste rock storage facility

- Temporary mineralized ore stockpile
- NAG waste disposal area
- Topsoil and growth media stockpiles.

The majority of the NAG material removed from the underground development was utilized in the construction of site facilities; the NAG waste dumps contained material that was used to construct access roads. Some additional NAG material was placed on the lower NAG road in 2008 and was sorted through a 6-in. grizzly to create a small “fines” stockpile for road maintenance (Figure 2-1).

The temporary PAG waste rock storage facility (Figure 2-2) was constructed on a stable foundation of crushed rock overlain by a 6-in. layer of compacted sand, and lined with 80-mil high-density polyethylene (geo-membrane) between two layers of geotextile fabric. This was overlain by another 6-in. layer of compacted sand as a service layer. The PAG liner construction was altered slightly from the original specifications within Niblack’s 2007 waste management permit application (NMC 2007), which specified that liner bedding would be placed in two horizontal layers of 12-in. maximum uncompacted depth. During construction, 6-in. layers of sand were used instead of the maximum of 12-in. layers originally specified. Modifications to the PAG liner design were approved by ADEC (Emswiler 2008, pers. comm.). However, no significant reduction in membrane integrity was anticipated and none was observed during the placement of the initial lift of PAG material on the liner (see Section 2.2 for quantities of materials).

The water treatment plant and several LAD zones were completed in early 2008. Land application of water from the settling ponds began in October 2007. The water treatment plant was tested for effectiveness in September 2009 and is ready to begin the treatment of mine wastewater should the need arise. To date, chemical water treatment has not been required.

As presented in Table 2-1 of the 2007 annual report (Integral 2008a) and Table 2-1 of the 2008 annual report (Integral 2009a), from December 2007 through early February 2008, the LAD system emitters were frozen and approximately 2 million gallons of water was discharged to the historical mine shaft. This was reported to ADEC, as required by Permit 2006-DB0037 (Section 1.4.5; ADEC 2007). No water has been directed to the historical mine shaft since that time. Land application of wastewater recommenced in February 2008, once the drip emitters had thawed, and continued through 2016. Water balance data for the project in 2016 is included in Table 2-1.

2.2 UNDERGROUND DEVELOPMENT

Underground construction and excavation commenced on September 21, 2007, and was completed on July 12, 2008, with only a temporary interruption of activities for the holidays between December 17, 2007, and January 6, 2008. The total underground development consists of 2,772 linear ft on the main access drift, 372 ft of short cross-cuts and utility bays, and 144 ft for two sumps, one near the portal and the other near the end of the drift (Figure 2-3). A total of 51,700 tons of waste rock (30,900 cubic yards expanded waste volume) was generated from underground development in 2008. The total volume excavated from 2007 through 2008 was approximately 66,150 tons (39,300 cubic yards).

Data from the Muck Segregation Plan (as described in the Niblack Project Operational Characterization Plan [Knight Piésold 2007a]) is included within a master acid base accounting geochemical database. The database is included in the appendices of the 2007, 2008, and 2009 Niblack Exploration Project annual reports (Integral 2008a, 2009a, 2010). The database has not changed since the 2007 annual report, and therefore it is not repeated here. The Niblack exploration drift totals 3,288 linear ft (main drift plus cross-cuts and sumps) and was constructed with a total of 286 blast rounds. Of this total, 43 rounds constituting 495 linear ft of drifting (approximately 9,960 tons or 5,920 cubic yards) were determined to consist of PAG materials, the majority of which (26 rounds for 299 linear ft) consists of sulfide mineralization within the Lookout Rhyolite, and related footwall alteration, at the end of the drift.

The first four rounds excavated from the Lookout Rhyolite (48 linear ft of the drift representing approximately 965 tons or 574 cubic yards of material) consisted of well-mineralized rock and was set aside for future test work. This material was placed on a lined laydown area between the temporary PAG storage site and the old camp and was covered with 80-mil geo-membrane (sealed) so as to prevent any introduction of surface water onto the pile. Regular checks are conducted around the perimeter of this pile to monitor for any potential leaks; none have been observed to date. The remainder of the PAG material (approximately 8,995 tons or 5,346 cubic yards of material) was placed on the temporary PAG storage site.

NAG waste rock, dominated by mafic volcanic rocks and mafic dykes, totaled 2,793 linear ft of the total excavation and represents some 56,200 tons, or 33,400 cubic yards, of material. All NAG waste rock has been used in construction activities, including the laydown areas expansion, the NAG site access roads and berms, the base for the temporary PAG storage facility, and road maintenance.

2.2.1 Water Discharge

Water balance data for the project in 2016 is included in Table 2-1. A total of 76.7 million gallons of water was discharged to the LAD system in 2016. Monthly discharge rates averaged 146 gallons per minute (gpm) and never exceeded the 300 gpm wastewater discharge limit. Figure 2-4 shows the monthly total flow volumes entering the LAD system, as measured at the outlet from the settling ponds. Since site activity began, land application of wastewater has occurred upgradient of surface water monitoring stations WQ4, WQ6, and WQ10, and groundwater monitoring wells MW2, MW3, and MW4. No land application of wastewater has occurred upgradient of Unnamed Creek #2 and the WQ13 monitoring station, nor has it occurred upgradient of the MW1 area.

During initial underground construction in 2007 and 2008, groundwater flows exceeded pre-project estimates and necessitated grouting to remain below the permitted wastewater discharge limit, which was 150 gpm at that time. To reduce flows, grout was applied along almost the entire length of the mine drift. The resulting grout curtain has been successful in eliminating significant water seepage into the drift. On August 13, 2008, approval was granted by the state for an increase in the permitted wastewater discharge limit to 250 gpm. An additional increase in the permitted wastewater discharge limit up to 300 gpm was approved by the state on December 31, 2009.

Following the completion of the initial phase of underground development and exploration, the exploration project went into temporary closure starting in October 2008. During this time, water was allowed to accumulate in the underground exploration drift. Committee Bay Resources Ltd. (CBR; the owner at the time) requested (Kleespies 2009b, pers. comm.), and received, approval from ADEC to conduct a dewatering operation to remove water that had accumulated in the underground exploration drift while the project was in temporary closure. The dewatering was initiated on August 26, 2009, and completed on September 11, 2009. During this period, approximately 2.4 million gallons of water were removed from the underground exploration drift (Turner 2009, pers. comm.). Additional water quality monitoring was conducted during and after mine dewatering. Water quality results from this monitoring are included in the Third Quarter 2009 Water Quality Monitoring Report (Integral 2009b). Following mine dewatering, several leaking split sets within the drift were sealed to reduce groundwater discharge into the drift.

In early 2010, site staff incorporated several measures to reduce the possibility of freezing conditions or over-saturation preventing proper functioning of the LAD system. System improvements included replacing the existing LAD system emitters, which discharged at a rate of 6 gpm, with higher-volume 12 gpm emitters in approximately 75 percent of the LAD zone areas. Regular alternation of LAD zones was initiated to allow extra time for discharge water and precipitation to percolate through system soils. Additionally, a daily process of system checks was initiated to monitor LAD system function; these system checks are still in place on a bi-weekly schedule when staff is on site and it is safe to do so, per the Modified Plan while under temporary closure.

Upline of the LAD system, screen filters were installed to reduce clogging in the LAD emitters. Coil water heaters were also installed to prevent discharge water from freezing in the LAD lines.

2.2.2 Site Temperature and Precipitation

Figure 2-5 presents available long-term (1910–2016) average temperature and precipitation data for Ketchikan, Alaska, from the Western Regional Climate Center (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak4590). Typical temperatures for the region average 45°F and range from -2°F to 89°F. Total precipitation averages 154 in. annually, and is generally greatest from September through February. Because of the mild temperatures, most precipitation falls as rain, with less than 40 in. of annual snowfall on average. Air temperature and precipitation measured from February 2008 through December 2016 at the Old Camp Weather Station located at the Niblack Exploration Project site[1] is presented on Figure 2-6 (upper plot). Precipitation in 2016 totaled approximately 148 in. at the site, and daily temperatures in 2016 ranged from 14 to 82°F (average 48°F).

Wintertime minimum temperatures provide information about the potential for freeze-up of the LAD system. Figure 2-6 (lower plot) compares observed daily onsite minimum temperatures to the 20-year (1995–2016) average daily minimum for Ketchikan measured at the National Oceanic and Atmospheric Administration (NOAA) Ketchikan Airport station (http://forecast.weather.gov/MapClick.php?zoneid=AKZ028). The daily minimum temperature fell below freezing on 31 days in 2016, all of which occurred between the months of January, February, November, or December. During the 2015/2016 winter season (November through March), daily mean temperatures averaged 41°F. This is similar to the 2014/2015 winter season, but somewhat warmer than the typical winter-season average daily temperatures observed from 2008 to 2014, which ranged from 34.8°F to 38.6°F.

2.3 EXPLORATION DRILLING

Overall, a total of 246 surface core boreholes and 164 underground core boreholes have been drilled on the Niblack Exploration Project property between 1975 and late 2012. NPLLC drilled approximately 199,362 ft in 157 holes (136 underground and 21 surface) between 2009 and 2012. No exploration drilling occurred in 2016.

2.3.1 Underground Exploration Drilling

Figure 2-7 shows areas of underground drilling since 2007. A total of 19,765 ft of underground exploration drilling was completed during 2008. Six drill holes (4,400 ft) were completed from the Mammoth Drill Station (east cross-cut #1), located approximately 485 ft into the exploration

[1] Onsite weather station was not available from 9/18/2009–2/28/2010, and several periods during 2012, 2014 and 2015 due to instrument malfunction; daily records for the Ketchikan Airport NOAA weather station are shown for these time periods. Onsite weather station was not available 6/15/2017-8/2/2017 and 10/16/2017-12/31/2017 due to on-site instrument malfunction; daily records from Annette NOAA weather station are shown for these time periods.

drift, between January 12 and February 13, 2008. An additional 17 drill holes (11,500 ft) were completed from the East Drill Station (east cross-cut #5), located approximately 2,440 ft into the drift, between June 15 and September 15, 2008. Finally, two drill holes (2,300 ft) were completed from the West Drill Station (west cross-cut #2), located approximately 2,370 ft into the drift, between September 15 and October 7, 2008. These drill holes were plugged with "packers" (sections of pipe with ball valves), which proved effective at reducing discharge from the drill holes.

In 2009, underground exploration drilling was conducted between September 26 and December 23. Eight drill holes (8,609.5 ft) were completed during this period: seven from drill station one (DS-1) and one from drill station two (DS-2), which are located 250 ft and 430 ft, respectively, north of Remuck Station #4 in the exploration drift. These drill holes were plugged with "packers" to prevent discharge from the drill holes and were sealed with grout in 2010.

A 25,000-ft underground diamond drill program was initiated in 2009 and continued into 2010. Two diamond drill rigs were utilized and the intent of the program was to expand and delineate the existing resources, as well as to find new resources in the Lookout Zone area. Underground work proceeded from drill stations located at approximately 200-ft intervals along the exploration drift. Holes were drilled in fan patterns designed to cross-cut the mineralization along the apparent strike of the zone. NPLLC drilled approximately 107,679 ft in 94 holes from the start of drilling in October 2009 through late December 2010. Approximately 90 percent of the holes drilled were plugged with grout in 2010. The remaining holes were grouted in 2011.

Underground drilling continued in 2011, following patterns similar to 2010. NPLLC completed 42 holes totaling approximately 68,343 ft from January through October 2011. No underground drilling has been conducted since 2011.

2.3.2 Surface Drilling

In May and June 2011, a helicopter-supported surface drill rig was added to the Niblack exploration program to test exploration targets in the area of the historic Niblack Mine, Lookout Zone, and Trio Zone. The four areas of surface drilling are shown as black circles and lines in Figure 2-8. Seven surface holes totaling approximately 6,700 ft were drilled. Surface disturbance in 2011 was approximately 0.1 acre, including all drill sites and helicopter landing zones.

In August and September 2012, 10 surface holes totaling approximately 15,563 ft were drilled. Surface disturbance in 2012 was approximately 0.15 acre, including all drill pads, helicopter landing zones, and walking paths. Of the three locations used for surface drilling in 2012, one drill pad was left intact for future use. This pad was already in place from previous operators and was stabilized and used in 2012. One additional location had a drill pad (and landing zone) prepared and constructed for drilling activities, but was not used. This site was left intact for use in potential future drill programs. All other areas disturbed during the course of the exploration program were restored as described in Section 2.4.3.

No surface drilling occurred from 2013 through 2016.

2.4 RECLAMATION

Reclamation activities in 2016 included interim reclamation, due to the site status of temporary closure. The various reclamation activities, as described in the *Niblack Reclamation and Closure Plan Post-Construction Update* (Integral 2013b), are summarized below.

2.4.1 Construction Reclamation

Construction reclamation activities are those activities that occur during and directly after the exploration tunnel and associated facilities are constructed. This phase of reclamation involves the removal and storage of topsoil and growth media from disturbed areas. During construction, vegetation was cleared from the surfaces that were developed, primarily from the PAG and water treatment facility. Topsoil and soil-like growth media were removed where possible and stockpiled for reclamation. Stockpiles are located along the outer edge of access roads and laydown areas (Figure 2-2). Following the construction of the majority of the site facilities and access roads in 2007, there have been only minor construction reclamation activities. These activities were limited to the completion of the NAG site, which consisted of the felling of trees and construction of access roads, run-on diversion ditches, and berms. Concurrent reclamation of the lower NAG haul road included placement of topsoil along the lower side of the road and berm.

2.4.2 Interim Reclamation

Interim reclamation is defined as temporary measures for reducing the potential for erosion and sedimentation, and other activities required to protect surface water and groundwater resources. Interim reclamation has been undertaken to stabilize and maintain road cuts, stockpiles, and other disturbances resulting from construction activities. Interim reclamation measures completed in 2009 included seeding over road cuts, installing and maintaining sedimentation control systems, and employing other best management practices (BMPs) commonly used for construction and exploration projects. Since 2009, erosion/sedimentation control features have been maintained under BMPs and in accordance with the Permit. Visual Site Inspection Forms (Appendix B) document these practices.

2.4.3 Surface Drilling Reclamation

In 2011, the majority of surface drilling activity took place on patented claims. Surface drilling in 2012 was conducted on Bureau of Land Management and U.S. Forest Service land. All surface drill sites were reclaimed according to the standards for state or federal land. All areas disturbed during the course of this exploration program were restored to the extent possible, and reasonable measures were taken to prevent and undo unnecessary degradation. Any areas leveled to assist in drill pad construction were rebuilt to approximate topography before drilling operations. Where possible, felled trees were used in pad construction and all trees were bucked, limbed, and laid flat on the ground during reclamation activities. There was no surface drilling in 2013 through 2016.

2.5 TEMPORARY CLOSURE

Temporary closure[2] describes the cessation of project activities for a period of between 90 days and 3 years. The Niblack Exploration Project began a period of temporary closure on October 28, 2012, upon completion of 2012 surface drilling, which has continued through 2016. During periods of temporary closure, the site has been maintained in accordance with all operating permits, and environmental monitoring and facility maintenance continued on a regular basis. Water has continued to be routinely pumped from the underground sumps. As water flow is significantly reduced and will not accumulate in the drift, a major dewatering program is not anticipated upon reopening of the drift.

A reduction in environmental monitoring requirements during temporary closure was granted under a modification of the Suspension of Operations Plan (Niblack 2013) in January 2014 by ADEC (Evans 2014, pers. comm.). The monitoring frequency for locations and activities is monthly (when it is safe to do so), and includes the following:

- Daily LAD flow meter readings while personnel are on the project site and it is safe to do so
- Regular visual inspection of the LAD once per month during non-freezing conditions
- Monthly water quality field parameters of monitoring sites EFF1 and PAG facility
- Monthly visual site inspections
- Monthly SWPPP inspections.

A supplemental reduction in environmental monitoring requirements during temporary closure was granted under a modification of the Suspension of Operations Plan (Niblack 2013) June 29,

[2] Permit 2013DB-0001 uses the term "suspension of operations" to define a suspension of site activities (Section 1.8; ADEC 2013). The term "temporary closure" has been retained here for consistency with past reports.

2016 by ADEC (Collingwood 2016, pers. comm.). The monitoring and reporting frequency is annually – during late summer or early fall, when concentrations of metals exhibit seasonal highs – at the following locations:

- Surface water quality sites WQ4, WQ6, WQ10, and WQ13.
- Groundwater quality sites MW1, MW2, MW3, and MW4.
- PAG/ML site underdrain and the PAG/ML pond.
- Effluent going to the LAD from the mine dewatering treatment pond, site EFF1

Q1 and Q2 samples for 2016 had been collected before the reduction was requested and have been included in this report, along with Q4 (sample event early fall; October 10, 2016) and were implemented in accordance with the requirements of the Permit, Site Monitoring Plan, and QAPP.

Previous temporary closure at the site occurred from January 13, 2009, to August 26, 2009. This closure was requested in order to provide CBR (the project owners at that time) an opportunity to compile and examine the data and findings generated during Phase I of the underground drill program (Kleespies 2009a, pers. comm.). The site was maintained in accordance with all operating permits, and environmental monitoring continued on a regular basis. During the temporary closure period, the water was allowed to accumulate in the underground exploration drift. CBR requested (Kleespies 2009b, pers. comm.), and received, approval from ADEC to conduct a dewatering operation to remove water that had accumulated in the underground exploration drift while the project was in temporary closure. The dewatering was initiated on August 26, 2009, and completed on September 11, 2009. During this period, approximately 2.4 million gallons of water were removed from the underground exploration drift (Turner 2009, pers. comm.). Additional water quality monitoring was conducted during and after mine dewatering. Water quality results from this monitoring indicated that drift dewatering did not negatively impact surface or groundwater quality; the results are included in the Third Quarter 2009 Water Quality Monitoring Report (Integral 2009b). The Niblack Exploration Project underwent another period of temporary closure between October 26, 2011, and June 30, 2012. This closure was necessary to provide NPLLC an opportunity to compile and examine the data and findings generated during the previous 2 years of underground drilling.

2.6 WORK PLANNED FOR 2017

Currently, there are no plans for continuation of surface or underground drilling in 2017. NPLLC received APDES permit AK0053708 for a marine outfall on September 1, 2015 to replace the LAD system, and approval for easement of the outfall was granted by ADNR on May 6, 2016. The water management modifications include routing PAG settling pond water downhill in a new pipe, mixing PAG pond and portal water in-pipe after settling, and final discharge of the mixed waters to the Niblack Anchorage. The changes will eliminate the pipe from the PAG settling pond to the main sediment/treatment ponds and are intended to improve site water management by reducing the chance of freezing in the LAD system and in the low gradient pipe connecting the PAG pond and the main sediment/treatment ponds. The marine outfall will also reduce the chance of erosion from the LAD system. Construction of the new system has not been initiated.

3 WATER QUALITY REPORTING

This section summarizes the water quality monitoring conducted in 2016 at the Niblack Exploration Project in accordance with the requirements of the Permit (ADEC 2013), providing a summary of 2016 sampling and analysis activities, the resultant data and data quality (QAPP, Integral 2013d), and visual observations of conditions considered relevant to interpretation of water quality monitoring data.

3.1 SURFACE WATER AND GROUNDWATER MONITORING LOCATIONS

Onsite surface water and groundwater quality monitoring locations are shown on Figure 3-1, with currently active monitoring stations shown in blue. Stations shown in green are either no longer monitored or are monitored on a voluntary basis at the discretion of NPLLC; monitoring at these stations is not required under the Permit. Figure 3-2 shows voluntary offsite reference surface stream monitoring locations. Table 3-1 presents station coordinates, descriptions, activity status, and purpose. The Permit compliance points are downstream surface water stations (WQ4, WQ6, WQ10, and WQ13) and downgradient groundwater wells (MW1, MW2, MW3, and MW4).

The Permit includes a reduction in the location and frequency of surface water and groundwater monitoring compared to the original Waste Management Permit (2006-DB0037). In particular, regular water quality monitoring was discontinued at upstream surface water locations (WQ8, WQ7, and WQ12) and at upgradient/offsite groundwater sites (MW7, MW8, and MW9). Data from these locations is presented here for informational purposes.

3.1.1 Surface Water Monitoring Stations

Within Waterfall Creek, two water quality sites were established: WQ4 and WQ8. WQ4 is located near the creek outlet, just upstream from the high tide water line. This station was monitored for pre-activity baseline conditions and serves as a compliance monitoring station. WQ8 is located on the northern headwaters tributary, upstream of the access road. WQ8 is considered to be the upstream control site for the Waterfall Creek stream system and is no longer monitored per the Permit.

Three sites were established within the Camp Creek stream system: WQ6, WQ5, and WQ7. WQ6 is located near the creek outlet. Pre-activity baseline was collected at WQ6; this station now serves as a compliance monitoring station.[3] WQ5 is located upstream and approximately

[3] The WQ6 sampling location was changed on October 17, 2009, because the creek path naturally modified and the creek bed was dry at the original monitoring location. The current WQ6 station is located approximately 100 ft upstream of the original station.

50 to 100ft below the access road; this station was monitored during historical baseline sampling from 1996 to 2006 and is no longer sampled. WQ7 is located further upstream, just above the road. WQ7 is considered to be the upstream control site for the Camp Creek stream system and is no longer monitored per the Permit.

There are three water quality sample sites within the Unnamed Creek 1 drainage system: WQ10, WQ12, and the "Seep." WQ10 is situated just upstream of the old camp site (outside the influence of any historic mining) and downstream of the access road and PAG temporary waste disposal area. Pre-activity baseline was collected at WQ10; this station now serves as a compliance monitoring station. WQ12 is located upstream of the road in the southernmost headwater tributary to this stream, which is routed via a ditch to Unnamed Creek 1. The "Seep" site was unearthed during the construction of the road and is a well-defined groundwater channel, originally several meters below the natural ground surface. This seep has a strong flow that is directly related to precipitation events, and water from this site now enters into the ditch that flows into Unnamed Creek 1 upstream of WQ10. Water from the "Seep" and WQ12 are considered to be upstream control sites within Unnamed Creek 1and monitoring of these stations is not required by the Permit. WQ13 is located on the Unnamed Creek 2 drainage. Pre-activity baseline was collected at WQ13 and the station now serves as a compliance monitoring station.

Four outlying water quality sites were established further from the central core of the study area in creeks referred to as Dear Pasture Creek, Lookout Creek, Myrtle Creek, and Boulder Bay; monitoring at these four stations is not required by the Permit (Figure 3-2). WQ1 is a reference site located at the base of Dear Pasture Creek, just above the high tide line. This site is located near the mouth of the inlet, approximately 1.4 miles (2.2 km) to the southeast of the main property. WQ2 is situated at the base of Lookout Creek, just above the high tide line. This site is located on the southern side of the inlet approximately 0.8 mile (1.3 km) to the southeast of the main property. WQ3 is located at the base of Myrtle Creek, just above the high tide line. Myrtle Creek is the main drainage point to the isolated small lake to the north of the main property. WQ14 is located near the outlet of a stream that drains the south side of Lookout Mountain.

3.1.2 Groundwater Monitoring Stations

Four permanent monitoring wells (MW1, MW2, MW3, and MW4) were established in February 2007 to monitor the shallow groundwater in wetlands downgradient of the site facilities and the water discharge LAD system. The wells are located in wetlands at depths of 24 to 36 in. The wells consist of a stainless steel mesh, silica sand, pre-packed, 2.5-ft PVC screen with 2.5-ft riser. The well inner diameter is 1.5 in. and the outer diameter is 2.4 in. Locking caps and bentonite mounded at the base of the riser prevent downward infiltration of rain and surface waters.

Monitoring well MW1 is located downgradient of the NAG waste disposal area. Wells MW2, MW3, and MW4 are located immediately downgradient of LAD water discharge system zones. These wells were sited within 50 ft or less of the interface between upland LAD zones and wetland. Wells MW2 and MW3 are also downgradient of the PAG temporary storage facility and the settling/treatment ponds. These four monitoring wells serve as groundwater compliance stations for the Permit.

Well MW7 is located outside the area impacted by human activities to provide reference data. Two bedrock monitoring wells (MW8 and MW9, Figure 3-1) were installed for baseline groundwater monitoring in June 2007. MW8 is upgradient of the settling ponds and access road; MW9 is north of the PAG storage facility.

3.1.3 Groundwater and Surface Water Sampling and Analysis

Three analytical chemistry sampling events were conducted during 2016 at the water quality monitoring sites indicated on Figures 3-1 and 3-2. Sample station location information and purpose is tabulated in Table 3-1. Samples were collected by field personnel from 55 North Environmental. Regular quarterly monitoring was conducted in February (Q1) and April (Q2), before a reduction in monitoring requirements from quarterly to annually during temporary closure was granted by ADEC (Collingwood 2016, pers. comm.). Per the modification for annual monitoring to occur during late summer or early fall, the annual sample event for 2016 occurred in early October. As the Q1 and Q2 samples had been collected and analyzed, all three sample events were used in this report.

Field parameters were monitored monthly at the PAG pond and EFF1. The field kinetic test barrel study was put on temporary hold on July 20, 2015. The temporary barrel closure may be reversed and sampling continued at the discretion of NPLCC. Table 3-2 summarizes the analytical chemistry and field parameter sampling events.

Analytical chemistry samples were collected at the Permit-required water quality monitoring sites as described in the project QAPP (Integral 2013d) during 2016, as summarized in Table 3-2. Table 3-3 presents the current analyte monitoring list and sample collection methods. Table 3-4 lists all parameters monitored since 2007 and includes analytical methods and relevant water quality criteria. Table 3-5 details the monitoring schedule and analyte list for surface water and groundwater stations sampled from 2007 through 2016. Results of surface and groundwater quality monitoring from 2006 through 2016 are presented in Appendix C. Results of surface and groundwater quality monitoring for 2016 are discussed in Section 4.

Field quality assurance and quality control (QA/QC) samples were collected during the sampling events in 2016, as summarized in Tables 3-6a-b. The QA/QC samples included a field replicate for the surface water stations and a field replicate for the groundwater stations, and field blanks for all analytes including total and dissolved trace elements. The water quality and field QA/QC samples for the 2016 sampling events were analyzed for the parameters identified in the Permit (ADEC 2013), the project QAPP (Integral 2013d), and as identified in Tables 3-4 and 3-5. An evaluation of field replicate samples collected in 2016 is presented in Section 3.2.1.2. Field replicate results from 2006 through 2016 are presented in Appendix C, Tables C-4a through C-4d.

3.2 DATA QUALITY EVALUATION

The QAPP (Integral 2013d) identifies the following two data quality objectives (DQOs) to ensure that data of adequate quantity and quality are generated to support the requirements of the Permit:

> DQO 1—Surface Water Quality. The DQO for surface water quality is to ensure that data of sufficient quantity and quality are collected to determine whether concentrations of water quality parameters in designated surface water monitoring locations meet water quality standards (18 AAC 70), and/or are within site-specific natural conditions. The site-specific natural conditions for surface water will be established by the combined data set from surface water monitoring conducted at pre-project reference locations before exploratory activity and from ongoing monitoring of upstream reference locations.
>
> DQO 2—Groundwater Quality. The DQO for groundwater quality is to ensure that data of sufficient quality and quantity are collected to determine whether concentrations of water quality parameters in designated forest floor wells conform to site-specific facility threshold values. The threshold values will be determined based on comparison of background (pre-activity) groundwater well concentrations to wastewater discharge concentrations, and non-acid generating material content.

Measurement quality objectives evaluate and control the data collection process to ensure that measurement uncertainty is within an acceptable range to meet DQOs. Measurement quality objectives define the acceptable quality of field and laboratory data for the project, in terms of data quality indicators, such as the precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters (USEPA 2002). PARCC parameters are commonly used to assess the quality of environmental data. These parameters, as well as analytical sensitivity (i.e., detectability), were used to assess conformance of surface water, groundwater, and effluent data with quality control criteria, as detailed in the following sections.

As specified in the QAPP (Integral 2013d), a readiness review was conducted on the entire set of water quality data collected in 2016. This review assures that all data underwent complete quality assurance review and validation and that all qualifiers assigned during validation were entered into the database and verified.

3.2.1 Data Validation and Detectability

As specified in the QAPP (Integral 2013d), a quality assurance review of the laboratory data from chemical analyses of surface water and groundwater samples was conducted for all water quality sampling events conducted in 2016. Laboratory analytical data were validated according to the data validation procedures in the U.S. Environmental Protection Agency (EPA) guidance for inorganic data review (USEPA 2010). Data that did not meet the applicable laboratory or data validation quality control limits were qualified as undetected (assigned a *U* qualifier), estimated (assigned a *J* qualifier), or rejected (assigned an *R* qualifier) during the quality assurance review. The tabulated analytical summary data presented in Appendix C and Section 4 also present the data validation qualifiers assigned to the project data.

Detectability refers to the ability of the analytical method to reliably measure a concentration above background. Two components are used to define detectability: the method detection limit (MDL) and the practical quantitation limit (PQL) or method reporting limit (MRL).

- The MDL is the minimum value that the instrument can discern above background, but with no certainty to the accuracy of the measured value. For field measurements, the manufacturer's listed instrument detection limit can be used.
- The PQL or MRL is the minimum value that can be reported with confidence.

Sample data measured below the MDL were reported as nondetect. Sample data measured ≥MDL but ≤PQL or MRL were reported as estimated data (assigned a *J* qualifier). Sample data measured above the PQL or MRL were reported as reliable data unless otherwise qualified per the specific sample analysis. The tabulated analytical summary data presented in Appendix C include the data validation qualifiers assigned to the project data.

Field data were verified during preparation of samples and again during data entry. After field data were entered into the project database, field staff conducted 100 percent verification of the entries to ensure the accuracy and completeness of the database.

3.2.1.1 Zinc Data Qualification

The quality assurance review included assessment of the field blank results, as well as evaluation of natural samples, for each sampling event. Field blanks were collected for each sampling event for all parameters, including total and dissolved trace elements. As indicated in the 2007 and 2008 annual reports (Integral 2008a, 2009a) and the Q1 2008 quarterly report (Integral 2008b), zinc was detected in all field blanks collected from July 2007 through March 2008 at concentrations ranging from 0.64 to 51.9 µg/L. Zinc concentrations were systematically higher in the dissolved fraction than in the total fraction in the field blanks collected over this period. In addition, a systematic positive bias was observed in the dissolved versus total results for natural samples of surface water collected from July 2007 through March 2008 (64 percent).

Based on these results, surface water sample collection procedures were modified beginning in Q2 2008 to follow the groundwater protocols (i.e., use of a peristaltic pump and in-line cartridge filters for dissolved samples) in an effort to reduce or eliminate the potential for introducing zinc contamination to dissolved surface water during filtration. For field blank samples collected since Q2 2008, zinc concentrations ranged from 0.2 to 6.23 μg/L. No systematic positive bias was observed in the dissolved versus total field blanks sampled since Q2 2008. The improvements in the field blank results since sampling protocols were adjusted in Q2 2008 suggest that the changes in the surface water sampling protocols reduced zinc contamination during filtration, and therefore will continue to be used for both surface water and groundwater sampling.

Table 3-7 presents the site-specific qualification scheme developed for zinc samples collected since Q1 2008. In Q3 2009, the qualifiers for zinc samples collected in Q1 and Q2 2009 were re-evaluated based on the full set of blank data collected since sample collection methods were changed in Q2 2008. Of the 44 total and dissolved zinc samples collected at permit stations from Q1 and Q2 2009, this adjustment lead to the requalification of nine samples. Of these nine samples, five qualifiers were adjusted from *U*-qualification to *J*-qualification, and four qualifiers were revised from no qualifier to *J*-qualification. For all zinc samples collected since Q1 2009, qualifiers were assigned based on the 95th percentile of the distribution of the field blank concentrations across all sampling events from April 2008 through the sample event of interest. This results in unique zinc qualification action levels for each individual sampling event. For each sample event, results less than or equal to 2 times the 95th percentile values were qualified as undetected (assigned a *U* qualifier) and results greater than 2 times the 95th percentile but less than 5 times the 95th percentile distribution were qualified as estimated (assigned a *J* qualifier). Results greater than 5 times the 95th percentile distribution were not qualified. Revised qualifiers are included in the water quality results tables in Appendix C.

After additional sampling results become available, the zinc qualification scheme may be revised to reflect the reductions in field blank zinc contamination that have been observed since the revised sampling protocols were implemented in Q2 2008. Any such changes will be documented in the quarterly and annual reports.

3.2.1.2 Precision

Precision reflects the reproducibility between individual measurements of the same property. Surface water and groundwater field replicates were collected to assess the precision of the project results. Field replicate samples were generated using a peristaltic pump to collect water from one location into two separate sets of bottles at approximately the same time; the two sets of bottles were labeled as representing two separate sample locations in order to “blind” the replicate relationship at the analyzing laboratory.

The comparability of the field replicate results was assessed by calculating the relative percent difference (RPD) and sample difference (replicate sample – normal sample) of the results, as presented in Tables 3-6a-b and Appendix C, Tables C-4a-d. Results for normal/replicate sample pairs were evaluated against a control limit of ±50 RPD, as specified in the QAPP (Integral 20013d). Greater variability is expected for results near or below the reporting limit because the background signal variations (i.e., "noise") are greater relative to the analyte levels.

As shown in Tables 3-6a-b, the surface water and groundwater normal/replicate pairs collected in 2016 had RPDs below the control limit (RPD = ±50.

As shown in Appendix C, Table C-4a, since surface water monitoring began in 2006 the control limit (RPD = ±50) was exceeded for TDS in four sampling events (November 2007, May 2008, August 2010, and January 2011), hardness in one sampling event (April 2011), alkalinity in one sampling event (May 2009), nitrate and nitrite in one sampling event (December 2007), dissolved aluminum in one sampling event (January 2011), dissolved copper in one sampling event (August 2007), and dissolved nickel in one sampling event (April 2012). The surface water RPD values were within control limits for all other parameters. For TDS, the variability in samples could be the result of variations in sampling techniques (i.e., movement of peristaltic tube within the water column) and/or sample matrix at the time of collection, or of variations associated with the gravimetrically based analytical method (SM 2450C). Cases of RPD >50 for hardness, alkalinity, nitrate and nitrite, dissolved aluminum, dissolved copper, and dissolved nickel were isolated incidents with no clear cause.

Fourteen parameters showed normal/replicate pair differences greater than the RPD = ±50 control limit during one or more groundwater sampling events, as summarized in Appendix C, Table C-4b. For physical parameters, control limit exceedances were observed for TDS (September 2007, November 2007, April 2008, January 2011, and January 2014), hardness (October, November, December 2007; June 2008; September 2009; and October 2013), and total suspended solids (TSS) (July 2007, March 2008, August 2008, and March 2009). For these physical parameters, the variability in samples could be the result of variations in sampling techniques (i.e., movement of peristaltic tube within the water column) and/or sample matrix at the time of collection, or of variations associated with the analytical methods. Alkalinity and chloride exceeded the RPD control limit during August 2008 and October 2008, respectively. Finally, isolated cases where trace element normal/replicate pairs exceeded control limits were observed for total aluminum, chromium, copper, iron, lead, magnesium, nickel, and/or silver, as well as dissolved chromium, copper, and nickel, during multiple sample events in 2007, 2008, 2011, 2013, 2014 and 2015. Variability between the normal and replicate pairs for total (unfiltered) parameters may be associated with differences in suspended particles collected in the samples and variations in sampling techniques and/or sample matrix at the time of collection.

3.2.1.3 Accuracy

Accuracy (bias) represents the degree to which a measured concentration conforms to a reference value. Matrix spike/matrix spike duplicate (MS/MSD) samples and field blanks were analyzed to assess the data accuracy. The accuracy of the results was assessed by calculating the percent recovery for the MS/MSD samples. MS/MSD results for all analyses conducted by ALS Environmental (Kelso, Washington; formerly Columbia Analytical Services) since July 24, 2007 have been monitored and reviewed. MS/MSD data for the most recent 3 years (2011–2014) are presented in Table 3-8a for surface water and Table 3-8b for groundwater and are discussed here.

For surface water, cases where the percent recovery was outside of the control criteria are highlighted with bold font in Table 3-8a. The MS/MSD percent recoveries for chloride and sulfate in sample WQ4 in Q1 2013 and Q4 2013, respectively, were outside of the control criteria because of suspected matrix interference. Because of the interference, the results for these analytes contained a potential high bias. The results were qualified as estimated (*J*/*UJ*) during data validation. The control criteria for MS/MSD percent recoveries were not applicable for WQ6 in Q2 2012 because the analyte concentrations were significantly higher than the added spike concentrations, preventing accurate evaluation of the spike recovery.

For groundwater, cases where the percent recovery was outside of the control criteria are highlighted with bold font in Table 3-8b. Percent recovery outliers were observed for isolated analyses of sulfate, aluminum, and iron in 2011. For each of these cases, the control criteria for MS/MSD percent recoveries were not applicable because the analyte concentrations were significantly higher than the added spike concentrations, preventing accurate evaluation of the spike recovery. Percent recovery outliers were also observed for selenium in sample MW2 (Q1 2011). For this case, the laboratory noted that associated laboratory control spikes were acceptable, and that the matrix spike outlier suggests a potential low bias for the analyte in the particular matrix.

3.2.2 Representativeness

Representativeness is the degree to which data represent a characteristic of an environmental condition. All samples collected in 2016 were collected according to QAPP protocols (Integral 2013d); no discrepancies were noted. All samples were properly handled (i.e., proper preservation and shipping temperature) during collection and receipt by the laboratory, unless stated otherwise below.

3.2.3 Completeness

Data completeness refers to the amount of usable data collected. Percent completeness by parameter group was calculated for surface water and groundwater samples collected since

2006. Table 3-9 summarizes data counts and completeness, by quarter, for surface water and groundwater. No data for 2016 were rejected during data validation and review; completeness for both surface water and groundwater data was 100 percent.

3.2.4 Comparability

Comparability is the qualitative similarity of one data set to another (i.e., the extent to which different data sets can be combined for use). EPA analytical methods were used by the laboratory to analyze all 2016 samples. No discrepancies were noted between methods used by the laboratory and those listed in the QAPP (Integral 2013d). Sample results from 2016 are comparable to results from previous sampling events, with PAG pond exceptions in cadmium, copper and zinc, as described in sections 6.2.2.3, 6.2.2.5 and 6.2.2.9 , respectively.

4 SAMPLING RESULTS

This report presents the results of Permit-required and voluntary water quality monitoring conducted at the Niblack Exploration Project. The objectives of this water quality monitoring summary are to provide ADEC with the following:

- Tabulated results of laboratory analyses and field parameter measurements from the surface water and groundwater quality monitoring sites included in the Permit (ADEC 2013)
- A discussion of any concentrations measured above applicable water quality criteria
- Graphical, time-series presentation of water quality monitoring results for general water quality parameters and constituents required under the Permit, to facilitate trend detection.

These objectives provide multiple lines of evidence for evaluating water quality at the Niblack Exploration Project.

Tabulated surface water and groundwater quality monitoring results for the Niblack Exploration Project for 2016 are provided in Tables 4-1a-c. Tables 4-1a-c include results for all surface water and groundwater stations identified in the Permit for all field and laboratory parameters included on the analyte list (Table 2-3). The PAG underdrain was not sampled in 2016 because it was dry. On July 20, 2015, the field barrels were covered to temporarily close the study. This temporary closure of the barrels may be reversed and sampling resumed at the discretion of NPLLC. No voluntary offsite surface water samples were collected in 2016. Tables 4-1a-c also include results for mine discharge, PAG pond. Data are presented in individual tables for field parameters (Table 4-1a); conventional parameters and anions (Table 4-1b); and trace elements (Table 4-1c). MDLs for surface water, groundwater, effluent, PAG pond, and field barrel samples are provided in Tables 4-2a-b. Surface water and groundwater replicate results and quality control measures are discussed in Section 3.2 and presented in Tables 3-6a-b.

Results for the entire period of record, beginning in 2006, are presented in the attached Appendix C tables. These data are submitted in Acrobat PDF and Microsoft Excel format. Tables C-1a-d contain *in situ* field results. Tables C-2a-d present conventional parameters and anions, and trace elements in individual table sections. MDLs are provided in Tables C-3a-d, and field duplicate sample results and RPDs are presented in Tables C-4a-d and are discussed in Section 3.

Surface water and groundwater quality parameters at the Niblack Exploration Project were monitored in Q1, Q2 and Q4 in 2016 at the locations and frequencies listed in Tables A and B of the Permit (ADEC 2013). Table 4-3 presents a summary of the screening results for all surface water and groundwater parameters currently required at Permit stations, evaluated for samples collected from 2006 to 2016. Tables 4-4a-b present detailed, station-specific screening results for individual surface water and groundwater samples. Surface water quality is evaluated based on Alaska water quality standards (18 AAC 70). As required in the Permit, surface water results are screened against ADEC water quality criteria specified in regulation 18 AAC 70 and detailed in the *Alaska Water Quality Manual for Toxic and Deleterious Organic and Inorganic Substance*s (ADEC 2008). Groundwater measurements were screened against the site-specific groundwater well threshold values. As stated in the Permit Section 1.5, groundwater quality in the forest floor below the active project area (measured at sites MW1, MW2, MW3, and MW4) must be maintained within facility-specific threshold limits, which are based on pre-activity groundwater quality. Specific procedures for establishing site-specific water quality thresholds are described in the Permit and in the Niblack Water Quality Monitoring Plan, Post-Construction Update (Integral 2013c).

In 2016, all parameters were below ADEC screening levels. A detailed discussion of water quality screening and trends is presented in Section 5.

5 TIME SERIES ANALYSIS AND TREND DETECTION—SURFACE WATER AND GROUNDWATER

Visual analysis of time series plots provides important insights to the measured magnitude of water quality parameters, as well as patterns and trends observed both before and after initiation of exploration activity at the site in September 2007. Figures 5-1a-c through 5-25a-c present time series concentration plots for select conventional parameters and anions (Figures 5-1a-c through 5-7a-c), and trace elements (Figures 5-8a-c through 5-25a-c). These plots present surface water and groundwater samples collected from February 2006 through December 2016 under Permit 2013-DB0001. Values qualified as nondetect, by the laboratory or during data validation, are plotted as hollow symbols at half the qualified value, and a vertical gray line on each plot indicates the initiation of project activities on September 21, 2007. Solid colored lines, where present, indicate the Alaska water quality criteria (18 AAC 70) screening values for surface water and site-specific permit-required thresholds for groundwater discussed in Section 4.

Results for surface water monitoring stations located on streams that flow through the project area (WQ4, WQ6, WQ10, and WQ13) are presented on Figures 5-1a through 5-25a. Upstream reference surface water monitoring location results (WQ7, WQ8, and WQ12) are presented on the same plots for comparison; however, these upstream locations are no longer monitored as discussed in the 2012 annual report (Integral 2013e). Figures 5-1b through 5-25b show groundwater monitoring well results located downgradient of site facilities (MW1, MW2, MW3, and MW4). Upgradient monitoring wells MW8 and MW9, and offsite monitoring well MW7, are presented on the same figures for comparison but are no longer sampled. Finally, four offsite surface water stations (WQ1, WQ2, WQ3, and WQ14), previously monitored by NPLLC, are presented on Figures 5-1c through 5-25c; these four offsite surface water stations were monitored and compared to ADEC screening criteria for informational purposes only and are not an indication of Permit compliance. No voluntary monitoring was conducted at offsite or inactive stations during 2016.

5.1 CONVENTIONAL PARAMETERS AND ANIONS

Figures 5-1a-c through 5-5a-c present time series concentration plots for five conventional parameters—temperature, pH, hardness, conductivity, and TDS. Figures 5-6a-c and 5-7a-c present time series concentration plots for nitrate and nitrite (as N) and sulfate.

5.1.1 Comparison to Water Quality Criteria

Surface water temperature, pH, and TDS were compared to fresh water aquatic life criteria specified in 18 AAC 70. No applicable screening criteria exist for hardness, conductivity, nitrate and nitrite, or sulfate. All conventional parameters and anions measured at surface water stations were within water quality criteria ranges in 2016.

5.1.2 Graphical Time Series Review

Surface water and groundwater temperature results show clear and consistent seasonal fluctuations at all monitoring stations (Figures 5-1a-c). Surface and groundwater pH values are generally circumneutral at all stations both before and after the initiation of mining activity (Figures 5-2a-c). For pH, the individual surface water measurements recorded above aquatic life screening limits in 2016 fell within or near the range of previously measured values and are not indicative of changing water quality associated with site activities.

In 2016, surface water and groundwater hardness (Figures 5-3a-c) levels generally fell within historical ranges at groundwater wells MW1, MW2 and MW3. Hardness in monitoring well MW2 in 2015 exhibited a high at 82 mg/L as $CaCO_3$, the highest since 2008, but returned to normal levels (ranging from 18-12 mg/L as $CaCO_3$,) in 2016. Hardness in monitoring well MW4 was 70 mg/L as $CaCO_3$ in August 2015, above the previous maximum (51.2 mg/L as $CaCO_3$ in June 2014), but returned to a typical low values (ranging from 30.4 to 46.4 mg/L as $CaCO_3$) during Q4 2015.

Conductivity (Figures 5-4a-c) and TDS (Figures 5-5a-c) are measures of impurities in water. Conductivity at surface water stations WQ4, WQ6, WQ10, and WQ13 has generally decreased since the peak measurements in 2010, but did show some increases during 2016, which will continue to be monitored. All surface water and groundwater station conductivity measurements in 2016 were within the historical range. In groundwater, conductivity levels are variable. At well MW4, conductivity remains somewhat higher than pre-activity condition measurements, but has decreased following the maximum value recorded in Q2 2013. No patterns are evident in the TDS data, with surface water and groundwater results covering a similar range of magnitude and variability before and after initiation of mining activities.

Nitrate and nitrite concentrations remained low across all surface water and groundwater sampling sites through 2016 (Figures 5-6a-c), with the exception of MW4, which observed an increase in Q4, 2016 to 0.515 mg/L.

Surface water and groundwater also show low sulfate concentrations since monitoring began (Figures 5-7a-c). In 2016 sulfate concentrations at downstream surface water stations WQ4, WQ10, and WQ13 were sporadically slightly higher in Q4 than the historical record, with a maximum of 7.57mg/L measured at WQ4 and 13.3 mg/L measured at WQ13 in October 2016. However, sulfate concentrations measured during Q4 2016 were on an upward trend from lows earlier in the year, where they were lower than pre-mining levels and sulfates at these stations tend to exhibit spikes and dips. Groundwater station MW1 sulfate has gradually increased since initiation of mining activity, with a maximum measurement of 25.5 mg/L in June of 2014. The concentration of sulfate at MW1 in October 2016 was 22.9 mg/L. At station MW2 and MW3, sulfate remained near pre-mining levels. At groundwater station MW4, sulfate concentrations rose to a maximum of 29 mg/L in 2008 and have been decreasing but variable from 2008 through 2016. In Alaska, there is no aquatic life standard for sulfate. Surface water and groundwater sulfate levels continue to be well below drinking water standards (secondary maximum contaminant level of 250 mg/L) for taste and odor at Niblack Exploration Project monitoring stations (Figures 5-7a-b).

5.1.3 Comparison to Offsite Stations

Comparison of the time series plots for onsite (WQ4, WQ6, WQ10, and WQ13) and offsite (WQ1, WQ2, WQ3, and WQ14) surface water stations shows that conventional parameter water quality is generally consistent across stations, and that conventional parameters measured in onsite and offsite streams cover similar concentration ranges. Nitrate and nitrite concentration ranges are also comparable for onsite and offsite streams, with the exception of isolated higher concentrations measured at onsite stations during construction of the mine access drift in 2007 and 2008. Onsite and offsite surface water stations show comparably low concentration ranges for sulfate.

5.2 TRACE ELEMENTS

Figures 5-8a-c through 5-25a-c present time series plots for dissolved and total concentrations of nine trace elements listed in Permit Tables A and B—aluminum, arsenic, cadmium, chromium, copper, lead, mercury, selenium, and zinc. Values qualified as nondetect, by the laboratory or during data validation, are plotted as hollow symbols at half the qualified value, and a vertical gray line on each plot indicates the initiation of project activities on September 21, 2007. Solid colored lines indicate the Alaska water quality criteria (18 AAC 70) screening values for surface water and permit-required thresholds for groundwater. Under the Permit, collection of dissolved metals, with the exception of cadmium, copper, and zinc, is no longer required.

5.2.1 Comparison to Water Quality Criteria

During 2016, surface water concentrations of all Permit-regulated trace elements at surface water monitoring locations WQ4, WQ6, WQ10, and WQ13 were below ADEC screening levels. Concentrations of all Permit-regulated trace elements in groundwater samples collected in 2016 at stations MW1, MW2, and MW3 were below site-specific groundwater well permit threshold values for all constituents. No site-specific groundwater threshold values exist for MW4.[4]

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[4] For groundwater wells located downgradient of the LAD discharge area (MW2, MW3, and MW4), the groundwater threshold values were assigned to parameters with concentrations more than 3 times greater in the LAD discharge

5.2.2 Graphical Time Series Review

For trace elements monitored in surface water and groundwater, the time series plots (Figures 5-8a-c through 5-25a-c) show that, with individual isolated exceptions discussed below, the concentrations of trace elements in surface water and groundwater samples fall within the range of pre-activity concentrations. No consistent patterns or trends of changes in water quality are evident for any trace elements in surface water or groundwater. For surface water and groundwater stations, many trace element concentrations were below instrument detection limits, as shown by hollow symbols on the figures.

5.2.2.1 Aluminum

As shown in Figure 5-8a and Figure 5-9a, dissolved and total aluminum concentrations at all four surface water compliance stations (WQ4, WQ6, WQ10, and WQ13) in 2016 were close to or within the range of concentrations measured prior to initiation of mining activity. Total aluminum concentrations in surface water at station WQ4 were elevated compared to upstream measurements at WQ8 in some measurements taken prior to February 2008, but dissolved aluminum concentrations (Figure 5-9a) at station WQ4 have remained generally comparable to upstream levels through the entire monitoring period. The relatively high total aluminum measurements at WQ4 are likely associated with natural variability and the capture of solids in the unfiltered water sample and are not likely an indication of contamination. In July 2009, concentrations of both total and dissolved aluminum were somewhat high relative to previous measurements at all four downstream surface water compliance stations. Concentrations decreased to typical low levels in the subsequent sampling events.

In groundwater, dissolved and total aluminum concentrations measured at compliance wells MW1, MW2, MW3, and MW4 (Figures 5-8b and 5-9b) generally show relatively higher concentrations from 2007 through 2008, followed by lower concentrations in 2009 through 2016. Dissolved aluminum in groundwater may show a seasonal pattern of higher concentrations in the warmer summer and fall months. Dissolved aluminum monitoring is no longer required by the Permit, and was not monitored in surface water or groundwater after Q2 2013.

5.2.2.2 Arsenic

Figures 5-10a-b and 5-11a-b present total and dissolved arsenic concentrations for surface water and groundwater. Arsenic concentrations at surface water or groundwater compliance monitoring stations have remained low during the life of this project, with surface water concentrations significantly below aquatic life standards. For surface water, the maximum total arsenic concentration of 0.63 μg/L was measured in 2008 at WQ4; most concentrations

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water (as measured at station EFF1) than in background (pre-activity) groundwater. Evaluation of water quality at MW4 showed that no threshold values are applicable to this station.

measured both before and after initiation of mining activities at the site fall below instrument detection limits. There is a slight upward trend in arsenic at MW2 in October 2016 at 0.46 µg/L, but on trend with historical averages. The maximum total arsenic concentration in groundwater (2.36 µg/L) was measured in 2007, prior to initiation of site activities, at offsite reference well MW7. Dissolved arsenic monitoring is no longer required by the Permit.

5.2.2.3 Cadmium

Figures 5-12a-b and 5-13a-b present total and dissolved cadmium concentrations for surface water and groundwater. Similar to arsenic, no consistent concentration trends have been observed for cadmium at the surface water or groundwater compliance monitoring stations since monitoring began. For surface water, the maximum total cadmium concentration of 0.073 µg/L was measured in 2012 at WQ4; the paired dissolved sample was below detection. Most surface water total and dissolved cadmium concentrations measured both before and after initiation of mining activities at the site fall below instrument detection limits, and all measured dissolved concentrations were below the chronic and acute aquatic life standards. In June 2014, total cadmium at WQ6 was somewhat high relative to previous measurements; this increase was likely associated with natural variability and the capture of solids in the unfiltered water sample. Concentrations were below detection in the paired WQ6 dissolved cadmium sample, and concentrations decreased to typical nondetect levels in the subsequent sampling events. The maximum detected total cadmium concentration in groundwater was 0.097 µg/L, measured in September 2007at MW4, prior to any discharge from the LAD system. All detected groundwater dissolved cadmium concentrations measured since monitoring began at MW2 and MW3 were below the site-specific groundwater well threshold values.

5.2.2.4 Chromium

Figures 5-14a-b and 5-15a-b present total and dissolved chromium concentrations for surface water and groundwater. Prior to 2013, chromium monitoring was required at station EFF1 only; total chromium was generally not analyzed after June 2008 until Q2 2013 at surface water and groundwater stations.

For total (unfiltered) chromium at surface water Permit stations (Figure 5-14a), the highest concentration in 2015 was 0.34 µg/L in WQ4 during Q4. This value is within historical ranges in the permit stations.

In groundwater, total (unfiltered) chromium concentrations during 2016 varied between 0.17 µg/L at MW1 during Q1 and 1.59 µg/L at MW4 in Q1 (Figure 5-14b). Total chromium concentrations at all stations have been low (under 15 µg/L) over the period of record except for relatively high values (peak of 71.5 µg/L) measured at MW4 prior to project activity. One measurement, recorded in August 2008 prior to establishment of the site-specific thresholds, was equal to the threshold value of 6.31 µg/L.

All surface water and groundwater total chromium concentrations were compared to the unfiltered chromium (VI) water quality standard of 50 µg/L, in order to determine if dissolved chromium (VI) sampling may be requested by ADEC. No surface water or groundwater concentrations have exceeded the chromium VI standard since monitoring began, with the exception of the anomalous measurement at MW4 in February 2007. Neither dissolved nor species-specific chromium sampling is required at this time.

5.2.2.5 Copper

Concentrations of total copper at surface and groundwater compliance stations have remained low in 2016. Dissolved copper concentrations at surface water compliance stations WQ4, WQ6, and WQ10 (Figure 5-16a) closely track their respective upstream reference station measurements and generally fall well within pre-activity concentration ranges for the entire monitoring period. There is no upstream reference station for WQ13. As observed for aluminum, dissolved copper concentrations were somewhat high relative to previous measurements at all four downstream surface water compliance stations (WQ4, WQ6, WQ10, and WQ13) during temporary mine closure in July 2009, but decreased to well within pre-activity concentration ranges in the subsequent 2009 through 2016 sampling events. The concentrations of dissolved copper at surface water stations WQ4, WQ6, WQ10 and WQ13 were less than the hardness-based chronic aquatic life standard in 2016.

At groundwater stations MW1, MW2, MW3, and MW4, dissolved copper concentrations (Figure 5-17b) were relatively high during project initiation and prior to discharge from the LAD system, but fell to concentrations within or below pre-activity concentration ranges in sampling events from 2008 through 2016. As with dissolved aluminum, a seasonal pattern may be evident in the groundwater monitoring data, with annual dissolved copper concentration peaks generally observed in summer or early autumn at all four groundwater compliance stations. As with arsenic, there is a slight upward trend in copper at MW2 in October 2016 at 3.08 µg/L, but on trend with historical averages. All groundwater dissolved copper concentrations measured since monitoring began at MW1 have been below the site-specific groundwater well threshold value of 2.61 µg/L.

5.2.2.6 Lead

Concentrations of total lead at surface and groundwater compliance stations have remained very low through 2016 (Figures 5-18a-b0. Dissolved lead has rarely been detected in surface water compliance stations (Figure 5-19a). Review of the time series plots indicates that dissolved lead generally is not present in surface water in elevated concentrations either pre- or post-initiation of the project. Furthermore, all detected surface water concentrations have been below the chronic and acute aquatic life lead criteria throughout the monitoring record. In groundwater, dissolved lead (Figure 5-19b) concentrations were higher during project initiation, but have decreased to below pre-activity ranges in the subsequent 2009 through 2013 sampling events, when sampling for dissolved lead was no longer required. As observed for aluminum and copper in surface water, a possible seasonal pattern for groundwater dissolved lead may be evident, with concentration peaks observed in summer or early autumn.

5.2.2.7 Mercury

Total and dissolved mercury concentrations in both surface water and groundwater have been generally below laboratory detection limits since monitoring began at the site (Figures 5-20a-b and 5-21a-b). Mercury is not present at elevated concentrations either pre- or post-initiation of the project.

5.2.2.8 Selenium

No consistent concentration trends have been observed for dissolved selenium at the surface water or groundwater compliance monitoring stations during the life of this project (Figures 5-22a-b). As with arsenic and copper, there is a slight upward trend in selenium at MW2 in October 2016 at 0.6 µg/L, but below historical maximums. Most concentrations measured both before and after initiation of mining activities at the site were below instrument detection limits, and all surface water total selenium concentrations were below the chronic and acute aquatic life standards (Figures 5-23a-b).

5.2.2.9 Zinc

Concentrations of total zinc at surface and groundwater compliance stations were nondetect in 2016 and were consistent with low zinc concentrations observed through the monitoring record (Figures 5-24a-b). Dissolved zinc has rarely been detected in surface water samples (Figure 5-25a), and was not detected in 2016. Zinc is generally not present in surface water either pre- or post-initiation of the project.

In groundwater, dissolved zinc (Figure 5-25b) concentrations were below detection limits in all samples collected from 2008 through 2016 at wells MW1 and MW2. At well MW3, a single sample measured in January 2010 (19.6 µg/L) was higher than any previous measurement at this location. In MW4 samples, detected concentrations of dissolved zinc that were higher than the maximum pre-activity concentration (10.7 µg/L) were observed in six sampling events from October 2007 through July 2009, with concentrations ranging up to 22.7 µg/L. No consistent patterns of elevated zinc concentrations are evident in the groundwater data, and all concentrations measured since April 2010 were below detection limits. All groundwater dissolved zinc concentrations measured at MW2 and MW3 in 2016 were below the site-specific groundwater well permit threshold values. Individual measurements recorded in 2007 and 2008 at MW2, and in 2007 and 2010 at MW3, prior to establishment of the site-specific thresholds, were above the site-specific threshold values.

5.2.3 Comparison to Offsite Stations

Sampling at offsite stations is not required by the Permit and was not conducted during 2016. Comparison of the time series plots for onsite (WQ4, WQ6, WQ10, WQ13) and offsite (WQ1, WQ2, WQ3, WQ14) surface water stations shows that trace element water quality is generally consistent across stations, and that conventional parameters measured in onsite and offsite streams cover similar concentration ranges. Concentrations above the aquatic life standards for several trace elements (total aluminum, dissolved cadmium, dissolved copper, and dissolved zinc) were observed at offsite stations during the period of record. These relatively high concentrations suggest naturally elevated levels of trace elements near the project site.

5.3 SUMMARY

In summary, concentrations of all Permit-regulated trace elements at surface water and groundwater monitoring stations were below aquatic life screening levels or Permit groundwater thresholds during 2016.

For conventional parameters and cations/anions, surface water and groundwater monitoring results generally show expected seasonal fluctuations and consistent ranges since monitoring began. Sulfate measured at some surface water and groundwater stations has increased somewhat since initiation of mining activity but remains far below standards; monitoring of these stations and review of the data will continue as required by the Permit.

The graphical time series and trend evaluation shows that, for trace elements, the concentrations in surface water and groundwater samples collected after initiation of exploration activity generally fall within the range of pre-activity concentrations and, therefore, do not appear to depart from natural conditions. As discussed in previous annual reports (e.g., Integral 2013e), certain trace elements (dissolved aluminum, copper, and lead) were observed in relatively high concentrations at surface water stations WQ4, WQ6, WQ10, and WQ13 in July 2009 during the temporary mine closure period (October 2008 through mid-September 2009). Samples collected at these stations since October 2009 show that concentrations have returned to the range of values observed prior to temporary mine closure. No consistent patterns or indication of trend changes in water quality are evident for any trace elements in surface water or groundwater. The slight upwards trend at MW2 in arsenic, copper and selenium should be closely monitored in future samples for indication overall trend, but fall below historical spikes and on trend with historical averages.

Based on the compliance monitoring data collected after the initiation of underground exploration from September 2007 through December 2016, the graphical analyses presented in this report, and statistical analyses presented in the previous 2007 through 2015 annual reports (Integral 2008a, 2009a, 2010, 2011, 2012a, 2013e, 2014, 2015, 2016), the weight of evidence indicates that site exploration activities have not resulted in significant changes to natural surface water and groundwater quality in the vicinity of the project. Compliance monitoring and trend evaluation will continue as the monitoring program proceeds and additional data becomes available.

6 WASTE ROCK AND MINE WATER MONITORING PROGRAM

Mine discharge water is monitored at the outlet to the LAD system (station EFF1, at the outflow of the settling pond) and waste rock leachate and runoff are monitored at the PAG pond (station PAG) as required by the Permit. The water quality discussed in this section also includes the water quality associated with the mine portal (station PORTAL), and onsite waste rock kinetic field barrel tests (stations LO1, LO2, and HW1). These monitoring stations are shown on Figure 3-1 and discussed in more detail below, followed by a discussion of the water quality monitoring results. The PAG area monitoring program is designed to inform site water and waste rock management decisions; these waters are not subject to aquatic life or site-specific standards. The 2016 monitoring record and analyte list are summarized in Tables 3-2 and 3-3, respectively. Their historical sampling schedules are described in Table 3-5.

6.1 BACKGROUND AND MONITORING LOCATION DESCRIPTIONS

The excavation of a 2,800-ft exploration drift (completed June 2008), along with construction of a variety of supporting infrastructure (Figure 2-2), has provided materials for geochemical characterization to determine the potential for acid rock drainage on the Niblack Exploration Project site. Each drift excavation blast round was subjected to analysis to determine if the rock was PAG, following the specifications outlined in the Plan of Operations (Niblack 2007). A storage facility was constructed onsite (Figure 6-1) for the temporary storage of PAG blast rock. Current mine plans involve the return of the PAG material to the underground drift for final reclamation and site closure.

Of the approximately 286 blast rounds completed, 43 were determined to comprise mainly PAG rock. Of the 43 “PAG rounds,” 4 rounds were considered to be “well mineralized” and were placed in a small stockpile located just east of the PAG storage facility, on a layer of geo-membrane, and subsequently covered by geo-membrane to prevent weathering (Figure 2-2). The remaining 39 rounds (approximately 9,000 tons), primarily sulfide-bearing Lookout rhyolite, were placed in the temporary PAG storage facility, which is also referred to as the PAG pile (Figure 6-1).

Based on QA/QC verification test work conducted as a part of the operational characterization plan, the material in the PAG pile is anticipated to average ~1 percent total sulfur, predominantly as sulfide-sulfur, with low neutralization potentials, <~20 kg $CaCO_3$/t equivalent, and corresponding neutralization potential ratios of <0.5 (MESH Environmental 2009).

Following the completion of underground drilling in October 2008, NPLLC (then CBR) initiated the process of placing the project on temporary closure, as defined within several of its operating permits. Originally, ADEC requested that the PAG rock pile be covered during the period of temporary closure. However, NPLLC (then CBR) requested approval to leave the PAG rock pile uncovered. A waiver of the intermediate cover requirement (18 AAC 60.243) under the Permit was granted by ADEC on January 26, 2009 (Buteyn 2009, pers. comm.). The uncovered pile provides an opportunity to evaluate the weathering behavior of the PAG rock and provides quantitative information for waste management practices for possible future site development.

The leachate and runoff water captured in the PAG pond is monitored on a monthly basis for field parameters including pH, sulfate, conductivity, dissolved oxygen, and total dissolved solids. Approval was received from ADEC on January 16, 2014 to change monitoring field parameters from weekly to monthly due to the continued temporary closure status of the project site. Field parameter monitoring serves as an early indicator for any potential changes in PAG pond water quality. If a significant reduction in pH, or increase in sulfate or other field parameter, is observed, the chemistry monitoring frequency may be increased, as determined by NPLLC and ADEC. A cover will be placed on the PAG pile if required due to a change in the chemistry of the PAG pond or at the request of ADEC or the Alaska Department of Natural Resources.

Water from the PAG rock pile accumulates in the PAG pond before flowing to two settling ponds (Figure 6-1) where it comingles with water from the exploration drift portal and direct rainfall to the ponds. The settling ponds are monitored at station EFF1 (discussed in Section 6.1.3).

6.1.1 PAG Pond

The PAG waste rock storage facility was constructed in spring 2008 for the temporary storage of the blast rock determined to be potentially acid generating during drift excavation. Runoff and leachate from the PAG waste rock pile is monitored at the PAG pond (Figure 3-1) on a monthly basis for field parameters and annually for analytical chemistry parameters.

6.1.2 Portal Water (PORTAL)

The mine effluent has been monitored in two general areas: at the point of inflow to the settling ponds and near the portal entrance. Mine effluent samples are referred to as PORTAL locations, or sometimes drift samples. Portal water quality monitoring at the inflow to the settling ponds is not required under the Permit and was not conducted during 2016. Voluntary monitoring has historically provided information about the quality of water entering the settling ponds that may be useful for site operations and management decisions.

From 2007 through 2010, 27 samples were collected at the portal entrance and within the drift at distances from 150 to 2,775 ft from the portal entrance. These samples were collected to fulfill previous permit (ADEC 2007) requirements that samples be collected at seeps or drill holes near the portal entrance, facilitating determination of natural groundwater quality in support of post-closure monitoring.

6.1.3 Effluent (EFF1)

Station EFF1 is located in the site settling ponds (Figure 3-1). Sample water is collected from within the ponds at the outlet pipe which flows to the LAD system. Water sampled at station EFF1 is representative of the water that is discharged from the LAD system emitters. Monitoring at EFF1 includes monthly field parameter measurements and full water chemistry on an annual basis.

6.1.4 Field Barrels

Three field barrels (HW1, LO1, and LO2) were established to further characterize the natural weathering of Niblack Exploration Project waste rock. Details on the material loaded into each field barrel are provided in Appendix D. Field barrels were monitored on a weekly basis for field parameters from July 2008 until January 2014, monthly until July 2015, and quarterly for complete chemistry analysis from July 2008 until July 2015, at which time the study was placed on temporary closure (e.g., covered). This temporary closure of the barrels may be reversed and sampling resumed at the discretion of NPLLC.

6.2 RESULTS

Surface water and groundwater quality monitoring results for the Niblack Exploration Project for 2016 are provided in Tables 4-1a-c, including results for mine discharge and PAG pond for all field and laboratory parameters included on the analyte list (Table 3-3). Data are presented in individual tables for field parameters (Table 4-1a); conventional parameters and anions (Table 4-1b); and trace elements (Table 4-1c). MDLs for all samples are provided in Tables 4-2a-b.

Results for the entire period of record, beginning in 2006, are presented in the attached Appendix C tables. These data are submitted in Acrobat PDF and Microsoft Excel format. Tables C-1a-d also include results for offsite surface water, effluent, PAG pond, and test barrel samples. *In situ* field results are presented in Table C-1d. PAG area water quality data are presented in individual table sections for conventional parameters and anions, and trace elements in Table C-2d. MDLs for mine water samples are provided in Table C-3d, and field duplicate sample results and RPDs are presented in Table C-4d and are discussed in Section 3.

Figures 6-2 through 6-31 present time series concentration plots for select conventional parameters and anions (Figures 6-2 through 6-11) and trace elements (Figures 6-12 through 6-31). These plots present water quality results for the PAG pond, EFF1, portal, and field barrel samples collected from June 2007 to December 2016. On each plot, values qualified as nondetect, by the laboratory or during data validation, are plotted as hollow symbols at half the qualified value and a vertical gray line indicates the initiation of project activities on September 21, 2007. Visual analysis of the time series plots provides important insights to the measured magnitude of water quality parameters, as well as patterns and trends observed at the site.

6.2.1 Conventional Parameters and Anions

The settling/treatment ponds (EFF1), PAG pond, and field kinetic test barrels are monitored quarterly for the parameters specified in Table A of the Permit, concurrent with quarterly, (annually hereafter while in temporary closure) surface water and groundwater monitoring. Additionally, these stations are monitored monthly for field parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity. The field kinetic test barrels were monitored until July 2015, when they were covered and the study put on hold. The temporary closure of the study can be reversed and sampling resumed at the discretion of NPLLC. During 2016, personnel were onsite at least monthly; field parameters were monitored when personnel were onsite. Figures 6-2 through 6-8 present time series concentration plots for conventional parameters—temperature, pH, hardness, conductivity, TDS, turbidity, and dissolved oxygen.

6.2.1.1 Conventional Parameters

Temperature (Figure 6-2) shows strong seasonal fluctuation in the PAG pond and the settling ponds (EFF1), which continued through 2016.

The 2016 field pH values (Figure 6-3) from the PAG pond monthly sampling events continued to be circumneutral, ranging from 7.62 to 6.27. Overall, PAG pond pH values continued to follow the seasonal trend of lower pH values through the winter months (values ~6) in comparison to summer months (values ~7.5). EFF1 monthly pH ranged from 6.19 to 7.83 during 2016. Field pH results for the PAG pond and EFF1 were generally comparable throughout the entire monitoring record, with the exception of October 2010, during grout application, and in February and March 2011, when the PAG pond was frozen.

Hardness (Figure 6-4) in the PAG pond fluctuates seasonally, with maximum yearly values consistently occurring in summer months. PAG pond hardness was measured at its highest concentration (790mg/L) in October 2016, up from its historical range in January (205 mg/L). EFF1 hardness remained near historical levels. The level of hardness in EFF1 is somewhat lower than PAG pond hardness.

Conductivity in the PAG pond is more variable than at EFF1 (Figure 6-5). Conductivity typically increases in the summer for the PAG pond; in contrast, clear seasonal patterns are not evident for EFF1. During 2016, conductivity in the PAG pond ranged from 372 to 1410 μS/cm, while EFF1 ranged from 176 to 208 μS/cm.

TDS (Figure 6-6) in the PAG pond and field barrels generally shows overall higher values in the summer months than during winter, corresponding with seasonal changes in both temperature and conductivity. The highest value for TDS in the PAG pond was recorded October 2016 at 1140 mg/l. Summertime TDS concentrations at EFF1 are generally lower than the concentrations observed in the PAG pond.

Turbidity (Figure 6-7) is generally low (<10 nephelometric turbidity units [NTU]) in the PAG pond, with greater fluctuation at EFF1. Since Q3 2011, turbidity measurements at EFF1 have shown lower average values and less variability.

No clear seasonal or temporal pattern exists for dissolved oxygen (Figure 6-8) at the PAG pond or EFF1. In 2016, dissolved oxygen measurements range from 7.4 to 14.15 mg/L.

Conventional and monthly field parameters continue to fluctuate within yearly seasonal norms, indicating little change in the system dynamics in the PAG pond or EFF1. None of the conventional parameters measured in mine water stations shows evidence of a substantial or ongoing change in magnitude, trend, or pattern over the monitoring record. Furthermore, the conventional parameter results measured throughout 2016 are generally consistent in magnitude with previous monitoring data. No portal samples were collected in 2016.

6.2.1.2 Anions

Figures 6-9 through 6-11 present time series concentration plots for alkalinity, nitrate and nitrite as nitrogen, and sulfate. With the exception of isolated cases described below, none of these parameters has changed in magnitude, trend, or pattern during the mine water monitoring period.

Alkalinity monitoring is not required under the Permit and it was not measured during 2016. It is discussed here to provide additional information about settling pond and waste rock leachate chemistry. PAG pond and EFF1 alkalinity (Figure 6-9) have remained relatively stable over the monitoring record.

In the PAG pond, nitrate and nitrite concentrations (Figure 6-10) have decreased to near detection limits from early highs (up to 192 mg/L as N) measured in 2008. Nitrate and nitrite observed in the PAG pond may be related to blasting residue intermixed in the rock material during drift construction. The sharp decrease in nitrate and nitrite concentrations indicates that the nitrogen from blasting has been flushed from the PAG waste rock. EFF1 has shown consistently low (<18 mg/L as N) concentrations since monitoring began in 2006.

Sulfate (Figure 6-11) in the PAG pond shows overall higher values in the summer months than during winter, corresponding with seasonal changes in both temperature and conductivity. The PAG pond 2016 results are consistent with previous years, with the exception of an increase in Q4. The increase is consistent with seasonal patterns (Figure 6-11), but Q4 2016 was the highest value ever recorded at 846 mg/L (previous high was 680 mg/L in 2015). Monthly field parameter monitoring indicated sulfate concentrations are within normal range (100 to 175 mg/L between September and December 2016; Table 4-1a, Appendix C, Table C-1d). The increase in sulfate concentrations did not translate to increases in concentrations in EFF1 or discharge to the LAD. Sulfate concentrations measured at EFF1 are consistently lower and less variable than in the PAG pond water. In 2016, all sulfate measurements at EFF1 were below 50 mg/L.

Monthly field sulfate results (Appendix C, Table C-1d) are comparable to the analytical laboratory results (Appendix C, Table C-2d) for all of the mine water stations with the recent exception. However, the field tests are not capable of reliable measurements above 200 mg/L or below 50 mg/L.

6.2.2 Trace Elements

Acid rock drainage is commonly caused by the oxidation of iron sulfides, which causes solutions to become more acidic and certain trace elements (e.g., copper, cadmium, zinc) to therefore become more soluble. Other metals (e.g., arsenic, selenium) can be soluble at near-neutral pH. The waters in the Niblack Exploration Project mine water monitoring program exhibit circumneutral pH, and trace element concentrations are typically low. While non-iron-bearing sulfides still oxidize under atmospheric conditions, they can be less acid generating than iron-bearing sulfides. The notable presence of zinc, cadmium, and copper in solution, particularly in field test barrel LO1, suggests that non-iron-bearing sulfides may play an important role in the geochemistry and acid generation potential of the Niblack Exploration Project PAG rock.

Figures 6-12 through 6-31 present time series total and dissolved concentration plots for 10 trace elements identified for monitoring in surface water and groundwater in Table B of the Permit—aluminum, arsenic, cadmium, chromium, copper, lead, mercury, selenium, zinc, and iron. Values qualified as nondetect, by the laboratory or during data validation, are plotted as hollow symbols at half the qualified value, and a vertical gray line on each plot indicates the initiation of project activities on September 21, 2007.

6.2.2.1 Aluminum

Total aluminum concentrations (Figures 6-12 and 6-13) have generally been lower at EFF1 than in PAG pond and barrel tests. Total aluminum in PAG pond increased from generally < 40 µg/L to 91.9 µg/L in Q4 2015. The levels did drop in 2016, ranging from 44.2 µg/L to 50.9 µg/L. Dissolved aluminum was not collected and analyzed during 2016 because it is not required under the Permit. EFF1 aluminum concentrations have decreased from relatively higher values observed during drift construction from 2007 to 2008, with 2016 total aluminum concentrations of ranging from 9 µg/L in Q4 to 17.4 µg/L in Q1. The PAG pond has exhibited relatively steady dissolved aluminum concentrations over the monitoring record, which are generally below 50 µg/L.

6.2.2.2 Arsenic

In 2016, total arsenic concentrations (Figure 6-14) ranged from nondetect to 0.2 µg/L in the PAG pond. Dissolved arsenic (Figure 6-15) was not collected and analyzed during 2016 as it is not required under the Permit. As shown on the time series plots, first flush field barrel arsenic concentrations measured through early 2009 were higher in the field barrels than in the PAG pond; however, arsenic concentrations in the PAG pond have been similar and low (less than 1 µg/L) since early 2010. Total arsenic at EFF1 measured between 0.35 and 0.4 µg/L during 2016; over the period of record, total arsenic concentrations have fluctuated between 0.1 µg/L and a June 2008 high of 3.4 µg/L.

Comparison of the total and dissolved arsenic concentrations over time shows that arsenic is present primarily in the dissolved fraction in the settling ponds and field barrel leachate.

6.2.2.3 Cadmium

PAG pond and HW1 cadmium concentrations (Figures 6-16 and 6-17) have historically been low. In 2016 however, PAG pond cadmium concentrations increased significantly in Q4 to the highest measured since project initiation, with total and dissolved cadmium concentrations of 105 and 100 µg/L, respectively. In Q3 2015, as noted in the 2015 Annual Report (Integral 2016) cadmium concentrations showed an increase with total and dissolved cadmium concentrations of 12.3 and 12.1 µg/L, respectively. In Q4 2015, total and dissolved cadmium concentrations decreased slightly to 10.1 and 10.2 µg/L, respectively. It was noted at the time that a concentration of total cadmium being less than the dissolved cadmium concentration is not logical and is likely a result of sediment entrained in the sample. In Q1 and Q2 of 2016, cadmium concentration appeared to be decreasing towards normal values, which makes the magnitude of the increase in Q4 very unusual. It could be a change related to PAG pile weathering, or higher concentration of some metals in the sample due to the PAG pond water level being low at the time. There was very little total precipitation the two weeks prior (< 1") to the sample event.

EFF1 cadmium concentrations at EFF1 show a slight gradual increase since 2013, but have remained low throughout the period of record with the exception of small increases during temporary closure in 2009 (Integral 2010), an anomalous spike in 2011, and another starting in April 2013. Total and dissolved cadmium at EFF1 decreased at the beginning of 2016, seemingly returning to normal levels following an uncharacteristic increase at the end of 2015. Q1 and Q2 2016 concentrations appeared to be trending down towards historic levels, but increased again comparable to results at the end of 2015. EFF1 total cadmium was 0.873 µg/L and dissolved cadmium was 0.89 µg/L in Q4, 2016. Again, a concentration of total cadmium being less than the dissolved cadmium concentration is not logical and is likely a result of sediment entrained in the sample. Though EFF1 cadmium concentrations show a gradual increase since 2013, they do not translate to the significant increase at the PAG pond. This could further support the indication the concentrations in the PAG pond sample are a result of low water levels. NPLLC will continue to monitor water quality in the PAG pond and EFF1 to determine if the cadmium levels measured are anomalous or indicative of a trend over time.

6.2.2.4 Chromium

Total chromium is a newly required monitoring constituent in the Permit for the PAG pond, and therefore has a limited number of samples for time series visual comparisons at that station. Total chromium concentrations (Figure 6-18 and 6-19) in 2016 varied between nondetect (0.12 µg/L) and nondetect (0.14 µg/L) at the PAG pond, and 0.26 µg/L and 0.32 µg/L at EFF1. At station EFF1, chromium concentrations have remained consistently low after the drift excavation, which occurred between 2007 and early 2008 (Figures 6-18 and 6-19). Dissolved chromium monitoring is generally not required[5] and was not performed in 2016. Dissolved chromium at EFF1 was low throughout the monitoring record; concentrations measured at EFF1 during drift excavation from 2007 through early 2008 were somewhat higher, ranging from 6.8 to 33.4 µg/L.

6.2.2.5 Copper

PAG pond copper concentrations (Figure 6-20 and 6-21) were consistently low (less than 4.1 µg/L) until Q3 2015 when total copper increased to 20.1 µg/L and increased further in Q4 to 54.7 µg/L. Dissolved copper did not increase until Q4 2015 (35.8 µg/L). As with cadmium concentrations, copper concentrations in PAG pond samples seemed to be decreasing towards historic levels in Q1 and Q2 2016 before a significant increase in Q4 to the highest concentrations for copper recorded since project initiation, with total and dissolved copper concentrations of 392 and 353 µg/L, respectively. Again, this could be a change related to PAG pile weathering, or higher concentration of some metals in the sample due to the PAG pond water level being low at the time.

Copper concentrations at EFF1 have been variable, but generally low, with the exception of an isolated spike in September 2011 (63.5 µg/L). Though there was an increase in PAG pond copper concentrations, these did not translate to increases at EFF1. In 2016, total copper concentrations at EFF1 ranged from 5.81 in Q2 to 7.69 µg/L in Q4, following historic levels.

[5] Table B of the Permit states that if the unfiltered total chromium value exceeds the chromium (VI) water quality standard of 50 µg/L, samples of dissolved chromium (VI) may be requested by ADEC.

6.2.2.6 Lead

Total and dissolved lead (Figure 6-22 and 6-23) have generally remained low in the PAG pond and EFF1. There was a slight increase in total lead at PAG pond in Q4 2015 (0.963 μg/L) but levels trended down throughout 2016, with Q4 2016 total lead 0.448 μg/L. The concentration of total lead at EFF1 fluctuated until Q2 2011 when concentrations stabilized near the detection limit (0.01 μg/L). The period of increased dissolved lead concentration (up to 0.79 μg/L) at EFF1 from March through July 2009 was associated with a period of temporary closure of the exploration drift and limited flows. Samples were not analyzed for dissolved lead in 2016 because it is not required by the Permit.

6.2.2.7 Mercury

Mercury was not detected during 2016 in waters sampled from the PAG Pond and EFF1 (Figures 6-24 and 6-25). Mercury detection limits have remained at 0.02 μg/L since May 2009. Mercury results have been dominated by nondetects through the project history. Samples were not analyzed for dissolved mercury in 2016 because it is not required by the Permit.

6.2.2.8 Selenium

Total and dissolved selenium (Figures 6-26 and 6-27) concentrations at the PAG pond and EFF1 have remained fairly consistent (generally below 2 μg/L at the PAG pond and below 1 μg/L at EFF1) over the monitoring record and through 2016. Samples were not analyzed for dissolved selenium in 2016 because it is not required by the Permit.

6.2.2.9 Zinc

Historically total and dissolved zinc concentrations (Figures 6-28 and 6-29) have been generally stable and low in the PAG pond and EFF1. As with cadmium and copper, at the end of 2015 the concentration of total zinc increased in the PAG pond; Q1 and Q2 2016 concentrations showed a decrease before a significant increase in Q4 to the highest concentrations for zinc recorded since project initiation, with total and dissolved zinc concentrations of 20,800 and 20,000 μg/L, respectively. At station EFF1, dissolved and total zinc decreased in early 2016, before increasing slightly to levels similar to end of 2015 at 131 μg/L and 129 μg/L, respectively, in Q4 2016. As with cadmium, a concentration of total zinc being less than the dissolved zinc concentration is not logical and is likely a result of sediment entrained in the sample

6.2.2.10 Iron

Iron monitoring is not required under the Permit; iron is discussed here to provide additional information about settling pond and waste rock leachate chemistry. Iron was not measured during 2016; trends through Q2 2013 are discussed here. Time series plots of total and dissolved iron are presented on Figures 6-30 and 6-31. At the PAG pond, EFF1, and field barrels, dissolved iron measurements frequently fell below detection limits; the maximum dissolved iron concentration measured in mine water was 234 µg/L at station EFF1 in September 2011. Based on the geochemical properties of iron and the circumneutral pH levels measured in effluent, it is expected that much of the iron will precipitate as a solid. Comparison of dissolved iron and total iron at the settling pond and field barrel monitoring stations during the period of record indicates that iron in the system is dominated by the total (particulate) form.

For total iron, PAG pond concentrations decreased through 2013 from a maximum of 311 µg/L measured during early monitoring in October 2008. Fluctuations in total iron concentration continued to occur, with maximums in the fall.

At settling pond station EFF1, total iron fluctuated over the monitoring record, with maximum concentrations in excess of 6,000 µg/L observed in 2008 during construction of the exploration drift, which fell to measurements consistently below 100 µg/L from the end of 2011 through the period of record.

As observed for several other trace elements (e.g., arsenic, copper, selenium), field barrels exhibited higher total iron concentrations during initial measurements in 2008, suggesting an early flushing of the field barrel rock material. Total iron concentrations in the field barrels subsequently remained generally low (<100 µg/L) and were frequently below detection limits.

6.2.3 Summary

PAG pond and EFF1 water pH levels have remained circumneutral since monitoring began in 2006, and conventional parameters, anions, and trace elements have remained stable within annual seasonal fluctuations. Generally, concentrations of sulfate and some dissolved trace elements (i.e., copper and zinc) have shown slight increases in the summer months (July/August), suggesting potential seasonal trends in sulfide oxidation.

The significant increases in PAG pond total and dissolved cadmium, copper and zinc concentrations in at the end of 2016 is highly uncharacteristic. All three trace elements showed slight increases at the end of 2015, to which NPLLC agreed to monitor closely in Q1 2016 samples, which showed a decrease, a trend which followed in Q2, making the Q4 increase even more unusual. As described, the increases could be a result of PAG weathering or higher concentrations of trace elements due to low PAG pond water levels. No other trace elements exhibited similar trends, and did not translate to patterns at EFF1, where solute concentrations generally remained within historical ranges in 2016. Total and dissolved chromium did exhibit some increases at EFF1 in Q4 compared to Q2, but not nearly as significant as PAG pond concentrations and remained below historical highs. Water discharged to the LAD system remained relatively unaffected by the increases in PAG pond concentrations. NPLLC will continue to monitor water quality at these stations to determine if concentrations measured in Q4 2016 are anomalous.

7 STORMWATER POLLUTION PREVENTION PLAN REPORTING

This section presents a summary of activities performed under the SWPPP (RTR 2006), including visual inspections and spill reports.

7.1 VISUAL INSPECTIONS

Visual inspections of the site for stress to vegetation, channelization in wastewater application areas, and function of stormwater controls were conducted at a minimum frequency of monthly, as allowed under the modified suspension of operations plan (Evans 2014, pers. comm.), instead of weekly, as required in Section 1.2.3.6 of the Permit and in the SWPPP (RTR 2006). No stress to vegetation and no channelization were observed in the land application area during 2016. Ditches and settling ponds were cleared during ongoing maintenance to facilitate proper function. Visual site inspection forms are provided in Appendix B.

Past interim remediation efforts, such as the maintenance of both upstream and downstream culvert settling ponds, increases in road lifts and ditch depths to properly control water flow, and the addition and maintenance of flow control measures (e.g., geotextile/silt fences and rock barriers) have led to a visible reduction in the turbidity of stormwater discharge.

Minor issues were recorded during inspections conducted in 2016 and descriptions of corrective actions were included in subsequent inspection reports (presented in Appendix B). General inspection of stormwater BMPs by site personnel is conducted monthly or when personnel are onsite. A visual inspection of the stormwater controls, waste storage areas, and water treatment areas is documented monthly on a visual inspection form.

Non-stormwater source contributions to surface water are minimal at the Niblack Exploration Project site. All inspections take into account any potential contributions from site activities. For example, fueling facilities and vehicle maintenance areas are examined during each of the regular recorded inspections. Inspection records are archived in a binder at the Niblack Exploration Project camp office.

7.2 SIGNIFICANT SPILL REPORTS SUMMARY

There were no spills at the project site in 2016.

7.3 CHANGES MADE TO THE STORMWATER POLLUTION PREVENTION PLAN BEST MANAGEMENT PRACTICES

An update to the suspension of operations plan granted on January 16, 2014 (Evans 2014, pers. comm.) decreased the frequency of SWPPP inspections from weekly to monthly. There are no other changes planned to the SWPPP or to the BMPs described in the SWPPP at this time. All of the BMPs currently described in the SWPPP are good options for stormwater and associated sediment control at the site. As a result of the BMPs implemented onsite, and the stabilization of the site post-construction, the turbidity observed in stormwater has been significantly reduced.

8 DISCHARGE EVENTS

No discharge events occurred in 2016 that are out of compliance with the Permit.

9 ADEQUACY OF FINANCIAL RESPONSIBILITY

Renewal Waste Management Permit 2013-DB0001, which replaced Permit 2006-DB0037, was issued on March 13, 2013, and includes an updated financial responsibility cost estimate of $1,409,959. Reclamation cost estimates were based on as-built acreage disturbance estimates and current reclamation costs. Monitoring results to date provide no indication of a need for revisions to the financial responsibility cost estimate.

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