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8 Surface Water

The Copper Flat area falls within the Lower Rio Grande watershed, as defined by the New Mexico Water Quality Control Commission (WQCC). This watershed includes approximately 5,000 square miles in Catron, Socorro, Sierra, and Doña Ana Counties and is dominated by the Rio Grande and its tributaries as well as the two large reservoirs of Elephant Butte and Caballo. Numerous ephemeral tributaries feed into the Rio Grande from the west, but none contribute perennial flow to the Rio Grande.

Subsection 8.1 provides background information about surface water resources in the vicinity of the Copper Flat Mine Permit Area (Site), and Subsection 8.2 summarizes resources for pertinent historical data related to surface water sampling. The rest of this section focuses on the proposed sampling plan for surface water at the Site. Surface water baseline studies have been completed in the project area since the 1960s, and relevant information and data are referenced in subsequent sub-sections throughout Section 8.

8.1 Surface Water Characteristics of Site and Vicinity

The Site is drained by ephemeral streams (arroyos) within the Greenhorn Arroyo drainage basin, a 6th level sub-watershed defined by the Hydrologic Unit classification system (Seaber et al., 1987) that drains 29,414 acres of land on the eastern slope of the Animas Uplift to a single outlet into the Rio Grande (Figure 8-1). Flows within the Greenhorn Arroyo drainage basin are ephemeral, as they only occur in direct response to precipitation. As a result, this drainage, similar to others in the region, does not contribute any perennial surface water flow to the Rio Grande.

Numerous arroyos contribute to the trunk channel of Greenhorn Arroyo. Of these, Grayback Arroyo is the primary drainage through the Site. Grayback Arroyo originates west of the Site and drains eastward along the Site axis until it converges with the trunk channel of Greenhorn Arroyo approximately 8 miles east of the Site boundary (Figure 8-1). In pre-mining times, Grayback Arroyo drained directly through the mine area, but was later re-routed around the southern perimeter of the mine area for flood control purposes (Raugust, 2003). Newcomer and Finch (1993) measured flow rates in Grayback Arroyo of 12.5 gallons per minute (gpm) in March 1993 at a point east of the pit and former plant site. Three seeps have been identified along Grayback Arroyo (BLM, 1999). One seep with riparian vegetation is located near a buried storm water collection pond, a second is located downstream from the first seep and supports a small cottonwood/willow stand, and the third is south of the operations area (Figure 8-1).

Two creeks drain basins directly to the north and south of the Greenhorn Arroyo drainage basin: Las Animas Creek in the north and Percha Creek to the south (Figure 8-1). Both Las Animas and Percha Creeks have ephemeral, intermittent, and perennial reaches. Streamflow in Las Animas Creek varies from perennial to intermittent from the area near sampling site MAS (Figure 8-1) to Caballo Reservoir (BLM, 1999). For example, Davie and Spiegel (1967) show flow rates ranging from about 450 to 900 gpm in the upper reach (T14S R7W, Sections 34 through 36, near sampling sites LAC-A and LAC-B in Figure 8-1) and middle reach (within T15S R5W) of the creek; according to Davie and Spiegel, these reaches are “losing reaches” of the creek. Streamflow in Percha Creek is intermittent in the Hillsboro reach and perennial in the area known as the Percha Box, a steep-walled reach of the drainage that has incised into Paleozoic bedrock (BLM, 1996) (Figure 8-1). SRK (1995) reported measurable streamflows just east of the Percha Box of roughly 200 to 250 gpm. This was the only reach of Percha Creek with measurable flows during the SRK sampling period. Though both Las Animas Creek and Percha Creek have perennial reaches, neither creek contributes perennial flow to the Lower Rio Grande Basin.

Two springs are located within the Greenhorn Arroyo drainage basin to the north and west of the Site (Figure 8-1). Other unnamed seeps occur in the pit walls surrounding the pit lake after precipitation events;

these are likely the result of fractured flow through the bedrock exposed in the pit wall. Several springs in the Percha Creek basin and one in the Las Animas Creek basin have been identified for sampling, but have been studied less than those within the Greenhorn Arroyo basin. As a result, there is little information on their flow rates or quality, although Newcomer and Finch (1993) did attempt to measure flow.

The open pit that was mined during the early 1980s now contains a lake. Since 1989, the pit lake has been sampled for water quality approximately 65 times at various locations and depths, including samples collected by past operators of the mine, state regulatory agencies, and academic researchers studying the mine (BLM, 1999). For the proposed operations, the New Mexico Copper Corporation (NMCC) would consume the pit lake waters for mine operations and dust suppression. If necessary, pit water could be temporarily stored in a reservoir in the plant area (SRK, 2010a).

Mine water from milling operations would be discharged into an evaporation pond or re-used for several purposes: (1) plant processing streams, (2) the tailings facility with pump-back to the plant, and/or (3) dust control (SRK, 2010a). Both a National Pollution Discharge Elimination System permit and a New Mexico Environment Department (NMED) groundwater discharge permit are required for NMCC to discharge mine water. In preparation for both permits, NMCC will characterize the water quality of the mine discharge through scheduled gauging and sampling of discharge. In addition, NMCC will design a storm water management system to manage discharge for the proposed facilities. Mine water discharge is not expected to reach the Lower Rio Grande or any lake, spring, reservoir, riparian, or wetland areas.

8.2 Historical Data

Existing surface water data relevant to the NMCC sampling plan are discussed in this section and are summarized in Table 8-1. Surface water at the Site was most recently investigated by ABC (1996), who collected flow and water quality from Percha Creek and Las Animas Creek. Newcomer et al. (1993) performed a hydrologic assessment of the Greenhorn Arroyo drainage basin, measuring flow and water quality along Grayback Arroyo and at a number of seeps and springs. The oldest known surface water investigation at the Site was performed by Davie and Spiegel (1967), who collected flow data for Las Animas Creek. In addition, the surface water chemistry of Grayback Arroyo was initially investigated in 1977 at three locations as part of an environmental assessment prepared by the BLM in response to an application by Quintana Minerals Corporation for an open pit copper mine at the Site (BLM, 1978). The three locations sampled in 1977 generally correspond to the sampling locations proposed in Figure 8-1, with one location upstream of the permit boundary, one within the Site approximately 300 yards from the mine rim, and a third located where the arroyo leaves the Site (BLM, 1978). Water samples were collected in January, March, and July of 1977. Results of these investigations were compiled by Raugust (2003) and are also summarized in the Bureau of Land Management's (BLM) preliminary final environmental impact statement (PFEIS) for Copper Flat (1999).

Spring and seep flow rates are infrequently reported in the available literature for the Site and surrounding areas. Several springs and seeps have been identified within the Greenhorn Arroyo drainage basin. Two springs, identified as BG and BG-2, are located to the north and west of the Site (Figure 8-1) and several unnamed seeps occur in the walls surrounding the pit lake. BG and BG-2 were judged by Newcomer et al. (1993) to be ephemeral. The seeps along the pit walls are observed to flow in response to precipitation events, and, as mentioned above, are likely the result of fractured flow through the bedrock exposed in the pit wall. All known springs and seeps in the Greenhorn Arroyo drainage basin are upgradient of the proposed mine water discharge location. Other seeps and springs shown in Figure 8-1 have not been measured in the past and thus have no associated historical flow information.

The 12.8-acre lake that has formed in the existing pit (Figure 8-2) is estimated to be about 40 ft deep, based on a pit bottom elevation of 5,380 ft above mean sea level (amsl) and water level elevation of 5,420 ft amsl as measured in 1986 (SRK, 2010b). The water quality of the pit lake has been sampled over 65 times at various depths and locations since the initial samples were collected on April 13, 1989, by the New Mexico Environment Improvement Board (Raugust, 2003); the latest samples were collected in January 2010. Raugust (2003) concluded that the collective data show several trends in the variability of water quality over time, mainly that evapoconcentration and buffering processes are influencing the quality of the lake water. Pit water has historically exceeded the WQCC standards for sulfate, chloride, TDS, manganese, and uranium (20.6.2.4103 of the New Mexico Administrative Code) and has, at times, dropped below the acceptable pH range of 6 to 9.

Other key studies that discuss the water quality are summarized in SRK (1997) and include hydrogeologic and hydrogeochemical studies (SRK, 1995), post-closure pit water balance model calculations (SRK, 1997), water quality and host-rock geochemical studies (SRK, 1997), and post-hearing submittals that followed the 1997 New Mexico Mine Permit public hearing.

Evaluating these existing historical data is essential to completing a comprehensive Baseline Characterization Report. The statistical analysis method proposed to evaluate these historical volumetric flow and water quality data as baseline characterization data is discussed in detail in Section 9.1.5 of the SAP (see Section 9 – Groundwater). This statistical analysis will be used to justify the use of historical data, per the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) Mining and Minerals Division (MMD) draft Guidance Document for Part 6 New Mining Operations Permitting under the New Mexico Mining Act (MMD Guidance Document). Additionally, statistical analysis will be used to determine if the current baseline data are significantly different from existing baseline data where temporal data are available for the monitoring wells.

8.3 Sampling Objectives

The objective of sampling surface water is to characterize the volumetric flow and water quality of seeps, springs, streams, and the pit lake. Table 8-2 lists the frequency, location, and method for the proposed sampling program.

This information will be used for the following purposes:

1. Develop the discharge plan application for water produced during dewatering.
2. Further describe the seasonal variations in surface water quantity and quality in the vicinity of the Site.
3. Determine the likely impacts on the hydrologic regime, such as the quality and quantity of surface water systems in the vicinity, including dissolved and suspended solids under seasonal conditions.

Sources that could affect surface water quality include the disposal of mill tailings, acid rock drainage from mine stock piles, and erosion associated with reduced land cover and increased land disturbance. Dewatering activities associated with the pit as well as groundwater development for mine operations could affect surface water quantity. This plan outlines how, when, and where data will be collected to characterize baseline conditions in support of mitigating impacts to surface water quality and quantity.

8.4 Sampling Frequency

Perennial streams, springs, and the pit lake will be sampled four times over a 12-month period. Ephemeral or intermittent streams, springs and seeps will be sampled during opportunistic sampling events after precipitation events. The frequency of samples by location is presented in Table 8-2.

8.5 List of Data to Be Collected

A variety of data needs are associated with surface water. These needs are provided in Table 8-3 along with a plan for how each need will be addressed through this sampling and analysis plan.

8.6 Methods of Collection

In general, the methods used to collect surface water samples will follow the standard operating procedures defined by the NMED Surface Water Quality Bureau (SWQB) (2007) for streamflow measurement and water quality sampling, as described below. Methods deviate from NMED standard operating procedures for sampling volumetric flow and water quality from springs and seeps and water quality and sediment in the pit lake, as described in Section 8.6.2.

8.6.1 Surface Water Samples from Springs and Drainages

8.6.1.1 Volumetric Flow Measurements

Streams. Streamflow measurements will be made using classical techniques for open-channel flow. For reaches with perennial flow (Table 8-2), volumetric flow will be measured using a flow meter such as the Marsh-McBirney Flo-Mate™ 2000, which is designed for characterizing open-channel flow; a top-setting wading rod; and a tape measure or tagline. Assembly, calibration, and operation of the flow meter will follow the procedures described in NMED SWQB (2007). At each stream location listed in Table 8-2 that does not have an auto-sampler installed, a sampling station will be established by identifying (as close to the designated location as possible) a straight reach of the stream where the streambed is uniform and relatively free boulders and aquatic vegetation. The width of the stream will be measured using a tape measure, then subdivided so that each stream section between vertical profiles will contain no more than 10% of discharge (e.g., if the stream is <5-ft wide, vertical profiles would be 0.5 ft apart). Following procedures in NMED SWQB (2007), if the stream depth is greater than 2.5 ft, stream velocity will be measured at 20 percent, 60 percent, and 80 percent of the total depth of the stream at each profile location along the cross-section. If stream depth is more than 0.15 ft but less than 2.5 ft, the velocity measurement will be taken at a depth that is equal to 60 percent of the total depth when measured from the surface of the water (NMED SWQB, 2007). Following the same NMED SWQB procedures, if the stream is less than 0.15 ft deep, flow will be measured using the equation $0.9 \times Umax$, where $Umax$ is the maximum velocity recorded throughout the entire flow (Marsh-McBirney, 1990). Once measurements have been recorded, flow will be calculated in the field and recorded in the field book.

Given the unpredictable nature of flow in intermittent and ephemeral reaches of streams, streamflow in many of these locations will be recorded using deployed, portable, automatic sampling devices (auto-samplers). An auto-sampler, such as the Global Water FSS Flow Sampling System (or similar), will be installed to collect streamflow during periods in which there is measurable flow. A datalogger will record flow measurements in the unit's random access memory (RAM) and will be available for download onto a laptop computer following the storm event. Five auto-samplers will be installed within and in the vicinity of the Site, three within Greyback Arroyo, one in Percha Creek, and one in Las Animas Creek, as listed in Table 8-2 and shown in Figure 8-1.

Sites were selected for flow measurement following methods presented in NMED SWQB (2010). Established monitoring stations with historical data on each watershed were selected to examine trends in water flow. These include stream sampling stations listed in Table 8-2. Grayback Arroyo SWQ-1, SWQ-2, and SWQ-3 all have historical measurements for streamflow, but the data are sparse because auto-samplers were not installed and measurements were made by hand. These stations, however, are well positioned for the purposes of characterizing upstream, on-site, and downstream conditions because Site SWQ-1 is located upstream of the

Site, SWQ-2 is located within the Site, and SWQ-3 is located downstream of the portion of the Site that has been most disturbed by mining activities and still exhibits ephemeral flow. SWQ-1 is proposed as a reference site, as the water quality at this location has received the least amount of impact from past mining activities and the geology, gradient, and precipitation characteristics of SWQ-1 are similar to the sampling locations within and downstream of the Site, which have been more impacted by past mining operations and are likely to be more affected by the proposed NMCC mining operation. The selection of locations for the installation of auto-samplers in Percha and Las Animas Creeks was based on the criteria for site selection defined in NMED SWQB (2010), and reflects the fact that past measurements at these locations demonstrates that flow has occurred historically within the given reach.

Springs and Seeps. Volumetric flow from springs and seeps can be measured with a portable V-notch weir box or adjustable flume, if sufficient flow exists and channel conditions are appropriate. The V-notch weir box operates under the principle that discharge is related to the height of the water above the bottom of the V-shaped notch; the shape ensures that a small change in the discharge will effect a large change in the height of the water. Flow can be calculated from measurement methods defined for V-notch weirs by the U.S. Bureau of Reclamation (USBR, 2001).

If flows are insufficient for the use of a flume or V-notch weir (e.g., <0.1 cfs [44.8 gpm]), volumetric flow will be estimated using the "timed fill" method, as described by NMED SWQB (2007). This method uses a stopwatch to measure the time it takes to fill a 5-gallon bucket by diverting the entire flow of the spring or seep into the bucket below a weir or waterfall (NMED SWQB, 2007). To calculate flow using this procedure, 5 gallons per unit time may be converted to cfs using the following equation:

$$5\text{ g} = 0.6684\text{ ft}^3\text{, thus }440.6684/\text{elapsed time (seconds)} = \text{cfs}$$

8.6.1.2 Water Quality Sampling

Streams. Individual samples collected over a period of 15 minutes or less (i.e., grab samples) will be collected by the auto-samplers installed in Grayback Arroyo, Percha Creek, and Las Animas Creek at the locations listed in Table 8-2. Each sample will represent water quality conditions at the time the sample was collected. The auto-sampler consists of a 2.5-gallon polyethylene sample bottle, a peristaltic sampling pump, a pickup hose, a circuit board controller, a rechargeable gel cell battery, and a battery charger. With the exception of the pickup hose, the components are housed in a waterproof case mounted aboveground next to the sampling location, which is outside of the ordinary high water mark of channel.

Once the sample is collected, a radio unit in the sampler will communicate to a receiver installed in the meteorological tower (see Section 2), which will in turn notify the NMCC surface water lead via telemetry that a surface water sample has been collected. The sample will be retrieved by on-site mine staff, placed in a laboratory-provided sample container, and shipped overnight to the designated laboratory for analysis. All equipment preparation and cleaning, sample collection, and sample preservation will follow the standard operating procedures defined by NMED (NMED SWQB, 2007).

Springs and Seeps. During quarterly measurements of flow from seeps and springs, water quality samples will be collected using non-isokinetic, open-mouth samplers following U.S. Geological Survey protocols for sample equipment selection described in Lane et al. (2003). Methods will follow the 2007 NMED/SWQB Standard Operating Procedures for Data Collection, §7.3 Routine Water Chemistry Sampling.

Samples will be collected in clean polyethylene Cubitainer® containers. Where water flows at sufficient depth, samples will be collected by immersing the container by hand or by rod beneath the surface. Otherwise, water will be collected in a plastic bucket or disposable bailer held with nylon rope or twine, if necessary. Care will be taken to avoid contamination with debris from the rope or twine and the sampling area. Buckets and bailers will be rinsed three times with source water and sampling personnel will rinse their hands with source water before collecting samples. Samples will be collected immediately following rinsing. Buckets will be rinsed with spring water following use and cleaned with Liquinox and warm water prior to the next use.

Water will be transferred from the collection vessel to the sample container with a peristaltic pump or syringe, filtering as appropriate. Dissolved concentration samples will be filtered; total concentration samples will not be filtered. All samples for dissolved constituent analytes will be filtered with a 0.45-micron pore-size disposable in-line filter cartridge. Filters will be rinsed with sample water according to the manufacturer's recommendations prior to sampling.

Every effort will be made to take sonde readings in flowing water. When this is not possible, sonde readings will be made from the bucket or bailer after the sample has been collected and a note to this effect will be made on the field sheet.

8.6.1.3 Sediment Sampling in Streams

Sediment samples will be collected at each of the surface water sampling locations identified in Table 8-2. Sample collection methodology will depend on sample location. Field personnel will visit the locations and determine the best approach for ensuring collection of samples based on field reconnaissance. The objective in selecting a sample site is to obtain recently deposited fine sediment. Depositional zones include areas on the inside bend of a stream; areas downstream from obstacles such as boulders, islands, or sand bars; or simply shallow waters near the shore. Where possible, fine-grained surficial sediments will be obtained from several depositional zones that represent various flow regimes within a stream reach, and will be composited to yield a sample representing average conditions. However, depositional zones on small, ephemeral drainages may be limited in size, necessitating that a single zone be regarded as representative.

Samples will be collected following NMED SWQB Standard Operating Procedures for Data Collection (NMED SWQB, 2007), as follows:

1. Samples will be collected in a plastic or Nalgene® jar.
2. The sample will be composited from several representative depositional zones into an appropriate mixing container after decanting any excess water over the back of the scoop.
3. The sample will be mixed well.
4. An aliquot of the mixed material will be transferred to the final, labeled sample container (a 4-ounce, wide-mouthed glass jar) and placed on ice for transport to the analytical facility. If shipment cannot be accomplished in a timely manner, the sample will be frozen prior to shipment. (Sediment samples are not preserved.)

If water and sediment samples are to be collected at the same location, water samples will be collected (1) before collecting sediment samples, as sampling sediment will disturb the stream, and (2) downstream of sediment samples, as water sampling may disturb representative depositional zones. Personnel collecting samples will employ proper sample handling techniques, including wearing latex or nitrile gloves, avoiding hand contact with contaminating surfaces, and minimizing the number of sample handling steps. Sample containers will be covered while being moved to minimize the atmospheric input. All sample collection equipment will be rinsed as soon as possible after use and thoroughly rinsed with ambient water at each new sampling station before collecting a sample. Equipment used will be inert with respect to the analytes to be collected.

8.6.2 Pit Lake Sampling

8.6.2.1 Water Sampling

Lake water from a sampling station located at the deepest point in the lake will be sampled four times within a 12-month period, with one set of samples collected during each season. Only one sampling station is proposed, as the size of the lake is less than 100 acres, which is typically the threshold for establishing additional sampling stations (see Section 2.0 of NMED SWQB, 2010). The deepest point of the lake will be identified by surveying the lake bathymetry along predetermined parallel depth profiles. These parallel profiles will be spaced to provide adequate coverage with the addition of two tie lines perpendicular to the profiles to ensure consistency in the interpretation of water depth between each profile. Given the size of the pit lake, 5 profiles and 2 tie lines are proposed, as shown in Figure 8-2. The depth along each profile will be measured using a portable acoustic transducer tethered to the side of the boat 2 inches below the water surface. Each predetermined profile will be pre-loaded into a global positioning system (GPS) with horizontal accuracy of ≤3 meters (9.8 ft) to ensure that depth measurements follow the proposed profile lines in the field.

During each of the four quarterly sampling events, vertical profiles of temperature, pH, oxygen/reduction potential, dissolved oxygen, and conductivity will be measured at a resolution of up to every 12 inches. These profiles will be used to define seasonal trends in the water column and the discrete depths at which surface water quality samples should be collected.

Based on the results from the vertical profile, a surface water sample will be collected from up to three depths at the deepest point within the lake. These three samples, taken quarterly, are needed to determine whether the lake is either thermally or chemically stratified and to support geochemical modeling of the pit lake system. If the vertical temperature profile shows that no thermocline present in the lake (i.e., there is less than 1°C difference between the temperature of the surface and bottom of the lake), then three water-quality samples will be collected from within the euphotic zone. The euphotic zone is defined as the depth of light extinction, which will be measured by lowering a secchi disk into the water and measuring the depth below water at which the disk is no longer visible through a secchi disk viewer. Following the NMED SWQB (2007) procedures for sampling lakes, 5-liter samples from the top, middle, and bottom of the euphotic zone will be collected for the water quality analyses listed in Table 8-4; a rinsed Kemmerer® water bottle will be used for sample collection. The 5-liter samples will be composited in a 5-gallon, acid-washed container. If a thermocline is present (i.e., if there is greater than 1°C difference between the surface and bottom temperatures of the lake), 5-liter samples will be taken from the top, middle, and bottom of the entire water column instead of just the euphotic zone. The 5-liter samples will then be composited in a 5-gallon, acid-washed container.

Each 5-liter water-quality sample will be collected using a Wildco® discrete-depth sampler that is capable of collecting a continuous column of water from a desired depth. A 5-gallon Cubitainer® will be filled with water from each of the three samples to create a composited sample. Following NMED SWQB (2007) sampling protocols for lakes, all water quality samples will be poured off from the composited sample into their respective containers, which will be either individually rinsed, 1-liter Cubitainers® or other containers as prescribed by the analysis to be performed. Dissolved nutrient and metal samples will be filtered prior to being poured into individually rinsed, 1-liter Cubitainers®. After the composited sample is divided into individual containers, the samples for total and dissolved nutrients will be preserved in the field with 2 milliliters (ml) of concentrated sulfuric acid per liter of sample water (to reduce pH to < 2). Samples for total and dissolved metal analyses are preserved with 5 ml of concentrated nitric acid per liter of sample water (to reduce pH to <2). Samples for cyanide are preserved with 8 to 10 tablets of NaOH per liter of sample water (to increase pH to >12).

8.6.2.2 Sediment Sampling

A core of recently deposited fine-grained sediment will be collected from the lake during the first sampling event using a Glew Corer (Glew, 1988; Glew et al., 2001), a gravity-driven coring device composed of cylindrical aluminum alloy and a Teflon body with a nominal diameter of 2.8 inches. The upper part (core body) houses the closing piston, release mechanism, and captive float. The float relays the motion of the messenger to the trigger and gives the corer vertical stability in the water. The core body caries a sleeve and clamping device that secures a 2.5-inch diameter Lexan-core tube capable of collecting up to 24 inches of undisturbed sediment. The Glew Corer is specially designed to collect undisturbed samples from the sediment-water interface where the bed material is loosely consolidated. In contrast to other sediment sampling devices, the flow of water through the Glew Corer is not impeded because the design of the coring device allows water to pass freely through the device with little resistance. As a result, the Glew Corer eliminates the hydraulic pressure that normally forms ahead of other devices. This hydraulic pressure can cause the top sediment to blow out when the device is lowered to the sediment-water interface, which results in sample loss even before the sample is collected by the device.

The sediment sample will be collected from a boat held in position over the deepest point in the lake by at least three anchors. The corer will be assembled and tested according to Glew et al. (2001). First, the messenger weight and Lexan core tube will be attached to the line and core body, respectively. The core tube will be attached flush with the core body to ensure there is a tight seal. Once assembled, the corer will be lowered slowly from the side of the boat approximately 1 to 2 ft above the sediment-water interface. Holding the messenger weight in one hand, the corer will penetrate the sediment by letting the rope slide through the other hand. Once the corer has penetrated the sediment, the messenger weight will be dropped to trigger the closing piston. The corer will then be lifted by hand to a level where the bottom of the core tube remains just the water surface. A rubber stopper will be inserted by a gloved hand into the bottom of the core tube before the core tube is lifted above the water surface.

Once the corer is on the boat, the piston sealer will be lifted from the core body and the tube removed by unscrewing the band clamp that holds the core tube onto the corer. Holding the core tube upright, the core body will be detached from the tube and capped immediately before bringing the core back to shore. On shore, core samples will be extruded from core tubes into sampling jars in the field using an extruding device specifically designed for the Glew Corer (see Glew, 1988 and Glew et al., 2001). The extruding device will push the sediment through the top of the core tube and into sampling jars provided by the laboratory. The sample extruded from the core tube will be homogenized and then sub-sampled into a container submitted to a laboratory for analysis for the parameters listed in Table 8-4. The sediment sample will be collected only after the required water sample has been collected to avoid disturbing or suspending sediment that would contaminate the surface water sample.

8.7 Parameters to Be Analyzed

During the year of sampling, 12 water quality samples from the pit lake (1 sample site x 3 sample depths x 4 quarterly sampling events) will be collected. The samples will be analyzed for the suite of parameters and methods provided in Table 8-4. Additionally, it is assumed that the streams, seeps, and springs listed in Table 8-2 will be analyzed for the same suite of parameters.

8.8 Maps Showing Proposed Sampling Locations

Locations for proposed sampling locations for streams and springs are shown in Figure 8-1. These locations were selected by NMCC because they were sampled in the past (e.g., SWQ series in Grayback Arroyo, PC series in

Percha Creek, and select sites within the LAC series along Las Animas Creek) or represent an area of interest where volumetric flow or water quality data would be of importance to understanding regional characteristics of surface water quality and quantity. The water quality and sediment samples collected from the deepest point in the lake will be based on the results of the depth profiles shown in Figure 8-2.

8.9 Laboratory and Field Quality Assurance Plans

Data collected to characterize the water quality and flow of surface water resources discussed in this section of the Sampling and Analysis Plan will conform to the NMCC Quality Assurance Project Plan (Attachment 1) with respect to field methods, sampling procedures, and recording of field notes. If procedures for sampling or analysis are not specifically defined in Attachment 1, by the sampling method, or by the analytical method, the NMED SWQB (2007) protocols for field data sampling, equipment calibration and cleaning, sample containment and handling, and photographic documentation will be followed as appropriate and/or applicable to the site conditions.

The samples for chemical analysis will be properly preserved and field filtered, if necessary, before shipment to an analytical laboratory certified by the U.S. Environmental Protection Agency. All samples will be shipped within the holding times defined by the analytical method to be used. In addition, containers specific to a given analytical method will be used as appropriate. To provide quality control, duplicates and/or equipment blanks will be collected/used. Analytical results will be stored in a project database that will be provided to the New Mexico Mining and Minerals Division electronically as well as in hard-copy as an attachment to the Baseline Summary Report.

8.10 Discussion in Support of Proposal

The existing water quality and flow data for surface water within and in the vicinity of the Site will be bolstered by the new data collected as outlined in this section of the Sampling and Analysis Plan. New data will establish baseline conditions in that they will represent the nature of flow and quality of surface water and sediment prior to any operations or activities by NMCC. These data will also help guide future planning and designing decisions with regard to mine water discharge.

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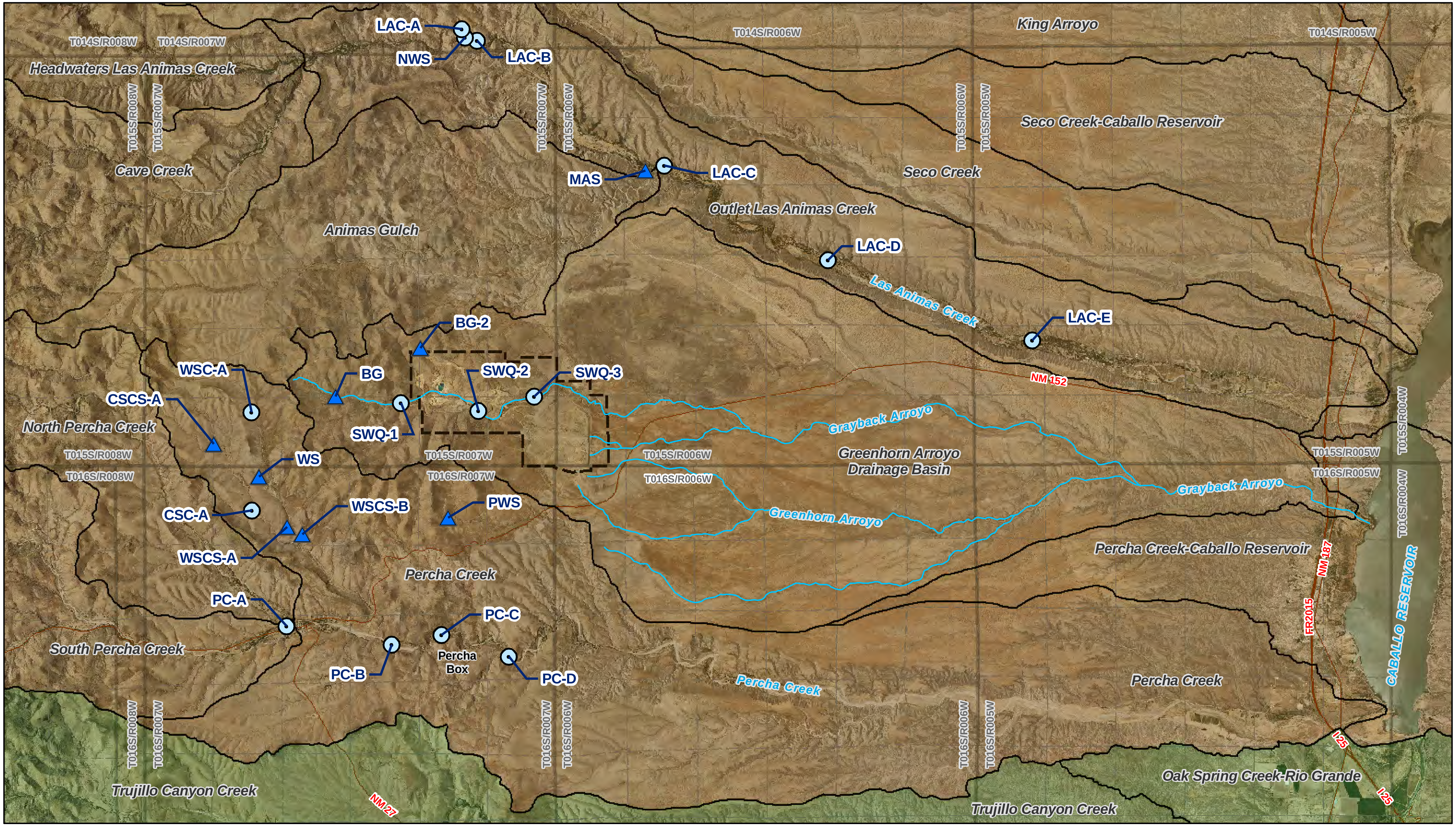
Figures



N W E S

Watersheds:
USGS Hydrologic Unit Map
Mine Boundary:
Tom Van Bebber
Imagery Information:
-USGS 7.5-Minutes County DOQQ mosaic
Sierra County, 2009
Projection Information:
-New Mexico State Plane West, NAD 1927

INTERA

0 3,500 7,000 14,000 21,000

Feet

Legend

- Stream Sample
- Spring Sample
- Proposed Mine Permit Boundary

Watersheds
- Caballo
- El Paso-Las Cruces
- Sub-Watershed

Figure 8-1
Proposed Surface Water Sampling Locations
New Mexico Copper Corporation

Imagery Information:
-USGS 7.5-Minutes County DOQQ mosaic
Sierra County, 2009
Projection Information:
-New Mexico State Plane West, NAD 1927

Figure 8-2
Proposed Parallel Profiles for Pit Lake Survey
New Mexico Copper Corporation

Tables

Table 8-1
Historical Flow and Water Quality Parameters

Location	Date	Description	Flow (cfs)	pH	Conductivity (µS/cm)	Temperature (°C)
Las Animas Creek	1967	Upper Reach	1.0 – 2.0	NM	NM	NM
Las Animas Creek	1967	Middle Reach	1.0 – 1.5	NM	NM	NM
Las Animas Creek	1996	LAC-E	0.546	8.2	400	17
Percha Box	1996	1200' u/s of Box entry	Dry	NA	NA	NA
Percha Box	1996	700' u/s of Box entry	0	8.1	600	32
Percha Box	1996	400' u/s of Box entry	Dry	NA	NA	NA
Percha Box	1996	Box entry	0.265	7.7	500	23
Percha Box	1996	1500' d/s of Box entry	0.446	8.2	500	23
Percha Box	1996	Box exit	1.02	8.4	400	25
Percha Box	1996	2400' d/s of Box exit	0	9.3	400	32
Percha Box	1996	2500' d/s of Box exit	Dry	NA	NA	NA
Percha Box	1996	5000' d/s of Box exit	0.394	9.0	400	28
Percha Box	1996	5400' d/s of Box exit	0	9.0	400	32
Percha Box	1996	5500' d/s of Box exit	Dry	NA	NA	NA
Percha Box	1996	3 miles d/s of Box exit	Dry	NA	NA	NA
Percha Box	1996	5 miles d/s of Box exit	Dry	NA	NA	NA
Grayback Arroyo	4/1/93	SWQ-1	1 – 2	8.3	1150	NM
Grayback Arroyo	5/7/93	SWQ-1	Dry	NA	NA	NA
Grayback Arroyo	3/31/93	SWQ-2	< 1	7.7	3150	NM
Grayback Arroyo	3/31/93	SWQ-3	12.5	8.1	3330	NM
Spring/Seep	4/1/93	BG	1 – 2	8.2	1090	NM
Spring/Seep	5/7/93	BG	Dry	NA	NA	NA
Spring/Seep	4/1/93	BG-2	< 1	8.2	1030	NM
Spring/Seep	5/7/93	BG-2	< 1	NM	NM	NM
Spring/Seep	1997	PW-2	NM	8.16	NM	NM
Spring/Seep	1967	WS	0.8	NM	NM	81.5
Spring/Seep	4/2/93	WS	0.00735	8.5	1980	NM

Notes:

Box = Percha Box
u/s = upstream
d/s = downstream
NA = no water present for sampling
NM = parameter not measured or not available

Table 8-2

Proposed Surface Water Monitoring Locations (shown on Figure 8-1) with Method of Measurement and Frequency of Collection

Sample Location	Location Type	Likely Flow Type	Description of Location	Quarterly or Opportunistic Flow Measurement	Method of Collection	Quarterly Water Quality Sample
LAC-A	Stream	Perennial	Las Animas Creek u/s of North Warm Spring (NWS)	Quarterly	Flow meter	
LAC-B	Stream	Perennial	Las Animas Creek d/s of North Warm Spring	Quarterly	Flow meter	
LAC-C	Stream	Intermittent	Las Animas Creek d/s of Meyers Animas Spring (MAS)	Opportunistic	Auto sampler	X
LAC-D	Stream	Intermittent	Las Animas Creek at site previously named STA8	Quarterly	Flow meter	
LAC-E	Stream	Intermittent	Las Animas Creek at site previously named LAC-1	Quarterly	Flow meter	
SWQ-1	Stream	Ephemeral	Grayback Arroyo at site previously named GA-A	Opportunistic	Auto sampler	X
SWQ-2	Stream	Ephemeral	Grayback Arroyo at site previously named GA-B	Opportunistic	Auto sampler	X
SWQ-3	Stream	Ephemeral	Grayback Arroyo at site previously named GA-C	Opportunistic	Auto sampler	X
PC-A	Stream	Intermittent	Percha Creek u/s of Warm Springs Canyon	Quarterly	Flow meter	
PC-B	Stream	Intermittent	Percha Creek u/s of Percha Box	Quarterly	Flow meter	
PC-C	Stream	Perennial	Percha Creek in Percha Box	Opportunistic	Auto sampler	X
PC-D	Stream	Ephemeral	Percha Creek in Sec. 21 T16S R5W	Quarterly	Flow meter	
WSC-A	Stream	Ephemeral	Upper Warm Springs Canyon	Quarterly	Flow meter	
CSC-A	Stream	Ephemeral	Upper Cold Springs Canyon	Quarterly	Flow meter	
NWS	Stream	Perennial	North Warm Spring on Las Animas Creek	Quarterly	Flow meter	
WS	Spring	Ephemeral	Warm Spring	Quarterly	Weir	
BG	Spring	Ephemeral	BG Spring	Quarterly	Weir	X
BG-2	Spring	Ephemeral	BG-2 Spring	Quarterly	Weir	X
PWS	Spring	Ephemeral	Paxton Well Spring	Quarterly	Weir	
MAS	Spring	Ephemeral	Meyers Animas Spring	Quarterly	Weir	X
CSCS-A	Spring	Ephemeral	Cold Spring Canyon spring	Quarterly	Weir	
WSCS-A	Spring	Ephemeral	Warm Spring Canyon spring #1	Quarterly	Weir	X
WSCS-B	Spring	Ephemeral	Warm Spring Canyon spring #2	Quarterly	Weir	X

Table 8-3

Surface Water Resources Data Needs

Data Need	Plan to Address Data Need
Nature of flow and water quality in Grayback Arroyo	Three sampling stations are proposed to characterize streamflow and water quality by collecting opportunistic samples and measurements during storm events. Sites are proposed upstream, within, and downstream of the mine operations at sites that have been sampled in the past. Installation of auto-samplers along this ephemeral reach will enable opportunistic sampling.
Nature of flow and water quality in Percha Creek	Three sampling stations along perennial, intermittent and ephemeral reaches are proposed to characterize streamflow and water quality by collecting quarterly samples and measurements and a fourth sampling station on an intermittent reach is proposed to characterize streamflow and water quality opportunistically. Sites are proposed upstream, within, and downstream of the Percha Box at locations that have been sampled in the past. Installation of an auto-sampler along the intermittent reach will enable opportunistic sampling.
Nature of flow and water quality in Las Animas Creek	Four sampling stations along perennial and intermittent reaches are proposed to characterize streamflow and water quality by collecting quarterly samples and measurements and a fifth sampling station on an intermittent reach is proposed to characterize streamflow and water quality opportunistically. Sites are proposed in the upper, middle, and lower reaches of Las Animas Creek at sites that have been sampled in the past. Installation of an auto-sampler along the intermittent reach will enable opportunistic sampling.
Potential of mine discharge to have a significant, quantifiable effect on intermittent or perennial flow	Opportunistic streamflow and water quality samples collected at three sites Grayback Arroyo.
Seasonal variability in water quality conditions in the pit lake, including stratification	High-resolution, vertical profiles of water quality coupled with discrete-depth samples taken from the epilimnion, metalimnion, and hypolimnion (if present) on a quarterly basis.
Geochemical characteristics of sediment	Sediment samples will be collected concurrently with surface water samples collected from perennial reaches of streams and from the pit lake. The list of sediment parameters to be analyzed is presented in Table 8-4.
Nature of flows from springs and seeps	Eight springs are proposed to characterize spring flow and water quality by collecting quarterly water samples and measurements. Sites are proposed within the Greenhorn Arroyo drainage basin, Percha Creek drainage basin, and Las Animas Creek drainage basin.

Table 8-4

Analytical Parameters and Analysis Methods for Surface Water and Sediment Samples

(Sediment samples will be prepared using EPA Method 1312-SPLP, Synthetic Precipitation Leaching Procedure, to determine the concentrations of water-soluble constituents in the sediments.)

Analytical Parameter	Analysis Method for Water	Lab Detection Limit (mg/L unless noted)	Analysis Method for Sediment	Lab Detection Limit for Sediments (mg/kg unless noted)
Anions				
Fluoride	EPA Method 300.0	0.1	NA	NA
Chloride	EPA Method 300.0	0.1	NA	NA
Nitrogen, Nitrite (as N)	EPA Method 300.0	0.1	NA	NA
Nitrogen, Nitrate (as N)	EPA Method 300.0	0.1	NA	NA
Nitrogen, Ammonia (as N)§	EPA Method 300.0	0.1	NA	NA
Sulfate	EPA Method 300.0	0.5	NA	NA
Dissolved Metals				
Aluminum	EPA Method 200.7	0.02	EPA Method 200.7	1.0
Antimony	EPA Method 200.8	0.005	EPA Method 200.8	0.25
Arsenic	EPA Method 200.8	0.02	EPA Method 200.8	1.0
Barium	EPA Method 200.7	0.002	EPA Method 200.7	0.1
Beryllium	EPA Method 200.7	0.002	EPA Method 200.7	0.1
Boron	EPA Method 200.7	0.04	EPA Method 200.7	2.0
Cadmium	EPA Method 200.7	0.002	EPA Method 200.7	0.1
Calcium	EPA Method 200.7	0.50	EPA Method 200.7	5.0
Chromium	EPA Method 200.7	0.006	EPA Method 200.7	0.3
Cobalt	EPA Method 200.7	0.006	EPA Method 200.7	0.3
Copper	EPA Method 200.7	0.0003	EPA Method 200.7	0.2
Iron	EPA Method 200.7	0.02	EPA Method 200.7	1.0
Lead	EPA Method 200.7	0.005	EPA Method 200.7	0.25
Magnesium	EPA Method 200.7	0.50	EPA Method 200.7	5.0
Manganese	EPA Method 200.7	0.002	EPA Method 200.7	0.1
Mercury	EPA Method 7470 CVAA	0.0002	M7471A CVAA	0.03
Molybdenum	EPA Method 200.7	0.008	EPA Method 200.7	0.4
Nickel	EPA Method 200.7	0.01	EPA Method 200.7	0.5
Potassium	EPA Method 200.7	1.0	EPA Method 200.7	10
Selenium	EPA Method 200.8	0.02	EPA Method 200.8	1.0
Silicon	EPA Method 200.7	0.08	EPA Method 200.7	4.0
Silver	EPA Method 200.7	0.005	EPA Method 200.7	0.25

Analytical Parameter	Analysis Method for Water	Lab Detection Limit (mg/L unless noted)	Analysis Method for Sediment	Lab Detection Limit for Sediments (mg/kg unless noted)
Sodium	EPA Method 200.7	0.5	EPA Method 200.7	5.0
Thallium	EPA Method 200.7	0.01	EPA Method 200.7	0.5
Titanium	EPA Method 200.7	0.005	EPA Method 200.7	0.25
Uranium	EPA Method 200.8	0.01	EPA Method 200.8	0.5
Vanadium	EPA Method 200.7	0.005	EPA Method 200.7	0.25
Zinc	EPA Method 200.7	0.005	EPA Method 200.7	0.25
Solids				
Total Suspended Solids (TSS)	SM 2540D	1.0 µg/L	NA	NA
Total Dissolved Solids (TDS)	SM 2540C	10	NA	NA
Percent Solids	NA	NA	CLPSOW290 Part F, D-98	NA
Alkalinity				
Alkalinity, total (as $CaCO_3$)	SM 2320B	20	NA	NA
Carbonate	SM 2320B	20	NA	NA
Bicarbonate	SM 2320B	20	NA	NA
Other				
pH	150.1	12.45	NA	NA
Specific Conductance	120.1	0.01 µS/cm	NA	NA
Cyanide	Kelada-01	0.005	M9012A	0.5
Temperature§	EPA Method 170.1	ND	NA	NA
Dissolved Oxygen§	EPA Method 360.1	ND	NA	NA

Notes:

NA = not applicable as sample will not be analyzed for a given parameter
ND = not determined or dependent on the instrument
§ = run for pit lake sample only and not run for samples from stream, spring, or seep