Appendix A

Large Reservoir Water Quality Sampling Plan (Revised June 2015)

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WATER QUALITY SAMPLING PLAN
UTAH GROUNDWATER DISCHARGE PERMIT UGW350006
Zone 1, Zone 2 and the Desilting Basin
of the Bingham Large Reservoir System

1.0 Introduction

This plan presents the sampling, analysis and quality assurance guidelines to be performed by Rio Tinto Kennecott (RTKC) for water quality sampling of the groundwater protection features of the Large Bingham Reservoir System, including Zones 1, 2, and the Desilting Basin.

1.1 System Description - Zone 1

Monitoring of water quality in the Zone 1 Reservoir and its groundwater protection facilities will be conducted utilizing the design features of the reservoir liner system. Drawing 450-C-188 (included with original permit submittal) presents multiple sections and plan-sections of the reservoir liner, concrete penetrations, and leak detection pipe sets.

The Zone 1 Reservoir is lined with a system consisting of the following, from bottom to top:

- 12" (min.) layer of low-permeability (less than or equal to 1 x 10^{-7} cm/sec) clay, shaped for leak detection areas and sumps.
- 8 oz. non-woven geotextile underlayment for protection of the 60-mil liner.
- Black 60 mil HDPE liner sheet, with electrically conductive underlayer and double wedge welded seams. The liner sheet conforms to the topography of the clay, creating five leak detection areas and sumps in the reservoir bottom.
- HDPE "Geogrid" drainage layer between the 60-mil and 80-mil HDPE liner sheets. An envelope of geotextile filter fabric, washed sand, and 1 " minus washed rock surrounds the leak detection pipe in each sump.
- White 80 mil HDPE white liner sheet with an electrically conductive underlayer for spark detection of leaks, as described in the Leak Detection and Repair Program.

The five sets of sump monitoring pipes extend between the liners and emerge above the surface of the Divider Dike crest. A concrete-supported steel rack provides support and

stability for each pipe set. An allowance has been made for longitudinal movement due to thermal expansion and contraction. The pipe sets extend down the west sloping face of the Divider Dike between the two liners, ending in the five leak detection sumps approximately 260 feet from the crest, as shown on Drawing No. 450-C-188.

Each pipe set consists of the following:

- A composite six-inch HDPE pipe around a four inch stainless steel pipe that can be equipped with a two inch or larger submersible electric pump for sampling, purging or evacuation of the sump. This pump is utilized to measure the rate of leakage in the sump when used in combination with the transducer. The transducer is attached to the submersible pump and is hard-wired to a central control unit where its signal is electronically converted to measure the sump water levels. Sump water levels are monitored in the South Area Water Services (SAWS) control room.

- A single 6" pumping/sampling pipe, which can be equipped with a 3" submersible electric Grundfos pump for evacuation of the sump, or a 2" Grundfos for compliance test pumping. A transducer is attached to the pump and is hard-wired to a central control unit where its signal is electronically converted to measure sump water levels.

- Two 1.5 inch HDPE pipes are attached to the outside of the six inch HDPE pipe. The pipes were originally intended to house the transducer, but it was determined that it is best to attach the transducer to the pump column located inside the six inch HDPE pipe.

- Two 4" pipes have been welded into the assembly to provide for structural rigidity of each set.

- A rubber plug on the end of each pipe provides closure.

With this information, it is possible to accurately monitor the flow rate in any given sump, in conjunction with the operation of the variable flow sample pump.

1.2 System Description - Zone 2

Monitoring of water quality and the ground water protection facilities in the Zone 2 Reservoir will be conducted utilizing the design features of the reservoir liner system. Please refer to drawings in original permit submittal for liner detail and cross sections.

The Zone 2 Reservoir is lined with a system consisting of the following, from bottom to top:

- 12" (min.) layer of low-permeability clay (equal to or less than 1 x 10^{-7} cm/s), shaped for leak detection areas and sumps.

- 8 oz. non-woven geotextile underlayment, for protection of the 60-mil liner.

- Black 60 mil HDPE liner white sheet, with electrically conductive underlayer and double wedge welded seams. The liner sheet conforms to the topography of the clay, creating five leak detection areas and sumps in the reservoir bottom.

- HDPE "Geogrid" drainage layer is present between the 60 mil and 80 mil HDPE liner sheets.

- White 80-mil HDPE white liner sheet with electrically conductive underlayer for spark detection of leaks, as described in the Leak Detection and Repair Program.

The leak detection system consists of five independent leak detection sumps. The sump monitoring pipes extend up the divider dike and emerge above the surface of the Divider Dike crest. A concrete-supported steel rack provides support and stability for each pipe set. An allowance has been made for longitudinal movement due to thermal expansion and contraction. The pipe sets extend down the west sloping face of the Zone 2 Reservoir within the clay liner and under the two HDPE liners, ending in the five leak detection sumps approximately 330 feet from the crest.

The leak detection sumps are constructed of 304 stainless steel pipe with flange connections. The sump monitoring pipes are completely buried in a clay envelope which extends from the stainless steel sump all the way up the face of the divider dike. Each pipe set consists of the following HDPE pipes:

- A composite six-inch HDPE pipe around a four inch stainless steel pipe that can be equipped with a two inch or larger submersible electric pump for sampling, purging or evacuation of the sump. This pump is to be utilized to measure the rate of leakage when used in combination with the transducer. The transducer is attached to the submersible pump and is hard-wired to a central control unit where its signal is electronically converted to measure the sump water levels. Sump water levels are monitored in the South Area Water Services (SAWS) control room.

- A single 6" pumping/sampling pipe, which can be equipped with a 3” submersible electric Grundfos pump for evacuation of the sump, or a 2" Grundfos for compliance test pumping. A transducer is attached to the pump

and is hard-wired to a central control unit where its signal is electronically converted to measure sump water levels.

- Two 1.5-inch HDPE pipes are attached to the outside of the six inch HDPE pipe. The pipes were originally intended to house the transducer but it was determined that it is best to attach the transducer to the pump column located inside the six inch HDPE pipe.

- A rubber plug on the end of each pipe provides closure.

1.3 System Description - Desilting Basin

The Desilting Basin is a three-chamber basin constructed as follows:

Chamber 1: (from bottom to top): a 95% compacted-fill soil sub-base, four-inch thick road base, 16 oz. geotextile felt layer, 80 mil HDPE synthetic liner, 16 oz. geotextile felt layer, 12-in. thick road base, and 8in. thick concrete. This bottom lining system is secured to a reinforced concrete curb ring. The sloping sides of the chamber are lined with compacted-fill sub-base, 12-in. thick compacted low permeability clay layer, 8 oz. geotextile felt and 80-mil HDPE liner.

Chambers 2 and 3: The liner systems are the same as Chamber 1 except that no HDPE liner underlies the 8 in. thick concrete bottom.

1.4 Leak Detection - Desilting Basin

Leak detection and monitoring methods within the Desilting Basin are described in Appendix D.

2.0 Project Organization and Responsibilities

The RTKC Manager – Environmental Operational Support will serve as the Compliance Project Manager and will have overall responsibility for direction of the sampling and compliance program, quality control, notifications, and reporting. The RTKC Sampling Supervisor will serve as technical director and will be responsible for execution of all activities in accordance with this sampling plan.

RTKC Superintendent of SAWS will be responsible for weekly observations of the leak detection sumps to determine if permit levels are exceeded. In the event that a leak is detected and the observed flow rate is greater than 3.47 gpm (based on the 24-hour 5,000 gpd ALR), the RTKC Superintendent of SAWS or his designate will alert the RTKC Environmental Department and Sampling Department technicians will collect water quality samples as specified in Section 4 of this sampling plan.

All water quality samples will be collected in accordance with this sampling plan and the GCMP. The RTKC Laboratory Manager will ensure that all water quality samples are analyzed using approved methods within the specified holding times.

The RTKC Manager – Tailings and Water Services will report results of water quality sampling and volume pumped from leak detection sumps to the Director of the Utah Water Quality Board. Maintenance, repair and monthly inspections will be the responsibility of the RTKC SAWS staff.

3.0 Water Quality Sampling Locations

3.1 Monitoring Sumps

The sumps to be monitored are along the divider dike on the east side of Zone 1 and the west side of Zone 2. No monitoring sumps are located in the Desilting Basin.

Table 1: Large Reservoir Sump and Sample Identification tag Numbers

Zone 1 Surface Sample ID	LRP896	Zone 2 Surface Sample ID	LRP1319
Sump ID	Sample ID	Sump ID	Sample ID
LIT205	LRP891	LIT212	LRP1314
LIT204	LRP892	LIT211	LRP1315
LIT203	LRP893	LIT210	LRP1316
LIT202	LRP894	LIT209	LRP1317
LIT201	LRP895	LIT208	LRP1318

Notes: Identification Tag numbers in Table 1 are listed top to bottom from north to south for each reservoir zone.

3.2 Reservoirs

Surface water samples are collected from Zones 1 and 2 of the Reservoir using the fabricated access steps, or using the outlet mechanical screen on the north side. Surface scum and debris will be avoided during sampling. Samples will be collected from Desilting Basin using the vehicle access ramp located in Chamber 1. Water quality sampling and analysis of the reservoir waters will be performed on a semi-annual basis.

3.3 Monitoring Wells

Ground water monitoring for Zone 1 and Zone 2 of the Large Reservoir is inclusive in RTKC Ground Water Monitoring System. Ground water sampling for the Desilting Basin will be conducted in accordance with the approved Desilting Basin Monitoring Plan (Appendix D).

4.0 Water Quality Sampling Procedures

4.1 Monitoring Sumps

Water quality sampling can only be conducted when sufficient water is present to pump. The Maximum Allowable Head (MAH) in Zone 1 is four feet. Pumping is not necessary if there is less than four feet of water above the base of the sump. The MAH in Zone 2 is two feet above the sump flange where the liners connect to the stainless steel sump. Water head within each sump will be monitored to determine if pumping and sampling are necessary. When the MAH sump level threshold is reached, pumping will be initiated to determine if the allowable leakage rate (ALR) is being exceeded and to provide accurate water quality samples if the ALR is exceeded.

Once a leak detection sump pump test is initiated, all pertinent observations will be logged. Results of the pump test will be noted and recorded. The 2" Gundfros pump will be inserted into the 6" monitoring pipe and positioned into the leak detection sump. The variable speed pump will be adjusted to deliver the ALR of 3.47 gpm (5,000 gpd). The exact measured rate and the variable speed drive setting will be recorded in the test log.

Once calibration is completed, the time will be noted, and the pump test will be initiated. The duration of the pump test will be recorded in the log book. Pumping will be performed for a minimum of one hour. Water levels will be recorded at the beginning and end of the test. A reduction in the level of water will mean that the leakage rate is below permitted levels and the observation program should be continued. Should the water increase or remain the same during the test, the effective leakage rate is greater than or equal to 3.47 gpm (or the permit maximum of 5000 gpd), then the approved Leak Detection and Repair Program will be implemented and samples will be collected.

Visual inspection of the physical condition of the above-grade equipment will be conducted during sample collection. Inspection of the physical conditions includes checking for evidence of damage, cracks or other visible problems.

Field parameters of pH, temperature, and conductivity will be measured and recorded as described in Section 8.0. Chain of custody documentation will be initiated as required. After sample collection is complete, the test apparatus will be removed, cleaned and stored; the monitoring pipe cap will be secured. The area will be cleaned and the completion time recorded.

4.2 Monitoring Reservoir Waters

Water in the reservoir will be sampled on a semi-annual basis. Water levels will be recorded weekly or whenever water is present within Chamber 1 of the Desilting Basin or in Zone 1 or 2. Water levels in the Desilting Basin will be obtained using measuring methods. The analytical parameters will be the same as those sent to the RTKC Environmental Laboratory identified for the sumps.

4.3 Groundwater Monitoring

All sampling will be in compliance with the current RTKC Ground Water Characterization and Monitoring Plan (GCMP).

5.0 Sample Custody

5.1 Field Operations

The following records and actions will be completed as part of the water quality sampling of the Large Bingham Reservoir System.

- Field Logs: A complete record of all field sampling activities will be kept by the sampler. The field logs will document the date, time, and location of sampling and the name of the person(s) performing the sampling, as well as any other pertinent information.

- Sample Labels- Sample containers will be labeled with the information necessary to prevent misidentification of samples. Each sample container will be clearly labeled with the sample location, date and time of collection, preservative(s), filtered or unfiltered, and the name of the person(s) performing the sampling.

- Chain-of-Custody Record: In order to establish the documentation necessary to trace sample possession, a chain-of-custody record will be filled out to accompany every sample shipment from the time of collection through receipt by the analytical laboratory. The samples will be delivered to the laboratory for analysis as soon as possible.

- All sampling will be noted and recorded as required in the current RTKC GCMP.

5.2 Laboratory Operations

The primary laboratory to be used for analysis of the water quality samples will be the Kennecott Environmental Laboratory (KEL). KEL is certified by the State of Utah (certification No. E-21). Any other laboratories used, if necessary, will be certified by the State of Utah. The laboratories will maintain internal chain-of-custody control in accordance with their own standard quality assurance program.

The date and time of analyses, name of person(s) performing the analyses, and methods used, will be documented by the laboratory.

6.0 Analytical Parameters

All water quality samples from the monitoring sumps, reservoirs, and Desilting Basin, will be analyzed for the field measurements (pH, specific conductance, and temperature), major ions (alkalinity, chloride, sulfate, potassium, sodium, magnesium, and calcium),trace metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc), and TDS. All samples will be analyzed using EPA approved methods as specified in Utah Regulation R317-6-6.3.

7.0 Schedule for Water Quality Sampling

7.1 Monitoring Sumps

Monitoring sumps will be inspected weekly for water levels and Water Quality samples shall be collected from any sump whose flow rate is above the ALR (3.47 gpm or 5,000 gpd).

7.2 Reservoir Sampling

The schedule for sampling each of the Large Reservoir facilities will be semi-annually; for comparative purposes a sample will also be collected each time the ALR is exceeded during a sump pump test.

7.3 Ground Water Sampling

Ground water monitoring wells will be sampled in accordance with the approved Desilting Basin Monitoring Plan (Appendix D).

8.0 Field Calibration Procedures

8.1 pH

Field pH will be measured with an expanded milli-volt meter with two decimal place resolution, and automatic temperature correction. Manufacturer's instructions for operation and standardization of the pH instruments will be followed. A two-buffer calibration will be performed with buffers approximately three pH units apart and spanning the anticipated measurement values prior to each sampling event. The pH electrodes will be stored in pH/7 buffer.

8.2 Specific Conductance

Specific conductance will be measured with a commercially available conductivity meter. All meters will be calibrated in accordance with the manufacturer's instructions Calibration will be performed prior to each sampling event.

8.3 Temperature

Temperature will be measured using a calibrated thermometer.

9.0 Internal Quality Control Checks

9.1 Overview

All work will be conducted in accordance with the GCMP Quality Assurance Project Plan.

9.2 Laboratory Operations

The certified laboratory will conduct its own internal quality control checks in accordance with its quality assurance program. This will include running at least 5 percent duplicates spike and control samples.

Laboratory equipment maintenance will be in accordance with the laboratory QA plan.

All samples will be analyzed using EPA approved methods as specified in Utah Regulation R317-6-6.3. The methods to be used and target detection levels are specified in the (GCMP).

10.0 Reporting

Water quality sampling results and data from the leak detection system will be submitted semi-annually, as stated in II.G.1 of the Permit, according to the following schedule:

Semi-Annual Period	Report Due On
1st January through June	August 15
2nd July through December	February 15