Official Draft Public Notice Version **September 8, 2025**
The findings, determinations, and assertions contained in this document are not final and subject to change following the public comment period.

STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY
P.O. BOX 144870
SALT LAKE CITY, UTAH 84114-4870

Ground Water Discharge Permit
Permit No. UGW350010

In compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended, the Act,

Kennecott Utah Copper LLC
4700 W. Daybreak Parkway
South Jordan, Utah 84009

hereafter, referred to as the Permittee, is granted a Ground Water Discharge Permit for the operation of the **Bingham Canyon Mine and Water Collection System** in Salt Lake County, Utah.

The Bingham Canyon Mine and Water Collection System is located on the following tracts of land (Salt Lake Base and Meridian):

Township 3 South, Range 2 West - Portions of Sections 17, 18, 19, 20, 21, 29, 30, 31, and 32
Township 3 South, Range 3 West - Portions of Sections 11, 12, 13, 14, 22, 23, 24, 25, 26, 27, 33, 34, 35, and 36
Township 4 South, Range 2 West - Portions of Sections 6 and 7
Township 4 South, Range 3 West - Portions of Sections 1, 2, 3, 9, 11, and 12

The permit is a renewal of the original groundwater discharge permit issued May 1, 1999. The permit is based on representations made by the permittee and other information contained in the administrative record. It is the responsibility of the permittee to read and understand all provisions of this permit.

The facility shall be constructed and operated in accordance with conditions set forth in the permit and the Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6).

This permit shall become effective on _____, 2025.

This permit and the authorization to operate shall expire at midnight, _____, 2030.

_____
John K. Mackey, P.E.
Director
Utah Division of Water Quality

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Table 3: Bingham Canyon Mine Informational Wells for Permit #UGW350010
Table 4: Groundwater Discharge Permit #UGW350010 Sample Point Coordinates

DRAWINGS:

Drawing: 451-T-9080; East Side Collection System, Typical Drainage Facility
Drawing: 454T-0119; Bingham Canyon Mine and Water Collection System 2012 EWRE Modification

FIGURES:

Figure 1: Bingham Canyon Mine and Water Collection System
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APPENDICES:

Appendix A: Compliance Monitoring Plan
Appendix B: Bluewater Repository Waste Characterization Plan
Appendix C: Contingency and Corrective Action Plan
Appendix D: Conceptual Closure Plan
Appendix E: Operational Monitoring Plan
Appendix F: Best Management Practices Plan
Appendix G: Dry Fork Management Plan
Appendix H: Operations & Maintenance Manual East Waste Rock Extension Water Collection System
Appendix I: Operations & Maintenance Manual South Waste Rock Reclamation Detention Basins
Appendix J: Groundwater Characterization and Monitoring Plan

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PART I CONSTRUCTION PERMIT ISSUANCE AND BEST AVAILABLE TECHNOLOGY (BAT) STANDARD

A. Authorized Construction

Construction permits approved in 2024 are hereby issued to Kennecott as summarized below for 1) the extension of the Toe Drain from the Copper IV to Yosemite drainages, which ties the East Waste Rock and South Waste Rock areas, and 2) Bluewater repository expansion within the approved area in the Bluewater 1 drainage. These construction permits are incorporated into this ground water discharge permit renewal.

B. Design and Construction

Under authority of the Utah Water Quality Act, Section 19-5-108(1) Utah Code Ann. 1953, as amended and Utah Administrative Code R317-1, the authorized facilities are constructed in accordance with the engineering design plans and specifications, which received construction permits from the Division of Water Quality ("Division").

Construction elements include:

1. The extension of the Toe Drain water collection system, from the Copper IV to Yosemite drainages, was constructed in 2024. The Division issued the construction permit on March 28, 2024.

2. The Bluewater Repository Expansion in the Bluewater 1 Drainage is planned to be completed in 2025 according to the engineering design drawings and specifications. The Division issued a construction permit on April 3, 2024.

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PART II SPECIFIC PERMIT CONDITIONS

A. Ground Water Classification

The ground water classification for the uppermost aquifer in the area of the Bingham Canyon Mine and Water Collection System ranges from Class I to Class II ground water. There are areas where ground water has been impacted by acidic water, resulting in degraded water quality classified as Class III and Class IV. Ground water at each compliance monitoring well has been classified based on historical monitoring data.

B. Ground Water Protection Levels

Ground water Protection Levels for compliance monitoring wells for this permit are represented in Table 1.

C. Best Available Technology Performance Standard

1. The Best Available Technology (BAT) for the Bingham Canyon Mine and Water Collection System will be a Discharge Minimization approach designed, constructed, and operated in accordance with approved designs and specifications (Part II.E). The design for conveying mine-impacted water consists of a combination of concrete cut-off walls, toe drains, French drains or seepage collection trenches, HDPE pipelines, collection boxes, and extraction wells. Meteoric precipitation is conveyed through either the HDPE pipelines or concrete-lined ditches, which also act as secondary containment mechanisms for the mine-impacted water HDPE pipeline system in cases where flows exceed the pipeline capacity or where maintenance of the pipeline is required. The Southeast Waste Rock Optimization (SEWOP) project required extending a toe drain by 2,000 feet in the Copper IV drainage, with no modifications to the existing cut-off walls and other features of the contact water collection system in the area.

   The BAT for the Dry Fork area shall include the operation and maintenance of two extraction wells: the Mid-Valley well (COP2701) and the Picnic Flats well (COG2865, replacement for COG1172, which experienced biofouling issues), both located up-gradient of the Dry Fork dump. These wells are in place to capture water before it comes into contact with the waste rock dumps and the underlying contaminated groundwater.

   The operation and maintenance of a series of three alluvial extraction wells, located down-gradient of the toe of the Bingham Canyon dump, will include the following components. The primary well is the Bingham Canyon Alluvial Well (ECG2787), located within Bingham Creek. The secondary alluvial extraction well, Curtis Springs (VWK83), is located down-gradient of ECG2787 and also within the alluvial channel of Bingham Creek. A third alluvial well named Copperton Channel (ECG1185) is located due north of Curtis Springs and intercepts water from an alluvial channel adjacent to and north of Bingham Creek. Production from these wells is dependent upon 1) seasonal conditions, 2) available mine-impacted water

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from within the alluvium, and 3) the influence of up-gradient wells on the yield of down-gradient wells.

Operating parameters and regulatory obligations related to Dry Fork wells are listed in Table 2, with additional information regarding Dry Fork management contained in Appendix G.

A series of down-gradient compliance monitoring wells screened in bedrock also monitors bedrock contamination from the Dry Fork and Bingham Canyon area. The wells are ECG2789A, ECG2789B, ECG1100A, ECG1100B, and VWK93, which have established compliance limits. Monitoring wells ECG2866A and ECG2866B replaced ECG2789A and ECG2789B in 2020 to accommodate the installation of a new conveyor belt, which was installed in 2021. Regarding the compliance monitoring wells, a remedial strategy is necessary to address bedrock groundwater contamination from Dry Fork, as outlined in Appendices C and G and as directed by the Director.

BAT shall also include inspection and maintenance commitments included in the Compliance Monitoring Plan (Appendix A). The operations and maintenance manual for the East Waste Rock Extension Water Collection System (Appendix H) contains details of the East Side Water Collection system design and description, operational controls, and maintenance strategy.

2. Best Available Technology for the Bluewater Repository is a low-permeability clay liner and cap system as specified in Part II.E.2. Only materials approved by the Director may be disposed of in the repository following analysis under the Waste Characterization Plan (Appendix B). The Bluewater Repository and its footprint were permitted in 1991. Only a portion of the footprint was occupied through 2024. The Bluewater Repository expansion of 500,000 cubic yards has been designed to occupy approximately half of the remaining permitted area by 2024, with construction work scheduled for completion in 2025. The expansion design fully meets the preexisting BAT requirements specified in Part II.E.2. It is anticipated that the repository footprint will be expanded further in the next several years within the original permitted footprint and in accordance with the permitted specifications.

3. The Best Available Technologies instituted for the Chalcopyrite Heap Leach Project (CHLP) consist of double-lined HDPE facilities for the Heap, Pregnant Leach Solution (PLS) Pond, and Raffinate Pond. Each facility incorporates two layers of 60-millimeter HDPE liner with independent leak collection and detection systems. Performance criteria are outlined in Appendix F. If the CHLP facilities listed here do not meet the performance criteria outlined in Appendix F, Kennecott shall refer to Part II.H of this permit. The Chalcopyrite Heap Leach facility was dismantled in 2016. The reference to the facility is maintained in Appendix F to ensure compliance with BAT requirements that may be applicable should a similar facility be constructed in the future.

4. Closure - The Bingham Canyon Mine and Water Collection System shall undergo closure in accordance with the requirements of the approved closure plan

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(Appendix D – Bingham Canyon Mine 2003 Reclamation and Water Management Plan, March 2003) as updated by a final closure plan submitted in conformance with Part II.J.4 of this permit.

5. Implementation of Best Management Practices - Kennecott Utah Copper LLC (Kennecott) shall operate the facilities specified in the Best Management Practices Plan as required under Appendix F of this permit.

D. Permitted Facilities

The Facilities authorized under this permit include:

1. The Bingham Canyon Mine and existing associated facilities: All Bingham Canyon Mine maintenance facilities, South Area Water Services (SAWS), and the Bingham Canyon Water Treatment Plant (also permitted by the Utah Division of Drinking Water).

2. The East, South, and West Side waste rock dumps and collection systems.

3. Pipelines, conveyance ditches, collection boxes, pump back wells, and associated structures used to convey flows of meteoric and storm water that originate from Kennecott's waste rock piles adjacent to the Bingham Canyon Mine. The Large and Small Bingham Reservoirs are not included in this permit but are covered under separate ground water quality discharge permits.

4. Bluewater Repository – The repository is located on the north end of the east waste rock piles. As specified in Appendix B, the Bingham Canyon Mine and Water Collection System ground water quality discharge permit includes pertinent portions of the prior Bluewater Repository ground water quality discharge permit. Each segment of the repository features a leachate collection system that directs flows to the leachate collection pipeline.

5. SXEW (Solvent Extraction/Electrowinning) Facilities pursuant to approval of plans and specifications.

6. The Bingham Detention Basin, constructed in 2020, and managed in accordance with Appendix A and under the general requirements for detention basins described in the operation and maintenance (O & M) manual attached as Appendix I.

E. Design and Construction

1. The Bingham Canyon Mine and Water Collection System is constructed according to the specifications, plans, and drawings included in the permit application titled:

   a. Bingham Canyon Mine Eastside Collection Monitoring Network Ground Water Discharge Permit Application (revised) dated April 1996 (submitted June 13, 1996).

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b. Geohydrology of the Dry Fork Region, Bingham Canyon Mine, Kennecott Utah Copper, May 1994 (submitted February 25, 1997).

c. Supplemental application materials transmitted in letters dated October 23, 1997, from Elaine Dorward-King and January 6, 1998, and August 31, 1998, from David J. Cline.

d. Contaminant Investigation and Corrective Action Plan for the Dry Fork Area, September 2002 (Submitted September 26, 2002).

e. Supplemental application materials related to the Dry Fork area detailed in letters dated January 21, February 11, and March 10, 2003 (from Paula Doughty to the Division).

f. Supplemental Dry Fork Management Plan materials titled "Proposal to Relocate Dry Wells – Rio Tinto Kennecott Utah Copper (KUC) Bingham Canyon Mine Water Collection System Ground Water Discharge Permit No. UGW350010" dated September 22, 2008

g. Groundwater Discharge Permit Modification Application for East Waste Rock Extension, groundwater discharge permit UGW350010, submitted August 2012.

h. Groundwater Discharge Permit Modification Application for South Waste Rock Reclamation, groundwater discharge permit UGW350010, submitted November 2014.

i. Bingham Detention Basin construction drawings submitted in March 2020.

j. Construction Permit Approval of engineering drawings and specifications for an extension of the Toe Drain from the Copper IV to Yosemite drainages in March 2024.

k. Construction Permit Approval of engineering drawings and specifications for the Bluewater Repository expansion in the Bluewater 1 drainage in April 2024.

2. The Bluewater North Repository segment and the Bluewater Main Repository segment are constructed according to the design specifications and drawings submitted May 17, 1991, as amended by Addendum No. 1, submitted June 6, 1991, and plans for expansion of the repository submitted December 18, 1992. These include:

a. *Clay Bottom Liner* - the bottom liner consists of a 12-inch-thick clay layer with an in-place hydraulic conductivity of no greater than 1×10^{-7} cm/sec.

b. *Seepage Collection System* - a seepage collection system constructed on the bottom clay liner consisting of a 4-inch minimum HDPE slotted pipe buried

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in 3/8-inch gravel surrounded by geotextile and running the length of the landfill.

c. *Clay Barrier* - a 12-inch-thick clay cap constructed on top of the tailings. The cap has a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec.

d. *Clay Soil Layer* - a 34-inch clay soil layer placed on top of the 12-inch clay barrier. This layer has a hydraulic conductivity no greater than 1 x 10^{-4} cm/sec.

e. *Topsoil Layer* - An eight-inch layer of topsoil placed on top of the clay cap layers. This layer will be vegetated in accordance with the reclamation requirements of the Division of Oil Gas and Mining.

f. *Run-on and Run-off Control* - Surface water run-on is controlled by site grading and ditches to direct drainage away from the repository.

F. Monitoring

1. General Provisions

a. *Future Modification of the Monitoring Network* - If at any time the Director determines the monitoring program to be inadequate for determining compliance with BAT, applicable permit limits, or ground water protection levels, Kennecott shall submit within 30 days of receipt of written notice from the Director a modified monitoring plan that addresses the inadequacies noted by the Director.

Within 60 days of completion and development of any new or replacement compliance or operational monitoring well, Kennecott shall submit documentation demonstrating that the well is in conformance with the EPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, 1986, OSWER-9950.1 (RCRA TEGD) Section 3.5.

b. *Compliance Monitoring Period* - Monitoring shall commence upon the issuance of this permit and shall continue through the life of this permit. For compliance monitoring wells that are installed during the term of this permit, monitoring shall commence upon completion of the well installation and development as described in Part II.F.1(a).

c. *Laboratory Approval* - All water quality analyses shall be performed by a laboratory certified by the State of Utah to perform such analysis.

d. *Water Level Measurement* - In association with each well sampling event, water level measurements shall be taken in each monitoring well prior to removal of any water from the well bore. These measurements will be collected from a permanent single reference point clearly marked on the top of the well or surface casing. Measurements will be made to the nearest

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0.01 foot.

e. *Sampling Protocol* - Water quality samples will be collected and handled in accordance with the Director-approved version of the Kennecott Ground Water Characterization and Monitoring Plan (Appendix J).

f. *Constituents Sampled* - The following analyses shall be performed on all water quality samples collected:

i. Field Measurements: pH, specific conductance, temperature

ii. Laboratory Analysis:

a. Alkalinity
b. Major Ions: (chloride, sulfate, sodium, potassium, magnesium, and calcium)
c. Metals (dissolved): (arsenic, cadmium, chromium, copper, lead, selenium, and zinc)
d. TDS

g. Analytical Procedures - Water sample analysis will be conducted in accordance with the test procedures specified under UAC R317-6-6.3.

2. Operational Monitoring

Operational Monitoring will be used to assess the effectiveness of the water collection system, including the following aspects:

a. Mine-Impacted Water - Flow and water quality data from the water collection system.

b. Bluewater Repository Leachate Collection System - Water quality from the leachate collection system.

c. Tunnel Flows - Flows from the mine tunnels that underlie the Waste Rock Piles for the Bingham Canyon Mine.

d. Informational Wells – Table 3 lists the informational monitor wells that will be used to supplement compliance monitor wells down-gradient of the collection system and within the Dry Fork area.

e. Groundwater Extraction Rates – Annual volume of water removed from the three alluvial extraction wells down-gradient of Dry Fork (ECG2787, VWK83, and ECG1185) as well as the Bingham Canyon cut-off wall and the two water capture wells up-gradient of Dry Fork (COP2701 and COG2865, which replaced COG1172).

3. Monitoring Frequency

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a. *Well Monitoring Frequency* - All existing compliance monitoring wells scheduled for sampling are listed in Table 1. Compliance monitoring wells screened in alluvium will be sampled quarterly throughout the term of this permit, while compliance monitoring wells screened in bedrock, including those in the Dry Fork area, will be sampled semi-annually. Any newly drilled monitoring wells (to be used as compliance wells) will be sampled quarterly for 12 consecutive quarters (3 years) following installation to establish baseline groundwater quality. However, if a preexisting monitoring well has at least three years of data, the compliance limits for that well will be calculated and established. Following completion of 12 quarterly samples, monitoring shall change to a semi-annual (bedrock completion) or quarterly (alluvial completion) sampling frequency unless more frequent sampling is required under other terms of this permit.

b. *Operational Monitoring Frequency* - Operational monitoring, including collection system flows, tunnel flows, informational wells, pumping rates from extraction wells, and leachate collected from the Bluewater Repository, shall occur as specified in Appendix E of this permit.

4. Post-Closure Monitoring

Kennecott shall conduct post-closure monitoring in accordance with the post-closure monitoring program (Appendix D) that has been submitted and approved in conformance with Part II.J.4 of this permit.

5. Suspension of Compliance Reporting Requirements

The Division is suspending the compliance reporting and sampling requirements in compliance monitoring wells as follows:

a. If the TDS concentration exceeds the limit in any compliance well due to regular salt concentration other than sulfate, compliance reporting requirements, including those identified in Part II.G, H, and I, are suspended unless results are greater than 15% over the current protection level. All exceedances will still be included in quarterly reports corresponding to the sampling period. This will prevent unnecessary notifications of elevated TDS due to the routine salting of mine roads for winter access.

b. Monitoring wells completed in the bedrock: The ECG1100B, ECG907, and ECG925 wells can be sampled semi-annually, even though they show exceedances for TDS and sulfate concentrations. The groundwater transmissivity in the bedrock is extremely low, and more frequent sampling will not present any new data. The results should be included in the quarterly reports corresponding to the sampling period.

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G. Non-Compliance for Ground Water Protection Levels

1. Probable Out of Compliance - If the concentration of a pollutant from any compliance monitoring well sample exceeds the compliance limit (in the case of pH exceeding the higher or lower limit) (Table 1), Kennecott shall:

   a. Notify the Director in writing within 30 days of receipt of the data;

   b. Initiate monthly sampling for the compliance monitoring well(s) that have exceeded the compliance limit (Table 1), unless the Director determines that other periodic sampling is appropriate, for a period of two months or until the compliance status of the facility can be determined.

2. Out-of-Compliance Status

   An out-of-compliance status exists when two or more consecutive samples from a compliance monitoring well exceed the compliance limit for a pollutant (Table 1). Upon determining that an out-of-compliance situation exists, Kennecott shall:

   i. Notify the Director of the out-of-compliance status within 24 hours of discovery, followed by a written notice within 5 business days of the detection.

   ii. Initiate monthly sampling unless the Director determines that other periodic sampling is appropriate until the facility is brought into compliance.

   iii. Submit a Source Assessment and Compliance Schedule to the Director within 30 days of detection of the out-of-compliance status that outlines the following:

      a. Steps of action that will assess the source, extent, and potential dispersion of the contamination.
      b. Evaluation of potential remedial actions to restore and maintain ground water quality and ensure the compliance limits will not be exceeded at that compliance monitoring point
      c. Measures to ensure the best available technology will be re-established.

   iv. Implement the Source Assessment and Compliance Schedule as directed by the Director.

H. Non-Compliance for Best Available Technology

1. Kennecott is required to maintain the Best Available Technology in accordance with the approved design and practice for this permit. Failure to maintain BAT or maintain the approved design and practice shall be a violation of this permit. In the

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event a compliance action is initiated against the permittee for violation of permit conditions relating to best available technology, Kennecott may affirmatively defend against that action by demonstrating the following:

a. Kennecott submitted notification in accordance with R317-6-6.13;

b. The failure was not intentional or caused by Kennecott's negligence, either in action or in failure to act;

c. Kennecott has taken adequate measures to meet permit conditions in a timely manner or has submitted for the Director's approval an adequate plan and schedule for meeting permit conditions, and

d. The provisions of UAC 19-5-107 have not been violated.

I. Reporting Requirements

1. Reporting

a. *Monitoring Wells* - Water quality sampling results for compliance monitoring wells shall be submitted quarterly to the Director as follows:

Quarter Sampled In	Results Due On
1st (Jan, Feb, March)	May 15
2nd (April, May, June)	August 15
3rd (July, Aug, Sept.)	November 15
4th (Oct, Nov, Dec.)	February 15

b. *Operational Monitoring* - Operational monitoring results and analysis, including results from collection sites, the Bluewater Repository, tunnels, informational wells, extraction wells, and surface water sites (seeps), shall be submitted in an annual report by March 31 of each year in accordance with the requirements of Appendix E.

c. Failure to submit reports within the specified timeframe shall be deemed as noncompliance and may result in enforcement action**.**

2. Delivery Requirements - The permittee will electronically submit the required reports using a transmittal mechanism and format approved by the Director. If requested by the Director, hard copies shall also be submitted.

J. Compliance Schedule

1. *Permit Renewal* Application *Items* - As part of the application for permit renewal, which is submitted every five years, Kennecott will include a water quality summary of the previous data collected for operational and compliance monitoring wells. Data from the Operational Monitoring program will be included in this summary. The summary will include an analysis of trends and any changes in the

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data throughout the life of the permit.

2. *Updated Site Maps and Well Information* - Kennecott will provide within one year of permit issuance:

   a. Updated site maps and diagrams of all monitoring wells, leach water collection sites, cut-off walls, and all other parts of the East Side Collection System, including updated plume maps, aquifer contour maps with flow rate and direction, and

   b. Coordinates of all monitoring wells and leach water collection sites associated with the East Side Collection System.

3. *BAT Inspection* - Kennecott will conduct a comprehensive BAT inspection of the entire East Side Collection System within 2 years of permit issuance to ensure that all components of the collection and drainage system are functioning as designed and to identify any maintenance work that may be necessary.

   a. Kennecott will submit a BAT inspection work plan within 1 year of permit issuance for approval by the Division.

   b. Kennecott will provide the Division with the results of the BAT inspection, identifying any deficiencies found.

   c. Kennecott will provide the Division with a plan to correct any deficiencies within 90 days of completion of the BAT inspection, including milestones and completion schedules for Director approval.

   d. Kennecott will begin implementing the approved schedule and provide updates in quarterly reports submitted to the Division.

4. *Final Closure* - Kennecott has an approved conceptual closure plan attached in Appendix D of this permit. One year prior to final closure, Kennecott shall submit, for approval by the Director, a final closure plan that addresses the water quality management aspects of closure.

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PART III MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples collected in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity.

B. Analytical Procedures. Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3L, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results. Monitoring results obtained for each monitoring period specified in the permit shall be submitted to the Director, Utah Division of Water Quality, at the following address no later than 45 days after the end of the monitoring period (unless specified otherwise in this permit):

State of Utah
Division of Water Quality
Department of Environmental Quality
P.O. Box 144870
195 North 1950 West
Salt Lake City, Utah 84114-4870
Attention: Ground Water Protection Section

E. Compliance Reporting. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using approved test procedures as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

G. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this

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permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended at the request of the Director at any time.

I. Twenty-four Hour Notice of Noncompliance and Spill Reporting.

1. The permittee shall verbally report any noncompliance or spills subject to the provisions of UAC 19-5-114, which may endanger public health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24-hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 538-6146, during normal business hours (8:00 am - 5:00 pm Mountain Standard Time).

2. A written submission shall also be provided to the Director within five business days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

3. Reports shall be submitted to the addresses in Part III.D, Reporting of Monitoring Results.

J. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours, shall be reported at the time that monitoring reports for Part II.I are submitted.

K. Inspection and Entry. The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

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4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

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PART IV COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

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PART V GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

B. Anticipated Noncompliance. The permittee shall give advance notice of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and re-issuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or any report to the Director, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Director shall be signed and certified.

1. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer;
   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.
   c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and

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submitted to the Director, and,

b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to Authorization. If an authorization under Part V.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.G.2. must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential by the permittee, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Director. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

J. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held

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invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

L. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

M. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by Section 19-5-117 of the Act.

N. Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. If new ground water standards are adopted by the Board, the permit may be reopened and modified to extend the terms of the permit or to include pollutants covered by new standards. The permittee may apply for a variance under the conditions outlined in R317-6-6.4(D)

2. If alternate compliance mechanisms are required

3. If water quality of the facility is significantly worse than represented in the original permit application.

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Official Draft Public Notice Version **September 8, 2025**
The findings, determinations, and assertions contained in this document are not final and subject to change following the public comment period.

GROUND WATER QUALITY DISCHARGE PERMIT

STATEMENT OF BASIS

Kennecott Bingham Canyon Mine and Water Collection System

Introduction

The Division of Water Quality ("Division"), under the authority of the Utah Ground Water Quality Protection Rules[1] (Ground Water Rules), issues ground water discharge permits to facilities which have a potential to discharge contaminants to ground water[2]. As defined by the Ground Water Rules, such facilities include mining operations[3]. The Ground Water Rules are based on an anti-degradation strategy for ground water protection, as opposed to non-degradation; therefore, discharge of contaminants to ground water may be allowed provided that current and future beneficial uses of the ground water are not impaired and the other requirements of Utah Administrative Code (UAC) R317-6-6.4.A are met[4]. Following this strategy, ground water is divided into classes based on its quality[5]; and higher-quality ground water is given greater protection[6] due to the greater potential for beneficial uses. The Division has developed permit conditions consistent with UAC R317-6 and appropriate to the nature of the mined materials, facility operations, maintenance, best available technology[7] (BAT), and the hydrogeologic and climatic conditions of the site, to ensure that the operation will not contaminate ground water.

Basis for Permit Issuance

Under UAC R317-6-6.4A, The Division may issue a ground water discharge permit if:

1) The applicant demonstrates that the applicable class total dissolved solids (TDS) limits, ground water quality standards protection levels, and permit limits established under UAC R317-6-6.4E will be met;
2) The monitoring plan, sampling and reporting requirements are adequate to determine compliance with applicable requirements;
3) The applicant is using best available technology to minimize the discharge of any pollutant; and
4) There is no impairment of present and future beneficial uses of ground water.

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1. Utah Admin. Code Rule 317-6
2. https://deq.utah.gov/water-quality/current-permits-utah-ground-water-quality-protection-program
3. Utah Admin. Code Rule 317-6-6.1(A)
4. Preamble to the Ground Water Quality Protection Regulations of the State of Utah, sec. 2.1, August 1989
5. Utah Admin. Code Rule 317-6-3
6. Utah Admin. Code Rule 317-6-4
7. Utah Admin. Code Rule 317-6-1(1.3)

Purpose

Ground Water Discharge Permit No. UGW350010 for the Bingham Canyon Mine and Water Collection System is undergoing the renewal process, which occurs every five years. The permit was last renewed in 2020. As part of the renewal process, the permit will also incorporate modifications associated with new waste rock placement within the Copper IV to Yosemite drainage areas and relocation of the toe drain in the area.

The permit was originally issued in 1999 and included several source control measures such as the cessation of active waste rock leaching and the installation of an engineered water collection system along the toe of the valley-facing waste rock dumps. This renewal will comprise changes to the original permit and, if needed, include adoption of permit limits determined in accordance with Part II.F.3 for all wells covered by the permit.

Description of Facility

Bingham Canyon Mine - The Kennecott Utah Copper Bingham Canyon Mine operations are located in the Oquirrh Mountains, approximately 18 miles southwest of Salt Lake City, Utah. This mine produces copper and other metals that are currently extracted using an open-pit method of mining. Open-pit operations have been conducted at this site for over 120 years. Increased underground mine operation in the pit started in 2023 and is expected to ramp up in the coming years. Facilities included in the mine operations include the truck maintenance shops, warehouses, and mine support activities.

Waste Rock Dumps - The waste rock associated with this mining operation has been placed adjacent to the open pit on the slopes of the Oquirrh Mountains. The waste rock disposal areas consist of over 6 billion tons of waste rock located in three principal areas. These three areas are referred to as the East Side, South Side, and West Side waste rock dumps. The waste rock consists of low concentrations of sulfide mineralization and trace metals in an intrusive host rock, limestone, and quartzite.

Active leaching of the waste rock dumps ended in October 2000. Previously, parts of the dumps were leached by recycling water collected at the base of the dumps and placing it back on top of the waste rock. Although active leaching, i.e., recycling the collected water, has stopped, poor-quality mine-impacted water is still collected in the water collection system at the base of the dumps. Other portions of the dumps were not actively leached but do generate acidic drainage due to the contact of meteoric precipitation with waste rock. This water is collected and used as process water or discharged, as permitted under the Utah Pollutant Discharge Elimination System (UPDES) permit (UT0000051).

The current collection system for the East Side dumps was constructed between 1993 and 2017 and consists of a series of 26 cut-off walls (see Figure 1) constructed in each drainage downgradient of the waste rock dumps. To augment the effectiveness of the cut-off walls in the formerly leached area from Bluewater 1 to the Copper IV drainage, toe and French drains were installed.

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The collection system downgradient of the east waste rock dumps was modified starting in 2012 to accommodate the continuation of mining, which includes placing waste rock to the east of the existing East Side dumps. This project, generally referred to as the East Waste Rock Extension (EWRE), was approved by the Division in 2013. In this effort, nine cut-off walls were replaced with 12 new cut-off walls between the Copper and Midas drainages to accommodate the eastern extension of waste rock. Where modifications were made, the modified collection system employs a toe drain beginning at the Copper IV drainage and ending at the Midas drainage, where it overlaps the existing toe drain collection system in the Midas drainage. The newly installed collection system runs continuously along the entire eastern toe of the new waste rock dump between the Copper IV and Midas drainages and acts as the primary means of collecting waste rock contact water (WRCW). The new cut-off walls act as a secondary collection point for WRCW and the point of compliance.

The South East Waste Rock Optimization (SEWOP) project required extending a toe drain by 2,000 feet in the Copper IV drainage. The existing cut-off walls and other features of the contact water collection system in the area were not modified. The Division approved the engineering drawings as a construction permit on March 28, 2024.

In addition to the EWRE, a reclamation project referred to as the South Waste Rock Reclamation (SWRR) project began in 2014, which modified portions of the water collection system associated with the South Dumps, primarily in Butterfield Canyon. The SWRR project included the placement of waste rock adjacent to the existing south dumps and eventual reclamation of the dumps associated with the drainages from Yosemite to Olsen. Three existing cut-off walls were relocated and replaced with four newly constructed cut-off walls to better accommodate a relaxed and reclaimed waste rock slope. The drainages affected by reclamation activities and cut-off wall relocations include Yosemite, Butterfield 1, and Olsen. Modifications to the south dump drainages also include enhanced storm water detention basins. Operation and Maintenance manuals for the cut-off walls and detention basins are included in Appendix H (EWRE) and Appendix I (SWRR) of the permit.

The collected water is conveyed by HDPE pipelines to the South Area Water Services (SAWS) Precipitation Plant for metal extraction or to the Large Reservoir system. Following the extraction of copper, the collected water is stored in the lined Bingham Reservoirs (permit #UGW350006) and/or pumped to the tailings pipelines and then gravity-fed to the Tailings Impoundment (permit #UGW350011).

Leach water was applied to the Dry Fork waste rock dump until 1999. The Dry Fork plume is located under the historic Dry Fork leaching operation and is the result of historic mining activities. Controls related to the plume and WRCW include the cut-off wall in lower Bingham Canyon and groundwater extraction wells located in Bingham Canyon and Dry Fork. These wells are designed to either intercept groundwater impacted by the historic leach water applications or to capture clean water before it comes in contact with waste rock.

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SXEW Operations - Kennecott has conducted a pilot-scale Solvent Extraction/Electrowinning (SXEW) project in a lined and monitored area on the Dry Fork dump. The original pilot plant was decommissioned in 1999. The pads associated with the project were being used for heap leach test work. However, the pads are currently not in operation and have been taken out of service; the associated facilities have been removed. This system will be further evaluated to decide if the type of operation should be decommissioned. Pregnant leach solution from this type of test facility is either used in pilot SXEW operations adjacent to the heap leach or can be piped to the Precipitation Plant area at the mouth of Bingham Canyon. The extent of SXEW operations depends on various future market conditions.

Bluewater Repository - The Bingham Canyon Mine and Water Collection System groundwater quality discharge permit includes pertinent portions of the prior groundwater permits issued for the Bluewater Repository. Each segment of the repository consists of a leachate collection system that routes flows to the leach collection pipeline. Only a portion of the footprint was occupied through 2024. The Bluewater repository expansion of 500,000 cubic yards has been designed to occupy around half of the remaining permitted area in 2024, and the construction work is expected to be completed in 2025. The design of the expansion fully meets the pre-existing BAT requirements specified in Part II.E.2. It is anticipated that the repository will be expanded over the next several years within the original permitted footprint and in accordance with the permitted specifications.

Site Hydrogeology

Tertiary volcanic bedrock is the primary stratigraphic unit that underlies the majority of the East Side waste rock dumps. The South Side waste rock is underlain by both Tertiary volcanic and Paleozoic bedrock. There is a thin layer of unsaturated alluvial and colluvial material under parts of the waste rock dumps. Beneath the Tertiary volcanics are quartzites and limestones of Paleozoic age. The Paleozoic bedrock beneath the Dry Fork waste rock dump area is fractured and is more permeable than the bedrock beneath the other waste rock dumps. Beneath most of the dumps, water tends to perch at the waste rock/bedrock contact. To the east of the waste rock disposal areas, the Tertiary volcanics and Paleozoic bedrock are covered by Pliocene-Pleistocene alluvial deposits. These deposits thicken to the east to form the principal aquifer in the Southwest Salt Lake Valley[8].

The central portion of the Salt Lake Valley is generally characterized as having a shallow unconfined and a principal confined aquifer system. Confining layers are generally not present or discontinuous near the base of the mountains and are more pronounced towards the center of the valley[9]. Except for a thin veneer of alluvial material in the area from the Copper IV drainage northward to the Bluewater drainage, Kennecott's East Side waste rock dumps and water collection system are located on top of Tertiary volcanic rocks that transition to the alluvial aquifer system to the east of and downgradient from the collection system. Based on mapping of recharge

8. Bingham Canyon Mine East Side Collection Monitoring Network Ground Water Discharge Permit Application. Kennecott Utah Copper, April 1996.
9. Hydrogeology of recharge areas and water quality of the principal aquifers along the Wasatch Front and adjacent areas, Utah. U.S. Geological Survey Water Resources Investigations Report 93-4221. P.B. Anderson, D.D. Susong, S.R. Wold, V.M. Heilweil, and R.L. Baskin, 1994.

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areas completed by the U.S. Geological Survey, Kennecott's former East Side leaching operations are immediately adjacent to the primary recharge area for the west side of the Salt Lake Valley.

Background Water Quality

Water quality in the principal aquifer adjacent to the East Side and South Side waste rock dumps is somewhat variable. The effects of historic mining practices are evident in certain areas. Generally, the water quality downgradient of the non-leached waste rock dumps has a total dissolved solids (TDS) value between 500 mg/L and 3,000 mg/L, which is Class II water. There are a few areas that exhibit Class I water, with TDS values less than 500 mg/L. In areas impacted by acidic waters, a typical water quality signature includes Class III or Class IV water with elevated levels of TDS, sulfate, magnesium, copper, cadmium, and zinc.

Basis for Permit Issuance

Kennecott has proposed a discharge minimization approach coupled with source control for this groundwater discharge permit. Discharge minimization is achieved through the use of a cut-off wall/collection system, which Kennecott has installed to enhance the capture of WRCW. Changes to the existing permit anticipated during the new permit term include the addition of a toe drain extension from the Copper IV to Yosemite drainage.

Control Technology - Cut-off walls have been placed in all principal drainages along the perimeter of the East Side and South Side waste rock dumps. The site for each wall was excavated to bedrock to allow the wall to be keyed into bedrock. Along with the concrete cut-off wall, a collection pond immediately upstream of the wall is installed. In the Bluewater 1 to the Midas drainages, the collection basins upstream of the walls are lined, and seepage collection trenches extend from each side of the wall to the top of the local drainage catchment. These trenches are excavated to bedrock, clay-lined, and have a perforated collector pipe laid in a filter-cloth enclosed gravel drain on top of the clay liner. The trenches augment interception of subsurface flow in the thin veneer of alluvial material and direct the water to the collection pond upgradient of the cut-off wall.

In the modified collection system from Midas to the Copper IV drainages, seepage is captured along the toe of the dump using a trench system that employs dual 12" perforated pipe excavated into bedrock and lined with clay, which directs water via piping to drainage bottoms and the cut-off walls. The wall acts as a secondary collection system and employs a 6" perforated pipe along the base of the wall to capture water seepage not collected by the trench. The modified system also employs storm water detention basins, which manage surface water separately from sub-surface water. These basins will help reduce maintenance requirements associated with scale, which forms when two sources of water of varying quality commingle and generate precipitates. The storm water will be transported separately by HDPE to the Bingham Canyon Reservoir. Waters collected at a cut-off wall are directed via a HDPE pipeline to the primary collection pipe.

Two concrete-lined canals, with an upper canal from Congor to the Eastside Reservoir and a lower canal from Copper III to the Bingham Reservoir, function as a secondary means of conveying the collected water. The upper canal is designed primarily to convey mine-impacted water under upset

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conditions or pipeline cleanout, and the lower canal is principally used for storm water conveyance. The lower canal can also serve as a secondary containment structure for water piped from Bingham Tunnel and/or Lark Shaft to the Large Reservoir and/or the Wastewater Disposal Pump Station. The lower canal can also be used to capture water generated from upset conditions, such as a pipeline break. The concrete ditch is not used for routine conveyance of mine-impacted water.

Flows from the South Side are collected by gravity flow and commingled with flows from the East Side. Cut-off walls are excavated into bedrock. Sedimentation basins are located upstream of each cut-off wall. In some cases, additional basin capacity will be established downstream of the cut-off walls but will continue to report to the primary collection pipe under gravity flow.

Flows from the Dry Fork waste rock dump and other West Side dumps that drain into the Bingham Canyon are contained and collected as follows, with specific permit conditions outlined in Table 2 and discussed in detail in Appendix G; well locations can be identified in Figure 2 of the Permit:

1. Two clean water extraction wells (Mid Valley and Picnic Flats) are maintained in upper Dry Fork Canyon to capture water before it contacts the waste rock dumps and underlying contaminated groundwater. Water is collected by the Mid Valley well (COP2701) and the Picnic Flats well (COG2865, which replaced COG1172) and routed to the Copperton Concentrator for use as process water.

2. The Bingham Creek cut-off wall was constructed upstream of the Bingham Reservoir System in 1994-95 to collect surface and subsurface alluvial flow in the Bingham Creek drainage. The scale of this wall is considerably larger than that of other cut-off walls constructed for the East Side dumps. The depth of the excavation to bedrock exceeded 100 feet. The wall is over 300 feet across at the top, with a maximum thickness of 20 feet at its base. Alluvial flows are collected by the wall through pumping and are ultimately sent to the tailings pipeline.

3. An alluvial extraction well identified as the Copperton Channel well (ECG1185) is located in the Copperton channel, a small alluvial channel that trends eastward. The well was commissioned for alluvial extraction in 1996. The well is screened between 130 and 200 feet below ground surface to capture subsurface alluvial flows. Flows captured in this channel are ultimately sent to the tailings pipeline.

4. An alluvial extraction well in Bingham Creek, identified as ECG2787, was installed in Bingham Canyon in 2009. The well is screened in alluvium between 75 and 129 feet below ground surface and extracts mine-impacted water from the surrounding alluvium. This well is located downgradient of the Bingham Canyon waste rock dump. Under normal operating conditions, water from this well is sent to the Precipitation Plant to recover copper.

5. An alluvial extraction well identified as Curtis Springs (K83) has operated in Bingham Canyon since the 1960s. The well is located downgradient of ECG2787 and is screened

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in alluvium between the depths of 46.5 and 96.5 feet below ground surface. Flows reporting to and captured by this well are contingent upon alluvial water levels. Water levels for K83 respond to pumping conducted at the upgradient ECG2787.

The Bingham Canyon Mine pit acts as a large groundwater collection basin in this portion of the Oquirrh Mountains. On average, Kennecott removes water from the pit continuously at a rate of approximately 1,000 to 1,500 gallons per minute. Several water quality issues related to mine closure are addressed in the closure plan (Appendix D). This 2003 conceptual plan has been approved by the Director. The water management concepts in Appendix D remain the same as projected for the term of this reissued permit. Water management planning may be separated into a stand-alone version of Appendix D from reclamation requirements; this would not automatically trigger a review or substantive revision of the conceptual plan but could include minor and administrative changes. Likewise, changes to Appendix D that are not under the Division's purview would not automatically trigger a review or revision. The majority of these issues are related to pit water accumulation and quality, as well as flows from various tunnels associated with mine operations. The increased underground mine operation, which began in 2023, does not have any new water features outside the pit basin and is part of the dewatering operation of the Bingham Open Pit Mine.

Monitoring Approach

A monitoring well network of 43 wells, 36 on the east side and 7 in the Dry Fork area, is utilized for compliance monitoring of the Bingham Canyon Mine and Water Collection System. In addition, the wells listed in Table 3 will be used for additional informational monitoring on the east side and within the Dry Fork/Bingham Canyon area. Before 2004, only 15 wells were used for compliance monitoring. In 2004, 28 wells were added to the existing network of compliance monitoring wells. The primary objective of compliance wells is to monitor the principal valley-fill aquifer system. Permit limits are based on groundwater class protection levels and monitor the effectiveness of the upgraded cut-off walls, source controls, and collection system.

Where possible, East Side well locations were selected to provide completions in the saturated alluvial aquifer system to the east of the waste rock disposal areas. where at least 50 to 100 feet of saturation exists adjacent and above bedrock. In the southern portion of the East Side and the South Side waste rock disposal areas, as well as in areas immediately downgradient of the cut-off walls, compliance monitor wells are completed in bedrock because no saturated alluvial deposits exist.

The seven compliance wells located in the Dry Fork/Bingham Canyon area (Table 1) are screened in bedrock and are sited to confirm that contamination is not migrating out of the Dry Fork/Bingham Canyon area via bedrock flow paths. These compliance monitoring wells are all located upgradient of the Bingham Canyon cut-off wall.

Permit limits for pH, total dissolved solids, sulfate, and dissolved metals of cadmium, copper, and zinc (Table 1) were established in 1999 for the original 15 compliance wells; in 2004 for the additional compliance wells; and adjusted in 2010 to account for the full history and data available for each compliance well. These parameters were selected as good indicators of mine-impacted water. The permit limits established in 1999 were based on monitoring data collected over a period

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of 4 to 5 years, while limits established in 2004, 2010, 2015, and 2020 are based on monitoring data collected over 10, 15, 20, and 25 years, respectively.

Operational monitoring for this permit includes flow and quality sampling of mine-impacted waters from the collection system, tunnel flows, leachate from repository sumps, seeps (if present), informational wells, and extraction wells.

One of the technical issues associated with the monitoring well system is the ability to distinguish contamination that is historical in nature from contamination that has a recent origin. Before the installation of the upgraded cut-off wall systems in 1994-1996 and 2016-2018, the old cut-off wall system was in operation. The old cut-off wall system was less effective, resulting in a significant loss of leach water. Additionally, the velocity of groundwater in the bedrock material is relatively low, as indicated by numerous hydraulic conductivity tests conducted by Kennecott. It is likely that the contaminated groundwater present in the vicinity of some monitoring wells is from a time frame that predates the installation of the upgraded cut-off wall system. The monitoring well data will need to distinguish between historical contamination and any recent contamination. If recent contamination is detected, it may indicate that the upgraded cut-off wall system is not performing properly. Kennecott conducted several studies to age-date and identify the source of groundwater contamination in the area to provide clarification on this issue (DWQ-2001-001082, DWQ-2002-001141, and DWQ-2002-001101).

Although most of the compliance monitoring wells show stable water quality results below the established protection limits, six wells show TDS exceedance, and five wells show sulfate concentrations exceeding the limit as of 2024.

Basis for Specific Permit Conditions

1. *Suspension of Specific Compliance Reporting Requirements* - The Division is suspending the compliance reporting and sampling requirements in compliance monitoring wells as follows:

    a. If the TDS concentration exceeds the limit in any compliance well due to regular salt concentration other than sulfate, compliance reporting requirements, including those identified in Part II.G, H, and I, are suspended unless results are greater than 15% over the current protection level. All exceedances will still be included in quarterly reports corresponding to the sampling period. This will prevent unnecessary notifications of elevated TDS due to routine salting of mine roads for winter access.

    b. Monitoring wells completed in the bedrock: The ECG1100B, ECG907, and ECG925 wells can be sampled semi-annually, even though they show exceedances for TDS and sulfate concentrations. The groundwater transmissivity in the bedrock is extremely low, and more frequent sampling will not present any new data. The results should be included in the quarterly reports corresponding to the sampling period.

2. *Permit Renewal Application Items* - As part of the application for permit renewal, which is

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submitted every five years, Kennecott will include a water quality summary of the previous data collected for operational and compliance monitoring wells. Data from the Operational Monitoring program will be included in this summary. The summary will include an analysis of trends and any changes in the data throughout the life of the permit.

3. *Updated Site Maps and Well Information* – Kennecott will provide within one year of permit issuance:

    a. Updated site maps and diagrams of all monitoring wells, leach water collection sites, cut-off walls, and all other parts of the East Side Collection System, including updated plume maps, aquifer contour maps with flow rate and direction, and

    b. Coordinates of all monitoring wells and leach water collection sites associated with the East Side Collection System.

4. *BAT Inspection* - Kennecott will conduct a comprehensive BAT inspection of the entire East Side Collection System within 2 years of permit issuance to ensure that all components of the collection and drainage system are functioning as designed and to identify any maintenance work that may be necessary.

    a. Kennecott will submit a BAT inspection work plan within 1 year of permit issuance for approval by the Division.

    b. Kennecott will provide the Division with the results of the BAT inspection, identifying any deficiencies found.

    c. Kennecott will provide the Division with a plan to correct any deficiencies within 90 days of completion of the BAT inspection, including milestones and completion schedules for Director approval.

    d. Kennecott will begin implementing the approved schedule and provide updates in quarterly reports submitted to the Division.

5. *Final Closure* - Kennecott has an approved conceptual closure plan attached in Appendix D of this permit. One year prior to final closure, Kennecott shall submit, for approval by the Director, a final closure plan that addresses the water quality management aspects of closure.

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STATE OF UTAH
DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY
P.O. BOX 144870
SALT LAKE CITY, UTAH 84114-4870

Ground Water Discharge Permit
Permit No. UGW350010

In compliance with the provisions of the Utah Water Quality Act, Title 19, Chapter 5, Utah Code Annotated 1953, as amended, the Act,

Kennecott Utah Copper LLC
4700 W. Daybreak Parkway
South Jordan, Utah 84009

hereafter, referred to as the Permittee, is granted a Ground Water Discharge Permit for the operation of the **Bingham Canyon Mine and Water Collection System** in Salt Lake County, Utah.

The Bingham Canyon Mine and Water Collection System is located on the following tracts of land (Salt Lake Base and Meridian):

Township 3 South, Range 2 West - Portions of Sections 17, 18, 19, 20, 21, 29, 30, 31, and 32
Township 3 South, Range 3 West - Portions of Sections 11, 12, 13, 14, 22, 23, 24, 25, 26, 27, 33, 34, 35, and 36
Township 4 South, Range 2 West - Portions of Sections 6 and 7
Township 4 South, Range 3 West - Portions of Sections 1, 2, 3, 9, 11, and 12

The permit is a renewal of the original groundwater discharge permit issued May 1, 1999. The permit is based on representations made by the permittee and other information contained in the administrative record. It is the responsibility of the permittee to read and understand all provisions of this permit.

The facility shall be constructed and operated in accordance with conditions set forth in the permit and the Utah Administrative Rules for Ground Water Quality Protection (UAC R317-6).

This permit shall become effective on _____, 2025.

This permit and the authorization to operate shall expire at midnight, _____, 2030.

_____
John K. Mackey, P.E.
Director
Utah Division of Water Quality

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Table 1: Permit Limits for Dry Fork, Bingham Canyon Mine and Water Collection System Compliance Wells
Table 2: Permit Conditions for Dry Fork Extraction Wells
Table 3: Bingham Canyon Mine Informational Wells for Permit #UGW350010
Table 4: Groundwater Discharge Permit #UGW350010 Sample Point Coordinates

DRAWINGS:

Drawing: 451-T-9080; East Side Collection System, Typical Drainage Facility
Drawing: 454T-0119; Bingham Canyon Mine and Water Collection System 2012 EWRE Modification

FIGURES:

Figure 1: Bingham Canyon Mine and Water Collection System
Figure 2: Dry Fork Management Plan

APPENDICES:

Appendix A: Compliance Monitoring Plan
Appendix B: Bluewater Repository Waste Characterization Plan
Appendix C: Contingency and Corrective Action Plan
Appendix D: Conceptual Closure Plan
Appendix E: Operational Monitoring Plan
Appendix F: Best Management Practices Plan
Appendix G: Dry Fork Management Plan
Appendix H: Operations & Maintenance Manual East Waste Rock Extension Water Collection System
Appendix I: Operations & Maintenance Manual South Waste Rock Reclamation Detention Basins
Appendix J: Groundwater Characterization and Monitoring Plan

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PART I CONSTRUCTION PERMIT ISSUANCE AND BEST AVAILABLE TECHNOLOGY (BAT) STANDARD

A. Authorized Construction

Construction permits approved in 2024 are hereby issued to Kennecott as summarized below for 1) the extension of the Toe Drain from the Copper IV to Yosemite drainages, which ties the East Waste Rock and South Waste Rock areas, and 2) Bluewater repository expansion within the approved area in the Bluewater 1 drainage. These construction permits are incorporated into this ground water discharge permit renewal.

B. Design and Construction

Under authority of the Utah Water Quality Act, Section 19-5-108(1) Utah Code Ann. 1953, as amended and Utah Administrative Code R317-1, the authorized facilities are constructed in accordance with the engineering design plans and specifications, which received construction permits from the Division of Water Quality ("Division").

Construction elements include:

1. The extension of the Toe Drain water collection system, from the Copper IV to Yosemite drainages, was constructed in 2024. The Division issued the construction permit on March 28, 2024.

2. The Bluewater Repository Expansion in the Bluewater 1 Drainage is planned to be completed in 2025 according to the engineering design drawings and specifications. The Division issued a construction permit on April 3, 2024.

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PART II SPECIFIC PERMIT CONDITIONS

A. Ground Water Classification

The ground water classification for the uppermost aquifer in the area of the Bingham Canyon Mine and Water Collection System ranges from Class I to Class II ground water. There are areas where ground water has been impacted by acidic water, resulting in degraded water quality classified as Class III and Class IV. Ground water at each compliance monitoring well has been classified based on historical monitoring data.

B. Ground Water Protection Levels

Ground water Protection Levels for compliance monitoring wells for this permit are represented in Table 1.

C. Best Available Technology Performance Standard

1. The Best Available Technology (BAT) for the Bingham Canyon Mine and Water Collection System will be a Discharge Minimization approach designed, constructed, and operated in accordance with approved designs and specifications (Part II.E). The design for conveying mine-impacted water consists of a combination of concrete cut-off walls, toe drains, French drains or seepage collection trenches, HDPE pipelines, collection boxes, and extraction wells. Meteoric precipitation is conveyed through either the HDPE pipelines or concrete-lined ditches, which also act as secondary containment mechanisms for the mine-impacted water HDPE pipeline system in cases where flows exceed the pipeline capacity or where maintenance of the pipeline is required. The Southeast Waste Rock Optimization (SEWOP) project required extending a toe drain by 2,000 feet in the Copper IV drainage, with no modifications to the existing cut-off walls and other features of the contact water collection system in the area.

   The BAT for the Dry Fork area shall include the operation and maintenance of two extraction wells: the Mid-Valley well (COP2701) and the Picnic Flats well (COG2865, replacement for COG1172, which experienced biofouling issues), both located up-gradient of the Dry Fork dump. These wells are in place to capture water before it comes into contact with the waste rock dumps and the underlying contaminated groundwater.

   The operation and maintenance of a series of three alluvial extraction wells, located down-gradient of the toe of the Bingham Canyon dump, will include the following components. The primary well is the Bingham Canyon Alluvial Well (ECG2787), located within Bingham Creek. The secondary alluvial extraction well, Curtis Springs (VWK83), is located down-gradient of ECG2787 and also within the alluvial channel of Bingham Creek. A third alluvial well named Copperton Channel (ECG1185) is located due north of Curtis Springs and intercepts water from an alluvial channel adjacent to and north of Bingham Creek. Production from these wells is dependent upon 1) seasonal conditions, 2) available mine-impacted water

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from within the alluvium, and 3) the influence of up-gradient wells on the yield of down-gradient wells.

Operating parameters and regulatory obligations related to Dry Fork wells are listed in Table 2, with additional information regarding Dry Fork management contained in Appendix G.

A series of down-gradient compliance monitoring wells screened in bedrock also monitors bedrock contamination from the Dry Fork and Bingham Canyon area. The wells are ECG2789A, ECG2789B, ECG1100A, ECG1100B, and VWK93, which have established compliance limits. Monitoring wells ECG2866A and ECG2866B replaced ECG2789A and ECG2789B in 2020 to accommodate the installation of a new conveyor belt, which was installed in 2021. Regarding the compliance monitoring wells, a remedial strategy is necessary to address bedrock groundwater contamination from Dry Fork, as outlined in Appendices C and G and as directed by the Director.

BAT shall also include inspection and maintenance commitments included in the Compliance Monitoring Plan (Appendix A). The operations and maintenance manual for the East Waste Rock Extension Water Collection System (Appendix H) contains details of the East Side Water Collection system design and description, operational controls, and maintenance strategy.

2. Best Available Technology for the Bluewater Repository is a low-permeability clay liner and cap system as specified in Part II.E.2. Only materials approved by the Director may be disposed of in the repository following analysis under the Waste Characterization Plan (Appendix B). The Bluewater Repository and its footprint were permitted in 1991. Only a portion of the footprint was occupied through 2024. The Bluewater Repository expansion of 500,000 cubic yards has been designed to occupy approximately half of the remaining permitted area by 2024, with construction work scheduled for completion in 2025. The expansion design fully meets the preexisting BAT requirements specified in Part II.E.2. It is anticipated that the repository footprint will be expanded further in the next several years within the original permitted footprint and in accordance with the permitted specifications.

3. The Best Available Technologies instituted for the Chalcopyrite Heap Leach Project (CHLP) consist of double-lined HDPE facilities for the Heap, Pregnant Leach Solution (PLS) Pond, and Raffinate Pond. Each facility incorporates two layers of 60-millimeter HDPE liner with independent leak collection and detection systems. Performance criteria are outlined in Appendix F. If the CHLP facilities listed here do not meet the performance criteria outlined in Appendix F, Kennecott shall refer to Part II.H of this permit. The Chalcopyrite Heap Leach facility was dismantled in 2016. The reference to the facility is maintained in Appendix F to ensure compliance with BAT requirements that may be applicable should a similar facility be constructed in the future.

4. Closure - The Bingham Canyon Mine and Water Collection System shall undergo closure in accordance with the requirements of the approved closure plan

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(Appendix D – Bingham Canyon Mine 2003 Reclamation and Water Management Plan, March 2003) as updated by a final closure plan submitted in conformance with Part II.J.4 of this permit.

5. Implementation of Best Management Practices - Kennecott Utah Copper LLC (Kennecott) shall operate the facilities specified in the Best Management Practices Plan as required under Appendix F of this permit.

D. Permitted Facilities

The Facilities authorized under this permit include:

1. The Bingham Canyon Mine and existing associated facilities: All Bingham Canyon Mine maintenance facilities, South Area Water Services (SAWS), and the Bingham Canyon Water Treatment Plant (also permitted by the Utah Division of Drinking Water).

2. The East, South, and West Side waste rock dumps and collection systems.

3. Pipelines, conveyance ditches, collection boxes, pump back wells, and associated structures used to convey flows of meteoric and storm water that originate from Kennecott's waste rock piles adjacent to the Bingham Canyon Mine. The Large and Small Bingham Reservoirs are not included in this permit but are covered under separate ground water quality discharge permits.

4. Bluewater Repository – The repository is located on the north end of the east waste rock piles. As specified in Appendix B, the Bingham Canyon Mine and Water Collection System ground water quality discharge permit includes pertinent portions of the prior Bluewater Repository ground water quality discharge permit. Each segment of the repository features a leachate collection system that directs flows to the leachate collection pipeline.

5. SXEW (Solvent Extraction/Electrowinning) Facilities pursuant to approval of plans and specifications.

6. The Bingham Detention Basin, constructed in 2020, and managed in accordance with Appendix A and under the general requirements for detention basins described in the operation and maintenance (O & M) manual attached as Appendix I.

E. Design and Construction

1. The Bingham Canyon Mine and Water Collection System is constructed according to the specifications, plans, and drawings included in the permit application titled:

   a. Bingham Canyon Mine Eastside Collection Monitoring Network Ground Water Discharge Permit Application (revised) dated April 1996 (submitted June 13, 1996).

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b. Geohydrology of the Dry Fork Region, Bingham Canyon Mine, Kennecott Utah Copper, May 1994 (submitted February 25, 1997).

c. Supplemental application materials transmitted in letters dated October 23, 1997, from Elaine Dorward-King and January 6, 1998, and August 31, 1998, from David J. Cline.

d. Contaminant Investigation and Corrective Action Plan for the Dry Fork Area, September 2002 (Submitted September 26, 2002).

e. Supplemental application materials related to the Dry Fork area detailed in letters dated January 21, February 11, and March 10, 2003 (from Paula Doughty to the Division).

f. Supplemental Dry Fork Management Plan materials titled "Proposal to Relocate Dry Wells – Rio Tinto Kennecott Utah Copper (KUC) Bingham Canyon Mine Water Collection System Ground Water Discharge Permit No. UGW350010" dated September 22, 2008

g. Groundwater Discharge Permit Modification Application for East Waste Rock Extension, groundwater discharge permit UGW350010, submitted August 2012.

h. Groundwater Discharge Permit Modification Application for South Waste Rock Reclamation, groundwater discharge permit UGW350010, submitted November 2014.

i. Bingham Detention Basin construction drawings submitted in March 2020.

j. Construction Permit Approval of engineering drawings and specifications for an extension of the Toe Drain from the Copper IV to Yosemite drainages in March 2024.

k. Construction Permit Approval of engineering drawings and specifications for the Bluewater Repository expansion in the Bluewater 1 drainage in April 2024.

2. The Bluewater North Repository segment and the Bluewater Main Repository segment are constructed according to the design specifications and drawings submitted May 17, 1991, as amended by Addendum No. 1, submitted June 6, 1991, and plans for expansion of the repository submitted December 18, 1992. These include:

a. *Clay Bottom Liner* - the bottom liner consists of a 12-inch-thick clay layer with an in-place hydraulic conductivity of no greater than 1×10^{-7} cm/sec.

b. *Seepage Collection System* - a seepage collection system constructed on the bottom clay liner consisting of a 4-inch minimum HDPE slotted pipe buried

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in 3/8-inch gravel surrounded by geotextile and running the length of the landfill.

c. *Clay Barrier* - a 12-inch-thick clay cap constructed on top of the tailings. The cap has a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec.

d. *Clay Soil Layer* - a 34-inch clay soil layer placed on top of the 12-inch clay barrier. This layer has a hydraulic conductivity no greater than 1 x 10^{-4} cm/sec.

e. *Topsoil Layer* - An eight-inch layer of topsoil placed on top of the clay cap layers. This layer will be vegetated in accordance with the reclamation requirements of the Division of Oil Gas and Mining.

f. *Run-on and Run-off Control* - Surface water run-on is controlled by site grading and ditches to direct drainage away from the repository.

F. Monitoring

1. General Provisions

a. *Future Modification of the Monitoring Network* - If at any time the Director determines the monitoring program to be inadequate for determining compliance with BAT, applicable permit limits, or ground water protection levels, Kennecott shall submit within 30 days of receipt of written notice from the Director a modified monitoring plan that addresses the inadequacies noted by the Director.

Within 60 days of completion and development of any new or replacement compliance or operational monitoring well, Kennecott shall submit documentation demonstrating that the well is in conformance with the EPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, 1986, OSWER-9950.1 (RCRA TEGD) Section 3.5.

b. *Compliance Monitoring Period* - Monitoring shall commence upon the issuance of this permit and shall continue through the life of this permit. For compliance monitoring wells that are installed during the term of this permit, monitoring shall commence upon completion of the well installation and development as described in Part II.F.1(a).

c. *Laboratory Approval* - All water quality analyses shall be performed by a laboratory certified by the State of Utah to perform such analysis.

d. *Water Level Measurement* - In association with each well sampling event, water level measurements shall be taken in each monitoring well prior to removal of any water from the well bore. These measurements will be collected from a permanent single reference point clearly marked on the top of the well or surface casing. Measurements will be made to the nearest

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0.01 foot.

e. *Sampling Protocol* - Water quality samples will be collected and handled in accordance with the Director-approved version of the Kennecott Ground Water Characterization and Monitoring Plan (Appendix J).

f. *Constituents Sampled* - The following analyses shall be performed on all water quality samples collected:

i. Field Measurements: pH, specific conductance, temperature

ii. Laboratory Analysis:

a. Alkalinity
b. Major Ions: (chloride, sulfate, sodium, potassium, magnesium, and calcium)
c. Metals (dissolved): (arsenic, cadmium, chromium, copper, lead, selenium, and zinc)
d. TDS

g. Analytical Procedures - Water sample analysis will be conducted in accordance with the test procedures specified under UAC R317-6-6.3.

2. Operational Monitoring

Operational Monitoring will be used to assess the effectiveness of the water collection system, including the following aspects:

a. Mine-Impacted Water - Flow and water quality data from the water collection system.

b. Bluewater Repository Leachate Collection System - Water quality from the leachate collection system.

c. Tunnel Flows - Flows from the mine tunnels that underlie the Waste Rock Piles for the Bingham Canyon Mine.

d. Informational Wells – Table 3 lists the informational monitor wells that will be used to supplement compliance monitor wells down-gradient of the collection system and within the Dry Fork area.

e. Groundwater Extraction Rates – Annual volume of water removed from the three alluvial extraction wells down-gradient of Dry Fork (ECG2787, VWK83, and ECG1185) as well as the Bingham Canyon cut-off wall and the two water capture wells up-gradient of Dry Fork (COP2701 and COG2865, which replaced COG1172).

3. Monitoring Frequency

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a. *Well Monitoring Frequency* - All existing compliance monitoring wells scheduled for sampling are listed in Table 1. Compliance monitoring wells screened in alluvium will be sampled quarterly throughout the term of this permit, while compliance monitoring wells screened in bedrock, including those in the Dry Fork area, will be sampled semi-annually. Any newly drilled monitoring wells (to be used as compliance wells) will be sampled quarterly for 12 consecutive quarters (3 years) following installation to establish baseline groundwater quality. However, if a preexisting monitoring well has at least three years of data, the compliance limits for that well will be calculated and established. Following completion of 12 quarterly samples, monitoring shall change to a semi-annual (bedrock completion) or quarterly (alluvial completion) sampling frequency unless more frequent sampling is required under other terms of this permit.

b. *Operational Monitoring Frequency* - Operational monitoring, including collection system flows, tunnel flows, informational wells, pumping rates from extraction wells, and leachate collected from the Bluewater Repository, shall occur as specified in Appendix E of this permit.

4. Post-Closure Monitoring

Kennecott shall conduct post-closure monitoring in accordance with the post-closure monitoring program (Appendix D) that has been submitted and approved in conformance with Part II.J.4 of this permit.

5. Suspension of Compliance Reporting Requirements

The Division is suspending the compliance reporting and sampling requirements in compliance monitoring wells as follows:

a. If the TDS concentration exceeds the limit in any compliance well due to regular salt concentration other than sulfate, compliance reporting requirements, including those identified in Part II.G, H, and I, are suspended unless results are greater than 15% over the current protection level. All exceedances will still be included in quarterly reports corresponding to the sampling period. This will prevent unnecessary notifications of elevated TDS due to the routine salting of mine roads for winter access.

b. Monitoring wells completed in the bedrock: The ECG1100B, ECG907, and ECG925 wells can be sampled semi-annually, even though they show exceedances for TDS and sulfate concentrations. The groundwater transmissivity in the bedrock is extremely low, and more frequent sampling will not present any new data. The results should be included in the quarterly reports corresponding to the sampling period.

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G. Non-Compliance for Ground Water Protection Levels

1. Probable Out of Compliance - If the concentration of a pollutant from any compliance monitoring well sample exceeds the compliance limit (in the case of pH exceeding the higher or lower limit) (Table 1), Kennecott shall:

   a. Notify the Director in writing within 30 days of receipt of the data;

   b. Initiate monthly sampling for the compliance monitoring well(s) that have exceeded the compliance limit (Table 1), unless the Director determines that other periodic sampling is appropriate, for a period of two months or until the compliance status of the facility can be determined.

2. Out-of-Compliance Status

   An out-of-compliance status exists when two or more consecutive samples from a compliance monitoring well exceed the compliance limit for a pollutant (Table 1). Upon determining that an out-of-compliance situation exists, Kennecott shall:

   i. Notify the Director of the out-of-compliance status within 24 hours of discovery, followed by a written notice within 5 business days of the detection.

   ii. Initiate monthly sampling unless the Director determines that other periodic sampling is appropriate until the facility is brought into compliance.

   iii. Submit a Source Assessment and Compliance Schedule to the Director within 30 days of detection of the out-of-compliance status that outlines the following:

      a. Steps of action that will assess the source, extent, and potential dispersion of the contamination.
      b. Evaluation of potential remedial actions to restore and maintain ground water quality and ensure the compliance limits will not be exceeded at that compliance monitoring point
      c. Measures to ensure the best available technology will be re-established.

   iv. Implement the Source Assessment and Compliance Schedule as directed by the Director.

H. Non-Compliance for Best Available Technology

1. Kennecott is required to maintain the Best Available Technology in accordance with the approved design and practice for this permit. Failure to maintain BAT or maintain the approved design and practice shall be a violation of this permit. In the

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event a compliance action is initiated against the permittee for violation of permit conditions relating to best available technology, Kennecott may affirmatively defend against that action by demonstrating the following:

a. Kennecott submitted notification in accordance with R317-6-6.13;

b. The failure was not intentional or caused by Kennecott's negligence, either in action or in failure to act;

c. Kennecott has taken adequate measures to meet permit conditions in a timely manner or has submitted for the Director's approval an adequate plan and schedule for meeting permit conditions, and

d. The provisions of UAC 19-5-107 have not been violated.

I. Reporting Requirements

1. Reporting

a. *Monitoring Wells* - Water quality sampling results for compliance monitoring wells shall be submitted quarterly to the Director as follows:

Quarter Sampled In	Results Due On
1st (Jan, Feb, March)	May 15
2nd (April, May, June)	August 15
3rd (July, Aug, Sept.)	November 15
4th (Oct, Nov, Dec.)	February 15

b. *Operational Monitoring* - Operational monitoring results and analysis, including results from collection sites, the Bluewater Repository, tunnels, informational wells, extraction wells, and surface water sites (seeps), shall be submitted in an annual report by March 31 of each year in accordance with the requirements of Appendix E.

c. Failure to submit reports within the specified timeframe shall be deemed as noncompliance and may result in enforcement action**.**

2. Delivery Requirements - The permittee will electronically submit the required reports using a transmittal mechanism and format approved by the Director. If requested by the Director, hard copies shall also be submitted.

J. Compliance Schedule

1. *Permit Renewal* Application *Items* - As part of the application for permit renewal, which is submitted every five years, Kennecott will include a water quality summary of the previous data collected for operational and compliance monitoring wells. Data from the Operational Monitoring program will be included in this summary. The summary will include an analysis of trends and any changes in the

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data throughout the life of the permit.

2. *Updated Site Maps and Well Information* - Kennecott will provide within one year of permit issuance:

   a. Updated site maps and diagrams of all monitoring wells, leach water collection sites, cut-off walls, and all other parts of the East Side Collection System, including updated plume maps, aquifer contour maps with flow rate and direction, and

   b. Coordinates of all monitoring wells and leach water collection sites associated with the East Side Collection System.

3. *BAT Inspection* - Kennecott will conduct a comprehensive BAT inspection of the entire East Side Collection System within 2 years of permit issuance to ensure that all components of the collection and drainage system are functioning as designed and to identify any maintenance work that may be necessary.

   a. Kennecott will submit a BAT inspection work plan within 1 year of permit issuance for approval by the Division.

   b. Kennecott will provide the Division with the results of the BAT inspection, identifying any deficiencies found.

   c. Kennecott will provide the Division with a plan to correct any deficiencies within 90 days of completion of the BAT inspection, including milestones and completion schedules for Director approval.

   d. Kennecott will begin implementing the approved schedule and provide updates in quarterly reports submitted to the Division.

4. *Final Closure* - Kennecott has an approved conceptual closure plan attached in Appendix D of this permit. One year prior to final closure, Kennecott shall submit, for approval by the Director, a final closure plan that addresses the water quality management aspects of closure.

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PART III MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples collected in compliance with the monitoring requirements established under Part I shall be representative of the monitored activity.

B. Analytical Procedures. Water sample analysis must be conducted according to test procedures specified under UAC R317-6-6.3L, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results. Monitoring results obtained for each monitoring period specified in the permit shall be submitted to the Director, Utah Division of Water Quality, at the following address no later than 45 days after the end of the monitoring period (unless specified otherwise in this permit):

State of Utah
Division of Water Quality
Department of Environmental Quality
P.O. Box 144870
195 North 1950 West
Salt Lake City, Utah 84114-4870
Attention: Ground Water Protection Section

E. Compliance Reporting. Reports of compliance or noncompliance with, or any progress reports on interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using approved test procedures as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted. Such increased frequency shall also be indicated.

G. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and copies of all reports required by this

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permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended at the request of the Director at any time.

I. Twenty-four Hour Notice of Noncompliance and Spill Reporting.

1. The permittee shall verbally report any noncompliance or spills subject to the provisions of UAC 19-5-114, which may endanger public health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Utah Department of Environmental Quality 24-hour number, (801) 536-4123, or to the Division of Water Quality, Ground Water Protection Section at (801) 538-6146, during normal business hours (8:00 am - 5:00 pm Mountain Standard Time).

2. A written submission shall also be provided to the Director within five business days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

   d. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

3. Reports shall be submitted to the addresses in Part III.D, Reporting of Monitoring Results.

J. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours, shall be reported at the time that monitoring reports for Part II.I are submitted.

K. Inspection and Entry. The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

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4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

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PART IV COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 19-5-115(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

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PART V GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required when the alteration or addition could significantly change the nature of the facility or increase the quantity of pollutants discharged.

B. Anticipated Noncompliance. The permittee shall give advance notice of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and re-issuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a permit renewal or extension. The application should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or any report to the Director, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Director shall be signed and certified.

1. All permit applications shall be signed as follows:

   a. For a corporation: by a responsible corporate officer;
   b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.
   c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and

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submitted to the Director, and,

b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to Authorization. If an authorization under Part V.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of Part V.G.2. must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential by the permittee, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Director. As required by the Act, permit applications, permits, effluent data, and ground water quality data shall not be considered confidential.

J. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

K. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held

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invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

L. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Director at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

M. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, penalties established pursuant to any applicable state law or regulation under authority preserved by Section 19-5-117 of the Act.

N. Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. If new ground water standards are adopted by the Board, the permit may be reopened and modified to extend the terms of the permit or to include pollutants covered by new standards. The permittee may apply for a variance under the conditions outlined in R317-6-6.4(D)

2. If alternate compliance mechanisms are required

3. If water quality of the facility is significantly worse than represented in the original permit application.

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Table 1: Permit Limits for Compliance Wells of Bingham Canyon Mine and Water Collection System GWDP, UGW350010

Well ID	Screen Lithology	Sampling Frequency	Northing (ft)	Easting (ft)	pH	TDS mg/L	SO4 mg/L	Diss. Cd mg/L	Diss. Cu mg/L	Diss. Zn mg/L
BRG287	Bedrock	Semi-annually	14559	16105	6.19-8.5	3283	912	0.001	0.325	1.25
BRG921	Bedrock	Semi-annually	13190	16540	6.5-8.5	2291	896	0.001	0.325	1.25
BRG999	Bedrock	Semi-annually	14479	17043	6.5-8.5	1614	580	0.001	0.325	1.25
COG2806A	Bedrock	Semi-annually	17605	8389	6.5-8.5	495	43	0.001	0.325	1.25
COG2806B	Bedrock	Semi-annually	17605	8389	6.5-8.5	462	41	0.001	0.325	1.25
ECG1100A	Bedrock	Semi-annually	16058	12362	6.5-8.5	4148	2581	0.003	0.650	3.01
ECG1100B	Bedrock	Semi-annually	16058	12362	6.5-8.5	397	85	0.001	0.325	1.25
ECG1186	Alluvium	Quarterly	9646	18578	6.5-8.5	2002	875	0.001	0.325	1.25
ECG1187	Alluvium	Quarterly	7539	18457	6.5-8.5	1589	169	0.001	0.325	1.25
ECG1188	Alluvium	Quarterly	16105	22493	6.5-8.5	4181	1975	0.001	0.325	1.25
ECG1189	Alluvium	Quarterly	13054	19989	6.5-8.5	780	22	0.001	0.325	1.25
ECG1190	Alluvium	Quarterly	11715	19026	6.5-8.5	1092	71	0.001	0.325	1.25
ECG299	Bedrock	Semi-annually	13807	17474	4.36-8.5	4670	3230	0.020	2.51	2.78
ECG2866A	Bedrock	Semi-annually	16061	11586	6.5-8.5	774	150	0.001	0.325	1.25
ECG2866B	Bedrock	Semi-annually	16061	11586	6.5-8.5	4460	2512	0.003	0.65	2.5
ECG901	Bedrock	Semi-annually	13734	17716	6.5-8.5	1634	173	0.001	0.33	1.25
ECG902	Bedrock	Semi-annually	12180	17214	6.5-8.5	1311	332	0.001	0.325	1.25
ECG905	Bedrock	Semi-annually	10839	16434	6.06-8.5	2614	1477	0.001	0.325	1.25
ECG906	Bedrock	Semi-annually	9121	17481	6.5-8.5	4941	2480	0.003	0.325	1.25
ECG907	Bedrock	Semi-annually	7087	17875	6.5-8.5	2004	278	0.001	0.325	1.25
ECG916	Bedrock	Semi-annually	9692	15269	6.5-8.5	857	249	0.001	0.325	1.25
ECG917	Alluvium	Quarterly	6289	18385	6.5-8.5	1467	197	0.001	0.325	1.25
ECG924	Bedrock	Semi-annually	661	16870	6.29-8.5	5850	2994	0.004	0.325	1.25
ECG925	Bedrock	Semi-annually	1343	17470	6.39-8.5	3498	1365	0.001	0.325	1.25
ECG928	Bedrock	Semi-annually	5126	18358	6.5-8.5	930	76	0.001	0.325	1.25
ECG931	Bedrock	Semi-annually	-708	16395	6.39-8.5	5914	650	0.005	0.325	1.25
ECG932	Bedrock	Semi-annually	-2325	14914	6.5-8.5	816	170	0.001	0.325	1.25
ECG934	Bedrock	Semi-annually	-4704	14177	6.5-8.5	1131	423	0.001	0.325	1.25
ECG935	Bedrock	Semi-annually	-6210	13555	6.47-8.5	4572	2661	0.001	0.325	1.25
ECG936	Bedrock	Semi-annually	-6303	12389	6.35-8.5	5118	3071	0.003	0.325	1.25
ECG937	Bedrock	Semi-annually	-8174	11378	6.5-8.5	1345	461	0.001	0.325	1.25
ECG938	Bedrock	Semi-annually	-8909	9785	6.5-8.5	1016	261	0.001	0.325	1.25
LTG1191	Alluvium	Quarterly	3749	20548	6.15-8.5	5888	3590	0.087	0.325	22.38
K93	Bedrock	Semi-annually	16021	13562	6.5-8.5	480	39	0.050	0.100	0.06
VWP220	Bedrock	Semi-annually	10999	16234	6.5-8.5	2352	1050	0.005	0.325	1.25
VWP225	Bedrock	Semi-annually	11920	16886	6.5-8.5	1107	344	0.001	0.325	1.25
VWP228	Alluvium	Quarterly	-1491	13963	5.59-8.5	10370	7076	0.057	0.376	4.17
VWP244A	Alluvium	Quarterly	2266	16139	3.39-8.5	28567	21279	0.643	37.4	40.9
VWP244B	Bedrock	Semi-annually	2278	16124	6.34-8.5	6959	2389	0.009	0.650	2.50
VWP244C	Bedrock	Semi-annually	2285	16110	6.5-8.5	3876	1235	0.008	0.325	1.25
VWP248A	Alluvium	Quarterly	15485	17875	3.52-8.5	12329	8980	0.219	151.3	34.5
VWP248B	Bedrock	Semi-annually	15491	17849	3.90-8.5	5888	4089	0.172	22.1	17.7
ECG2859	Bedrock	Semi-annually	3485	17125	5.62-8.5	4945	2612	0.001	0.325	1.25

NOTES:
All units are mg/L; pH standard units

1) Compliance limits are based on 1.25 times the background concentration for TDS for class II and III ground water
2) For many wells cadmium, copper and zinc were predominantly non detects, compliance limits determined from the ground water quality standard.
3) Where the background concentrations is <detection, compliance limits are based on 0.25 times the ground water quality standard for Class II ground water and 0.50 times the ground water quality standard for Class III ground water for cadmium, copper and zinc
4) If background value exceeds the ground water quality standard; therefore, the Protection Level equals the background value
5) The Compliance Limits for IV ground water are the higher of the ground water quality standard, the mean *1.25 or the mean + 2 std. dev.
6) There is not a ground water quality standard for SO4
7) Compliance limits for sulfate were calculated as the higher of the mean+2 std. dev. or 1.25 times the mean
8) Range of pH values for Compliance Limits are based on the higher and lower limit of 6.5-8.5 and/or mean + and - 2 std. dev.
9) Coordinate system in KUCC True North southend map drawn in 1927 State Plane Utah central Zone
10) Limits were set using all available data for each individual well through 2008
11) If data shows an upward trend for Tds over past five years, the compliance limit as calculated in 2008 has been maintained

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Table 3. Informational Wells for Permit #UGW350010

Well ID	Site Description	Screen Lithology	Sampling Frequency	Northing (ft)	Easting (ft)
ECG2787	Extraction well at the Mouth of Bingham Canyon	Alluvium	Annually	16133	12382
ECG1185	Copperton Channel Extraction Well	Alluvium	Annually	16909	14862
ECG1184	the Mouth of Butterfield Canyon	Alluvium	Annually	-1537	17816
ECG933	Saints Rest Drainage	Bedrock	Annually	-2975	14227
COP2701 (Mid Valley)	Upper Dry Fork Extraction Well	Alluvium	Annually	20135	2199
COG2865 (Replacement for COG1172)	Second Upper Dry Fork Extraction Well	Bedrock	Annually	20580	200
COG995 A&B	Monitor well at the Mouth of Bingham Canyon	Bedrock	Annually	16814	11056
ECG1106A	Monitor well at the Mouth of Bingham Canyon	Bedrock	Annually	16554	12240
P272	Monitor well at the Upper Keystone	Bedrock	Annually	3964	16571
K83 (Curtis Springs)	Extraction well at the mouth of Bingham Canyon	Alluvium	Annually	16031	14582

Note
1) Coordinate system in KUCC True North southend map drawn in 1927 State Plane Utah Central Zone

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Table 2: Permit Conditions for Dry Fork Extraction Wells

Well ID & Name	General Location	Permit Condition
Up-gradient (Clean Water Capture)		
COP2701 (Mid-Valley)	300 ft. up-gradient of Dry Fork dump	- Keep surrounding alluvium substantially dewatered - Applies to both wells
COG2865[2] (Picnic Flats)	1500 ft. upgradient of Dry Fork dump, and it's replacement of COG1172	
Down-gradient (Alluvial Extraction)		
ECG2787 (Bingham Canyon Alluvial Well)	900 ft. down-gradient of Bingham Canyon dump	- Target pumping rate is 100 acre-feet/year based on a 3 year rolling average[1] - Pumping to continue until sulfate concentration <5000 mg/L - If sulfate concentration >5000 mg/L resume pumping
VWK83 (Curtis Springs)	3200 ft. down-gradient of Bingham Canyon dump	- Target pumping rate is 100 acre-feet/year based on a 3 year rolling average[1] - If alluvial well water level <92 feet then decrease pumping rate to match inflow - Pumping rate may be decreased or stopped to match inflow if it is determined that up-gradient alluvial pumping well(s) are diminishing available alluvial water - Pumping to continue until sulfate concentration <5000 mg/L - If sulfate concentration >5000 mg/L resume pumping
ECG1185 (Copperton Channel)	3500 ft. down-gradient of Bingham Canyon dump	- Pump alluvium at a rate consistent with available inflow of contaminated water - Pumping may cease if the quantity of alluvial water is less than the well can sustain
ECP2562 (Bingham Creek COW)	5600 ft. down-gradient of Bingham Canyon dump	- None specific to Dry Fork plume

Note:

[1] Target pumping rate is 100 acres-feet per year based upon a three year rolling average for both K83 and ECG2787 combined. The pumping rates for ECG2787 may influence available water that can be extracted from the alluvium by K83.

[2]COG2865 is a replacement for well COG1172 that was abandoned.

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Table 4: Groundwater Discharge Permit #UGW350010 Sample Point Coordinates

	KUC True North		Lat-Long DMS		State Plane	
Sample ID	**Northing (ft)**	**Easting (ft)**	**Lattitude**	**Longitude**	**SP83 North (ft)**	**SP83 East (ft)**
Compliance wells						
BRG287	14559	16105	40° 33' 25.87"	112° 6' 7.42"	7,372,272.70	1,473,128.20
BRG921	13190	16540	40° 33' 12.34"	112° 6' 1.80"	7,370,900.60	1,473,552.80
BRG999	14479	17043	40° 33' 25.08"	112° 5' 55.27"	7,372,186.50	1,474,065.50
COG2806A	17605	8389	40° 33' 56.04"	112° 7' 47.36"	7,375,360.97	1,465,220.63
COG2806B	17605	8389	40° 33' 56.04"	112° 7' 47.36"	7,375,360.97	1,465,220.63
ECG1100A	16058	12362	40° 33' 40.71"	112° 6' 55.91"	7,373,800.00	1,469,395.90
ECG1100B	16058	12362	40° 33' 40.71"	112° 6' 55.91"	7,373,800.00	1,469,395.90
ECG1186	9646	18578	40° 32' 37.31"	112° 5' 35.43"	7,367,342.20	1,475,564.70
ECG1187	7539	18457	40° 32' 16.49"	112° 5' 37.02"	7,365,236.10	1,475,428.00
ECG1188	16105	22493	40° 33' 41.10"	112° 4' 44.64"	7,373,771.80	1,479,527.50
ECG1189	13054	19989	40° 33' 10.97"	112° 5' 17.12"	7,370,739.10	1,477,000.60
ECG1190	11715	19026	40° 32' 57.75"	112° 5' 29.61"	7,369,407.60	1,476,027.70
ECG2866A	16061	11586	40° 33' 40.74"	112° 7' 5.96"	7,373,808.40	1,468,620.30
ECG2866B	16061	11586	40° 33' 40.74"	112° 7' 5.96"	7,373,808.40	1,468,620.30
ECG2859	3487	17122	40° 31' 36.61"	112° 5' 54.32"	7,361,192.15	1,474,065.95
ECG299	13807	17474	40° 33' 18.43"	112° 5' 49.69"	7,371,510.70	1,474,491.70
ECG901	13736	17713	40° 33' 17.88"	112° 5' 46.57"	7,371,436.20	1,474,732.77
ECG902	12180	17214	40° 33' 2.36"	12° 5' 53.08"	7,369,886.20	1,474,219.10
ECG905	10839	16434	40° 32' 49.11"	112° 6' 3.19"	7,368,550.60	1,473,429.70
ECG906	9121	17481	40.54229854	112.0971139	7,366,825.17	1,474,463.69
ECG907	7087	17875	40° 32' 12.03"	112° 5' 44.56"	7,364,788.60	1,474,842.90
ECG916	9692	15269	40° 32' 37.78"	112° 6' 18.30"	7,367,411.90	1,472,255.50
ECG917	6289	18385	40° 32' 4.14"	12° 5' 37.96"	7,363,986.80	1,475,347.10
ECG924	661	16870	40° 31' 8.54"	12° 5' 57.63"	7,358,370.50	1,473,790.70
ECG925	1343	17470	40° 31' 15.27"	112° 5' 49.86"	7,359,047.50	1,474,395.30
ECG928	5126	18358	40° 31' 52.86"	112° 5' 38.40"	7,362,831.63	1,475,302.28
ECG931	-708	16395	40° 30' 55.01"	112° 6' 3.80"	7,357,004.60	1,473,305.00
ECG932	-2325	14914	40° 30' 39.04"	112° 6' 22.99"	7,355,398.50	1,471,812.00
ECG934	-4704	14177	40° 30' 15.54"	112° 6' 32.55"	7,353,025.40	1,471,057.50
ECG935	-6210	13555	40° 30' 0.66"	12° 6' 40.61"	7,351,523.90	1,470,424.60
ECG936	-6303	12389	40° 29' 59.75"	112° 6' 55.70"	7,351,439.80	1,469,258.30
ECG937	-8174	11378	40° 29' 41.27"	112° 7' 8.80"	7,349,576.80	1,468,233.40
ECG938	-8909	9785	40° 29' 34.01"	112° 7' 29.42"	7,348,853.20	1,466,635.30
K93	16005	13576	40° 33' 40.18"	112° 6' 40.18"	7,373,738.00	1,470,609.60
LTG1191	3749	20548	40° 31' 39.02"	112° 5' 9.98"	7,361,430.60	1,477,490.80
P220	10999	16234	40° 32' 50.69"	112° 6' 5.78"	7,368,711.80	1,473,230.90
P225	11920	16886	40° 32' 59.79"	112° 5' 57.33"	7,369,628.30	1,473,889.30
P228	-1491	13963	40° 30' 47.29"	112° 6' 35.29"	7,356,239.80	1,470,867.70
P244A	2266	16139	40° 31' 24.40"	112° 6' 7.09"	7,359,980.40	1,473,071.00
P244B	2278	16124	40° 31' 24.52"	112° 6' 7.28"	7,359,992.60	1,473,056.40
P244C	2285	16110	40° 31' 24.59"	112° 6' 7.46"	7,359,999.80	1,473,042.50
P248A	15485	17875	40° 33' 35.01"	112° 5' 44.48"	7,373,185.80	1,474,905.00
P248B	15491	17849	40° 33' 35.07"	112° 5' 44.82"	7,373,192.10	1,474,878.80
Cut-Off Wall Sampling Points						
ECP2562	15784	16905	40° 33' 37.97"	112° 5' 57.05"	7,373,491.80	1,473,936.80
ECP2601	-9483	6350	40° 29' 28.35"	112° 8' 13.88"	7,348,304.60	1,463,196.40
ECP2603A	-8670	8481	40° 29' 36.38"	112° 7' 46.30"	7,349,102.10	1,465,332.90
ECP2605A	-7876	9515	40° 29' 44.22"	112° 7' 32.91"	7,349,888.20	1,466,372.90
ECP2606	-5637	13598	40° 30' 6.33"	12° 6' 40.05"	7,352,097.40	1,470,471.80
ECP2612	-4318	13304	40° 30' 19.36"	112° 6' 43.84"	7,353,418.00	1,470,188.00
ECP2614	-2797	13156	40° 30' 34.39"	112° 6' 45.75"	7,354,939.90	1,470,050.90
ECP2616A	-1302	12460	40° 30' 49.17"	112° 6' 54.75"	7,356,440.30	1,469,366.10
ECP2618A	915	15607	40° 31' 11.05"	112° 6' 13.99"	7,358,633.00	1,472,529.00
ECP2624A	2349	15760	40° 31' 25.22"	112° 6' 12.00"	7,360,065.90	1,472,692.40
ECP2627A	3223	15792	40° 31' 33.86"	112° 6' 11.57"	7,360,940.00	1,472,731.50

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ECP2629A	4127	16110	40° 31' 42.79"	112° 6' 7.45"	7,361,841.50	1,473,055.70
ECP2648A	5204	16175	40° 31' 53.43"	112° 6' 6.60"	7,362,917.80	1,473,128.60
ECP2651A	7084	16131	40° 32' 12.01"	112° 6' 7.15"	7,364,798.30	1,473,098.80
ECP2654A	8841	16584	40° 32' 29.52"	112° 6' 1.23"	7,366,550.01	1,473,567.67
ECP2662A	8733	15468	40° 32' 28.31"	112° 6' 15.72"	7,366,452.20	1,472,448.20
ECP2668	9189	15494	40° 32' 32.81"	112° 6' 15.38"	7,366,907.40	1,472,477.60
ECP2670	9391	15692	40° 32' 34.81"	112° 6' 12.82"	7,367,108.50	1,472,676.60
ECP2674	11022	16182	40° 32' 50.92"	112° 6' 6.45"	7,368,735.40	1,473,179.30
ECP2682	15145	13910	40° 33' 31.68"	112° 6' 35.86"	7,372,875.60	1,470,937.10
ECP2709	12271	16656	40° 33' 3.26"	12° 6' 0.31" W	7,369,981.00	1,473,661.60
ECP2856A	-317	16115	40° 30' 59.02"	112° 6' 7.38"	7,357,395.22	1,473,031.42
ECP2857A	1211	17103	40° 31' 14.12"	112° 5' 54.58"	7,358,916.18	1,474,030.62
MDP2679	14467	13613	40° 33' 24.98"	112° 6' 39.71"	7,372,199.60	1,470,635.40
Tunnels						
BMP2712	-1255	-2563	40° 30' 49.66"	112° 10' 9.26"	7,356,597.80	1,454,343.90
ECP2631	3569	17231	40° 31' 37.27"	112° 5' 52.94"	7,361,275.40	1,474,172.40
ECP2664	8990	16938	40° 32' 30.84"	112° 5' 56.68"	7,366,698.40	1,473,919.90
ECP2689	13680	7595	40° 33' 17.23"	112° 7' 57.68"	7,371,457.20	1,464,611.80
ECP2710	15715	14960	40° 33' 37.30"	112° 6' 22.25"	7,373,437.20	1,471,991.40
LWP2632	3736	17773	40° 31' 38.92"	112° 5' 45.92"	7,361,438.80	1,474,715.50
UPD010	-10026	10313	40° 29' 22.97"	112° 7' 22.59"	7,347,732.30	1,467,155.10
Seeps and sumps						
BRP1476	13770	15740	40° 33' 18.08"	112° 6' 12.16"	7,371,486.90	1,472,757.10
BRP292	14146	16561	40° 33' 21.79"	112° 6' 1.52"	7,371,856.80	1,473,580.80
ECS2786	-7263	5097	40° 29' 50.29"	112° 8' 30.10"	7,350,533.80	1,461,959.20
ECS2715	-7870	9688	40° 29' 44.28"	112° 7' 30.67"	7,349,893.10	1,466,546.00
LWS2717	3813	18837	40° 31' 39.67"	112° 5' 32.14"	7,361,507.60	1,475,780.10
Informational Wells						
COG1172	20926	952	40° 34' 28.84"	112° 9' 23.73"	7,378,751.70	1,458,023.10
COG2701	20224	2290	40° 34' 21.90"	112° 9' 6.40"	7,378,039.60	1,459,355.30
ECG1184	-1537	17816	40° 30' 46.81"	112° 5' 45.41"	7,356,165.30	1,474,719.80
ECG1185	16909	14862	40° 33' 49.10"	112° 6' 23.51"	7,374,631.90	1,471,902.30
ECG2787	16165	12323	40° 33' 41.76"	112° 6' 56.41"	7,373,906.50	1,469,358.10
ECG933	-2975	14227	40° 30' 32.62"	112° 6' 31.89"	7,354,753.50	1,471,120.20
P272	3964	16571	40° 31' 41.18"	112° 6' 1.48"	7,361,675.50	1,473,515.60
VWK83	16031	14582	40° 33' 40.43"	112° 6' 27.14"	7,373,756.50	1,471,616.20
COG2865	16407.46	6937	40.5738 N	112.1593 W	7,378,422.65	1,457,265.51
COG995A	‾16814	‾11056	‾40.56342421	‾112.12021945	7,374,565.03	1,468,095.56
COG995B	‾16814	‾11056	‾40.56342421	‾112.12021945	7,374,565.03	1,468,095.56
ECG1106A	‾16555	‾12239	‾40.56271093	112.1159593	7,374,297.00	1,469,277.38
Non-Contact water sampling points						
ECP2654B	7792	16070	40° 32' 19.01"	112° 6' 7.93"	7,365,507.10	1,473,043.30
ECP2603B	-8730	9428	40° 29' 35.92"	112° 7' 34.01"	7,349,032.19	1,466,282.20
ECP2605B	-7978	10990	40° 29' 43.35"	112° 7' 13.79"	7,349,773.35	1,467,849.72
ECP2616B	-1302	13771	40° 30' 49.3"	112° 6' 37.74"	7,356,427.83	1,470,680.00
ECP2618B	640	16600	40° 31' 8.48"	112° 6' 1.09"	7,358,349.24	1,473,523.57
ECP2624B	1463	17081	40° 31' 16.6"	112° 5' 54.86"	7,359,168.20	1,474,010.60
ECP2627B	3403	17206	40° 31' 35.78"	112° 5' 53.23"	7,361,107.59	1,474,149.22
ECP2629B	3405	17199	40° 31' 35.8"	112° 5' 53.31"	7,361,109.62	1,474,142.82
ECP2648B	6039	17718	40° 32' 1.82"	112° 5' 46.57"	7,363,739.29	1,474,681.03
ECP2651B	6838	17039	40° 32' 9.72"	112° 5' 55.35"	7,364,543.30	1,474,008.19
ECP2662B	8845	16579	40° 32' 29.55"	112° 6' 1.3"	7,366,553.29	1,473,562.73
ECP2858B	6679	17331	40° 32' 8.15"	112° 5' 51.57"	7,364,382.66	1,474,299.38
ECP2856B	‾322.90	‾16111.35	‾40.51637916	112.1020641	7,357,391.93	1,473,024.38
ECP2857B	‾1207.80	‾17094.34	‾40.52057887	112.0985248	7,358,915.28	1,474,018.62

KENNECOTT BINGHAM CANYON MINE AND WATER COLLECTION SYSTEM COMPLIANCE MONITORING PLAN

MONITORING REQUIREMENTS AND PLAN CONTENT

The Groundwater Quality Protection Regulations require a Compliance Monitoring Plan to demonstrate compliance with groundwater protection limits for the Bingham Canyon Mine and Water Collection System (WCS). The plan is required to evaluate groundwater flow directions, and water quality at the site and at compliance points. Many elements of the plan, particularly those dealing with site hydrogeology, hydro geochemistry, and background chemistry have been previously discussed in Sections 3 and 4 of the Water Collection Monitoring Network Groundwater Discharge Permit Application and the Water Collection Monitoring Network Groundwater Discharge Permit Application Addendum submitted to the Division of Water Quality (DWQ) in 2013. Kennecott Utah Copper LLC (KENNECOTT) has an existing general or operational, groundwater monitoring plan that is described in the currently approved Groundwater Characterization and Monitoring Plan (GCMP).

This Compliance Monitoring Plan for the Bingham Canyon Mine/Water Collection System includes:

- Monitoring strategy including criteria used in the selection of monitoring point locations and methods.
- Description of general monitoring program.
- Description of the compliance monitoring program, including compliance points monitoring parameters and standards.

Implementation of this plan will result in monitoring of the principal aquifer of the southwestern Jordan Valley to identify changes in conditions and to establish compliance criteria that will trigger response or investigative actions, should significant changes in ground water be identified.

MONITORING STRATEGY

Best Available Technology (BAT) Inspection, Maintenance, and Monitoring as well as groundwater monitoring have been selected as the compliance monitoring methods for the Bingham Canyon Mine and Water Collection System.

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BAT MAINTENANCE, INSPECTION, AND MONITORING PLAN

The BAT Monitoring Plan is intended to provide appropriate information to ensure that Kennecott meets the monitoring, compliance, and reporting requirements set by the DWQ for the Bingham Canyon Mine/ Water Collection System Ground Water Discharge Permit (GWDP). The purpose of these actions is to maintain the protection of groundwater provided by the WCS, and to reduce the mobility of potentially hazardous substances by preventing discharges to groundwater. The goal of this plan is to ensure that the Bingham Canyon Mine and WCS which include all of the structures contained within it for collecting and monitoring contact and waste rock contact water (WRCW) are maintained in working condition. Actions that will be conducted to ensure that the system is functional, compliant with operational and regulatory criteria, and meet BAT criteria include:

- Inspect and maintain sediment control structures;
- Inspecting and maintaining as necessary the de-silting/sedimentation basins within each drainage to ensure they are functioning as designed;
- Removing de-silting/sedimentation basin sediments as necessary to maintain proper function;
- Monitoring erosion controls and instituting new controls when necessary;
- Maintaining ditches, pipelines, flumes, and flow monitoring equipment;
- Monitoring flows and water quality parameters for each of the drainages; and
- Summarizing data generated from within the collection systems and items relevant to compliance issues.

Preventive maintenance, as governed by this plan, includes employee training, inspection of structures associated with the storm water collection system, good housekeeping practices, and maintenance responsibilities.

Detailed procedures that are followed regarding inspection and maintenance of cut-off walls and storm water detention basins are described in the Operation and Maintenance manuals that are attached as Appendix H and Appendix I to this permit.

Inspections

Frequency - Each cut-off wall, surface water and process water conveyance structures, surface water collection basins, pipelines and collection system component will be inspected quarterly. This may occur during routine maintenance or data collection visits.

Protocol - A standard inspection protocol will be followed for each inspection conducted. The inspection report form will be completed and signed by the inspector. The operational status of each structure will be noted along with any needed corrective actions or maintenance items. The physical condition of collection boxes and gratings, the accumulation of silt or sand in the de-silting/sedimentation areas, and/or the clogging of collection box gratings with debris will also be noted. Any necessary repairs or cleaning will be completed within 45 days of the date when inspected. Typically clogged drains or pipes are addressed as soon as practical by operational

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personnel. The completed inspection form will be reviewed by SAWS Operations and any maintenance or repair items will be completed within 45 days of the inspection.

Record keeping - Copies of each inspection performed will be maintained on file to document compliance with this program as specified in Section II H of the permit. Inspection reports will be available for review by DWQ representatives during compliance visits. A log of inspections completed each quarter will be included in the quarterly water quality sampling reports provided to the DWQ.

Spills and Overflows

Kennecott will respond to all overflow spills of mine waters or sediments as soon as they are discovered. DWQ will be notified in accordance with spill reporting requirements in the Permit (Part III.I.1). The cause of the spill or overflow will be corrected/repaired and reported to DWQ as required under Part III.I.2 of the Permit. Kennecott personnel will remove any standing water which may have accumulated during the event and place it back into the collection system. Inspections of all storm water collection structures will be conducted quarterly.

Debris that may cause a blockage of flow in the collection system will be removed. If a discharge is detected, field parameters (pH and conductivity) of the sample will be recorded and a sample of the overflow will be collected. Chemical analysis of overflow waters will be conducted as with regular monitoring. Any overflow will be contained immediately and placed back into the collection system. A field logbook will be used to record all field observations and sampling data as per Kennecott's Water Sampling SOP's. Any damage that occurred due to a breach or an overflow will be repaired to restore specifications of the approved design.

In the event of low pH water pooling in desilting/sedimentation basins, the water will be pumped into the nearest collection pipeline to prevent seepage to ground water. Appropriate equipment will be available at the site to respond to any emergency spill situations.

Seeps

Seeps occur along the Bingham Canyon Mine waste rock disposal areas. Most occur naturally during times of heavy spring runoff due to super-saturated soils; however, the potential exists that seeps may occur due to leakage from the east side collection system. Kennecott will assess the collection system area for seeps on a quarterly basis. For each seep observed, Kennecott will determine if flows from the seep report to the cutoff wall/collection system. If Kennecott determines that flow from the seep(s) reports to the collection system, no further action is necessary. If Kennecott is unable to determine if seep flow reports to the collection system or determines that flows do not report to the collection system, a sample of seep water will be analyzed for pH and conductivity. Any seep that has a measured pH less than 4.5 and conductivity greater than 5,000 µmhos/cm. will cause Kennecott to take the following actions:

1. Obtain a water quality sample from the seep and analyze for the constituents noted in Part II, Section F, Item 1 (f) (Constituents Sampled).

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2. Undertake one or more of the following corrective actions that will include the following, as appropriate, to assure flows report to either the leach collection or storm water collection system:

   a. Excavation and installation of perforated pipe into the seepage area with a collection system and piping to the collection system.

   b. Diversion of the seepage to toe drains, the wetlands header pipe, or other collection system structures, depending on their location.

   c. Construction of a temporary earthen dam and installation of a surface pipe to carry the water to the collection system.

   d. Installation of an additional cut-off wall.

3. Report the location, approximate flow rate, and water quality of each seep in the quarterly monitoring results required in the permit under Part II, Section I, item 1 (b).

Corrective action to contain seep flows with pH less than 4.5 and conductivity greater than 5,000 µmhos/cm will be completed within 45 days of discovery unless weather or permitting requirements prohibit. The DWQ will be notified of any such instance where more than 45 days will be taken to address a seep with poor water quality (pH<4.5 and conductivity > 5000). The notification will include the reason for delay in capturing seep waters and will provide a schedule when such action will be completed.

The prior actions will be performed to prevent leach water from potentially migrating offsite or to the principal aquifer of the southwestern Jordan Valley. Chemical analysis of seepage waters will be conducted during regular monitoring. A field logbook will be employed to record grab sample parameters, the date the seep was found, recent precipitation events that may have induced the seep, a visual description of the water, and an estimate of the seep discharge rate.

If a seep is found to have poor water quality (i.e. pH <4.5 and conductivity greater than 5,000 µmhos/cm), and after a reasonable amount of time it is determined to be a permanent seep, the seep will be added to the surface water sampling list.

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WATER QUALITY MONITORING PROGRAM

Groundwater Sampling

A monitoring well network is utilized for compliance monitoring of the Bingham Canyon Mine and Water Collection System. The primary objective of the compliance wells is to measure any water quality impact that may influence the principal aquifer system from Kennecott operations. In as many locations as possible, wells have been selected to provide completions in the alluvial aquifer system immediately to the east of the waste rock dumps where at least 50 to 100 feet of saturated thickness exists. The remaining compliance wells are completed in bedrock because no saturated alluvial deposits exist in most areas, particularly in the southern portion of the East Side dumps, areas closer to the cutoff walls and in the Dry Fork area.

Compliance monitoring wells are located down gradient from each of the water collection facilities to monitor potential releases from the collection system into the principal aquifer and underlying bedrock. Compliance monitor wells located in the southern part of the waste rock disposal area monitor groundwater down gradient from the storm water collection system where active leaching did not occur.

The compliance well monitoring network is designed to achieve the following objectives:

1. Identify flow into the principal aquifer, which would cause the aquifer to exceed relevant permit requirements for any compliance parameter.

2. Sampling over a long period of time which allows historical trending of water quality in the area down gradient of the mine and waste rock disposal areas.

3. Provide samples of water for analysis, which accurately reflect the quality of water in the aquifer location in which they are completed.

4. Utilize wells completed in alluvium (where present) where there is between 50 and 100 feet of saturation. The screened interval will extend throughout the entire saturated interval.

5. Be constructed and completed in accordance with Kennecott's approved Groundwater Characterization and Monitoring Plan.

The compliance monitoring wells are listed in Table 1 of the GWDP for the Water Collection System. These wells are located in each major drainage and are intended to represent the most likely flow paths for meteoric or storm water that could potentially escape the cutoff wall system.

Well Installation Protocol

Current and all future operational and compliance wells are and will be constructed utilizing guidance approved in the EPA Resource Conservation and Recovery Act Ground Water Monitoring Technical Enforcement Guidance Document, EPA, 1986. Lithologic logs and well construction data for the new monitoring wells will be provided in accordance with permit requirements.

MONITORING TECHNIQUES AND DATA VALIDATION

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All groundwater monitoring will be performed using the methods for sampling, analyses, and quality control specified in the GCMP and attachments.

If data outliers or quality assurance/quality control problems are identified, the sample will be retested, and the wells will be re-sampled within 30 days. If the results from the retesting or re-sampling show that the data is an outlier, normal monitoring will resume.

MONITORING FREQUENCY

Quarterly sampling and analysis will be performed for all compliance monitoring wells screened in alluvium. Compliance monitor wells screened in volcanic or Paleozoic bedrock will be sampled on a semi-annual basis (Table 1).

REPORTING and PARAMETERS

Groundwater samples from compliance monitoring wells will be analyzed for the parameters listed in the GWDP.

Kennecott will submit compliance groundwater monitoring data to the DWQ on a quarterly basis. The reports will include a summary of all monitoring data collected during the quarter. Field measurements (ground water levels, specific conductance, pH) and certificates of analysis will be provided.

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WASTE CHARACTERIZATION PLAN

KENNECOTT UTAH COPPER LLC
BLUEWATER 1 MAIN REPOSITORY

1.0 Scope

This waste characterization plan will be used to characterize the nature of any waste materials planned to be disposed of in the Bluewater 1 Main Repository. Wastes already placed in the repository are representative of the Bingham Creek Tailings, previously provided.

As specified in Groundwater Discharge Permit #UGW350010 issued July 14th, 2010, the Bluewater 1 Main Repository may only accept tailings, sludge, soil and waste rock generated from mining activities. No organic chemicals will be permitted in the repository, although minor amounts of organic matter (grasses, leaves, sticks, etc…) may unavoidably be mixed with the large volume, low toxicity waste materials. This primary information will be supported by visual inspection and by a level of sampling and analysis appropriate to the extent and type of waste deposit.

2.0 Objectives

The objectives of the Waste Characterization Plan are as follows:

- Ensure, through knowledge and understanding of the waste genesis and visual inspection, that the waste materials do not contain synthetic organic chemicals;
- Characterize the nature of total metals and inorganic metals in the waste;
- Characterize the variability in composition of the waste with respect to total metals and inorganics; and
- Characterize the leachability of metals from the waste.

3.0 Criteria

As noted above, the primary method used to characterize the waste material will be the identification and knowledge of the process and processes that generated the waste material. Specifically, information regarding waste deposition patterns and potential migration pathways, as well as information supporting the hypothesis that only inorganic (i.e. no synthetic organic chemical) wastes are present will be evaluated. The waste must also fit within a broad definition of tailings, waste rock, soil and sludge from mining activities.

The second criteria that will be used to determine character of the waste will be the area and vertical extent of the waste deposit and its heterogeneity. The criteria will be based on visual inspection and sampling as necessary. The number of samples collected will be based on the size of the deposit, taking into account possible variability with depth. In addition, the homogeneity or heterogeneity of the waste will also be judged to adjust the

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number of samples to be collected and analyzed. The precise design of sampling grids and types and numbers of samples will be developed and submitted to the Utah Division of Water Quality (DWQ) on a case-by-case basis; however, the following sampling plan provides a representative approach for tailings and waste rock.

Approximately, the following number of grab or composite samples will be prepared and analyzed:

Estimated Waste Volume (cu yd)	Number of Samples
<100	1-3
100-1,000	5
1,000-10,000	15
>10,000	20

The number of samples will be adjusted accordingly depending on the degree of heterogeneity of the waste. Composite samples will consist of a minimum of three sub samples.

4.0 Sampling Methods

Two types of samples may be collected, grab samples and composite samples. The choice of sample type will be decided based on knowledge of the waste and visual inspection for heterogeneity. Grab samples will generally only be used for waste materials which are quite homogeneous, whereas composite samples will be used for more heterogeneous wastes. Based on the envisioned analytical suit, each grab or composite sample will contain approximately five pounds of waste material. All sampling will be performed in accordance with the Standard Operating Procedures in Kennecott Utah Copper LLC (KUC) Quality Assurance Standards. This includes the use of plastic sampling tools and appropriate decontamination methods. KUC's Health and Safety Standards will also be used for personnel protection.

Composite samples will be prepared by dividing the waste into approximately 100ft x 100ft grid. The grid size will be adjusted based on the extent of the waste deposit. A proportional volume of waste material will be collected from the center of each grid to the full depth of the waste deposit. The individual grab samples will be accumulated in a large container until the appropriate number of sub samples has been collected. Then material will be manually but thoroughly mixed until homogenized. A sub sample will be collected from the homogenized mass for analysis.

5.0 Analytical Methods

Samples will be analyzed for total metals, total inorganics, and leaching characteristics. Since the waste will be placed in the Bluewater 1 Main Repository, and no organic waste will be placed in this disposal facility, there is not a likelihood of generating organic acids which could solubilize metals. Therefore, the Toxicity Characteristics Leaching procedure (TCLP, EPA Method 1311) is not appropriate for waste materials to be placed

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in the Bluewater 1 Main repository. The Synthetic Precipitation Leaching Procedure (SPLP, EPA Method 1312) is more appropriate and will be used as the principal method for assessing leachability. Nevertheless, both SPLP and TCLP methods will be performed on representative samples of the waste materials so that a worst-case assessment can be made. Any waste failing TCLP is characteristically hazardous and cannot be placed in the Bluewater 1 Main Repository.

Tables B1 and B2 list the specific analytical methods which will be used as reference. All methods for metals and leaching characteristics are based on EPA Method SW-846. The methods for conventional inorganics are also based on standard reference documents. The Practical Quantitation Limits (PQLs) are provided along with specific method references. All metals, except mercury, will be analyzed through acid digestion and Inductively Coupled Argon Plasma (ICP). Mercury analysis will be analyzed by cold vapor atomic adsorption to ensure the attainment of low detection limits.

Table B1. Standardized Preparation/Analytical Methods & Detection Limits for Analytes in Soils.

Total Metals	Method Index	Method Reference	Practical Quantitation Limit (mg/kg)
Arsenic	3050B	6010C	4
Barium	3050B	6010C	2
Cadmium	3050B	6010C	1
Chromium	3050B	6010C	2
Cobalt	3050B	6010C	1
Copper	3050B	6010C	5
Iron	3050B	6010C	1
Lead	3050B	6010C	3
Manganese	3050B	6010C	1
Mercury	3050B	7471A	0.10
Molybdenum	3050B	6010C	1
Nickel	3050B	6010C	1
Silver	3050B	6010C	5
Selenium	3050B	6010C	5
Zinc	3050B	6010C	5

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Table B2. Standardized Preparation/Analytical Methods & Detection Limits for Leachable Metals in Soils.

EPA Method	Method Index	Method Reference	Practical Quantitation Limit (mg/L)
TCLP-1311			
Arsenic	1311/3010A	6010C	0.1
Barium	1311/3010A	6010C	0.1
Cadmium	1311/3010A	6010C	0.01
Chromium	1311/3010A	6010C	0.1
Lead	1311/3010A	6010C	0.05
Mercury	1311/3010A	7471A	0.0010
Selenium	1311/3010A	6010C	0.1
Silver	1311/3010A	6010C	0.1
SPLP-1312			
Arsenic	1312/3010A	6010C	0.1
Barium	1312/3010A	6010C	0.1
Cadmium	1312/3010A	6010C	0.01
Chromium	1312/3010A	6010C	0.1
Lead	1312/3010A	6010C	0.05
Mercury	1312/3010A	7471A	0.0010
Selenium	1312/3010A	6010C	0.1
Silver	1312/3010A	6010C	0.1

NOTE: Method Index/Method reference

1. SW 846 “test Methods for Evaluating Solid Waste,” 3rd Edition, November 1986.

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Appendix C Permit # UGW350010

KENNECOTT BINGHAM CANYON MINE AND WATER COLLECTION SYSTEM CONTINGENCY AND CORRECTIVE ACTION PLAN

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INTRODUCTION

This plan describes the contingency responses, procedures and corrective actions that Kennecott Utah Copper LLC (KUC) will follow, if triggered, under the Bingham Canyon Mine and Water Collection System Groundwater Discharge Permit.

CONTINGENCY PLAN

The Contingency Plan describes response actions which will be undertaken if an out of compliance status occurs for a compliance monitoring well.

Compliance Wells

In the event that the compliance limit is exceeded in a compliance monitoring well for two or more consecutive samples for a given parameter, the following steps will be taken:

a. KUC shall take reasonable and practical interim measures to stop the source and minimize the spread of any contaminants. These actions may include the following:

- Pumping the well at a steady flow for an extended period of time (pumping back) to determine whether there is any positive or negative impact on the water quality of the well.
- Installation of piezometer(s) (if applicable) to measure the hydraulic performance of the cut-off walls, drain systems, and other control structures.
- Drill a larger well or additional pump back wells, trenching with the addition of slurry or liners, excavating and pumping, or other actions if groundwater contamination is documented and persists.
- Other alternative remedial options which implement newer technologies or better address the source of the impact.

b. Investigate the source, nature, extent, and potential dispersion of contamination.

c. Submit a Source Assessment and Compliance Schedule in accordance with the requirements of the ground water discharge permit.

CONTAMINATION INVESTIGATION

The Director shall evaluate the effectiveness of all Source Assessment and Compliance Schedule measures for compliance monitoring wells. If the Director determines that these efforts are not effectively addressing detected and or potential ground water contamination, KUC shall be notified and requested to submit a Source Contamination Investigation Plan. The Contaminant Investigation will conform to the requirements of UCA R317-6-6.15 D and may include an endangerment assessment. The endangerment assessment will be completed in the event that Alternate Corrective Action Concentration Limits or other standards are proposed.

The endangerment assessment will consider potential human and ecological receptors in evaluating potential adverse effects of the release. More specifically, the endangerment assessment will address:

- Potential routes of exposure and contaminant concentrations.
- Potential effects of the contaminant on humans (e.g. toxicity).
- Human populations at risk.
- Potential or actual adverse effects on affected plants, animals, ecosystems, and other natural resources.
- Potential or actual adverse effects on future uses of groundwater.

The endangerment assessment will take into consideration any down-gradient water users and supply wells within a two mile radius down and cross-gradient of the facility.

CORRECTIVE ACTION PLAN

If the Contamination Investigation identifies a potential risk that requires groundwater remediation, KUC will conduct a feasibility evaluation to examine the various options available for a formal Corrective Action Plan. The feasibility evaluation may include:

- Evaluating passive management or monitoring to assess whether natural processes reduce the contamination to levels below the permitted levels.
- Assessing the feasibility and effectiveness of extracting and treating groundwater using wells or drains.
- Examining the feasibility and effectiveness of isolating the contaminated groundwater by slurry walls, grout curtains, sheet piles, and/or capping.

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- Evaluating in-situ chemical neutralization options.

- Petitioning the Water Quality Board for an Alternate Corrective Action Concentration Limits consistent with the potential risks identified.

Corrective Action Plans will be written in accordance with UCA R317-6-6.15 D and submitted for approval to the Division of Water Quality upon completion of the Contaminant Investigation.

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Appendix D Permit # UGW350010

BINGHAM CANYON MINE AND WATER COLLECTION SYSTEM CONCEPTUAL MINE CLOSURE PLAN

VERSTION DATE 2003

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Paula H. Doughty
Manager, Environmental Affairs and
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Kennecott

April 25, 2003

Wayne Hedberg, Permit Supervisor
Minerals Reclamation Program
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Don A. Ostler, Director
Division of Water Quality
Utah Department of Environmental Quality
P.O. Box 144870
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Gentlemen:

Subject: Submittal of Bingham Canyon Mine Reclamation and Water Management Plan for DOGM Permit# M/035/002 and for Groundwater Discharge Permit # UGW350010

Attached to this letter is the Kennecott Utah Copper Corporation's (Kennecott's) 2003 Bingham Canyon Mine Reclamation and Water Management Plan. Also attached are responses to the Division of Oil, Gas and Mining (DOGM) comments on the third draft of the plan dated January 31, 2003. Based upon conversations and e-mail communications between Kennecott and Department of Environmental Quality (DEQ) personnel over the past week, Kennecott believes that all of the comments from both Divisions have been addressed in this final update of the plan.

With the submittal of this document Kennecott assumes that the permit requirement for a conceptual closure plan listed in Ground Water Discharge Permit UGW350010 has been fulfilled.

The original Reclamation Plan for the Bingham Canyon Mine was submitted to DOGM in 1976 and was incorporated into the final Mined Land Reclamation Contract signed on September 28, 1978. As requested by the Division, and in accordance with the regulations that were in effect in 1978, Kennecott is pleased to submit this update to the original Reclamation Plan. It should be noted that although the new Reclamation Plan represents a refinement over the 1976 plan, the nature of the reclamation envisioned by both plans does not differ substantially.

It has been a pleasure working with your staff on this project over the past few years. If you have any questions or comments about the final version of the plan, please give me a call at 569-7120.

Sincerely,

Paula Doughty, Manager Environmental
Affairs and Strategic Resources

Attachments

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bcc: Vicky Peacey
OPS-RR-MF-Closure Plan ✓

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BINGHAM CANYON MINE 2003 RECLAMATION AND WATER MANAGEMENT PLAN

DOGM PERMIT NUMBER M/035/002

GROUND WATER DISCHARGE PERMIT NUMBER UGW350010

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Submitted to

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Submitted by

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March 2003

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Appendix E – Geochemical Evolution of Sulphide-Bearing Waste Rock Soils at the Bingham Canyon Mine, Utah
Appendix F – Vegetative Community Analysis of Biosolids Test Plots After Five Years of Growth

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1.0 INTRODUCTION

This report is intended to provide the Utah Division of Oil, Gas and Mining (DOGM) with an update to the Reclamation Plan for mining-related disturbance within the boundaries of Permit Number M/035/002. This report is also designed to fulfill the requirements for a conceptual closure plan required by Ground Water Discharge Permit UGW350010 (Bingham Canyon Mine and Leach Collection System). Kennecott Utah Copper Corporation (KUCC) submitted the original Mining and Reclamation Plan to DOGM in 1976. It was incorporated into the final Mined Land Reclamation Contract signed on September 28, 1978. Reclamation bonding was waived in lieu of a personal guarantee on the part of KUCC.

The original reclamation plan is still valid for KUCC's existing operations and consistent with the reclamation activities described in this report. However, the original plan could not be very specific about future reclamation options because of the long life expectancy of the mining operation. These same planning difficulties exist in 2003 because the surface mine is currently expected to be in operation for at least another 10 years.

This report proposes tentative reclamation actions and attempts to establish a decision-making framework for selecting optimum reclamation actions in the future. To aid in this process, this report also identifies information needed to make reclamation decisions that is not currently available but that will be collected in the future.

1.1 PERMIT NUMBER M/035/002 1976 RECLAMATION PLAN

A copy of the 1976 Mining and Reclamation Plan is attached in Appendix A. Figure 1-1 is a map showing the boundaries of Permit M/035/002 and all subsequent DOGM permits. The original plan divided the permit area into seven operational land use categories and specified maximum areas that could be disturbed within each category: 1) Mine - 3100 acres, 2) Mine Waste Disposal - 8000 acres, 3) Excess Mine Water Disposal - 2700 acres, 4) Ore Transfer - Mine to Process - 400 acres, 5) Ore Processing Facilities - 1800 acres, 6) Tailings Disposal - 6000 acres, and 7) Excess Process Water Disposal - 1000 acres. For each land use category, the plan described the physical setting in 1976 and the land use and vegetation that was present before mining began. It also presented potential post-mining land uses and general reclamation strategies.

1.2 SUBSEQUENT RECLAMATION PLANS

A series of new reclamation plans have been submitted to DOGM since 1976 for new construction projects or land uses that are different from the original 1978 Permit. A new DOGM permit number was issued for each of these projects and bonding was required. These new permits include the Fourth Line/Copperton Concentrator, Pine Canyon, and the North Impoundment Expansion. None of these new permit areas is discussed in detail in this report because they each have their own detailed reclamation plan. Several additional reclamation plans

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relating to dust control and groundwater quality protection for the existing tailings impoundment have also been submitted to various State agencies.

1.2.1 Copperton Concentrator/Fourth Line Expansion Reclamation Plan

A reclamation plan for the Copperton Concentrator, ore conveyor and tailings pipeline corridor was initially submitted to DOGM in April 1986. Amended plans were subsequently submitted for the addition of the Molybdenum Plant and for a fourth mill line. These plans describe building demolition and reclamation activities and costs for the ore conveyor and Copperton Concentrator. Total bonding for these facilities is currently $19,029,000. The original pipelines within the tailings pipeline corridor were exempted from bonding because of plans to use the pipelines for post-mining water management. However, the second tailings pipeline within the corridor is bonded in order to provide coverage for reclamation costs in the event that it is not used for post-mining water management. These facilities are all managed under DOGM Permit Number M/035/011.

1.2.2 Tailings Pond Reclamation Plans

Several reclamation plans have been submitted for the South Tailings Impoundment and for the North Impoundment expansion. The Tailings Pond Final Reclamation Plan was submitted to the Utah Air Conservation Committee and DOGM in July 1988. The plan focused on revegetation strategies and techniques for dust control on the impoundment. It assumed that the South Impoundment would be in operation for another 30 to 35 years, but this plan became obsolete when the North Impoundment expansion was initiated. The initial notice of intent for the North Impoundment expansion was submitted in 1994 and contained a detailed reclamation plan for the new impoundment. Permit number M/035/015 was issued for the North Impoundment in February 1996 and is currently bonded for $20,628,000. Two more recent reclamation plans have been submitted to State agencies that describe closure and reclamation of the South Impoundment. The Tailings Modernization Fugitive Dust Abatement Program, submitted to the Utah Division of Air Quality in 1994, contains a detailed revegetation plan for the surface of the South Impoundment. The Final Closure Plan for Groundwater Issues, submitted to the Utah Division of Water Quality in 1997, describes how surface and groundwater will be managed on the South Impoundment at closure. These plans are attached in Appendices B and C.

1.2.3 Pine Canyon Reclamation Plan

A reclamation plan for the Pine Canyon Mine and Mill Site was submitted in 1988. The plan was approved and has largely been implemented. Total bonding for Permit M/045/004 is $120,800 for reclamation of the few remaining structures and disturbed acres in the canyon.

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1.3 OTHER PERMITS AND LAWS GOVERNING RECLAMATION AND POST-CLOSURE LAND USE

KUCC will have to comply with all applicable permits and laws governing surface water, groundwater, air emissions, hazardous wastes and soil contamination both during and after closure. Many of these laws and permits will influence the extent and character of reclamation that takes place at closure. In particular, as described below, Ground Water Discharge Permit UGW350010 requires the submittal of a closure plan that addresses groundwater quality issues around the mine and waste rock disposal areas.

1.3.1 Groundwater Discharge Permits

Ground Water discharge permits are managed by the Utah Division of Water Quality (DWQ). KUCC's permits require ground water monitoring, reporting and corrective actions if an out of compliance situation exists.

Ground Water Discharge Permit UGW350010 for the Bingham Canyon Mine and Leach Collection System (Part I, K.3) requires the submittal of a conceptual closure plan. The plan is required to "provide detail on all aspects of closure that are related to or have an impact on water quality". This includes preliminary designs and a schedule to modify the waste rock dumps to minimize infiltration, and a description of post-closure monitoring. The permit also requires that a final closure plan be submitted one year before closure. The Bingham Canyon Mine 2003 Reclamation and Water Management Plan (this document) is intended to fulfill the permit's requirements for a conceptual closure plan.

The Groundwater Discharge Permit for the tailings disposal area may also require post-closure maintenance and long-term monitoring. It is likely that the groundwater discharge permit for the North Concentrator area will have fewer post-closure requirements after demolition and reclamation have been completed there.

1.3.2 National Historical Site Registry for Bingham Pit

The Bingham Canyon open pit was designated as a National Historic Landmark in 1966. The designation was based upon the historical significance of the pit as well as its overall physical appearance. The National Historic Preservation Act was passed with the specific intention of identifying and assuring the continued existence of National Historic landmarks. Furthermore, State law requires that each State agency take into account the effect of an undertaking on any district, site, building, structure or specimen that is included in or eligible for inclusion in the National Historic Register of Historic Places or the State Register. Accordingly, reclamation obligations that would alter or amend the Landmark should consider the implications of the activities on the Landmark.

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1.3.3 UPDES Permit

The DWQ will also manage the UPDES permit for surface water discharges off the property after closure. The UPDES permit will specify water quality criteria at each permitted outfall point and may specify storm water management practices. KUCC or its designate will continue to manage both surface water and captured groundwater of various qualities from throughout the property after closure.

1.3.4 Air Permits

The Utah Division of Air Quality (DAQ) manages Air Approval Orders, Title V Operating Permits and sections of the State Implementation Plan at the Mine, Concentrators and Tailings Impoundment. Air emissions at the concentrators will end at closure, though certain air quality requirements may apply during demolition and reclamation. The level of dust emissions from the mine, waste rock disposal areas and tailings impoundment will be highly dependent upon the reclamation actions that are selected. It is likely that the DAQ will continue to require oversight of these facilities during and after closure.

1.3.5 CERCLA Sites and NRDC for Acid Plume

Under the terms of various Environmental Protection Agency (EPA) Comprehensive Environmental Response Compensation and Liability Act (CERCLA) administrative orders and a 1995 Memorandum of Understanding (MOU), the EPA and the State Division of Environmental Response and Remediation (DERR) provide oversight and specify minimum cleanup standards during remediation activities at historically contaminated sites. As part of the 1995 MOU, KUCC agreed to "complete environmental assessments of currently identified on-site historic facilities and their associated wastes and conduct cleanups of these wastes if shown necessary by the ecological and human health risk assessments". Figures 1-2 and 1-3 are maps and lists of historical sites within the boundaries of DOGM permit M/035/002. To date, the majority of sites that fall within the permit boundaries have received a "No Further Action" status from the EPA and DERR as identified in two Records of Decision dated December 13, 2000 and September 28, 2001. Most of the remaining sites will be addressed many years before closure, but it is possible that new sites will be identified or that remediation will continue after closure at other sites.

Historical leach water and acid rock drainage (ARD) losses that occurred at the base of the waste rock disposal areas, from the former Bingham Creek Reservoirs and from the South Jordan Evaporation Ponds contaminated portions of the alluvial aquifer in the southwest Jordan Valley. Concentrations of sulfate and metals in some parts of the aquifer are above human health standards for some constituents.

Several corrective measures were taken in the early to mid 1990s to prevent additional releases to the aquifer. These included: 1) taking the South Jordan evaporation ponds out of service, removing and/or consolidating sludges on-site, and capping and reclaiming the area; 2) temporarily taking the Bingham Creek reservoirs out of service and replacing them with

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reservoirs that have a triple-layer liner system; and 3) improving the capture of seepage from the Eastside
waste rock disposal areas by upgrading the surface and subsurface collection systems. In addition, active leaching of the waste rock disposal areas was terminated in Fall 2000. These steps are important source control measures for protecting the regional aquifer against further contamination.

Development of a plan to efficiently remediate the existing groundwater contamination involved groundwater management and treatment specialists, state and federal regulators, local community leaders and local water purveyors. Settlement of the Natural Resources Damage Claim made by the State of Utah for the Bingham Creek Groundwater plume requires, among other things, that the acidic portion of the groundwater plume be extracted. Barrier wells installed at the plume's terminus will be pumped in perpetuity to contain the sulfate portions of the plume. These activities will take place before, during and after closure.

1.4 1998 UPDATE OF MINING OPERATIONS

The final draft of the 1998 Update on Mining Operations Conducted Under DOGM Permit Number M/035/002 was submitted to DOGM on September 30, 1998. The 1998 Update describes in detail the mining operations that existed within the permit boundaries in 1998 and provides a brief history of the operations since the original permit was received in 1978.

1.5 REPORT ORGANIZATION

This reclamation report is organized in the same general manner as the 1976 Mining and Reclamation Plan. Section 2.0 describes general reclamation strategies that are common to each land use category described in the original plan. Sections 3.0 through 9.0 present tentative reclamation activities for each land use category. These sections also describe the issues and data requirements that need to be addressed in order to refine and finalize the selected tentative activities. Section 10.0 describes post-closure water management activities and Section 11.0 briefly describes future and on-going research that is being conducted in support of reclamation and closure.

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2.0 GENERAL RECLAMATION STRATEGY

The following sections describe the general decision making processes that were used to determine if and when a site should be reclaimed, and to select the most appropriate actions at sites that have been scheduled for reclamation.

2.1 RECLAMATION TIMING

The ultimate fate of facilities that currently exist within the permit boundaries is: 1) to be reclaimed during the life of the mine, 2) to be reclaimed during mine closure, or 3) to not be reclaimed. Any facilities that are to be left in place after closure will need to have a confirmed post-closure use.

It may be logical to close and reclaim some facilities before general mine closure. For example, changes in process or economics may make some facilities obsolete. Facilities that reach the end of their designed operational life, such as the South Tailings Impoundment, may also be reclaimed before general mine closure. Facilities that are inactive and that may pose a risk of contaminant release to the environment will generally be demolished and remediated before general closure.

Under current plans, most facilities will be reclaimed at the time of general mine closure. However, some facilities may be left in place if they have a demonstrated post-mining use and if they do not pose a threat to human health or the environment.

2.2 SELECTION OF RECLAMATION ACTIVITIES

Tentative reclamation actions for each land use category specified in the 1978 Permit are selected according to the following steps:

- closure issues are identified
- possible post-closure land uses are identified
- information that is needed before final closure options can be selected is identified
- tentative reclamation actions are selected.

The following subsections provide a general description of each of these steps. Sections 3.0 through 9.0 are also organized according to the format described here.

2.2.1 Closure Issues

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Regulations and permits governing closure, in particular, actions required by the 1976 Mining and Reclamation Plan or Groundwater Discharge Permit UGW350010, are identified for each land use category. Known hazards and environmental liabilities that will exist at closure are also described, and the environmental goals of the reclamation process are listed.

2.2.2 Possible Post-Closure Land Uses

Possible post-closure land uses are identified based upon the limitations imposed by the regulatory, chemical and physical setting that will exist at closure. In the future, land use may also be selected based upon cleanup standards derived from exposure and risk assessments. Sites without long-term maintenance requirements and where all physical and chemical hazards are removed, may have an unrestricted post-closure land use. At the other extreme, sites that will require continuous maintenance after closure, or that will still pose physical or chemical hazards, will have a more limited set of possible post-closure land uses. The identification of these limitations early in the planning process can help define the reclamation strategy.

2.2.3 Data Requirements

This section identifies information that is not currently available but is needed in order to refine the tentative reclamation actions.

2.2.4 Reclamation Activities

Tentative reclamation activities are selected for each land use category based upon the incomplete data set that is currently available. These actions may be refined in the future as necessary data requirements are filled and as new technologies become available.

2.3 RECLAMATION OF BUILDINGS AND STRUCTURES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified that all surface facilities, utilities, railroads, paved areas and equipment would be razed and/or removed except for those with a post-mining use. This is a common requirement to each of the operational areas specified in the 1978 Permit, and reclamation will generally be conducted in a similar fashion at each site.

Table 2-1 lists the major facilities and structures that currently exist within the permit boundaries, and specifies the closure approach and status currently planned for each facility. Figures 2-1 and 2-2 show the locations of buildings and structures around the mine and the North Concentrator/Magna Tailings area. The closure approach consists of one or more activities for each facility. A brief description of the principle activities is provided below:

- Demolition (Demo) involves the removal of salvageable equipment and destruction of buildings or structures and foundations.

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- Remediation (Remed) involves excavation and removal of contaminated soils and debris.

Table 2-1 Facilities and Structures within the Permit Boundaries

FACILITY DESCRIPTION	CLOSURE APPROACH	STATUS
MINE		
Water Tanks	Demo and Reclaim	Final
General Buildings	Demo and Reclaim	Final
Visitors Center and Parking Area	Leave in Place	N/A
Lead Mine Townsite	Demo and Reclaim	Final
Lark Mine Buildings	Demo and Reclaim	Final
Yosemite Road	Demo and Reclaim	Final
Yosemite Truck Shop & Dispatch Tower	Demo	Final
Explosive Storage	Demo and Reclaim	Final
Dry Fork Warehouse & Shops	Demo	Interim
In-Pit Crusher	Demo	Final
6190 Truck Shop	Demo	Final
Code 80 Fuel & Lube Shop	Demo and Reclaim	Final
Miscellaneous Shafts	Demo and Reclaim	Final
44 KV Power Distribution Line	Leave in Place	N/A
Power Lines associated with dewatering	Leave in Place	N/A
Miscellaneous Power Lines	Demo and Reclaim	Final
Miscellaneous Tunnels	Demo and Reclaim	Final
Mine Access Road	Leave in Place	N/A
Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
MINE WASTE DISPOSAL		
Small Bingham Reservoir	Leave in Place	N/A
Large Bingham Reservoir System	Leave in Place	N/A
Precipitation Plant	Demo, Remed and Reclaim	Interim
Water Management System Facilities	Leave in Place	N/A
ARD Collection System Facilities	Leave in Place	N/A
Leach Water Pumping Facilities	Demo and Reclaim	Final
6600 ARD Storage and Evaporation Ponds	Leave in Place	N/A
Pilot-Scale Water Treatment Facilities	Demo and Reclaim	Interim
SX-EW Pilot Plant	Demo and Reclaim or move	Interim
Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
EXCESS MINE WATER DISPOSAL		
Evaporation Ponds and Associated Facilities	Demo, Remed and Reclaim	Completed(1)
ORE TRANSFER-MINE TO PROCESS		

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Ore Reload	Demo and Reclaim	Final
Rail Tracks and ties	Demo and Reclaim	Interim
Rail Ballast	Remed and Reclaim	Interim
Copperton Rail Yard	Demo and Reclaim	Final
Railroad Car Repair Shop	Demo and Reclaim	Final
Ore Conveyor (in pit and 5490 Tunnel)	Demo	Final
Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
ORE PROCESSING FACILITIES		
Magna Concentrator Area	Demo, Remed and Reclaim	Interim
Magna Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
Arthur Shops Area	Demo and Reclaim	Final
Arthur Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
Bonneville Area	Demo and Reclaim	Final
Bonneville Asphalt/Concrete Parking Areas	Demo and Reclaim	Final
Pipelines	Demo and Reclaim	Final
TAILINGS DISPOSAL		
Magna Tailings Pond Structures	Demo and Reclaim	Interim
EXCESS PROCESS WATER DISPOSAL		
Excess Process Water Disposal Structures	Leave in Place	N/A
NOTE: Any facilities to be left in place will have a post mining use.		
(1) As described in Section 5, follow-up remediation is currently planned to remove gypsum-bearing		
sludge from the repository in the Evaporation Pond area.		

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- Reclamation (Reclaim) involves regrading and revegetating the affected areas except for structures located in the Bingham Pit, on the waste rock surfaces or on the tailings impoundment. These sites will be reclaimed according to the reclamation activities described in Sections 3, 4 and 8 respectively.

- Leave in Place indicates that the facility will remain for future commercial, water management or other uses. Any facility to be left in place will have a demonstrated post-mining use at closure.

The closure status options listed in Table 2-1 are:

- Interim - indicates that the facility will probably become inactive and be reclaimed before general mine closure.

- Final - indicates that the facility will probably become inactive and be reclaimed during general mine closure.

- Not Applicable (N/A) - indicates that the facility may have a post-mining use or that the final closure option has not been selected.

- Completed - indicates that the facility has already been reclaimed.

Before each facility closes, residual feedstock materials and products will be identified, collected and processed, sold or otherwise removed. During demolition, salvageable and recyclable materials will also be sold or recycled. Uncontaminated construction debris that remains after all commercially valuable materials have been removed will either be transported to a Class IV landfill on KUCC property or buried on-site. Wherever possible, construction debris will be used as fill material to minimize the need to excavate and transport fill material from elsewhere. Shaft, adit and tunnel portals that are both within the permit boundaries and on Kennecott property will be assessed to determine if they would pose a risk to the public after closure. Those portals identified as a risk by the hazard assessment will be gated or sealed.

Soils beneath and adjacent to buildings and structures will be sampled during and/or after demolition. Sampling will be performed if it is believed that contamination may be present because of historical activities or field observations. Soils, construction debris or other materials that are determined to be contaminated with metals or organic compounds will be sent to an appropriate disposal or treatment facility. Selected materials may be decontaminated and recycled. Hazardous wastes will be sent to an off-site hazardous waste landfill, or may be disposed of on-site in the Arthur Repository if they meet the requirements of the corrective action management unit. According to their chemical characteristics, other materials will be bioremediated, sent to an industrial landfill, or sent to the waste rock disposal areas. Contaminated materials will be handled in compliance with all existing permits and regulations. However, within this legal framework, material-handling decisions will be based upon cleanup standards derived from exposure and risk assessments. For example, if the post-mining land use

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is industrial, then the cleanup standards for soils will address industrial worker exposures. If the post-mining land use is wildlife habitat, the clean up standards will be based upon exposures to potentially impacted species.

The footprint of demolished facilities within the Bingham Pit, on the waste rock dumps or on the tailings impoundment will be treated in accordance with the reclamation activities described in Sections 3, 4 and 8 respectively. For facilities that are not underlain by the pit, waste rock or tailings surfaces, fill material will be imported, drainages will be reconstructed, and the land surface will be graded and contoured consistent with the surrounding terrain. If the existing soils or fill materials do not provide a suitable growth media, topsoil will be imported and spread to a minimum depth of six inches. Subsoil will also be imported in addition to topsoil if required to provide a minimum of two feet of rooting media. Wherever possible, topsoil will be taken from nearby existing stockpiles. Reclaimed sites will be planted with native and select non-native species. Species mixes will be adjusted based upon parameters such as elevation and slope orientation. If field assessments indicate it is required, all the surfaces to be revegetated will also receive a light application of chemical fertilizer to provide nitrogen, phosphorus and potassium (not to exceed 50 lbs/acre available nitrogen) or may receive biosolids at application rates not to exceed 10 tons/acre of pure biosolids. If biosolids have been mixed with wood chips or another carbon source, the application rate of the mixture may be as high as 30 dry tons/acre, as long as the biosolids component of the mixture does not exceed 10 dry tons/acre. In general, phosphorus application rates will be higher than nitrogen application rates, which will be higher than potassium application rates.

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3.0 MINE AREA

The Bingham Pit is currently about 13,000 feet across at its widest point and covers approximately 2300 acres. The associated support facilities cover about 170 acres and are generally sited on top of old waste rock disposal areas adjacent to the pit. A list of the support facilities is provided in Table 2-1. The open pit extends from approximately 8000 feet above mean sea level (amsl) to about 4500 feet amsl. Overall pit slopes will range between 32 and 52 degrees at closure and will be composed of a series of benches that average about 50 to 100 feet high and 40 to 50 feet wide. The Conveyor Tunnel connects the pit with the Salt Lake Valley. It has a western portal on the northeastern side of the pit at an elevation of about 5490 feet amsl and an eastern portal at an elevation of 5465 feet amsl in lower Bingham Canyon about 2000 feet west (up gradient) of the Bingham cutoff wall and reservoirs (Figure 2-1). According to the current surface mine plan, the pit will be approximately 300 feet deeper and cover several hundred additional acres at closure.

The distribution of sulfide mineralization within the walls of the Bingham pit provides the primary control on contact water chemistry and on the chemistry of soils that form on the pit benches. As the sulfides are oxidized, they produce acid that may be neutralized in situ if sufficient acid neutralizing minerals such as calcium carbonate are present in the rock. The amount of acid that a rock could produce if it is completely oxidized is termed its acid potential (AP) and the amount of acid that a rock can neutralize is termed its neutralization potential (NP). The net neutralization potential (NNP) is calculated by subtracting the AP from the NP and the neutralization potential ratio (NPR) is calculated by dividing NP by AP. A rock with a negative NNP or an NPR of less than one will likely generate acid rock drainage (ARD) as it weathers. In theory, a rock with a positive NNP or NPR greater than one will not generate ARD and may neutralize acidic solutions with which it comes into contact. However, because of the uncertainties created by differential reaction kinetics, leaching rates and mineral distribution in the rock, a commonly used screening criteria assumes that rocks with NNP values above zero and NPR values above one are possibly acid-generating unless the sulfide sulfur content is less than 0.3 % (AP < 10 tons/1000 tons) or the NPR is greater than 2 (Price et al., 1997).

Figure 3-1 is a map of acid potential on the current pit walls and Figure 3-2 is a graph showing the vertical distribution of acid potential. The acid potential is likely overestimated by about ten percent on these figures because it has been calculated from total sulfur analyses and so includes sulfur from non-acid-generating sulfate and sulfide minerals. On average, all of the current pit benches above 6900 feet amsl and most of the benches below 5000 feet amsl contain less than 0.3 percent sulfur (Figure 3-2). The primary acid-generating sulfide minerals in the Bingham Pit are pyrite, chalcopyrite, bornite and molybdenite. Pyrite is generally the most abundant and reactive of these sulfides and its distribution is the most significant control on the AP of the pit walls. Figure 3-3 is a graph showing the vertical distribution of AP derived from pyrite alone on the current pit walls. Below 5100 feet, the average pyrite AP varies between about two and ten tons/1000 tons. Much of the rest of the AP in the bottom of the pit is provided by molybdenite. Although molybdenite may generate acidity under some surface weathering conditions, in practice it is one of the most resistant sulfide minerals to oxidation and so is likely to be a minor contributor to acid production (Plumlee, 1999). The center of the pyrite halo

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around the ore body, where rock has the strongest potential to generate acid is largely confined to a band between 5500 and 6200 feet amsl.

The NP of the current pit walls is highly variable. Limestone beds tend to have the highest NP values while quartzites and late stage intrusive rocks tend to have the lowest (Table 3-1). Most of this NP is provided by calcium carbonate, but a small amount is also provided by various silicate minerals. For each sedimentary rock type, NP tends to be highest on the uppermost benches of the pit and decreases towards the center of the pit. In general, the sedimentary sequence on the northeast side of the pit has much less NP than in other areas. Within the igneous rocks, NP values tend to be highest in areas adjacent to limestone beds.

The distribution of NNP on the current pit surface is shown on Figures 3-4 and 3-5a. In plan view, the distribution of NNP in the pit can be visualized as donut shaped, with a positive (net-neutralizing) 3500-foot diameter core surrounded by a negative (net acid-generating) 10,000-foot diameter ring. As shown on Figure 3-4, the center of the low-grade core of the ore body has NNP values above 25 tons/1000 tons. The current pit walls are generally net acid-neutralizing below about 5200 feet amsl, are net acid-generating between 5200 and 6600 feet amsl, and are net acid-neutralizing again above about 6600 feet amsl (Figure 3-5a). The rock exposed in the lower 400 feet of the pit has average NPR values of two or higher (Figure 3-5b). As mining continues, more and more of the net neutralizing core will be exposed in the bottom of the pit. Figures 3-6a and 3-6b are vertical profiles of NNP and NPR for an ultimate pit that extends to a depth of 4240 feet amsl. The profiles are based on approximately 250 borehole intercepts with the estimated ultimate pit surface. The exact depth and geometry of the planned ultimate pit changes on a regular basis in response to new analytical data, changing copper prices and technological advances, but the 4240 ft amsl depth represents one of the deeper pit versions currently being considered. Based upon data from the current and 4240 ft ultimate pits, at closure almost all of the rock exposed in the lower 700 feet of the pit will likely be net neutralizing. The lower 200 feet will have average NNP values of greater than 20 tons/1000 tons and NPR values of greater than two. A more detailed description of the acid/base accounting geochemistry of the ore body is presented in the paper "Environmental Geochemistry of the Bingham Canyon Porphyry Copper Deposit, Utah" (Borden, 2003). This paper is attached in Appendix D.

The pit is surrounded by several small waste rock disposal areas (Figure 2-1). Some upper pit benches were mined through these old waste rock deposits as the pit expanded. This waste rock is generally net acid generating.

Surface and ground water inflows into the pit currently average about 1000 gallons per minute (gpm). Dewatering of the pit, combined with pumping from underground workings surrounding the pit, has created a large cone of depression in the groundwater table and caused radial flow towards the pit from all surrounding areas. These waters are currently pumped out of the pit and enter the process water circuit. Without pumping, water levels in the pit would recover to some elevation significantly higher than 5212 feet amsl. This was the maximum surface elevation of the lake that formed in the pit after only three years of filling and with intermittent pumping during the shutdown in the mid 1980s.

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The pit is almost entirely surrounded by bedrock ridges and mountains that vary between 6800 and 9200 feet amsl. The lowest point on the pit walls is at the intersection with upper Bingham Canyon, here the bedrock elevation is 5900 ft amsl. As shown on Figure 3-7, the bedrock water table surrounding the open pit tends to mimic the topography. In 2001, the dry bottom of the pit was at approximately 4600 feet amsl and water was being pumped from underground workings on the west and northeast sides of the pit. Despite this peripheral dewatering, the down-gradient water table beneath Bingham Canyon and the 6800 to 7400 ft high ridge to the east of the pit was everywhere above 5449 ft amsl. In 2001, there was thus at least 800 feet of head driving water flow towards the pit from the down-gradient (east) side of the pit. This probably underestimates the actual gradient towards the pit because few of the monitoring points are located beneath the ridge crest, where water levels are likely highest. In 1998, immediately before pumping of the North Ore Shoot began, the bottom of the pit was at 4750 ft amsl and the water level in the North Ore Shoot was at 5647 ft amsl. The North Ore Shoot is located at the upper end of Bingham Canyon, about 5500 feet north-northeast from the bottom of the pit. In 1998, the head difference here was thus 900 feet and the gradient was 160 ft/1000 ft towards the bottom of the pit.

At closure, if other pumping on the perimeter of the pit is discontinued, the estimated annual average inflow could be as much as 2500 gpm. Water quality from different areas on the pit walls is variable depending on the characteristics of the bedrock with which the water has come into contact, and its residence time on the surface or within the surrounding rock mass.

Figure 3-8 is a conceptual model of water movement and water quality in and adjacent to the pit. The primary assumption made to create the conceptual model is that water will be pumped from the pit after closure to limit the elevation of pooled water in the bottom of the pit. If the pit is allowed to partially flood, the lake surface will be maintained at a low enough level to ensure radial groundwater flow into the pit and to minimize contact with the net acid-generating portions of the ore body and pyrite halo. The most significant chemical and physical controls on pit water chemistry are labeled with letters and the most significant flow paths and chemical interactions are labeled with numbers.

Physical and Chemical Controls

A) The low-grade core of the ore body exposed in the bottom of the pit contains few acid generating sulfide minerals and is generally net neutralizing.

B) The main copper-bearing zone of the ore body and the surrounding pyrite halo contain abundant pyrite and chalcopyrite and are generally composed of net acid-generating rock. For convenience in the following discussions this entire rock mass is described as the pyrite halo.

C) Bedrock exposed on the uppermost benches of the pit and surrounding the pyrite halo in the subsurface contains few acid generating sulfide minerals and is generally net neutralizing.

D) Historic waste rock disposal areas fill most of the tributary drainages that discharge into the open pit. This waste rock contains abundant acid-generating sulfide minerals and is typically net

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Figure 3-8 Conceptual Model of Water Movement In and Around the Bingham Pit

acid generating. The waste rock not only contains abundant pyrite, but it has been rubblized so the release of sulfide oxidation products is much more rapid than for undisturbed bedrock.

E) Numerous underground workings surround the open pit and some intersect the pit surface. These workings provide flow conduits for groundwater and if dewatered allow the access of oxygen into the deep bedrock, accelerating sulfide oxidation reactions. Most of these underground workings were used for mining lead-silver deposits surrounding the copper ore body, and are located outside of the pyrite halo (see Figure 3-7 for a map of underground workings above the regional water table in 2001).

Flow Paths and Chemical Interactions

1) Precipitation falls everywhere within the drainage basin created by the open pit. This includes undisturbed mountain slopes surrounding the pit, waste rock disposal areas surrounding the pit, pit walls above the pyrite halo, pit walls within the pyrite halo and pit walls below the pyrite halo. Precipitation water is removed from the ground surface via evapotranspiration thereby reducing the amount of water that is available to infiltrate or run off. Evapotranspiration is most efficient on well-vegetated surfaces.

2) Water that does not infiltrate or evaporate immediately will flow towards the bottom of the pit as runoff. Runoff is greatest on sloped and compacted or otherwise impermeable surfaces. This water will either flow all the way to the pit bottom as runoff, infiltrate at a location down gradient from where it originally fell or be removed by evapotranspiration at a down gradient location. Runoff from undisturbed mountain slopes surrounding the open pit generally flows onto waste rock surfaces where it infiltrates, contributing to the flow described in 3a. Runoff water that reaches the bottom of the pit by flowing over the pyrite halo will transport some dissolved and suspended contaminants to the pit floor. However, because the contact time is relatively short this water will generally contain fewer dissolved constituents than water that has percolated through waste rock or through unsaturated portions of the pyrite halo.

3) Precipitation that is not removed by evapotranspiration or runoff to the pit floor will infiltrate. There are five general paths by which this water may migrate in the subsurface:

3a) Water that infiltrates into the net acid generating waste rock disposal areas will generally become the poorest quality ARD that drains into the pit. This water will either perch at the bedrock/waste rock contact and discharge onto the upper surface of the pit, or it will pass through the bedrock/waste rock contact and will discharge onto a lower pit surface.

3b) Some of the water that infiltrates into the undisturbed mountainsides surrounding the pit may flow in the shallow subsurface (colluvial and shallow bedrock flow) and discharge into waste rock that covers buried seeps and springs, thereby contributing to the flows described in 3a. This is generally the best quality groundwater surrounding the open pit, but after contacting the waste rock it degrades into the poorest quality ARD reporting to the pit.

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3c) Some of the water that infiltrates in the pit drainage basin will pass through the net acid-generating pyrite halo in the vadose zone before it reaches the water table. This water will generally become poor quality ARD because it is in contact with the oxygenated portion of the pyrite halo. Once this water reaches the water table, it will flow laterally and discharge into the bottom of the pit.

3d) Some of the water that infiltrates in the pit drainage basin will pass through net neutralizing bedrock in the vadose zone before it reaches the water table. This water will then flow laterally below the water table and will ultimately discharge into the bottom of the pit. Neutralization reactions may take place below the water table if the water contacts reactive neutralizing minerals, but sulfide oxidation reactions will be inhibited by a lack of oxygen. The quality of this water will remain relatively good because it only contacts the reduced portion of the pyrite halo below the water table.

3e) Water that infiltrates into the bedrock surrounding the pit that is beyond the zone of groundwater capture for the pit will not discharge to the pit floor. The quality of this ground water will be relatively good because it typically will not contact the pyrite halo. The lower the water level that is maintained in the pit, the further from the center of the pit the zone of capture will extend.

4) Water that discharges into the pit will be pumped out. The rate of pumping will be highest for a nearly dry pit and will decrease as the height to which the pit is allowed to flood increases. The lower the water level that is maintained in the pit, the greater the thickness of the pyrite halo that will be exposed above the water table in the bedrock surrounding the pit.

5) Water flows in many of the underground workings surrounding the pit. The majority of underground workings are located outside of the pyrite halo, but some are within the pyrite halo. Water in unflooded workings within the pyrite halo may become poor quality ARD similar to flows described in 3c. Water quality in flooded workings within the pyrite halo may be intermediate in quality between 3c and 3d, and water in workings outside the pyrite halo may be similar to that described in 3e.

5a) Some underground workings drain groundwater into the open pit. If not captured, this water contributes to infiltration and runoff within the pit (flows 2, 3c and 3d). This water may be similar in quality to the flows described in 3c or 3d.

5b) Some underground workings gravity drain groundwater away from the open pit. This water discharges at tunnel portals in Butterfield Canyon and along the east and west side of the Oquirrh Mountains. This water may be similar in quality to flows described in 3d or 3e.

5c) Some underground workings are currently dewatered by pumping and could continue to be dewatered after closure. If not captured, much of this water would contribute to flow 3c or 3d and would need to be removed from the pit (flow 4).

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6) If a pit lake is allowed to form in the bottom of the pit, water will be added directly to the lake by precipitation. Water will be removed from the lake by evaporation from the water surface. In this geographical area, evaporation exceeds precipitation on an average annual basis, so this will ultimately reduce the amount of water that must be removed from the pit, but will also increase the concentration of dissolved constituents in the pit lake. The surface area of any lake that is allowed to form in the pit increases with increasing water depth, so the evaporative losses are likely to increase with an increasing depth of flooding.

7) If a pit lake is allowed to form, sulfide oxidation reactions will be inhibited by the lack of oxygen in the surrounding wall rock that is fully and permanently saturated, but neutralization reactions between the lake water and the small percentage of carbonate minerals in the wall rock will continue. Wall rock interactions, water mixing, the potential addition of neutralizing agents and biological activity may cause the precipitation and settling of some metals and other dissolved constituents. These chemical sediments will accumulate on the pit floor along with detrital sediments. Older sediments will become isolated from significant pit water contact by overlying younger sediments, but under certain circumstances, materials may also be redissolved from the upper portion of the sediment column.

The chemistry of water that collects in and is removed from the bottom of the pit will be determined by a complex interaction of each of the flow paths and chemical reactions described above. However, the long-term average water quality in the pit may be roughly similar to water that is currently removed from the pit floor or that collected in the pit during the shutdown of the mid-1980s. A small number of the samples collected from pit dewatering flows in 2000 through 2002 had the following average characteristics: pH – 6.9, alkalinity – 100 mg/L, total dissolved solids (TDS) – 2600 mg/L, sulfate – 1700 mg/L, copper – 2 mg/L, manganese – 0.9 mg/L and zinc – 0.8 mg/L. Iron, aluminum and nickel averaged less than 0.1 mg/L, and arsenic, cadmium, chromium, selenium and silver all averaged less than 0.01 mg/L. A limited amount of data is also available from a lake that formed in the bottom of the pit during the shutdown in the mid 1980s. The pit floor during the shutdown was at an elevation of 5168 feet and so was likely at the base of the net acid-generating portion of the ore body and pyrite halo. The pit lake existed for three years and reached a maximum depth of about 50 feet. The lake was pumped periodically throughout the period and never contained more than about 650 acre-feet of water. Typical values for this pit water were: pH - 6.0, total dissolved solids (TDS) - 2500 mg/L, sulfate - 1500 mg/L, copper - 10 mg/L and cadmium - 30 ug/L. Water that will be removed from the pit may not meet water quality standards acceptable for irrigation, drinking water or discharge to surface water without treatment. At closure, when this water is no longer used in the process water circuit, it may have to undergo some form of treatment for pH, TDS, sulfate, copper and trace metals before it can be released from the property (Section 10.0).

3.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the mine area at closure:

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- pit sides will be stabilized at a slope of 30 to 50 degrees from horizontal

- it is unlikely that the pit will be revegetated because most of the exposed surface will be solid rock containing natural sulfide mineralization

- surface facilities including buildings, railroad tracks, power lines and poles and equipment will be removed.

The primary closure issues at the pit are driven by the need to ensure long-term groundwater and surface water quality protection. The most significant water management issues are:

- ensuring that contaminated water does not escape from the pit into the surrounding groundwater system

- managing water movements in and around the pit to minimize water quality degradation

- ensuring that any surface water discharges from the pit meet applicable water quality criteria

- minimizing the impacts of pit dewatering on surrounding aquifer recharge and water levels

- minimizing ecological risks posed by water that may accumulate in the pit.

The mine has also been placed on the National Historic Register. This may require that public access be permanently maintained to some point within or adjacent to the pit. However, safety considerations around steep and potentially unstable areas on the pit walls will require the public be excluded from most of the mine area.

3.2 POSSIBLE POST-CLOSURE LAND USE

Based upon the requirement for long-term water management in and around the mine, and the public safety issues associated with steep and potentially unstable areas on the pit walls, post-mining land uses will, by necessity, be limited.

Whatever final closure scenario is ultimately selected, the entire open pit will have to be a water management facility with limited public access. Parts of the pit where vegetation can become established will also become wildlife habitat, and selected areas of the pit may be established as public access points to the National Historic Site.

3.3 DATA REQUIREMENTS

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In order to select a final closure scenario the following data requirements will have to be addressed:

- final geometry of the ultimate pit
- acid/base accounting geochemistry of ultimate pit walls
- hydrogeology of the post-closure pit
- geochemistry of water extracted from a largely dry pit or a partially flooded pit, in particular how lake and outflow water chemistry would vary with pit flooding level

Unfortunately, many of these data requirements cannot be addressed until the mine is nearing the end of its life and the geometry and geochemical characteristics of the ultimate pit can be predicted with more certainty.

3.4 RECLAMATION ACTIVITIES

Tentative reclamation activities have been selected based upon the existing incomplete data set and on the assumption that the current mine plan adequately predicts the ultimate geometry of the pit. These tentative plans will be refined as the data gaps identified in Section 3.3 are filled.

All surface facilities including buildings, railroad tracks, most power lines and equipment will be removed from the mine area at closure except for those with a confirmed post-mining use. Demolition of these facilities will be conducted as described in Section 2.3 and reclamation of the underlying footprints will vary depending on the geochemistry of the underlying bedrock (See Sections 3.4.1 through 3.4.4 for details). The only facilities that may be left in place are those related to long-term water management or directly related to public access to the National Historic Site. These facilities may include water pipes, tanks, pump houses, some repair shops, offices, access roads, some power lines and the Visitors Center. Public access to most of the pit will be limited with a combination of engineering and institutional controls. Shaft, adit and tunnel portals within the pit area will be sealed or gated. Roads will be blocked off, and fences and signs will be erected.

Water levels in the pit will be maintained below 4900 feet amsl. Depending upon the final geometry of the ultimate pit floor, water will either be present in 1) a collection pool at the very bottom of the pit, 2) a series of collection pools at various elevations between the bottom of the pit and 4900 feet amsl, or 3) a single lake in the bottom of the pit with a surface elevation of less than 4900 feet amsl. This elevation insures that pooled water is below the pyrite halo on the pit walls. As discussed earlier in this section and as illustrated on Figure 3-7, even at the maximum filling elevation of 4900 feet, there would be more than 500 feet of head driving water flow towards the pit from all sides, insuring that radial flow into the pit is maintained. In reality this value likely underestimates the gradient driving radial flow towards the pit, because water levels will also recover in the down-gradient bedrock if the pit were allowed to partially fill, increasing

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the calculated head difference. The 4900 ft elevation is also more than 1000 feet below the bedrock and topographic low where Bingham Canyon intersects the pit, about 2000 feet below the bedrock ridge line that separates the pit from Jordan Valley to the east, and about 4000 feet below the bedrock ridge line that separates the pit from Tooele Valley to the west.

If a pit lake is allowed to form, lime or another neutralizing agent will be added if required, in order to maintain a circumneutral pH and minimize metals solubility during flooding. If neutralizing agents are used, they will be added in a manner that assures appropriate mixing. Other options that will also be considered to maximize pit water quality will be the addition of organic matter and the active promotion of biological activity (Castro and Moore, 2000). To maintain water levels below 4900 feet amsl, water will have to be removed from the pit in perpetuity. Water will be pumped from the collection pond(s) or lake surface to the 5490 tunnel and then will be piped to lower Bingham Canyon. If the Elton Tunnel is ever rehabilitated and connected to the open pit, it could also potentially be used to transmit water out of the pit. In order to reduce pit inflows, some water may also be removed in perpetuity from underground workings that surround the pit. This water has a circumneutral pH, but a water treatment facility may be required to treat these outflows to acceptable levels for discharge or sale (Section 10.0).

In order to minimize water quality degradation in and around the pit, and to improve the quality of water that collects in the bottom of the pit, the following activities will also be completed prior to or at closure. These activities are generally designed to minimize water contact with the waste rock disposal areas surrounding the pit and with the pyrite halo in the vadose zone.

3.4.1 Adjacent Waste Rock Disposal Areas

In order to limit infiltration into waste rock surfaces surrounding the open pit (flow 3a on Figure 3-8), most waste rock surfaces will be recontoured to reduce pooling and selected surfaces will also be revegetated to maximize evapotranspiration (Section 4.0). In order to minimize flows from the surrounding unimpacted mountainsides to the waste rock disposal areas (flows 2 and 3b on Figure 3-8), water collection systems will be placed up gradient in drainages that have significant surface or shallow groundwater flow (Section 10.0). These collection systems may include surface impoundments, horizontal drains, collection sumps and shallow groundwater extraction wells. These flows are likely of drinking water quality and will be piped out of the mine area for use or sale.

3.4.2 Pit Benches above the Pyrite Halo

In order to minimize infiltration and runoff (flows 2, 3c and 3d on Figure 3-8), vegetation establishment will be encouraged on pit benches that are above the pyrite halo. These are generally areas that have an NNP that is greater than zero on Figure 3-4 (typically above 6600 feet amsl). Most pit benches are not safely accessible, but benches that are safely accessible with a dozer will be ripped. This will generally limit the ripping to haul and support roads that do not have a post-closure use. Ripped areas will be seeded and seed will also be broadcast onto pit benches that do not have a nearby seed source. Where practicable, surface flows that occur above the pyrite halo from seeps, springs, horizontal drains, tunnel and adit portals and runoff

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will be captured on the upper benches of the pit and either piped out of the pit or piped to the bottom of the pit so that the water does not contact the pyrite halo (Section 10.0).

3.4.3 Pit Benches within the Pyrite Halo

No revegetation efforts are possible within the pyrite halo because the soils forming on roads and benches will generally be acidic and have high salinity. These are generally areas that have an NNP that is less than zero on Figure 3-4 (typically between 5200 and 6600 feet amsl). In order to minimize infiltration (flow 3c on Figure 3-8) runoff will be encouraged. All roads will be left in a compacted condition. Where practicable, surface flows that occur within the pyrite halo from seeps, springs, horizontal drains, tunnel and adit portals and runoff will be captured and either piped out of the pit or piped to the bottom of the pit so that the water does not infiltrate through the pyrite halo (Section 10.0).

3.4.4 Pit Benches Below the Pyrite Halo

Depending upon the final closure scenario that is selected, much of this area may be flooded. However, in order to minimize infiltration and runoff, vegetation establishment will be encouraged on selected pit benches that are below the pyrite halo. These are generally areas that have an NNP that is greater than zero on Figure 3-4 (typically below 5200 feet amsl). Most pit benches are not safely accessible, so no reclamation work will be completed on the benches. However, seed will be broadcast onto pit benches that do not have a nearby seed source. Road surfaces that are not needed after closure will be also be ripped and broadcast seeded

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4.0 MINE WASTE DISPOSAL AREA

The mine waste rock disposal area currently covers about 5100 unreclaimed acres and contains approximately 4 billion tons of material. An additional 410 acres at the foot of the Eastside disposal areas have already been reclaimed. About 250 acres surrounding the disposal areas are being used to manage leach water drain-down and meteoric water flows (ARD) that have contacted the waste rock. A list of the support facilities associated with the disposal areas and water management systems is provided in Table 2-1. The large angle-of-repose (35 to 37 degrees) slopes on the eastern margins of the waste disposal areas are the most prominent visual features from the Salt Lake Valley, but they actually cover less than 15 percent of the total disturbed area. The highest inactive slope is 1200 feet high, but currently no active slopes are higher than 500 feet. Most of the disposal area is composed of flat to slightly irregular waste rock surfaces and angle of repose slopes that are less than 150 feet tall.

Future mine plans call for the placement of nearly one billion additional tons of waste rock before mine closure. The majority of this material will be placed in Bingham Canyon or in lifts on top of existing disposal areas. In some areas waste rock will have to be placed on previously unimpacted ground, so the total area impacted by disposal activities may increase by approximately 200 acres before closure. The additional disturbed acreage will be within the boundaries of DOGM permit number M/035/002 and will not exceed the 8000 acre area allocated for waste rock disposal in the 1978 Mining and Reclamation Plan. The impacted acreage could also increase during reclamation activities when angle of repose slopes are reduced, thereby increasing the waste rock footprint in some areas.

Mine waste is composed of a mixture of intrusive rocks, quartzite, limestone and limestone skarn. Except for copper, average total metals concentrations are relatively low, as illustrated from a 66-sample average for the following elements: arsenic 31 mg/kg, barium 70 mg/kg, cadmium 2.0 mg/kg, chromium 55 mg/kg, copper 809 mg/kg, lead 380 mg/kg, selenium 2.6 mg/kg and zinc 311 mg/kg. The average sulfide concentration, predominantly pyrite, in unweathered waste rock from the pit is about three percent, but sulfides are generally less abundant in waste rock exposed on the surface of the disposal areas. The pyrite begins to oxidize immediately after the waste rock is placed, causing a decline in sulfide abundance and a release of sulfate, iron and acidity. Soils forming on the waste rock surface have paste pH values between 2 and 8; and paste conductivities, a measure of soil salinity, of between 20 and 9000 umhos/cm. Figure 4-1 is a map of the waste rock disposal areas showing the distribution of soil pH and salinity characteristics. The primary controls on soil pH are the percentage of sulfides in the waste rock, the percentage of limestone in the waste rock and the age of the waste rock surface on which the soil is forming. The primary controls on soil conductivity are the percentage of sulfides in the rock and the age of the waste rock surface. In general, the older the waste rock surface, the lower the pH, the lower the conductivity, and the fewer sulfide minerals that are present. On the oldest surfaces with little intact pyrite, flushing of the soil by precipitation will eventually create a soil with a pH above 5 and low salinity. The geochemistry of the waste rock soils is described in detail in the paper "Geochemical evolution of sulphide-bearing waste rock soils at the Bingham Canyon Mine, Utah (Borden 2001). This paper is attached in Appendix E.

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Volunteer vegetation is becoming established on almost all dump surfaces that have favorable soil chemistry. Botanical surveys were conducted on the waste rock disposal areas in 1999, 2001 and 2002. One hundred sites with various soil pH and salinity conditions were visited during these surveys and species counts and estimates of total vegetation cover were made at each site. Waste rock surfaces where any historic reclamation activities had occurred were excluded from the survey. The percent gravel (percent not passing a 2 mm sieve) and the compaction (blows with a four pound hammer to drive a one half inch diameter rebar eight inches) at most of the sites were also measured. As shown on Figures 4-2 through 4-5, vegetation has become established on most sites with soil pH above 4.0 and with conductivity below 1000 umhos/cm. Below a pH of 6, nitrogen and phosphorus availability begins to decline in most soils, and below a pH of 5 the toxicity of soluble aluminum and manganese also becomes significant in most soils and will inhibit plant growth (Tucker et al. 1987). Volunteer vegetation density and diversity is highest on surfaces that have a soil pH above 5 and a conductivity of less than 500 umhos/cm. The volunteer vegetation cover for the 31 survey sites with a pH above 5 and conductivity below 500 umhos/cm varied between 0% and 98% and averages 29%. The number of species observed at the sites varies between 0 and 26 and averages 12. Waste rock surfaces that had favorable soil chemistry but which do not support abundant vegetation generally have clear physical barriers to plant establishment. These physical barriers include strongly compacted surfaces, steep slopes with surface creep or lack of fine-grained material on the waste rock surface. Correlation coefficients and the square of the correlation coefficients (R^2 values) were calculated to illustrate the relationship between each of these variables and vegetation cover and species occurrence. A positive correlation coefficient indicates that the two variables are positively related (an increase in one leads to an increase in the other). A negative correlation indicates that the two variables are inversely related. Both the correlation coefficient and the R^2 value vary between 0 and 1. A value of 0 indicates that there is no relationship between the variables and a value of 1 indicates that there is a perfect correlation. The R^2 value can be interpreted as the proportion of the variance in one variable that is attributable to the variance in the other variable. For flat surfaces with favorable chemistry, the correlation coefficient between vegetation cover and the degree of compaction is –0.40 (r^2=0.16) and between diversity and compaction it is –0.41 (r^2=0.17). Generally, end dumped or deeply ripped surfaces do not exhibit any negative impacts due to compaction. For relatively low compaction surfaces with favorable chemistry, the correlation coefficient between cover and slope angle is -0.35 (r^2=0.12), and between diversity and slope angle is -0.43 (r^2=0.18). On average, angle of repose slopes have about 2/3 as much cover as comparable flat surfaces. There is no significant correlation between vegetation cover, diversity and the percent gravel comprising the waste rock surface (r^2=<0.01 and r^2=0.04 respectively) but at gravel concentrations above about 90%, most surfaces support little or no vegetation.

For the nine waste rock survey sites that had no significant physical or chemical barriers (flat, ended dumped or ripped surfaces with gravel <90%, pH > 5 and conductivity < 500 umhos/cm), the percent vegetation cover varied from 20% to 98% and averaged 47% with a 95% confidence interval of 16%. The number of species observed at each site varied between 9 and 22 and averaged 15 with a 95% confidence interval of 3. These surfaces vary between 15 and 40 years old and average 25 years old.

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The paste conductivity test used to measure the salinity of the waste rock soils involved mixing the soil with an equal weight of distilled water (1:1 mix) and measuring the conductivity of the decanted liquid. Most agricultural assessments of plant salt tolerance are performed on a saturation extract from the soil. To perform the saturation extract test, distilled water is mixed into the soil sample only until it is saturated, then the water is vacuum extracted from the paste. In order to compare the conductivity results derived by the two tests, sub-samples were collected from 22 homogenized samples and analyzed by both methods. The test results indicate that for the same sample, the saturation extract method yields conductivity values that are approximately 1.9 times higher than the 1:1 extract method. The r^2 value for the two methods was 0.96. If the conductivity values presented in this study are increased by 1.9, it indicates that salinity appears to limit plant growth in the range of 1000 to 1500 umhos/cm. This is consistent with the conductivity tolerance cited by Mass (1990) for salt sensitive crops. According to Mass (1990) salt sensitive species begin to exhibit decreased yield at 1200 umhos/cm.

Table 4-1 lists the most common species observed volunteering on the 31 waste rock surfaces with favorable surface chemistry. For waste rock soils with pH above 5 and conductivity below 500 umhos/cm, almost all of the cover is provided by native, non-weedy species. However, for soils with lower pH and higher salinity, much of the thin vegetation cover that is present is provided by noxious weed species. The waste rock surfaces where soil chemistry is favorable for the establishment of native vegetation cover about 700 acres. There are approximately 200 additional acres where the soil pH is low, but which have very low salinity and very few intact sulfides. These sites are considered marginally favorable for vegetation establishment. This combined 900-acre area is shown in green on Figure 4-1. These surfaces are generally located on the south and southeast sides of the pit, and at higher elevations on the Eastside disposal area. Most of these sites are located above 6800 feet above sea level and are ten to more than fifty years old. Waste rock that was deposited in these areas was generally mined from higher, less mineralized and more weathered benches in the pit.

Groundwater and precipitation that contacts the waste rock generally becomes acidified (becoming ARD). For approximately 50 years, acidic leach water was also continuously recirculated between the Precipitation Plant and the waste rock disposal areas in order to recover copper. However, in 1999 leach water application rates began to be reduced and all leach water applications were terminated in September 2000. Between 1999 and the end of 2002, flows from the base of the disposal areas in Bingham Canyon and on the east side of the Oquirrh Mountains have decreased from more than 25,000 gpm to less than 2000 gpm. Meteoric water that contacts the waste rock and leach water drain-down either reports to the Bingham Pit or is captured by the Eastside Collection System (ECS), a series of State-permitted cutoff walls, sumps, drains, basins and pipes at the foot of the waste rock disposal areas. The ECS captures ARD that discharges from the toe of the Eastside waste rock disposal areas and that flows in the alluvium in Bingham Canyon and other drainages. Most of these flows are perched, and in only a few drainages do the cutoff walls intersect the regional water table. Recent studies have confirmed that the large majority of water that infiltrates into the Eastside waste rock disposal areas perches at the bedrock/waste rock contact and then discharges at the toe of the disposal area slope where it is captured by the ECS (Solomon et. al., 2001). A detailed conceptual model of ARD movement in the vicinity of the Eastside waste rock disposal areas is provided in a report by Borden (2002).

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Waste rock contact flows are currently routed to the concentrator process water circuit. During peak runoff periods, excess water is temporarily stored in the Large Bingham Reservoir. Anticipated post-closure flows associated with the waste rock disposal areas are discussed in Section 10.0.

Erosional events and failures have occurred on various waste rock slopes in the past. Since the termination of active dumping on the high slopes facing the Salt Lake Valley in 1984 the frequency and magnitude of slope failures have decreased significantly. However, several shallow surface slumps and debris flows have occurred in the past decade. Precipitation greater than the 25-year, 24-hour storm event (the minimum system requirements specified by the storm water regulations) that falls on the slopes has also exceed the capacity of some down gradient storm water and sediment collection systems in tributary drainages to Butterfield Creek. North of the Butterfield Creek tributary drainages, the Eastside Collection System was designed to handle leach water base flows plus the 10-year, 24-hour storm event. With the termination of leach water applications, base flows in this area have declined from greater than 25,000 gpm to less than 1000 gpm, so the collection system is likely able to handle flows that are greatly in excess of the 25-year, 24 hour storm event. Erosional events may also fill the sedimentation basins of the water collection systems with sediment, increasing the frequency and cost of maintenance. In the past decade these events have most commonly occurred on the waste rock disposal areas above Butterfield Creek on the southeast side of the pit. In only two cases has contaminated sediment or water escaped the property since the ECS was upgraded between 1993 and 1996. Both events occurred in tributary drainages to Butterfield Creek and corrective actions were taken to minimize the risk of future releases in these areas.

4.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the mine waste disposal area at closure:

- all dumps will be left in a safe and stable condition
- collection systems will be provided to contain natural seepage in the area
- dikes and ponds will be constructed on the upper levels of the dumps to prevent slope wash and possible mud slides
- no major revegetation is planned because the majority of the waste material contains natural sulfide mineralization
- if and when revegetation practices or methods are developed which would make vegetation economically practicable, such practices and methods will be employed on the dumps

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- when no longer needed in mining, mineral extraction or subsequent operations, surface facilities including buildings, above ground utilities, railroads, piping and equipment will be removed.

Current permits and regulations require KUCC to control contact water flows from the waste rock disposal areas in order to protect surface and groundwater quality. The goal of these regulations is to prevent any unpermitted discharge of contaminated water or sediment from the property. Groundwater Discharge Permit number UGW350010 also requires that KUCC take steps to minimize the infiltration of meteoric water into the waste rock. After closure, KUCC will continue to maintain the existing groundwater and surface water collection systems at the foot of the disposal areas to comply with all applicable requirements. In order to ensure compliance after closure in the most cost effective manner, the following goals must be considered during closure planning:

- ensure that catastrophic events cannot compromise the water collection systems and transport contaminated water and sediment off KUCC property

- reduce long-term ARD generation from the disposal areas to minimize the risk of down gradient groundwater contamination and long-term water handling and treatment costs

- minimize the loading of sediment and debris from the disposal areas to reduce long-term maintenance costs for the water collection systems.

4.2 POSSIBLE POST-CLOSURE LAND USE

Based upon the requirement for long-term water management on and around the waste rock disposal areas, the acidic nature of the waste rock, and the public safety issues associated with steep slopes, post-mining land uses in these areas will, by necessity, be limited.

Whatever final closure scenario is ultimately selected, most of the waste rock disposal areas will likely be operated as a water management facility with limited public access. Those parts of the disposal area that are revegetated will also become wildlife habitat.

4.3 DATA REQUIREMENTS

In order to identify the final reclamation options for each portion of the waste rock disposal area, the following data requirements will have to be filled:

- final geometry of the waste rock disposal areas, in particular the location and soil chemistry characteristics of future waste rock piles

- base ARD flows from various parts of the disposal area

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- relative effects of each reclamation technique on infiltration and runoff

Many of these data requirements are being addressed by ongoing reclamation programs on the waste rock disposal areas and by the operation of pilot-scale water treatment facilities. The final geometry and geochemistry of the waste rock surface cannot be determined until waste rock disposal and recontouring has been completed.

4.4 RECLAMATION ACTIVITIES

Tentative reclamation activities have been selected based upon the existing incomplete data set and on the assumption that the current mine plan adequately predicts the final geometry of the waste rock disposal area. Figure 4-6 is a map of the waste rock disposal area showing the reclamation activities that are currently planned. The actual acreage and boundaries of the various reclamation treatments may be modified in response to changes in the mine plan or other new information as it becomes available. Long-term water management plans on and adjacent to the waste rock disposal area are described in Section 10.0.

All surface debris, utilities and facilities without a post-closure use will be removed from the entire waste rock disposal area at closure. Reclamation of these facilities will be as described in Section 2.3. Based upon current assumption of post-mining use, the only facilities that may be left in place within the waste rock disposal area will be those related to long-term water management such as the Large and Small Bingham Reservoirs, cutoff walls, sumps, drains, settling ponds, monitoring wells, utilities, selected roads and associated pipes and lined ditches. Public access will be controlled with a combination of engineering and institutional controls. Roads below the waste rock dumps without a post-mining use will be recontoured, ripped and seeded. These roads will also be blocked off if appropriate, and fences and signs will be erected. Additional reclamation activities planned for selected portions of the waste rock dumps are described in the following sections.

4.4.1 Completed Reclamation Activities

Reclamation work has already been completed on about 410 acres of the waste rock disposal area. The sites that have been reclaimed are located on the northeast portion of the disposal area and in drainages along the eastern edge of the disposal area (Figure 4-6). It should be noted that this acreage estimate only includes areas that were directly impacted by Bingham Canyon Mine waste rock disposal. It does not include several hundred additional acres that have also been reclaimed within the DOGM permit boundaries, but that were impacted by historic leach water contact or by other historic mining operations unrelated to open pit mining at Bingham Canyon. Most of these areas are in drainages located between the foot of the Eastside waste rock disposal area and Highway 111.

Waste rock has been removed from about 80 acres within drainages below the Eastside disposal area (Figure 4-6). Some of this waste rock was transported into the drainages by erosion caused by the historic leaching operations and some was intentionally placed in the drainages to create

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dams and settling ponds for the historic leach collection system. All of this waste rock was moved back to the foot of the waste rock disposal areas and the drainage surfaces were recontoured, had topsoil applied if needed and were seeded.

About 330 acres on the northeast margin of the Eastside disposal area were recontoured, capped and revegetated. The angle of repose slopes were reduced to slopes of 2.5:1 or less and between 18 and 48 inches of growth media were placed on top of the waste rock before the surfaces were revegetated.

4.4.2 Areas to be Recontoured and Revegetated

Approximately 900 acres of the waste rock surface are currently planned to be recontoured and revegetated. Most of the areas that are intended to be revegetated are located above 6800 feet on the southwest, south and east sides of the pit (Figure 4-6). Almost all of these sites are underlain by waste rock soils that will support vegetation after relatively minor soil modification. The waste rock soils in these areas contain very few intact sulfide minerals, generally have conductivity values that are less than 500 umhos/cm and have pH values between 2.5 and 8.

The anticipated benefits of the recontouring and revegetation activities will be:

- To reduce infiltration into these waste rock surfaces by enhancing evapotranspiration. This will reduce the amount of waste rock contact water that must be collected and treated at the toe of the disposal area and that may reach the regional water table (Section 10.0).

- To provide wildlife habitat.

- To provide a native seed source for surrounding waste rock surfaces that currently cannot support vegetation but that may be able to after additional weathering.

- To enhance slope stability and limit erosion.

- To create a surface that resembles the surrounding natural landforms.

Most angle of repose slopes will be reduced to 2.5:1 or less and will be cross-ripped. On flat or gently sloping surfaces, depressions will be filled, end dump piles will be smoothed out and most areas will be deeply ripped. This ripping will loosen compacted surfaces, will limit erosion potential on slopes, will bring fine material to the surface and will create microhabitats to encourage plant establishment. Studies at other mines have indicated that truck-induced compaction declines dramatically within the first two feet below the waste rock surface, so ripping will extend to a depth of at least two feet (Uhrie and Koons, 2001). Surfaces will be recontoured to minimize the transport of runoff from large relatively flat surfaces to adjacent slopes. Wherever possible, native mature volunteer vegetation on the dump surface will be left undisturbed during these recontouring and ripping activities. This will enhance surface stability and will supply a native seed source to the surrounding recontoured waste rock surface. The

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recontouring will also be designed to limit the amount of previously unimpacted land that is disturbed. Many of these waste rock disposal surfaces surround small islands of native hillside that can also provide a valuable seed and mycorrhizae source to the surrounding waste rock surface. In some locations angle of repose slopes will be left in place if they already support native vegetation or if the recontouring will cover important unimpacted areas below them. It is anticipated that the recontouring and ripping will remove most physical barriers to vegetation establishment except for the relatively small percentage of the surfaces that are underlain by very coarse gravel (sites where >90% of the soil is composed of gravel).

The pH of acidic surfaces will be raised above 6 by the addition of crushed limestone or another neutralizing agent that does not inhibit plant growth. Because there are few intact acid-generating sulfides in the waste rock, these surfaces will not reacidify once the pH has been raised. This technique has been successfully used for direct planting of weathered acidic waste rock and soil surfaces at many other mine and smelter sites (Winterhalder 1988; Nawrot et. al. 1988). Depending on the initial soil chemistry at each site, anywhere from 0 to 10 tons/acre of crushed limestone or equivalent will be applied to the surface. In general, no limestone will be added to surfaces that already have a pH above 6.5. Surfaces with a pH of less than 4 will receive a minimum of 5 to 10 tons/acre of limestone, surfaces with pH values of 4 to 5 will receive a minimum of 3 to 5 tons/acre of limestone, and surfaces with a pH of 5 to 6.5 will receive a minimum of 0.5 to 3 tons/acre of limestone. The actual application rate will be dependent upon the average pH, the soil salinity and the amount of intact sulfides that are present. Generally, within each pH range, if the paste conductivity is above 500 umhos/cm the higher application rate will be used and if the conductivity is below 100 umhos/cm the lower rate will be used. If field assessments indicate it is required, all the surfaces will also receive a light application of chemical fertilizer to provide nitrogen, phosphorus and potassium (not to exceed 50 lbs/acre available nitrogen) or may receive biosolids at application rates not to exceed 10 tons/acre of pure biosolids. If biosolids have been mixed with wood chips or another carbon source, the application rate of the mixture may be as high as 30 dry tons/acre, as long as the biosolids component of the mixture does not exceed 10 dry tons/acre. In general, phosphorus application rates will be higher than nitrogen application rates, which will be higher than potassium application rates. Studies at Bingham Canyon and elsewhere indicate that over-fertilization with nitrogen in biosolids or chemical fertilizers promotes the establishment of weedy species and inhibits species succession (Black and Borden 2002; McLendon and Redente 1992). The study that was conducted at Bingham Canyon is summarized in the attached paper (Appendix F).

A seed mix that is predominantly composed of native grasses, forbs, shrubs and trees will be broadcast or drill seeded onto the surface. The seed mixes that are used will largely be composed of native species that are already volunteering onto the waste rock surface or closely related species (Table 4-1). However, the exact composition of the seed mixes will vary depending on elevation and slope aspect of the surface to be seeded, and on species availability and assessments of earlier revegetation efforts. For sites with elevations below about 6500 feet, the seed mix may be altered significantly from the species listed in Table 4-1. For instance, Douglas fir, Bigtooth maple and Aspen may not be appropriate for most low elevation sites. Conversely, other species that are not listed on Table such as Western wheatgrass, Slender wheatgrass and

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Fourwing saltbush have been very successful on reclaimed sites at lower elevations on the waste rock disposal areas (Black and Borden, 2002).

Most of these reclamation activities will occur between the present and mine closure.

4.4.3 Areas to be Recontoured

Approximately 3200 acres of the waste rock surface are currently planned to be recontoured without revegetation. This area includes flat and irregular surfaces as well as angle of repose slopes that are less than 150 feet high (Figure 4-6). These areas will not be revegetated because they currently contain abundant unweathered sulfides, have elevated soil salinity and generally have low pH. If limestone were applied to neutralize the acidity in these areas, continued sulfide oxidation would cause most surfaces to reacidify (Doolittle and Hossner 1997). Even if the surface pH could be maintained at near neutral, the salinity of these soils would prevent native vegetation establishment because they will continue to contain abundant gypsum precipitated during the in situ neutralization of acid generated from the oxidizing sulfides (Borden 2001). Water in contact with gypsum will maintain a conductivity of approximately 2000 umhos/cm, well above the salinity tolerance of most native species growing on the waste rock surfaces and in the surrounding mountains (Figures 4-4 and 4-5) (Richards 1954; Wali 1999).

The anticipated benefits of the recontouring activities will be:

- To reduce infiltration into these waste rock surfaces by reducing pooling on the surface. This will reduce the amount of waste rock contact water that must be collected and treated at the toe of the disposal area and that may reach the regional water table (Section 10.0).

- To create a surface that resembles the surrounding natural landforms.

- To remove physical barriers to vegetation establishment such as steep slopes with surface creep and compacted surfaces. Continued weathering and sulfide oxidation on these surfaces will eventually create soils that are geochemically favorable to native vegetation establishment.

- To enhance slope stability.

Most angle of repose slopes that are less than 150 feet tall will be reduced to 2.5:1 or less, depressions in the surface will be filled and end dump piles will be smoothed out. Surfaces will be recontoured to minimize the transport of runoff from large relatively flat surfaces to adjacent slopes. Neutralizing agents such as cement kiln dust, waste lime or waste limestone may be applied to selected surfaces if they become available in the future and if they can be placed economically. Some relatively short angle of repose slopes may be left in place if the slope reduction would cover important facilities or previously unimpacted land. Slopes will be cross-ripped to minimize surface flow and potential erosion. These areas will generally be recontoured between the termination of waste rock production and one to two years after mine closure.

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It is anticipated that in the future, continued weathering on these waste rock surfaces will create additional waste rock soils that may be revegetated by direct planting (Borden 2001). After closure and after all recountering has been completed, a follow-up soil chemistry survey will be performed on this portion of the waste rock surface. Large, contiguous areas that contain few intact sulfides and that have soil paste conductivity values below 500 umhos/cm will be revegetated in the same manner as described in Section 4.4.3. This will include ripping or re-ripping most surfaces followed by limestone, fertilizer and seed application.

4.4.4 Areas to Undergo Slope Stabilization Study

A slope stabilization study is being performed on approximately 200 acres located on the southeast margin of the waste rock disposal areas (Figure 4-6). This area covers the angle of repose slopes that are located at the upper end of six dry tributary drainages to Butterfield Creek, a perennial stream. The individual drainages are listed along with selected physical characteristics on Table 4-2. The maximum height of the angle of repose slopes in these drainages ranges from approximately 700 to 900 feet and they are all less than a mile from Butterfield Creek. A preliminary assessment of these areas indicates that they have the greatest potential of any slopes to release contaminated sediment and contact water from the property. All six of the drainages are well-defined, narrow channels with generally thin alluvial deposits and relatively steep gradients. The gradients vary between 650 feet/mile and 990 feet/mile from the toe of the waste rock angle of repose slope to the drainage intersection with Butterfield Creek. Since the Eastside Collection System at the foot of the Eastside disposal area was upgraded between 1993 and 1996, there have only been two incidents in which contaminated sediment or water have escaped the property. These incidents occurred in the Olsen and Castro drainages at the southern end of the 200-acre area. Sediments deposited down gradient during these incidents were cleaned up and returned to the waste rock disposal area.

The slope stabilization study will involve a detailed assessment of the risk of contaminated water and sediment release in each drainage. An assessment of long-term maintenance costs in each drainage with and without slope stabilization will also be made. The study also will involve an engineering assessment of the cost and efficacy of various slope stabilization methods in each drainage. The study is planned for completion in the next two years and slope stabilization plans for each drainage will be created. It is possible that the angle of repose slopes in the Olsen, Butterfield, Castro, South Saints Rest and Saints Rest drainages will need to be reduced, capped with a growth media and revegetated unless another suitable stabilization alternative can be identified. Waste rock with favorable physical and chemical characteristics may be used as a growth media if available in sufficient quantities (pH > 6.5, conductivity < 500 umhos/cm, % gravel < 85%). The requirements for the slopes within the Yosemite drainage cannot be identified until the assessment is completed. This drainage generally poses a lesser risk of contaminant release because it has a lower gradient and has a longer travel distance to reach Butterfield Creek than the other drainages (Table 4-2).

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4.4.5 Areas to be Recontoured, Capped and Revegetated

The extension of waste rock disposal operations into lower Bingham Canyon will allow a stair-stepped outer dump face to be created that will be reclaimed (Figure 4-6). The reclaimed face will be about 850 feet high and will cover approximately 140 acres. It will tie into native ridges on either side of the canyon and will be recontoured to a maximum slope of 2.75:1. The slope will have 15-foot wide benches every 150 vertical feet. These benches will slope approximately two degrees towards the north or south edge of the dump face. The soils forming on the waste rock surface will likely be acidic and/or saline, so the outer face will be capped with an average of two feet of growth media. The thickness of the growth media will be varied so that approximately 30 % of the face will be capped with up to three feet of material and about 70% will be capped with 18 inches of material. The outer dump face will be cross-ripped or otherwise roughened before placement of the growth media. At least a portion of the cap material will likely come from the growth media stockpile on the 5900 ft level of the waste rock dumps about 3000 feet south of Bingham Canyon (approximate mine coordinates N3500, E13800 and N1500, E13500). The areas with a thick cap will be able to support some trees and woody shrubs, but grasses and forbs will likely dominate the areas with a thinner cap. This will create a natural mosaic of plant communities on the outer face. The face will again be cross-ripped or pitted after the placement of the cap and before it is seeded. Cross ripping will be shallow enough to avoid mixing waste rock into the cap material. The 140-acre outer dump face will be seeded with the seed mix listed in Table 4-3. In addition to seed application, Gambel oak and Curl leaf mountain mahogany seedlings will be planted at a rate of 40 plants/acre each (80 seedlings/acre total) on the three-foot thick portions of the cap. The three-foot cap areas will also receive 0.05 lbs/acre of Curl leaf mountain mahogany seed. If field assessments indicate it is required, the capped surface will receive a light application of chemical fertilizer to provide nitrogen, phosphorus and potassium (not to exceed 50 lbs/acre available nitrogen) or may receive biosolids at application rates not to exceed 10 tons/acre pure biosolids. If biosolids have been mixed with wood chips or another carbon source, the application rate of the mixture may be as high as 30 dry tons/acre, as long as the biosolids component of the mixture does not exceed 10 dry tons/acre. In general phosphorus application rates will be higher than nitrogen rates, which will be higher than potassium application rates.

Reclamation will be completed within two years of the termination of waste rock placement on the outer dump face.

4.4.6 Areas Where No Further Action is Currently Planned

No further action is currently planned for approximately 800 acres within the waste rock disposal area. These acres are entirely comprised of angle of repose slopes that are greater than 150 feet tall. The majority of these slopes are located on the eastern margin of the waste rock dumps, north of the Butterfield Canyon tributary drainages, but this area also includes the angle of repose slopes in upper Dry Fork Canyon and Freeman Gulch, and miscellaneous slopes on top of the waste rock disposal area (Figure 4-6). As described earlier in this section, surface debris, utilities and facilities without a post-mining use will be removed from these slopes. The upper crest of

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the angle of repose slopes will also be bermed, and the overlying waste rock surfaces will be contoured, to prevent runoff from flowing onto the slopes.

None of these slopes pose a significant risk of contaminant transport off the property and the costs of slope stabilization would not be offset by the reductions in long-term maintenance costs for the sediment and water collection systems located down gradient from the slopes. All of these slopes are either located above relatively flat waste rock surfaces or are above relatively low gradient, poorly defined drainages. All of these slopes are also relatively distant from any down gradient public access points or water bodies (Table 4-2). These slopes are tall, so the cost per acre for slope reduction would be prohibitively high. All of these slopes are also composed of waste rock with abundant pyrite, high salinity and low pH, so revegetation would not be practicable. However, if additional stability assessments identify slopes that pose a significant risk of offsite waste rock and contaminant transport, or if new reclamation techniques are developed that would make the recontouring of these slopes practicable in the future, some of these slopes may be partially or fully reclaimed at closure.

About half of the east-facing angle of repose slopes where no further action is planned are located immediately above large, flat waste rock surfaces. Shallow failures or erosional events on these slopes will merely deposit material onto the lower waste rock surface. The remaining east-facing angle of repose slopes are located above broad, poorly defined, alluvium-floored and relatively low-gradient dry drainages (Copper and Keystone drainages on Table 4-2). The Eastside Collection System at the base of the east-facing slopes north of the Butterfield tributary drainages was designed to handle leach water base flows plus the 10-year, 24-hour storm event. With the termination of leach water applications, base flows in this area have declined from greater than 25,000 gpm to less than 1000 gpm, so the collection system is likely able to handle flows that are greatly in excess of the 25-year, 24 hour storm event. The closest water body of any kind is the Provo Reservoir Canal more than five miles down gradient and the closest public access point is Highway 111 more than one mile down gradient. The Jordan River is located more than nine miles down gradient.

The tall angle of repose slopes in upper Dry Fork Canyon and Freeman gulch are facing up-canyon, so the risk of significant up gradient transport of sediment and water from these slopes is minimal. If these slopes were reduced it would also cover previously unimpacted, forested areas within these drainages.

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5.0 EXCESS MINE WATER DISPOSAL AREA

At present there are no areas devoted to this activity as it was defined in the 1978 Permit. Mine water generated by pit dewatering operations, surface runoff and groundwater capture other than from leaching areas is currently piped to the Copperton Concentrator and used in the process water circuit. Between 1936 and 1986 this water was sent to the South Jordan Evaporation Ponds area. The ponds were located seven miles east of the Bingham Mine, one mile south of Bingham Creek and five miles west of the Jordan River. At closure in 1986, the site contained approximately four million tons of neutralized sludges in 25 individual ponds covering 530 acres. Total metals analysis of the material showed it to contain elevated concentrations of arsenic, cadmium, copper, lead and zinc. However, batch leach testing indicated that the metal-bearing material was not leachable and therefore did not pose a significant risk of migration. Leachable sulfate, which is not regulated, was the most significant contaminant of concern at the site because of its concentration and solubility.

Groundwater beneath the site contains elevated sulfate and total dissolved solids concentrations, but does not contain elevated metals concentrations. Much of this water is above the Utah Groundwater Quality Protection standard of 500 mg/L for sulfate but below the health limit of 1500 mg/L.

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the excess mine water disposal area at closure:

- stabilization will be accomplished consistent with subsequent land use and may include removal or covering of accumulated salts, treatment with neutralizer, grading and revegetation work

- the area will be left in a safe, stable condition suitable for future use and without hazard of erosion or surface water accumulation

- any revegetation work would likely be accomplished to suit farming requirements.

5.1 COMPLETED RECLAMATION PROGRAM

In 1994 and 1995, KUCC reclaimed the evaporation ponds with oversight by EPA and DERR. The remediation and reclamation activities were completed in accordance with the Administrative Order on Consent for the South Jordan Evaporation Ponds (USEPA Docket Number CERCLA-VIII-18) and the Record of Decision, Kennecott South Zone Site (USEPA, Region 8, 2001). A completion certificate for this removal has been issued by the EPA. Some of the material in the ponds was returned to the waste rock disposal areas at Keystone Notch or was placed in the Bluewater I Repository. The remaining materials, composed of gypsum and gypsum-contaminated soils, were consolidated into a 210-acre low mound within the northern footprint of the ponds. The entire area was regraded, and the mound was capped with three to five feet of clean topsoil and seeded. During the reclamation an estimated seven million cubic

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yards of contaminated soils were moved and four million cubic yards of clean soil were emplaced.

The removal of materials with elevated metals concentrations, and the consolidation and capping of the remaining sediments, has minimized this site as a source of groundwater contamination. Infiltration of precipitation and irrigation canal water in the area is diluting and dispersing the remains of the historic sulfate groundwater plume.

5.2 FUTURE RECLAMATION PLANS

The 210-acre repository was designed to hold the gypsum and gypsum-bearing soils in perpetuity. However, current plans are to remove this material and place it in a repository with a much smaller footprint that is located up-gradient of the Eastside Collection System at the mine. The likely repository location is in Copper Notch at the foot of the Eastside waste rock dumps.

5.3 POST-CLOSURE LAND USE

The majority of the excess mine water disposal area can now be used for non-mining purposes without restriction. Most of the reclaimed site is currently open space, but in the future it may also be used for agricultural, residential, recreational, commercial, industrial or other purposes. After the remaining gypsum-bearing sludge has been removed, the 210-acre repository area may also be used without restriction.

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6.0 ORE TRANSFER AREA - MINE TO PROCESS

Ore was transferred 15 miles by standard gauge rail from the Mine to the North Concentrator until the concentrator was permanently closed in 2001. The track and railroad maintenance facilities associated with ore transfer cover about 330 acres. The railway network and operations are largely the same as described in the 1978 Permit. The entire ore haulage track is owned by KUCC and is within the permit boundaries. A conveyor transfers ore from the in-pit crusher to the Copperton Concentrator. Demolition and reclamation of the conveyor below the open pit and the 5490 tunnel is covered by DOGM permit M/045/004

6.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the ore transfer area at closure:

- at such time as the railroad is no longer needed in the mining or processing operations or for subsequent use, trackage and surface facilities will be removed and the area left in a condition suitable for conversion to other use

- revegetation will be accomplished if appropriate for the subsequent use.

Some areas adjacent to the tracks may contain historic ore spillage or other materials associated with rail haulage. If left in place these materials could inhibit the reestablishment of vegetation.

6.2 POSSIBLE POST-CLOSURE LAND USE

After the removal of all process materials, demolition and reclamation have been completed, there will be no restrictions on post-closure land use. Much of the land will probably be returned to farming, wildlife habitat or to some other use. Some sections of track may be left in place to service sites of post-mining industrial or commercial development.

6.3 DATA REQUIREMENTS

The only information still needed to select final reclamation activities is the determination of post-closure land use. In particular, segments of track that should be left in place and areas that will be returned to farming after closure will need to be identified.

6.4 RECLAMATION ACTIVITIES

Tentative reclamation activities have been selected based upon the existing incomplete data set.

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Before closure, the entire ore transfer area will be surveyed for ore and other process materials. Identified materials will be removed and either processed, placed on the waste rock disposal areas or properly handled in another manner. Any other contaminated areas will be cleaned up as described in Section 2.3. The ore conveyor in the open pit and in the 5490 tunnel will be removed. Those sections of track with a post-mining use will be left in place, and all other track and buildings will be demolished. All steel and as many ties as possible will be salvaged. Any materials that are not salvageable will be properly disposed. Based upon its volume and chemical characteristics, ballast and fill material from some areas may be excavated and removed for proper disposal.

All sites except those located on waste rock disposal areas will be regraded to conform to the surrounding land surface and natural surface drainage will be reestablished. All areas will be reseeded, except for those that will be used for farming within one growing season or where post-mining construction activities are planned immediately after closure.

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7.0 ORE PROCESSING FACILITIES AREA

The North Concentrator consists of the Bonneville Crushing and Grinding Plant, the Magna Flotation Plant, a few remaining structures from the Arthur Concentrator and the Arthur maintenance shops and warehouse (Table 2-1 and Figure 2-2). The entire complex covers approximately 220 acres. In 1997 the complex processed 9,700,000 tons of ore and produced 229,866 tons of concentrate. The North Concentrator was permanently closed in 2001.

The North Concentrator Complex is located immediately west of the town of Magna, and has good access to the interstate highway and railroad systems. The area also has a well-developed infrastructure including water supply systems, electrical transmission lines, sewage treatment facilities and arterial roadways and rail lines. The western limits of Magna, adjacent to the North Concentrator Complex, is zoned for heavy industrial use.

In the past, soils in and around the North Concentrator complex were contaminated with metal-bearing process materials, hydrocarbons and reagents in the course of normal operations. Soils with elevated lead and arsenic concentrations have already been identified and cleaned up at the old Arthur Concentrator, the Magna Concentrator and the Bonneville Crushing and Grinding Plant. Clean-up levels were established to allow industrial use of the site in the future. It is possible that other contaminated soils are present beneath existing structures.

7.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the ore processing facilities area at closure:

- surface facilities including buildings, utilities, railroads and equipment that are no longer needed for ore processing or related purposes and are not convertible to some other use, will be razed and/or removed

- all hazardous conditions will be eliminated and ground surfaces stabilized and planted.

In addition to these DOGM requirements several other issues should be considered during closure planning:

- at closure the land should be left in a condition which maximizes its value and minimizes restrictions that will be placed on post-closure land use

- materials or conditions that may have a significant negative impact on surface or groundwater quality will need to be removed or corrected before closure

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7.2 POSSIBLE POST-CLOSURE LAND USE

The primary limits on post-closure land use are the concentration and extent of soil and groundwater contamination that remains on the site at closure. To comply with the requirements of the 1976 Mining and Reclamation Plan and to maximize the post-closure value of the land, remediation and reclamation will be designed at a minimum to allow industrial/commercial land use at closure. Within much of the disturbed area it is assumed that there will be unrestricted land use at closure that could include industrial/commercial, residential and wildlife habitat.

7.3 DATA REQUIREMENTS

In order to select final and detailed reclamation actions, the following data requirements will have to be filled:

- the character and extent of soil or groundwater contamination that may remain on site
- the regional economic and demographic conditions at the time of closure and the viability of selling or leasing specific buildings to another party for industrial development.

7.4 RECLAMATION ACTIVITIES

Tentative reclamation activities have been selected based upon the existing incomplete database. Before closure all process materials will be processed, sold or otherwise remediated. Currently it is assumed that all facilities will be demolished unless a valid post-mining use can be identified in the future. Contaminated soils and debris that are identified before or during demolition activities will be removed, treated or buried in place to allow at least industrial/commercial land use after closure. After demolition and remediation have been completed all sites will be reclaimed as described in Section 2.3.

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8.0 TAILINGS DISPOSAL AREA

The South Tailings Impoundment currently contains about two billion tons of material and until recently received about 55 million additional tons annually. The original footprint of the impoundment was about 5800 acres, of which less than 2000 acres are currently not reclaimed. The current flat, interior portion of the impoundment covers about 3500 acres and the embankment covers about 2300 acres. Since 1999, the area of active tailings deposition has been reduced on top of the impoundment and new tailings deposition is currently only occurring intermittently on the eastern quarter of the impoundment. Interim and permanent reclamation activities are currently being performed on the inactive interior areas. Approximately 1100 acres of the embankment have been permanently reclaimed with trees and shrubs, and most of the remaining embankment area has undergone reclamation with a mix of fast growing grasses and forbs for dust control. The top of the impoundment is almost 250 feet high and the overall embankment slope is maintained at approximately 11 degrees.

The South Tailings Impoundment has almost reached its operational capacity and construction of the new North Impoundment expansion began in 1996. The transition to the North Impoundment is scheduled to extend from 1998 to 2004.

The tailings contain fewer sulfides and a lower acid potential (AP) than the ore produced in the mine because almost all of the chalcopyrite, bornite and molybdenite, and some of the pyrite, is removed during the beneficiation process and sent to the Smelter as concentrate. Samples of tailings from the Magna and Copperton Concentrators collected between 1996 and 2002 contain about 0.6 percent sulfide sulfur on average. If all of these sulfides were oxidized, the weighted average AP would be about 18 tons of calcium carbonate per 1000 tons of tailings. The sampling program also indicates that the tailings contain the equivalent long-term weighted average neutralization potential (NP) of about 29 tons of calcium carbonate per 1000 tons of tailings. The seven year weighted average net neutralization potential (NNP) of the tailings is thus 11 tons/1000 tons with a 95% confidence interval of 5 tons/1000 tons. The neutralization potential ratio (NPR) of the Magna and Copperton tailings has a weighted average of 1.6. However, coarse tailings material, which generally accumulates on the margins of the impoundment near the discharge points, has a higher concentration of sulfide minerals and tends to be more acid-generating than the impoundment tailings as a whole. More than 250 samples were collected from the surface and subsurface of the embankment between 1994 and 1996 (Shepard Miller, Inc. and Schafer and Associates, 1995; Shepard Miller, Inc., 1997). These samples represent a historical record of tailings deposition spanning several decades. The average AP of the data set was 22 tons/1000 tons and the average NP was 28 tons/1000. The average NNP was 6 tons/1000 tons with a 95% confidence interval of 6 tons/1000 tons. The average NPR of the tailings embankment samples was 1.3.

These NNP and NPR values are not clearly diagnostic of ARD potential under field conditions, so kinetic tests are also being performed on tailings samples in compliance with Utah Ground Water Discharge Permit UGW350011. Kinetic net acid generation (NAG) tests have recently been completed on 21 tailings samples with a range of NNP and NPR values. During NAG tests, tailings are mixed with a hydrogen peroxide solution for 24 hours and the pH and temperature of

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the mixture are continuously monitored. Hydrogen peroxide is a strong oxidizing agent, so the sulfides in the sample are oxidized at a rapid rate, mimicking years or decades of surface weathering during the short-term test. As shown on Figures 8-1a and 8-1b, the NNP and NPR are very good predictors of the final pH of the oxidized tailings. Samples with an NNP of less than –2 tons/1000 tons (NPR=0.8) all acidified, whereas samples with an NNP of greater than 3 tons/1000 tons (NPR=1.2) maintained a neutral pH throughout the test. Sulfide oxidation reactions are strongly exothermic, and samples with an excess of AP all exhibited very elevated temperatures during the tests (Figure 8-2a and 8-2b). Samples with an excess of NP all remained near room temperature throughout the test.

These results indicate that, although portions of the South Impoundment will acidify, the overall risk of ARD from the impoundment as a whole is low. On a mass basis, it is estimated that less than ten percent of the South Impoundment material has the potential to become acidic because of its NNP characteristics or because it will remain saturated in perpetuity. (Shepard Miller Inc. and Schafer and Associates, 1995). Most of the tailings will remain saturated in perpetuity. The sulfides in tailings that are below the water table are unlikely to ever be oxidized, but the NP of these saturated tailings will be able to neutralize any acidic solutions that they may contact.

Portions of the embankment surface will likely acidify because 1) sulfides are preferentially partitioned to the margins of the impoundment, and 2) oxygen is more readily available in the well-drained and coarse-grained embankment than in the fine-grained interior. Based upon the data collected between 1994 and 1996 and the new NAG test results, approximately 50 % of the tailings exposed on the embankment surface have the potential to acidify in the long term (assuming that all tailings with an NNP of less than 0 could ultimately acidify). Recent tailings deposited on some portions of the existing interior surface of the South Impoundment have also been more acid-generating than the long-term average. Acid-base accounting and kinetic NAG testing of new tailings deposited in the impoundment will continue in the future.

Some tailings may also have elevated salinity, predominantly associated with NaCl, because they are deposited by saline process water. The process water tends to be saline because some of it is derived from water with a relatively high total dissolved solids content and because it is continuously recirculated and undergoes evaporative concentration. In some locations, the salinity may be high enough to inhibit vegetation establishment.

Except for copper, the tailings have relatively low average total metals concentrations, as illustrated by a 61-sample average for the following elements: arsenic 25.1 mg/kg, barium 199 mg/kg, cadmium 0.3 mg/kg, chromium 47.3 mg/kg, copper 785 mg/kg, lead 23.0 mg/kg and selenium 1.2 mg/kg. Synthetic Precipitation Leaching Procedure analyses (EPA Method 1312) conducted on 30 un-weathered tailings samples yielded average leachate concentrations of less than detection for all of these elements.

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8.1 CLOSURE ISSUES

The original mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the South Tailings Impoundment at closure:

- when no longer needed for tailings deposition, mineral recovery or material source, grading and revegetation of dike slopes not already done will be completed
- the surface of the tailings pond will be stabilized using the most practicable technology available upon the termination of the deposition of the tailings.

In addition to the DOGM requirements, the primary closure issues at the South Tailings Impoundment include:

- dust must be controlled from the impoundment in perpetuity
- surface water runoff and surface seepage of tailings water from the impoundment must be captured and conveyed to a designated outfall point where it must meet applicable water quality criteria to be discharged
- groundwater quality must not be degraded
- long-term slope stability must be maintained.

8.2 SUMMARY OF EXISTING CLOSURE PLANS

The existing closure plans described in Section 1.2.2 and attached in Appendices B and C detail the reclamation activities that will occur when the South Impoundment closes. The ultimate goal for the surface of the South Impoundment is to establish a permanent, self-sustaining vegetative cover to minimize dust generation, water infiltration and erosion, while improving wildlife habitat, slope stability and aesthetics. In some areas of the South Impoundment interior, where vegetation establishment may be difficult because of salinity issues, the primary goal will be to create a stable surface that will inhibit dust generation.

Areas of the South Impoundment have been taken out of service sequentially, from west to east, to allow continued use of the decant pond until final closure of the existing impoundment. This has been done by constructing access dikes to subdivide the existing active surface. The peripheral discharge system has been reestablished on each new dike to keep the remaining active surface properly wetted. As each new area is isolated and begins to dry, it has been initially stabilized by one or more of the following methods: planting of rapid-growing grass seed, hydromulching, or temporary dust control using water or suppressants. Permanent revegetation of the surface is being conducted after the surface has dried sufficiently or in the next appropriate season. For tailings that have acidified or that may acidify in the future, limestone or another neutralizing agent will be added to maintain a near-neutral pH in the long-

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term. For some tailings with elevated salinity, final reclamation may need to be delayed several years to allow the salts to be removed by precipitation, infiltration and runoff. Recent sampling and historical studies indicate that this natural leaching process likely occurs within several years on the embankment surface and on portions of the interior, but it may involve decades on portions of the flat interior surface underlain by very saline, very fine-grained tailings (Utah State University, 1974). It may not be possible to establish vegetation on some very saline interior surfaces. In these areas other methods of permanent surface stabilization may be employed such as capping with a growth media, capping with coarse material, capping with a growth media underlain by a capillary break or promoting the formation of salt crusts.

At final closure, the flat, upper tailings surface will be constructed so that all precipitation will be retained on the surface. Captured precipitation will either infiltrate or will be removed by evapotranspiration. Water falling on the embankment and seepage that discharges from the base of the embankment, will report to the toe collection ditch. Ultimately, this water will be discharged through a UPDES outfall (Section 10.0). Groundwater monitoring will continue for some time after closure to ensure that there are no adverse impacts to groundwater quality.

More detailed descriptions of the closure activities are provided in the attached plans.

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9.0 EXCESS WATER MANAGEMENT AREA

Facilities that are currently used for excess water management cover about 100 acres. As defined in the 1978 Permit under the land use category of excess process water disposal, this includes all the facilities that handle water from the tailings impoundment for disposal or recycling. Excess water from the South Impoundment is transferred from the decant pond to the clarification canal. From the canal, water flows around the southeast side of the impoundment to a pump station that returns it to the concentrator. Excess water not subject to recycle requirements is discharged to the Great Salt Lake from a series of permitted outfall points.

All of the other areas included under the excess process water land use category in the 1978 Permit are either closed or are only used by the Smelter or Refinery and so are not covered by DOGM permits. This includes the former wastewater treatment plant (WWTP) and its associated sludge lagoons that were demolished and reclaimed in 2001. Metals-bearing gypsum sludge generated during the neutralization process at the WWTP was discharged to five lagoons. Approximately 1.1 million cubic yards of sludge were moved from the lagoons to the Arthur Step Back Repository on the southwest side of the existing tailings impoundment. This repository was constructed under EPA oversight to meet the conditions of a RCRA Subtitle C facility. A portion of the repository underwent permanent capping and closure in 2001. The remainder has been temporarily capped and is authorized by EPA for future hazardous material disposal that meets the conditions of the corrective action management unit. It will be filled, closed and capped at closure.

9.1 CLOSURE ISSUES

The original Mining and Reclamation Plan submitted to DOGM in 1976 specified the following activities for the excess process water disposal area at closure:

- surface facilities that are no longer needed, and that are not convertible to some other use will be razed and/or removed
- sludge ponds and evaporation ponds will be left in a condition suitable for conversion to other uses, this may involve filling or covering, or other stabilization and revegetation work
- canals will most likely be left indefinitely for conveyance of natural surface flows and drainage to the Great Salt Lake.

After closure some of the facilities associated with excess water management will have to be used in perpetuity to handle surface water flows and seepage from the South Impoundment and the North Impoundment. It is also probable that some waters from the mine area and the mine waste disposal area will need to be routed through the existing process water disposal systems and into the Great Salt Lake. After closure all discharges will continue to be regulated under UPDES permit UT0000051 or a subsequent UPDES permit.

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9.2 POSSIBLE POST-CLOSURE LAND USE

Based upon the long-term need to handle water from the tailings impoundments and possibly other areas, much of the area will be used for water management in perpetuity after closure. Some of the area may also be preserved as wetlands wildlife habitat. Selected areas, particularly those associated with process water recycling, may have an unrestricted land use after closure, demolition and reclamation.

9.3 DATA REQUIREMENTS

Some of the data requirements that will need to be filled before final post-mining closure options are selected include:

- the ultimate character of the post-mining water management system in the Oquirrh Mountains

- the final geometry of the tailings impoundments and their required water management systems.

9.4 RECLAMATION ACTIVITIES

Tentative reclamation activities have been selected based upon the existing incomplete data set. An outfall point or multiple points will be maintained in perpetuity to discharge water from the tailings impoundments and from other sources in the Oquirrh Mountains into the Great Salt Lake. Selected waters from the mine and the mine waste disposal areas will likely be transported north in existing pipelines within the tailings pipeline corridor. Most existing canals and ditches will be left in place to use for water management and to provide wildlife habitat. Structures currently associated with process water recycling, such as pump houses and pipes, will be removed unless they are determined to have a post-mining use. All buildings and structures that do not have a post-mining use will be demolished and reclaimed as described in Section 2.3.

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10.0 POST-CLOSURE WATER MANAGEMENT

After closure the surface and shallow groundwater flows listed on Table 10-1 will need to be captured and managed in perpetuity. The table generally lists flows that have been impacted by contact with waste rock, tailings, underground workings or the open pit. Figure 10-1 is a map of the Bingham Canyon mine area showing watersheds that contribute to these flows and the existing surface water collection systems. Generally, watersheds that contain waste rock surfaces where leach water was historically applied have the lowest water quality. Watersheds that contain waste rock that was never leached have intermediate water quality and up gradient watersheds that are undisturbed contain potable quality water. Currently the surface and shallow groundwater flow in all of the up gradient drainages except for Dry Fork infiltrates into the down gradient waste rock dumps and is ultimately captured as ARD below the dumps. These up gradient watersheds also tend to receive significantly more precipitation than the areas below, so they will contribute relatively more water to the collection systems than is implied by their surface areas. Some watersheds near the range crest of the Oquirrh Mountains receive more than 30 inches/year average precipitation compared to an average of around 16 inches/year near the base of the waste rock disposal areas. Potable quality water discharging from springs, seeps or adits has been identified in several drainages. Listed in decreasing order of annual surface flow these include: Dry Fork, Freeman, Zelnora, Log Fork, Cottonwood and Sap gulches (Figure 10-1). Although Markham Gulch does not currently have any surface flow, historical records indicate that in the past it has produced as much water as Freeman Gulch.

Also listed on Table 10-1 is the water that will be produced as part of the Southwest Jordan Valley Plume remediation. Not included in the table are natural surface flows elsewhere within the permit boundaries in the Oquirrh Mountains or surrounding the Tailings Impoundment. Water extracted from the acid plume remediation contains the largest amount of acidity that will need to be treated, but the great majority of the acid plume will be removed before closure. It is anticipated that the water discharging from the toe of the north Eastside waste rock disposal areas and water flowing in the Bingham Canyon alluvium will contain the great majority of the acidity that must be managed in perpetuity. Both of these areas have been impacted by acid-generating waste rock disposal and historic leach water applications.

Most of the water quality data used to construct Table 10-1 was collected between 2000 and 2002. It is likely that before closure, flushing by precipitation and relatively clean groundwater flow will cause an improvement in water quality in some areas; particularly those that were impacted by historic leach water applications. Proper management of up gradient water, as well as reduced infiltration because of vegetation establishment may also improve some water quality. Conversely, it also is possible that continued sulfide oxidation in the pyrite halo of Bingham pit, the Magna Tailings Impoundment or in the newer waste rock disposal areas in Bingham Canyon may cause water quality in some of these areas to worsen with time.

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10.1 CLOSURE ISSUES

The primary closure issues associated with water management are defined by the need to comply with all surface and groundwater regulations and permits in the most cost effective manner. The primary water management issues that will need to be addressed after closure are to:

- comply with the requirements of the UPDES and groundwater discharge permits
- minimize contact of precipitation, surface and groundwater with waste rock, tailings and sulfide-bearing bedrock
- capture contaminated water that has contacted waste rock, tailings and sulfide-bearing bedrock
- segregate different quality water flows to avoid contaminating relatively good quality water with poor quality water
- minimize contaminant loading into down gradient surface and groundwater
- remediate down gradient waters that have been impacted by historical contaminant loading
- treat water to a quality that is consistent with its ultimate end use
- transport water to the appropriate end users or discharge point
- perform groundwater and surface water quality monitoring to ensure down gradient areas are not being adversely impacted

10.2 POST-CLOSURE WATER MANAGEMENT ACTIVITIES

Post-closure water management will involve the collection, treatment and transport of relatively good quality up gradient waters, contaminated contact waters and contaminated waters extracted during remediation activities. Table 10-2 lists the facilities that may be left in place after closure to complete these tasks and lists their locations where available. The final location and configuration of many facilities cannot be determined yet. The final facility designs will be dependent upon water quality and flow data collected between now and closure. Most of the water management facilities are already in existence or will be constructed before closure. After closure on-going management of these facilities will include periodic inspections, routine maintenance and repairs.

10.2.1 Up Gradient Water Collection Systems

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As described in Sections 3.0 and 4.0, collection facilities will be constructed up gradient from the waste rock disposal areas and the pyrite halo in the open pit to capture relatively clean water

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before it contacts sulfide-bearing waste rock and bedrock. These facilities will generally be located in drainages that have significant surface or shallow groundwater flow which discharges to the waste rock disposal areas. Selected surface water flows from the upper, net neutralizing benches in the open pit will also be captured and removed before they contact the pyrite halo. Collection sites will be located in upper Dry Fork Canyon, upper Freeman Gulch, selected drainages surrounding the open pit (most likely in Zelnora, Log Fork, Cottonwood, Sap and Markham Gulches) and on selected upper pit benches (Figure 10-1). In most cases the collection sites will be designed to capture water flowing on the surface or in alluvium, colluvium or shallow bedrock. Collection structures may include ponds, sumps, ditches, cutoff walls, horizontal drains or extraction wells. Once captured the water will be piped out of the area so that it does not contact any sulfide-bearing material. Pipes will likely transport the water to the mouth of Bingham Canyon, where it can be distributed to end-users. Small recharge areas, poor water quality, lack of surface flow and low bedrock porosity on undisturbed land within Muddy Gulch and Galena Gulch (South Side Natural on Figure 10-1) will generally prevent any significant water capture in these areas.

Gravity flow from some underground workings such as the Bingham, Mascotte, Utah Metals and Butterfield tunnels will continue to dewater some bedrock on the pit margins after closure (Figure 3-7). Selected up gradient underground workings may also continue to be dewatered by pumping after closure. Water is currently being removed from the North Ore Shoot shaft in upper Bingham Canyon and the Carr Fork workings in Pine Canyon. A shaft within the Utah Metals tunnel may also provide a viable up gradient dewatering point. Extraction from these workings would keep the north and west sides of the pit dewatered. After closure, the continued removal of water from selected underground workings surrounding the open pit will prevent groundwater quality from degrading as it flows through the pyrite halo towards the bottom of the pit. In most cases, the captured up gradient water will be of good quality and could be used or discharged without any restrictions.

10.2.2 Contact Water Collection Systems

As described in Sections 3.0, 4.0 and 8.0, contact water collection systems will be maintained after closure to capture water that has been degraded by contact with sulfide-bearing waste rock, tailings and bedrock. The anticipated flows that will need to be captured and treated in perpetuity are listed in Table 10-1. However, the capture of up gradient flows, and the increase in evapotranspiration on recontoured and revegetated surfaces may ultimately reduce the amount of contact water that must be collected.

The Eastside Collection System will continue to operate after closure. This system collects water that has contacted the Eastside, Bingham Canyon and Dry Fork waste rock disposal areas. The collection system captures water that discharges from the toe of the Eastside waste rock disposal areas and that flows in the alluvium of Bingham Creek and several other drainages. The Eastside Collection System is composed of a series of collection sumps and ponds, settling ponds, cutoff walls, pipes, canals and pump stations. Water will also continue to be extracted in upper Bingham Canyon and lower Dry Fork Canyon after closure. Collection systems will include pumping from the West Mountain Shaft or its replacement and pumping from an extraction well

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located at the intersection of Dry Fork and Bingham Canyons. This collection system is designed to minimize the migration of contaminated water from the Dry Fork/Bingham Canyon area into lower Bingham Canyon. Water extraction at these sites in upper Bingham Canyon will likely decrease the quantity and improve the quality of water that must be captured at the cutoff wall.

Surface water collection systems will also be established on the lower, net acid-generating walls of the open pit to capture water from runoff, springs, and underground workings before it can infiltrate into the pyrite halo. The water will be captured in collection sumps and will either be piped to the bottom of the pit, or it will be piped directly out of the pit. Water that discharges into the bottom of the pit will ultimately be pumped out via the 5490 tunnel.

Collection systems on the margins of the South Tailings Impoundment will also need to be maintained after closure. Contact water from seeps and springs on the lower embankment slopes will be captured in ponds, sumps or ditches. This water will then be managed in conjunction with contact waters from other parts of the operation.

In most cases, contact water that is captured will have to be treated before it will meet standards acceptable for irrigation, drinking water or discharge to surface water.

10.2.3 Bingham Creek Groundwater Remediation

The historic groundwater contamination in the southwest Jordan Valley has been subdivided into two zones, Zone A and Zone B, for management purposes. Zone B, includes an area east and southeast of the former KUCC evaporation ponds in South Jordan, and is characterized by sulfate concentrations averaging approximately 700 mg/L. Zone B treatment will be addressed through a Reverse Osmosis (RO) treatment plant which will be constructed by the Jordan Valley Water Conservancy District (JVWCD) located at approximately 1300 West and 8200 South.

The most significant portion of Zone A, is located immediately down gradient from the Large Bingham Reservoir. Water in the core of Zone A is characterized by low pH (<4.5), elevated heavy metals, and high sulfate (>20,000 mg/L). The settlement of a Natural Resource Damage (NRD) claim made by the State of Utah against KUCC for contamination of groundwater in the southwestern Jordan Valley required among other things that the acidic portion of the plume be pumped at an annual rate of 250 gpm based on a rolling five year average. The principal objective of the NRD claim is to "restore, replace or acquire the equivalent" of the damaged groundwater resource. There are portions of the settlement that overlap the scope of CERCLA remedial actions that are also required. These include among others, preventing the migration of contaminated groundwater into previously uncontaminated portions of the aquifer. The U.S. Environmental Protection Agency's Record of Decision (ROD) for the CERCLA action also provides that KUCC:

- Monitor the plume to follow the progress of natural attenuation for the portions of the Zone A plume which contain sulfate in excess of the state primary drinking water standard for sulfate (500 ppm sulfate).

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- Disposal of treatment concentrates via the existing pipeline used to slurry tailings to the tailings impoundment prior to mine closure.

- Develop a post-mine closure plan to handle treatment residuals for use when the mine and mill are no longer operating.

Recent groundwater modeling suggests a much higher pumping rate than 250 gpm is required to contain the plume. The Remedial Investigation and Feasibility Study (RI/FS) for the contaminated groundwater demonstrated that the plume will continue to flow towards the Jordan River unless hydraulically contained and that the extracted acidic water must be treated before discharge. The RI/FS calls for the installation of additional groundwater extraction wells in the acidic portion of the plume that will be pumped at a rate of approximately 2000 to 2500 gpm. The pumping rate will remove most of the acidic plume before closure and will satisfy the NRD settlement and CERCLA corrective action requirements. Additionally, as proposed in the RI/FS, a barrier well system to extract elevated sulfate in groundwater and hydraulically contain the plume will be installed at the plume terminus.

The acidic water removed from the core of Zone A will be neutralized with lime and tailings and will be discharged to the tailings line during the active life of the mine. It is anticipated that before closure, one or more lime treatment plants will be built somewhere near the mouth of Bingham Canyon. The lime treatment capacity will be sized to handle the anticipated post-closure flows. A plant for treating Zone A sulfate water from the margins of the plume will be constructed by KUCC near the barrier wells. The treatment system will use RO treatment technology to produce approximately 3500 acre-feet/year of drinking quality water. As required by the EPA ROD, the clean RO permeate water will be sent to municipal supply for delivery through the Jordan Valley Water Conservancy District (JVWCD) distribution pipelines to affected users. The RO concentrate will be discharged to the tailings line during the active life of the mine. Studies have been conducted as part of the Remedial Design Workplan to ensure that the deposition of treatment sludges and precipitates in the North Tailings Impoundment (DOGM permit number M/035/015) will not adversely impact the geochemical stability of the tailings. Geochemical monitoring will also continue for the life of the project.

The current assumptions for the post-closure management of RO concentrate and lime-neutralized water is for it to be discharged to the Great Salt Lake through a future permitted discharge outfall. Further studies, to confirm the feasibility of this option and address post-closure management of lime treatment sludges will be conducted over the next few years as part of the Remedial Design Workplan. Options to be evaluated include stabilization of the sludge and placement on the waste rock disposal areas or construction of a repository.

10.2.4 Mine Water Treatment and Discharge

Acidic post-closure flows from the mine area may total about 1500 gpm (Table 10-1). Depending on the final closure scenario selected for the pit, up to about 2500 gpm may also need to be treated at closure (pit with a small collection pond or ponds) or treatment may be delayed for up to 30 years after closure (partial flooding scenario). It is anticipated that all of these post-

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closure flows will be treated by lime neutralization, sedimentation and clarification. It is also possible that a small pretreatment plant may also remain in place after closure to recover copper from selected copper-bearing flows that discharge from the waste rock disposal areas. This plant would likely be located above the cutoff wall in lower Bingham Canyon and will feed water to the lime plant.

As indicated in section 10.2.3, KUCC intends to remove most of the acidic groundwater plume before closure. At closure, the reduction in treatment needs for the acid plume, will allow for lime treatment plant capacity to be available for the mine flows. The treated effluent may be pumped to the tailings pipeline and ultimately discharged into the Great Salt Lake. Some of the water may also be provided for municipal use if it is treated sufficiently. The sludges generated during the treatment of mine waters will be handled in a similar manner to the sludges generated by the acid plume remediation. During active operations these sludges will be discharged to the tailings impoundment, but after closure they will be handled as determined in the Remedial Design Workplan.

10.2.5 Long-Term Monitoring

Long-term monitoring of surface water and groundwater quality will be required after closure to ensure that remediation objectives have been attained and to ensure that down gradient areas are not negatively impacted by waste rock, tailings and sulfide-bearing bedrock. Monitoring will generally be accomplished by the periodic sampling of wells and surface flows. Figures 10-2 and 10-3 are maps showing the existing wells owned by Kennecott within the permit boundaries. The wells are designated as permit monitoring wells, production wells and other monitoring wells. After closure it is likely that many of the monitoring wells required by groundwater discharge permits and most of the production wells will be left in place. Continued access to some of the non-permit monitoring wells will also be needed after closure. Those wells that do not have a post-mining use will be abandoned in accordance with all applicable regulations including with the State Engineers specifications.

It is anticipated that after closure at least 25 years of monitoring will be required for Groundwater Discharge Permits UGW350010 and UGW350011. These permits are associated with the waste rock disposal areas and the tailings impoundment respectively. Post-closure monitoring requirements for the groundwater discharge permit associated with the North Concentrator may be of a shorter duration. After all process materials and facilities have been removed from the North Concentrator site and the land has been reclaimed, there will be no potential contaminant sources remaining. Other than general assumptions about the duration of monitoring, it would be premature to try to designate post closure sampling points and frequencies at this time. A detailed post closure monitoring plan for the ground discharge permits will be prepared a short time before closure based upon the surface and groundwater conditions at that time.

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11.0 FUTURE AND ON-GOING RESEARCH IN SUPPORT OF CLOSURE

KUCC has been conducting research in support of reclamation and closure since 1978. Much of this work has focused on long-term management of water resources and on the development and testing of reclamation techniques.

In particular, since 1992 KUCC has developed and tested several revegetation methods for the waste rock and tailings disposal areas. This work has been focused on several technologies including slope reduction techniques, the use of biosolids and other soil amendments, the placement of various types and thicknesses of cap materials, the use of acid-neutralizing agents and the planting of mycorrhizae-inoculated and un-inoculated seeds and seedlings. These efforts began with test plots and culminated in the slope reduction, capping and revegetation of 330 acres of low pH waste rock surfaces and additional acres on the existing tailings impoundment. Investigations have recently focused on direct planting onto older waste rock surfaces that have favorable soil chemistry. To date approximately 200 acres of waste rock surfaces with favorable soil chemistry have been recontoured into natural landforms, amended with liming agents and have been directly planted. This research will continue in the future, testing new technologies as they become available and existing techniques in new physical and geochemical environments.

Preliminary studies of waste rock soil geochemical evolution, volunteer vegetation establishment on waste rock surfaces, reclamation and infiltration modeling, direct planting on waste rock surfaces, long-term implications of biosolids application and pit wall acid/base accounting geochemistry have also been completed recently. There are many other ongoing or planned research projects that are designed to fill some of the data requirements identified in Sections 3.0 through 10.0. These studies include:

Study Description	**Status**
Acidification Potential of the Tailing Impoundments	On-going
Acid Base Accounting Study of Current and Ultimate Pit Walls	On-going
Waste Rock Revegetation Test Plots with Various Soil Amendments	On-going
Botanical Surveys of Past Reclamation Sites	On-going
Pit-Slope Stability Analysis	On-going
Waste Rock Stability Analysis	On-going
Waste Rock Disposal Area Water Balance	On-going
Treatability Study of the Bingham Groundwater Plume	On-going
Treatability Studies of Leach Water and ARD	On-going
Ecological/Human Health Risk Assessment	On-going
Regional Numeric Groundwater Modeling	On-going
Land Use Master Plan	On-going
Waste Rock Disposal Area Design Studies	On-going
Geochemical Evolution of Tailings Impoundment Soils	On-going
Slope Stabilization Study of South Eastside Waste Rock Disposal Areas	On-going
Survey of Surface and Shallow Groundwater Flow Around the Open Pit	On-going
Precipitation Plant Closure Plan	Planned

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Hydrogeology of the Post-closure Pit	Planned
Water Chemistry of the Post-Closure Pit	Planned
Long-Term Sustainability Plan	Planned
Closure Waste Rock Soil Geochemistry Survey	Planned

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APPENDIX A - 1976 MINING AND RECLAMATION PLAN

PN DRAFT

SCOTT M. MATHESON
Governor

GORDON E. HARMSTON
Executive Director,
NATURAL RESOURCES

CLEON B. FEIGHT
Director

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771

OIL, GAS, AND MINING BOARD

I. DANIEL STEWART
Chairman

CHARLES R. HENDERSON
JOHN L. BELL
THADIS W. BOX
C. RAY JUVELIN

October 2, 1978

#CT/35/002

Mr. Chuck Stillman
Kennecott Copper Corporation
P.O. Box 11299
Salt Lake City, Utah 84147

Re: Final Approval for
Kennecott Copper Corporation's
Mining and Reclamation Plan
Bingham Canyon Mine

Dear Mr. Stillman:

The Board of Oil, Gas, and Mining, at its September 28, 1978 executive meeting, approved your previously submitted surety contract for reclamation of the Bingham Canyon Mine.

Enclosed herewith is Kennecott's copy of the fully executed Mined Land Reclamation Contract. Therefore I hereby issue final approval to the Kennecott Copper Corporation's Bingham Canyon Mine to operate under the Utah Mined Land Reclamation Act.

Sincerely,

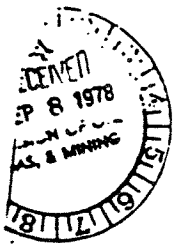
Cleon Feight

CLEON B. FEIGHT
DIRECTOR

CBF/sp
enc: Reclamation Contract

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STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
BOARD OF OIL, GAS, AND MINING
1588 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH 84116

* MINED LAND RECLAMATION CONTRACT *

THIS CONTRACT, made and entered into this 28TH day of SEPTEMBER, 1978, between Kennecott Copper Corporation a corporation duly authorized and existing under and by virtue of the laws of State of Utah as party of the first part, and hereinafter called the Operator, and the BOARD OF OIL, GAS, AND MINING, duly authorized and existing by virtue of the laws of the State of Utah, as party of the second part hereinafter called the Board.

WITNESSETH:

WHEREAS, the Operator is the owner and in possession of certain mining claims and/or leases hereinafter more particularly mentioned and described in Exhibit "A" attached hereto.

WHEREAS, the Operator did on the Ninth day of August 1976, file with the Division of Oil, Gas, and Mining, a "Notice of Intention to Commence Mining Operations" and a "Mining and Reclamation Plan" to secure authorization to engage, or continue to engage, in mining operations in the State of Utah, under the terms and provisions of the Mined Land Reclamation Act, Section 40-8, U.C.A., 1953.

WHEREAS, the Operator is able and willing to reclaim the above mentioned "lands affected" in accordance with the approved Mining and Reclamation Plan, the Mined Land Reclamation Act of 1975 and the rules and regulations adopted in accordance therewith.

WHEREAS, the Board has considered the factual information and recommendations provided by the Staff of the Division of Oil, Gas, and Mining as to the magnitude, type and costs of the approved reclamation activities planned for the land affected.

WHEREAS, the Board is cognizant of the nature, extent, duration of operations, the financial status of the Operator and his capability of carrying out the planned work.

NOW THEREFORE, for and in consideration of the mutual covenants of the parties by each to the other made and herein contained, the parties hereto

DRAFT

agree as follows:

1. The Operator promises to reclaim the land affected in accordance with its Mining and Reclamation Plan which was approved by the Board on February 22, 1978, the Mined Land Reclamation Act, and the rules and regulations adopted in accordance therewith.

2. The Board, in lieu of accepting the posting of a bond or other surety, accepts the personal guarantee of the Operator to reclaim the land affected in accordance with its approved reclamation plan.

3. The Board and Operator both agree that the Operator will be obligated to expend a minimum average, excluding salaries, but not operating wages, of $50,000 - 1978 dollars per year for each three (3) year period, in maintaining a program of experimentation and in the application of the best available technology toward rehabilitation of land associated with or affected by mining or processing operations.

4. The Board and Operator further agree that the annual expenditure as set forth in paragraph three (3) above, unless waived by the Board, will continue until mining as described in the notice of intention is permanently terminated, and that said annual expenditure will not constitute the fulfillment of the obligations of the Operator as to mined land reclamation. The Operator further agrees to waive the requirements for the fixed sum as surety as required in Section 40-8-14 (8), U.C.A., 1953.

5. The Operator agrees to provide to the Board and Division annually, a detailed report of reclamation work performed during the preceeding year, including a cost accounting for said reclamation work in 1978 dollars.

6. The Operator further agrees to work jointly with the Division in establishing annual reclamation plans for each forthcoming year. Said plan will be subject to the review of the Board. Consideration will be given to the annual report of the previous year in establishing such plans.

7. The Operator agrees to designate a responsible individual who is involved in the Operator's on-going reclamation efforts, who will serve as liaison to the Division.

8. This contract shall be binding on all successors and assigns, to the Operator.

IN WITNESS THEREOF, the parties of the first and second parts, hereto have respectively set their hands and seals this 28 day of September, 1978

KENNECOTT COPPER CORPORATION

By: _____
President
Its ~~Metal Mining Division~~

ATTEST:

_____
Asst Secretary

APPROVED
Pursuant to 3 Comp.
By _____

BOARD OF OIL, GAS, AND MINING

By _____
Chairman

Note: If the Operator is a corporation, the agreement should be executed by its duly authorized officer with the seal of the corporation affixed.

DRAFT

EXHIBIT A
MINING APPLICATION
NO. ACT-035-002

Date August 9, 1976

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1588 West North Temple
Salt Lake City, Utah 84116

NOTICE OF INTENTION TO COMMENCE MINING OPERATIONS
(See Rule M of General Rules and Regulations)

1. Name of Applicant or Company Kennecott Copper Corporation, Utah Copper Division
Corporation (X) Partnership ( ) Individual ( )

2. Address P. O. Box 11299, Salt Lake City, Utah 84147
Permanent

3. Name and title of person representing company B. B. Smith, General Manager

4. Address P. O. Box 11299, Salt Lake City, Utah 84147 Office Phone 322-1533

5. Location of Operations Salt Lake and Tooele within the following sections:
County

Sec 7, 8, 9, 10, 11, 17, 18, 19, 20, 21, 30, 31 & 32, T1S, R2W, SLB&M;
Sec 9, 10, 11, 12, 13, 14, 15, 16, 22, 23, 24, 25, 26 & 36, T1S, R3W, SLB&M;
Sec 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 22, 23, 27, 28 & 33, T2S, R2W, SLB&M;
Sec 7, 17, 18 & 19, T3S, R1W, SLB&M;
Sec 4, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 21, 24, 25, 28, 29, 30, 31 & 32, T3S, R2
R2W, SLB&M;
Sec 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 26, 27, 33, 34, 35 & 36, T3S, R3W, SLB&M;
Sec 6 & 7, T4S, R2W, SLB&M;
Sec 1, 2, 3, 11 & 12, T4S, R3W, SLB&M.

6. Name of Mine Bingham Canyon Mine

7. Mineral to be mined:

( )	Coal	( )	Flagstone
(X)	Copper	( )	Gravel
( )	Manganese	( )	Shale
( )	Iron Ore	( )	Uranium
( )	Phosphate	( )	Gilsonite
( )	Potash	( )	Bituminous Sandstone
( )	Fluorspar	( )	Tungsten
(X)	Other (specify)	Minerals associated with copper.	

Mining methods:

Open pit, waste leaching, insitu leaching, underground.

8. Have you or any person, partnership or corporation associated with you received an approved Notice of Intention to Commence Mining Operations by the State of Utah for operations other than described herein?
( ) Yes (X) No *
If yes, list all approval numbers now under surety:
* Kennecott's Tintic Mines Division may have requested approval.

PN DRAFT

9. Owner/Owners of record of the surface area within the land to be affected:

Kennecott Copper Corporation	Address	161 East 42nd Street, New York, NY 10017
U. V. Industries	Address	(Local Office) University Club Bldg, Salt Lake City, UT
The Anaconda Company	Address	(Local Office) 1849 West North Temple, Salt Lake City, UT

10. Owner/Owners of record of minerals to be mined:

Kennecott Copper Corporation	Address	161 East 42nd Street, New York, NY 10017
U. V. Industries	Address	(Local Office) University Club Bldg, Salt Lake City, UT

11. Owner/Owners of record of all other minerals within any part of the land affected:

The Anaconda Company	Address	(Local Office) 1849 West North Temple, Salt Lake City, UT

11a. Have the above owners been notified in writing?
(X) Yes ( ) No

12. Source of Operator's legal right to enter and conduct operations on land to be covered by the Notice:

Legal documents, including deeds, easements, mining claims, agreements, licenses, etc.

13. Approximate acreage to be disturbed:

Mine	3,100 acres
Mine waste disposal	8,000 acres
Excess mine water disposal	2,700 acres
Ore transfer - mine to process	400 acres
Ore processing facilities	1,800 acres
Tailing disposal	6,000 acres
Excess process water disposal	1,000 acres
Total	23,000 acres

14. Give the names and post office addresses of every principal Executive, Officer, Partner, (or person performing a similar function) of Applicant:

	Name:	Title:	Address:
a.	B. B. Smith	General Manager Utah Copper Division	P. O. Box 11299 Salt Lake City, UT 84147
b.	H. H. Kremer	President Metal Mining Division	161 East 42nd Street New York, NY 10017
c.	F. B. Milliken	President	161 East 42nd Street New York, NY 10017

PN DRAFT

15. Has Applicant, any subsidiary or affiliate of any person, partnership, association, trust, or corporation controlled by or under common control with Applicant, or any person required to be identified by Item 14, ever had an approval of a Notice of Intention withdrawn or has surety relating thereto ever been forfeited?

( ) Yes (X) No

If yes, explain:

STATE OF UTAH)
: ss
COUNTY OF SALT LAKE)

I, B. B. Smith, having been duly sworn depose and attest that all of the representations contained in the foregoing application are true to the best of my knowledge; that I am authorized to complete and file this application on behalf of the Applicant and this application has been executed as required by law.

KENNECOTT COPPER CORPORATION
Utah Copper Division

By B. B. Smith
Its General Manager

Taken, subscribed and sworn to before me the undersigned authority in my said county, this 9th day of August, 1976.

Keith L. Hansen
Notary Public

My Commission Expires:
November 1, 1979

PN DRAFT

MINING APPLICATION

NO. ACT-035-002

DATE: August 9, 1976

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1588 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH 84116

MINING AND RECLAMATION PLAN

PREAMBLE

Planning for rehabilitation of an operation mine is always difficult. This difficulty is magnified many times when the expected life of the mine may be decades or even a century. Such is the case of the Bingham Mine. It is not even possible to determine the approximate land uses at the end of the mining operation. For that reason, this rehabilitation plan cannot be as specific as that of other, more short-lived, operations.

However, regardless of the end use of the land, it is the intention of Kennecott to leave the land in a stable and productive condition consistent with location, possible uses, and topography, recognizing that since the mine is open pit in nature that the land itself cannot be restored as it was prior to commencement of mining.

To accomplish these objectives, Kennecott will maintain a program of experimentation and will apply the best available technology toward rehabilitating each piece of land as it moves from mining to other uses. A detailed annual report of reclamation work performed during the preceding year will be developed for review by the Board of Oil, Gas and Mining. These annual reports will be utilized by Kennecott and the Division in jointly establishing reclamation plans for the forthcoming year with the intent of accomplishing the overall objectives.

The following plan represents an attempt to outline some of the possible land uses and describe the steps the company will take to reach the general objectives.

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MINING AND RECLAMATION PLAN

A. Applicant - Kennecott Copper Corporation, Utah Copper Division.

B. Type of Operation - Mining and processing for mineral extraction. Mining method and processing facilities are continually modified and updated to meet natural and physical requirements and conditions of market, technology, governmental regulation, economics and other factors. Large scale mining operation has been underway since about 1904. Remaining life of the mining operation will depend upon many things including the likelihood that eventual mineral shortages and improved technology will justify mineral extraction from materials now considered waste. It is, therefore, impossible to predict a terminal point for the mining and processing operations. However, it is not expected that this terminal point will occur within the next 50 years.

The Utah Copper Division operations extend from in and around the Bingham Mine to just beyond the north end of the Oquirrh Mountains near Magna (see CONFIDENTIAL map, Exhibit A). The operation is divided into the following areas which are identified on Exhibit A, shown in schematic arrangement on process diagram Exhibit B, and covered separately herein:

1. Mine
2. Mine Waste Disposal
3. Excess Mine Water Disposal
4. Ore Transfer-Mine to process
5. Ore Processing Facilities
6. Tailing Disposal
7. Excess Process Water Disposal

1. Mine Area

The mine area from which overburden and ore is removed comprises approximately 3100 acres.

Prior to open pit mining which began in 1904, this mountainous area had been a source of timber and was being used for underground mining operations with associated surface facilities, residences, businesses, etc. As open pit mining has expanded, these other used have been discontinued.

Determination of a definite use for the area after mining operations cease is difficult due to many uncertainties involved, but will be determined in light of potential

PN DRAFT

use of the land and the condition of the land after reclamation by means that are technologically and economically practicable. Possibilities include:

Scenic attraction.

Historical landmark.

Other public or private use.

Very little vegetation remains in the mining area because of the considerable volume of material having been displaced. The remaining vegetation consists of grasses, forbs, shrubs, and trees such as aspen, mountain mahogany, Utah juniper and fir. The pH of undisturbed soils ranges from 4.5 to 7.5 as determined by mixing 100 gm of soil with 100 ml of distilled water. Most materials removed from or exposed in the mine are acidic. Surface elevation ranges from approximately 5240 feet to over 7800 feet above sea level.

Underground workings and natural bedrock aquifers have been, and will continue to be, encountered during mining operations. The drainage from these abandoned mines and fault-related aquifers is discharged through a railroad tunnel to supply make up water for leaching operations. At times the water is bypassed by pipeline and canal to a disposal area (see Area 3). Typical analysis of this water is listed below:

pH	4.7	Fe	100 ppm
TDS	2,400 ppm	Cl	70 ppm
SO_4	1,400 ppm	Ca	500 ppm
Al	5 ppm	Cu	4 ppm
Mg	50 ppm		

Experiments are being conducted to determine if this water can be used for irrigation.

Since open pit mining began, over 1,350,000,000 tons of ore and 2,400,000,000 tons of waste have been removed. This is one of the largest mining operations ever undertaken, having produced more copper than any other mine in history. The present excavation is approximately 2-1/4 miles wide and 1/2 mile deep (see photograph Exhibit C). There are now 56 levels or benches in the mine which typify open-pit mining, a feasible and economical system for handling the low grade ore and overburden in vast quantities. Height of the benches ranges between 40 and 50 feet. Material is now being removed from 20 lower benches and from upper benches by truck.

PN DRAFT

SCOTT M. MATHESON
Governor

GORDON E. HARMSTON
Executive Director,
NATURAL RESOURCES

CLEON B. FEIGHT
Director

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771

OIL, GAS, AND MINING BOARD

I. DANIEL STEWART
Chairman

CHARLES R. HENDERSON
JOHN L. BELL
THADIS W. BOX
C. RAY JUVELIN

October 2, 1978

#CT/35/002

Mr. Chuck Stillman
Kennecott Copper Corporation
P.O. Box 11299
Salt Lake City, Utah 84147

Re: Final Approval for
Kennecott Copper Corporation's
Mining and Reclamation Plan
Bingham Canyon Mine

Dear Mr. Stillman:

The Board of Oil, Gas, and Mining, at its September 28, 1978 executive meeting, approved your previously submitted surety contract for reclamation of the Bingham Canyon Mine.

Enclosed herewith is Kennecott's copy of the fully executed Mined Land Reclamation Contract. Therefore I hereby issue final approval to the Kennecott Copper Corporation's Bingham Canyon Mine to operate under the Utah Mined Land Reclamation Act.

Sincerely,

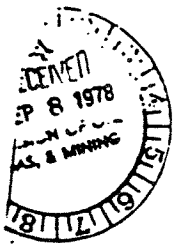
Cleon Feight

CLEON B. FEIGHT
DIRECTOR

CBF/sp
enc: Reclamation Contract

PN DRAFT

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STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
BOARD OF OIL, GAS, AND MINING
1588 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH 84116

* MINED LAND RECLAMATION CONTRACT *

THIS CONTRACT, made and entered into this 28TH day of SEPTEMBER, 1978, between Kennecott Copper Corporation a corporation duly authorized and existing under and by virtue of the laws of State of Utah as party of the first part, and hereinafter called the Operator, and the BOARD OF OIL, GAS, AND MINING, duly authorized and existing by virtue of the laws of the State of Utah, as party of the second part hereinafter called the Board.

WITNESSETH:

WHEREAS, the Operator is the owner and in possession of certain mining claims and/or leases hereinafter more particularly mentioned and described in Exhibit "A" attached hereto.

WHEREAS, the Operator did on the Ninth day of August 1976, file with the Division of Oil, Gas, and Mining, a "Notice of Intention to Commence Mining Operations" and a "Mining and Reclamation Plan" to secure authorization to engage, or continue to engage, in mining operations in the State of Utah, under the terms and provisions of the Mined Land Reclamation Act, Section 40-8, U.C.A., 1953.

WHEREAS, the Operator is able and willing to reclaim the above mentioned "lands affected" in accordance with the approved Mining and Reclamation Plan, the Mined Land Reclamation Act of 1975 and the rules and regulations adopted in accordance therewith.

WHEREAS, the Board has considered the factual information and recommendations provided by the Staff of the Division of Oil, Gas, and Mining as to the magnitude, type and costs of the approved reclamation activities planned for the land affected.

WHEREAS, the Board is cognizant of the nature, extent, duration of operations, the financial status of the Operator and his capability of carrying out the planned work.

NOW THEREFORE, for and in consideration of the mutual covenants of the parties by each to the other made and herein contained, the parties hereto

DRAFT

agree as follows:

1. The Operator promises to reclaim the land affected in accordance with its Mining and Reclamation Plan which was approved by the Board on February 22, 1978, the Mined Land Reclamation Act, and the rules and regulations adopted in accordance therewith.

2. The Board, in lieu of accepting the posting of a bond or other surety, accepts the personal guarantee of the Operator to reclaim the land affected in accordance with its approved reclamation plan.

3. The Board and Operator both agree that the Operator will be obligated to expend a minimum average, excluding salaries, but not operating wages, of $50,000 - 1978 dollars per year for each three (3) year period, in maintaining a program of experimentation and in the application of the best available technology toward rehabilitation of land associated with or affected by mining or processing operations.

4. The Board and Operator further agree that the annual expenditure as set forth in paragraph three (3) above, unless waived by the Board, will continue until mining as described in the notice of intention is permanently terminated, and that said annual expenditure will not constitute the fulfillment of the obligations of the Operator as to mined land reclamation. The Operator further agrees to waive the requirements for the fixed sum as surety as required in Section 40-8-14 (8), U.C.A., 1953.

5. The Operator agrees to provide to the Board and Division annually, a detailed report of reclamation work performed during the preceeding year, including a cost accounting for said reclamation work in 1978 dollars.

6. The Operator further agrees to work jointly with the Division in establishing annual reclamation plans for each forthcoming year. Said plan will be subject to the review of the Board. Consideration will be given to the annual report of the previous year in establishing such plans.

7. The Operator agrees to designate a responsible individual who is involved in the Operator's on-going reclamation efforts, who will serve as liaison to the Division.

8. This contract shall be binding on all successors and assigns, to the Operator.

IN WITNESS THEREOF, the parties of the first and second parts, hereto have respectively set their hands and seals this 28 day of September, 1978

KENNECOTT COPPER CORPORATION

By: _____
President
Its ~~Metal Mining Division~~

ATTEST:

_____
Asst Secretary

APPROVED
Pursuant to 3 Comp.
By _____

BOARD OF OIL, GAS, AND MINING

By _____
Chairman

Note: If the Operator is a corporation, the agreement should be executed by its duly authorized officer with the seal of the corporation affixed.

DRAFT

EXHIBIT A
MINING APPLICATION
NO. ACT-035-002

Date August 9, 1976

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1588 West North Temple
Salt Lake City, Utah 84116

NOTICE OF INTENTION TO COMMENCE MINING OPERATIONS
(See Rule M of General Rules and Regulations)

1. Name of Applicant or Company Kennecott Copper Corporation, Utah Copper Division
Corporation (X) Partnership ( ) Individual ( )

2. Address P. O. Box 11299, Salt Lake City, Utah 84147
Permanent

3. Name and title of person representing company B. B. Smith, General Manager

4. Address P. O. Box 11299, Salt Lake City, Utah 84147 Office Phone 322-1533

5. Location of Operations Salt Lake and Tooele within the following sections:
County

Sec 7, 8, 9, 10, 11, 17, 18, 19, 20, 21, 30, 31 & 32, T1S, R2W, SLB&M;
Sec 9, 10, 11, 12, 13, 14, 15, 16, 22, 23, 24, 25, 26 & 36, T1S, R3W, SLB&M;
Sec 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 22, 23, 27, 28 & 33, T2S, R2W, SLB&M;
Sec 7, 17, 18 & 19, T3S, R1W, SLB&M;
Sec 4, 8, 9, 13, 14, 15, 16, 17, 18, 19, 20, 21, 24, 25, 28, 29, 30, 31 & 32, T3S, R2
R2W, SLB&M;
Sec 11, 12, 13, 14, 15, 21, 22, 23, 24, 25, 26, 27, 33, 34, 35 & 36, T3S, R3W, SLB&M;
Sec 6 & 7, T4S, R2W, SLB&M;
Sec 1, 2, 3, 11 & 12, T4S, R3W, SLB&M.

6. Name of Mine Bingham Canyon Mine

7. Mineral to be mined:

( )	Coal	( )	Flagstone
(X)	Copper	( )	Gravel
( )	Manganese	( )	Shale
( )	Iron Ore	( )	Uranium
( )	Phosphate	( )	Gilsonite
( )	Potash	( )	Bituminous Sandstone
( )	Fluorspar	( )	Tungsten
(X)	Other (specify)	Minerals associated with copper.	

Mining methods:

Open pit, waste leaching, insitu leaching, underground.

8. Have you or any person, partnership or corporation associated with you received an approved Notice of Intention to Commence Mining Operations by the State of Utah for operations other than described herein?
( ) Yes (X) No *
If yes, list all approval numbers now under surety:
* Kennecott's Tintic Mines Division may have requested approval.

PN DRAFT

9. Owner/Owners of record of the surface area within the land to be affected:

Kennecott Copper Corporation	Address	161 East 42nd Street, New York, NY 10017
U. V. Industries	Address	(Local Office) University Club Bldg, Salt Lake City, UT
The Anaconda Company	Address	(Local Office) 1849 West North Temple, Salt Lake City, UT

10. Owner/Owners of record of minerals to be mined:

Kennecott Copper Corporation	Address	161 East 42nd Street, New York, NY 10017
U. V. Industries	Address	(Local Office) University Club Bldg, Salt Lake City, UT

11. Owner/Owners of record of all other minerals within any part of the land affected:

The Anaconda Company	Address	(Local Office) 1849 West North Temple, Salt Lake City, UT

11a. Have the above owners been notified in writing?
(X) Yes ( ) No

12. Source of Operator's legal right to enter and conduct operations on land to be covered by the Notice:

Legal documents, including deeds, easements, mining claims, agreements, licenses, etc.

13. Approximate acreage to be disturbed:

Mine	3,100 acres
Mine waste disposal	8,000 acres
Excess mine water disposal	2,700 acres
Ore transfer - mine to process	400 acres
Ore processing facilities	1,800 acres
Tailing disposal	6,000 acres
Excess process water disposal	1,000 acres
Total	23,000 acres

14. Give the names and post office addresses of every principal Executive, Officer, Partner, (or person performing a similar function) of Applicant:

	Name:	Title:	Address:
a.	B. B. Smith	General Manager Utah Copper Division	P. O. Box 11299 Salt Lake City, UT 84147
b.	H. H. Kremer	President Metal Mining Division	161 East 42nd Street New York, NY 10017
c.	F. B. Milliken	President	161 East 42nd Street New York, NY 10017

PN DRAFT

15. Has Applicant, any subsidiary or affiliate of any person, partnership, association, trust, or corporation controlled by or under common control with Applicant, or any person required to be identified by Item 14, ever had an approval of a Notice of Intention withdrawn or has surety relating thereto ever been forfeited?

( ) Yes (X) No

If yes, explain:

STATE OF UTAH)
: ss
COUNTY OF SALT LAKE)

I, B. B. Smith, having been duly sworn depose and attest that all of the representations contained in the foregoing application are true to the best of my knowledge; that I am authorized to complete and file this application on behalf of the Applicant and this application has been executed as required by law.

KENNECOTT COPPER CORPORATION
Utah Copper Division

By B. B. Smith
Its General Manager

Taken, subscribed and sworn to before me the undersigned authority in my said county, this 9th day of August, 1976.

Keith L. Hansen
Notary Public

My Commission Expires:
November 1, 1979

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MINING APPLICATION

NO. ACT-035-002

DATE: August 9, 1976

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING
1588 WEST NORTH TEMPLE
SALT LAKE CITY, UTAH 84116

MINING AND RECLAMATION PLAN

PREAMBLE

Planning for rehabilitation of an operation mine is always difficult. This difficulty is magnified many times when the expected life of the mine may be decades or even a century. Such is the case of the Bingham Mine. It is not even possible to determine the approximate land uses at the end of the mining operation. For that reason, this rehabilitation plan cannot be as specific as that of other, more short-lived, operations.

However, regardless of the end use of the land, it is the intention of Kennecott to leave the land in a stable and productive condition consistent with location, possible uses, and topography, recognizing that since the mine is open pit in nature that the land itself cannot be restored as it was prior to commencement of mining.

To accomplish these objectives, Kennecott will maintain a program of experimentation and will apply the best available technology toward rehabilitating each piece of land as it moves from mining to other uses. A detailed annual report of reclamation work performed during the preceding year will be developed for review by the Board of Oil, Gas and Mining. These annual reports will be utilized by Kennecott and the Division in jointly establishing reclamation plans for the forthcoming year with the intent of accomplishing the overall objectives.

The following plan represents an attempt to outline some of the possible land uses and describe the steps the company will take to reach the general objectives.

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MINING AND RECLAMATION PLAN

A. Applicant - Kennecott Copper Corporation, Utah Copper Division.

B. Type of Operation - Mining and processing for mineral extraction. Mining method and processing facilities are continually modified and updated to meet natural and physical requirements and conditions of market, technology, governmental regulation, economics and other factors. Large scale mining operation has been underway since about 1904. Remaining life of the mining operation will depend upon many things including the likelihood that eventual mineral shortages and improved technology will justify mineral extraction from materials now considered waste. It is, therefore, impossible to predict a terminal point for the mining and processing operations. However, it is not expected that this terminal point will occur within the next 50 years.

The Utah Copper Division operations extend from in and around the Bingham Mine to just beyond the north end of the Oquirrh Mountains near Magna (see CONFIDENTIAL map, Exhibit A). The operation is divided into the following areas which are identified on Exhibit A, shown in schematic arrangement on process diagram Exhibit B, and covered separately herein:

1. Mine
2. Mine Waste Disposal
3. Excess Mine Water Disposal
4. Ore Transfer-Mine to process
5. Ore Processing Facilities
6. Tailing Disposal
7. Excess Process Water Disposal

1. Mine Area

The mine area from which overburden and ore is removed comprises approximately 3100 acres.

Prior to open pit mining which began in 1904, this mountainous area had been a source of timber and was being used for underground mining operations with associated surface facilities, residences, businesses, etc. As open pit mining has expanded, these other used have been discontinued.

Determination of a definite use for the area after mining operations cease is difficult due to many uncertainties involved, but will be determined in light of potential

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After crushing, the ore will be conveyed out of the pit to a new grinding facility located approximately one mile north of Copperton. Waste will be hauled by truck to the existing waste dumps.

The ore body is in the shape of a plug, or an inverted cone. As the mine progressively develops in depth, all benches must be pushed farther and farther back to gain necessary operating space and assure safety by maintaining a stable slope ranging from 25 1/4 to 29 1/4 from horizontal. Modernization and other technological advances, such as innovative dewatering techniques, will allow maintenance of stable pit slopes as a function of specific rock type and moisture conditions in the various sections of the mine. At the conclusion of mining, pit sides will be stabilized at a slope of 30° to 50° from horizontal as a function of location in the mine.

The mining sequence includes drilling, blasting, loading by shovel and haulage by trucks, waste cars and ore cars. At the present time, approximately 108,000 tons of ore and 380,000 tons of waste are removed during each operating day. Ore is transported by rail to process plants, and waste is deposited in outlying areas of the mine (see Area 2). Equipment size continues to increase through improved materials and technology. Haulage trucks now in use at the mine range in capacity from 65 tons to 150 tons. Shovels range from 6-yard to 25-yard capacity.

It is expected that in the future other mining methods such as underground mining and in-situ extraction may become economically feasible and practiced for recovery of lower lying minerals in the Bingham mine area.

At present, it is not possible to perform any revegetation on active dumps or in the pit as open pit mining progresses because the total area is continually being disturbed. At the conclusion of open pit mining, sides will be stabilized at a slope in the range of 32 1/4 to 37 1/4 from horizontal. It is very unlikely that the pit could be revegetated at that time because most of the exposed surface will be solid rock containing natural sulfide mineralization. Meteoric water and atmosphere will generate acidic conditions from these minerals. The bottom of the pit may eventually fill with water; however, the level can be limited by discharge through one of the available railroad tunnels. Such discharge water would either be processed for mineral extraction and neutralization, impounded, used for other acceptable purposes or otherwise safely disposed of as may be

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determined in the future by the appropriate regulatory agency.

Surface facilities including buildings, railroad tracks, power lines and poles and equipment will be removed from the mine area when no longer needed in the mining or subsequent operations.

2. Mine Waste Disposal Area

Waste material or overburden removed from the mine is deposited in outlying areas in Bingham Canyon, on the west front of the Oquirrhs and in Butterfield Canyon. Total area comprises approximately 8000 acres. Leaching and precipitation operations are conducted for recovery of minerals from this waste material.

Prior to use for waste disposal, the area ranged in elevation from 5200 feet to 7900 feet above sea level and had been a source of timber, was used for dry farming, grazing, and underground mining with associated facilities, residences, business, etc. These uses have been discontinued as waste material has covered the area. However, some grazing and dry farming continues on low lying perimeter areas.

It is expected that leaching and precipitation operations and possibly other processing methods will be used for mineral extraction from the dumps long after final deposition of mine waste is completed. Some possible ultimate uses of the area may include:

A source of borrow and granular material
Residential, commercial or industrial development
Recreational
Scenic
Other

Little or no vegetation exists on areas covered by waste dumps. Vegetation on area that will eventually be covered consists of grasses, forbs, shrubs and trees such as juniper, mountain mahogany and maple. The pH of undisturbed soils ranges from 4.5 to 7.5 as determined by mixing 100 gm of soil and 100 ml of distilled water. Waste dumps tend to become acidic from meteoric water and atmosphere and from the leach solutions (pH 3 - 3.5) that are distributed over the dumps.

The leaching and collection system, including the protection against escape of leach water from waste dumps into lower lying areas, is shown in schematic arrangement on Exhibit D. It consists of reservoirs, pumps and

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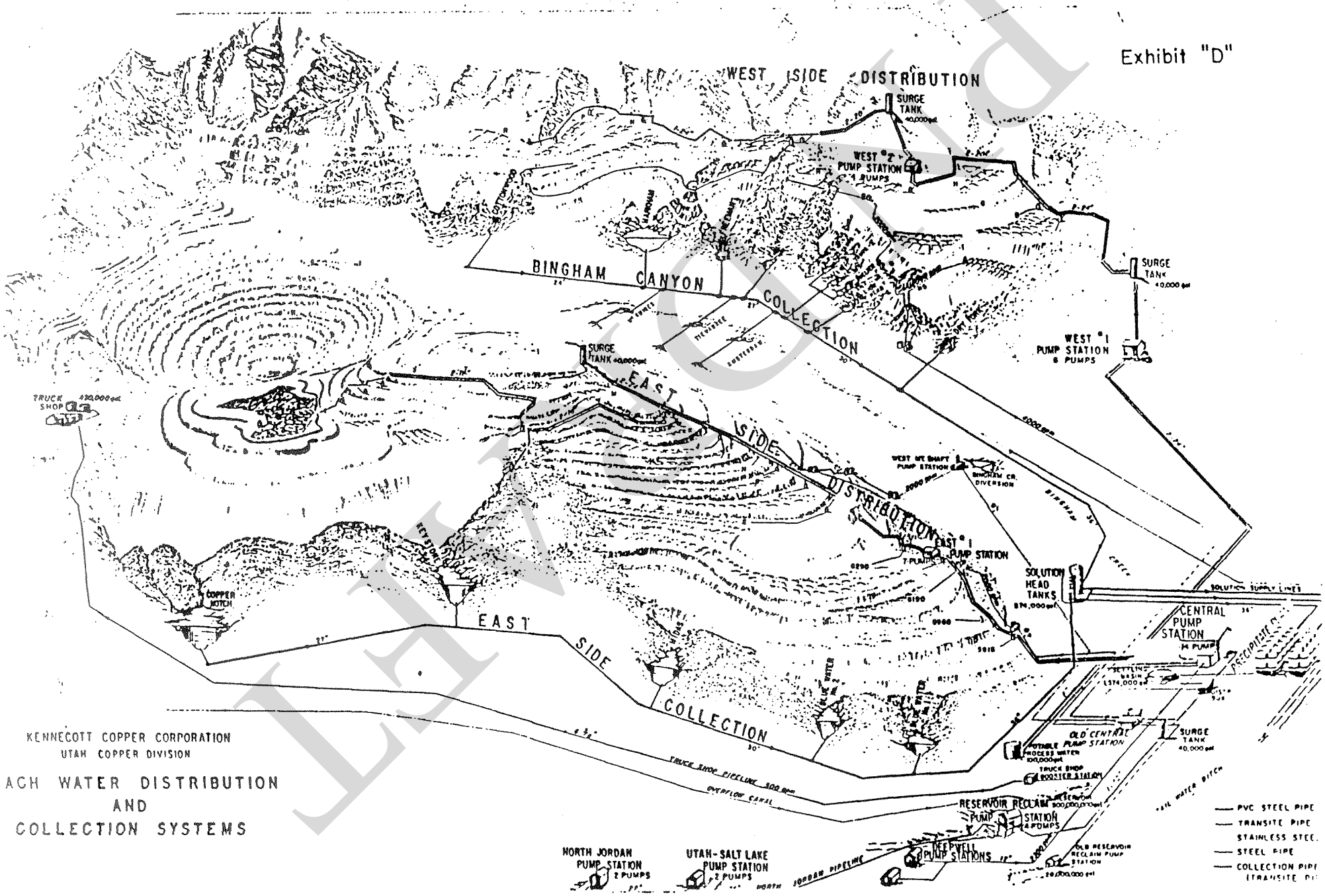
piping to distribute solution on the dumps, pipelines from dams to the precipitation plant and an overflow canal to collect and convey any escaping solution to the reservoir. Leach solution is processed at the precipitation plant for mineral recovery. During extremely wet or high runoff period, excess leach solution may accumulate in the reservoirs and require discharge to the Excess Mine Water Disposal Area (Area 3).

As noted under Area 1, waste dumps presently comprise approximately 2,400,000,000 tons of material and are increasing at the rate of 380,000 tons per day. Waste is transported from the mine by trucks and is dumped over the banks to a natural angle of repose. Rail dumps are terraced at approximately 100 foot levels which progress out generally in a uniform manner. Truck dumps are higher and are extended out at the same level without terracing. Problems in dumps stability have been encountered on some large truck dumps which are generally associated with inadequate foundation material underlying the dumps. Slides have occurred from failure of this underlying or foundation material. However, because these dumps are active, no attempt is needed to stabilize these areas other than monitoring and precautionary systems for safety. Movement detection switches and movement noise detectors have been installed to detect any dump movement prior to failure. These systems will continue to be maintained and improved as mining progresses. In addition, computer models have been developed to simulate conditions in dumps to estimate the position of the dump crest when stability becomes critical. In the future, control points or a survey net may be established to check dump movement and settlement. After dumps become inactive for dumping, other steps will be implemented so that all dumps are left in a safe and stable condition. Techniques to accomplish this may include terracing and hydraulic methods consistent with subsequent use determined at that time. Necessary collection systems will be provided to contain natural seepage in the area. Dikes and ponds will be constructed on the upper levels of dumps to prevent slope wash and possible mud slides.

No major revegetation is planned because the majority of the waste material contains natural sulfide mineralization which becomes acidic when exposed to meteoric waters and the atmosphere. However, in some small areas of the dumps where there is little or no sulfide mineralization, tests are being conducted to determine possible methods and types of vegetation suitable for these areas. These tests include aerial

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Exhibit "D"



KENNECOTT COPPER CORPORATION
UTAH COPPER DIVISION

ACH WATER DISTRIBUTION AND COLLECTION SYSTEMS

LEGEND

seeding of approximately 20 acres with grasses, forbs and shrubs, and hand planting of a two-acre control area for more detailed study which is being conducted jointly with the U. S. Forest Service. If and when revegetation practices or methods are developed which would make vegetation economically practicable, such practices and methods will be employed on the dumps. When no longer needed in the mining, mineral extraction or subsequent operations, all surface facilities, including buildings, above ground utilities, railroads, piping and equipment will be removed. Much of this type effort has been accomplished in the past, including demolition of buildings in the city of Bingham Canyon, removal of trackage from old rail dumps and removal of bridges in Carr Fork and other demolition and clean up work. Appropriate revegetation of these areas will take place.

3. Excess Mine Water Disposal Area

This involves an approximate 2700-acre area upon which excess mine water is transported and contained in ponds for evaporation. Facilities may be installed at a later date for treatment of water prior to disposal.

Prior to use for excess mine water disposal, which commenced in 1935, the land was used for grazing and dry farms. After construction of the Bingham Creek reservoir at the mouth of Bingham Canyon in 1965, discharge to the evaporation pond area was considerably reduced and now required only during extremely wet or high runoff periods. Currently, much of the land is used for dry farming and sand and gravel operations.

Possible future uses of the land when no longer needed in the mining operation may include one or more of the following:

Sand and gravel operations
Farming
Water storage and evaporation
Recreational
Sludge or water disposal by others
Residential, commercial or industrial development
Other

In addition to dry-farm wheat, the area contains natural grasses, forbs and shrubs. The pH of the natural soils ranges from 6.5 to 7.5 as determined by mixing 100 gm of soil and 100 ml of distilled water. Surface elevation ranges from approximately 4675 feet to 5200 feet above sea level.

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Residues of evaporation are acidic and contain soluble ions of iron, aluminum, magnesium and sulfate. Depending upon specific source of excess water from mine operation, water analysis will range between the following values:

pH	4.7 - 3.2	Fe	100 - 2,400 ppm
TDS	2,400 - 6,700 ppm	Cl	70 - 180 ppm
SO_4	1,400 - 52,000 ppm	Ca	400 - 500 ppm
Al	5 - 4,600 ppm	Cu	4 - 100 ppm
Mg	50 - 6,300 ppm		

Evaporation ponds are contained and separated by dikes constructed of earth from the area. Dikes are approximately four feet high and twelve feet wide on top. Side slopes are approximately two horizontal to one vertical. Dikes are monitored and maintained to prevent spill of solution.

At such time as area is no longer needed for excess water disposal or other purposes associated with mining operation, stabilization will be accomplished consistent with subsequent use determined at that time. Stabilization will take into account all pertinent factors including surrounding land usage, potential use, and may include removal or covering accumulated salts, treatment with neutralizer, grading and revegetation work. In any event, area will be left in a safe, table condition suitable for future use and without hazard of erosion or surface water accumulation.

Because the area appears better suited for future uses in farming than other vegetative purposes, any revegetation work would most likely be accomplished to suit farming requirements. In the event of farming, or soil stabilization, this would involve testing by standard agricultural analysis (e.g. Utah State Soils Laboratory), application of fertilizer and cultivation. Such crops as wheat, barley, alfalfa, wheatgrass and clover could be raised. irrigation could be considered if sufficient water becomes available.

There will be no changes in the excess mine water disposal area as a result of modernization. Kennecott is conducting an extensive surface water study. The results of this study may change water usage practice. Kennecott is also conducting a detailed five-year study relevant to this area in cooperation with the State of Utah and Salt Lake County. Any recommendations for amendment of this area will be forthcoming after the study is completed.

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4. Ore Transfer - Mine to Process Area

From the mine area at Bingham, ore was transported to the processing plants near Magna by railroad cars. Instead, the ore will be conveyed to a grinding plant located one mile north of Copperton. Approximately 37 acres of right-of-way between the mine and grinding plant will be disturbed by the construction of the conveyor. After construction is completed, the right-of-way will be replanted with a mixture of grass seeds. When the conveyor is no longer needed for mining or other activities, the surface structures will be removed. The area will then be returned to the farming and pasture usage currently ongoing on the property.

The existing railroad between the mine and the facilities near Magna will be maintained and will be used for the transport of precipitate copper and general freight.

Land along the railroad is used primarily for dry farming. It may have been previously used for grazing.

When no longer needed in the mining operation, the railroad may be used to serve future industrial or commercial needs. Otherwise, the railroad right-of-way will have potential use for:

Residential, commercial or industrial development
Utility right-of-way
Roadway
Other

In addition to dry farm wheat, the area contains natural grasses, forbs and shrubs. The pH of the soils ranges from 6.5 to 7.5 as determined by mixing 100 gm of soil and 100 ml of distilled water. Surface elevation ranges from approximately 5400 feet to 4500 feet above sea level.

At such time as the railroad is no longer needed in the mining or processing operations or for subsequent use, trackage and surface facilities will be removed and area left in condition suitable for conversion to other use determined at that time. Revegetation will be accomplished if appropriate for the subsequent use when the trackage and surface facilities are removed and the right-of-way has no future use as such.

5. Ore Processing Facilities Area

Over the years ore processing facilities have been added, changed, enlarged and improved to suit needs and

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conditions. Many more such modifications are expected in the future. Facilities at one time consisted of the Arthur, Magna, and Bonneville concentrators, power plant, railroad car and engine shops, lime plant, foundry and other supporting and related surface structures and utilities. Total land area comprises approximately 1600 acres. Other separated facilities include water supply and distribution systems and maintenance shops. This represents a total additional area of approximately 200 acres.

As modernization takes place, ore will be received via conveyor at a coarse ore stockpile located at a new ore grinding plant north of Copperton. Ore will be reclaimed from beneath the pile and will be ground in semi-autogenous (SAG) mills and ball mills. The ground ore will be gravity slurried, via pipeline, to the existing concentrators for additional processing through the existing facilities.

The grinding plant will be located on a 100-acre site currently under cultivation for wheat. Following construction, the disturbed but undeveloped areas will be replanted. When the grinding plant is no longer needed for mining or other activities, the surface structures will be removed. The area will then be returned to agriculture or will be available for other types of development.

The pipeline corridor will pass through areas used for wheat cultivation, pasturage, railroad right-of-way, manufacturing, and mining. Approximately 210 acres of the corridor will be on land previously undeveloped for mining or manufacturing purposes. After construction is completed, the disturbed areas within the pipeline right-of-way will be replanted with a mixture of grass seeds. When the slurry pipeline is no longer needed for mining or other activities, the surface structures will be removed. The area will be returned to agriculture or will be available for other types of development.

Possible future uses of the area when no longer needed for ore processing may include one or more of the following:

Other industrial or commercial operations
Residential
Other public or private use

Prior to construction of initial process facilities in about 1906, vegetation consisted of natural grasses, forbs and shrubs such as sagebrush, oak, service,

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mahogany and juniper. Most of this vegetation remains in undisturbed portions of the area. Other vegetation has been added for stabilization and appearance. This includes trees such as Russian Olive and Chinese Elm, and plants such as alfalfa, clover and various grasses. The pH of natural soils ranges from 6.5 to 7.5 as determined by mixing 100 gm of soil and 100 ml of distilled water. Surface elevation ranges from approximately 4200 feet to 5400 feet above sea level.

At such time as the surface facilities, including buildings, utilities, railroads, equipment, etc., are no longer needed for ore processing or related purposes and if not convertible to some other use, they will be razed and/or removed. All hazardous conditions will be eliminated and ground surfaces stabilized and planted using vegetation types natural or subsequently determined to be best suited to the area.

6. Tailings Disposal Area

Tailing produced from the ore concentrators is discharged as a slurry into a 6000-acre tailing pond adjacent to north of the concentrators. The original ground surface which ranged in elevation from 4210 feet to 4340 feet above sea level is believed to have been a sparsely vegetated, highly alkaline soil such as present perimeter areas. Prior to use for trailing disposal, which began about 1916, some limited livestock grazing may have been attempted.

In its terminal condition for deposition, the tailing pond may be considered as a resource. It will contain unrecovered minerals that eventually may justify reprocessing for recovery. Tailing material also has value as fill for land reclamation and construction such as currently used for highway embankment work. Studies have demonstrated that mixing tailing material with alkali soils enhances capability of sustaining a wide range of vegetation. Considerable areas of Western Utah and Nevada may be reclaimed for agricultural and other purposes by this material.

When no longer needed for foregoing purposes, the tailing disposal area will have potential use for one or more of the following:

Farming
Residential, commercial or industrial development
Recreational
Scenic Attraction
Other

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Natural vegetation in the area includes salt grass, wire swamp grass, cattails and salt bush. The pH of the natural soils ranges from 8.5 to 9.0 as determined by mixing 100 gm of soil and 100 ml of distilled water. High clay content of the soil, close proximity to Great Salt Lake, and poor drainage would have contributed to the highly alkaline condition.

The tailing pond is a continually rising area (currently rising at about 3-1/2 feet per year) and is contained by a dike which extends completely around its perimeter. This dike must also be continually raised and be maintained in a stable condition. Initially, dike fill was rock waste from the mine; later fill hauled from areas adjacent to the concentrator plants was used; and more recently, dike build up is being accomplished by relocation of previously placed dike fill material by drag line. This is followed by sealing of the pond side of the dike with a berm of coarse tailing distributed by a perimeter pumping system. To obtain adequate dike stability, the outside of the dike is maintained at 5 to 1 slope as recommended by consultants on slope stability. Periodic inspections are conducted by consultants to assure long-range stability of the system. Present elevation of the pond surface averages approximately 4345 feet above sea level. Dewatering of the tailing pond is by means of two buoy-supported siphon lines which remove clear water, most of which is reclaimed as concentrator process water.

The area near the top of the dike which is subject to being disturbed in the subsequent dike build up, and roads on the dike, are stabilized and will be stabilized to prevent wind erosion. Farther down the outside slope where the surface is permanent, revegetation is practiced. Current plantings include several plant and tree species along the dike slopes. Success has been achieved with Japanese millet, rye, yellow sweet clover, wheatgrass, brome, range alfalfa and vetch plants, and Russian olive, larch and elm trees. Because of the continually rising tailing deposition, permanent stabilization or revegetation of the pond surface is not possible as long as operation continues. However, wind erosion control is and will be practiced. About 90% of the pond surface is kept moist at all times by the natural meandering of the tailing stream discharged into the pond. The remaining areas are treated by several different methods to stabilize the surface. Where possible, the surface is wetted by tailing distribution lines installed for this purpose. If this is not feasible, and the dry areas are accessible to land vehicles, the surface is treated with stabilizing agents.

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If not accessible by land vehicles, dry areas are treated by application of a polymer product with aircraft. Use of fast growing grasses is also being investigated for wind erosion control.

Based upon current operating rates and practices, by the year 2025, the tailing pond surface will be reduced to approximately 3,000 acres and the average elevation will be approximately 4560 feet above sea level.

When no longer needed for tailing deposition, mineral recovery or material source, grading and revegetation of dike slopes not already done will be completed. Drainage will not be a problem. As noted previously, the outer surface of the dike will have an average 5 to 1 slope. The pond surface will have, or will be graded to, a natural slope which will be more than adequate for drainage needs, considering that this is a region of low precipitation and the surface can adequately absorb normal precipitation.

Revegetation is also receiving consideration by Kennecott and other mining companies for stabilization and subsequent reclamation of inactive tailing pond surfaces. To this end, test work is being conducted to ascertain which species of vegetation are suitable, and procedures required to obtain adequate vegetation growth. Planting Japanese millet at the rate of 10 to 15 pounds per acre with fertilizer may be a means of vegetating the tailing pond surface after deposition is completed and to a limited extent during the deposition process. The surface of the tailing pond will be stabilized using the most practicable technology available upon the termination of the deposition of the tailing.

7. Excess Process Water Disposal Area

This comprises a treatment plant, sludge disposal area, canals and diversion facilities now existing, as well as possible additional treatment facilities, water storage and evaporation ponds and other facilities that may be required in the future. It involves perimeter areas around the tailing disposal area (Area 6) comprising a total of approximately 1000 acres. Any excess water is discharged under the provisions of NPDES Permit UT-0000051. The discharge criteria may be modified in the future as a result of the surface water study cited in Section 3.

Most of the area remains in a natural state and may have been used for very limited grazing prior to the early 1900's.

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Possible future uses of the area when no longer needed for water treatment and disposal may include one or more of the following:

Other industrial or commercial operations
Residential development
Other public or private use

Natural vegetation in the areas includes salt grass, wire swamp grass, cattails and salt bush. The pH of the natural soils ranges from 8.5 to 9.0 as determined by mixing 100 gm of soil and 100 ml of distilled water. The area is comparable to the original ground surface of the tailing disposal area. Surface elevation ranges from 4210 feet to 4300 feet above sea level.

Canals have been constructed around the tailing pond area to convey natural flows and drainage and excess water from tailing pond and treatment plant to the Great Salt Lake. Sludge from the treatment plant is deposited in a low diked area.

At such time as the surface facilities including treatment plant, piping and utilities are no longer needed, and if not convertible to some other use, they will be razed and/or removed. Sludge ponds, evaporation ponds and possible other areas will likewise be left in condition suitable for conversion to other use determined at that time. This may involve filling or covering with tailing and other stabilization and revegetation work comparable to that designated for the tailing disposal area. Canals will most likely be left indefinitely for conveyance of natural surface flows and drainage to Great Salt Lake.

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APPENDIX B - TAILINGS MODERNIZATION PROJECT
FUGITIVE DUST ABATEMENT PROGRAM
(PAGES ADDRESSING THE EXISTING IMPOUNDMENT ONLY)

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APPENDIX C - FINAL CLOSURE PLAN, GROUND WATER ISSUES
KENNECOTT TAILINGS IMPOUNDMENT
(WITHOUT PLATES)

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APPENDIX D – ENVIRONMENTAL GEOCHEMISTRY OF THE BINGHAM CANYON PORPHYRY COPPER DEPOSIT, UTAH

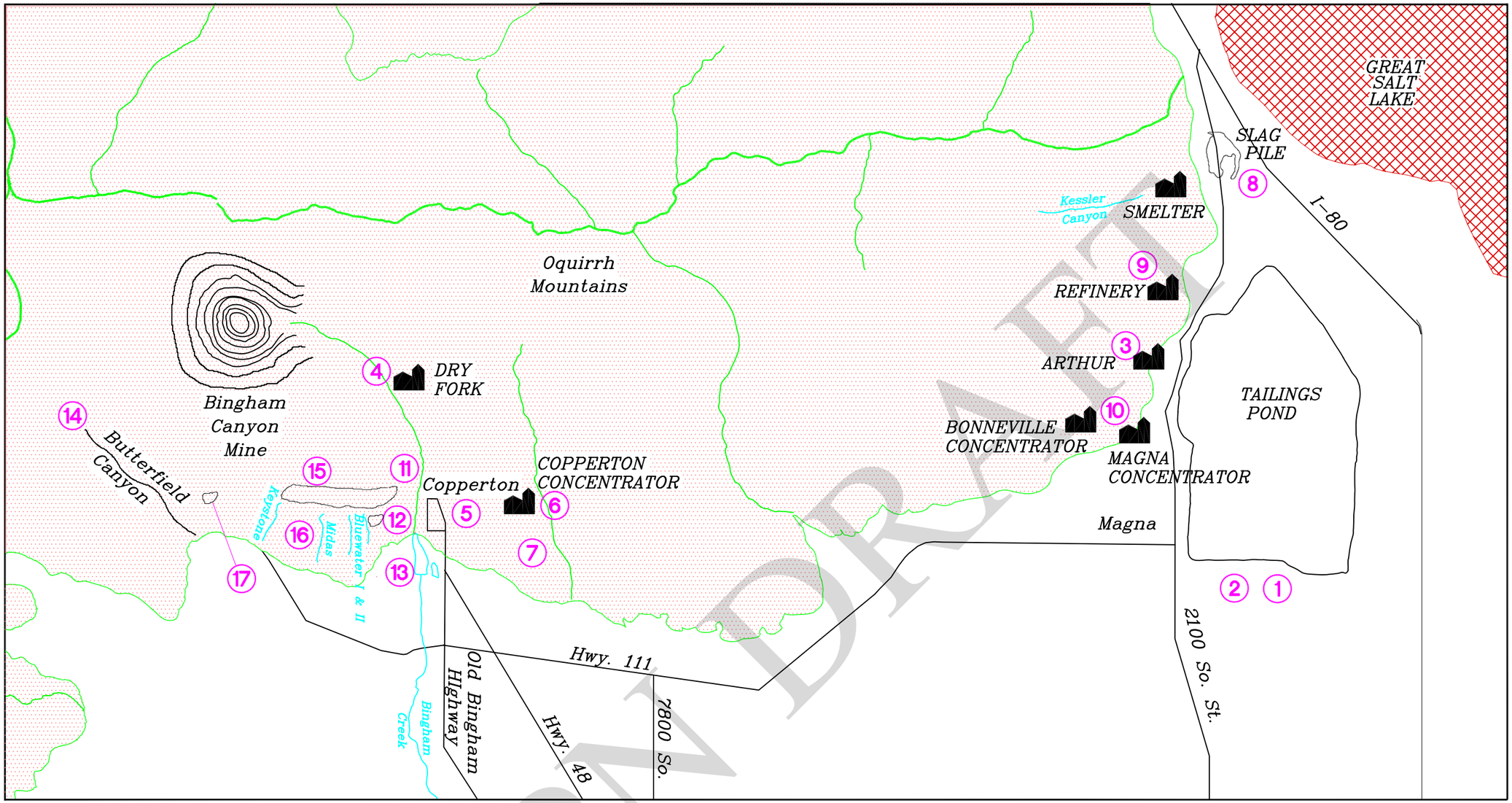
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APPENDIX E – GEOCHEMICAL EVOLUTION OF SULPHIDE-BEARING WASTE ROCK SOILS AT THE BINGHAM CANYON MINE, UTAH

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APPENDIX F – VEGETATIVE COMMUNITY ANALYSIS OF BIOSOLIDS TEST PLOTS AFTER FIVE YEARS OF GROWTH

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RECLAMATION PROJECT SITES

1. TAILINGS IMPOUNDMENT REVEGETATION
2. TAILINGS IMPOUNDMENT TALL TREE PROGRAM
3. ARTHUR REHABILITATION /RECLAMATION
4. BINGHAM CANYON ENTRANCE ROAD
5. COPPERTON/BINGHAM CANYON CORRIDOR PROJECT
6. COPPERTON CONCENTRATOR 4TH LINE EXPANSION
7. REVEGETATION DEMONSTRATION PLOT
8. WETLANDS CREATION/ENHANCEMENT
9. REFINERY BORROW PIT
10. NORTH MILL AND CONCENTRATOR
11. PRECIPITATION PLANT LAUNDERS
12. BLUEWATER I REPOSITORY
13. LARGE BINGHAM CREEK RESERVOIR
14. BUTTERFIELD WASTE ROCK REMOVAL ACTION
15. BINGHAM CANYON MINE–SLUDGE STORAGE/WASTE DUMPS
16. EASTSIDE COLLECTION SYSTEM
17. LARK WASTE ROCK/ CRAPO REPOSITORY

PLANT PROJECTS GROUP		
SCALE: 1"=8500'		DATE
DESIGNED BY	LJW	8/11/92
DRAWN BY	RMG	8/11/92
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

KENNECOTT
UTAH COPPER

ORIENTATION MAP OF RECLAMATION AREAS

Job No. --- Dwg. No. 451-T-013 REV. A DATE 8/11/92

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EXPLANATION

IGNEOUS ROCK TYPES

TERTIARY — Eocene

Tlatp — Quartz Latite Porphyry
Andy dike and apophyses. Medium brown and light greenish-gray, hornblende-biotite quartz latite porphyry. Hornblende is altered to phlogopite and/or chlorite within the pit area. Hosts late stage chalcopyrite and pyrite mineralization. Distinguished from other latitic dikes by the presence of relatively large quartz phenocrysts and higher percentage of aphanitic groundmass. Groundmass usually contains considerable hornblende.

Tlap — Latite Porphyry
Fortuna sill, Main Hill and Starless dikes, and apophyses. Light to medium gray, hornblende-augite-biotite quartz latite porphyry. Ferromagnesian minerals are altered to phlogopite and chlorite in pit area. Locally contains ore grade chalcopyrite, bornite, and pyrite mineralization, both disseminated and in veins.

Tlx — Endoskarn
Intrusive rock, the composition of which is changed due to assimilation of calcareous sedimentary rocks. Usually found at contact zone between monzonite and major limestone units. Texture is igneous; composition is extremely variable. Dominant minerals include actinolite, orthoclase, phlogopite, and epidote. Calcite veining is common.

Thp — Hybrid Quartz Monzonite Porphyry
Quartz monzonite porphyry, the composition of which is changed due to assimilation of monzonite. Medium gray, amphibole-biotite quartz monzonite porphyry. Amphibole is altered to biotite; plagioclase is altered to clay and sericite. Calcite veining is locally present. Contains ore grade chalcopyrite-pyrite mineralization.

Tbqmp — Quartz Monzonite Porphyry
Bingham Stock. Light gray, amphibole-biotite quartz monzonite porphyry. Amphibole is altered to phlogopite and quartz plagioclase is altered to sericite and clay. Calcite veining is locally present. There are no exposures of unaltered rock. Contains pyrite, chalcopyrite, bornite and molybdenite mineralization. Inferred source of mineralizing fluids.

Tpqm — Porphyritic Quartz Monzonite
Ohio Copper dike. Medium gray to greenish gray, porphyritic, amphibole-biotite quartz monzonite. Pale pink orthoclase and white plagioclase phenocrysts in a phanaritic groundmass. A distinct late phase of Bingham and Last Chance (quartz) monzonite. Calcite veining is locally present. Pyrite occurs in veins

Tm — Monzonite
Bingham stock, Phoenix dike, and Last Chance stock. Medium to dark gray, augite-biotite-amphibole (quartz) monzonite. Where altered, augite is replaced by actinolite, chlorite, phlogopite, and quartz. Some plagioclase is replaced by orthoclase. Calcite veining is locally present. Contains pyrite, chalcopyrite, bornite and molybdenite mineralization. Original magnetite is replaced by sulfide minerals. Molybdenite occurs primarily in veins. Main ore host.

SEDIMENTARY ROCK TYPES

PENNSYLVANIAN — Upper

OQUIRRH GROUP

BINGHAM MINE FORMATION
MARKHAM RIDGE MEMBER

IPbmm — Quartzite and Calcareous Sandstone
Tan to light gray orthoquartzite and calcareous quartzite, interbedded with thin calcareous sandstone and sandy limestone beds. Locally laminated and crossbedded. Calcareous sandstone and sandy limestone beds are altered to hornfels. Quartzite (qzt), limestone (ls), and thin calcareous sandstone and sandy limestone (ss), are differentiated.

BINGHAM MINE FORMATION
CLIPPER RIDGE MEMBER

IPbmc — Quartzite, Limestone, and Calcareous Sandstone
Tan to light gray orthoquartzite and calcareous quartzite, interbedded with limestone, and thin calcareous sandstone and sandy limestone beds. Locally laminated and crossbedded. Two large cherty limestones are interbedded near base. Limestones are altered to skarn. Calcareous sandstone and sandy limestone beds are altered to hornfels. Base of formation is at base of Jordan limestone bed. Quartzite (qzt), limestone (ls), and thin calcareous sandstone and sandy limestone (ss), are differentiated.

PENNSYLVANIAN — Middle

BUTTERFIELD PEAKS FORMATION

IPbp — Quartzite, Calcareous Quartzite, and Calcareous Sandstone
Tan to light gray orthoquartzite, calcareous quartzite and calcareous sandstone, cyclically interbedded with medium to dark gray, sandy, bioclastic limestone, containing thin-bedded lenses and nodules of black chert.

Breccia

1997 Topography

NOTES:
NET NEUTRALIZATION POTENTIAL (NNP) WAS CALCULATED FROM NEUTRALIZATION POTENTIAL (NP) MINUS THE ACID POTENTIAL (AP). AP IS BASED UPON ABOUT 80,000 TOTAL SULFUR VALUES FROM THE YEAR 2000 PIT SURFACE. NP IS BASED UPON 116 SOBEK NP ANALYSIS FROM OUTCROP AND BORING SAMPLES, ABOUT 250 BORING TOTAL CARBON SAMPLES, AND LITHOLOGIC DISTRIBUTION ON THE PIT SURFACE. NNP IS EXPRESSED IN TERMS OF TONS CALCIUM CARBONATE PER 1000 TONS OF ROCK. A NEGATIVE VALUE INDICATES THAT THE ROCK IS NET ACID GENERATING AND A POSITIVE VALUE INDICATES THAT IT IS NET NEUTRALIZING.

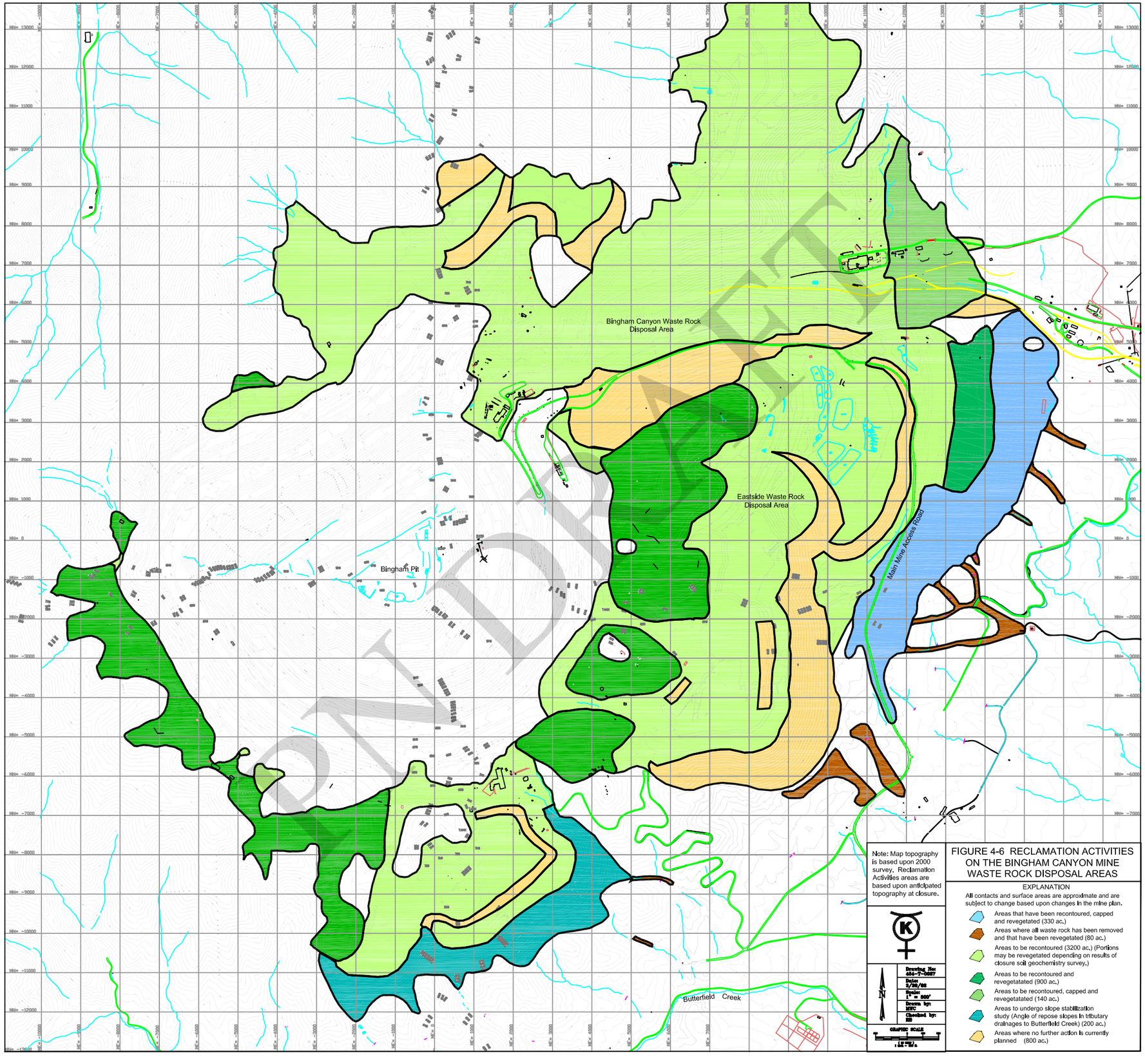
MAGNETIC DECLINATION JANUARY, 1991
31° 00' East
14° 13' Magnetic North
True North

400 200 0 400
FEET

Date	Revision
4/10/02	0
Drawing Number	
455-T-0035	

Bingham Canyon Mine

FIGURE 3-4
GEOLOGIC MAP OF THE BINGHAM PIT
SHOWING NET NEUTRAIZATION POTENTIAL


Bingham Canyon Waste Rock
Disposal Area
Eastside Waste Rock
Disposal Area
Bingham Pit
Main Mine Access Road
Butterfield Creek
Note: Map topography is based upon 2000 survey. Reclamation Activities areas are based upon anticipated topography at closure.
Drawing No: 454-2-20027
Date: 5/30/03
Scale: 1" = 800'
Drawn by: MTMC
Checked by: RH
GRAPHIC SCALE
FIGURE 4-6 RECLAMATION ACTIVITIES ON THE BINGHAM CANYON MINE WASTE ROCK DISPOSAL AREAS
EXPLANATION
All contacts and surface areas are approximate and are subject to change based upon changes in the mine plan.
Areas that have been recontoured, capped and revegetated (330 ac.)
Areas where all waste rock has been removed and that have been revegetated (80 ac.)
Areas to be recontoured (3200 ac.) (Portions may be revegetated depending on results of closure soil geochemistry survey.)
Areas to be recontoured and revegetatated (900 ac.)
Areas to be recontoured, capped and revegetatated (140 ac.)
Areas to undergo slope stabilization study (Angle of repose slopes in tributary drainages to Butterfield Creek) (200 ac.)
Areas where no further action is currently planned (800 ac.)

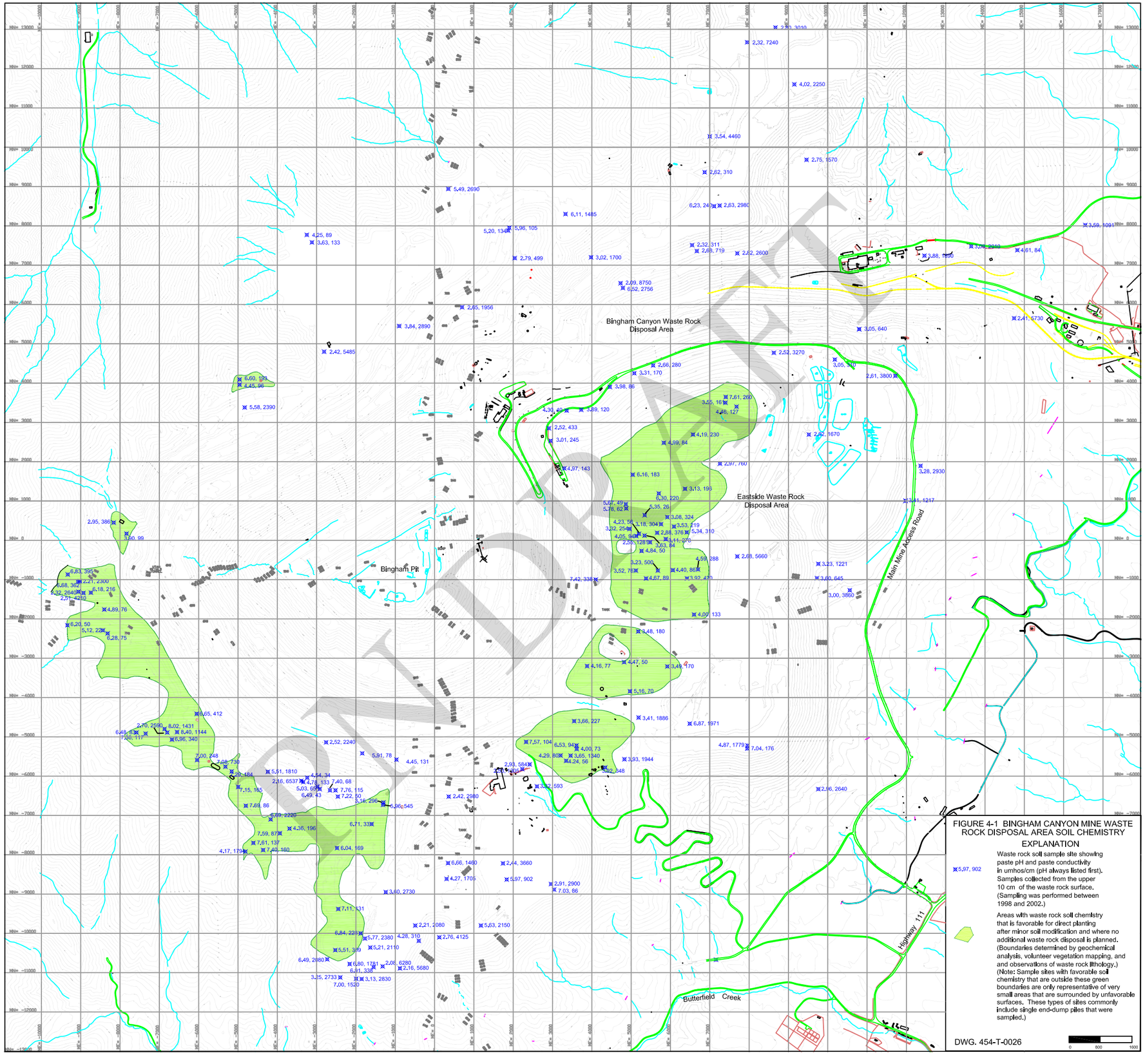


FIGURE 4-1 BINGHAM CANYON MINE WASTE ROCK DISPOSAL AREA SOIL CHEMISTRY

EXPLANATION

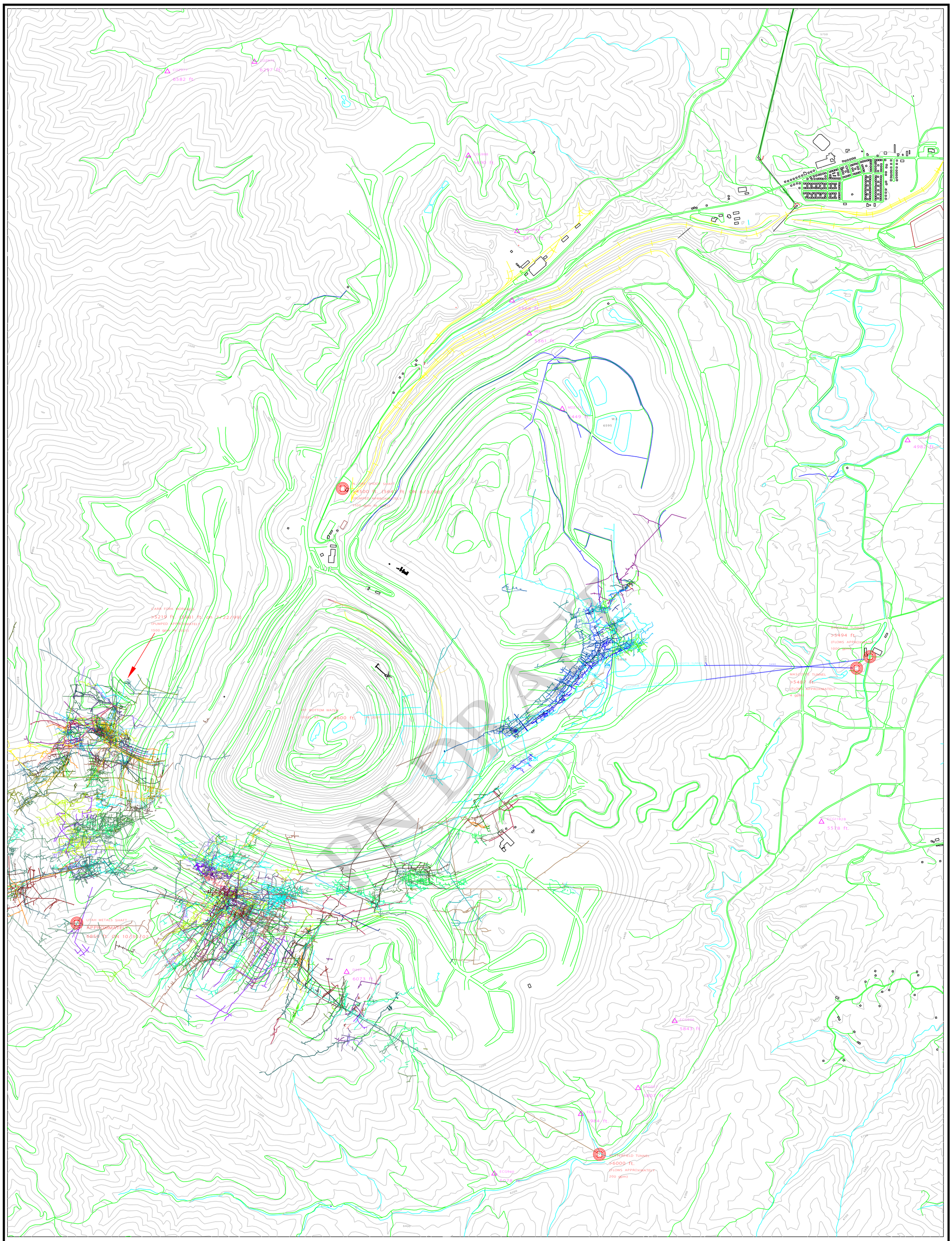
5,97, 902 — Waste rock soil sample site showing paste pH and paste conductivity in umhos/cm (pH always listed first). Samples collected from the upper 10 cm of the waste rock surface. (Sampling was performed between 1998 and 2002.)

Areas with waste rock soil chemistry that is favorable for direct planting after minor soil modification and where no additional waste rock disposal is planned. (Boundaries determined by geochemical analysis, volunteer vegetation mapping, and and observations of waste rock lithology.) (Note: Sample sites with favorable soil chemistry that are outside these green boundaries are only representative of very small areas that are surrounded by unfavorable surfaces. These types of sites commonly include single end-dump piles that were sampled.)

DWG. 454-T-0026

0 800 1600

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STRATEGIC RESOURCES GROUP

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UTAH COPPER

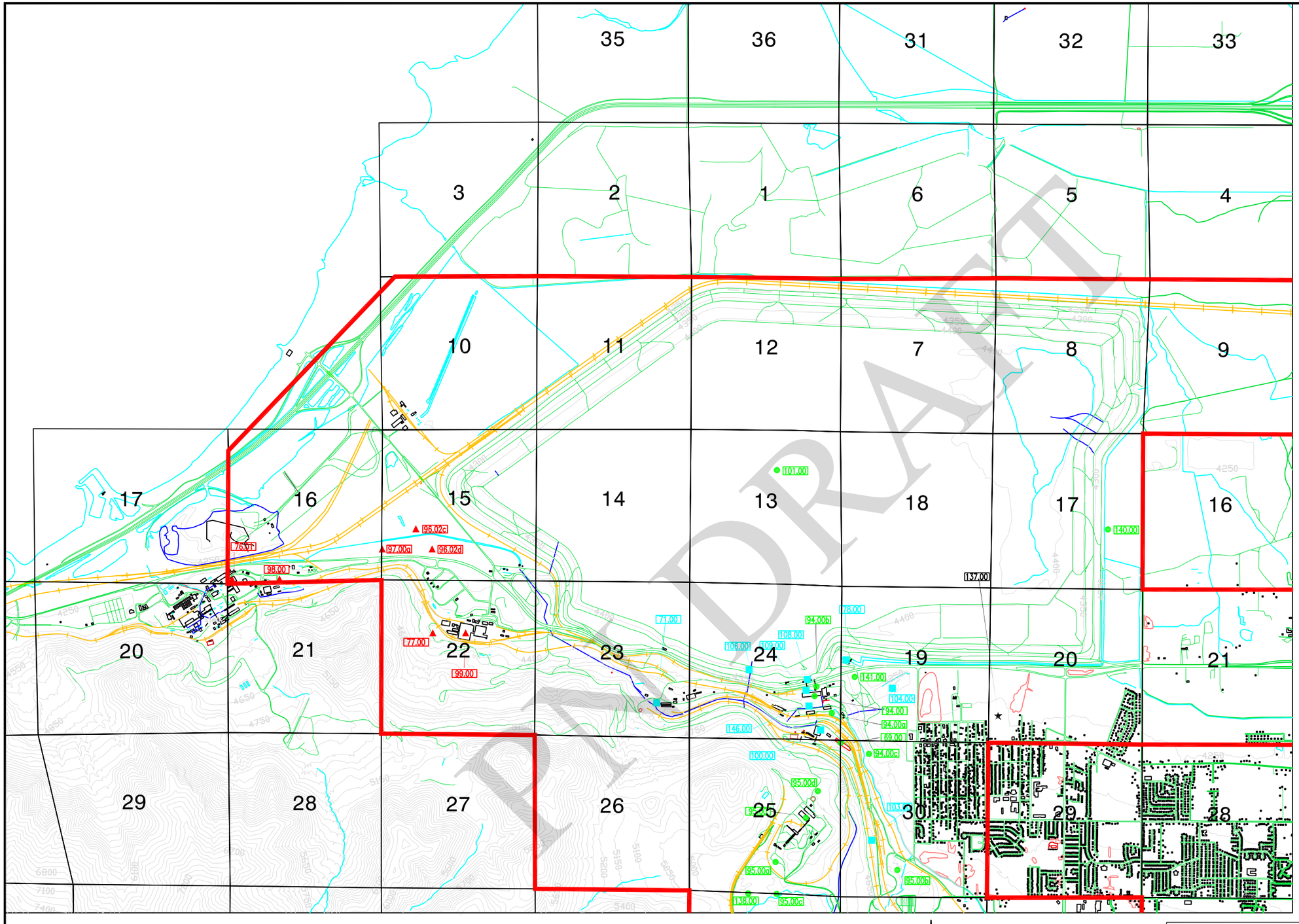
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DESIGNED BY	RKB	6/14/02
DRAWN BY	MWC	6/14/02
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

FIGURE 3-7 WATER LEVELS IN THE PALEOZOIC BEDROCK AQUIFER AROUND THE BINGHAM CANYON MINE OPEN PIT SPRING 2001

Job No. - - -

Dwg. No. 454-T-0014

REV
REV
DATE



Priority 1 Sites

- 76.01 Standby Fuel Station
- 77.00 Refinery evaporation Ponds
- 77.03 Wetlands Mitigation Area (North of I-80, ISSR Site)
- 96.02 Modernized smelter footprint
- 96.02c Smelter Area Soils: Return Canal (S11)
- 96.02d Smelter Area Soils: Slag Tailings Pipeline (S15)
- 97.00 Acid Plants- Garfield
- 97.00a Smelter Area Soils: Weak Acid Coridor (S12)
- 98.00 Acid storage facility(acid tanks)
- 99.00 Refinery
- 143.00 Miscellaneous Spills

Priority 2 Sites

- 69.00 Magna Leaching Facility
- 94.00 Magna Concentrator
- 94.00a Magna Concentrator: Railroad Slope Site
- 94.00b Magna Concentrator: Concentrate Loading Site
- 94.00c Magna Concentrator: East Debris Site
- 95.00 Bonneville Crusher
- 95.00a Bonneville CrusherScrap Yard Site (B01)
- 95.00b Bonneville Crusher: Gate Hillside Site (B02)
- 95.00c Bonneville Crusher: Little Valley Settle Site (B04)
- 95.00d Bonneville Crusher: North Slope Site (B10)
- 101.00 Magna Tailings Pond
- 138.00 Little Valley
- 140.00 C -7 Ditch
- 141.00 Magna Groundwater Plumes
- 142.00 Road Construction (as shown)

Priority 3 Sites

- 71.00 Boston Consolidated Mill (Arthur Cocen.)
- 78.00 Utah copper power plant (old plant)
- 100.00 New Power Plant
- 103.00 Rail Grave Yard
- 104.00 Diving Board Tailings
- 106.00 Magna Tailings Pond Landfill
- 108.00 Tailings Slurry Pipeline
- 109.00 Concentrate Slurry Pipeline
- 144.00 Demolition Debris (multiple sites from demolition, will be addressed in site specific facilities)
- 145.00 Railroad right of way (see tracks)
- 146.00 Truck & Rail maintenance facilities

Non-Priority Sites

- ★ 70.00 Calera Smelter (Cobalt Leaching Facility)
- ★ 137.00 Magna Soils

Note: Sites such as pipelines and canals are placed in one location

- ▲ Priority 1 site
- ● Priority 2 site
- ■ Priority 3 site
- ★ Non-Priority site
- Boundary of Permit M/035/002

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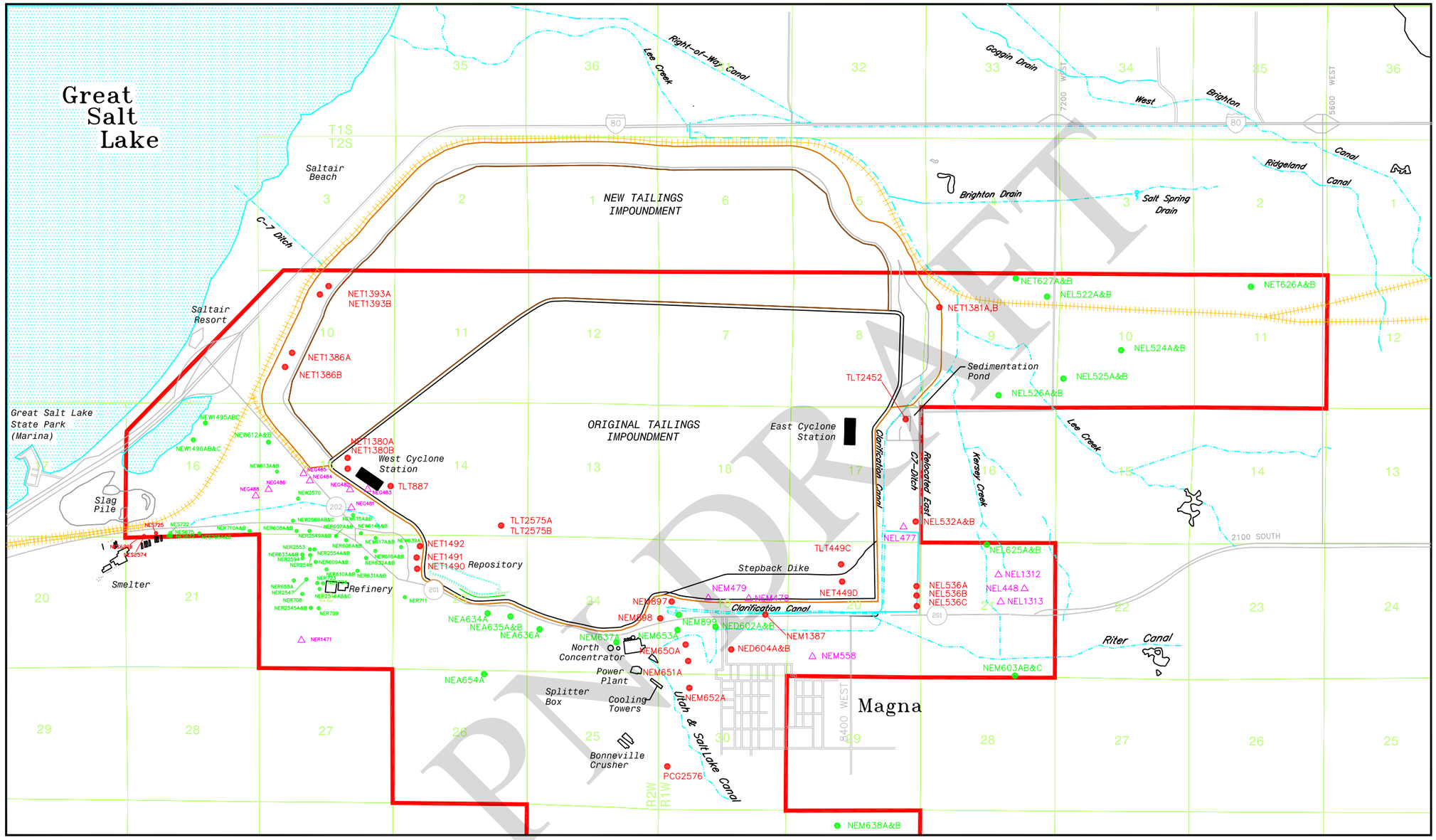
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(IN FEET)

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DESIGNED BY	RKB	1/28/02
DRAWN BY	MWC	2/02/02
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

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UTAH COPPER

FIGURE 1-3
MAP OF HISTORICAL SITES WITHIN THE NORTERN BOUNDARIES OF PERMIT M/035/002

Job No. ---
Dwg. No. 454-T-0012
REV



LEGEND

- Railroad
- Footprint of Tailings Impoundment Complex
- Division of Oil, Gas & Mining Permit Boundary for M/035/002
- KUC Production Well Location with Site ID
- KUC Monitoring Well Location with Site ID
- Groundwater Discharge Permit Well Locations with Site ID

N

GRAPHIC SCALE

2000 0 1000 2000 4000

(IN FEET)
1 inch = 2000 ft.

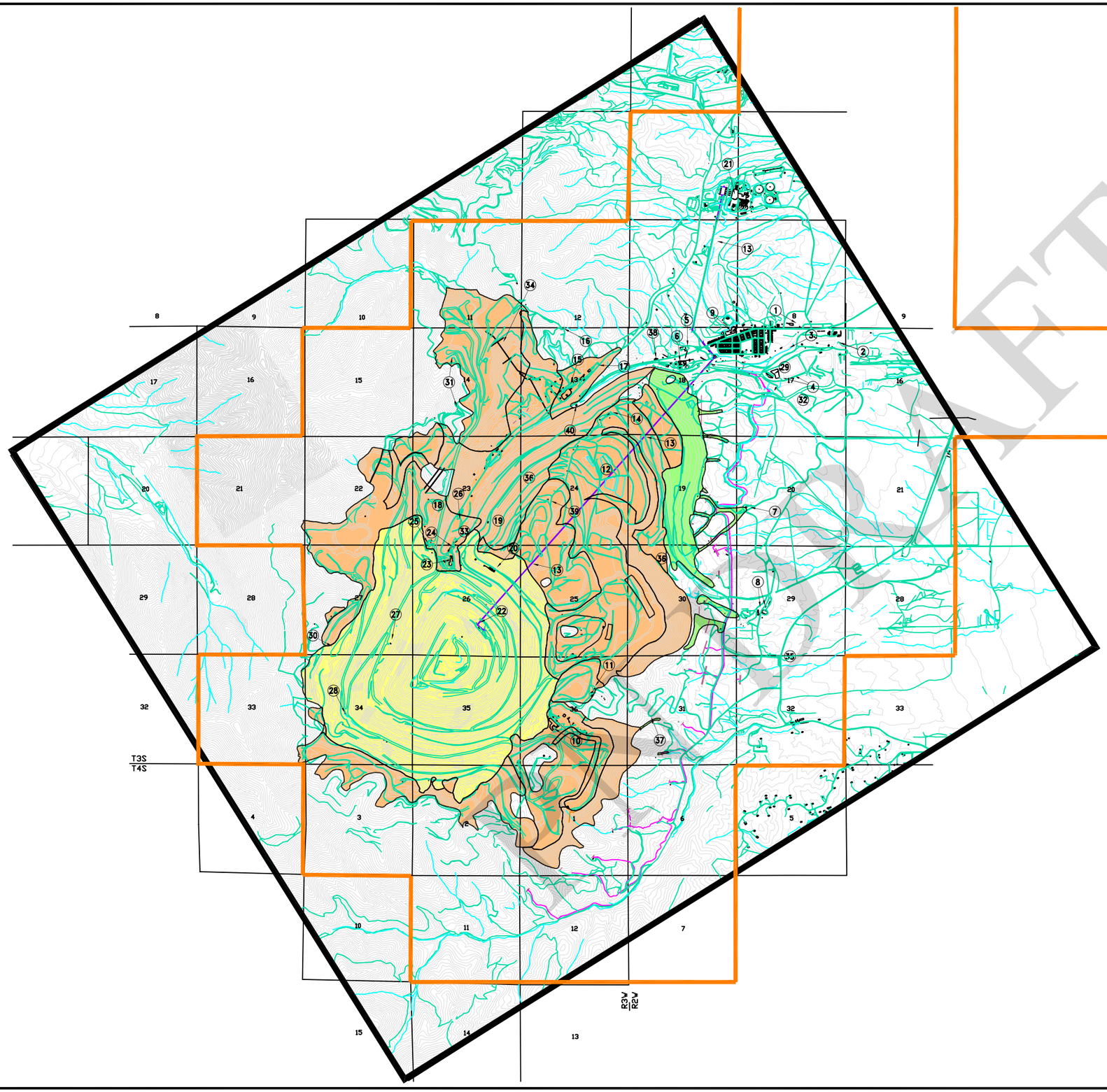
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SCALE: 1" = 2000'		DATE
DESIGNED BY	RKB	1/23/02
DRAWN BY	MWC	1/23/02
CHECKED BY	RKB	1/23/02
PROJECT ENGINEER		
PROJECT MANAGER		

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FIGURE 10-3
MAP OF WELL LOCATIONS WITHIN THE NORTHERN BOUNDARIES OF DOGM PERMIT M/035/002

Job No. --- Dwg. No. 454-T-0011 REV

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Area	Description	Area	Description
1	Old Division Headquarters	21	Copperton Concentrator (not included in this permit)
2	Small Bingham Reservoir	22	In-Pit Crusher
3	Copperton Rail Yard	23	Truck Shop (6190)
4	Large Bingham Reservoir	24	Change House
5	Geology Building	25	Code 80 Fuel & Lube Station
6	Precipitation Plant	26	North Ore Shoot Shaft
7	Midas Pump Station	27	Carr Fork Exhaust Shaft & Pine Canyon Tunnel
8	Lark Mine Buildings	28	Utah Metals Tunnel
9	Bingham Middle School	29	Desilting Basin
10	Yosemite Shops	30	Apex Shaft
11	Explosives Storage	31	SX/EW Pilot Plant
12	6600 ARD Storage & Evaporation Ponds	32	Biosulphide Pilot Plant and Membrane Filtration Plant
13	Ore Conveyor and 5490 Tunnel	33	Main Substation
14	East Pump Station	34	Dry Fork Tunnel
15	Dry Fork Warehouse & Shops	35	Mine Entrance
16	West 1 Pump Station	36	Primary Mine Access Road
17	Reload Area	37	Yosemite Road
18	Explosives Shops	38	Lead Mine
19	Process Water Tank		Leach Water
20	Visitor's Center, Heliport, Mine Office	40	West Mountain Shaft

Bingham Canyon Mine
Surface Facilities
(Permit # M/035/002)

DOGM Permit Boundaries

Legal Section Line

Cut-Off Walls } Eastside Collection System (ECS)

Drainage System } Eastside Collection System (ECS)

Current Reclaimed Waste Rock Disposal Area

Current Disturbed Waste Rock Disposal Area

Current Disturbed Mine Area

DRAFT

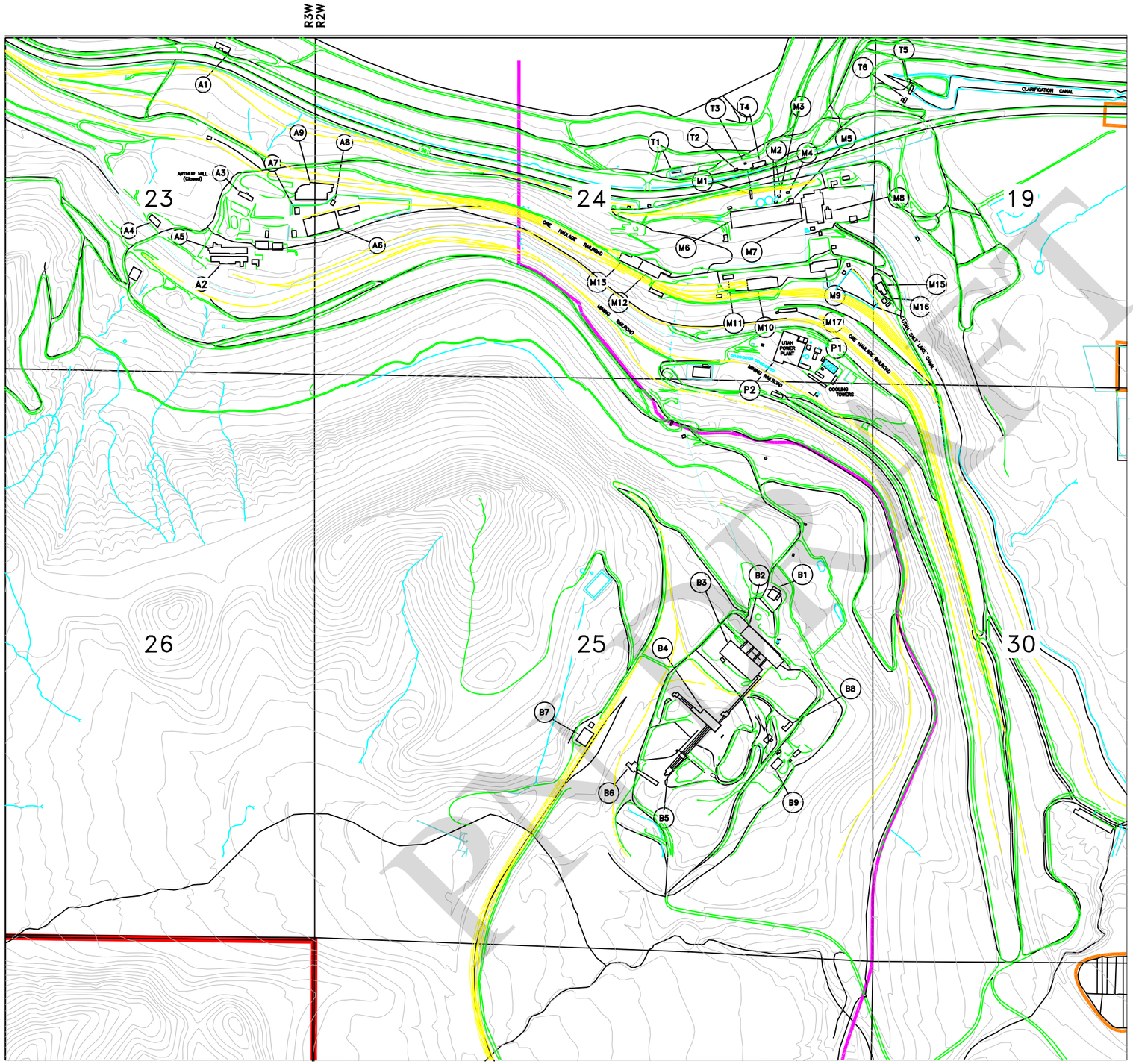
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DESIGNED BY	RKB	1/3/02
DRAWN BY	MWC	1/9/02
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

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FIGURE 2-1
MAP OF SURFACE FACILITIES
IN THE VICINITY OF THE
BINGHAM CANYON MINE

Job No. ---
Dwg. No. 454-T-0009
REV 0

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ALL SECTIONS ARE WITHIN T1S

CONTOUR INTERVAL = 20 FEET

N

SURFACE FACILITIES

ARTHUR AREA	
A1	Arthur Tailings Pump House
A2	Machine Shop
A3	Arthur Administration Building
A4	Arthur Substation
A5	Arthur Carpenter Shop
A6	Arthur Central Warehouse
A7	Acetylene & Oxygen Building
A8	Radioactive Material Storage Building
A9	Central Lab

TAILINGS AREA	
T1	Tailings Compound
T2	Adverse Pumphouse
T3	Magna Cyclone Station
T4	Magna Tailings Pumphouse
T5	Pump Station No.1
T6	Tailings Pipeline

NORTH (MAGNA) CONCENTRATOR FACILITY	
M1	Car Loading
M2	Thickener Control Room
M3	Filter Plant Pump House
M4	Mt. Fuel Gas House
M5	Magna Heating Plant
M6	Magna Filter Plant
M7	Magna Flotation Plant
M8	Magna Administration Office
M9	Electric & Pipe Shops
M10	Engine House
M11	Magna Main Substation
M12	North Service Garage
M13	Railroad Car Repair Shop
M14	UPP Pump House
M15	Pump Station No. 3A
M16	Pump Station No. 3
M17	Water Storage

BONNEVILLE AREA CRUSHING FACILITY	
B1	Bonneville Substation
B2	Grinding Plant
B3	Fine Ore Storage
B4	Symons Building
B5	Syntrons Building
B6	Drive House No. 1
B7	Dumper Building (Primary Crusher)
B8	Bonneville Administration Offices
B9	Boiler Shop & Warehouse

POWER PLANT AREA	
P1	Reverse Osmosis Building
P2	Utah Power Plant

GRAPHIC SCALE

500 0 250 500 1000

(IN FEET)

1 inch = 500 ft.

NOTE:

1. TOPOGRAPHY DERIVED FROM 1994 AERIAL SURVEY BY AERO GRAPHICS

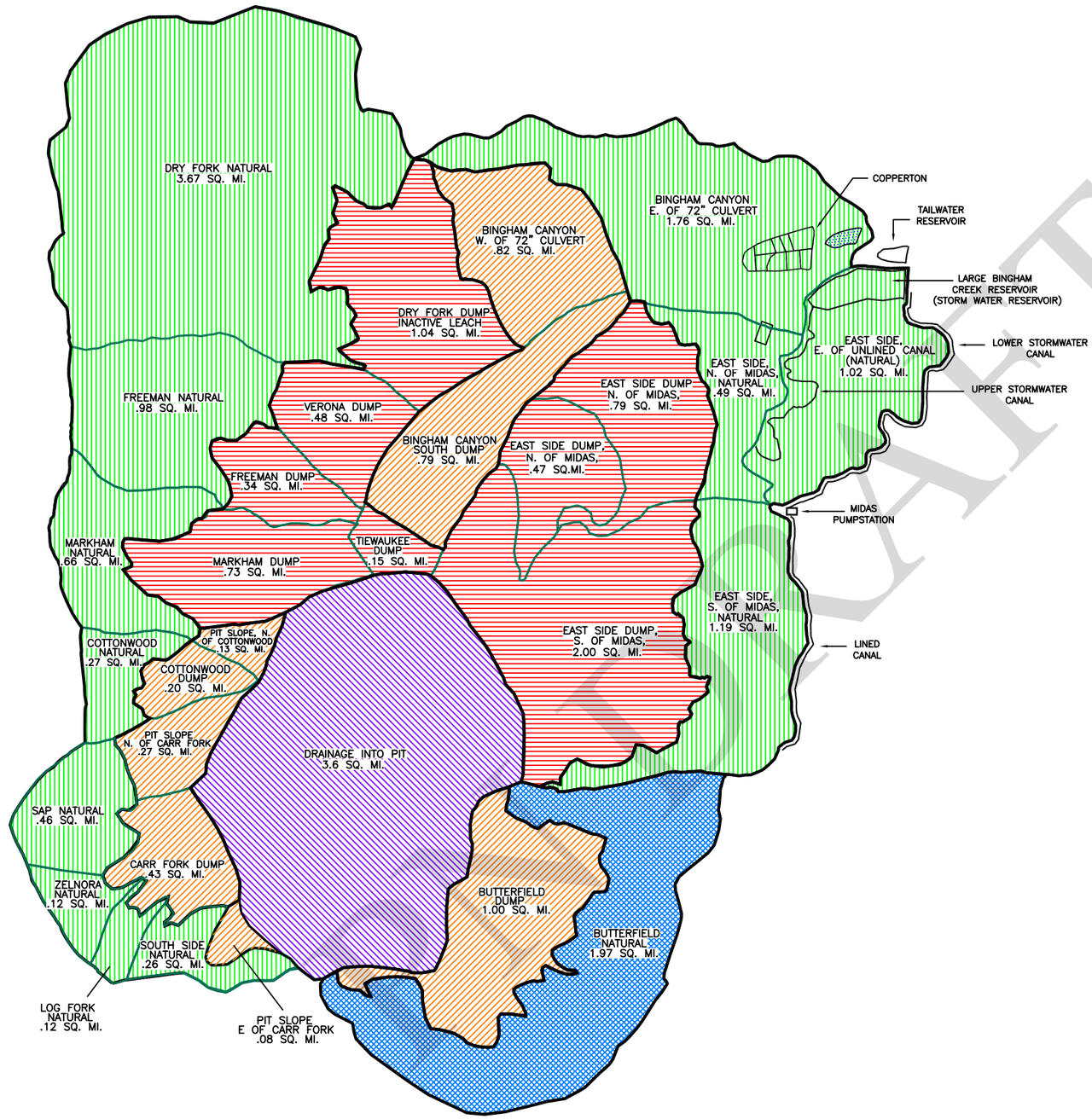
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SCALE: 1"=500'		DATE
DESIGNED BY		
DRAWN BY	PT	1/98
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

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FIGURE 2-2
MAP OF ARTHUR, SOUTH TAILINGS, MAGNA AND BONNEVILLE SURFACE FACILITIES

Job No. --- Dwg. No. 454-T-0008 REV 2 DATE 1/09/02

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	TOTAL AREA		LEGEND
	Sq. Mi.	Acres	
	6.0	3800	WATERSHEDS THAT CONTAIN WASTE ROCK DISPOSAL AREAS WHERE LEACH WATER WAS APPLIED IN THE PAST TO RECOVER COPPER. ALL LEACH WATER APPLICATIONS WERE TERMINATED IN 2000. MAY ALSO INCLUDE SOME UNDISTURBED GROUND.
	3.7	2400	WATERSHEDS THAT CONTAIN WASTE ROCK DISPOSAL AREAS WHERE LEACH WATER WAS NEVER APPLIED. MAY ALSO INCLUDE SOME UNDISTURBED GROUND.
	3.6	2300	BINGHAM CANYON MINE OPEN PIT WATERSHED. NOTE: ALL OF THE CARR FORK AND COTTONWOOD WASTE ROCK DISPOSAL AREAS, UPGRADIENT NATURAL DRAINAGES, AND PORTIONS OF THE MARKHAM WATERSHEDS (TOTAL OF 1400 ACRES) DRAIN TOWARDS THE PIT ALTHOUGH THEY ARE LISTED UNDER OTHER CATAGORIES.
	11.0	7000	UNDISTURBED WATERSHEDS WITHIN THE CAPTURE ZONE OF THE MINE'S RUNOFF COLLECTION SYSTEMS. APPROXIMATELY 4200 ACRES OF THIS AREA ARE LOCATED IMMEDIATELY UP GRADIENT OF WASTE ROCK DISPOSAL AREAS.
	2.0	1300	UNDISTURBED WATERSHED WITH DRAINAGE THAT DOES NOT REPORT TO THE MINE'S RUNOFF COLLECTION SYSTEMS.

NOTE: DRAINAGE AREAS ARE LISTED IN ORDER OF GENERALLY IMPROVING WATER QUALITY.

GRAPHIC SCALE

0 2100 4200 8400

(in feet)

1 inch = 4200 ft.

N

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NO.	DATE	REVISION	BY	CHK	APP
2	1/22/02	REDRAWN	MWC		
1	6/30/94	REDRAWN	PT	LJW	LJW

NO.	DATE	REVISION	BY	CHK	APP

REFERENCE DRAWINGS	NUMBER
ORIGINAL VERSION OF MAP	451-T-0020
SUB-DRAINAGE BASIN MAP	451-T-023

REFERENCE DRAWINGS	NUMBER

ENGINEERING SERVICES

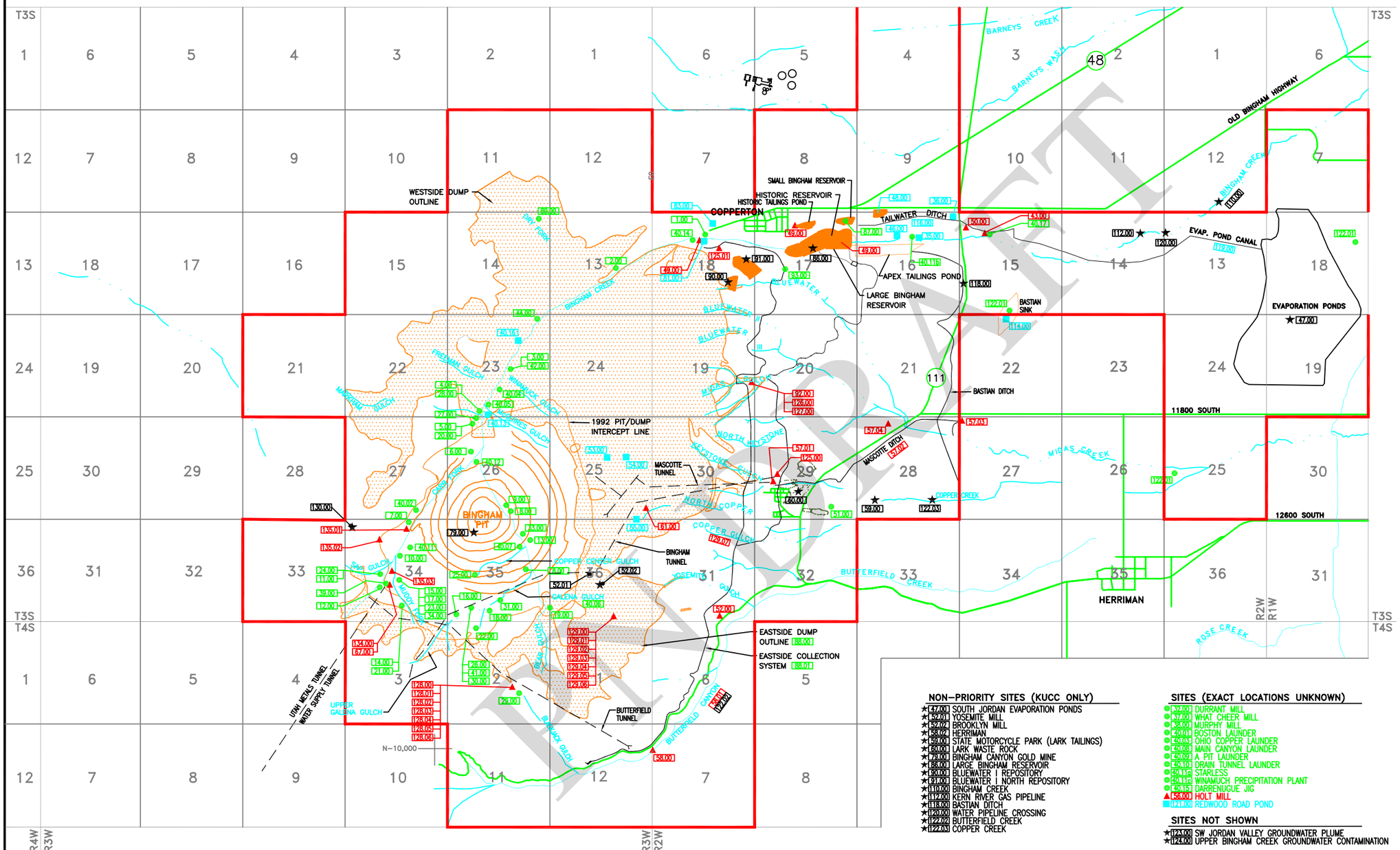
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		DRAWN BY MWC	1/8/02
		CHECKED BY BV	6/00
		PROJECT ENGINEER	
		PROJECT MANAGER	

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FIGURE 10-1 MAP OF BINGHAM CANYON MINE AREA SHOWING WATERSHEDS AND SURFACE WATER COLLECTION SYSTEMS

Job No. --- Dwg. No. 454-T-0007 REV 2

4540007.dwg 01/30/03 10:27 krthiede



DRAFT

BINGHAM CREEK ROD HISTORICAL FACILITIES

- 1.00 LEAD MINE MILL
- 2.00 UTAH COPPER CO. MILL
- 3.00 WINNAMUCK MILL
- 4.00 MARKHAM MILL
- 5.00 WALLS MILL
- 6.00 SHAWMUT MILL
- 7.00 UTAH APEX MILL
- 8.00 ROGERS MILL (MOVED 1 MILE DOWN GRADIENT)
- 9.00 BOSTON CONSOLIDATED MILL
- 10.00 STEWART NO.2 MILL
- 11.00 HIGHLAND BOY MILL
- 12.00 BINGHAM-NEW HAVEN COPPER & GOLD MILL
- 13.00 COLUMBIA COPPER CO. MILL
- 14.00 LAST CHANCE MILL
- 15.00 NEW ENGLAND GOLD & COPPER CO. MILL
- 16.00 JORDAN MILL (GALENA MILL)
- 17.00 STEWART NO.1 MILL
- 18.00 SPANISH MILL (NIAGARA MILL)
- 19.00 TELEGRAPH MILL (US MINING CO. MILL)
- 20.00 BI-MS MILL
- 21.00 WEST MTN. MINING CO. CONCENTRATOR
- 22.00 SILVER SHIELD MILL
- 23.00 BINGHAM MINING & MILLING CO. MILL
- 24.00 UTAH CONSOLIDATED GOLD MINE MILL
- 25.00 BINGHAM GOLD MINING CO.
- 26.00 UTAH CONCENTRATOR (AKA UTAH MILL)
- 27.00 HEASTON CONCENTRATOR JIGS
- 28.00 MASSASOIT MILL
- 30.00 UTAH MILL (AKA UTAH CONCENTRATOR)
- 31.00 BROOKS MILL
- 33.00 EAGAN & BATES MILL
- 34.00 BINGHAM-NEW ENGLAND MILL
- 35.00 ROBBE CELLS
- 40.02 APEX YARDS
- 40.04 TIEWAUKEE DUMP
- 40.05 McGUIRES GULCH
- 40.06 GALENA GULCH
- 40.07 COPPER CENTER GULCH
- 40.11 INGERSOLL GULCH
- 40.11b McGREGOR PLANT
- 40.12 COPPER PLACER PLANT
- 40.13 CUPRUM PRECIPITATION PLANT
- 40.14 C.W. WATSON'S JIG
- 40.16 VERONA URANIUM PLANT
- 40.17 NEW YORK & UTAH MILL
- 41.00 UTAH SMELTER
- 42.00 WINNAMUCK SMELTER
- 43.00 REVERE SMELTER
- 44.00 YAMPA SMELTER
- 83.00 YELLOW CAKE PLANT

NON-BINGHAM ROD HISTORICAL FACILITIES

- 29.00 QUEEN MILL
- 36.00 PROLER
- 46.00 MIXED TAILS
- 48.00 CEMETERY POND
- 49.00 COPPERTON DUMPS (3 LOCATIONS)
- 50.00 REVERE SWITCH TAILINGS POND
- 51.00 OHIO COPPER CO. MILLS
- 52.00 REVERE MILL
- 53.00 FORTUNE MILL
- 54.00 NEW MAMMOTH MILL
- 55.00 DALTON & LARK MILL
- 57.01 MASCOTTE TUNNEL
- 57.02 MASCOTTE DITCH
- 57.03 MASCOTTE POND
- 57.04 MASCOTTE TAILINGS
- 58.00 BUTTERFIELD MINE WASTE ROCK
- 58.01 BUTTERFIELD CANYON
- 61.00 COPPER GULCH MINES
- 81.00 PRECIPITATION PLANT IN COPPERTON
- 87.00 SMALL BINGHAM RESERVOIR
- 88.00 EAST SIDE DUMPS
- 88.01 EAST SIDE COLLECTION SYSTEM
- 89.00 DRY FORK DUMPS
- 92.00 MIDAS POND
- 93.00 EAST SIDE RESERVOIR
- 117.00 BASTIAN SINK
- 118.00 TAILWATER DITCH
- 119.00 EVAPORATION PONDS CANAL
- 122.01 MINE WASH AREAS (3 LOCATIONS)
- 125.00 BINGHAM TUNNEL
- 125.01 5490 TUNNEL
- 126.00 OLD BINGHAM TUNNEL
- 127.00 UNNAMED ADIT
- 128.00 TO 128.06 BLACK JACK GULCH MINES
- 129.00 TO 129.06 YOSEMITE & SAINTS REST MINES
- 129.07 COPPER GULCH
- 135.01 APEX (PARVENU) TUNNEL
- 135.02 ARMSTRONG TUNNEL
- 135.03 HIGHLAND BOY TUNNEL

NON-PRIORITY SITES (KUCC ONLY)

- ★47.00 SOUTH JORDAN EVAPORATION PONDS
- ★52.01 YOSEMITE MILL
- ★52.02 BROOKLYN MILL
- ★54.02 HERRIMAN
- ★55.00 STATE MOTORCYCLE PARK (LARK TAILINGS)
- ★80.00 LARK WASTE ROCK
- ★79.00 BINGHAM CANYON GOLD MINE
- ★88.00 LARGE BINGHAM RESERVOIR
- ★90.00 BLUEWATER I REPOSITORY
- ★91.00 BLUEWATER I NORTH REPOSITORY
- ★110.00 BINGHAM CREEK
- ★112.00 KERN RIVER GAS PIPELINE
- ★118.00 BASTIAN DITCH
- ★120.00 WATER PIPELINE CROSSING
- ★122.02 BUTTERFIELD CREEK
- ★122.03 COPPER CREEK

SITES (EXACT LOCATIONS UNKNOWN)

- 32.00 DURRANT MILL
- 37.00 WHAT CHEER MILL
- 38.00 MURPHY MILL
- 40.01 BOSTON LAUNDER
- 40.03 OHIO COPPER LAUNDER
- 40.08 MAIN CANYON LAUNDER
- 40.09 A PIT LAUNDER
- 40.10 DRAIN TUNNEL LAUNDER
- 40.11a STARLESS
- 40.11c WINNAMUCH PRECIPITATION PLANT
- 40.15 DARRENLIQUE JIG
- ▲58.00 HOLT MILL
- 121.00 REDWOOD ROAD POND

SITES NOT SHOWN

- ★123.00 SW JORDAN VALLEY GROUNDWATER PLUME
- ★124.00 UPPER BINGHAM CREEK GROUNDWATER CONTAMINATION

LEGEND

- ▲ =PRIORITY ONE SITES
- ■ =PRIORITY TWO SITES
- ● =PRIORITY THREE SITES
- ★ =NON-PRIORITY SITES
- — =PERMIT BOUNDARY (M/035/002)

GRAPHIC SCALE
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(IN FEET)

N

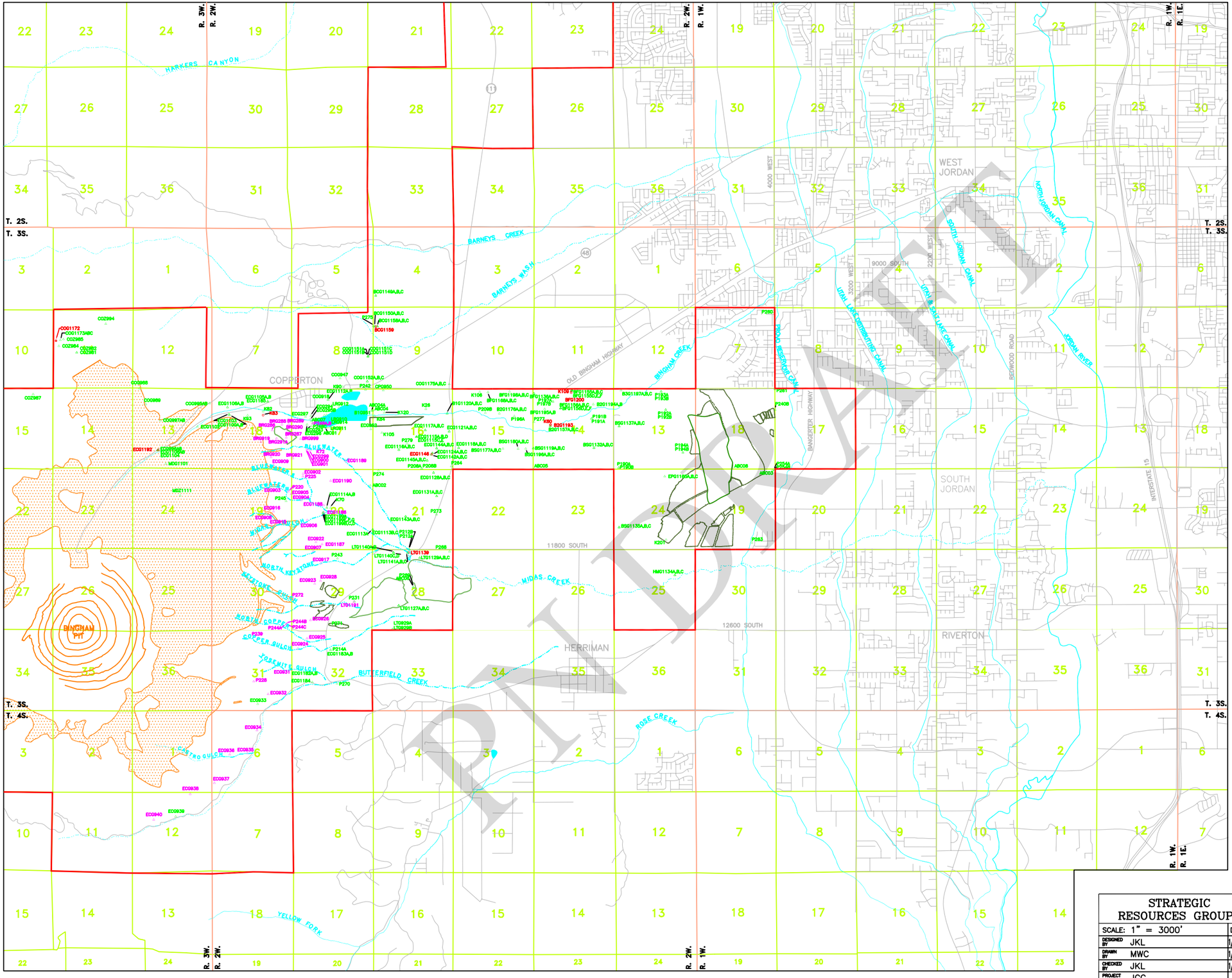
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		DRAWN BY MWC	1/8/02
		CHECKED BY	
		PROJECT ENGINEER	
		PROJECT MANAGER	

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UTAH COPPER

FIGURE 1-2
MAP OF HISTORICAL SITES WITHIN THE SOUTHERN BOUNDARIES OF PERMIT M/035/002

Job No. --- | Dwg. No. 454-T-0006 | REV L

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LEGEND

WELL DEFINITION

○ LTG1139	KUC PRODUCTION WELL LOCATION WITH SITE ID
△ BSG1133ABC	KUC MONITORING WELL LOCATION WITH SITE ID
△ ECG1187	GROUND WATER DISCHARGE PERMIT #UGW350010 WELL LOCATION WITH SITE ID

MAP FEATURES

- ROADS
- PERENNIAL STREAMS AND CANALS
- EPHEMERAL STREAMS AND GULCHES
- PREVIOUS LOCATION OF TAILINGS, EVAPORATION PONDS AND WASTE ROCK
- DIVISION OF OIL, GAS AND MINING MINE PERMIT BOUNDARY FOR M/035/002

N

GRAPHIC SCALE

3000 0 1500 3000 6000

(IN FEET)
1 inch = 3000 ft.

DRAFT

STRATEGIC RESOURCES GROUP		
SCALE: 1" = 3000'		DATE
DESIGNED BY	JKL	1/03/02
DRAWN BY	MWC	1/11/02
CHECKED BY	JKL	1/11/02
PROJECT ENGINEER	JCC	
PROJECT MANAGER		

KENNECOTT
UTAH COPPER

FIG 10-2
MAP OF WELL LOCATIONS WITHIN THE SOUTHERN BOUNDARIES OF DOGM PERMIT M/035/002

Job No. --- Dwg. No. 454-T-0002 REV BY DATE

N:\DOCUMENTS\454\45440002 01/11/02 kjlucy

APPROXIMATE FACILITIES LOCATIONS

1. NORTH TAILINGS IMPOUNDMENT
2. SOUTH TAILINGS IMPOUNDMENT
3. SMELTER
4. REFINERY
5. NORTH CONCENTRATOR FACILITIES (SEE FIGURE 2–2 FOR DETAILS)
6. TAILINGS PIPELINE CORRIDOR
7. COPPERTON CONCENTRATOR
8. BINGHAM CANYON MINE (SEE FIGURE 2–1 FOR DETAILS)
9. RECLAIMED SOUTH JORDAN EVAPORATION PONDS
10. ORE CONVEYOR

LEGEND

- NORTH IMPOUNDMENT PERMIT BOUNDARY (M\035\015)
- 1978 PERMIT BOUNDARY (M\035\002)
- PINE CANYON PERMIT BOUNDARY (M\045\004)
- COPPERTON CONCENTRATOR PERMIT BOUNDARY (M\035\011)
- KUC PROPERTY BOUNDARY

GRAPHIC SCALE

4500 0 2250 4500 9000

(IN FEET)
1 inch = 4500 ft.

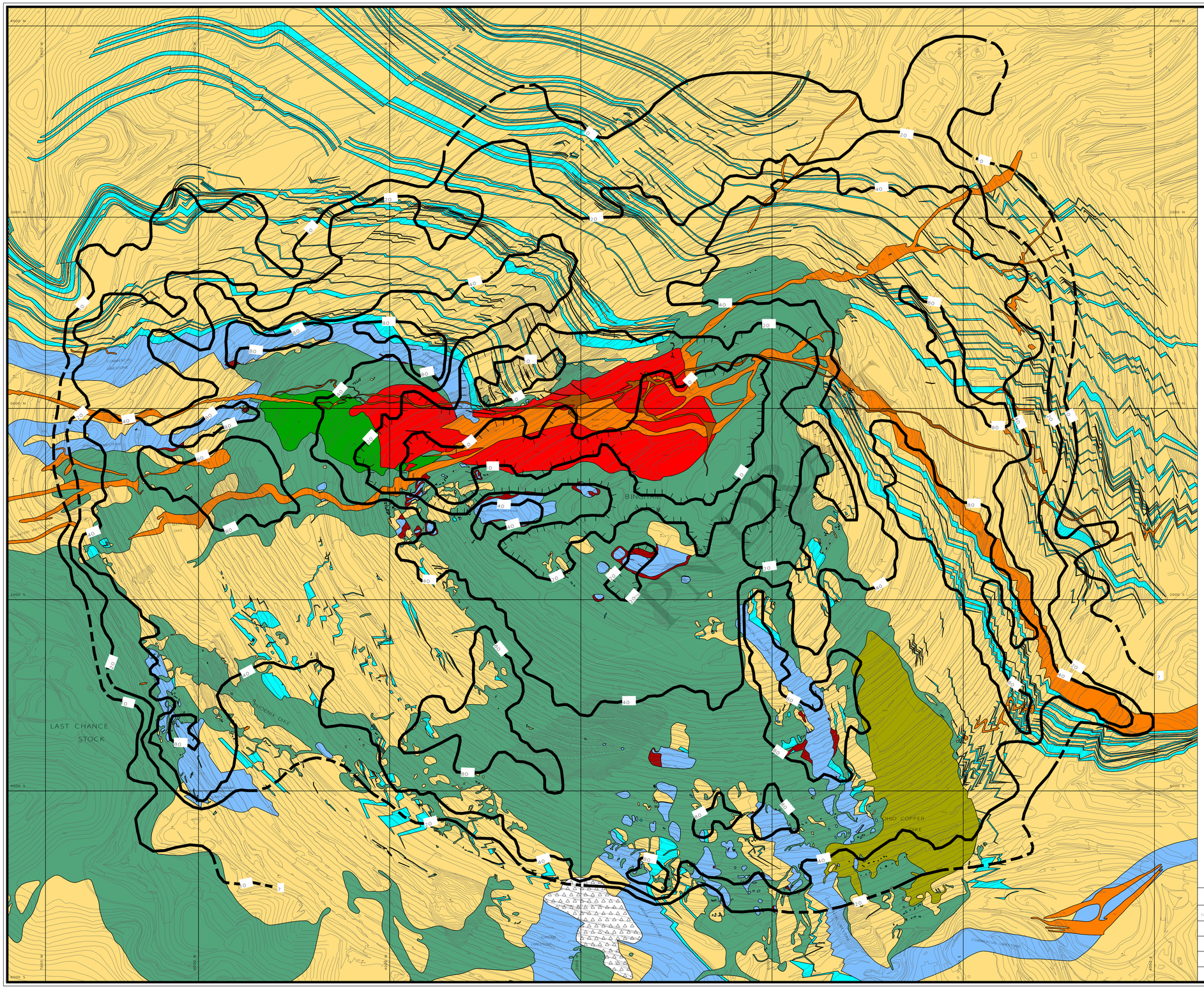
N

STRATEGIC RESOURCES GROUP		
SCALE: 1" = 4500'		DATE
DESIGNED BY	RKB	1/3/02
DRAWN BY	MWC	1/3/02
CHECKED BY		
PROJECT ENGINEER		
PROJECT MANAGER		

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FIGURE 1–1
DOGM PERMIT BOUNDARIES

Job No. --- Dwg. No. 454–T–0001 REV
REV DATE



EXPLANATION

IGNEOUS ROCK TYPES

TERTIARY

Eocene

Quartz Latite Porphyry

Knob, dike and apophyses. Medium brown and light greenish gray, hornblende-biotite quartz latite porphyry. Hornblende is altered to phlogopite and/or chlorite within the pit area. Hosts late stage chalcopyrite and pyrite mineralization. Distinguished from other latitic dikes by the presence of relatively large quartz phenocrysts and higher percentage of aphanitic groundmass. Groundmass usually contains considerable hornblende.

Latite Porphyry

Fortuna sill, Main Hill and Starless dikes, and apophyses. Light to medium gray, hornblende-augite-biotite quartz latite porphyry. Ferromagnesian minerals are altered to phlogopite and chlorite in pit area. Locally contains ore grade chalcopyrite, bornite, and pyrite mineralization, both disseminated and in veins.

Endoskarn

Intrusive rock, the composition of which is changed due to assimilation of calcareous sedimentary rocks. Usually found as contact zone between monzonite and major intrusional units. Texture is igneous, composition is extremely variable. Dominant minerals include actinolite, orthoclase, phlogopite, and epidote. Calcite veining is common.

Hybrid Quartz Monzonite Porphyry

Quartz monzonite porphyry, the composition of which is changed due to assimilation of monzonite. Medium gray, amphibole biotite quartz monzonite porphyry. Amphibole is altered to biotite, plagioclase is altered to clay and sericite. Calcite veining is locally present. Contains ore grade chalcopyrite pyrite mineralization.

Quartz Monzonite Porphyry

Bingham Stock. Light gray, amphibole-biotite quartz monzonite porphyry. Amphibole is altered to phlogopite and quartz, plagioclase is altered to sericite and clay. Calcite veining is locally present. There are no equivalent pit unaltered rock. Contains pyrite, chalcopyrite, bornite and molybdenite mineralization. Inferred source of mineralizing fluids.

Porphyritic Quartz Monzonite

Unit Copper Alley. Medium gray to greenish gray, porphyritic, amphibole-biotite quartz monzonite. Pale pink orthoclase and white plagioclase phenocrysts in a phanetic groundmass. A distinct dark phase of Bingham and Last Chance Quartz Monzonite. Calcite veining is locally present. Pyrite occurs in veins.

Monzonite

Bingham stock, Phoenix dike, and Last Chance stock. Medium to dark gray, augite-biotite, amphibole (quartz) monzonite. Where altered, augite is replaced by actinolite, chlorite, phlogopite, and quartz. Some plagioclase is replaced by orthoclase. Calcite veining is locally present. Contains pyrite, chalcopyrite, bornite and molybdenite mineralization. Original magnetite is replaced by sulfide minerals. Molybdenite occurs primarily in veins. Main ore host.

SEDIMENTARY ROCK TYPES

PENNSYLVANIAN

Upper

OQUIRRH GROUP

BINGHAM MINE FORMATION

MARKHAM RIDGE MEMBER

Quartzite and Calcareous Sandstone

Tan to light gray orthoquartzite and calcareous quartzite, interbedded with thin calcareous sandstone and sandy limestone beds. Locally laminated and crossbedded. Calcareous sandstone and sandy limestone beds are altered to hornfels. Quartzite (sp?), limestone (ls), and thin calcareous sandstone and sandy limestone (cs), are differentiated.

BINGHAM MINE FORMATION

CLIPPER RIDGE MEMBER

Quartzite, Limestone, and Calcareous Sandstone

Tan to light gray orthoquartzite and calcareous quartzite, interbedded with limestone and thin calcareous sandstone and sandy limestone beds. Locally laminated and crossbedded. Two large cherty limestones are interbedded near base. Limestones are altered to skarn. Calcareous sandstone and sandy limestone beds are altered to hornfels. Base of formation is at base of Jordan limestone bed. Quartzite (sp?), limestone (ls), and thin calcareous sandstone and sandy limestone (cs), are differentiated.

Middle

BUTTERFIELD PEAKS FORMATION

Quartzite, Calcareous Quartzite, and Calcareous Sandstone

Tan to light gray orthoquartzite, calcareous quartzite and calcareous sandstone, cyclically interbedded with medium to dark gray, sandy, thin-bedd limestone, containing thin bedded lenses and nodules of black chert.

Breccia

Contact

1997 Topography

ACID POTENTIAL CONTOUR (DASHED WHERE APPROXIMATE; HATCH MARKS INDICATE A DEPRESSION IN THE SURFACE.)

NOTES:

ACID POTENTIAL (AP) CONTOURS ARE BASED UPON 80,000 BLASTHOLES AND DEEP BORING SAMPLES LOCATED WITHIN 100 FEET OF THE YEAR 2000 TOPOGRAPHIC SURFACE.

ACID POTENTIAL (AP) WAS CALCULATED BASED UPON TOTAL SULFUR. THIS MAY TEND TO OVERESTIMATE AP BY ABOUT 10% ON AVERAGE BECAUSE SOME SULFUR IS ASSOCIATED WITH NON-ACID GENERATING SULFATE MINERALS AND NON-ACID GENERATING SULFIDE MINERALS SUCH AS CHALCOCITE, GALENA AND SPHALERITE. AP IS REPORTED AS TONS OF CALCIUM CARBONATE REQUIRED TO NEUTRALIZE ALL OF THE ACIDITY GENERATED BY COMPLETE OXIDATION OF 1000 TONS OF ROCK. GENERALLY A ROCK WITH AP >10 TONS/1000 TONS WILL NOT GENERATE ACID ROCK DRAINAGE.

MAGNETIC DECLINATION 14°30' E
(AUGUST, 1997)

400 200 0 400
FEET

Date	Revision
12/12/01	0
Drawing Number	
451-T-4933	

Bingham Canyon Mine

FIGURE 3 - 1

GEOLOGIC MAP OF THE BINGHAM PIT SHOWING ACID POTENTIAL

GREAT SALT LAKE

DOWNTOWN SALT LAKE CITY

80

2100 SOUTH

WASTE WATER TREATMENT PLANT SLUDGE (2)

REFINERY (9)

SMELTER SLAG AND LAGOON (1)

MAGNA TAILINGS POND (4)

DIVING BOARD AREA (5)

SMELTER (8)

NORTH END GROUNDWATER (10)

POWER PLANT (7)

MAGNA SOILS (6)

KESSLER CANYON DRAINAGE (3)

NORTH FACILITIES SOILS (2)

JORDAN RIVER

OQUIRRH MOUNTAINS

7800 SOUTH

111

15

TOWN OF COPPERTON

SMALL RESERVOIR (14)

9000 SOUTH

BINGHAM CREEK TAILINGS (11)

CEMETERY POND (12)

DRY FORK GROUNDWATER PLUME (23)

SOUTH JORDAN EVAPORATION PONDS (17)

EASTSIDE COLLECTION SYSTEM (16)

GROUNDWATER PLUME (13)

LARGE RESERVOIR (15)

LARK TAILINGS (19)

BINGHAM CANYON MINE

HERRIMAN (22)

LARK WASTE ROCK (18)

BUTTERFIELD TAILINGS (21)

BUTTERFIELD WASTE ROCK (20)

N

- COMPLETED CLEAN-UP SITES
- GROUND WATER PLUME RESPONSE
- WWTP SLUDGE AND NORTH FACILITIES SOIL REMOVAL ACTION
- EPA CLEAN-UP
- OLD SMELTER AND NORTH FACILITIES DEMOLITION
- BOUNDARY OF GROUNDWATER AND SURFACE WATER STUDIES

0 5 MILES

SCALE

DRAFT

PLANT PROJECTS GROUP		
SCALE: NONE		DATE
DESIGNED BY	CDC	4/09/98
DRAWN BY	PT/CDC	4/09/98
CHECKED BY	JFC	4/09/98
PROJECT ENGINEER	JFC	4/09/98
PROJECT MANAGER	JFC	4/09/98

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PLATE 3
ZONES OF GROUNDWATER AND SURFACE WATER STUDIES

Job No. ---

Dwg. No. 451-T-4913

REV 1 DATE 4/09/98

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Appendix E Permit # UGW350010

BINGHAM CANYON MINE AND WATER COLLECTION SYSTEM
OPERATIONAL MONITORING PLAN

MONITORING REQUIREMENTS AND PLAN CONTENT

Operational monitoring includes flow and quality sampling of meteoric and storm-water flow. Kennecott Utah Copper LLC (Kennecott) has an existing general, operational, and groundwater monitoring plan that is described in the Ground Water Characterization and Monitoring Plan (GCMP) Kennecott, 2014.

This Operational Monitoring Plan for the Bingham Canyon Mine/Water Collection System includes the Water Quality Sampling program.

WATER QUALITY MONITORING PROGRAM

Surface Water Sampling

Meteoric and Water Collection System - As a part of a continuing operational monitoring program, water quality samples from all drainages associated with the water collection system will be collected two times per year. The Water Collection System concrete drainage structures will be sampled once in April or May and again in September or October. The Surface Water Sample Sites Drawing (Figure 1 of the Permit) shows the current locations of the 23 operational surface water sample sites. There are 25 surface water sampling sites (refer to figure 454-T-0119).

Tunnels and Seeps - Additionally, quarterly flow and semiannual water quality samples will be collected for each of the flows from mine tunnels that underlie the Bingham Canyon Mine Waste Rock Piles. Surface seeps will also be sampled for semiannual flow and water quality. Refer to Appendix A for additional permit conditions related to surface seeps.

Table E-1 lists all current monitoring sites for the operational monitoring program and E-2 lists new and replaced cutoff walls installed during the EWRE.

Table E-3 lists the cutoff walls removed or moved during the SWRR project. The cutoff walls kept their designation descriptions.

Flow information for each surface water sample site will be provided in the annual report as part of the operational monitoring discussion.

All sampling will be performed in compliance with the protocols and standard operating practices specified in the current approved version of the GCMP and attachments. The water quality date will be provided in the annual report as part of the operational monitoring discussion.

Bluewater Repository - The leachate collection system sumps for the Bluewater Repository shall be

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examined semi-annually. A semi-annual water quality sample will be collected of leachate flowing into each collection sump. Results from sampling will be reported in the annual operational monitoring report provided to the Utah Division of Water Quality (DWQ). Refer to Appendix B for additional permit conditions related to the repository.

MONITORING TECHNIQUES AND DATA VALIDATION

All monitoring will be performed using the methods for sampling, analyses, and quality control specified in the GCMP.

If data outliers or quality assurance/quality control problems are identified, the sample will be retested, and the wells will be re-sampled within 30 days. If the results from the retesting or re-sampling show that the data is an outlier, normal monitoring will resume.

REPORTING

Kennecott will submit compliance groundwater monitoring data to the DWQ on a quarterly basis. The reports will include a summary of all monitoring data collected during the quarter. Field measurements (groundwater levels, specific conductance, pH) and certificates of analysis will be provided.

Operational monitoring data for operational sites including cut-off walls, seeps, tunnels, Bluewater Repository, informational wells and extraction wells will be submitted to the DWQ in an annual report to be provided by March 31 each year. The annual report will contain results of monitoring in a tabular form with descriptive statistics such as: number of samples, average, standard deviation, maximum and minimum values for each site. Each site will be described with time series graphs of significant parameters over the period of record for that site; with analytical data reported from the past three years through the current reporting cycle A narrative description shall be included that describes any significant trends or observations on the data.

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Table E-1

OPERATIONAL SURFACE SITES	NORTHING	EASTING	MONITORING FREQUENCY
WATER COLLECTION SYSTEM			
Bingham Ck. Cut-off wall (ECP2562)	15784	16905	Semiannual water quality and quarterly volumetric flow
Bluewater 1/2 Collection Box (ECP2682)	15145	13910	Semiannual water quality and quarterly volumetric flow
Bluewater 1 Flume (MDP2679)	14467	13613	Semiannual water quality and quarterly volumetric flow
Bluewater 2 Flume (ECP2709)	12271	16656	Semiannual water quality and quarterly volumetric flow
Bluewater 3 Flume (ECP2674)	11022	16182	Semiannual water quality and quarterly volumetric flow
Midas 1 Flume (ECP2670)	9391	15692	Semiannual water quality and quarterly volumetric flow
Midas 2 Flume (ECP2668)	9189	15494	Semiannual water quality and quarterly volumetric flow
Midas Flume (ECP2662)	8842	16582	Semiannual water quality and quarterly volumetric flow
South Congor Flume (ECP2654)	8840	16582	Semiannual water quality and quarterly volumetric flow
Crapo Flume (ECP2651)	6831	17037	Semiannual water quality and quarterly volumetric flow
South Crapo Flume (ECP2858)	6670	17332	Semiannual water quality and quarterly volumetric flow
North Keystone Flume (ECP2648)	6029	17716	Semiannual water quality and quarterly volumetric flow
Keystone and Lost Creek Flume (ECP2629)	3397	17201	Semiannual water quality and quarterly volumetric flow
OPERATIONAL SURFACE SITES	**NORTHING**	**EASTING**	**MONITORING FREQUENCY**

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Copper 1 Flume (ECP2624)	1457	17078	Semiannual water quality and quarterly volumetric flow
Copper 2 Flume (ECP2857)	1205	17093	Semiannual water quality and quarterly volumetric flow
Copper 3 Flume (ECP2618)	629	16596	Semiannual water quality and quarterly volumetric flow
Copper 4 Flume (ECP2856)	-326	16111	Semiannual water quality and quarterly volumetric flow
Yosemite Cut-off wall (ECP2616)	-1302	12460	Semiannual water quality and quarterly volumetric flow
Saints Rest Cut-off wall (ECP2614)	-2797	13156	Semiannual water quality and quarterly volumetric flow
S. Saints Rest Cut-off wall (ECP2612)	-4318	13304	Semiannual water quality and quarterly volumetric flow
Castro Flume (ECP2606)	-5637	13598	Semiannual water quality and quarterly volumetric flow
Butterfield 1 Cut-off wall (ECP2605)	-7876	9515	Semiannual water quality and quarterly volumetric flow
Olsen Cut-off wall (ECP2603)	-8670	8481	Semiannual water quality and quarterly volumetric flow
Queens Cut-off wall (ECP2601)	-9483	6350	Semiannual water quality and quarterly volumetric flow
TUNNELS			
Old Bingham Tunnel (ECP2664)	8990	16938	Semiannual water quality and quarterly volumetric flow
Butterfield Tunnel (UPD010)	-10026	10313	Semiannual water quality and quarterly volumetric flow
Utah Metals Tunnel (BMP2712)	-1255	-2563	Semiannual water quality and quarterly volumetric flow
OPERATIONAL SURFACE SITES	**NORTHING**	**EASTING**	**MONITORING FREQUENCY**
Mascotte Tunnel (ECP2631)	3569	17231	Semiannual water quality and quarterly volumetric flow

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5490 Tunnel (ECP2710)	15715	14960	Semiannual water quality and quarterly volumetric flow
Bingham Tunnel (LWP2632)	3736	17773	Semiannual water quality and quarterly volumetric flow
SURFACE SEEPS			
Butterfield 1 Seep (ECS2715)	-7980	10500	Semiannual water quality and semiannual volumetric flow
Upper Keystone Seep (ECS2716)	4220	15520	Semiannual water quality and semiannual volumetric flow
Lower Keystone Seep (LWS2717)	3700	18600	Semiannual water quality and semiannual volumetric flow
Crapo Seep (ECS2718)	6930	16130	Semiannual water quality and semiannual volumetric flow
Upper Queen Seep (ECS2786)	-7263	5097	Semiannual water quality and semiannual volumetric flow
REPOSITORY			
Bluewater 1 North Sump (BRP292)	14146	16561	Semiannual water quality
Bluewater 1 Main Sump (BRP1476)	13770	15740	Semiannual water quality

Note: Coordinate system in Kennecott True North, See Permit Table 4 for Lat/Long Coordinates TBD – the lat and long will change when the construction is complete. The permit will be modified to reflect those changes.

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Table E-2

Original and New Cut-off Walls

Original Cut-off Wall (historic)	New Cut-off Wall (relocated)
Copper	Copper 4 Copper 3 Copper 2
North Copper	Copper 1 Lark
Lost Creek	Lost Creek
Keystone	Keystone
North Keystone	North Keystone South Crapo
Crapo	Crapo
South Congor 2	South Congor
Congor 1 Congor 2	Midas

Table E-3

Original and New Cut-off Walls

Original Cut-off Wall (historic)	New Cut-off Wall (relocated)
Yosemite	Upper Yosemite – Re-located ~500 feet down gradient of existing Yosemite cut-off wall Lower Yosemite – Located ~850' down gradient of Upper Yosemite cut-off wall
Castro	Upper wall breached and buried; lower Castro cut-off wall will remain in place
Butterfield 1	Butterfield 1 – Located ~1500' down gradient of existing cut-off wall
Olsen	Olsen – Located ~900' down gradient of existing cut-off wall

DWQ-2020-015196

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BINGHAM CANYON MINE AND WATER COLLECTION SYSTEM
BEST MANAGEMENT PRACTICES PLAN

BINGHAM CANYON MINE SUPPORT FACILITIES,
SOLVENT EXTRACTION ELECTRONWINNING PLANT, PRECIPITATION PLANT,
AND BINGHAM CANYON WATER TREATMENT PLANT
GROUNDWATER DISCHARGE PERMIT #UGW350010

1.0 INTRODUCTION

Groundwater Discharge Permit #UGW350010 was originally granted for the Kennecott Utah Copper, LLC (Kennecott) Bingham Canyon Mine and Water Collection System on May 3, 1999 and comes up for renewal on 5-year intervals. The permit area includes the open pit, waste rock dumps, support shops and various water management facilities. The permit requires that Best Available Technology (BAT) be used in the construction of all facilities and that they are operated according to Best Management Practices (BMP).

The permit also requires a BMP plan for any facilities within the permit boundaries that have the potential to affect groundwater quality. These facilities include various mine support shops, the Solvent Extraction/Electrowinning Plant, South Area Water Services (SAWS) and the Bingham Canyon Water Treatment Plant. Most of these facilities are upgradient from the Kennecott groundwater and surface water collection systems. In compliance with the permit, this BMP plan describes the physical and operational controls that are employed to minimize groundwater contamination at these sites.

2.0 BEST AVAILABLE TECHNOLOGY

2.1 Mine Support Facilities

Mine support facilities are used for vehicle operations and maintenance and include the Maintenance Shops at the 6190-ft level, the Code 80 Fuel and Lube Area, the Code 85 field maintenance lay down yard, and the 6880 Lube Station. Petroleum products are used and stored in bulk at all of these sites. The Explosives Processing Plant also stores diesel and ammonium nitrate in bulk. Diesel fuel, gasoline, lubrication oils, petroleum distillate solvents and ethylene glycol are used on a regular basis around the mine for vehicle maintenance. Each of these facilities is designed to minimize the risk of release, and to contain and collect any materials that are released.

All storage tanks are provided with secondary containment systems. Tanks are either double-walled or located in concrete basins that are capable of holding 110 percent of the largest tank volume.

Oil/water separators are used to treat water which is contaminated with petroleum products before it is reused or piped to the process water circuit. The oil/water separators handle waters

PN DRAFT

from wash pads, secondary containments, refueling pads and sumps. The recovered petroleum product is removed from the oil/water separator and shipped offsite for recycling or treatment.

Concrete pads which slope to concrete collection sumps underlie all vehicle-refueling areas. Spills which occur during refueling are immediately recaptured.

Concrete pads underlie all shop floors. There are no drains on the shop floors, and all sumps are concrete lined, so spilled materials are contained within the shop until they can be recovered.

Concrete pads which are sloped to concrete-lined settling basins underlie all vehicle wash areas. Wash water either flows through an oil/water separator and is reused at the pad or flows through an oil/water separator and is piped into Kennecott's process water circuit.

2.2 Solvent Extraction/Electrowinning Plant

The Solvent Extraction/Electrowinning (SXEW) pilot plant facility, located within the western edge of the Dry Fork dumps, was decommissioned in 2007 and 2008. The associated tank house and mixer/settlers were disassembled. Remaining is the lined leach pad containing low grade copper ore as well as the associated pregnant leach solution pond, raffinate pond and sulfuric acid tank with secondary containment. The leach pad covers approximately 420,000 square feet. From bottom to top, it is constructed of six inches of compacted clay, six inches of compacted silty sand and Low-Density Polyethylene (LDPE) and PVC lines.

In 2011 the heap leach underwent modification. A portion of the original heap (300' x 70') was removed in order to accommodate the placement of fresh ore for a new test. Before the fresh ore was placed, the opened area was isolated from the existing heap by means of two 60 mil High Density Polyethylene (HDPE) plastic liners; a leak detection system was also installed. All process solutions will be handled from the leach pad through an independent collector system to a new set of PLS and raffinate ponds with capacities of 300,000 and 75,000 gallons, respectively, which are constructed with one foot of compacted clay beneath two layers of 60-millimeter HDPE liners and also include a leak detection system.

The process solutions are treated in a portable SXEW pilot plant (capacity of 40 gallons per minute) to more accurately simulate a commercial operation in terms of acid balance and metal recovery.

Performance criteria for the Heap, PLS pond and Raffinate pond are listed in Table F-1. Performance of BAT is tracked through weekly inspections and documentation of leak detection systems. If the head below the upper liner and in any of the three individual sumps exceeds maximum allowable head (MAH) outlined in table F-1 the sump in question will be evacuated of leachate at which time the leakage rate will begin to be measured. If the leakage rate is determined to be above the action leakage rate for a 24-hour period Kennecott will initiate reporting requirements as outlined in the permit under Part II Section H.

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Table F-1: Chalcopyrite Heap Leach Ponds BAT Compliance GPD and GPM

Pond	Surface Area (acres)	Allowable Leakage Rate[1] (gpad)	Action Leakage Rate (gpd)	Action Leakage Rate (GPM)	Maximum Allowable Head in Leak Detection Sump (ft)
Raffinate Pond	0.15	1700	255	0.18	2
PLS Pond	0.37	1700	629	0.44	2
Heap	1.78	1700	3026	2.10	2

Notes:
gpad - Gallons per Acre per Day
ft - Feet
PLS - Pregnant Leach Solution
gpd – Gallons per Day
gpm – Gallons per Minute
[1] - Koerner, R. and Koerner, J 2009. Survey of U.S. State Regulations on Allowable Leakage Rates in Liquid Impoundments and Wastewater Ponds. Geosynthetic Institute GRI White Paper #15, p 7. ALR for in-situ leach mines.

The remaining facility is constructed on top of the Dry Fork waste rock disposal area. The facility is upgradient from several extraction and monitoring wells, the Bingham Canyon/Dry Fork area and the Bingham Canyon cutoff wall.

Past testing for the heap leach pads included pilot scale leaching of sulfide ore to better understand the geochemistry of copper heap leaching. This facility has been incorporated into the Dry Fork waste rock disposal area. Planning is in place to use similar technology on top of the Dry Fork waste rock disposal area.

2.3 South Area Water Services (SAWS)

The SAWS facilities, including the administration buildings and water treatment structures are constructed on alluvial sands and gravels in Bingham Canyon. The underlying contact between permeable alluvial deposits and relatively impermeable volcanoclastic bedrock causes groundwater flow below the plant to move through the alluvium to the Bingham Cutoff wall where it is captured. There is an upward vertical groundwater gradient in the bedrock beneath the facility which inhibits contaminant movement out of the alluvium.

The SAWS facility area is paved with either concrete or asphalt, any waters spilled or released due to an upset condition report to a sump or a lined reservoir. Excess water may be routed to either the Bingham Creek Desilting Basin, Small or Large Reservoirs (GWDP#UGW350006). About 80 percent of the HDPE and stainless steel piping included in the SAWS facilities is above ground and/or over paved surfaces. Buried pipe is stainless steel or HDPE.

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SAWS personnel oversee the operation and maintenance of the Bingham Canyon Mine Water Collection System, Desilting Basin, Large and Small Reservoirs and all associated piping and water collection and conveyance structures. There are flow meters and sump level indicators located at each of these sites. In the most critical areas, level indicators alarm to a central control room if sumps become too full or pipe flow decreases significantly. This allows rapid shut-down or redirection of water flows in the event of an upset condition.

2.4 Bingham Canyon Water Treatment Plant

The Bingham Canyon Water Treatment Plant (Zone A RO Plant) is located southwest of the Large Bingham Reservoir. The process area is contained within a building with a sloped concrete floor, which drains to an HDPE lined trench system and then to a sump. The sump is serviced by a pump, which returns all the effluent collected in the trench to the Eastside Collection System. Flow into the trench occurs either from the membrane washing cycle or from flushing and draining of lines within the system; effluents are pumped from the sump as required. Overflow from the sump is routed to the Large Bingham Reservoir Desilting Basin. Effluents are not allowed to stand in the trench for any length of time beyond the inflow/pump-out period.

The trench system has an emergency overflow to Chamber 1 of the Desilting Basin of the Large Bingham Creek Reservoir in the event of a long-duration power outage that coincides with uncontrolled inflows.

3.0 INSPECTION AND MAINTENANCE PROCEDURES

Facilities which are in operation are monitored on a continuous basis. All operating mine facilities described in this Plan are operated 24 hours per day, 365 days per year and all areas are inspected at least once per day and generally once per shift by assigned employees. The assigned operators or inspectors are responsible for correcting any problems discovered in a timely manner. Maintenance and repairs are initiated in response to inspection results or according to preventive maintenance (PM) schedules.

PM schedules at the mine are tracked with a computerized maintenance program. Based upon operator inspections and preset maintenance intervals, this program assists in scheduling and planning PMs. Standard Operating Procedures (SOPs) are used by the employee or group of employees assigned the responsibility for completing the PM. After the PM is completed, a signed PM checklist is returned to the maintenance scheduler. The maintenance planner notes any items identified during the inspection that require additional repair. A work order is then written and the additional work scheduled. The work-order tracking system is intended to ensure that proper and complete implementation of required repairs occurs in a timely fashion. The system continues to remind maintenance planners periodically until the work-order job is completed and closed out.

The Zone A RO Plant is manned on a continuous basis, twenty-four hours a day 365 days per year. The operators are also responsible for routine inspection and maintenance of the facility.

3.1 Mine Support Facilities

FINAL DRAFT

All secondary containments around tanks are inspected weekly during the rainy season and after precipitation events. If there is no oil sheen and the water has a pH between 6.5 and 9, it may be discharged to the ground. Water with oil sheen is conveyed to an oil/water separator.

The integrity of tanks, secondary containments, concrete wash pads, refueling pads and waste storage pads are inspected monthly. Pumps, valves and pipes associated with bulk storage tanks are inspected annually.

Oil/water separators situated below grade and away from secondary containment are inspected at least quarterly and used oil is removed as required. Sludge levels are inspected at a minimum annually and sludge removed as required.

The waste storage pad is inspected weekly to ensure the facility meets Environmental Protection Agency (EPA) guidelines, which include the containment of stored waste products.

3.2 Solvent Extraction/Electrowinning Facilities

During operation, all facilities associated with the SXEW plant are inspected on a daily basis. All observations are noted on a detailed log sheet.

3.3 South Area Water Services (SAWS)

All water collection and conveyance facilities that comprise the Bingham Canyon Mine Water Collection System, including drop boxes, junction boxes, diversion boxes, cutoff walls, valves, desilting basins, pipelines, sediment traps, canals, screens, weirs, and flumes are inspected on a quarterly basis as per the requirements of ground water discharge permit #UGW350010. Pumps and motors are maintained in accordance with the preventive maintenance schedules. If any deficiencies are found, they are corrected immediately, or a work order is written for the required repairs. All structures associated with the Large and Small Reservoirs are inspected as per the requirements of ground water discharge permit #UGW350006.

3.4 Bingham Canyon Water Treatment Plant

During operation, the operators are responsible for the PM program, which is implemented at the beginning of each shift. PM consists of visual inspection of the equipment, its foundations and mounting assemblies, checks for excessive heat, noise or vibration, and inspection of associated piping for leaks and proper sealing. Pumps have lubricating fluids changed as directed by the manufacturer's instructions. Level control in the sump is checked annually to ensure that the controls activate at the appropriate levels.

After the PM is completed, the operator reports any deficiency. A work order is then written for implementation of the required repairs, which generally take place within seven days.

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4.0 PERFORMANCE CRITERIA

4.1 Housekeeping

All facilities adhere to strict housekeeping standards. Housekeeping standards have been established for the principal purpose of ensuring consistent application of housekeeping throughout Kennecott. Kennecott's facility standards require floors to be washed at an interval necessary to keep them in a clean state. Floors are kept as dry as possible to minimize potential for slips and falls. Hoses, brooms and similar types of equipment are located in strategic areas to facilitate housekeeping. All containers must be in good condition, properly labeled and compatible with the stored material. Spilled materials must be promptly cleaned up and work areas kept reasonably free of grease, oil and other process materials. Area supervisors, through employee training and regular site inspections, enforce these standards. Kennecott supervisors are trained annually on the environmental aspects of proper housekeeping.

4.2 Spill Prevention, Response and Reporting

All mine facilities are included in the Spill Prevention, Control and Countermeasures (SPCC) Plan which is covered by the Clean Water Act and only regulates petroleum-based material. This plan specifies physical and institutional controls to minimize the likelihood of spills and identifies procedures to be followed in the event of a petroleum-based spill. In general, spill response involves: 1) identifying the spilled material; 2) isolation of the spill immediately if it is safe to do so; 3) containing the spilled material as soon as safely possible; and 4) cleaning up and properly disposing of the spilled material and any contaminated soils or debris. Spill response kits are located at strategic locations at each facility. Employees are trained annually on the SPCC Plan.

A verbal report of noncompliance, or spills subject to the provisions of UCA 19-5-114 which may endanger public health or the environment, are made as soon as possible, but no later than twenty-four hours from the time Kennecott first becomes aware of the reportable incident. The report is made to the Utah Division of Environmental Quality 24-hour number, (801) 536-4123 or to the Division of Water Quality, Groundwater Protection Section at (801) 538-6146, during normal business hours. Other notifications required under RCRA or SARA are made if reportable quantities are exceeded. A written report containing specific details of the incident and Kennecott's response is required to be submitted within five business days.

4.3 Materials Handling

Before new products are allowed on site, their material safety data sheets (MSDSs) are reviewed by procurement personnel as well as health, safety and environmental personnel as outlined in Kennecott's standard 14.2. An attempt is made to exclude chemicals that may pose health or environmental risks, and which would be persistent in the environment if released. Existing product usage is also periodically reviewed to determine if less hazardous materials can be substituted.

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Although the mine is regulated under the Mining Safety and Health Administration (MSHA), Kennecott enforces the Occupational Safety and Health Administration (OSHA) requirements for hazard communications at all facilities. The OSHA standards that are enforced for materials handling include:

- labels and (or) appropriate warnings are placed on all tanks and other containers
- MSDSs are maintained and readily available for all chemicals on site
- employees are informed and trained regarding chemical hazards and hazard communications
- contractor employers are informed concerning hazardous chemicals to which their employees may be exposed to while working at the Bingham Canyon Water Treatment Plant
- material transfer operations are conducted in such a manner as to minimize the potential for spillage; chemicals are stored in compatible containers and tanks; containers are properly labeled with NFPA stickers.

4.4 Training

All new employees receive an overview of Kennecott's environmental policy and procedures, including training on housekeeping, hazard communication and SPCC requirements. Throughout the year all Kennecott employees receive site specific training on a variety of environmental topics including materials handling, waste handling, hazard communication and spill prevention and response.

4.5 Recordkeeping

Records that document compliance with the elements mentioned in the BMP are maintained for a minimum of three years. Copies of the required records will be kept at the appropriate location.

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Kennecott Bingham Canyon Mine and Water Collection System: Dry Fork Management Plan

Operational Plan Summary

This plan targets groundwater monitoring and controls of historic mine impacted waters in the Dry Fork area. The management of these waters is separated into three areas:

1. Clean water capture upgradient of Dry Fork area;
2. Bedrock groundwater monitoring; and
3. Alluvial extraction of Dry Fork/Bingham Creek area mine groundwater.

The plan is formatted into five sections and summarizes well "as-built" specifications, pumping rates, historic concentrations of key analytes and geologic and hydrogeologic conditions where applicable. The five sections specifically addressed are:

1. Upgradient clean water capture;
2. Peripheral or lateral monitoring wells;
3. Alluvial pumping wells below the toe of Bingham Canyon waste rock disposal area;
4. Bedrock monitoring wells between Bingham Canyon waste rock disposal area and the Bingham Canyon cut-off wall; and
5. Bingham Canyon cut-off wall.

Historic Overview Including Geologic/Hydrologic Factors

Overview

Bedrock groundwater is known to have been impacted as a result of mining activities within the Dry Fork area. Efforts were made to monitor the extent of the contamination as well as extract contaminated water with sulfate concentrations in excess of 20,000 mg/l. During the extraction period which lasted between 1960s and 2003, the geologic, hydrologic conditions within the Dry fork area were studied extensively and are summarized in more detail below. Through various monitoring and extraction wells (Figure 2) the impacted groundwater was determined to be confined to Bingham Canyon and its alluvial and bedrock flow path impeded by local structures resulting in mine contact waters reporting to down canyon alluvium. Mining operations were modified in 2004 resulting in a change in Dry Fork plume management strategies. Kennecott placed waste rock in Bingham Canyon beginning in 1998 through the present, which covered most of the monitoring wells in Bingham Canyon. Monitoring is now performed from wells at the mouth of the canyon.

Geologic Conditions

The geology of the Dry Fork area consists of Paleozoic sedimentary bedrock which is heavily folded and faulted. Two large fold structures are known to exist within Dry Fork Canyon: the Copperton Anticline and the Copperton Overturn. The anticline is steeply dipping to the west

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and overturned on the east side. The Conger and Champion thrust faults cut across Bingham Canyon. These structures generally impose down gradient bedrock barriers which minimize the migration of ground water deeper into bedrock to the east where it could impact the Salt Lake Valley aquifer.

Hydrologic Conditions

Vertical head gradient at the confluence of Bingham Canyon and Dry Fork Canyon is predominantly upward and averages 0.026 ft/ft (not density corrected). The upward gradient is reflective of a compilation of piezometer data collected from locations within the canyon both historic and current. The lower and most eastern part of Bingham Canyon has an upwards gradient as large as 0.051 ft/ft (not density corrected). In these conditions, groundwater is reporting to alluvium where it can be captured in the alluvium pumping wells.

Waste rock was placed over approximately 100 feet of alluvial material in Bingham Canyon. Over this time period, the waste rock has drained meteoric water into the Bingham Canyon alluvial material and into bedrock. This change has affected the hydraulic gradient somewhat such that the upward gradient has decreased. Kennecott believes the alluvial material is not fully saturated and is partially influencing the water quality near the mouth of Bingham Canyon.

Monitoring Controls & Contingency Plan

Section 1: Upgradient Clean Water Capture

Two pumping wells are located upgradient of the Dry Fork dump area. The wells are COP2701 (Mid Valley Well) and COG1172 (Upper Dry Fork Well or Picnic Flats Well) as depicted in Figure 2. Well COG1172 is in the process of being replaced with a new extraction well (COG2865) located approximately 600 feet upgradient of COG1172. The purpose of the wells is to capture clean water upgradient of the Dry Fork waste rock area prior to coming into contact with waste rock contact water (WRCW) as well as minimize hydraulic head pressure created by upgradient groundwater sources in Dry Fork Canyon. Pumping on COP2701 began in the late 1990s, with an average monthly pumping rate of 130 gpm over the past 5 years when in use. Flow rates have ranged from approximately100 to over 500 gpm. Pumping of COG1172 was re-established in 2007 and was implemented to supplement COP2701. The average flow rate (5 year rolling average) for COG1172 based upon a monthly average is 50 gpm and has ranged between 40 to 70 gpm.

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Table 1: Dry Fork Area Clean Water Capture Wells Summary Information

Well ID	COP2701	COG1172/Replacement Well COG2865
Alias	Mid Valley Well	Picnic Flats Well
General Location	300 ft upgradient of Dry Fork dump toe	1500 ft upgradient of COP2701
Coordinate (state plane 83)	N 7378029.3 E 1459357.4	N 7378749.7 E 1458019.9
Years in Service	25	12
Surface elevation	6241	6341
Total Depth (ft)	345	962.8
Screen interval (ft)	20-275	80 – 952
Screened Lithology	Quartzitic alluvium/Quartzite	Quartzitic alluvium/Quartzite
Pump capacity (gpm)	500	375
Average Monthly pumping rate (gpm)[1]	130	50
Average annual water volume removed (acre-feet)	200[2]	60[3]
Static Water Level (ft)	~110	100

[1]Average pumping rate based upon months when pump is in service
[2]Average volume based upon 5 year rolling average annual data
[3]Average volume based upon 5 year rolling average annual data

Section 2: Peripheral Monitoring Well Controls

Peripheral monitoring of the Dry Fork area is performed through compliance monitoring wells COG2806A and B. The wells are located north and east of the Dry Fork Canyon and Bingham Canyon intersect, as depicted in Figure 2, and both intervals are screened in quartzite. The wells are intended to monitor the potential lateral movement of mine impacted ground water originating from Dry Fork Canyon. Groundwater monitoring wells ECG1106A & B, located approximately 600 feet north of ECG2787 and drilled in bedrock, can also be used as monitoring the northern/eastern edge of the Dry Fork water quality. In addition, COG995A & B located adjacent and northwest of the waste rock and ECG2866 A & B located on the eastern extent of the waste rock in Bingham Canyon are also used to monitor changes in water quality. The COG995 and ECG2866 sites are completed in bedrock, and each have shown minimal changes in water quality over the past years. Alluvial monitoring well ECG2854 and bedrock completion wells ECG2853A&B were located on top of the waste rock dump face, and the well casings had bent inward due to slight movements in the waste rock dump. These wells were appropriately abandoned in September 2024.

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Table 2: Peripheral Bedrock Monitoring Wells Summary Information

Well ID	COG2806A	COG2806B
General Location	NE corner of Dry Fork-Bingham Canyon Intersect	Same
Coordinate (state plane 83)	N 7375371.5 E 1468620.3	Same
Years in Service	4	Same
Casing elevation	6228.91	6228.67
Total Depth (ft)	800	1108
Screen interval (ft)	760-800	1068-1108
Screen Lithology	Limey Quartzite	Quartzite
Average DTW (ft)	691	695

Monitoring of contaminated waters to the immediate south is precluded by active waste rock placement and historic waste rock disposal areas. The east side collection system is located further south and east, which is comprised of a robust monitoring network of cut-off walls and monitoring wells. Bedrock groundwater contamination will be identified using these wells and operational control structures.

Section 3: Alluvial Controls

Down Gradient of Bingham Canyon Waste Rock Disposal Area

Groundwater impact to the alluvial material is controlled with three pumping wells situated between the toe of Bingham Canyon waste rock disposal area and the Bingham Canyon Cut-off Wall (COW) as depicted in Figure 2. Table 3 summarizes well statistics. The wells were placed to capture mine impacted water moving through alluvium and minimize water reporting to the Bingham Canyon COW. The goal of the wells is to maximize alluvial extraction before mine impacted waters can enter the bedrock, however pumping rates for individual wells may vary or cease all together based upon alluvial saturation conditions. There is no alluvial pumping located in Bingham Canyon between the Dry Fork pumping wells and ECG2866A & B. ECG2866A & B were replaced by ECG2789A & B in 2020 to accommodate the installation of a new conveyor belt.

Table 3: Alluvial Pumping Wells Summary Information

Well ID	ECG2787[1]	K83	ECG1185
Alias	NA	Curtis Springs	Copperton Channel
General Location	900 feet east of dump toe	3200 feet east of dump toe	3500 feet east of dump toe
Coordinate (state plane 83)	N 7373909 E 1469365	N 7373754.9 E 1471616.3	N 7374630.6 E 1471905.2
Surface elevation	5496	5426	5509
Total Depth (ft)	130	109.8	200.7
Screen interval (ft)	75 – 129	46.5 – 96.5	130 – 200
Pump capacity (gpm)	260	300	30
Average Monthly	120	200[2]	17

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pumping rate			
Average annual volume removed (acre-feet)	190	110	15
Average DTW (ft)	80	49[2]	144

[1] Well performance statistics based upon 2019 annual reporting.

[2] This well operates when needed based on groundwater flow. This well has only been operated approximately 10 months since 2015. and monthly average is for months when pumped in 2019.

Section 4: Bedrock Controls
Down Gradient of Bingham Canyon Waste Rock Disposal Area

Five monitoring wells screened in bedrock act as early warning detection for impacts from Mine impacted water potentially impacting groundwater. The well locations are depicted in Figure 2.

Table 4a: Bedrock Monitoring Wells Summary Information

Well ID	ECG2789 A & B (to be replaced in 2020 with ECG2866)	ECG1100 A & B	K93
Comment	Paleozoic dual completion bedrock well ECG1202 replacement	Paleozoic dual completion bedrock well	Paleozoic-Volcanic Bedrock contact MDG1101 Replacement
General Location	Toe of Bingham Canyon dump	900 feet east of dump toe	2100 feet east of dump toe
Coordinate (state plane 83)	N 7373789 E 1468530	N 7373797 E 1469391.8	N 7373736.3 E 1470610.3
Year built	2009	1994 (mod. 1997)	1968
Surface elevation	5558	5511	5451
Total Depth (ft)	730	861	765
Screen interval (ft)			
A Completion	297 – 337	406 – 426	685 – 765
B Completion	675.7 – 715.7	828 – 857	NA
DTW (ft)			
A Completion	108.2	90.2	14.8
B Completion	108.3	83.4	NA

Table 4b: Permit Limits for Bedrock Compliance Monitoring Wells

Well ID	Screen Lithology	Sampling Frequency	pH	TDS (mg/l)	SO4 (mg/l)	Dissolved Cd (mg/l)	Dissolved Cu (mg/l)	Dissolved Zn (mg/l)
ECG1100A	Bedrock	Semi-annual	6.5-8.50	4148	2581	0.003	0.650	3.01
ECG1100B	Bedrock	Semi-annual	6.50-8.50	391	81	0.001	0.033	1.25
ECG2789A (ECG2866A)	Bedrock	Semi-annual	TBD	TBD	TBD	TBD	TBD	TBD
ECG2789B (ECG2866B)	Bedrock	Semi-annual	TBD	TBD	TBD	TBD	TBD	TBD
K93	Bedrock	Semi-annual	6.50-8.50	480	39	0.050	0.100	0.06

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Bedrock Contamination Contingency Plan

The purpose of the bedrock monitoring wells is to monitor groundwater conditions relative to historic Dry Fork plume concentrations prior to 2003. The average sulfate concentration in the Dry Fork plume has been known to be 20,000 mg/l. The following contingency measures will be used as a guide if the sulfate concentrations in bedrock as indicated by the above compliance monitoring wells reach historic levels and action levels:

- Evaluate potential risks to human health and the environment.
- Evaluate potential contamination to waters of the state.
- Assess the feasibility and effectiveness of extracting and treating ground water using wells or drains.
- Petitioning of the Water Quality Board for an alternative Corrective Action Concentration Limits consistent with the risks identified.

Corrective Action Plans will be written in accordance with UCA R317-6-6.15 D and submitted for approval to the DWQ upon completion of the Contamination Investigation.

Section 5: Bingham Creek Cut-off Wall

The Bingham Creek COW is a concrete structure that spans Bingham Canyon and is built into volcanic bedrock, which has very low permeability. The wall is located approximately 5600 feet down canyon from the toe of the waste rock disposal area as depicted in Figure 2. The wall is designed to capture alluvial water migrating down Bingham Canyon not captured by the alluvial pumping wells up canyon. Water collected at the wall's sump is removed through pumping. Pumping rates fluctuate seasonally and can be dependent upon the effectiveness of the alluvial pumping wells in Bingham Canyon upgradient of the cutoff wall listed in Table 3.

Table 5: Bingham Creek Cut-off Wall Specifications

Site ID	ECP2562
Alias	Bingham Creek COW
General Location	5600 ft down gradient of dump toe
Coordinate (state plane)	N 7373492.5 E 1473938.0
Years in Service	1995 to present
Surface elevation	5353
Total Depth (ft)	110
Pump capacity (gpm)	900 total (2 pumps)
Average Monthly pumping rate	300[1]
Average annual volume removed (acre-feet)	513
Average DTW in sump (ft)	85

[1] Average monthly pumping rate based upon 2019 monthly data.

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The Bingham Creek Cut-off wall spans approximately 375 feet across Bingham Creek channel and is approximately 100 feet deep and built into volcanic bedrock. During excavation and construction of the wall, the majority of the alluvial flow comes from the bottom 20 feet of coarse quartzitic gravel immediately above bedrock. Several previous borings/wells into the underlying volcanic bedrock were exposed during the excavation for the wall and water flowed upward from the bedrock into the excavation area. Head measurements were not conducted on the upgradient flow. Water quality from the upward flow had conductivities measuring less than 2,000 umhos/cm. After the cutoff wall was completed, down gradient monitoring wells completed in alluvium and volcanic bedrock exhibited decreases in sulfate concentrations.

Reporting

Kennecott will follow guidelines set forth by permit # UGW350010 regarding compliance well monitoring and reporting and will be reported on a quarterly basis. Operational and monitoring sites of the Dry Fork and Bingham drainage areas will be sampled on an annual basis (if available to sample) for water quality per Table 3 of the permit. Water flow data, specifically average monthly pumping rates and corresponding annual totals will be tracked throughout the year for operational locations and reported in the annual report as well as associated water quality data.

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Operations & Maintenance Manual East Waste Rock Extension Water Collection System

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SECTION 1

Context and Purpose

1.1 Context

Rio Tinto Kennecott Copper (RTKC) and its Bingham Canyon Mine are required to effectively manage waste rock contact water (WRCW) and the discharge to groundwater, surface water, sediment and debris associated with the waste rock dumps on property. These requirements are outlined in Section 5 under the applicable permits associate with the operation. The agencies and permits are listed in Table 1.

Table 1-1. Applicable operating permits related to groundwater and surface water management

Agency	Permit
Utah Department of Environmental Quality - Division of Water Quality	Groundwater Discharge Permit No. UGW350010 Bingham Canyon Mine and Water Collection System
Utah Department of Environmental Quality - Division of Water Quality	UPDES Permit No. UT0000051 Storm Water Pollution Prevention Plan
Utah Department of Natural Resources - Division of Oil, Gas and Mining	Permit No. M/035/0002 Mining and Reclamation Plan

In order to best meet obligations to the public and regulatory agencies specifically related to the East Waste Rock Extension (EWRE) (Figure 1-1), an integrated system of toe drains, detention basins, cut-off walls and conveyance lines were constructed throughout 2015 and 2016 (Figures 1-2, 1-3, 1-4). The effort was completed to accommodate continuation of mining and waste rock placement while carefully managing the surface and groundwater capture and conveyance.

1.2 Purpose

This Operations and Maintenance (O&M) manual is designed to provide the operator with clear instructions and reference material for the proper care and upkeep of the EWRE project groundwater and surface water control infrastructure.

1.3 Disclaimer

This operation and maintenance manual was created to (1) fulfill the construction permit condition for the EWRE project which requires an O&M manual in order to operate the system, and (2) provide general guidance to the South Area Water Services (SAWS) operators and maintenance staff as part of the handover of the newly constructed capture system. This manual is applicable only to the infrastructure associated with the EWRE project.

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SECTION 2

Design and Operation

2.1 Overview of EWRE Water Collection System

The EWRE water collection system affectively captures WRCW through a toe drain system on top of low-permeable bedrock and directly at the toe of the relaxed waste rock slope. The WRCW is moved by gravity through HDPE pipes and lined concrete structures. Secondary containment of all WRCW conveyance is in place down gradient of the cut-off walls to minimize the potential for a release of WRCW to the environment. The system is also designed to capture surface water (up to a 100 year-24-hour event) off of the face of the waste rock dump.

Key features of the EWRE water collection system include the following:

- The system captures surface and alluvial water (groundwater) up gradient of the cut-off walls; WRCW reporting to the toe of the waste rock is collected in subsurface toe drains filled with coarse quartzite, keyed into bedrock, and conveyed in a system of HDPE pipes (double contained down gradient of the cut-off wall) separate from surface water.
- The toe drain is the primary collection point for WRCW and the cut-off wall acts as the secondary collection point in the event the toe drain under performs.
- WRCW from the toe drains and all drainages from Copper 4 to Midas is transported via gravity to the Midas Pump Station (MPS), and then pumped to the existing ACC plant for copper recovery.
- The cut-off wall locations permit gravity flow from the cut-off wall collection piping via the down gradient collection system piping.
- Secondary containment and leak detection exists for all WRCW piping and structures down gradient of the cut-off walls.
- Storm water is collected in detention basins and released slowly to the storm water piping system so as not to overwhelm the associated piping and concrete lined canal.
- WRCW and storm water flows are recorded on data loggers using weirs, flumes and level indicators.
- WRCW water samples can be collected at the weir boxes.

A conceptual representation of the EWRE water collection system design is shown in Figure 2-1.

The collection system is described from top to bottom.

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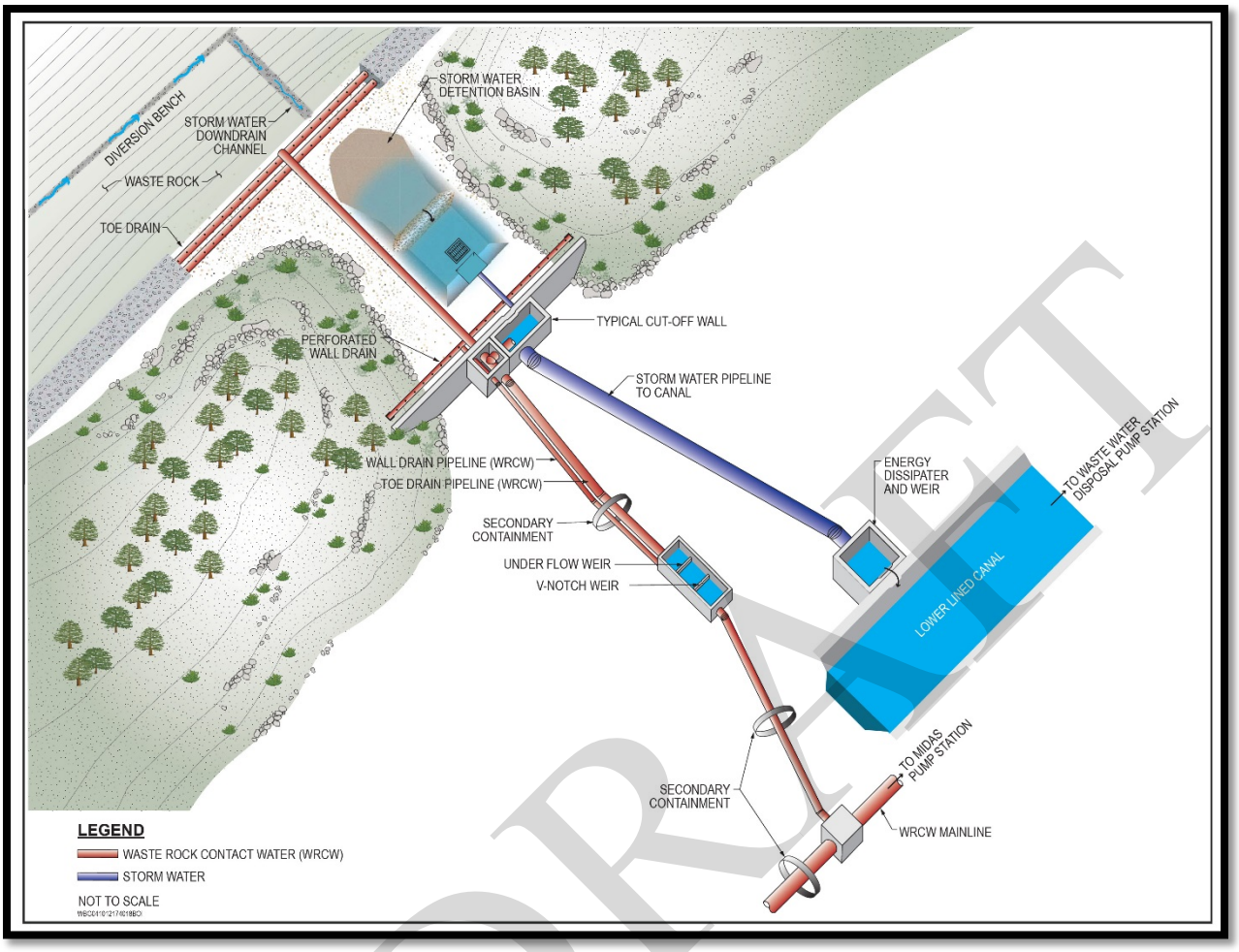


Figure 2-1. EWRE water collection system schematic (typical).

2.2 Typical Component Designs for the EWRE Water Collection System

The photographic representation of the typical water capture system components for the EWRE are shown on Figure 2-2. Specific details of the typical EWRE water collection system components are presented below.

2.2.1 Toe Drains

The toe drains are designed to intercept waste rock contact water (WRCW) moving along the bedrock contact as it reports directly from the toe of the waste rock. The toe drains are composed of two parallel, 12-inch-diameter perforated corrugated HDPE pipes placed along the lower permeability layer at the bedrock contact. There are three types of toe drains:

- Type 1 is a more robust design, clay down on the down gradient side of the toe drain is 8 feet thick, and was used primarily at drainage bottoms in the collection system where flow reporting from the waste rock is anticipated to be greatest and in cases where slope parallel with the toe drain is < 1% (Figure 2-3).
- Type 2 was used throughout the majority of the collection system and where flow from waste rock is anticipated to be less active and/or significantly diminished or slopes are ≥ 1%. Clay down gradient of the toe drain is 2 feet thick (Figure 2-3).

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- Type 3 was used on steep slopes greater than 45 degrees and incorporated no imported clay. Type 3 was used where constructability of Type 2 toe drains was not achievable (Figure 2-4).

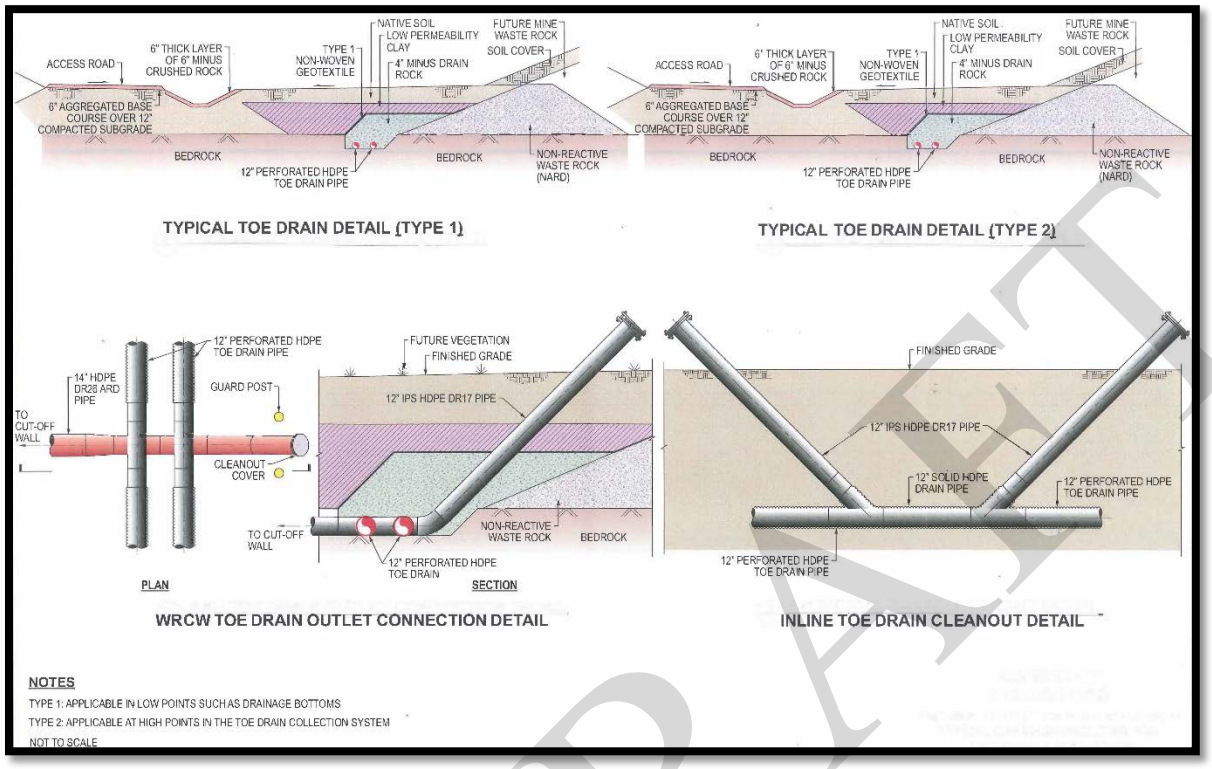
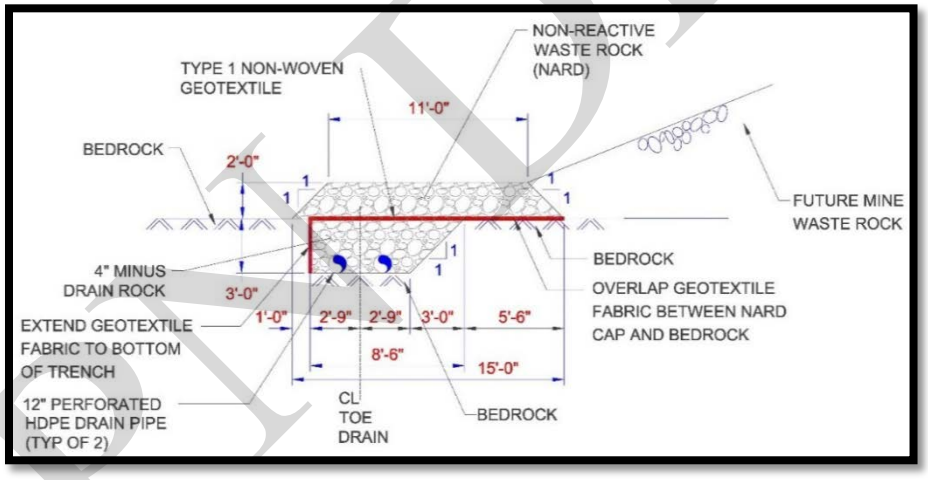


Figure 2-3. Type 1 and Type 2 toe drain details.



Note: This toe drain detail is applicable to ground slopes greater than 1:1 (45°), such as the south slope of the Lost Creek drainage and the south slope of the Keystone drainage.

Figure 2-4. Type 3 toe drain detail.

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Within each drainage basin, the perforated 8" toe drain piping connects to a solid wall 14-inch-diameter HDPE conveyance pipeline. This piping extends down gradient from the toe drain through the cut-off wall and reports to a collection weir box. Two oblique angled 14-inch-diameter capped HDPE pipe cleanouts are located approximately every 500-feet of toe drain, in addition to the cleanouts at branch connection. Photographs of the completed and 'in construction' toe drain are shown in Figures 2-5 and 2-6, respectively.



Figure 2-5. Typical toe drain showing clean-outs, rip-rap surface water ditch and the access road.

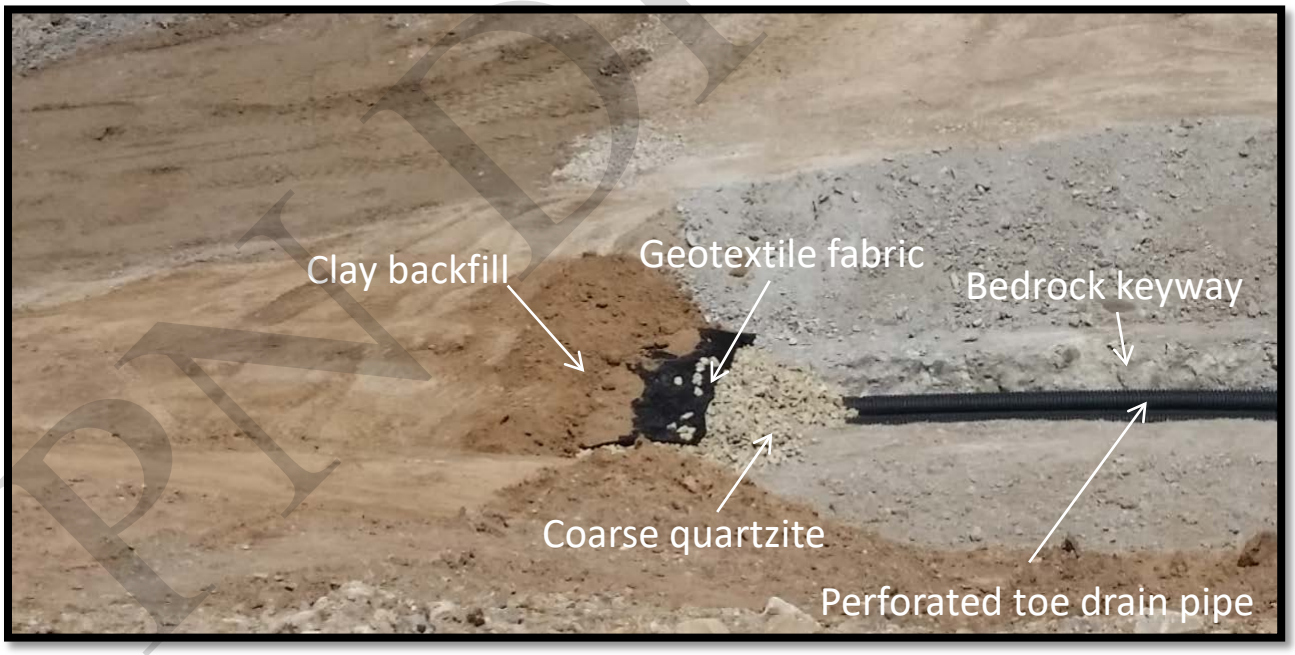


Figure 2-6. Typical toe drain under construction.

Upstream of the toe drain are finger drains built with coarse non-acidic (non-reactive) rock (quartzite) drainage (NARD) material. In most cases, the coarse quartizte fingers drains were keyed into bedrock; however, in a few locations, the finger drains were placed in drainage lows once all soils were removed to bedrock. The locations of the coarse quartzite finger drains are illustrated on the EWRE Geology, Seeps and Springs Map (Appendix A).

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2.2.2 Storm Water Detention Basins

Storm water detention basins are located in all drainages associated with EWRE. The size of each detention basin was determined based on the modeled peak storm water flow rates reporting from the waste rock face. Basic design criteria used is based on a 100-year, 24-hour storm event and the planned, reclaimed waste rock and site topography. At a minimum, the storage provided in each detention basin will be sufficient to detain the estimated peak storm volume (Table 2-1).

The detention basins are designed to drain to a topographic low point, and are bounded at the inlet by a pervious rock embankment approximately 6 feet tall designed to capture sediment and debris. A primary outlet box is located at the basin's topographic low point. The detention basin is designed to drain in a 24-hour period. The primary outlet box is generally 4 feet tall, and includes a variably-sized inlet orifice (Table 2-1), a fiberglass top grate, and a 24-inch-diameter HDPE outlet pipe. The primary outlet box directs storm water into a 24-inch-diameter HDPE outlet pipe through the cut-off wall storm water collection vault and ultimately the canal. In the event the outlet box fails or cannot keep up with a given storm event, the detention basin embankment contains an emergency overflow (between 4 and 9 feet above the basin floor), which directs storm water via a pervious rip rap rock spillway to a second grated inlet on the wet-side of the cut-off wall.

The detention basins are slightly oversized to accommodate sediment buildup, and include a staff gauge near the topographic low to visually monitor sediment accumulation.

Table 2-1. Storm water detention basin dimensions

Basin	Basin Volume (acre-feet)	Average Basin Depth (feet)	Basin Floor Elevation (feet)	Outlet Box Top Elevation (feet)	Emergency Overflow Weir Elevation (feet)	Berm Top Elevation (feet)
Copper 4	6.3	6.7	5,635	5,642	5,644	5,645
Copper 3	1.9	3.3	5,635	5,639	5,640	5,641
Copper 2	2.8	5.7	5,610	5,617	5,618	5,620
Copper 1	2.3	4.3	5,603	5,607	5,608	5,610
Lost Creek	1.9	5.4	5,578	5,585	5,686	5,588
Keystone Upper	0.9	5.1	5,554	5,563	5,564	5,566
Keystone Lower	2.6	5.8	5,534	5,541	5,542	5,544
North Keystone	5.6	3.8	5,560	5,565	5,566	5,568
South Crapo	4.1	3.8	5,549	5,553	5,554	5,556
Crapo	1.9	4.4	5,525	5,532	5,533	5,535
South Congor	3.4	4.2	5,530	5,534	5,535	5,538
Midas	7.4	3.7	5,540	5,544	5,545	5,547

2.2.3 Cut-Off Walls

The cut-off walls are designed to serve as a secondary capture system for alluvial groundwater, with the toe drains functioning as the primary capture system. Figure 2-7 shows a typical cut-off wall in cross section.

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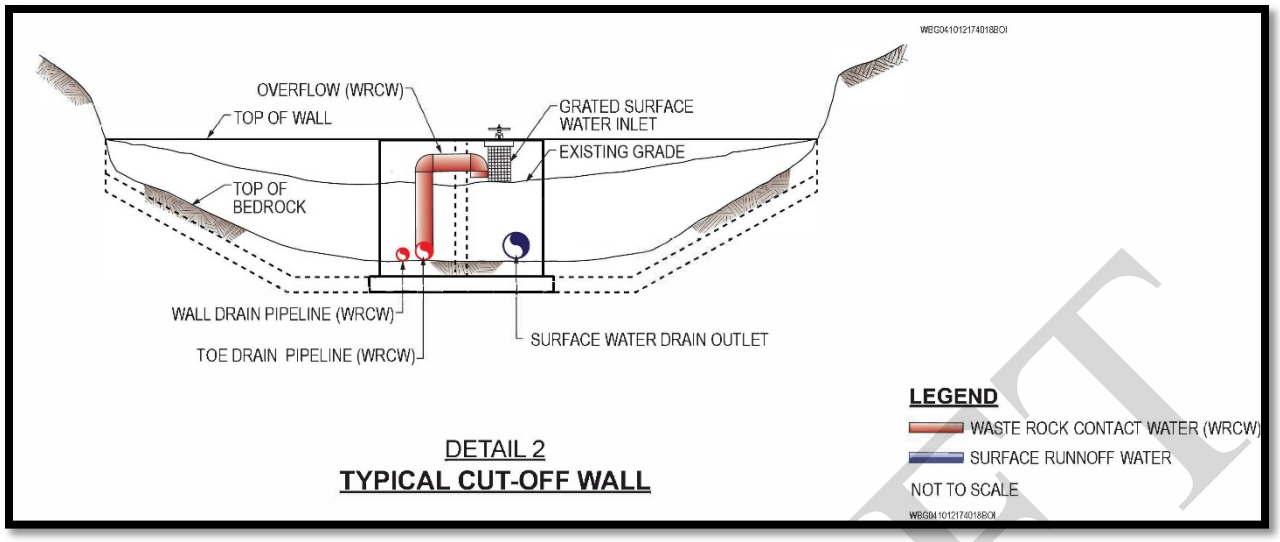


Figure 2-7. Typical cut-off wall.

Cut-off walls are located in each of the major drainages (Figures 1-2, 1-3, 1-4), and are keyed into bedrock for structural support and to enhance capture effectiveness. Additionally, the upgradient wet-side of the cut-off walls are protected from WRCW by a HDPE liner.

Three pipes pass through each cut-off wall:

1. A French drain with a perforated 8-inch-diameter HDPE pipe runs parallel to the base of each cut-off wall, along the surface of the bedrock. This French drain captures WRCW originating between the toe drain and the cut-off wall or WRCW in the event the toe drain under performs. The 8-inch-diameter HDPE pipe, passes through the valve vault at the cut-off wall, becomes double contained inside a 12-inch-diameter HDPE pipe at the cut-off wall and gravity drains to the weir box.
2. The 14-inch-diameter HDPE pipe from the toe drain, passes through the valve vault at the cut-off wall, becomes double contained inside a 24-inch-diameter HDPE pipe at the cut-off wall and gravity drains to the weir box.
3. The 24-inch-diameter HDPE pipe from the storm water detention basin outlet structure enters the cut-off wall storm water vault, passes through the storm water vault to exit via another 24-inch-diameter HDPE pipe, and gravity drains to the lower concrete lined canal. The water can be diverted to the storm water line in the event the 14-inch-diameter WRCW line requires repair (Figure 2-8).

Storm water arriving at the cut-off wall via the spillway overflows into the storm water vault, and is then carried through the cut-off wall and downgradient to the lower concrete lined canal via a 24-inch diameter HDPE pipe. Before storm water enters the canal, it passes through either a weir box or flume where flow is measured.

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Figure 2-8. (A) WRCW by-pass valve located in each cut-off wall; (B) manipulated with valve tool; (C) valve tool attaches to valve stem for manipulation.

2.2.4 Weir Boxes

Waste rock contact water from the toe drain and the cut-off wall are comingled in weir boxes. A weir box is an HDPE lined concrete structure that includes a baffle for stilling the water, a V-notch weir (Figure 2-9) and level indicator for flow measurement, leak detection, and a data logger.

On the upgradient side of the weir box, WRCW reports from the 14-inch-diameter HDPE pipe from the toe drain (double contained within a 20-inch-diameter HDPE pipe) and the 8-inch-diameter HDPE pipe from the base of the cut-off wall (double contained within a 12-inch-diameter HDPE pipe). On the downgradient side of the weir box, a 14-inch-diameter HDPE pipe (double contained in a 20-inch-diameter HDPE pipe) of combine WRCW gravity drains to the WRCW main line.

Leak detection is located outside of the weir box in three (visible) vertical 18-inch-diameter HDPE pipes (Figures 2-10 and 2-11). The three 18-inch-diameter leak detection inspection pipes are connected to the secondary WRCW pipes and concrete weir box via 3-inch HDPE pipes. Signage in the field indicates which leak detection 18-inch-diameter HDPE pipe correlates to which respective pathway.

The real-time flow datalogger collects flow data at the V-notch weir or flume. The datalogger and digital station are powered by a solar panel (Figure 2-11). Data acquisition is acquired manually at the data logger (Figure 2-12).

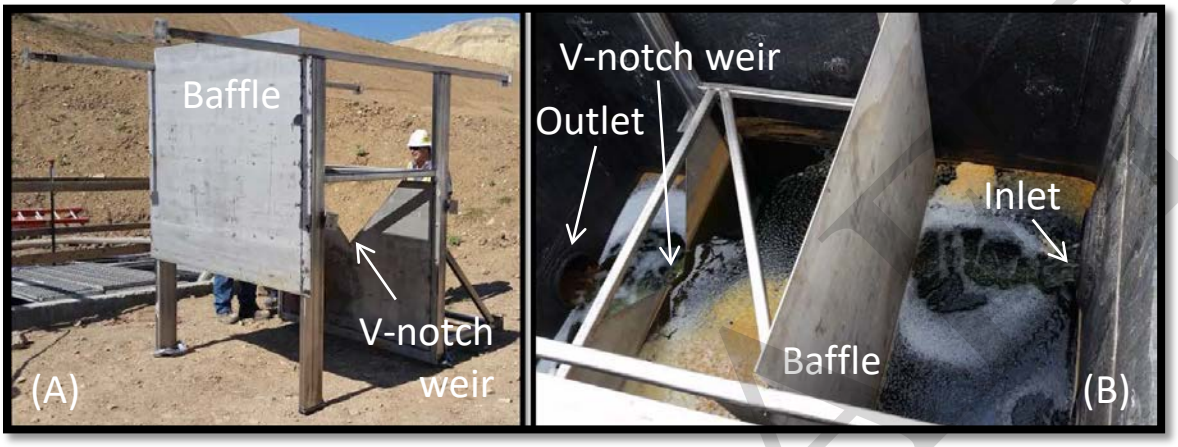


Figure 2-9. (A) Space frame with baffle and V-notch; (B) weir Box with space frame.



Figure 2-10. Lost Creek-Keystone weir box and carrier pipe leak detection.

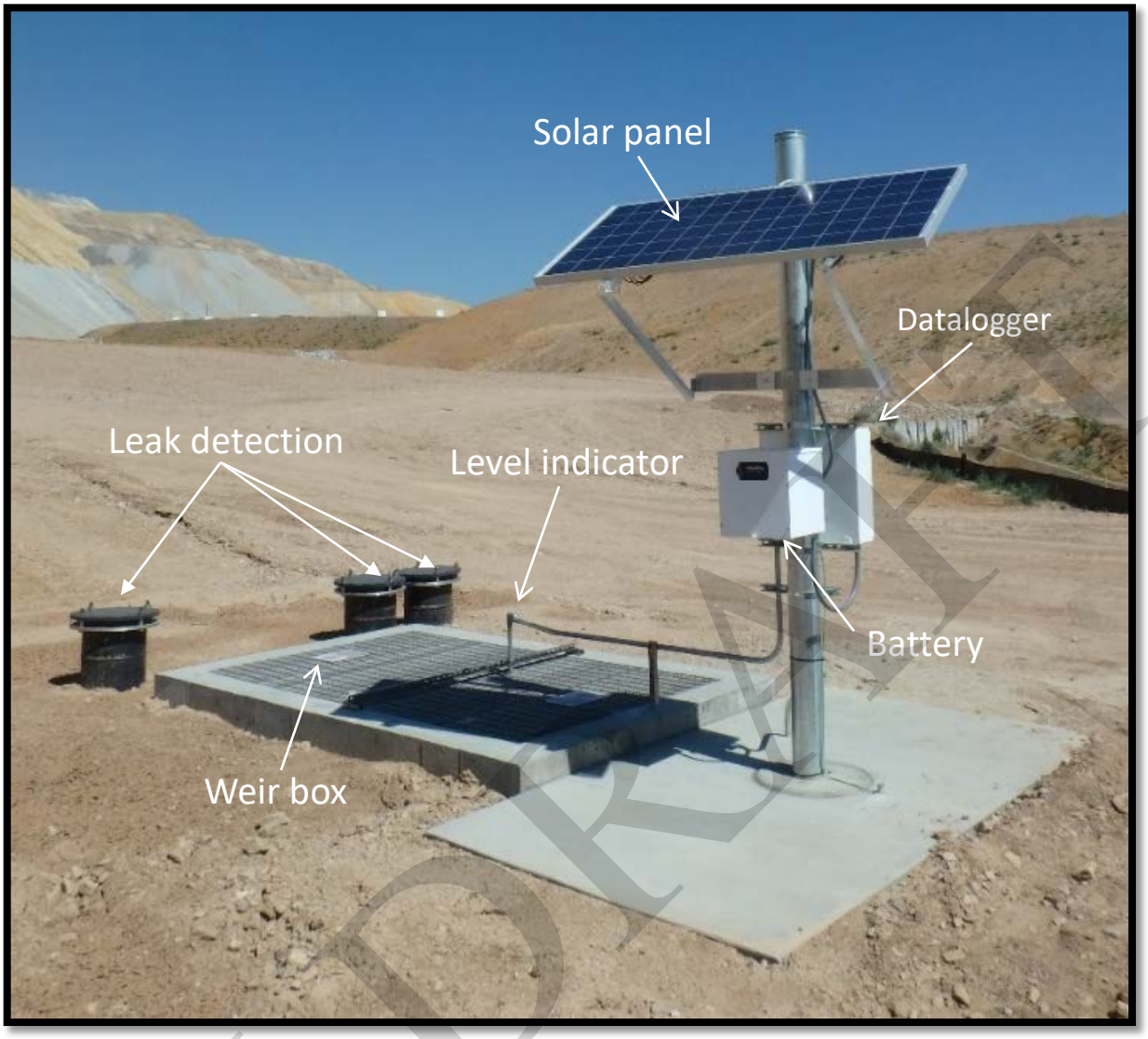


Figure 2-11. Photograph of a newly constructed weir box and auxiliary components.

Bolt penetrations through the weir liner are problematic to seal. A space frame (Figure 2-9A) was used to eliminate the need to penetrate the liner in order to mount the baffle and v-notch plates.

If water is found in the leak detection sumps, test water quality to determine if it matches WRCW characteristics and to rule out malfunctioning leak detection piping as displayed in Figures 2-10 and 2-11.

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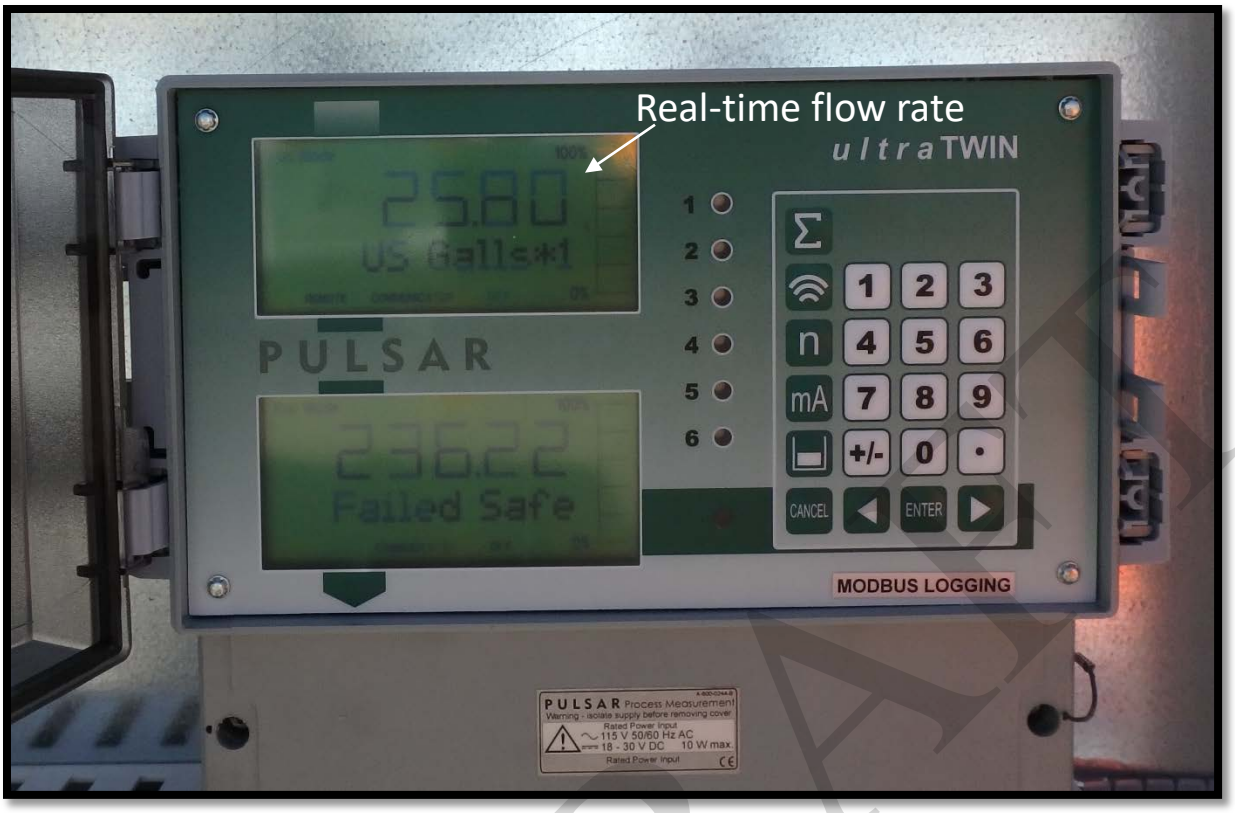


Figure 2-12. Typical datalogger display showing real-time flow rate through the weir V-notch.

2.2.5 Storm Water Weir/Flume and Lower Concrete Lined Canal

Water reporting from storm water detention basin outlet boxes is conveyed via 24-inch-diameter HDPE pipe through the cut-off walls to the lower concrete lined canal, which ultimately conveys flow to Zone 2 of the Large Reservoir. Storm water weirs and flumes with level indicators are present where the 24-inch-diameter HDPE pipe connects to the lower concrete lined canal. In some instances, the new system used historic existing branch canals. The lower concrete lined canal originates in the Copper 3 drainage (Figure 1-2). The EWRE system ties into the south dumps at the South Area Drainage (SAD) box. Storm water exits the SAD box via a 36-inch-diameter HDPE storm water overflow line. The line increases in diameter to a 42-inch line at the Copper 4 drainage. The Copper 4 drainage does not have a means of flow measurement and is connected via hard pipe at the Copper 4 deep branch connection. Water from south dumps and the Copper 4 drainage enter the lower concrete lined canal at an outlet box at the head of the canal. The canal is sized to manage storm water from all EWRE basin simultaneously during a 24-hour 100-year event.

2.2.6 Branch Connection Vault and WCRW Main Line

The WRCW branch connection vaults are situated parallel to the storm water main line and lower concrete lined canal, and receive WRCW from the dual contained 14-inch-diameter HDPE branch line(s) (Figure 2-13). The branch lines tie into the 16-inch-diameter HDPE WRCW main line pipe (double contained within a 24-inch-diameter HDPE pipe). This 16-inch-diameter HDPE pipe diameter increases in diameter to 24-inch at the Crapo branch connection vault.

A typical branch connection vault is accessible via a metal hatch (Figure 2-13). Dual containment of the WRCW main line

Opening the hatch and exposing the opening in the lid of the box **will require fall protection**.

Entering the vault will require conformance with **confined space entry** protocol.

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and the weir box branch connection drain directly into the branch connection vault; thus, water flowing into the branch connection vault is indicative of a leak in the respective conveyance piping.

Many branch connection vaults contain automated leak detection sensor that are connected to strobe lights on the associated weir box datalogger station for the respective drainage basin. In the case of branch connection vaults that are located in close proximity to one another, such as Crapo and South Crapo, only one leak detection strobe is used per datalogger. A leak from a secondary pipe will enter the vault triggering the strobe once water comes in contact with the sensor. Water will continue down the secondary pipe associated with the outlet triggering each downstream probe as the water accumulates.

The main line pipe conveys WRCW from the EWRE water collection system, as well as flows from the existing system south of Copper 4, to the Midas Pump Station (MPS). The WRCW main line pipe is buried, and is located parallel to and adjacent to the existing lower concrete lined canal (Figures 1-2, 1-3, and 1-4).

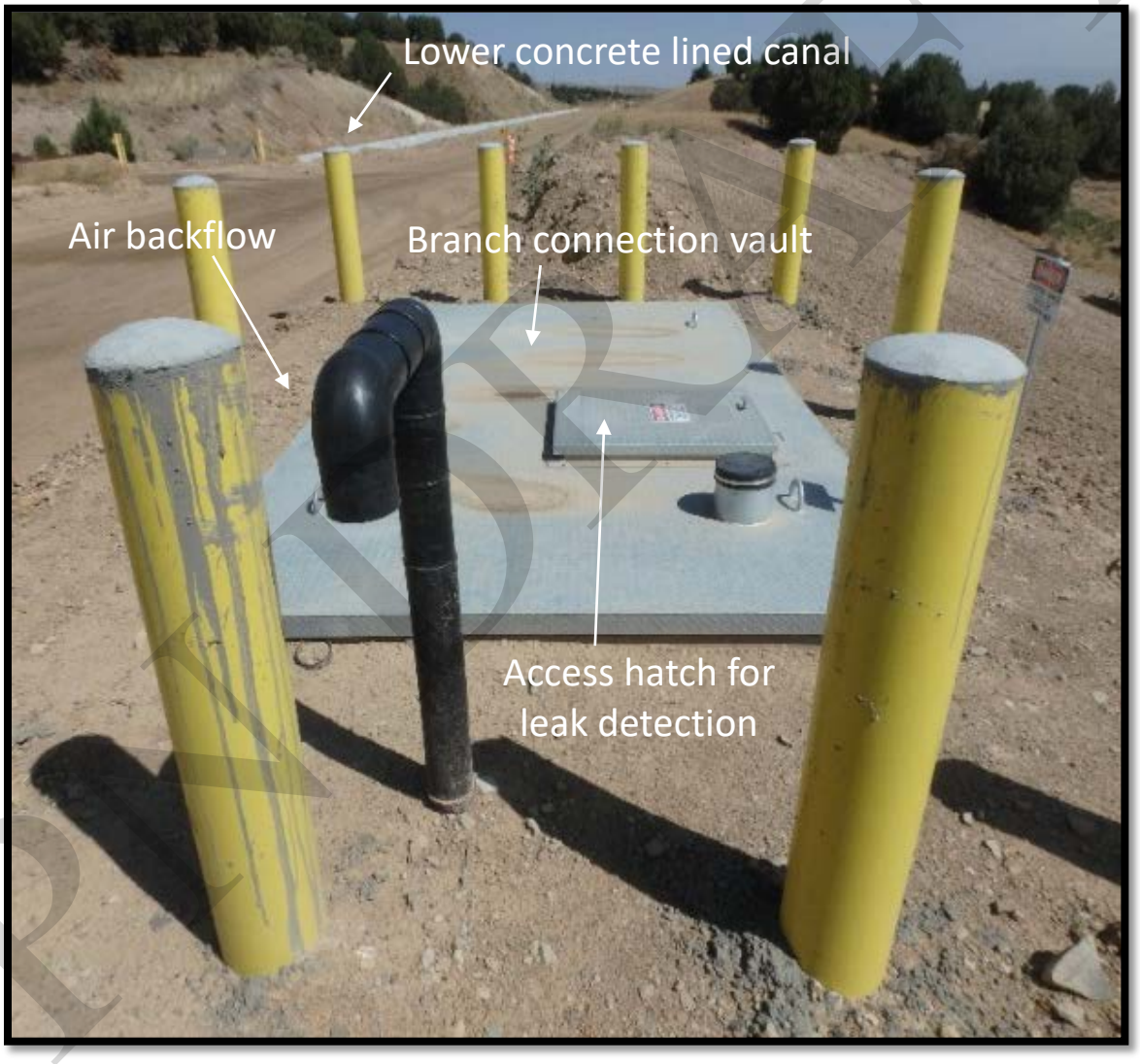


Figure 2-13. Photograph of a newly constructed WRCW branch connection vault.

2.2.7 Settling Basin

The WRCW Mainline terminates in the settling basin (Figure 2-14). The settling basin also receives inflow directly from the comingled flows of South Congor, Midas and the Old Bingham Tunnel (OBT). From the settling basin, the WRCW is conveyed to the MPS. In the event the MPS cannot receive additional

WRCW, WRCW in the settling basin can be diverted directly to the lower concrete lined canal. The settling basin also has a fail-safe overflow pipe that directs water to the lower concrete lined canal in the event the outlets of the settling basin are plugged or malfunctioning, thus preventing WRCW spills to ground. The settling basin is also equipped with leak detection for the HDPE liner, as well as the WRCW piping reporting to the settling basin.

Sediment accumulation in the settling basin is estimated to be considerable in the first one to two years of operation as the WRCW collection system (e.g., finger drains, toe drain, piping,) rinses free of fine sediment. Further guidance is provided in Section 3.2.10.

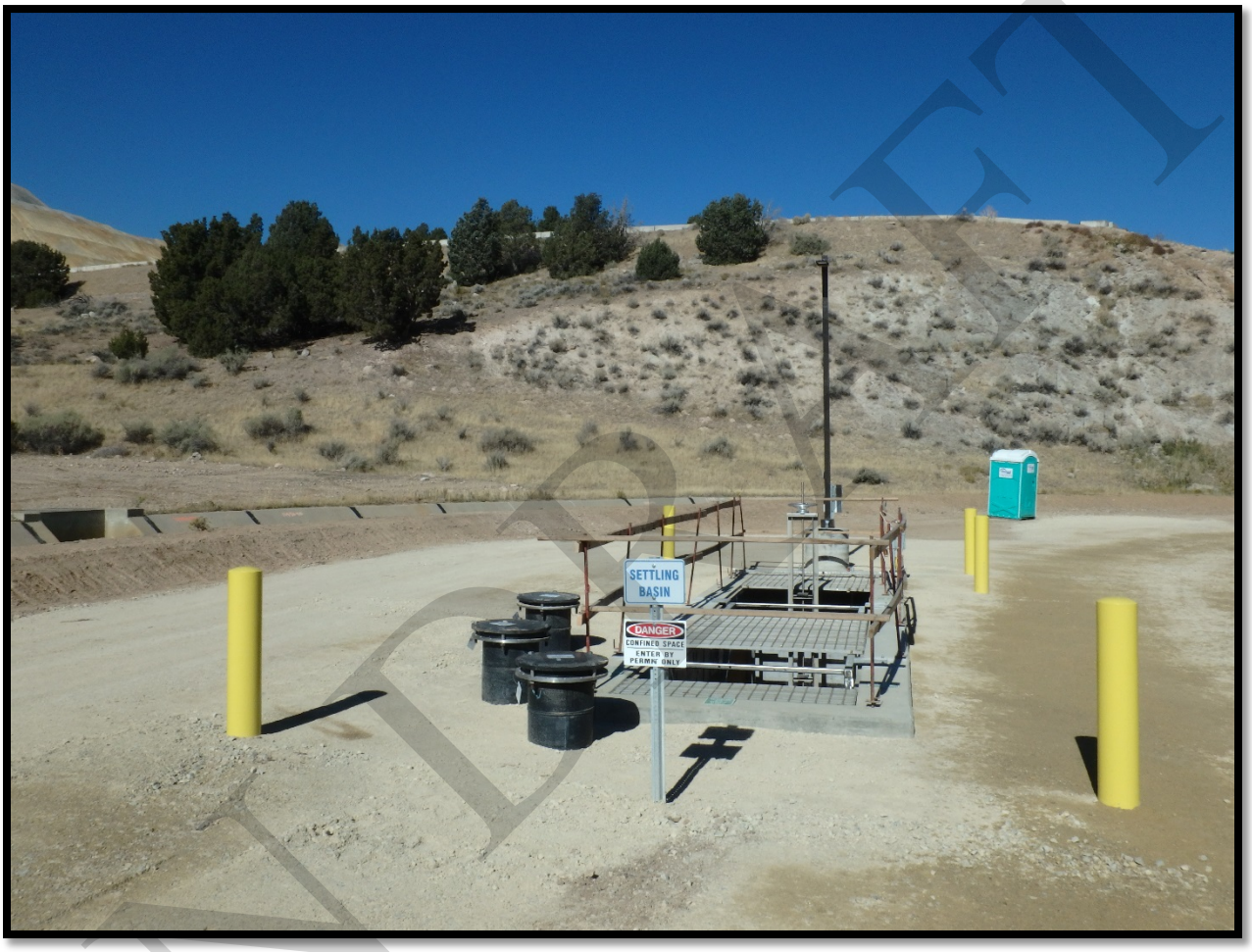


Figure 2-14. The WRCW Mainline terminates in the settling basin; from the settling basin, WRCW is conveyed to the Midas Pump Station.

Piping for specific components of the EWRE water collection system are detailed in Table 2-2. The table describes the function of each pipe, as well as the pipe diameter and dual lining diameter (if applicable). Figure 2-15 is a design drawing detailing the typical and atypical components of the EWRE water collection system.

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Table 2-2. East Waste Rock Extension water collection system conveyance description and size

EWRE Water Collection Piping	Description of Piping	Pipe Diameter (inches)	DR Rating	Dual Lining Diameter (inches)	DR Rating
Toe Drain Pipe	Two parallel perforated HDPE pipes; union at tow drain branch connection	12	17	None	None
Toe Drain Clean Out Pipes	Two oblique capped HDPE pipes; each attached to single toe drain pipe	12	17	None	None
Toe Drain Branch Connection Pipe	Solid wall HDPE pipe; transitions at cut-off wall	14	26	None	None
Storm Water Outlet Box Inlet Orifice	Upgradient penetrating port through concrete	See Table 2-1	N/A	None	None
Storm Water Outlet Box Outlet Pipe	Downgradient penetrating pipe through concrete; terminates at storm water vault and lower concrete lined canal	24	26	None	None
Cut-off Wall French Drain Pipe	Perforated HDPE pipe; transitions at cut-off wall	8	26	None	None
Toe Drain WRCW from Cut-off Wall to Weir Box	Solid wall HDPE pipe; terminates at weir box	14	26	20	32.5
Cut-off Wall WRCW to Weir Box	Solid wall HDPE pipe; terminates at weir box	8	26	12	32.5
Weir Box Outlet Pipe	Solid wall HDPE pipe; terminates at branch connection vault	14	26	20	32.5
Branch Connection Vault Inlet from Weir Box	Solid wall HDPE pipe	14	26	20	32.5
Branch Connection Vault Outlet (WRCW main line upgradient of Crapo)	Solid wall HDPE pipe; terminates at settling basin	16	26	24	32.5
Branch Connection Vault Outlet (WRCW main line downgradient of Crapo)	Solid wall HDPE pipe; terminates at settling basin	24	26	36	32.5
Storm water main line from SAD box to Copper 4	Solid wall HDPE pipe	36	17	None	None
Storm water mainline from Copper 4 to lower concrete lined canal	Solid wall HDPE pipe	42	26	None	None

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2.3 Atypical Designs of the EWRE Water Collection System

While the majority of the components present in each drainage are constructed identically, there are a few distinct differences within the drainages. These atypical design components are summarized in Table 2-3, and described in subsequent sections below.

Table 2-3. Atypical designs of the EWRE water collection system

Drainage	Unique Feature
Copper 4 (Section 2.3.1)	Storm water branch line ties into storm water mainline at storm water branch connection; no weir is present.
Copper 3 (Section 2.3.2)	Storm water branch line ties into canal at head of canal through pre-existing flume.
Copper 2 (Section 2.3.3)	1. Two toe drain branch lines report to the cut-off wall. 2. Storm water branch line ties into pre-existing branch canal and comingles with Copper 1 storm water flow; flow measured at pre-existing flume. 3. Branch vault leak detection light located on the Copper 1 datalogger station
Copper 1 (Section 2.3.4)	Storm water branch line ties into pre-existing branch canal and comingles with Copper 2 storm water flow; flow measured at pre-existing flume.
Lost Creek (Section 2.3.5)	1. WRCW branch lines comingle at Lost Creek/Keystone weir for one combined flow. 2. Storm water passes under Mine Access Road via HDPE pipe to storm water detention basin. 3. Commingled Lost Creek-Keystone storm water enters at pre-existing flume
Keystone (Section 2.3.5)	1. WRCW branch lines comingle at Lost Creek/Keystone weir for one combined flow. 2. Storm water passes under Mine Access Road via HDPE pipe to storm water detention basin. 3. Commingled Lost Creek-Keystone storm water enters at pre-existing flume 4. There are two detention basins in the drainage straddling the Bingham Tunnel
North Keystone (Section 2.3.6)	1. Finger drain of NARD material located west of Mine Access Road collects WRCW; this finger drain leads to HDPE pipe that passes under the Mine Access Road. The HDPE pipe under Mine Access Road opens into another NARD drain east of the Mine Access Road; this NARD drain leads to the toe drain. 2. Surface water from the Mine access road is captured in a rip rap basin and routed under the road, past the toe drain and reports to the detention basin. Care to properly abandon this pipe will be required before the waste rock is placed in this location to prevent the transport of WRCW across the toe drain.
South Crapo (Section 2.3.7)	None
Crapo (Section 2.3.8)	1. Storm water branch line ties into pre-existing branch canal; flow measured through pre-existing flume. 2. Storm water routed under the toe drain road via culvert. 3. The WRCW main line increases in pipe diameter from 16-inch-diameter to 24-inch-diameter 4. At branch connection diversion located downgradient of the Crapo branch connection vault permits WRCW to be segregated from the WCRW main line into the lower concrete lined canal.

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South Congor (Section 2.3.9)	1. WRCW branch lines comingle at South Congor/Midas weir for one combined flow, which also includes flow from Old Bingham Tunnel. The flow from the Old Bingham Tunnel enters the weir below the V-Notch. No leak detection for flow from the Old Bingham Tunnel. 2. Combine WRCW flow goes direct to Settling Basin and not WRCW Mainline. 3. Storm water combined for South Congor and Midas; flows combine at weir.
Midas (Section 2.3.9)	1. WRCW branch lines comingle at the South Congor/Midas weir for one combined flow. 2. WRCW flow out of the weir box includes flow from the Old Bingham Tunnel (OBT). The OBT flow is not accounted for in the combined South Congor/Midas flow as OBT flow enters the weir box below the V-Notch. There is no leak detection for the OBT conveyance pipe. 3. Combine WRCW flow goes direct to Settling Basin and not WRCW Mainline. 4. Storm water combined for South Congor and Midas; flows combine at weir.

Structure	Unique Feature
WRCW Branch Vault (Station 2134+00) (Section 2.3.10)	1. Valve to divert WRCW to lower concrete lined canal.
South Area Dumps (SAD) Box (Section 2.3.11)	1. 16-inch-diameter pipe with 6-inch-diameter orifice accepts base flow (approximately 100 gallons per minute) water from the South Area Dumps. 2. Portal to access 32-inch-diameter HDPE WRCW pipe and insert "pig."
Storm Water Inlet Structure at Canal (Section 2.3.12)	1. Energy dissipation structure that directs water from the 42-inch-diameter storm water pipe into the canal in the Copper 3 drainage.
Lower concrete lined canal (Section 2.3.13)	1. Curbing to extend top of canal near Copper 1 and Copper 2, where a flat grade of less than 1%.

2.3.1 Copper 4

Appendix B provides a photo log documenting the construction process of the Copper 4 drainage.

The one unique feature of the Copper 4 drainage basin is the following:

1. There is no storm water weir in the Copper 4 drainage; rather, the 24-inch-diameter HDPE storm water branch line ties directly into the 42-inch-diameter storm water mainline via a branch connection.

2.3.2 Copper 3

Appendix B provides a photo log documenting the construction process of the Copper 3 drainage.

The one unique feature of the Copper 3 drainage basin is the following:

1. Storm water in the Copper 3 drainage connects to the lower concrete lined canal through a pre-existing storm water flume, shown in Figure 2-16.

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Figure 2-16. Storm water in the Copper 3 drainage connects to the lower concrete lined canal through a pre-existing storm water flume.

2.3.3 Copper 2

Appendix B provides a photo log documenting the construction process of the Copper 2 drainage.

The two unique features of the Copper 2 drainage basin are the following:

1. The Copper 2 cut-off wall is unique in that two branch lines from the toe drain report to the cut-off wall. This is due to two low-elevation sections in the toe drain above the Copper 2 drainage basin. The two toe drain branch lines comingle below the wall in a single branch connection to the Copper 2 weir box.
2. The Copper 2 storm water branch line and the Copper 1 storm water branch line connect in a storm water vault upgradient of a pre-existing branch canal (Figure 2-17) to the lower concrete lined canal. The comingled flow of Copper 2 and Copper 1 storm water flow is measured with a data logger installed in a pre-existing flume.

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Figure 2-17. Copper 2 and Copper 1 storm water branch canal.

2.3.4 Copper 1

Appendix B provides a photo log documenting the construction process of the Copper 1 drainage.

The one unique feature of the Copper 1 drainage basin is the following:

1. The Copper 1 storm water branch line and the Copper 2 storm water branch line connect in a storm water vault upgradient of a pre-existing branch canal (Figure 2-17) to the lower concrete lined canal. The comingled flow of Copper 1 and Copper 2 storm water flow is measured with a datalogger installed in a pre-existing flume.

2.3.5 Lost Creek and Keystone

Appendix B provides photo logs documenting the construction process of the Lost Creek and Keystone drainages.

The Lost Creek and Keystone drainages basins are steeply incised drainages separated by a relatively narrow ridge. As such, the drainage basins are near to each other, and share three atypical design features. The three unique features of the Lost Creek and Keystone drainage basins are the following:

1. The WRCW branch lines from each respective cut-off wall comingle at a shared Lost Creek and Keystone weir box. As such, there are four dual-contained input pipes in the stilling portion of the weir box, five leak detection pipe surrounding the shared weir box, and the datalogger measures combined Lost Creek and Keystone WRCW flow through the V-notch.
2. Storm water and WRCW from upgradient portions of each respective drainage basin is conveyed under the Mine Access Road through a 24-inch-diameter HDPE pipe, and a 14-inch-diameter HDPE pipe, respectively. The 24-inch-diameter HDPE pipes drain into energy dissipation channels immediately upgradient of each respective storm water detention basin (Figures 2-18 and 2-19), and

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the WRCW 14-inch-diameter HDPE pipe continues to the cut-off wall. The conveyance pipes under the MAR were installed through directional drilling boreholes.

3. The combined flow of the Lost Creek and Keystone storm water branch lines is measured with a datalogger installed in the pre-existing Lower Keystone flume that drains to the lower concrete lined canal.



Figure 2-18. Lost Creek drainage directional boring outlet.



Figure 2-19. Keystone drainage directional boring outlet.

4. Two detention basins were constructed in the Keystone drainage in an effort to avoid construction and impounding water atop the Bingham Tunnel (Figure 2-20). As a result, additional concrete inlet and outlet structures are incorporated into the surface water conveyance structures which are not typical of other EWRE detention basins.

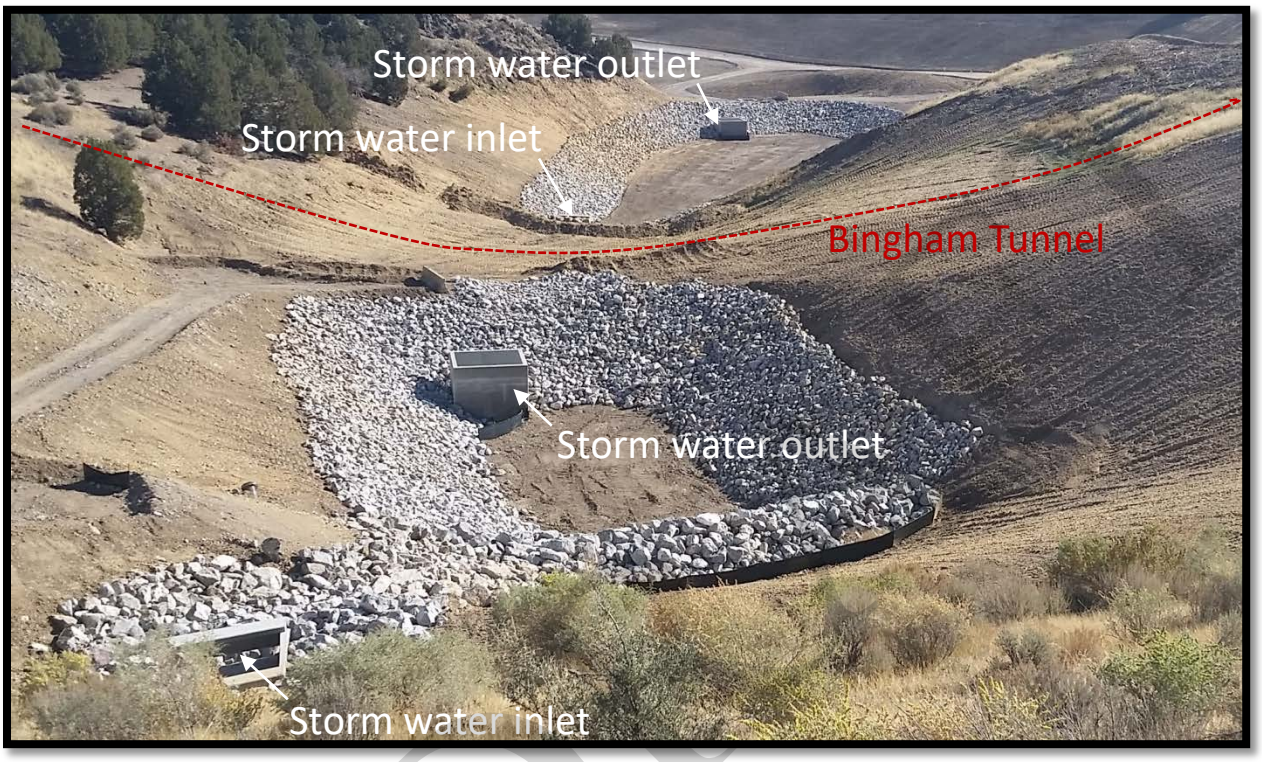


Figure 2-20. Keystone detention basins straddling the Bingham Tunnel.

2.3.6 North Keystone

Appendix B provides a photo log documenting the construction process of the North Keystone drainage.

The one unique feature of the North Keystone drainage basin is the following:

1. West of the Mine Access Road, in the upgradient portion of the North Keystone drainage basin, a coarse quartzite finger drain was installed to collect WRCW. This finger drain leads to a 14-inch-diameter HDPE pipe, which conveys the WRCW under the Mine Access Road. The 14-inch-diameter HDPE pipe opens into another coarse quartzite finger drain east of the Mine Access Road (Figure 2-21), which directs WRCW flow toward the North Keystone segment of toe drain.
2. The surface water drain moves water off the Mine Access Road, past the toe drain and into the North Keystone detention basin. The surface water conveyance pipe (Figure 2-22) will be covered by waste rock as part of the EWRE dump footprint, at which time the pipe will act as WRCW conveyance.

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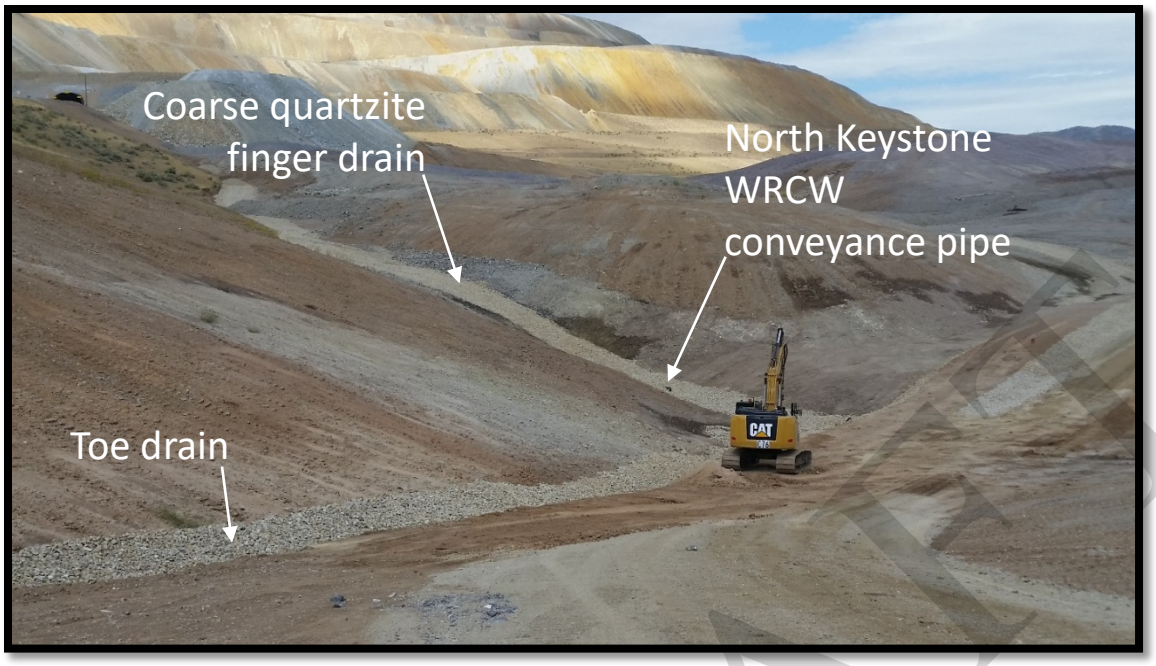


Figure 2-21. Photograph showing the 14-inch-diameter HPDE pipe conveying WRCW under the Mine Access Road in the North Keystone drainage basin. The coarse quartzite finger drain directs WRCW flow toward the North Keystone segment of toe drain.



IMPORTANT

The North Keystone storm water conveyance pipe must be properly abandoned in order to ensure WRCW is not conveyed across the toe drain and water collection system.

Figure 2-22. The North Keystone storm water conveyance pipe will eventually be covered by waste rock and will require proper abandonment to ensure effective WRCW capture.

2.3.7 South Crapo

Appendix B provides a photo log documenting the construction process of the South Crapo drainage.

No atypical water collection system design features are present in the South Crapo drainage basin.

2.3.8 Crapo

Appendix B provides a photo log documenting the construction process of the Crapo drainage.

There are four atypical features of the EWRE water collection system in the Crapo drainage basin. The four unique aspects are the following:

1. Storm water generated in upgradient areas of the Crapo drainage basin is routed under the toe drain road via culvert toward the Crapo storm water detention basin.
2. The Crapo storm water branch line ties into a pre-existing branch canal (Figure 2-23), where flow is measured with a datalogger installed in a pre-existing flume.
3. At the Crapo WRCW branch connection vault, the WCRW main line increases in pipe diameter from 16-inch-diameter to 24-inch-diameter. The WCRW main line remains 24-inch-diameter HDPE pipe to the settling basin.
4. At branch connection diversion located downgradient of the Crapo branch connection vault (Station 2134+00) permits WRCW to be segregated from the WCRW main line into the lower concrete lined canal (see Section 2.3.10). This feature will be used when repairs are necessary to the settling basin.



Figure 2-23. Photograph showing the Crapo storm water branch line connection to a pre-existing branch canal.

2.3.9 South Congor and Midas

Appendix B provides photo logs documenting the construction process of the South Congor and Midas drainages.

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The South Congor and Midas drainages basins are steeply incised drainages separated by a relatively narrow ridge. As such, the drainage basins are near to each other, and share four atypical design features. The four unique features of the South Congor and Midas drainage basins are the following:

1. The WRCW branch lines from each respective cut-off wall comingle at a shared South Congor and Midas weir box. As such, there are four dual-contained input pipes in the stilling portion of the weir box, five leak detection pipe surrounding the shared weir box, and the datalogger measures combined South Congor and Midas WRCW flow through the V-notch.
2. The WRCW flow out of the weir box includes tunnel discharge from the Old Bingham Tunnel (OBT) (Figure 2-24). The OBT flow is not accounted for in the combined South Congor and Midas flow, as the OBT flow enters the weir box below the V-Notch. Additionally, no leak detection for the OBT conveyance pipe was installed.
3. The combine South Congor, Midas, and OBT WRCW is conveyed directly to the settling basin, by-passing the WRCW Mainline.
4. Storm water generated in the South Congor and Midas drainage basins is combined in a storm water weir; the combined South Congor and Midas storm water flow is discharged to the lower concrete lined canal.



Figure 2-24. Photograph showing tunnel discharge from the Old Bingham Tunnel (OBT). The tunnel discharge from the OBT is conveyed to the combined South Congor and Midas weir box, but enters below the V-notch flow measuring point.

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2.3.10 WRCW Branch Vault Diversion Box (Station 2134+00)

This WRCW branch vault behaves similarly to all other WRCW vaults but in addition contains a gate valve that, once closed, will divert water into the lower concrete lined canal. The necessity of this feature became apparent during EWRE construction when repairs, modifications or maintenance was required at the Settling Basin. Access to the valve is inside the vault and requires a confined space entry.



Figure 2-25. WCRW branch vault (Station 2134+00) can divert water into the lower concrete lined canal when maintenance is required at the Settling Basin.

2.3.11 South Area Dumps (SAD) Box

The South Area Dump (SAD) box accepts water from the south dump drainages (Yosemite to Queen) via a 36-inch-diameter HDPE pipe (Figure 2-26). Base flow from the south dumps is typically less than 100 gallons per minute (gpm) and is accepted through the WRCW outlet line. The WRCW outlet is a 16-inch-diameter dual lined HDPE pipe with an 8-inch-diameter orifice. Should a storm event exceed the 100 gpm flow threshold into the SAD box, the comingled flow will rout through a 36-inch-diameter overflow pipe. The SAD box has an HDPE liner but does not have leak detection due to the chemical nature of the contact water. Contact water from the south dump drainages is of better water quality compared to contact water north of Copper 4 drainage.

Additionally, a port was installed upgradient of the connection box for pigging the line and temporarily stopping the flow for repairs or cleaning (Figure 2-26).

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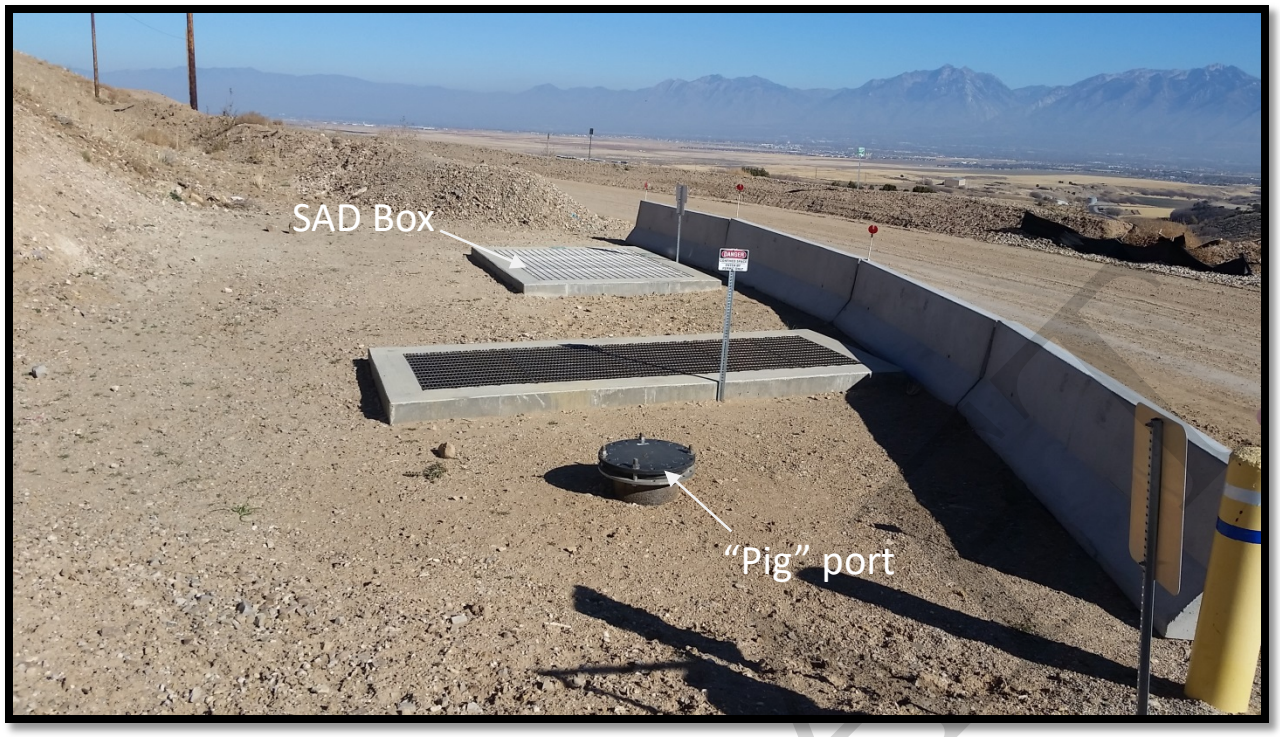


Figure 2-26. South Area Dump (SAD) box.

2.3.12 Storm Water Inlet Structure at Canal

The storm water inlet box (Figure 2-27) receives water from the south area dumps (Yosemite to Queen Drainages) via a 36-inch-diameter HDPE pipe and dissipates the energy of the water as it is introduced to the canal. The HDPE pipe is 36-inch-diameter from the SAD box to the Copper 4 branch line, at which time the HDPE pipe becomes 42-inch-diameter. A gate valve at the outlet structure allows for the drainage of standing water behind the structures energy dissipation baffle.



Figure 2-27. Storm water inlet structure by Copper 3.

2.3.13 Lower Concrete Lined Canal

The lower concrete lined canal was originally constructed in the 1990's and is permitted under groundwater discharge permit #UGW350010 to convey both storm water and process water under upset conditions. The lower concrete lined canal, while still functional, was refurbished as part of the EWRE project and modified in sections to accommodate the capacity needed under the modeled 100-year 24-hour storm event. Surface water reports to the lower concrete lined canal from the detention basins via HDPE pipe and/or sections of pre-existing branch canal. Water flow can be measured through pre-existing flumes or newly constructed weirs. Flow is recorded at the same data loggers that capture WRCW flow in the weir boxes.

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SECTION 3

Inspection and Maintenance

3.1 Overview

Inspection frequency is guided by groundwater discharge permit # UGW350010. The groundwater discharge permit specifically **requires quarterly inspection**; however, best practice recommends inspection following large rain events. Table 3-1 provides inspection guidance and frequency.

Table 3-1. Inspection frequency and guidance

Inspection Type	Frequency	Guidance
UDWQ Groundwater Discharge Permit #UGW350010 [1]	Quarterly	Groundwater Discharge Permit # UGW350010
Significant precipitation event [2]	As Needed	Rainfall period ≥10 year-24 hour as indicated by the Copper drainage rain gage
Other	As Needed	Examples for inspection may include a Health and Safety incident, Dump/Slope movement, or at the request of regulatory agency

Notes:
[1] Required by the groundwater discharge permit

[2] Not required by the groundwater discharge permit. Refer UPDES Permit (0000051) Statement of Basis (p. 21) and Part I.E as well as 40 CFR 440.131(c) for guidance.

3.2 Guidance for Inspection

Inspection checklists for evaluating the primary and auxiliary components of the EWRE water collection system are provided in Appendix C. Final as-built drawings of each drainage basin the respective water collection system components are provided in Appendix D. The following sections are descriptions of what to assess and evaluate during the inspection process, conditions that may result in a need for maintenance, and potential mitigation and repair recommendations.

3.2.1 Dump Face

A visual inspection of the dump face (Figure 3-1) is required for each respective drainage basin. Examples of potential issues with the dump face may include the following:

- Erosional gullies and/or debris flows developing
- Seeps or wet spots observed
- Settling, bulging or slumping observed
- Horizontal or vertical cracks developing

If evidence of any of these items is observed on the dump face, document the findings in the inspection checklist, photograph, and notify RTKC Mine operations for support and resolution.

3.2.2 Down Drains

Visual inspection of the down drains is required for each respective drainage basin. Examples of potential issues with the down drains may include the following:

- Erosion and channel development along the sides of the down drain

If evidence of any of these items is observed on the down drains, document the findings in the inspection checklist, photograph, and notify RTKC Mine operations for servicing.

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- Disturbed rip-rap channels altering drainage



Figure 3-1. Photographic overview of EWRE water collection system components.

3.2.3 Toe Drain

3.2.3.1 Access Road

Inspection of the toe drain access road (Figure 3-2) is required for each respective drainage basin. Examples of potential issues with the access road may include the following:

- Rutting related to weather and driving in wet conditions
- Channeling related to running water and erosion
- Maintenance of the surface water rip rap ditch adjacent to the access road

Mitigation may include redirecting surface water through engineered structures and/or regrading the access road.

3.2.3.2 Toe Drain Clean Outs

Inspection of the toe drain clean outs (Figure 3-2) is required for each respective drainage basin. Examples of potential issues with the clean outs may include the following:

- Access to the clean out port has changed due to rock, debris or erosion

Mitigation may include repair, removal of rock/debris, construction of a protective berm, and/or regrading the area around the clean out.

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- The clean out cover or pipe is damaged (e.g., struck by debris or equipment)

3.2.3.3 Rip Rap Ditch and Energy Dissipation

Inspection of the rip rap ditch (Figure 3-2) and energy dissipation system (not installed as of October 31, 2016) are required for each respective drainage basin. Examples of potential issues with these components may include the following:

- Erosion along the sides of the rip rap channel
- Rip rap channel full of sediment and debris
- Rock in the rip rap channel has moved or is missing
- A significant volume of water is ponded in the rip rap channel

For design and maintenance support, contact the Facility Environmental Engineer

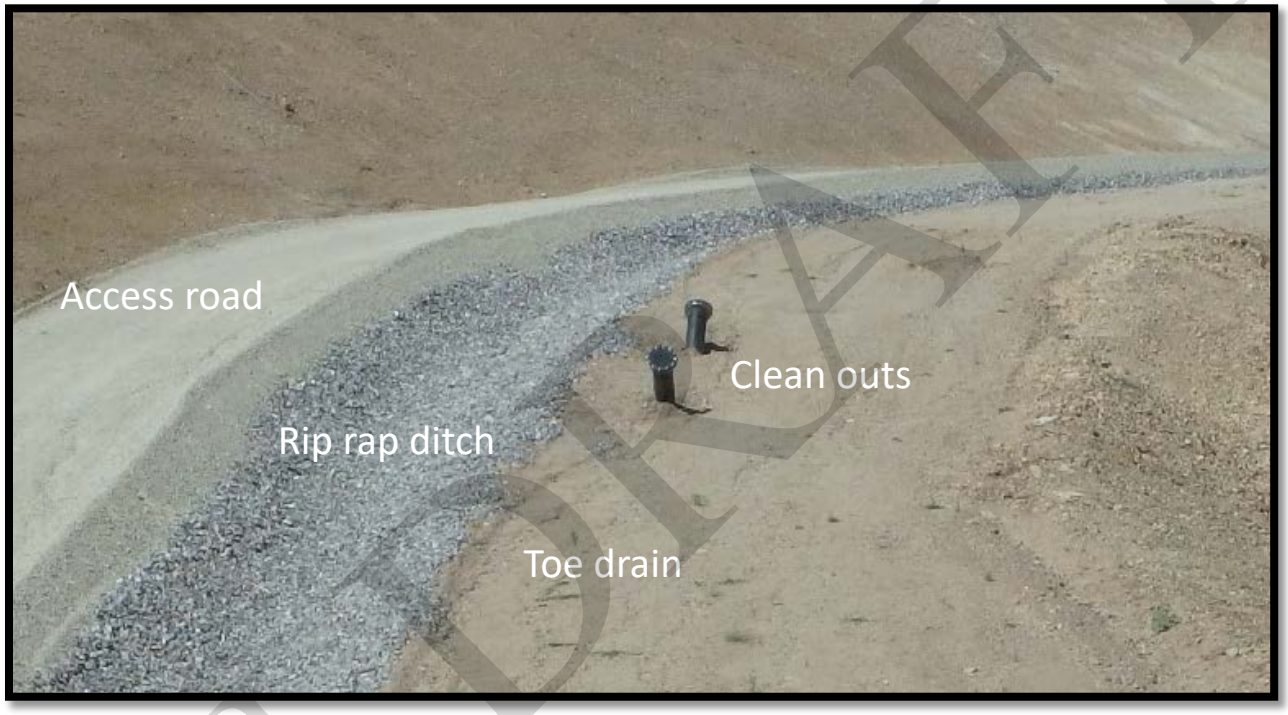


Figure 3-2. Photograph of a newly constructed segment of the toe drain; toe drain features include the clean outs, rip rap ditch and access road.

3.2.4 Storm Water Detention Basin

3.2.4.1 Check Dam Integrity

Inspection of the check dam (Figure 3-3) is required for each respective drainage basin. Examples of potential issues with the check dam may include the following:

- Erosion in upgradient portions of the drainage basin have caused excessive silting
- Check dam embankment material has moved or is missing
- The silt fence is damaged and/or full of sediment

Silt fence is advised to prevent silt plugging the desilting basin and outlet structure while **vegetation becomes established**.

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3.2.4.2 Storm Water Detention Basin

Inspection of the storm water detention basin (Figure 3-3) is required for each respective drainage basin. Excess silt, sediment and debris can decrease basin capacity or lead to system failure (i.e., plugged outlets). A staff gauge is included in each basin to easily conduct visual observations. In addition, as built drawings (Appendix D), XML terrain files and AutoCAD design files (Appendix E), redline design drawings (Appendix F), and documentation of cut-off wall survey monuments (Appendix G) are all available for reconstruction of the detention basin to original design schematics. Examples of potential issues with the storm water detention basin may include the following:

- The storm water detention basin is not draining
- The storm water detention basin has excessive silt

The storm water detention basin may not be draining due to a blocked overflow structure, or it may be draining, but a seep/spring has developed in the basin. If a seep is identified, estimate the flow rate and report the finding to the Facility Environmental Engineer (Table 5-1).

If sediment is greater than 1.5 feet at the staff gauge, the storm water detention basin should be scheduled for sediment removal and clean out.

3.2.4.3 Outlet Box

Inspection of the outlet box (Figure 3-3) is required for each respective drainage basin. Examples of potential issues with the outlet box may include the following:

- The low flow orifice is blocked by sediment, vegetation or debris
- The silt fence is damaged and/or full of sediment

If the low flow orifice to the outlet box is blocked greater than 10 percent of the diameter, then the orifice requires cleanout maintenance.

3.2.4.4 Embankments and Spillway

Inspection of the embankments (Figure 3-3) and spillway (Figure 3-4) are required for each respective drainage basin. Examples of potential issues with these components may include the following:

- Displacement or movement of spillway or embankment material
- Embankment instability, potentially caused by burrowing animals/tunneling
- Erosion along the edges of the spillway or through the embankments

Potential maintenance to embankments and spillways may include removal/replacement of embankment and spillway material, especially if erosion along the edge of the rip-rap channel begins to develop.

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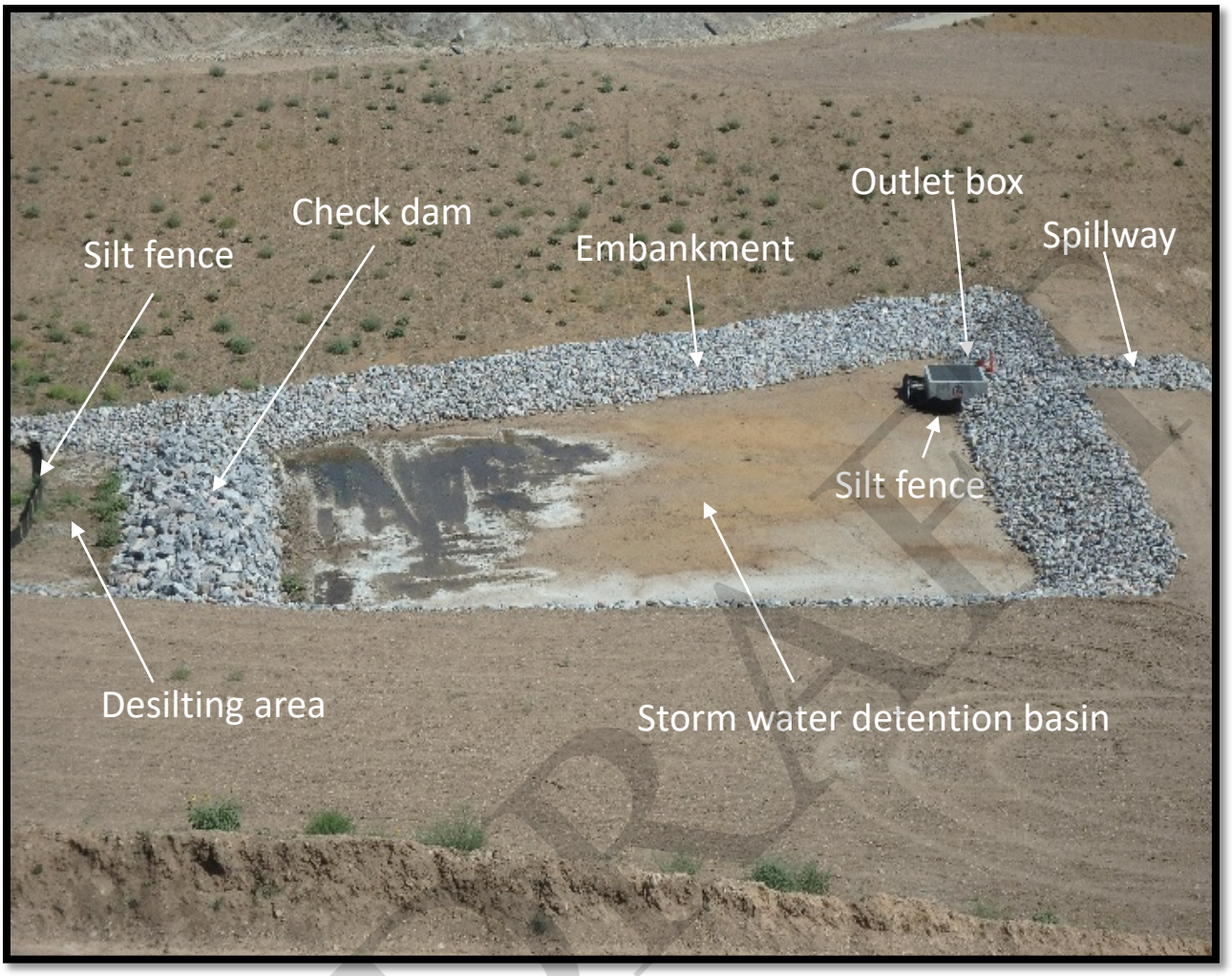


Figure 3-3. Photograph of a newly constructed storm water detention basin; features include desilting area, check dam, storm water detention basin, outlet box, spillway and silt fences.

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Figure 3-4. Photograph of a newly constructed spillway. The spillway connects the storm water detention basin to the cut-off wall.

3.2.5 Cut-off Wall

Inspection of the cut-off walls (Figures 3-5 and 3-6) are required for each respective drainage basin. Examples of potential issues with the cut-off walls may include the following:

- Cracks have developed and/or are enlarging in the cut-off wall concrete
- The cut-off wall has been damaged (i.e., equipment strikes or storm debris)
- Sediment has built-up behind the wall
- Associated cut-off wall piping is plugged, damaged or broken (evidence of a problem will not likely be visible at the cut-off wall proper, but rather in other areas along the storm water or WRCW flow paths)
- The storm water inlet grate is damage or clogged by vegetation or debris
- Associated cut-off wall pipe valves are stiff, leaking or damaged

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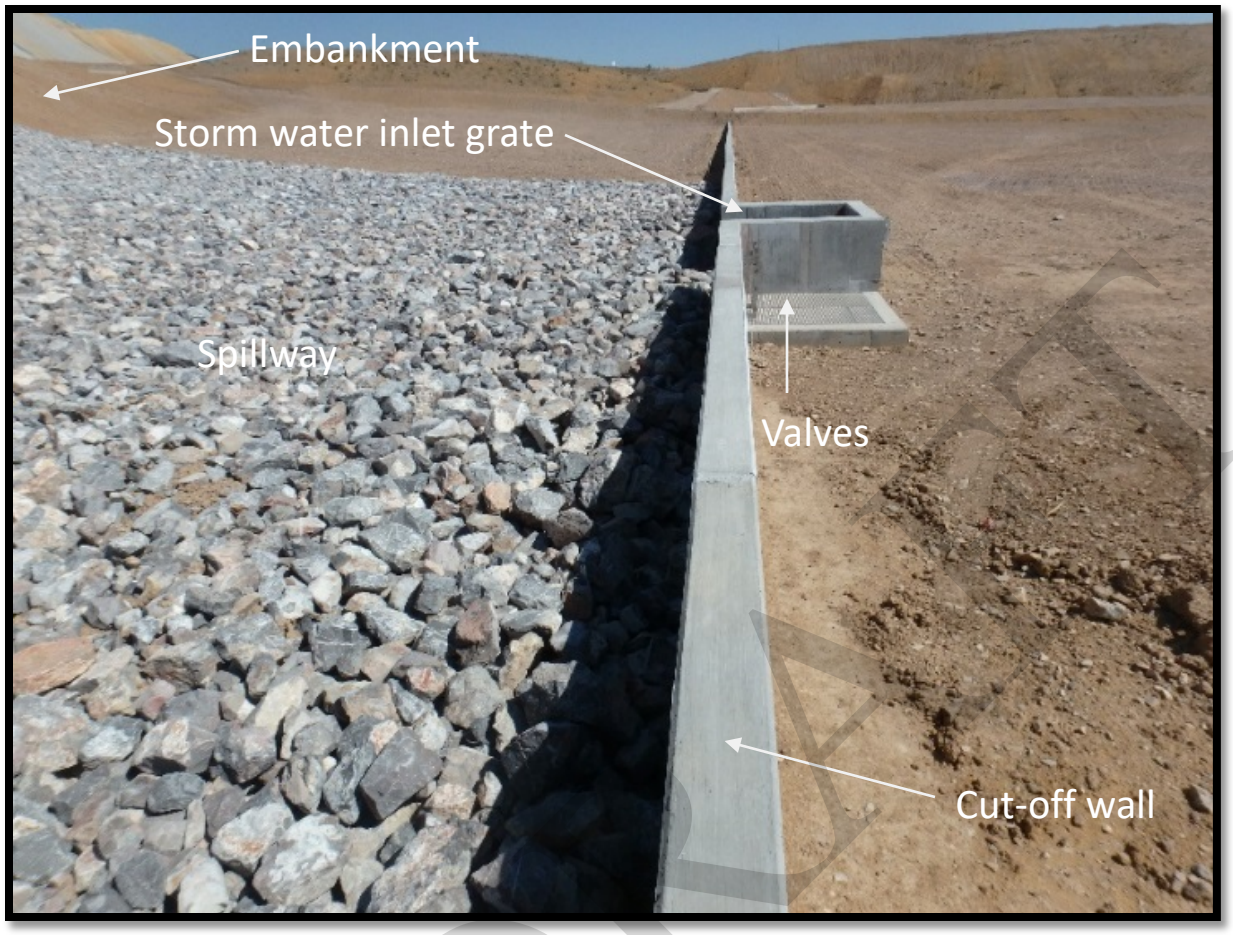


Figure 3-5. Photograph of a newly constructed cut-off wall. The spillway connects the storm water detention pond to the cut-off wall; the cut-off wall includes a storm water inlet grate and a valve vault.

3.2.6 Weir Box

3.2.6.1 Weir Box Integrity

Inspection of the weir box (Figure 3-7) is required for each respective drainage basin. Examples of potential issues with the weir box may include the following:

- The above ground concrete weir box curbing and/or surface grating is damage
- Weir box signage is missing or damaged
- Scale, debris, or sediment (at quantities that potentially may disrupt flow measurement) has accumulated in the weir box
- The weir box piping, liner, V-notch, and/or baffle is damaged
- The weir box piping has developed scale (at quantities that potentially may disrupt flow measurement)

In order to maintain accurate flow readings, it is recommended that level indicators be **calibrated approximately every six months**. In addition, the v-notch may begin to scale and require cleaning in order to accurately represent water level. Scale removal from the v-notch and calibration of the level indicator should be done in conjunction.

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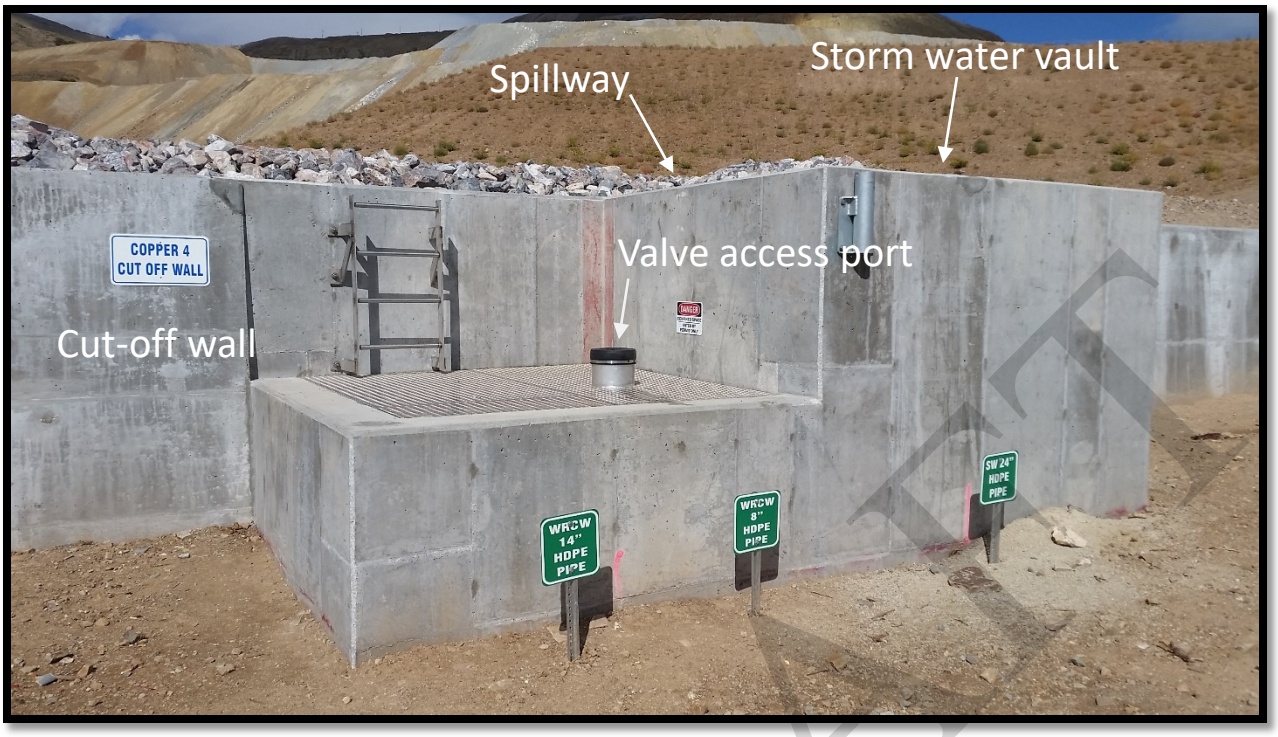


Figure 3-6. Photograph of a newly constructed cut-off wall. The valve port allows access to manipulate the WRCW flow valves.

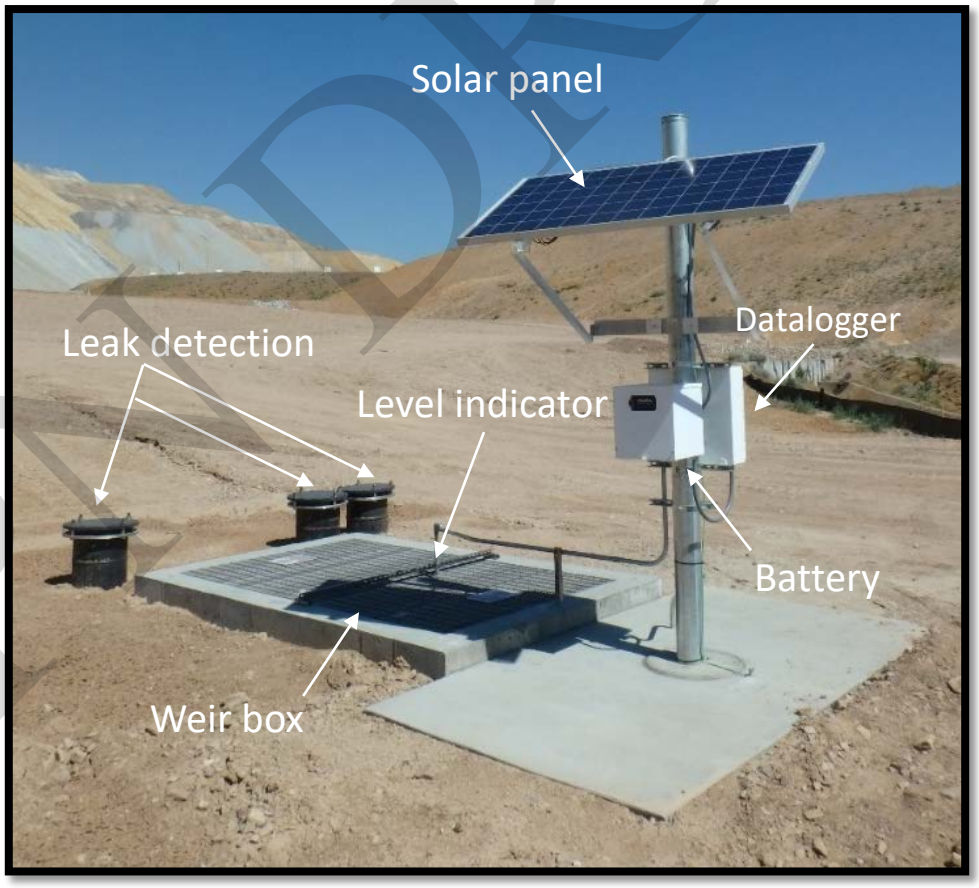


Figure 3-7. Photograph of a newly constructed weir box and auxiliary components.

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3.2.6.2 Data Logger

Inspection of the data logger stations (Figure 3-7) is required. Visually inspect the components of the data logger station to identify wear and tear, broken or missing parts, and to confirm all display components are functional. During the inspection, examine the solar panel for damage and clean off dust. If the data logger is not functioning, operational troubleshooting may be required. See the Reference Links in Section 5 for guidance on the operation of the datalogger and service contact information.

3.2.6.3 Leak Detection Sump

Inspection of the leak detection sumps (Figure 3-7) should be performed quarterly, or if there is suspected pipe damage along the WRCW flow path. If water is detected in any of the leak detection sumps, notify the facility environmental engineer (Table 5-1) as sample collection will likely be required.

3.2.7 Branch Connection Vault

Inspection of the branch connection vault (Figure 3-8) is required for each respective drainage basin. Examples of potential issues with the branch connection vault may include the following:

- Presence of standing water inside the vault
- Presence of sediment inside the vault
- Damage to the metal hatch, vent pipe or bollards
- Leak detection sensor malfunction

Potential maintenance to the branch connection vault may include determining the source(s) of standing water and/or sediment, draining/cleaning the branch connection vault, and repair of any damaged components. If flowing water is observed in the branch connection vault, there is a break in the pipe upstream that will require immediate repair. Notify the facility environmental engineer (Table 5-1) if flowing water is observed.

The **leak detection sensor** should be **tested annually** to confirm functionality; in order to test the sensor and datalogger station strobe, the sensor must be submerged in water. **A confined space permit is required to enter the branch connection vault.**

3.2.8 Storm Water Vault, Lower Concrete Lined Canal and Datalogger Station

Inspection of the storm water vault, lower concrete lined canal, and datalogger station (if applicable) (Figure 3-9) is required for each respective drainage basin. Examples of potential issues with the storm water vault and lower concrete lined canal may include the following:

- Damage to or development of cracks in the concrete vault or canal
- Accumulation of sediment or debris
- Datalogger malfunction

Potential maintenance to the storm water vault and lower concrete lined canal may include concrete repair and debris/sediment clean out.

Inspect the components of the data logger station to identify wear and tear, broken or missing parts, and to confirm all display components are functional. Examine the solar panel for damage and clean off dust.

Calibration of the storm water level indicators is recommended **annually** in order to maintain accurate measurements.

If the data logger is not functioning, operational troubleshooting may be required (see reference links in Section 5 for service contact information).

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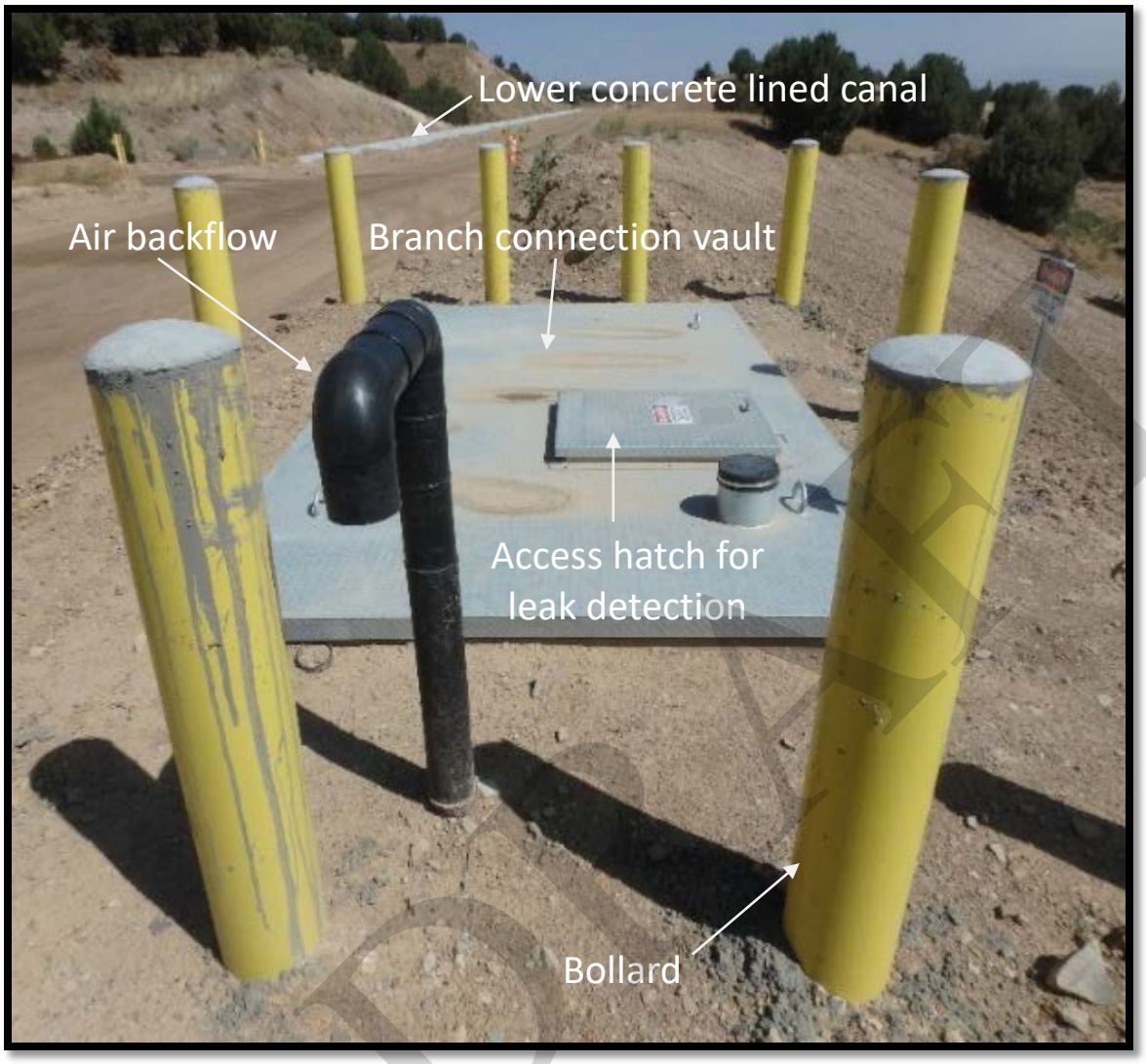


Figure 3-8. Photograph of a newly constructed WRCW branch connection vault.

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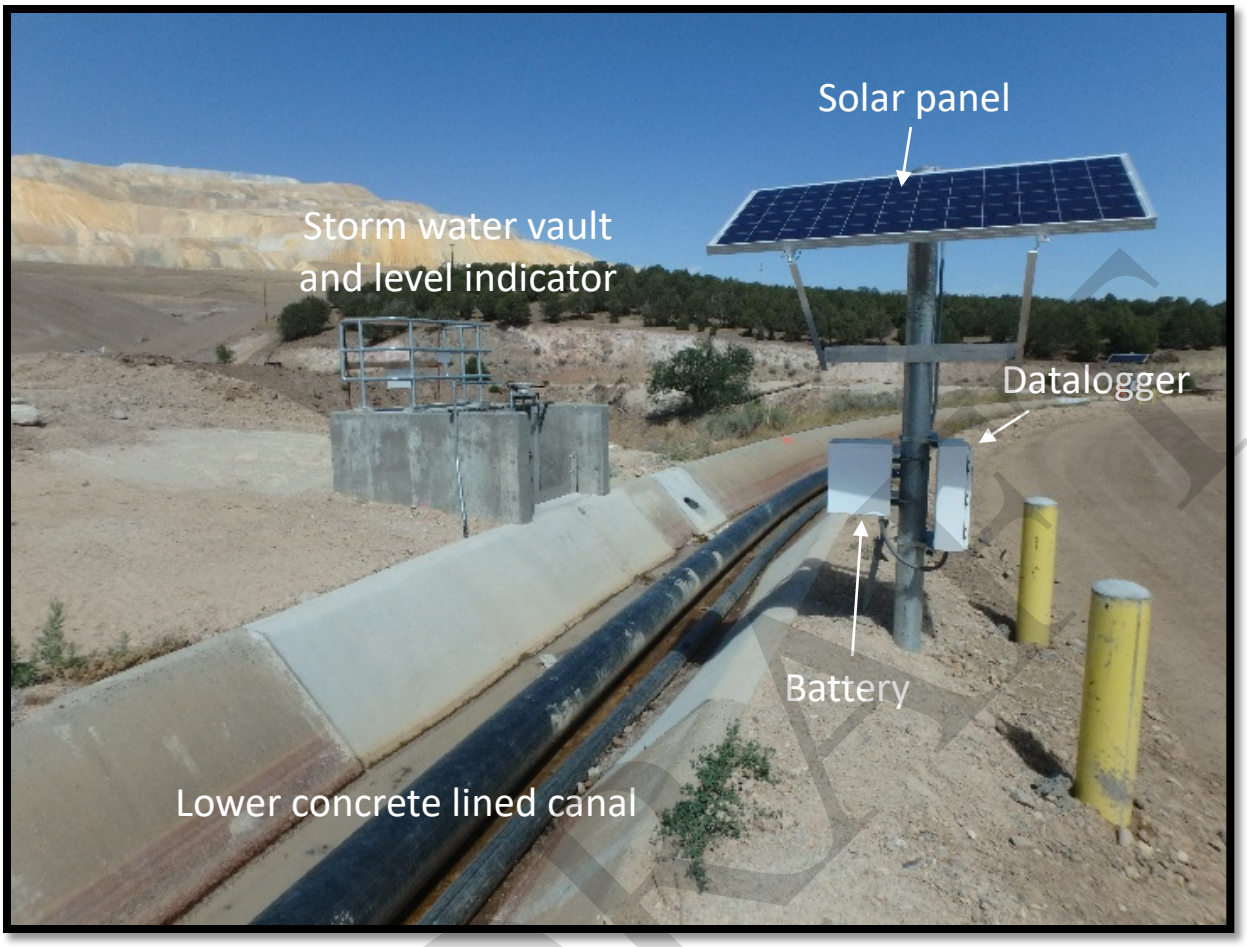


Figure 3-9. Photograph of a newly constructed storm water vault, level indicator and lower concrete lined canal.

3.2.9 Old Bingham Tunnel

Inspection of the Old Bingham Tunnel (OBT) is required. Examples of potential issues with the OBT may include the following:

- Collapse or failure of the tunnel entrance
- Accumulation of rock or debris in the tunnel discharge area
- Plugging of the tunnel discharge orifice

Potential maintenance to the OBT may include tunnel entrance repairs, excavation of rock and/or debris, and removing accumulated sediment from the discharge and drainage area.

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Figure 3-10. Photo of the Old Bingham Tunnel (OBT) entrance.

3.2.10 Settling Basin

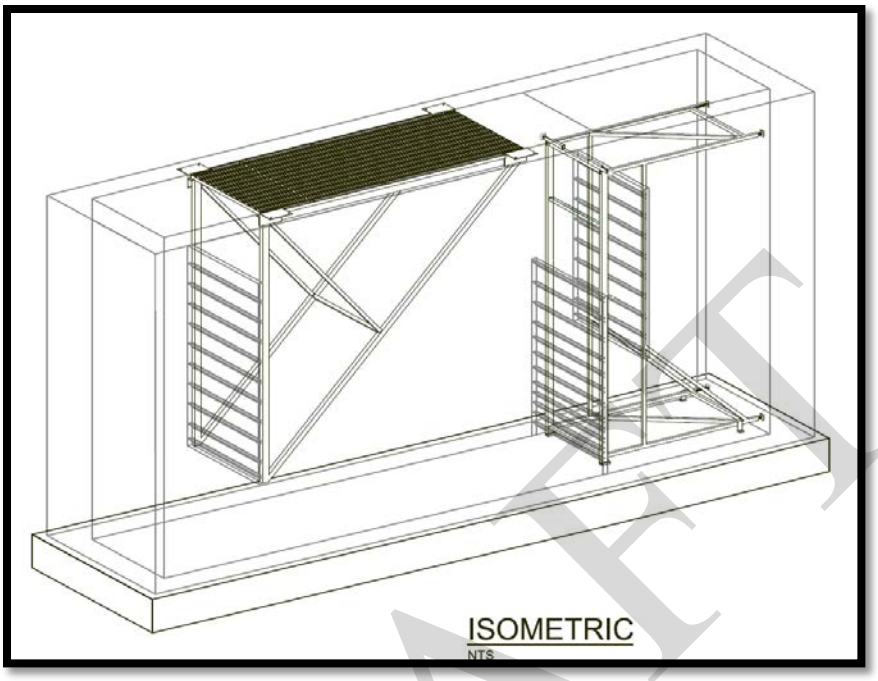
The Settling Basin (Figure 3-11) should be drained and inspected on a quarterly basis for two years starting 4Q2016 to establish a performance baseline. In order to perform the inspection, the following steps need to be taken:

- Place the WRCW into bypass by closing the valve at the WRCW Branch Vault diversion (Station 2134+00). Cross reference section 2.3.10 for additional details.
- Pump down the Settling Basin in manual to low shut-off.
- Remove the remaining water; use of a vacuum truck is strongly recommended due to the likely presence of silt.
- Remove the excess silt and water with a vacuum truck. Consult with the facility environmental engineer for proper disposal of sediment and water.
- **IMPORTANT. When vacuuming, always keep separation between the hose intake and the liner so as not to damage the liner**. The corner welds are stronger and better anchored than the center liner; vacuuming should be preferentially focused in these areas. In order to maintain space between the hose tip and the liner, incorporate a basket or similar implement.

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IMPORTANT

When vacuuming always keep separation between the hose intake and the liner so as not to damage the liner.



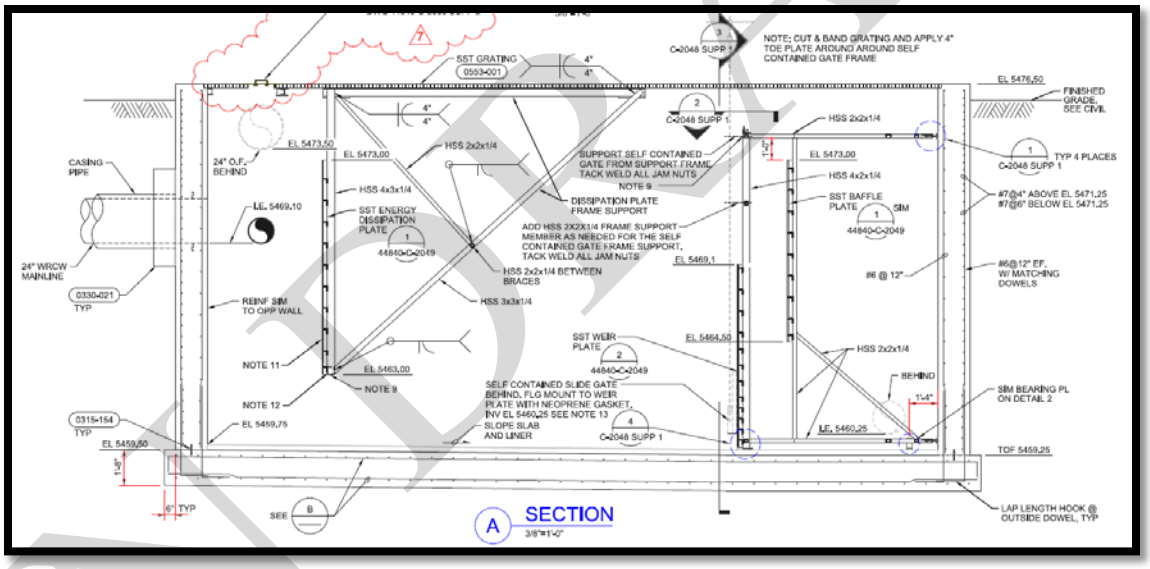


Figure 3-11. Settling Basin isometric projection and cross sectional view.

Examples of potential issues, other than accumulated sediment, occurring in the Settling Basin may include the following:

- The concrete Settling Basin curbing and/or surface grating is damage
- Signage is missing or damaged
- Scale or debris (at quantities that potentially may disrupt flow measurement) has accumulated in the Settling Basin
- The piping is damaged
- The piping has developed scale (at quantities that potentially may disrupt flow measurement)

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3.2.11 Lower Concrete Lined Canal

The lower concrete lined canal (Figure 3-12) should be inspected for accumulation of sediment and debris and the elimination of sources (i.e., eroded embankments). Sediment and debris should be removed regularly in order to maintain design capacity and best performance. Should vegetation develop, remove in order to maintain best performance. Quarterly inspection should include observations for settling and cracking of the lower concrete lined canal sections. Minor cracks will not hinder performance but should be addressed in order to prevent deterioration of the structure and costlier repairs in the future.



Figure 3-12. Section of the lower concrete lined canal.

3.2.12 WRCW Branch Vault Diversion Box (WRCW Vault Station 2134+00)

The inspection of the branch vault diversion box (Station 2134+00) is similar to the inspection of typical WRCW vaults (See Section 3.2.7), and can be done in conjunction with the settling basin inspection since this is where the basin bypass is accomplished. This vault does not contain a leak detection sensor and associated strobe. In addition to criteria outlined in section 3.2.7, the valve requires exercise and associated bypass piping requires inspection for leaks or damage.

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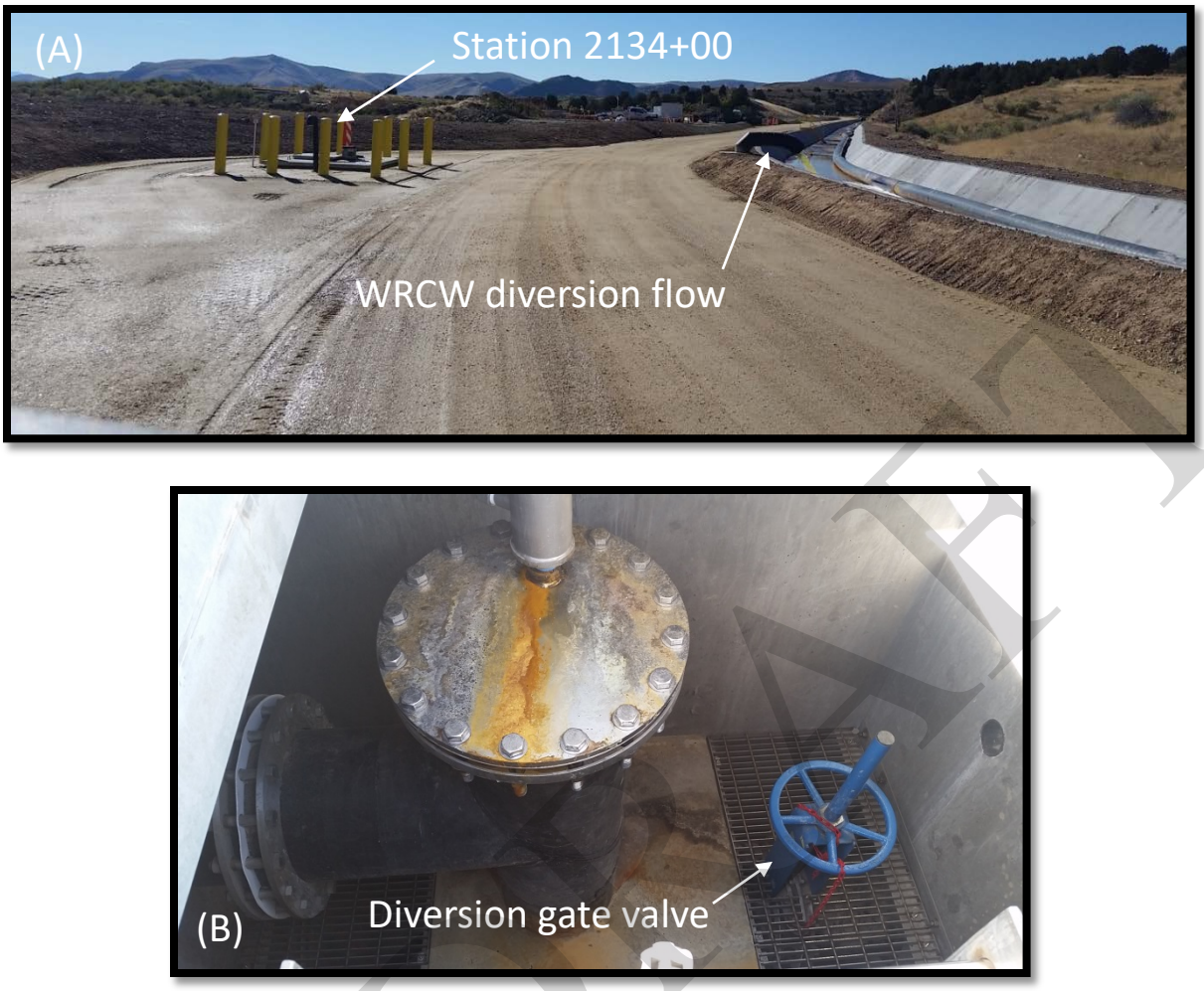


Figure 3-13. (A) WRCW branch vault diversion box (Station 2134+00); (B) diversion gate valve.

3.2.13 South Area Dumps (SAD) Box

The South Area Dump (SAD) Box does not have leak detection due to the relatively clean nature of the WRCW as compared to the WRCW reporting from the Copper drainages north. The important aspects to inspect in order to ensure proper function of the structure are:

- If sediment and debris are present in the box they should be removed immediately.
- Check for damage of the liner and pipe inlets/outlets due to sediment and debris.
- If scale is present it should be removed in order to preserve capacity.

IMPORTANT. When vacuuming always keep separation between the hose intake and the liner so as not to damage the liner.

3.2.14 Storm Water Inlet Structure at Lower Concrete Lined Canal

The storm water inlet structure at the lower concrete lined canal should require limited maintenance. Inspect for sediment and debris that could hinder capacity and full function of the structure. Large intense rain events will be of particular interest since this is about the only time the structure will have become active. Sediment and debris will need to be removed in order to maintain full functionality.

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3.3 Compliance Sampling Locations and Frequency

Compliance points such as cut-off walls, weir boxes, seeps and tunnels are associated with the Bingham Canyon Mine Groundwater Discharge Permit #UGW350010, and are required to be sampled on various frequencies for water quality and flow rate (Figure 3-14). The installation of the cut-off walls and toe drain associated with the EWRE required updating many of these sample points, as the legacy system was replaced and the new collection system was installed.

Appendix H details the transition from the legacy east side collection system to the newly installed EWRE water collection system. The operational sample identification numbers (i.e. cut-off walls) were kept the same at the new weir boxes in cases where the legacy flow was traced to the corresponding new toe drain section, branch line and weir box. In cases where new drainages were intercepted not corresponding to the legacy system, a new identification number was assigned.

Incorporated into the new system is capture of WRCW primarily at the toe drain and secondarily at the cut-off wall. Both sources for a particular drainage are collected at a shared weir box. The sample reporting from the toe drain has an “A” designation while the sample from the cut-off wall has a “B” designation. During construction, water quality from the A and B sources was typically different, in that toe drain water was more characteristic of waste rock contact water, and cut-off wall water was more characteristic of fresh water. Based upon this information, the following guidance is derived:

- When the two water qualities mix in the weir box, and are introduced to an open environment with increased oxygen, water chemistry will change and increased mineral precipitation (i.e. scale) can be expected.
- If water quality is to suddenly diminish in the “B” sample reporting from the cut-off wall, toe drain functionality could be in question, although all potential sources need to be considered and investigated.

Typically, each weir represents a single drainage; however, flow from the Lost Creek-Keystone drainages merge into a single weir box, and flow from the South Congor-Midas drainages merge into a single weir box. Discharge water from the Old Bingham tunnel also enters the South Congor-Midas weir box, but can still be sampled at the tunnel opening. In all cases the curb is labeled with the sample identification number for easy identification, and a sample port grate allows for sample collection access.

A number of seeps were identified during the EWRE project. The locations of these seeps, as well as the geology, are shown on Figure 3-15. This seeps, springs and area geology map was constructed to provide documentation of the EWRE site prior to waste rock coverage.

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SECTION 4

Training

4.1 General Requirements

Training for the operation of the basins consists of the following components:

- A complete read of the O&M and thorough review of the materials provided in the appendices;
- A site tour with a member of the construction team and/or operations team familiar with the basins and structures.

If, in the future, a knowledge gap is identified, contact a member of the RTKC Water Quality team (Table 5-1) and arrange for training support should knowledgeable members of the construction team or operations team not be available.

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SECTION 5

Reference Information

5.1 UDWQ Construction Permit

The collection system design and specifications were reviewed and approved by Mr. Woodrow Campbell, P.E. of the Utah Department of Environmental Quality – Division of Water Quality. Eight periodic field visits were conducted during the construction activities, including a final inspection on October 25, 2016. The State inspection reports are included in Appendix I.

5.2 Dam Safety Permit

The embankments associated with the detention basins were reviewed and approved through the Utah Department of Natural Resources – Water Rights – Dam Safety. Under the advisement of the Assistant State Engineer, the basins were lumped together by drainage and issued a permit number accordingly. The combined basins per drainage are classified as a small dam – low hazard with cumulative capacities by drainage of less than 20 acre-feet.

5.3 Groundwater Discharge Permit

The EWRE collection system components are associated with the Bingham Canyon Mine and Water Collection System Groundwater Discharge Permit # UGW350010, under the sections Part 1.D.3 and Part 1.D.2.

5.4 Project Contacts

Should questions arise in the future that are not covered in this document, RTKC contacts are provided below.

Table 5-1. EWRE project contact information

Name	Title	Contact Information
Tom Gibson	Construction Manager	970-946-0641
Steve Ferris	Project Manager	385-246-6938
Rob Watson	Construction Superintendent	801-824-1146
Scott Bird	Manager – HSEC & Quality	801-699-8337
Jason Hill	Quality and Engineering	435-841-9413
Zeb Kenyon	Environmental Compliance and Quality	801-913-2356
Jason Doyle	Operations Manager - Tailings	801-652-0028
Guillermo Salcedo	Operations Supervisor - SAWS	801-232-1297
Brian Vinton	Principal Advisor – Water Quality	801-712-4597

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Reference Links:

Datalogger Flow Monitoring Reference Material

The Pulsar Ultra Twin UL Instruction Manual (June 2011) is available at:

https://www.pulsar-pm.com/LinkClick.aspx?fileticket=BoFap_kwCtI%3d&tabid=771&portalid=0&mid=1111&language=en-GB

The Pulsar datalogger software is Ultra Log 5.1, and is available at:

https://www.pulsar-pm.com/support/downloads/software.aspx

Midas Pump Station Reference Material

The installation, operation and maintenance manual for the Goulds Pumps Model 3196 i-FRAME at the Midas Pump Station is available at:

https://www.gouldspumps.com/ittgp/medialibrary/goulds/website/Products/3196-i-FRAME/InstallationOperationMaintenance_3196_i_FRAME.pdf

5.5 Project Quality Assurance and Quality Control

Documentation of project quality assurance and quality control is provided in Appendix J. Quality Control was performed by Amec Foster Wheeler Environment and Infrastructure, Inc., and discrepancies were satisfactorily reported and corrected.

5.6 Revision History

To assist in future updates and revisions to the EWRE O&M Manual, the native Microsoft Word file is included in Appendix K.

Rev #	Description of Changes	Prepared by	Date
0	Original release of O&M to comply with UDWQ Permit #UGW350010 Permit to Construct, Condition #2	Zeb Kenyon, RT G&I	December 2016

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Appendix A
EWRE Geology, Seeps, and Springs Map

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Appendix B
Drainage Basin Photographic Logs

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Appendix C
South Area Water Services East Side Collection System – East Waste Rock Extension Groundwater Discharge Permit Inspection and Supplemental Inspection Forms

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Appendix D
Drainage Basin As-Built Drawings

PN DRAFT

PN DRAFT

Appendix E
XML Terrain Files and AutoCAD Design Files

PN DRAFT

PN DRAFT

Appendix F
Redline Design Drawings

PN DRAFT

PN DRAFT

Appendix G
Survey Monument Documentation

PN DRAFT

PN DRAFT

Appendix H
EWRE Compliance Monitoring Transition Documentation

PN DRAFT

PN DRAFT

Appendix I
State Inspection Reports

PN DRAFT

PN DRAFT

Appendix J
Quality Assurance and Quality Control Documentation

PN DRAFT

PN DRAFT

Appendix K
Operations and Maintenance Manual
Microsoft Word Document File

PN DRAFT

PN DRAFT

Appendix L
CH2M HILL Hydrology Report

Operations & Maintenance Manual South Waste Rock Reclamation Detention Basins

PN DRAFT

Rio Tinto Kennecott Copper

Operations and Maintenance Manual

South Waste Rock Reclamation Detention Basins

PN DRAFT

Groundwater Discharge Permit #UGW350010

Bingham Canyon Mine and Water Collection System

November 2018

Revision 2

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Appendices

A. Detention Basin As-Built Specifications (Hardcopy & CD)
B. As-Built Survey & Drawings (Hard Copy & CD)
C. Inspection Checklist (Hard Copy & CD)
D. Photo Documentation (CD)
E. Hydro Report (CD)
F. Data Files (DWG & XML) (CD)
G. Quality Assurance Reports (CD)
H. Operations & Maintenance Manual (CD)

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1.0 Context and Purpose

1.1 Context

Rio Tinto Kennecott Copper (RTKC) and the Bingham Canyon Mine are required to effectively manage surface water, sediment and debris associated with the waste rock dumps on property. These requirements are outlined in detail under the applicable permits associate with the operation. The agencies and permits are listed in Table 1.

Table 1. Applicable Operating Permits Related to Surface Water Management

Agency	Permit
Utah Department of Environmental Quality - Division of Water Quality	Groundwater Discharge Permit No. UGW350010 Bingham Canyon Mine and Water Collection System
Utah Department of Environmental Quality - Division of Water Quality	UPDES Permit No. UT0000051 Storm Water Pollution Prevention Plan
Utah Department of Natural Resources - Division of Oil, Gas and Mining	Permit No. M/035/0002 Mining and Reclamation Plan

In order to better meet our obligations to the public and regulatory agencies related to surface water management along the vicinity of the Bingham Canyon Mine south dump, the detention basins were designed and constructed between the fall of 2014 and fall of 2017. The effort increases basin capacity in conjunction with waste rock placement and subsequent reclamation activities thereby decreasing the risk of offsite release of waste rock contact water, sediment and debris.

1.2 Purpose

This Operations and Maintenance manual is designed to provide the operator with clear instructions and reference material for the proper care and upkeep of the detention basins associated with the south end waste rock placement facilities.

1.3 Disclaimer

This operation and maintenance manual was created to 1) fulfill the construction permit condition for basins constructed during 2014 through 2017 requiring an O&M manual in order to operate the system and 2) provide general guidance to the South Area Water Services (SAWS) operators and maintenance staff as part of the handover of the newly constructed basins. This manual is not all inclusive of the Bingham Canyon Mine Water Collection System originally constructed in the mid 1990's and modified in 2016 which included toe drains, french drains, cut-off walls, detention basins, and associated system of piping from Bingham Canyon to Queen cut-off wall.

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2.0 Design & Operation

2.1 General Overview

The basins are designed to 1) receive surface water and sediment off the face of the dump and 2) passively move alluvial and waste rock contact water (WRCW) through the basin system where the waters are conveyed by pipe via gravity to the cut-off wall where the water then continues via pipe to the east side collection pipe and ultimately the Process Plant and/or Large Reservoir.

Key basin design criteria and operation:

- The basins are designed and sized appropriately to manage precipitation events above the cut-off wall for ≥25 year-24 hour rain event. In addition, basin capacity has been established below the cut-off wall so that the composite capacity for each respective drainage is ≥100 year-24 hour rain event;
- If the precipitation event is within the design criteria, basins are designed to route all water through the east side collection system piping;
- The basins are designed to gravity drain within a 24 hour period;
- All surface water for events not exceeding the design capacity will rout water via gravity into the east side collection system piping system (Under the current design, storm water that exceeds the basin capacity will report to Butterfield Canyon drainage);
- Basin design and capacity accounts for sedimentation but requires routine removal of the sediment in order to maintain minimum capacity.

The basins are not designed or sized to:

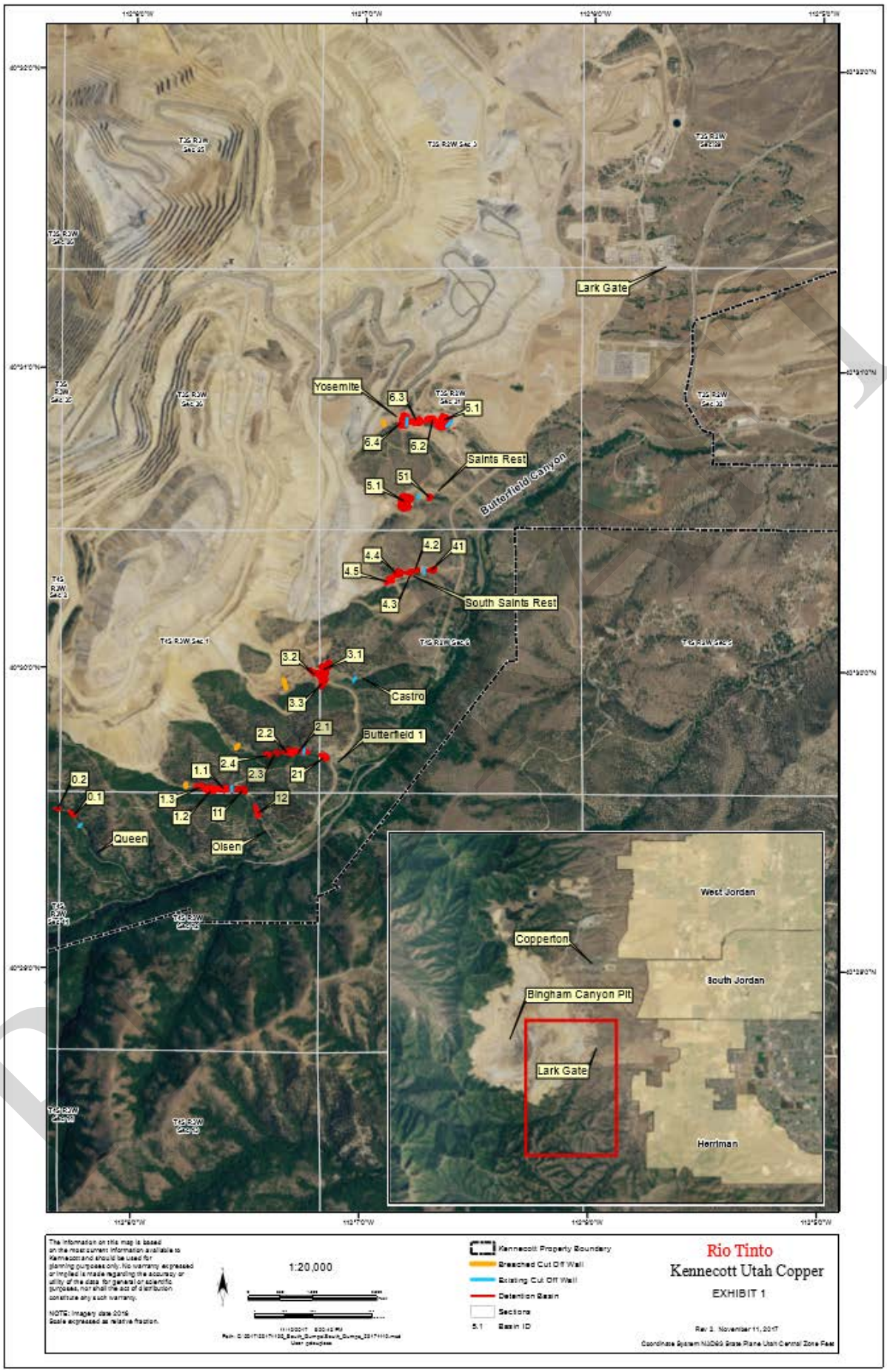
- Manage large amounts of debris (waste rock, cover soils, vegetation);
- Receive water from the dump flattops;
- Operate without routine inspection and maintenance.

Additionally, the basins are designed to drain in a 24 hour period. Ponded water in excess of the 24 hour period should be addressed as soon as possible in order to minimize the potential infiltration of WRCW to ground.

Exhibit 1 is a basic overview map identifying South Dump detention basin locations and names. More detailed drawings are included in Appendix B and photographs of the completed detention basins are included in Appendix D.

In Order to accommodate detention basins and waste rock reclamation, the relocation of cut-off walls was required in three drainages. The new wall design is similar to the existing walls located in the SWRR drainages. The cut-off walls are keyed into bedrock in order to intercept WRCW. Perforated pipe runs along the footing of the wall in order to best facilitate and convey the WRCW capture. In most cases a French drain containing coarse non-reactive rock and perforated pipe extends along the top of bedrock from the original cut-off wall location to the new further facilitating the conveyance and capture of WRCW.

PN DRAFT


Lark Gate
Yosemite
6.3
5.1
5.4
5.2
Saints Rest
51
5.1
Butterfield Canyon
4.2
41
4.4
4.5
4.3
South Saints Rest
3.2
3.1
3.3
Castro
2.2
2.1
Butterfield 1
2.4
1.1
2.3
21
0.2
0.1
1.3
1.2
11
12
Queen
Olsen
West Jordan
Copperton
South Jordan
Bingham Canyon Pit
Lark Gate
Herriman
1:20,000
Kennecott Property Boundary
Breached Cut Off Wall
Existing Cut Off Wall
Detention Basin
Sections
5.1 Basin ID
Rio Tinto
Kennecott Utah Copper
EXHIBIT 1
Rev 3. November 11, 2017

2.2 Detention Basin Specifications

Detailed basin dimensions are provided in Appendix A. A summary of key basin dimensions for quick reference based upon as-built survey data are included below in Table 2. Basins per respective drainage are identified beginning with downstream locations and progressing upstream. Basins below the lower most cut-off wall in a specific drainage are identified as a whole number (i.e. 51) while basins above the lower most cut-off wall in a specific drainage are identified with a decimal point, increasing in value moving upstream (i.e. 3.1, 3.2).

Table 2. Overview of Detention Basin Specifications

Basin ID	Capacity (ac-ft)	Outlet Elevation (ft)	Spillway Elevation (ft)	Outlet Orifice Dimension[1] (in)	Peak Outflow 100yr-24hr (CFS)	Grate Material[2]
Yosemite						
6.1	2.17	5800.1	5809.5	12	4.20	Galvanized
6.2	3.52	5845.0	5864.1	6	4.17	Galvanized
6.3	2.36	5874.1	5892.0	8	7.11	Galvanized
6.4	0.90	5903.0	5913.6	12	18.78	Galvanized
Saints Rest						
51	0.73	5778.2	5786.4	8	2.61	Galvanized
5.1	3.79	5843.1	5857.0	6	3.15	Galvanized
South Saints Rest[3]						
41	0.52	5792.4	5800.8	8	2.00	Stainless
4.2	0.77	5827.8	5841.8	6	3.13	Stainless
4.3	0.87	5846.6	5858.7	6	3.28	Stainless
4.4	2.74	5871.4	5886.6	6	3.63	Stainless
4.5	2.20	6054.0	5918.8	10	7.67	Stainless
Castro						
3.1	4.87	6166.0	6179.6	6	2.60	Galvanized
3.2	4.45	6161.3	6179.0	6	2.70	Galvanized
3.3	10.16	6151.3	6172.0	6	2.90	Galvanized
Butterfield 1						
21	4.83	6054.0	6073.0	6	3.64	Galvanized
2.1	0.75	6113.1	6126.5	8	5.57	Galvanized
2.2	4.18	6161.1	6180.3	8	5.05	Galvanized
2.3	0.94	6195.3	6207.9	10	6.74	Galvanized
2.4	1.37	6222.4	6237.3	10	6.72	Galvanized
Olsen						
12	2.77	6146.4	6165.4	6	4.15	Galvanized
11	1.82	6220.0	6233.0	8	4.91	Galvanized
1.1	3.16	6275.5	6293.6	8	4.98	Galvanized
1.2	3.49	6307.9	6326.6	8	5.12	Galvanized
1.3	1.50	6340.0	6352.7	9	5.68	Galvanized
Queen						
0.1	2.03	6491.9	6511.0	7	5.62	Galvanized
0.2	1.35	6539.7	6559.0	7	6.04	Galvanized

Notes.

1 - All detention basin outlet structures (excluding 3.1 and combination cut-off walls) are constructed with the same dimensions and inlet/outlet pipe sizing, however each 18" lower outlet pipe has an orifice plate that varies in size and can be changed out to modify the performance of the outlet structure.

2 – Outlet structure grates are either stainless steel or galvanized steel based upon drainage water quality.

3 - Basin 4.1 was in the original design and resided on the ridge above 4.2 but was omitted during construction due to lack of capacity and difficulty to access and was later replaced with 4.5.

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2.3 Cut-off Wall Design

The cut-off walls are designed to capture WRCW and convey that water via gravity to the contact water mainline. The wall accepts contact water from 1) a french drain (perforated pipe embedded in coarse non-reactive rock) leading up the drainage or 2) perforated pipe adjacent to the wall footing and atop bedrock. The contact water perforated piping is atop bedrock but below surface grade. This allows for segregation of contact water from storm water and optimum performance of the storm water basins. Ultimately contact water and storm water are comingled prior to entering the mainline collection pipe.

In some cases, the cut-off walls are designed to detain surface water and act as the lower embankment of the detention basin. The inlet box is slotted the entire height of the box. Water exits the box through an 18” outlet pipe. In the event the pipe at the bottom of the box plugs, water can exit through a 12” overflow pipe that routs water back into the primary 18” pipe. In the event both pipe outlets become plugged, water will exit over the wall through an overflow weir notch.

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3.0 Inspection & Maintenance

3.1 Overview

The detention basins, although not designed to primarily capture and route waste rock contact water (WRCW), do play an important role in protecting the structures and piping that are designed to manage WRCW. If storm water, sediment and debris were to overwhelm cut-off walls and associated infrastructure, the potential for the release of WRCW to the environment would greatly increase. The detention basins are designed to minimize adverse impacts to the primary acid rock drainage (ARD) collection system as well as convey WRCW through and require routine inspection and maintenance.

Inspection frequency is guided by groundwater discharge permit # UGW350010. The permit only specifically requires quarterly inspection, however best practice recommends a more frequent inspection following large rain events. Table 3 provides inspection guidance and frequency.

Table 3. Inspection Frequency and Guidance

Inspection Type	Frequency	Guidance
UDWQ Groundwater Discharge Permit #UGW350010[1]	Quarterly	Appendix A, Groundwater Discharge Permit # UGW350010
Significant precipitation event[2]	Varies	Rain depth ≥10 year-24 hour as indicated by the Copper drainage rain gage

Notes.

1 – Required by groundwater discharge permit #UGW350010

2 – Not required by the groundwater discharge permit. Refer UPDES Permit (0000051) Statement of Basis (p. 21) and Part I.E as well as 40 CFR 440.131(c) for guidance

The inspection checklist for the south dump detention basins is discussed in section 3.3 and included in Appendix C.

3.2 Basin Components

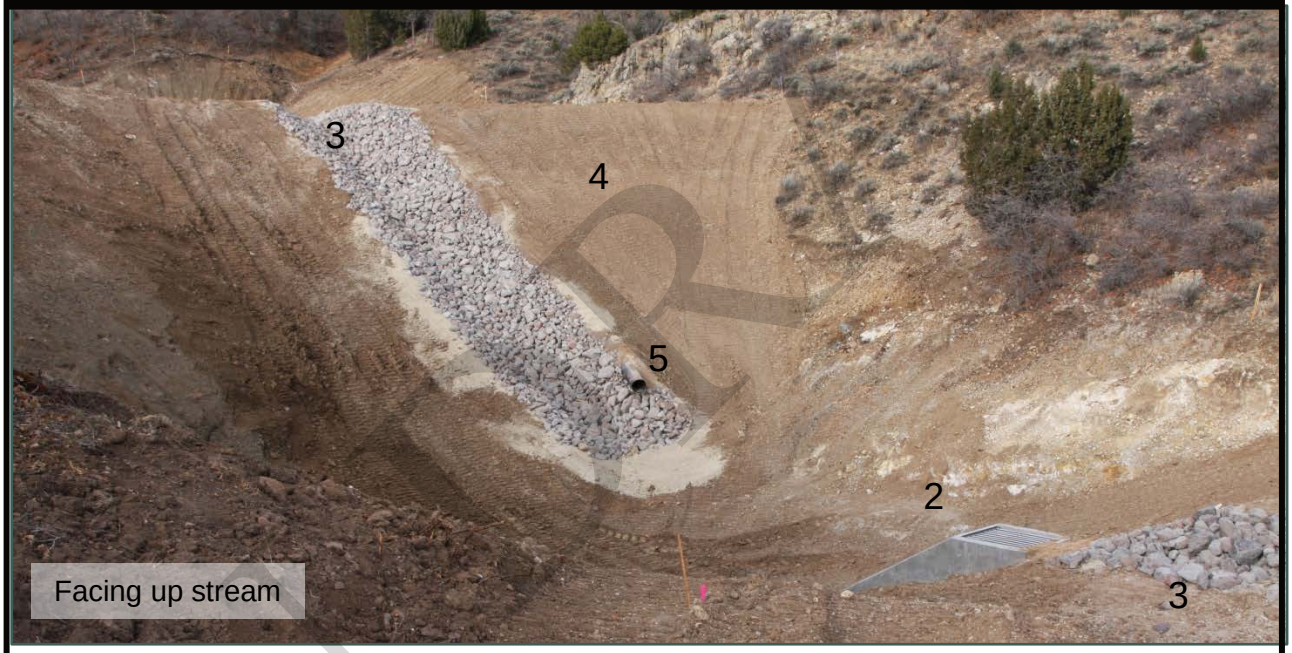
The basins are fairly simple by design. Alluvial water, storm water and sediment report from the dump toe, face or the native hillside and enter the drainages containing the detention basins and cut-off walls. The water passes through the rock weir in front of the outlet structure while coarse sediment is trapped behind the rock weir. Water then exits the detention basin through the outlet structure. Peak flow for a given rain event is regulated by the outlet structure and appropriately sized orifice plates so as to not overwhelm the capacity of the main collection pipe along the east side collection road. If the detention basin is overwhelmed due to either the size of the precipitation event or sediment and debris plugging off outlets, water then exits the basin through the overflow weir, reporting to the next basin in line. The basins for each respective drainage are designed to manage up to a 100 year-24 hour rain event. By design, in some cases when rain events are large, water will exit some basins via the overflow weir and report to the next basin.

Flow diagrams for the drainages are located with the as-built drawings in Appendix B.

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Exhibit 2. Basin Components Illustration





Key

1. Rock Weir. See dwg. # 10199-C-321.
2. Outlet Structure. See dwg. # 10199-C-322 & 10199-C-323.
3. Rip Rap Overflow Weir. See dwg. # 10199-C-321.
4. Basin Embankment. See dwg. # 10199-C-321.
5. Pipe Outlet. See dwg. # 10199-C-321.

PRELIMINARY

3.2.1 Rock Weir:

The rock weirs are four (4) feet tall. They are designed to filter out medium to coarse particulate and prevent the concrete outlet structure from becoming plugged with sediment and debris. Sediment may accumulate behind the rock weir over several rain events and seasons. If sediment depth reaches two (2) feet behind the rock weir then the basin should be scheduled for sediment removal. Use of the digital terrain model (DTM) file will assist in achieving the basins original shape and capacity. Care should be taken to maintain the integrity of the rock weir. In the event of a significant precipitation event that overwhelms one or more detention basins, the rock weir can be dismantled to remove fine grained particles and reconstructed. Details regarding the rock weir specifications are found in Appendix B, drawing # 10199-C-124. If not all the rocks for the weir cannot be salvaged, material that meets specification may need to be sourced to supplement reconstruction. Generally, the rock used for the weir needs to be resistant to erosion and non-reactive with the water found in the drainage.

3.2.2 Outlet Structure:

All outlet grates and orifices must be inspected following significant storm events as outlined in Table 3. The grates and piping inlets (orifices) must be clear of vegetation, sediment and debris in order to function as designed. In order to combat outlet plugging from floating debris, the Yosemite drainage incorporated “T”s that will allow head pressure to push water through the submerged pipe inlet while sediment floats on the surface, reducing the potential of debris blocking the inlet. Water can also flow in from the top of the “T”. A clean out access pipe is also included immediately down gradient of the outlet structure.

3.2.3 Pipe Outlets:

Pipe outlets are within the outlet structure should remain free of excess sediment and debris in order to provide proper functionality. If the rip rap at or below the pipe outlet show signs of deterioration (i.e. rock movement, erosion adjacent to the channel, etc.) repairs must be made.

3.2.4 Rip Rap Overflow Weir:

The rip rap overflow weirs are designed to move water from out of the basin to the next containment structure without damaging the integrity of the embankment. In many cases and in larger rain events, the basins are designed to move water through the overflow weir in addition to the outlet structure. The overflow weir will also move water should the outlet structure become plugged by sediment and debris. If an overflow weir shows indications of erosion adjacent to the rock channel, at the inlet or outlet, repairs must be made.

3.2.5 Distribution Boxes:

The distribution boxes are designed to accept water from two sources (i.e. cut-off wall and sediment basins) and route the water through a common pipe into the main east side collection pipe. These boxes also provide access for pipe cleaning. The boxes must be kept clean, free of sediment and debris. The inspection schedule needs to be the same as the cut-off walls and basins.

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3.3 Cut-off Wall Components

Cut-off wall components require inspection similar to the detention basin outlet structures. Some components (finger drains) are below grade and cannot be readily inspected. The cut-off wall manages both contact and non-contact water.

Exhibit 3. Cut-off Wall Components Illustration



Key

1. Concrete cut-off wall keyed into bedrock. See dwg. # 10199-C-305, 306, 315, 308 & 327.
2. Overflow weir notch. See dwg. # 10199-C-305, 306 & 315.
3. Surface water inlet box. See dwg. # 10199-C-327 & 328.
4. Hand wheel and slide gate valve. See dwg. # 10199-C-327.
5. Outlet box and piping. See dwg. # 10199-C-327.
6. Outlet pipe cleanout port. See dwg. # 10199-C-327.

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3.3.1 Concrete Wall, Box and Valves

The concrete wall is keyed into bedrock and designed to facilitate in the capture of all water moving down the drainage, contact and non-contact water. The wall contains an overflow weir (notch in the wall) to allow overflow of storm water in the event the outlet box and associated piping are overwhelmed or plugged. The inlet box has grating from the ground surface to the top of the box allowing for the free flow of water into the box as sediment and debris accumulate against the grating. A hand wheel atop the box operates the slide gate valve on the low level inlet at the back of the inlet box. A secondary inlet pipe is located near the top of the inlet box in the event the low level inlet becomes inoperable.

3.3.2 Finger Drains and Contact Water Capture at Cut-off Wall

The information provided in this section pertains to finger drains installed at the toe of the reclaimed waste rock slope (and extending beyond) in the Yosemite, South Saints Rest, Butterfield 1 and Olsen drainages. These finger drains are designed to capture WRCW at the highest point in the drainage and direct that water to the cut-off wall and collection system. Where practical, a finger drain is installed from the location of the legacy cut-off wall to the new cut-off wall along the drainage bottom against bedrock. The finger drain is 8” perforated pipe embedded in 2” non-reactive rock and wrapped in geotextile to prevent fine silt from plugging the pipe and ability to accept water.

The newly installed cut-off walls in Yosemite, Butterfield 1 and Olsen drainages incorporated perforated pipe below grade to capture WRCW in conjunction with the concrete wall. Along the footing of each cut-off wall resides a 4” perforated pipe embedded in 2” non-reactive rock and wrapped in geotextile. All water collected at the wall will enter the coarse rock channel and perforated pipe and report to the 12” HDPE pipe. In the case of the Upper Yosemite cut-off wall, Butterfield 1 and Olsen, the piping system passes through the cut-off wall and ultimately reports to the main collection line. In the case of the Lower Yosemite cut-off wall, the 4” pipe reports to the inlet box where it comingles with the surface water that enters the box through the grate.

3.3.3 Storm Water Conveyance

Storm water enters the inlet box through the grating and enters the 12” collection pipe on the floor of the back wall of the box. The outlet pipe does not have an orifice plate but does contain a slide gate valve. The valve typically stays in the fully open position and is only closed for maintenance purposes. In the event the 12” pipe inlet were to become plugged, a secondary 12” pipe is located approximately 5’ below the top of the box. In the event both pipes were to become plugged or otherwise fail, storm water would exit pass through the overflow weir notch atop the wall and adjacent to the outlet box. A hatch resides on the down gradient side of the box to allow access to the associated piping. Immediately down gradient of the wall are cleanouts for the 12” inch pipe.

3.4 Inspection Checklist:

Detention basin inspections should be conducted on a routine basis in conjunction with inspections of the east side collection system. An inspection checklist for the south dump detention basins is included in Appendix C. In the event of a significant precipitation event, more frequent inspections are advised (See Table 3 for guidance).

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3.5 Sediment Removal

There are two types of sediment deposition associated with the detention basins requiring maintenance, chronic and acute. Chronic sediment deposition includes sediment that can accumulate over multiple precipitation events occurring over weeks, months and even years. Acute sediment deposition may take place over one large rain event or several larger events in in a short period of time. In either case, maintenance will be required to remove the sediment and return the basin to its original capacity. A DTM file is provided that will assist the GIS equipped equipment to restore the basin to its original shape and capacity. If the DTM is not compatible with the selected contractor, detailed electronic as-built files are included with the O&M.

Care should be taken to not damage the outlet structures and piping. Use hand tools as needed to complete the close proximity maintenance.

4.0 Training

Training for the operation of the basins consists of the following components:

- A complete read of the O&M and thorough review of the materials provided in the Appendices;
- A site tour with a member of the construction team and/or operations team familiar with the cut-off walls, basins and associated structures.

If, in the future, a knowledge gap is identified, contact a member of the RTKC Water Quality team and arrange for training support should knowledgeable members of the construction team and operations team not be available.

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5.0 Reference Information

5.1 UDWQ Construction Permit

The detention basin design and specifications were reviewed and approved by Mr. Woodrow Campbell, P.E. of the Utah Department of Environmental Quality – Division of Water Quality. Periodic field visits were conducted during the construction activities including three final inspections based upon project phasing and completion:

- Saints, South Saints and Castro detention basins - December 15, 2014 for.
- Yosemite detention basins and cut-off walls - 3Q2016.
- South Saints Rest detention basin 4.5, Butterfield 1 cut-off wall and detention basins, Olsen cut-off wall and detention basins and Queen detention basins - October 23, 2017.

5.2 Dam Safety Permit

The embankments associated with the detention basins were reviewed and approved through the Utah Department of Natural Resources – Water Rights – Dam Safety. Under the advisement of the Assistant State Engineer, the basins were lumped together by drainage and issued a permit number accordingly. The combined basins per drainage are classified as a small dam – low hazard with cumulative capacities by drainage of less than 20 acre-feet.

Drainage	Permit #	Water Rights
Yosemite	UT53811	a6714 (base water right 59-42)
Saints Rest	UT53799	
South Saints Rest	UT53800	
Castro	UT53802	
Butterfield 1	UT53803	
Olsen	UT53804	
Queen	UT53876	

5.3 Groundwater Discharge Permit

The detention basins and associated piping are considered a component of the groundwater control structures associated with the Bingham Canyon Mine and Water Collection System Groundwater Discharge Permit # UGW350010 under the sections Part 1.D.3 and Part 1.D.2 with additional detail provided in Appendix A.

5.4 Project Contacts

Name	Title	Contact Information
Engineering and Projects (Construction Team)		
Jared Barlow	Project Manager	(801) 569-6610
Dave Hales	Project Engineer/Design & Interface	(801) 569-7800
Zeb Kenyon	Project Engineer/Design & Permitting	(801) 569-6035
Operations Team (South Area Water Services)		
Jason Doyle	Superintendent – Tailings & Water Services	(801) 569-6856
Guillermo Salcedo	Supervisor – SAWS Operations	(801) 204-3511
Environmental Team (Permit and Compliance)		
Brian Vinton	Principle Advisor – Water Quality	(801) 569-7887

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6.0 Revision History

Rev. #	Description of Change(s)	Prepared by	Date
0	Original release of O&M to capture basins completed in December 2014 for Saints Rest (5.1 & 51), South Saints Rest (4.4, 4.3, 4.2 & 41) and Castro (3.3, 3.2 & 3.1) and to fulfill DWQ construction permit obligations.	Zeb Kenyon, RT T&I	March 2015
1	Updated to incorporate basin and cut-off wall completion in Yosemite drainage and fulfill DWQ construction permit obligations.	Zeb Kenyon, Rio Tinto G&I	December 2016
2	Updated to incorporate basin and cut-off wall completion in South Saints Rest, Butterfield 1, Olsen and Queen drainages and fulfill DWQ construction permit obligations.	Zeb Kenyon, Rio Tinto G&I	November 2018

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INTRODUCTION

Kennecott Environmental and Industrial Hygiene Laboratory (KEIHL) is a component of Rio Tinto Kennecott Corporation (RTKC) and has provided analytical services to RTKC for over 40 years. KEIHL is in the Central Laboratory at 2500 South 9180 West, Magna, Utah. The laboratory provides in-house analytical services for environmental, industrial hygiene, geochemical, and process monitoring programs for RTKC only. KEIHL does not provide analytical services to outside clients and will review all new work proposed to ensure the appropriate facilities and resources exist before commencing work.

Laboratory Environment

KEIHL is a state-of-the-art facility. The building provides large test areas, energy sources, lighting, heating, and ventilation for the proper performance of test methods. The environmental monitoring systems within the building monitor, control, and record all environmental conditions as appropriate. Such environmental conditions may include dust, humidity, main voltage, and temperature. The work areas are effectively separated for possible incompatible work areas. KEIHL maintains good housekeeping standards to ensure that any contamination does not adversely affect data quality. Access is controlled by Rio Tinto Kennecott Corporation (RTKC) by using a card key system and limited to

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KEIHL personnel and RTKC's Health, Safety and Environmental Quality (HSEQ) department employees and authorized visitors. The laboratory area where environmental samples are stored and analyzed is considered a Resource Conservation Recovery Act (RCRA) secure area. A facility diagram can be found in *Section 1 Appendix A*.

Definition

This Quality Assurance Program Plan (QAPP) was developed using four regulatory guidelines. The first guideline is NELAC Chapter 5 Quality Systems. The second guideline is the State of Utah Rule for the Certification of Environmental Laboratories, Rule 444-14. KEIHL used a combination of NELAC Chapter 5 and R444-14-7 to compile a list of essential items required for a quality assurance plan. The Third guideline used is the U.S. Environmental Protection Agency (EPA) documented in "Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans," QAPPS 005/80 December 29, 1980, issued by the Office of Monitoring Systems and Quality Assurance Office of Research and Development. The fourth guideline is the AIHA/ISO 17025 for Industrial Hygiene procedures. KEIHL is in conformance with these four guidelines listed above and the Quality Assurance (QA) policy is stated in *Section 2.0*.

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Purpose

The purpose of this QAPP is to present an overview of the essential elements of KEIHL's quality assurance program. Elements not specified in the EPA and AIHA guidance documents are included in this QAPP to provide additional QA program elements required to meet the objectives of the QA policy. The QA policies and procedures described herein are designed to eliminate systematic errors and minimize the occurrence of other errors. However, no QA program can eliminate all errors which may occur during analysis. The QA program provides the framework for minimizing errors and identifying and correcting the errors that may occur. These QA policies and procedures must be coupled with the professional judgment of the technical staff to ensure that quality data is consistently produced.

Laboratory Organization

The organization of Kennecott Environmental and Industrial Hygiene Laboratory is described in *Section 3* of this document. Safety guidelines for the laboratory are provided in the Chemical Hygiene Plan, which is found in Bentley, a site-wide commercial document control system utilized at RTKC.

Rio Tinto Kennecott Corporation Safety Policies and Procedures can be found on the company intranet.

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A list of analytical services and corresponding Standard Operating Procedures (SOP) are in Bentley.

KEIHL monitoring programs are strengthened by a variety of certification, accreditation, or licensing programs. A brief synopsis of current accreditation and staff experience certifications is provided in *Section 1 Appendix B*. A list of KEIHL's instrumentation is provided in *Section 1 Appendix C*.

Code of Ethics

The purpose of this code is to provide a standard of ethical conduct to ensure the principles of integrity, accountability, independence, and impartiality are demonstrated by all employees at the Kennecott Environmental and Industrial Hygiene Laboratory. This code will:

- Maintain the highest level of integrity and professional competence.
- Produce data that is legally defensible.
- Follow the guidelines of NELAC, AIHA and KEIHL's Quality Assurance Program Plan (QAPP).
- Protect confidential information. *(See Section 1 Appendix D.)* Personnel, including any committee members, contractors, personnel of external bodies, or individuals' action on the laboratory's behalf, shall keep confidential all information obtained or created during the performance of laboratory activities, except as required by law.
- Be objective in the application of recognized scientific methods and in the interpretation of findings.
- Disseminate scientific knowledge for the benefit of employees, society, and the profession.
- Comply with Rio Tinto Kennecott Copper's policy on Principles of Business Conduct.
  (See Section 1 Appendix E.)

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- Maintain an objective attitude toward the recognition and evaluation of safety and health issues, regardless of external influences since the health and welfare of workers is of paramount importance.

The Laboratory is obligated to provide accurate and precise analytical data in a timely manner to support the various programs at RTKC. Laboratory employees are required to do all possible within their means to ensure that analytical results are of the highest quality. All data will be completed promptly with a quality sufficient to meet the needs of RTKC management and to ensure the health and safety of the individual employee.

All Laboratory employees must ensure all analytical methods, quality assurance and documentation procedures are followed. No undue pressure should be applied by any employee, manager or group that would cause a laboratory employee to compromise their work and the analytical results provided by the laboratory in any manner. If an employee has cause or feels that any form of unjustified pressure is being applied to their position, they can bring this immediately to the attention of the Laboratory Director. An employee can choose to contact the Human Resource Department if they are unable or unwilling to bring the issue to the Laboratory Director.

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MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Revision and review for 2006.	Melissa Olsen	08/02/06
TS00113	Statement added regarding the review of new work in first paragraph.	Melissa Olsen	04/13/07
9006	Revision and review for 2008. Updated instrumentation list.	Melissa Olsen	10/10/08
	Review for 2009.	Melissa Olsen	01/21/09
11532	Review for 2010. Updated laboratory address. Removed ELPAT from certifications and updated analytical instrumentation list.	Melissa Olsen	02/22/10
17479	Review for 2011. Updated instrumentation list to include Rigaku XRD and Perkin Elmer ICP-OES 7300 DV.	Melissa Olsen	10/11/2011
23199	Review for 2013. Updated Appendix C-Instrumentation List.	Melissa Olsen	04/25/2013
26233	Review for 2014. Updated instrumentation list. Removed "testing of biological sterility" under "Laboratory Environment". Updated branding.	Melissa Olsen	05/22/2014
30091	Review for 2015. Updated instrumentation list-added new mercury analyzer, NAG pH meters, etc.	Melissa Olsen	03/24/2015
31572	Review for 2016. Removed references to biological/clinical samples, removed clinical license from Appendix B. Updated Appendix C, Analytical Instrumentation.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes made.	Melissa Olsen	02/06/2017
53081	Review for 2018. Updated Appendix C-Instrumentation List.	Melissa Olsen	05/15/2018
58723	Review for 2019. Updated Appendix C-Instrumentation List. Removed statement regarding participation in USGS inter-laboratory studies from Appendix B.	Melissa Olsen	08/16/2019
60468	Added statements under Code of Ethics regarding impartiality and Confidentiality.	Melissa Olsen	01/03/2020

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MOC#	Description of Change	Prepared By	Date
67192	Review for 2020. Updated equipment list.	Melissa Olsen	09/15/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/02/2021
94373	Review for 2022. Updated instrumentation list.	Melissa Olsen	11/30/2022
102982	Updated instrumentation list. Rev. 20 to 21	Melissa Olsen/Angie Zuniga	09/06/2023

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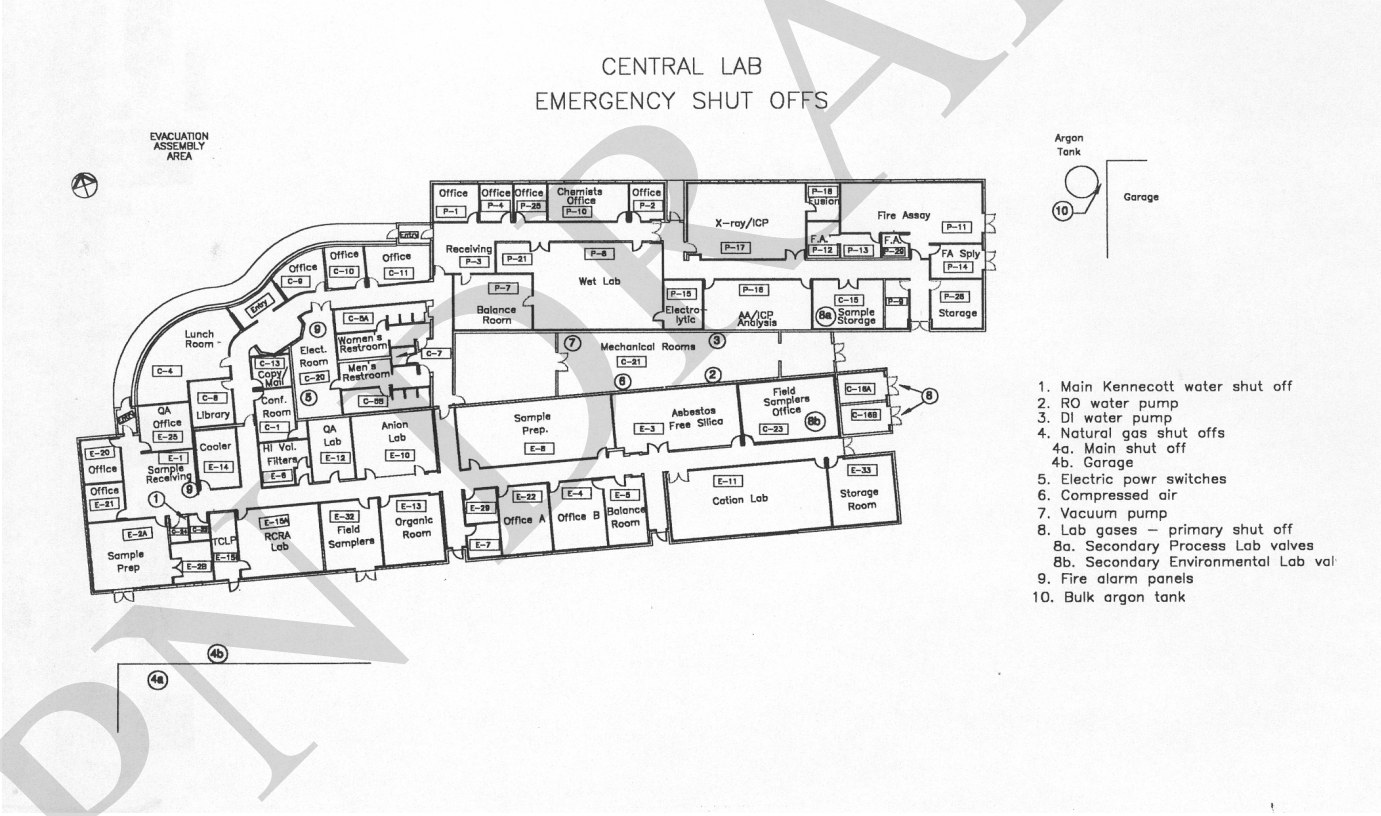
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Appendix A - KEL Building Plan



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Appendix B - Laboratory Accreditation and Certifications

Accreditation, Certification and Professional Experience

- Certified by the State of Utah, Environmental Testing is performed under the Safe Drinking Water Act (SDWA) the Clean Water Act (CWA) and the Resource Conservation and Recovery Act (RCRA). Certification # UT0019 (1979) (UT0019 since September 1979)

- Accredited by the American Industrial Hygiene Association (AIHA) for respirable silica and metals under the IHPAT program. Accreditation # 121 (1978)

Professional Experience and Certifications

Professional Experience

The professional staff of environmental scientists have earned college degrees in chemistry or related disciplines.

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Appendix C KEIHL Analytical Instrumentation

KEL Analytical Instrumentation

INSTRUMENT	VENDOR	SERIAL NUMBER	LOCATION
Oven - Honeywell	Grieve	620140	E-2
Rotap	WS Tyler	27430	E-2
(2) Ring and Puck	TM Engineering	NA	E-2
Jaw Crusher	Morse	2000-028	E-2
Mini Flex II	Rigaku	HD209711	E-3
Particle Size 2000	Malvern	MAL1060772	E-3
Balance-AB104-S	Mettler	1126481482	E-5
Balance-AB104-S	Mettler	1127140437	E-5
Balance-M104S	Mettler	B245502124	E-5
Oven-TFO-10	Cascade Tek	9018811	E-5
Secura 324-IS	Sartorius	36001909	E-5
Balance-MX5	Mettler	1127442247	E-6
Oven-Thermlyne	Thermo Scientific	152470301100730	E-8
Oven-732	Lindberg	927131	E-8
Hot Block 1	Environmental Express	3994CEC1863	E-8
Hot Block 2	Environmental Express	6843CECW3221	E-8
Hot Block 3	Environmental Express	3826CEC1851	E-8
Hot Block 4	Environmental Express	3994CEC1873	E-15
Hot Block 5	Environmental Express	2018CECW5024	E-8
Hot Block 6	Environmental Express	5837CEC2673	E-21
C/S Analyzer SC832 HT	LECO	54801	E-8
C/S Analyzer SC632	LECO	3268	E-8
Dionex AS-AP	Thermo Scientific	17121215	E-10
Integrion HPIC	Thermo Scientific	17121215	E-10
Dilutor-Microlab 500	Hamilton	MD91KB5266	E-10
311 Auto Sampler	Astoria	4625A10988	E-10
302 D	Astoria	302330	E-10
303 A	Astoria	303427	E-10
305 D	Astoria	305666	E-10
311 Auto Sampler	Astoria	4632A11095	E-10
Rapid Flow Analyzer-A2	Astoria	200102	E-10
311 Auto Sampler	Astoria	4721A12048	E-10
Rapid Flow Analyzer-A2	Astoria	200168	E-10
8900 ICP-MS	Agilent	17450348	E-13
Rapid Flow Analyzer-303A	Astoria	303427	E-10
Optima 8300 DV	Perkin Elmer	078S1211194	E-11
ASX-520	Cetac	091257A520	E-11

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INSTRUMENT	VENDOR	SERIAL NUMBER	LOCATION
Chiller for 7700X	Polyscience	1D12A0915	E-11
7700X	Agilent	JP11441372	E-11
M-7600 Hg	Cetac	101406Q76	E-11
ASX-260	Cetac	081428A560	E-11
ASX-500	Agilent	US0813203A520	E-11
Chiller	Dimplex	39266	E-11
7300 DV	Perkin Elmer	077C1072201	E-11
Dilutor-Microlab 500	Hamilton	ML600CL4187	E-11
5110 ICP	Agilent	MY18411003	E-11
G2392A Chiller	Agilent	5Q12B1695	E-11
SPS 4 Autosampler	Agilent	AU17253185	E-13
Balance-AE 50	Mettler	K54461	E-15A
Balance-MS6001S/03	Mettler	B332650103	E-15A
Centrifuge-5804	Eppendorf	5804YN814874	E-15A
Conductivity Meter-126	Orion	41567041	E-15A
Conductivity Meter-124	Orion	34664087	E-15A
Conductivity Meter-2052B	VWR (Amber)	906026	E-15A
Conductivity Meter	Traceable	192367356	E-15A
PH Meter	Oakton	558890	E-15A
PH Meter	Oakton	84146	E-15A
PH Benchtop Meter	Thermo	B22723	E-15A
PH Benchtop Meter	Thermo	X20832	E-15A
Conductivity Meter	Thermo	H06567	E-15A
Colilert Quantitray-Sealer Plus	Idexx	QTP13163701348	E-15B
Incubator-BOD	Fisher Scientific Model 307	10300096	E-15A
Incubator-BOD	Thermo Scientific-Precision	WB13554787	E-15B
Balance-AUX220	Shimadzu	D449511535	E-29
MA-3000 Hg	NIC	11740081	E-29
Balance-AE163	Mettler	E01679	NA
Optima 7300 Chiller	Polyscience	1911-01855	E-11
Agilent 5110 Chiller	Agilent	2208-02506	E-11
Agilent 8900 Chiller	Agilent	1710-04668	E-13
Rigaku XRD Chiller	Haskris	HB22292	E-3
Autosampler In-Motion Flex	Mettler	C201292652	E-10
Autosampler In-Motion Flex	Mettler	C202371211	E-10
Centrifuge-5702	Eppendorf	5702kr756137	E-10
Furnace- lindburg blue M	Thermo Fisher	1145492201220222	E-5
ASX-520	Cetac	030632A520	E-11
M-7600 Hg	Cetac	U22045001	E-11
ASX-560	Cetac	112136A560	E-11
SPS 4 Autosampler	Agilent	AU18154834	E-11

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INSTRUMENT	VENDOR	SERIAL NUMBER	LOCATION
Chiller for ICAP-RQ	Agilent	2208-02506	E-11
iCAP RQ	Thermo	ICAPRQ 03257	E-11
ASX-560	Teledyne Cetac	012247A560	E-11
Thermoflex 2500 chiller	Thermo	1171864801220200	E-11
MA-3000 Hg	NIC	21740743	E-29
T9 Autotitator	Mettler	C147030229	E-10
Dosing unit	Mettler	C148066397	E-10
Dosing unit	Mettler	C148066395	E-10
Sonicator	Branson	RMA10106024G	E-10

Acronym	Description
ICP/AES:	**Inductively Coupled Plasma Atomic Emission Spectroscopy**
ICP-MS	**Inductively Coupled Plasma-Mass Spectrometry**

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Appendix D – Corporate Confidentiality and Legal Agreement

In consideration of my employment or continued employment with Rio Tinto Kennecott Corporation, its successors, or assigns ("Company"), and in further consideration of the salary or other compensation to be paid to me by Company, I agree to the following terms and conditions:

1. NONDISCLOSURE OF CONFIDENTIAL INFORMATION. I acknowledge that during my employment with Company, I have obtained or will obtain information or access to information regarding Company including but not limited to its trade secrets, customer lists, customer purchasing histories and plans, costs, budgets, policies, procedures, processes, methods of operations, pricing, marketing plans, financial information, personnel information, compensation programs, vendor sources, vendor identities and capabilities, research, machine and component histories, engineering data, designs and drawings, design standards, formulas, computer software and programs. Inventions (as defined below), and other data, as well as information, which Company receives from a third party and holds in confidence (collectively, "Confidential Information"). Confidential Information may be oral or written and may reside in works which I have originated or will originate or which otherwise have come or will come into my possession or knowledge. I understand that Confidential Information does not include information concerning Company and its business which is widely disclosed to the public in published form, nor does it include generally available information concerning principles of business operations. I agree that I shall not at anytime during my employment with Company or at any time thereafter, directly or indirectly disclose to any person or entity or use any Confidential Information except in the normal course of my duties as an employee of Company.

2. OWNERSHIP OF MATERIALS AND RETURN. All books, records, papers, notes, documents or catalogs, compilations of information, drawings, correspondence, recordings, information stores for use in or with or from computers, tools, equipment, and other items and materials, including copies thereof, that I have developed or will develop or which have come or will come into my possession or control during my employment by Company, which relate to the business of Company, are the property of Company. Further, I shall promptly deliver all such materials and items to Company on termination of my employment or at any time Company may so request.

3. INVENTIONS. All inventions, discoveries, improvements, or ideas (jointly or severally, "Inventions") made, developed or conceived by me, individually or jointly with others, during the term of my employment that relate to Company's present or future business, or that are capable of beneficial use by Company shall be the property of Company. Without further salary or other compensation. I shall promptly disclose in writing such Inventions to my immediate supervisor and execute any patent applications, assignments, and other instruments deemed necessary by Company that relate to the Inventions. Company shall have exclusive control over all such Inventions. I shall cooperate fully, even after my termination, in a lawful manner and at the reasonable expense of Company, other than for my time, in the prosecution of patent applications and in any legal actions and proceedings concerning such Inventions.

4. CREATIONS. I hereby assign, convey, and transfer to Company, any and all manuscripts, writings, pictorial materials, computer programs or software, and other creations (collectively, "Creations") created by me, either individually or jointly with others, during my employment which relate to the present or future business of Company or which are capable of beneficial use by Company. All such Creations shall be "work made for hire," as this is defined in the Copyright Act, Title 17 of the United States Code. If for whatever reason a work is deemed other than a "work made for hire." I hereby assign all copyright interests to Company. Company shall have the full right to seek and procure copyright registration on the Creations, and I shall cooperate fully, even after my termination, in a lawful manner and at the reasonable expense of Company, other than for my time, in securing copyrights and in any legal actions and proceedings concerning the Creations.

5. POST-TERMINATION RIGHTS. Without diminishing the rights granted to Company above, if within one (1) year after leaving the employ of Company, an Invention related to existing or potential products, services, or business of Company is described in a patent application or is disclosed to third parties by me, or if a Creation relating to existing or potential products, services or business of Company is published or is disclosed to third parties by me, there shall be a presumption that the Invention or the Creation was conceived, made, developed, acquired, or created by me during my employment by Company and the Invention or Creation shall belong to Company.

6. REMEDIES. Irreparable damage shall result to Company in the event of the breach by me of this Agreement. In the event of a breach or threatened breach by me, Company shall be entitled to all remedies, including money damages, as well as injunctive relief and such other equitable relief to prevent or restrain any breach or threatened breach of this Agreement. Each remedy of Company shall be cumulative and not in limitation of any injunctive relief or other rights or remedies which Company is or may be entitled at law or in equity. Company shall be entitled to its reasonable

attorney's fees, expert witness fees, and other expenses and costs it incurs in enforcing this Agreement or pursuing damages for my breach of this agreement.

7. NO EMPLOYMENT AGREEMENT. The employment relationship between Company and me is one of employment-at-will and no rights to employment for a definite period of time are created by this Agreement. I acknowledge this Agreement survives the termination of my employment with Company.

8. SEVERABILITY. Any provision of this Agreement which is unenforceable in any jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such unenforceability without invalidating the remaining provisions hereof or affecting the validity or enforceability of such provision in any other jurisdictions.

7. GOVERNING LAW. This Agreement shall be construed and interpreted in accordance with the laws of the State of Utah, and the District Courts of Salt Lake County or the United States District Court for the Central District of Utah in session in Salt Lake City shall have exclusive and concurrent jurisdiction to entertain any action arising under this Agreement.

8. ASSIGNABILITY. This Agreement and the rights and obligations of Company hereunder may be assigned by Company. No rights or obligations of mine under this Agreement may be assigned or transferred by me.

9. NOTICES TO EMPLOYERS. For five (5) years following the termination of my employment with Company, I will disclose the terms of this Agreement to the persons or entities by which I may become employed, or to which I may render services, for example as a consultant, prior to accepting such employment or performing such services.

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Appendix E – Code of Conduct and Ethical Statement

General Code Of Conduct

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Notice To All Rio Tinto Kennecott Corporation:
All employees of Rio Tinto Kennecott Corporation are expected to use sound and prudent judgment in their approach to all employment–related matters. This approach requires employees to appropriately apply their skills, knowledge, and training with due respect for the rights and property of others to promote a safe, productive, and harmonious work environment. Employees who do not conform to this general code of conduct will be subject to discipline, up to and including termination. When in doubt about what this general code of conduct requires of you in a particular situation, ask your supervisor or Employee Relations Representative.

Violations of the general code of conduct include but are not limited to the following:

1. Failure to comply with established health and safety rules and regulations or operating procedures, or performing acts or engaging in behavior which endangers the safety of any employee or other person doing business with the company or on company property, including:
    a. Working without required personal protective equipment (PPE).
    b. Operating equipment or performing a task without required and documented training.
    c. Working at heights without fall prevention or protection equipment
    d. Entering into a confined space without following entry procedures.
    e. Working on plant or equipment without following lockout/isolation procedures.
    f. Failing to immediately report accidents and incidents which occur to yourself and/or others.
    g. Violating traffic rules while operating or being transported in mobile equipment.
    h. Failing to follow established safe-work procedures.
    i. Tampering with or making safety devices inoperable.
    j. Failing to perform a pre-operation or other required inspection prior to operating the responsibilities of the job.
2. Insubordination; failure or refusal to comply with instructions, perform work assignments, or complete the responsibilities of the job.
3. Bringing onto company property, posting, or distributing literature which is libelous, defamatory, scurrilous, abusive, or insulting; unauthorized distribution of literature during working time or in work areas; or unauthorized solicitations of employees during working time.
4. Leaving the job (work station) during working hours without supervisory permission.
5. Interfering with the work of others.
6. Damaging, destroying, or misusing company property or that of another employee or person doing business with the company.
7. Violation of the Drug and Alcohol Abuse Policy, including failure to submit to testing pursuant to that Policy, bringing onto company property, having possession of, being under the influence of, having or not being free from the presence of, using or consuming, transferring, selling or attempting to sell, any form of intoxicant, narcotic, depressant, stimulant, hallucinogen, or any mind-or perception-altering drug or substance (excepting only the taking, with notification to the supervisor for the purpose of determining any appropriate work restrictions, of a prescribed drug under the direction of a physician) at any time during working hours, or on company property.
8. Unexcused, chronic, or excessive tardiness, absenteeism, or early departure from work.
9. Falsifying company records or making false statements or reports concerning company business, including false wage or benefit claims.
10. Sleeping, loafing, malingering, or unauthorized reading on the job.
11. Theft, concealment, or unauthorized possession of company property or that of another employee or others doing business with the company.
12. Fighting or threatened or actual violence against another employee or other persons doing business with the company, whether on or off the job; gambling, playing cards or other games, horseplay, or other disorderly conduct on the job.
13. Harassment of other employees or other persons doing business with the company, including but not limited to verbal and physical conduct or unwelcome advances with regard to or on the basis of sex, race, color, national origin or ancestry, citizenship, age, religion, marital status, status as a Vietnam era or disabled Veteran or disabled person, or union or non union status.
14. Engaging in non-job-related activities during working time.

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15. Entering company property during off-duty hours without authorization.
16. Engaging in sexual acts or lewd behavior on company property.
17. Carrying or having firearms or other weapons on company property without written management authorization.
18. Unauthorized disclosure of confidential or proprietary information concerning company business, its customers, suppliers, employees or personnel associated with the company.
19. Unsatisfactory safety or work performance.
20. Unauthorized solicitation of vendors or contractors for non-company-sponsored events.

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Quality Assurance Program Plan

Section 2 Quality Assurance Policy

Effective Date: 9/8/2021	Document Number: CLMN4423-0002	Rev.: 13

QUALITY ASSURANCE POLICY

The objective of the Kennecott Environmental and Industrial Hygiene Laboratory (KEIHL) is to provide analytical data that is accurate, reliable, and adequate for the intended purpose. The quality assurance program will be continuously maintained to ensure the production and documentation of quality data that is legally and scientifically defensible. Laboratory management and personnel will perform due diligence and strive to ensure that all tests and calibrations comply with International Standard 17025, NELAP regulatory methods, and client requirements. The data generated by KEIHL will be used to support the Data Quality Objectives (DQOs) and monitoring programs of Rio Tinto Kennecott Corporation (RTKC). Therefore, the primary objective of the QAPP is to ensure that all results generated by the laboratory are valid representations of the environmental material in the samples at the time of sampling. It is the policy of Kennecott Industrial Hygiene and Environmental Laboratory to ensure all personnel familiarize themselves with, and subsequently implement, the policies addressed in this Quality Assurance Program Plan (QAPP) and all associated Standard Operating Procedures (SOPs). To meet the QAPP objective, it is essential that the following secondary goals be met:

- Maintain accreditation and certification from the following organizations:
    1. American Industrial Hygiene Association (AIHA) ISO17025, Laboratory Accreditation program.

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2. State of Utah, Environmental Testing Certification performed under the Safe Drinking Water Act (SDWA), Clean Water Act (CWA), and the Resource Conservation and Recovery Act (RCRA)

- Participate regularly in Inter laboratory Performance Evaluation testing for the Environmental Protection Agency (EPA), and Proficiency Analytical Testing (PAT) performance evaluations.

- Evaluate regularly and continuously the quality of the measurement process performed in the laboratory using Schuart type quality control charts for both accuracy and precision of all analyses performed.

- Review the Quality Assurance Program Plan (QAPP) and Standard Operating Procedures (SOP) at least once per year. It may be necessary to update the QAPP and/or SOPs more often to ensure that KEIHL is current with the most recent methods available for Industrial Hygiene and environmental analyses.

- Maintain the integrity of accepted samples. Perform analysis within the deadlines required by project managers and Sampling Analysis Plans (SAP).

- Adhere to Good Laboratory Practice (GLP) recommendations found in the Code of Federal Regulation 40 (CFR) Part 160, Revision July 1, 1997.

- Determine the accuracy and precision of all methods by analyzing duplicates, blanks, matrix spikes and matrix spike duplicates.

- Provide and document training of personnel for laboratory operations.

- Analyze samples using accepted laboratory methods and protocols published by EPA, NIOSH, ASTM, Standard Methods, and Agronomy Society.

- Report KEIHL performance measures including QA objectives and performance samples to Kennecott management.

- Remain committed to implementing effective processes which promote continuous improvement to remain a sustainable service.

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- Maintain all data records for Environmental work for five years.
- Maintain all data records for Industrial Hygiene work for ten years.

MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/2004
TS00046	2005 Review and improvement for ISO17025	Janna Hardman	03/30/2005
TS00085	Review for 2006	Melissa Olsen	08/04/2006
	Review for 2008.	Melissa Olsen	10/10/2008
	Review for 2009. No changes.	Melissa Olsen	01/27/2009
11532	Added statement regarding continuous improvement and the familiarization of all policies and procedures in the QAPP by laboratory personnel. Removed ELPAT. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	06/15/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/19/2013
26233	Review for 2014. Changed KEIHL to KEIHL. Removed KUC logo and replaced with Rio Tinto. Updated branding.	Melissa Olsen	04/21/2014
	Review for 2015. No changes.	Melissa Olsen	04/17/2015
31572	Review for 2016. Removed all references to clinical laboratory certification.	Melissa Olsen	03/08/2016
43586	Review for 2017. Removed participation in USGS proficiency testing studies.	Melissa Olsen	03/23/2017
53081	Review for 2018. No changes made.	Melissa Olsen	05/15/2018
58723	Review for 2019. Removed DMRQA proficiency testing.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes made.	Melissa Olsen	09/15/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/02/2021
94373	Review for 2022. No changes made.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes made.	Melissa Olsen	09/06/2023

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Quality Assurance Program Plan

Section 3 Organization and Responsibility

Effective Date: 12/06/2022	Document Number: CLMN4423-0003	Rev.: 27

ORGANIZATION AND RESPONSIBILITY

Kennecott Environmental and Industrial Hygiene Laboratory (KEIHL) continuously strives to implement an effective QA program in a laboratory that performs a broad scope of analytical services. This requires the commitment and attention of both management and staff. The organization chart for KEIHL is found in *Section 3 Appendix A, B, C, and D*. The QA/QC Officer coordinates the QA program. The Laboratory Director is responsible for the quality of data produced by the laboratory. The laboratory analysts assist both the QA/QC Officer and the Laboratory Director in daily operation of the QA program. Specific QA requirements and responsibilities of laboratory personnel are described in this section.

Certified Laboratory

A certified laboratory must meet the criteria listed below with regards to the Laboratory Personnel.

- A certified laboratory must have a laboratory director who meets the qualification requirements. The laboratory director may also serve as the laboratory supervisor or the laboratory quality assurance officer.
- A certified laboratory must have a laboratory supervisor who meets the qualification requirements. The laboratory supervisor may also serve as the laboratory director.
- A certified laboratory must have a laboratory quality assurance officer who meets the qualification requirements. The laboratory quality assurance officer may also serve as the Laboratory Director.

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- A certified laboratory must specify and document the responsibility, authority, and interrelation of all personnel who manage, perform, or verify work affecting the quality of testing.
- A certified laboratory must supervise its technical employees to assure quality test results.
- A certified laboratory must have job descriptions and describe the lines of responsibility for all key personnel and technical employees.
- A certified laboratory must maintain documentation of the qualifications of all key personnel.
- A certified laboratory must maintain a record of training for all key personnel and technical employees.

Laboratory Director/ Laboratory Supervisor/Superintendent/Technical Manager

The Laboratory Director is ultimately responsible for the quality of data produced by the laboratory. Accordingly, only the Laboratory Director has the authority to approve the release of analytical results and give final approval of analytical methods and SOPs. The Laboratory Director must meet one of the following qualification requirements.

- The Laboratory Director must have an earned doctoral degree in the medical, biological, chemical, or physical sciences from an institution of higher education, plus three years experience in a certified laboratory.
- The Laboratory Director must have a master's degree in biological, chemical, or physical sciences from an institution of higher education plus four years experience in a certified laboratory.
- The Laboratory Director must have a bachelor's degree in the biological, chemical, or physical sciences from an institution of higher education, plus six years work experience in a certified laboratory.

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- The Laboratory Director at KEIHL has the credentials found in NELAC Chapter 5.6.2.

The Laboratory Director at KEIHL is responsible to perform the following activities.

- The Laboratory Director at KEIHL defines the minimum qualifications, experience, and skill necessary for all technical employees.
- The Laboratory Director at KEIHL supervises the quality assurance officer and ensures the production and quality of all results reported by the laboratory.
- The Laboratory Director at KEIHL administers the use of accurate and current analytical methods and SOPs in the laboratory.
- The Laboratory Director is responsible for ensuring the effectiveness and integrity of the ISO17025 compliant quality management system.
- Ensures that all technical staff have documented capability in the activities for which they are responsible.
- The Laboratory Director at KEIHL maintains a work environment that emphasizes the importance of data quality.
- The Laboratory Director at KEIHL maintains a safe working environment for all personnel.
- The Laboratory Director at KEIHL provides management support to the QA Officer.
- The Laboratory Director at KEIHL ensures all analysts are trained to perform analytical methods with proper QA procedures.
- The Laboratory Director at KEIHL pursues and maintains external accreditation, licensing, and certification programs.
- The Laboratory Director at KEIHL participates in internal and external system audits.

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- The Laboratory Director at KEIHL participates in performance evaluation audits.

- The Laboratory Director at KEIHL reviews and approves data reports before release.

- The Laboratory Director at KEIHL assumes the responsibility if QA/QC Officer in the absence of the QA/QC Officer.

QA/QC Officer

The QA/QC Officer is directly responsible for the ongoing implementation of the QA program. The QA/QC Officer must meet the requirements found in NELAC Chapter 5.4.2.

- The QA Officer at KEIHL must serve as the focal point for quality assurance and oversee and review quality control data.

- The QA Officer at KEIHL must have documented training or experience in quality assurance procedures and be knowledgeable in the quality assurance requirements.

- The QA Officer at KEIHL must have knowledge of the NELAC and AIHA requirements and approved methods the laboratory uses and verify the laboratory is following them.

- The QA Officer at KEIHL is responsible for maintaining and improving the ISO17025 compliant Quality Management System.

- The QA Officer at KEIHL cannot analyze samples as part of the *regular* certified analyses performed by the laboratory.

- The QA Officer at KEIHL must have access to the highest level of management at which decisions are taken on laboratory policy and resources.

- The QA Officer at KEIHL must objectively evaluate data and objectively perform assessments, independent of outside influence.

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- The QA Officer at KEIHL must oversee all aspects of sample handling, testing, and reporting.
- The QA Officer at KEIHL must be responsible for an annual review of the entire technical operation of the laboratory.
- The QA Officer must notify laboratory management of deficiencies in the quality system and monitor corrective action.

The QA/QC Officer has the authority to discontinue the use of analytical methods and SOPs and can delay the release of sample data until QA requirements are achieved and corrective action has taken place, if required. Additionally, the QA/QC Officer is responsible for performing the following activities.

- The QA/QC Officer ensures laboratory participation in external system audits.
- The QA/QC Officer ensures that internal performance and system audits are conducted and documented.
- The QA/QC Officer provides QA reports and internal and external systems audit reports to the Laboratory Director.
- The QA/QC Officer oversees all aspects of sample handling, testing, report collation and distribution to produce high quality results.
- The QA/QC Officer identifies corrective action procedures and monitors their implementation.
- The QA/QC Officer ensures that all analysts are trained to perform their QA procedures at the bench level.
- The QA/QC Officer ensures laboratory participation in accreditation, licensing, and certification programs.
- The QA/QC Officer maintains an archive of all QC data, analytical methods, QA reports, and SOPs.

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- The QA/QC Officer maintains stocks of certified reference materials for use as check standards.
- The QA/QC Officer reviews all data produced for adherence to QA program requirements.
- The QA/QC Officer maintains the QC databases.
- The QA/QC Officer reports results of statistical analyses of QC data to the Laboratory Director and laboratory staff.
- The QA/QC Officer conducts and documents internal performance audits and system audits.

The QA/QC Officer is responsible for reviewing the Certificates provided for the Groundwater Characterization Monitoring Program (GCMP). The GCMP is a specific program within Kennecott Utah Copper. The QA/QC Officer is responsible to perform the following activities:

- The QA/QC Officer monitors status of the samples in the GCMP program.
- The QA/QC Officer reviews the certificates of analysis to ensure the samples meet the DQO's established for the GCMP program.
- The QA/QC Officer produces a rerun sheet for those samples that do not meet DQO's for GCMP.
- The QA/QC Officer prints final Certificates for the GCMP samples and gives the final certificates to the Laboratory Director for review and approval.

Laboratory Section Supervisors and Analysts

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Each laboratory section Supervisor or analyst is responsible for ensuring that QC criteria are met for the type of analysis they perform. The laboratory Supervisors must meet one the following educational requirements:

- The laboratory Supervisors must have an earned doctoral degree in the medical, biological, chemical, or physical sciences from an institution of higher education, plus two years experience in a certified laboratory.
- The laboratory Supervisors must have a master's degree in biological, chemical, or physical sciences from an institution of higher education plus four years experience in a certified laboratory.
- The laboratory Supervisors must have a bachelor's degree in the biological, chemical, or physical sciences from an institution of higher education, plus six years work experience in a certified laboratory.
- The laboratory Supervisors must ensure competency annually for each technical employee. KEIHL requires analysts to analyze a blank sample and laboratory fortified blank with every analytical batch. In addition, analysts must participate in and pass one proficiency test annually. Proficiency testing documentation will be kept with the QA/QC Officer.

The analyst is responsible for following the QA program while achieving a productive, compliant, and cohesive work environment. Accordingly, the laboratory analysts are required to perform the following activities.

- The analyst follows approved analytical methods and SOPs.
- The analyst must demonstrate the ability to produce reliable results through accurate analysis of Certified Reference Materials, proficiency testing samples or in-house control samples. This demonstration must be done every 6 months for AIHA and annually for NELAC certification.
- The analyst maintains the integrity of the analysis by charting the accuracy and precision of the system controls on control charts to ensure the quality of the data.

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- The analyst reviews all QC and sample data to ensure that QC criteria are achieved.
- The analyst evaluates and documents performed corrective actions as needed.
- The analyst maintains logbooks for instrument maintenance, standards, run logs, and instrument specific electronic data.
- The analyst performs and participates in peer review and data entry.
- The analyst reports and documents corrective action via the QA/QC manager.
- The analyst prepares and documents traceable standards and certificates of analysis.

Laboratory Technician

Laboratory Technicians work under the direction of the Laboratory Analysts, QA/QC Manager, and Laboratory Director. Laboratory technicians perform the following activities.

- The technician must demonstrate ability to produce reliable results through accurate analysis of Certified Reference Materials, proficiency testing samples or in-house control samples. This competency must be demonstrated every 6 months for AIHA and annually for NELAC certification.
- A Laboratory Technician follows approved analytical methods and SOPs.
- A Laboratory Technician prepares samples for analysis.
- A Laboratory Technician performs analysis under the direction of the Laboratory Analyst.
- A Laboratory Technician participates in peer review.

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- A Laboratory Technician performs data entry.
- To ensure compliance with the annual competence for each technical employee, KEIHL requires the analyst to analyze a blank sample and laboratory fortified blank with every analytical batch. In addition, the analyst must participate in and pass one proficiency test annually. The proficiency documentation will be kept with the QA/QC Officer.

Laboratory Training

Rio Tinto Kennecott Corporation (RTKC) encourages individual training for all employees. The trainers and contract personnel teach formalized training courses in computer skills, management, supervisory skills, emergency response, and MSHA/OSHA required instruction. In addition, the company mandates online training courses which are required annually for all employees. Also, the employee or the Laboratory Director may wish to attend additional training courses such as the following: instrument manufacturers training seminars, professional development courses, university courses, in-house courses and reviews, and courses taught by the State or Regulatory Agencies. Certificates of completion are kept in the individuals training file. The training file includes the training courses, method training records, instrument training records and performance evaluation records for each employee. Training records are updated as often as needed. (See Section 7 for training details.)

The Laboratory Director will complete an annual performance review with each employee. The review includes a personal interview and verbal or written comments

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on performance, goals and objectives. Performance reviews are part of the confidential Human Resource records and are not available for review by outside auditors.

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Quality Assurance Program Plan

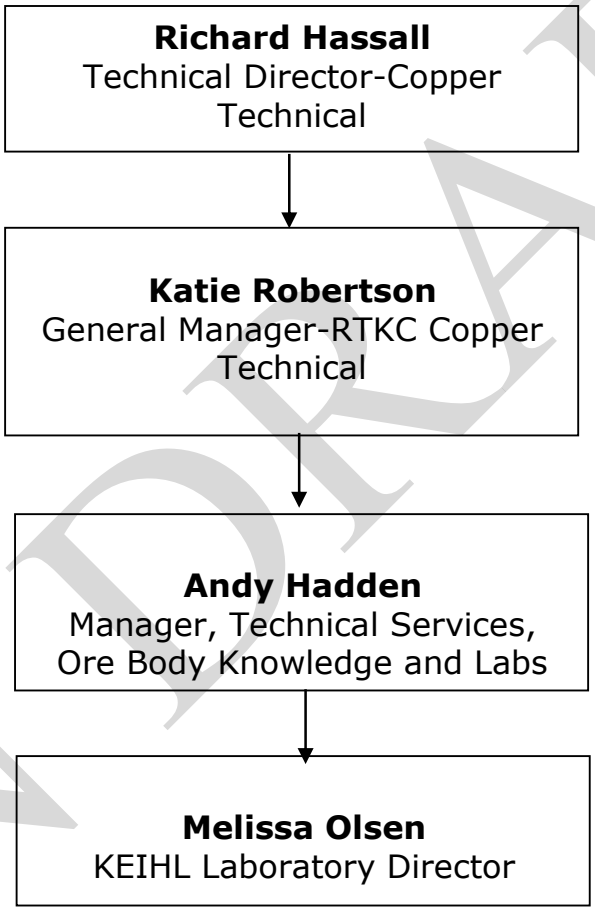
Section 3 Organization and Responsibility

Effective Date: 12/06/2022	Document Number: CLMN4423-0003	Rev.: 27

MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Revision and Review for 2006	Melissa Olsen	08/02/06
TS00113	Updates to organizational charts.	Melissa Olsen	04/13/07
9006	Updates to organizational charts.	Melissa Olsen	09/15/08
	Updated laboratory training to include the mandatory online training courses. Updated organization charts.	Melissa Olsen	01/21/09
11532	Review for 2010. Updated organization charts.	Melissa Olsen	02/22/2010
17479	Review for 2011. Updated organization charts.	Melissa Olsen	02/28/2011
	Inserted statements regarding the commitment of Lab Director and QA officer to comply with the ISO17025 standard.	Melissa Olsen	01/12/2011
23199	Review for 2013. Updated organization charts.	Melissa Olsen	04/23/2013
23227	Updated organization charts. Removed Donna Smith .	Melissa Olsen	07/15/2013
25673	Updated org. charts. Designated a deputy for the Technical Manager in case of absence in Appendix D. Removed Hyun Ah Choi from Environmental Org. Chart.	Melissa Olsen	12/07/2013 03/10/2014
26233	Updated Appendix A (removed Mick Routledge)and Appendix D (changed from manager to superintendent, process laboratory). Updated branding.	Melissa Olsen	04/22/2014
30091	Updated Appendix A: removed Stephan Leblanc and replaced with Nigel Steward. Updated Appendix B: Removed JaDee Bodell and added Tamara May. Appendix C: Removed JaDee Bodell, added Adam Sharp as analyst.	Melissa Olsen	04//17/2015
	Updated Org. Charts: Removed Josh Mackay and replaced with Tiffany Robinson;removed JD Bodell and Xiaoli Wang; replaced Scott Bruce with Ian Billinglsey to reflect new reporting relationship	Melissa Olsen	03/08/2016
43586	Removed Nigel Steward and replaced with Marc Cameron, Removed Ian Billingsley and replaced with Andrew Miller	Melissa Olsen	04/08/2017
53081	Updated Org. Charts. Removed Andrew Miller and replaced with Bill Forsyth and Saskia Duyvesteyn. Added contractors: Dane Schofield and Keyana Watson.	Melissa Olsen	05/15/2018
58723	Updated org. charts. Added Andy Hadden, Malcolm Reeves, and Jack Swanson. Rev. 22 to 23	Melissa Olsen	08/15/2019
N/A	No changes made.	Melissa Olsen	01/03/2020
67192	Updated Org. Charts. Removed Marc Cameron, Bill Forsyth and added Stephen Jones, Geraldine Lyons, Nadjla Borges.	Melissa Olsen	09/15/2020
79250	Updated Org. Charts. Removed Stephen Jones, replaced with Bhuvanesh Malhotra. Removed Jack Swanson as project contractor and added Chemist I, Arunjit Shergill. Updated Tiffany Robinson to Chemist II. Rev. 24 to 25.	Melissa Olsen	07/13/2021
94373	Updated Org. Charts. Removed Malcolm Reeves and added vacant Chemist II position. Rev. 25 to 26	Melissa Olsen	12/02/2022
102982	Updated Org. Charts. Replaced Bhuvanesh Malhotra with Richard Hassall. Replaced Geraldine Lyons with Katie Robertson. Added Jake Fisher in vacant Chemist II position. Removed Cation/Anion sections from Lab org. chart.Rev. 26 to 27	Melissa Olsen	09/07/2023

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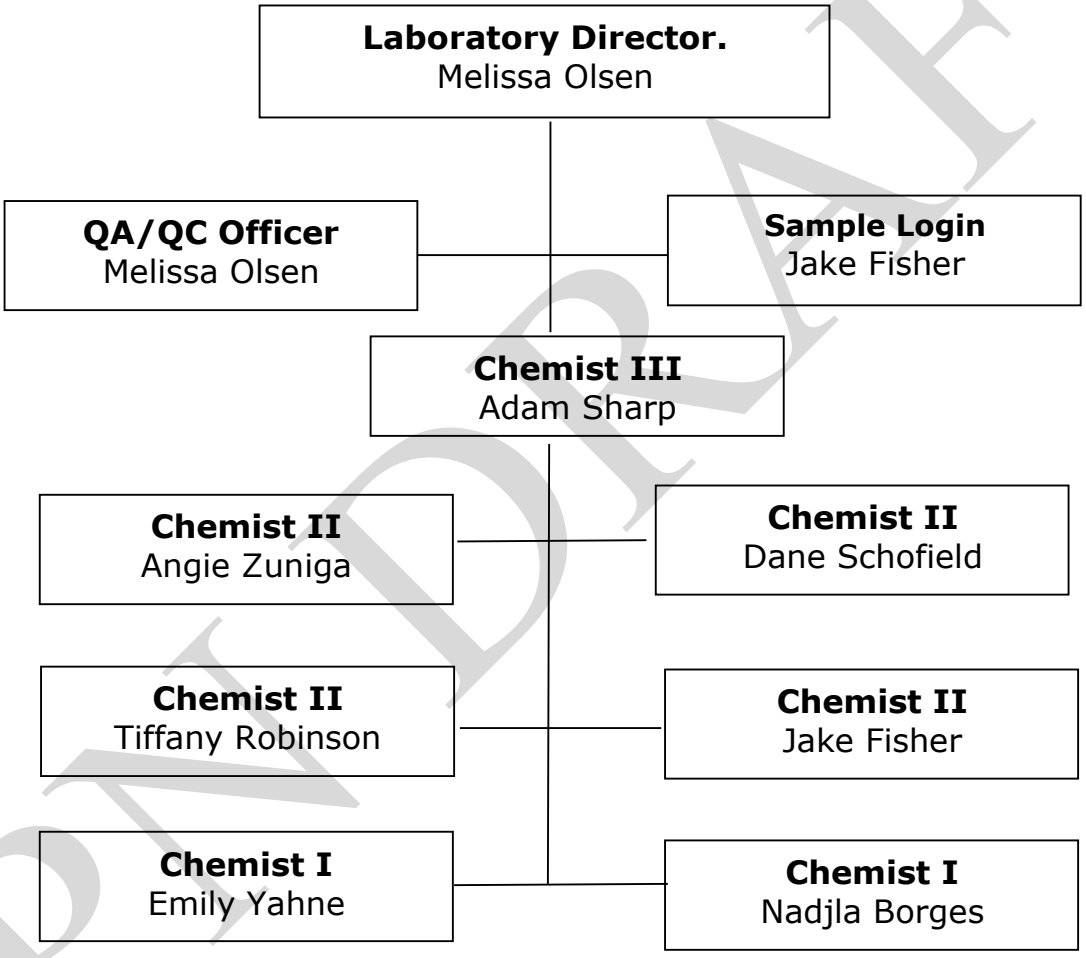
Rio Tinto Copper Operations Organization Chart



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Appendix A – Organizational Chart

Kennecott Environmental Laboratory Organization Chart



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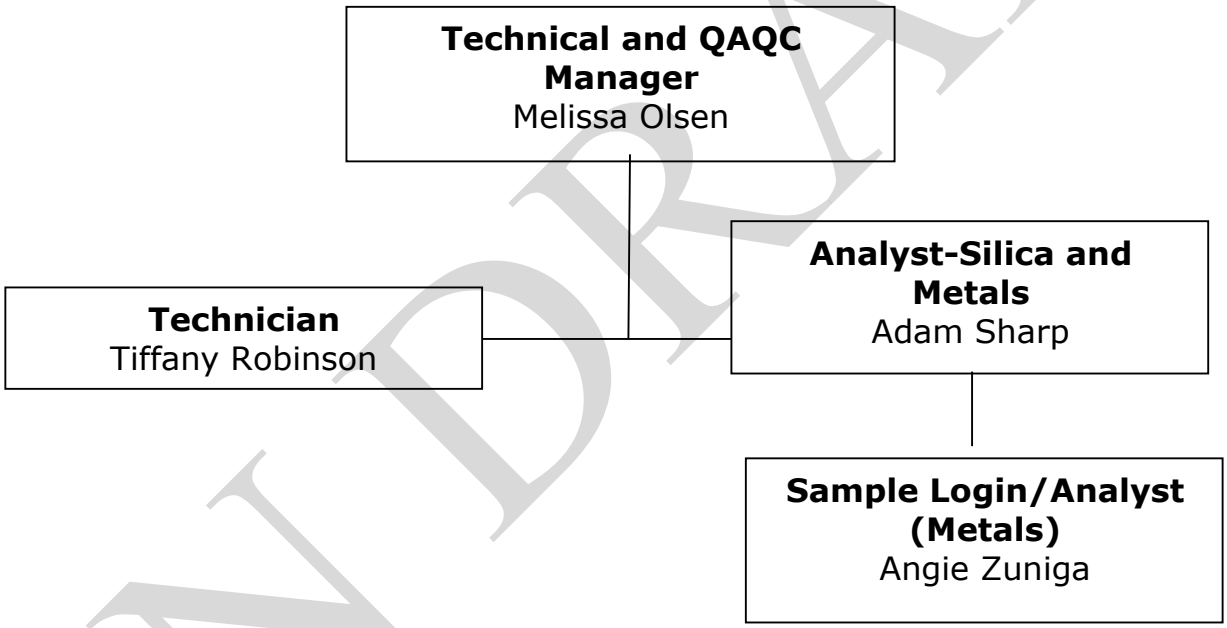
Appendix B – KEIHL Environmental Organizational Chart

Quality Assurance Program Plan

Section 3 Organization and Responsibility

Effective Date: 12/06/2022	Document Number: CLMN4423-0003	Rev.: 27

Kennecott Industrial Hygiene Laboratory Organization Chart

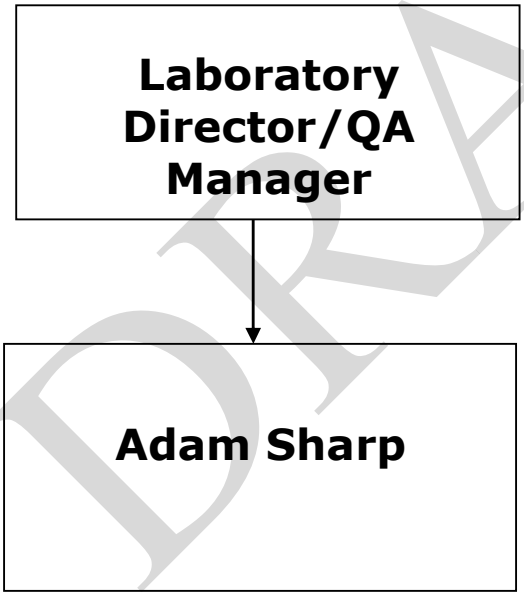


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Appendix C - KEIHL Industrial Hygiene Organizational Chart

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KEIHL - Organizational Chart for Nominated Deputies in case of absence



Appendix D – KEIHL in case of Absence

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Quality Assurance Program Plan

Section 4 Laboratory Services

Effective Date: 9/8/2021	Document Number: CLMN4423-0004	Rev.: 13

Laboratory Services

KEIHL'S activities encompass all processes from the review of vendors for external products and services to sample, equipment, supply, and data handling and reporting within the laboratory. The laboratory is ***not*** responsible for any sampling activities.

Environmental Analytical Services

KEIHL's analytical services include the routine analysis of samples of groundwater, drinking water, surface water, soil, sludge, waste, and air (particulate). A complete list of methods used by KEIHL is found in Section 6 - Analytical Methods of this manual. KEIHL's standard operating procedures (SOPs) are dynamic and follow approved EPA methodology for analysis of the following:

- Metals by inductively coupled plasma/atomic emission spectroscopy (ICP/AES), ICP/mass spectrometry (ICP/MS) methods, and classical wet chemistry procedures.
- Anions by Ion Chromatography as well as continuous flow analysis methodology.
- Cyanide by colorimetric methods.
- Physical parameters by conventional techniques.
- Volumetric, Gravimetric, Titrimetric, Colorimetric, and X-ray Techniques.

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Quality Assurance Program Plan

Section 4 Laboratory Services

Effective Date: 9/8/2021	Document Number: CLMN4423-0004	Rev.: 13

Industrial Hygiene Analytical Services

KEIHL's analytical services for Industrial Hygiene samples include analysis for metals, silica, and gravimetric dust. KEIHL maintains Industrial Hygiene Standard Operating Procedures (SOPs) for all Industrial Hygiene methods, which include the following:

- Crystalline silica analysis performed according to the NIOSH Method 7500 by XRD (SOP number CLSOP4423-7009).
- Metals analysis performed according to the NIOSH Method 7300 by ICP-MS (SOP number CLSOP4423-7021.).
- Gravimetric analysis performed according to the NIOSH Method 0500 and NIOSH 0600 (SOP number CLSOP4423-7020)

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Quality Assurance Program Plan

Section 4 Laboratory Services

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MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/2004
TS00085	Review for 2006.	Melissa Olsen	08/02/06
	Review for 2008. No changes.	Melissa Olsen	10/07/2008
	Review for 2009. Updated Environmental Analytical Services section to reflect current methodologies.	Melissa Olsen	01/21/09
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011.	Melissa Olsen	06/28/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/23/2013
25673	Updated IH methods and SOP references	Melissa Olsen	12/17/2013
26233	Removed ion chromatography (IC) from under Environmental Analytical Services. Updated branding.	Melissa Olsen	04/22/2014
	Review for 2015. No changes.	Melissa Olsen	04/17/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes.	Melissa Olsen	02/07/2017
53081	Review for 2018. No changes.	Melissa Olsen	05/16/2018
58723	Review for 2019. Removed NIOSH 0500 and 0600 from IH methods. Rev. 10 to 11.	Melissa Olsen	08/16/2019
60468	Added Laboratory Services section to describe the range of laboratory activities. Changed title from Analytical Services to Laboratory Services. Rev. 11 to 12.	Melissa Olsen	12/13/2019
67192	Added ion chromatography to analytical services	Melissa Olsen	09/15/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/02/2021
94373	Review for 2022. No changes made.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes made.	Melissa Olsen	09/07/2023

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Quality Assurance Program Plan

Section 5 Sample Custody

Effective Date: 12/06/2022	Document Number: CLMN4423-0005	Rev.: 19

SAMPLE CUSTODY

Every sample or group of samples submitted to KEIHL must have a completed Analytical Request Sheet *(Section 5 Appendix A).* The Analytical Request Sheet is a standard form used to record sample description, collection date and time, number of bottles, analytical field data, and the requested analyses. The Analytical Request Sheet serves as the sample Chain of Custody (COC).

Sampling Materials

KEIHL does not provide any sampling materials. Rio Tinto Kennecott Corporation (RTKC) has specific departments for Environmental Sampling and Industrial Hygiene sampling.

Sample Clerk

The Sample Clerk reviews the Analytical Request Sheets and sample containers are inspected for the criteria listed below prior to samples being accepted by KEIHL.

- Proper chain-of-custody documentation.
  Sample identification
  Number of Bottles
  Collection Date and time

- The sample bottles must include the following information:
  Sample identification
  Sample location, date, and time of collection
  Collectors name
  Preservative added

- Matrix

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- Adequate volume for the requested testing.
- Any special remarks concerning the samples.
- Condition and temperature of the samples and sample containers.
- Proper sample preservation is verified and documented in LIMS.
- Agreement between the Analytical Request Sheet and sample labels.
- A list of analyses ordered.
- Special instructions or precautions for handling.

Sample Acceptance/Client Communication

If the criteria listed above are not met, the samples are unacceptable, and the sample-receiving clerk is responsible for initiating action. The sample receiving clerk contacts the individual who submitted the samples to complete the COC properly. The Laboratory Director can accept samples at their discretion, even though some information is still incomplete if it is noted on the COC, and the final report.

Once the Analysis Request Sheet has been completed appropriately, the sample receiving clerk is then responsible for performing the activities listed below.

- Sign and accept the sample.
- Each Chain of Custody Sheet is considered a Login Group. Each Login Group is assigned a unique number.
- The Sample Clerk assigns each sample, including duplicates, matrix spikes and laboratory control samples a unique laboratory number by logging the samples into the LIMS system.

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- The LIMS program prints barcode labels. The labels are attached to the appropriate corresponding sample containers. The barcode label number is explained below:

Example: GA00001 (+Subcategory ID)

The first two letters in the number indicates the year,
i.e. FA= 2023 back to GA = 2022

The following five numeric characters are the numbers of samples received for the year. In the above example the sample would be the first sample of the year.

1. Each individual sample container received at the laboratory is given a unique laboratory number. The unique laboratory identification number is documented on the chain of custody. The sample container subcategories are listed below.

NUT1 = Nutrients non-preserved #1
NUT2 = Nutrients non-preserved #2 (SO4)
T1 = Total Metal preserved with HNO3 #1
T2 = Total Metal preserved with HNO3 #2
D = Dissolved Metal preserved with HNO3
HG= Mercury preserved with HNO3
NO3 = Nitrate preserved with H2SO4
SO4 = Sulfate preserved with HCl
CN = Cyanide preserved with NaOH
COLI1 = Fecal Coliform
COLI2 = Total Coliform
TML = Total Metals Soil
TCLP = TCLP Soil
SPLP = SPLP Soil
MISC1 = Misc #1
MISC2 = Misc #2
SPLIT = Split #1
SPLIT = Split #2

- The laboratory numbers are generated by the LIMS system to ensure that no number can be repeated.

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- The laboratory identification number is recorded on the original Analytical Request Sheet.

- All samples which require thermal preservation are placed in a refrigerator that can maintain temperatures ± 4°C. Samples that are hand delivered to the laboratory immediately after collection may not meet these criteria. In these cases, the samples are considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice.

- Samples are stored away from all standards, reagents, food and other potentially contaminating sources. Samples are stored in a manner to prevent cross contamination.

- All documentation, such as memos or transmittal forms, that may be brought to the laboratory by the sample transmitter are retained with the COC file.

Subcontracting Samples

Kennecott Environmental and Industrial Hygiene Laboratory (KEIHL) does not subcontract industrial hygiene samples. If RTKC Industrial Hygiene Group requires testing that KEIHL does not provide, the Industrial Hygiene Group must submit their samples to another laboratory. This is handled independent of KEIHL.

Sample Tracking

Samples are tracked through the laboratory by using the computerized Laboratory Information Management System or LIMS Progress Report. The progress report may contain the following information:

- Date samples are received.
- Date samples are logged into the LIMS system.
- Sample due date.
- Collection Date.
- The person to whom the results are reported.
- The laboratory sample numbers.

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- The sample matrix.
- The analytes requested.

The LIMS System is "**LABWORKS Desktop** for Windows", version 7.2.0.0, Build 7.2.0.135, serial number 91410206. The LIMS software operates on a P.C. based NT/SQL network, which includes an interface for analytical instrumentation. The LIMS program provides the means for assigning a unique sample identification number for samples. The unique sample identification number is then used for real-time scheduling, backlog management, accounting, sample tracking, quality assurance, audit trailing, reporting, archival data storage, data search, and data retrieval. Following analyst review, peer review, and the bench level quality control review, the analytical data is entered into LIMS either manually or imported directly from instrumentation data files. There are additional reviews including site history checks, ion balance checks, and total dissolved solids balance. The reporting of GCMP (Groundwater Characterization Monitoring Plan) samples typically involve comparability checks against historical data to identify trends and outlying data points. Once data is found compliant with agreed data quality objectives, analytical certificates are issued. Validation by the QA Manager and Laboratory Director is required prior to final reporting. Laboratory personnel can generate control charts. The QA/QC Officer can monitor data quality using LIMS and the SQL interface. LIMS database and the SQL interface are maintained by a designated in-house specialist or by contract help.

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Quality Assurance Program Plan

Section 5 Sample Custody

Effective Date: 12/06/2022	Document Number: CLMN4423-0005	Rev.: 19

Upon completion of analysis, the samples are returned to the designated storage place and archived for up to six months after the analytical results are released. After the archive time elapses, the QA/QC Officer arranges for proper disposal of the samples (refer to CLMAN4400-0006 Central Laboratory Waste Identification and Management).

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Quality Assurance Program Plan

Section 5 Sample Custody

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MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Review for 2006	Melissa Olsen	08/03/06
	Review for 2008. Updated Labworks information (version, build number and update).	Melissa Olsen	10/07/08
	Review for 2009. No changes.	Melissa Olsen	01/21/09
11532	Revision and review for 2010. Added Appendix B-Chain of Custody for Industrial Hygiene samples. Updated laboratory address in header.	Melissa Olsen	02/22/10
17479	Modified section on subcontracting samples.	Melissa Olsen	08/29/11
23199	Updated version of Labworks.	Melissa Olsen	05/20/13
26233	Review for 2014. Changed KEL to KEIHL. Updated branding. Added reference to CLMAN4400-0006 CL Waste Identification and Management.	Melissa Olsen	04/23/14
	Review for 2015. No changes.	Melissa Olsen	04/17/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Updated current Labworks version	Melissa Olsen	02/07/2017
53081	Review for 2018. No changes.	Melissa Olsen	05/17/2018
58723	Review for 2019. Updated Labworks version. Revision 16 to 17.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes.	Melissa Olsen	12/13/2019
67192	Review for 2020. No changes.	Melissa Olsen	09/15/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/03/2021
94373	Updated Labworks version, build and serial number. Rev. 17 to 18	Melissa Olsen	12/02/2022
102982	Updated Labworks version and build. Removed Perkin Elmer as the distributor of Labworks. Updated description for barcode label identification. Rev. 18 to 19	Melissa Olsen	09/08/2023

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Section 5 Sample Custody

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Appendix A - Chain of Custody/Analytical Request Sheet.

Log-in Group No._____

KENNECOTT
ENVIRONMENTAL LABORATORY
9600 West 2100 South Magna, Utah 84044

ANALYTICAL REQUEST SHEET
Sample Chain of Custody

_____ - _____ - _____
Sheet Request No.
Lab Use Only

#	Lab I.D. # (Lab Use Only)	Sample Description	Date Collected	Time Collected	Total # of Containers	Field Data						Analyses Requested
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												

Sample Submitted by: _____ **Telephone #** _____ **Fax #** _____
Report Results to : _____ **Telephone #** _____ **Fax #** _____

Sampler: _____ **Sampling Site:** _____ **Sampling Date:** _____ **Time:** _____

Surrendered By: _____ Received By: _____ Date/Time: _____
Surrendered By: _____ Received By: _____ Date/Time: _____
Surrendered By: _____ Received By: _____ Date/Time: _____

Comments / Special Instructions: _____

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Section 5 Sample Custody

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Appendix B - Chain of Custody/Analytical Request Sheet for Industrial Hygiene Samples

Kennecott Utah Copper
A member of the RIO TINTO Group
ENVIRONMENTAL LABORATORY
3325 So. 9200 W. Magna, Utah 84044

ANALYTICAL REQUEST SHEET
Sample Chain of Custody
For Industrial Hygiene

Log-in Group No._____

_____ - _____ - _____
Sheet Request No.
Lab Use Only

#	Lab I.D. # (Lab Use Only)	Sample Description	Date Collected	Time Collected	Field Data			Analyses Requested
						Flow Rate	Time	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								

Sample Submitted by: _____ **Telephone #** _____ **Fax #** _____
Report Results to : _____ **Telephone #** _____ **Fax #** _____

Sampler: _____ **Sampling Site:** _____ **Sampling Date:** _____ **Time:** _____
Surrendered By: _____ Received By: _____ Date/Time: _____
Surrendered By: _____ Received By: _____ Date/Time: _____
Surrendered By: _____ Received By: _____ Date/Time: _____
Comments / Special Instructions: _____

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Section 6 Analytical Methods

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ANALYTICAL METHODS

Analyses performed by KEIHL are designed to comply with regulatory guidelines and standards. Therefore, the laboratory analytical methods are predominantly based on those published by regulatory agencies. The methods used are those specified by federal agencies, state agencies, and professional organizations, as provided in the references listed below.

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act.", 40 CFR Part 136
- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020 (revised March 1994).
- Methods for the Determination of Metals in Environmental Samples, EPA-600/4-91/010 (June) EPA 1989
- Test Methods for Evaluating Solid Waste (SW-846). Office of Solid Waste and Emergency Response. Office of Solid Waste and Emergency Response, EPA
- Standard Methods for the Examination of Water and Wastewater, 20th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation Washington, D.C. (1998)
- Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association, American Water Works Association, Water Environment Federation (2012)
- Official Methods of Analysis, 16th Edition, Association of Official Analytical Chemists Arlington, Virginia (1996)
- Annual Book of ASTM Standards, Volumes 11.01 and 11.02, 11.03 American Society for Testing and Materials (ASTM), Philadelphia Pennsylvania (1996)

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- Techniques of Water Resources Investigations of the USGS, Book 5, Laboratory Analysis, United States Geological Survey (USGS), Washington D.C. (1979)
- NIOSH Manual of Analytical Methods, NMAM Fourth Edition. National Institute for Occupational Safety and Health Division of Physical Sciences and Engineering, Cincinnati, Ohio (1994)
- OSHA Analytical Methods Manual, Second Edition August 1991, Occupational Safety and Health Administration (1991)
- Methods of Soil Analysis, Parts I and II. American Society of Agronomy, No. 9.
- Modified Sobek Method for Acid Base Accounting.

KEL analytical methods and analytical methodologies are listed in Section 6 Figure *1*.

1. Methods for the Chemical Analysis of Water and Wastewater U.S. Environmental Protection Agency (EPA), EPA-600/4-79-020, March.
2. Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998 and 22nd Edition, 2012
3. Test Methods for Evaluating Solid Waste U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. SW-846 November 1986 Third Edition.

Standard Operating Procedures

Kennecott Environmental and Industrial Hygiene Laboratory have Standard Operating Procedures (SOP) for each analytical method. All SOPs for the laboratory are located in Bentley, a commercial online document control system. All SOPs are accessible for all personnel. The SOPs contains the following items:

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1. Identification of the test method.
2. Applicable matrix.
3. Detection limit.
4. Scope and application.
5. Summary of the test method.
6. Definitions
7. Interferences.
8. Safety.
9. Equipment and Supplies.
10. Reagents and Standards.
11. Sample Collection, preservation, and storage.
12. Quality Control
13. Calibration and Standardization.
14. Procedure.
15. Calculations
16. Method Performance
17. Pollution Prevention.
18. Data Assessment and sample acceptance.
19. Corrective Action
20. Contingencies for handling out-of-control data.
21. Waste Management
22. Reference.

On the title page or in the header section of every SOP, the following items are found effective date, revision number, signatures of approval and page numbers. Prior to the implementation of a new method or SOP, or any other significant change in instrument type or personnel, a new demonstration of capability is completed. The demonstration of capability record is filed in the personnel training records.

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Section 6 Analytical Methods

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Mei	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/2004
TS00045	Updated the Method List	Janna Hardman	03/21/2004
TS00085	Review for 2006	Melissa Olsen	08/04/2006
9006	Revisions to analytical methods list to comply with 40 CFR 136 method updates.	Melissa Olsen	09/16/2008
	Review for 2009. No changes.	Melissa Olsen	01/27/2009
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	10/11/2011
	Review for 2012. No changes.	Melissa Olsen	10/01/2012
23199	Review for 2013. No changes.	Melissa Olsen	04/19/2013
26233	Removed kinetic testing using humidity cells and selenium hydride generation. Updated branding.	Melissa Olsen	04/24/2014
30091	Added reference: Standard Methods 22nd Edition (2012)	Melissa Olsen	04/20/2015
31572	Reviewed for 2016. Added NIOSH 7300 and 7500 to analytical methods listed in Figure 1	Melissa Olsen	03/08/2016
43586	Review for 2017. Removed Documentum and replaced with Bentley.	Melissa Olsen	02/07/2017
53081	Review for 2018. No changes made.	Melissa Olsen	05/17/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes made.	Melissa Olsen	1/3/2020
67192	Review for 2020. Added method 300.1 to list. 14.2 to 15	Melissa Olsen	09/15/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/03/2021
94373	Review for 2022. Fixed minor grammatical errors. Rev. 14 to 15	Melissa Olsen	12/02/2022
102982	Removed RFA anion methods in list of methods. Rev. 15 to 16.	Melissa Olsen	11/03/2023

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Section 6 Analytical Methods

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Section 6 Figure1 – KEIHL Analytical Methods

Method #	Method Description
120.1	EPA - Conductivity
200.2	EPA - Water Preparation
200.7	EPA - Metal by Inductively Coupled Plasma (ICP)
200.8	EPA - Metals by Inductively Coupled Plasma Mass Spectroscopy (ICPMS)
245.2 (1974)	EPA - Mercury by Cold Vapor
300.1	EPA-Analysis of Ions by Chromatography
310.1	EPA - Alkalinity
335.4 (1993)	EPA – Cyanide, Total
350.1 (1993)	EPA – Ammonia
1311	SW-846 – TCLP
1312	SW-846 - SPLP
2310 B	Standard Methods– Acidity
2320 B	Standard Methods - Alkalinity (Titration)
2340 B	Standard Methods – Hardness by Calculation
2540 C	Standard Methods-Total Dissolved Solids
2540 D	Standard Methods-Total Suspended Solids
3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP.
3010A	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP.
3050B	Acid Digestions of Sediments, Sludge, and Soils.
4500 (Cn) E	Standard Methods-Cyanide
4500 (H+)	Standard Methods-pH (Electrometric)

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Section 6 Figure1 – KEL Analytical Methods

KEL Analytical Methods (continued)

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Section 6 Analytical Methods

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Method #	Method Description
6010 B	SW-846 – Metals by Inductively Coupled Plasma (ICP)
6020	SW-846 – Metals by Inductively Coupled Plasma Mass Spectroscopy (ICPMS)
7471 A	SW-846 – Mercury analysis in soils
9012 A	SW-846 Total and Amenable Cyanide
9040 B	SW-846 – pH meter
9045 C	SW-846 – pH in soils
9050 B	SW-846 – Conductivity
Modified NIOSH 7500	Industrial Hygiene Respirable Silica
Modified NIOSH 7300	Industrial Hygiene Respirable Metals

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Section 7 Quality Control Systems

Effective Date: 12/06/2022	Document Number: CLMN4423-0007	Rev.:14

QUALITY CONTROL SYSTEMS

KEIHL employs several types of essential quality control procedures to achieve high-quality data. The quality control procedures are discussed in this section of the QAPP.

Industrial Hygiene methods certified under ISO17025 utilize different terminology and require different frequencies relative to quality control. For Industrial Hygiene methods, please refer to the following standard operating procedures for specific quality control requirements: CLSOP 4423-7009, CLSOP4423-7021, and CLSOP4423-7020).

Training

Training is essential for a Laboratory to produce quality data. KEIHL employs several techniques. When a new analyst is hired, the new analyst must first read the QAPP. This informs the new hire of the type of quality they are to produce and the code of ethics they are required to meet. When a new assignment is made to the analyst, the analyst must complete training from the section supervisor and a checklist must be completed.

1. Read and understand the QAPP.
2. Read and understand the methods and the SOP's.
3. Learn the software and the hardware of the system.
4. Perform an analytical run using a sample batch which includes a QC set with an original, duplicate, matrix spike, matrix spike duplicate, blank and a blank spike under the supervision of the section supervisor or QA Manager
5. Where possible, use a reference sample with the batch.

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This training checklist is documented and kept in the analyst training record. Only analysts who have completed training are authorized to independently operate and use equipment. Ongoing demonstrations of capability for each analyst are performed annually for NELAC (National Environmental Laboratory Accreditation Certification) and semi-annually for AIHA (American Industrial Hygiene Association). Several types of studies may be used to demonstrate ongoing capability: 1) A quality control sample can be obtained from an outside source. (This may include a performance evaluation study or a reference sample). 2) The analyte may be diluted in clean matrix sufficient to prepare four aliquots at the concentration specified or to a concentration approximately 10 times the method stated, or laboratory calculated MDL. 3) At least four aliquots shall be prepared and analyzed according to the test method either concurrently or over a period of days. If the analyst chooses to perform number 2 or 3, the results of all the data are calculated for the mean recovery, and the standard deviation for the n-1 population. The information is then compared to the laboratory generated acceptance criteria for precision and accuracy. If the parameter meets the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters does not meet the criteria, the performance is deemed unacceptable for that parameter. The analyst must then locate and correct the problem and repeat the test for the parameters that fail to meet the criteria.

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Performance Evaluation (PE) Testing

KEIHL participates in 9 different PE events annually. Depending on the PE study these tests may be annual, bi-annual, tri-annual, quarterly or six times annually. KEIHL follows the proficiency testing provider's instruction for preparing the proficiency-testing sample and analyzes the PE sample in the same manner as a client sample. KEIHL uses certified reference materials in conjunction with the PE studies to detect any flagrant deviations from the analytical run. KEIHL may use a different method for a given sample (if needed) to capture the higher concentration analytes so that they are within the instrument calibration range. KEIHL may retain these samples for one year and use them later for monitoring methods, training new employees, and for demonstration of capability studies. KEIHL directs the PE provider to send result of each PE study results to the State of Utah. KEIHL maintains a copy of all PE testing records. If the laboratory fails a proficiency-testing audit, they must initiate a corrective action plan.

Laboratory Operations: Quality Control

KEIHL follows the Quality Control requirements of the methods. If there are no Quality Control limits described in the method, the analyst must meet quality control requirements specific to accuracy, precision, interference, contamination, selectivity, and sensitivity.

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Chemical Testing

When performing chemical testing, KEIHL uses both negative and positive controls to obtain high-quality data.

All Blanks/Negative controls

Negative controls include the use of Method Blanks. These are performed at a frequency of one per preparation batch per matrix, usually 1 in 20 samples. The result of the Method Blank analysis is used to assess possible contamination of the batch. If contamination is found, then the source must be investigated and measures taken to correct, minimize, or eliminate the problem. There are two Method Blank criteria which trigger action: 1.) If the blank contamination exceeds the concentration of greater than 1/10 of the measured concentration of any sample in the associated sample batch. 2.) The blank contamination exceeds the concentration present in the samples and is greater than 1/10 the specified regulatory limit. Any sample associated with the contaminated blank shall be reprocessed for analysis.

Additional types of blank samples routinely analyzed by KEIHL include the following: field, equipment, trip, instrument, and method blanks. Field, equipment, and trip blanks are analyzed as part of the field QC program as set forth in the Groundwater Characterization Monitoring Program (GCMP) or other appropriate documents. Instrument blanks are included in calibration curves and are evaluated before beginning sample analysis.

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Accuracy and Precision/Positive controls

1.) Laboratory Control Samples (LCS) are prepared and analyzed at a frequency of one per preparation batch or 1/20 per matrix, unless the method specifies a more stringent frequency. (Analytes that are exempt from this requirement are total volatile solids, pH, color, odor, temperature, dissolved oxygen, and turbidity.) The LCS is used to determine the acceptance of the preparation batch. KEIHL's performance is charted on control charts.

2.) Matrix Spikes are analyzed at a frequency of one per preparation batch of 20 samples for each matrix type, unless the method specifies a more stringent frequency. (Except for analytes for which spiking solutions are not available, such as total volatile solids, pH, color, odor, temperature, dissolved oxygen, and turbidity.) Matrix spikes are selected at random. Poor performance in a matrix spike sample may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike.

3.) Surrogates (Internal Standards) - Surrogate compounds are added to all samples, standard, and blanks for all mass spectroscopy and certain ICP methods. Poor surrogate recovery may indicate a problem with the sample composition or instrument fluctuation. The samples are reanalyzed if the surrogate recovery drops more than 20 percent of the known value for possible problems with the instrument. If the recovery drops a second time, the poor recovery is reported to the client.

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4.) Interference is determined by evaluating a matrix spike sample. Matrix spike and matrix spike duplicate samples are labeled as Spike 1 and Spike 2. Matrix spikes are analyzed at a frequency of one matrix spike every 10 samples for water samples and one matrix spike every 20 samples for soils. A matrix spike sample set is created in the laboratory by collecting two aliquots from a homogenized sample. One aliquot is not spiked and the remaining aliquot is spiked with a known concentration of standard reference material. Both aliquots are then processed through the entire analytical system, including sample preparation. Matrix spike results are reported by computing the percent recovery. The percent recovery is computed by using *Equation 1*.

Equation 1 **% Recovery = {(A – B)/ C} x 100**

A = Spiked Sample Result
B = Sample Result
C = Spike Value

KEIHL's acceptable limits for matrix spike samples are ± 25% for water, and ± 35% for soils. These limits were agreed to by the Utah State Department of Environmental Quality under the Consent Agreement Kennecott Utah Copper has for the Ground Water Characterization Monitoring Plan (GCMP). References are available.

Analytical Variability/ Reproducibility

Unless the method requires a more stringent frequency, Matrix Spike Duplicates and Laboratory Duplicates are analyzed at a minimum of 1 in 20

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samples per matrix type, sample extraction or preparation method. Samples are selected at random. Poor performance in duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate. The analytical results are reported by computing the Relative Percent Difference (RPD) using

Equation 2.

Equation 2 $\%\ RPD = \{(A - B)/[(A+B)/2]\} \times 100$

A = Spiked Sample Result
B = Sample Result

The RPD's are evaluated and compared to method specific acceptance criteria for a given matrix. RPD results provide an estimation of the precision for a given sample matrix. The relative percent difference must fall within ± 25% or the sample batch is reanalyzed. The results of these samples are captured in a web-based report and are reviewed monthly.

Method Evaluation

To ensure the accuracy of the reported result, the following procedures are in place:

1. Demonstration of Capability is performed initially and following significant change in instrument type, personnel, and sample matrix or test method.
2. Calibration protocols are specified in the calibration section of this QAPP.
3. Participation in performance evaluation to evaluate the ability to produce accurate data.

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Detection Limits

KEIHL performs MDL studies at least annually on all methods it performs by following the guidelines in 40 CFR, Part 140, and Appendix B. Refer to KEIHL SOP CLSOP4423-1013 for the process. An MDL study may be performed more frequently if significant changes occur, such as a change in location of the laboratory, a new technical employee, a new instrument, or a new technique.

Standard/Reagent and Reference Standard Preparation

A critical element of producing quality data is the purity, quality and traceability of the standard solutions and reagents used in the laboratory. To ensure the highest possible purity, all primary calibration standards, reference standards and standard solutions must be purchased from suppliers in conformance with ISO Guide 34 requirements. These types of standards are logged into the appropriate Standards and Reagent Log upon arrival at KEIHL. A logbook for this purpose is maintained in each lab section. The analyst preparing the standard gives the standard a unique identification number and documents the vendor, lot number, concentration, open/preparation date, preparer's initials, method of preparation, and expiration date. The standard's Certificate of Analysis is kept on file with the standard number, date received, and initials of the analyst. The Certificate of Analysis file is maintained by the analyst and/or the QA/QC Officer. These logbooks and Certificates of Analysis provide the traceability of the standards from the time the standard arrives at KEIHL to the time it is used for an analytical purpose. The standard log number is also recorded on the raw data for traceability.

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A second source standard must be used at a minimum of every three months. However, most analysts analyze the second source after the daily calibration to verify the calibration curve. The second source standard is prepared at a different time and is obtained from a different source or different lot number. This verification is used to evaluate the calibration and the vendor's product. Stock standards and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration. Care is exercised in the proper storage and handling of standard solutions. Standards are not stored with samples. Working standard reagent containers are clearly labeled with the following information: Standard number, description, preparation date, concentration, expiration date, preparer's initials, and special safety precautions or SDS (Safety Data Sheets) information.

The quality of the laboratory's reagent water source is continuously monitored through the analysis of blanks. The water must meet the method specified requirements.

Constant and Consistent Test Conditions

KEIHL maintains a temperature-controlled environment to assure that the test instruments consistently operate within the specification required for the application for which the instruments are used.

Glassware is cleaned to meet the sensitivity requirements of the test methods. All cleaning and storage procedures that are not specified by the test method are documented in the laboratory records and SOPs.

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MOC	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Revision and Review for 2006	Melissa Olsen	08/03/06
	Review for 2008. No changes.	Melissa Olsen	10/07/08
	Review for 2009. No changes.	Melissa Olsen	01/21/09
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Updated section on Performance Evaluations. Updated the frequencies stated under the Accuracy and Precision section #4.	Melissa Olsen	08/29/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/23/2013
25673	Under standard/reagent and reference standard preparation, added the requirement that all suppliers must conform to ISO Guide 34 requirements. Added statement regarding Industrial Hygiene methods and QC requirements.	Melissa Olsen	02/04/2013
26233	Expanded on statement regarding ongoing demonstration of capability to state the requirements of AIHA (2 DOC/year) and NELAC (annually). Updated branding.	Melissa Olsen	04/24/2014
30091	Changed frequency of analysis of laboratory reagent water from "daily" to "monitored through the analysis of blanks".	Melissa Olsen	04/20/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes.	Melissa Olsen	02/07/2017
53081	Review for 2018. No changes.	Melissa Olsen	06/19/2018
58723	Review for 2019. No changes.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/03/2020
67192	Updated number of PT studies to 9.	Melissa Olsen	09/15/2020
79250	Added comment "Unless the method specifies a more stringent frequency" to Accuracy and Precision #1 LCS, #2 Matrix Spikes and under Analytical Variability and Reproducibility. Rev. 12 to 13.	Melissa Olsen	09/03/2021
94373	Review for 2022. Fixed minor grammatical errors. Rev. 13 to 14	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes.	Melissa Olsen	11-03-2023

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Section 8 Calibration

Effective Date: 9/8/2021	Document Number: CLMN4423-0008	Rev.: 11

CALIBRATION

Calibration requirements are divided into two parts: (1) requirements for analytical support equipment and (2) requirements for instrument calibration.

Support Equipment

These devices are not the actual test instruments but include auxiliary equipment necessary to support laboratory operations. This equipment requires calibration documentation indicating they were calibrated by an organization accredited under ISO/IEC 17025 and therefore, in conformance with the necessary requirements. These include, but are not limited to, the following: balances, ovens, refrigerators, incubators, thermometers, volumetric dispensing devices, such as Eppendorfs, or automatic diluters. KEIHL maintains records of repairs and maintenance activity. All raw data records are maintained to document equipment performance. Results of the calibrations must be within the specifications required for the application for which the equipment is used. Prior to use, balances, ovens, and refrigerators are checked for expected temperature range with NIST traceable references. Mechanical volumetric dispensing devices are checked for accuracy quarterly.

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Weights and Balance Calibration

A contractor performs all necessary preventative maintenance and calibrates balances every six months and weights annually. The Class S weights are calibrated annually and checked against NIST traceable weights for accuracy. The contractor issues a certificate of calibration for both the weights and the balances that states the variability of the balances. Documented weight verification is performed each time the balance is used by the analyst. The analyst performs verification by placing one of the Class S weights on the balance and recording the result in the balance calibration book. The analyst should select a Class S weight in the weight range of the sample or reagent to be weighed.

Thermometer Calibration

Thermometer calibration is performed on all glass mercury thermometers annually. This is accomplished by using an NIST traceable thermometer. The NIST traceable thermometer is placed beside the glass mercury thermometer and allowed to equilibrate for one hour. The respective temperatures are recorded. If there are discrepancies between the NIST traceable thermometer and the glass mercury thermometer, it is noted on the label which is attached to the thermometer. Alternatively, thermometers can be sent out for calibration to an approved ISO17025 certified calibration service provider.

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Mechanical Pipette Calibration Verification

A calibration verification is performed on KEL's mechanical pipettes quarterly. The calibration verification is performed using "Pipette Tracker" software. Each pipette has a unique number. The unique number may be the pipette serial number or an assigned laboratory ID number. The unique number is engraved or labeled on the pipette. The non-adjustable pipettes are calibrated using a ± 2% criteria for precision and accuracy. The calibration verification acceptance range uses a ± 5% for precision and accuracy at the lowest adjustable reading and a ± 2% for precision and accuracy for every actual volume a minimum of three concentrations are verified for calibration. When the calibration verification has been completed, a Certificate of Calibration is printed and kept in the Pipette Calibration Book in the QA/QC Manager's Office.

Instrument Calibration

Instrument calibrations are divided into two parts: Initial Calibration and Continuing Instrument Calibration Verification.

Initial Calibration

Instrument calibration procedures are intended to ensure that analytical systems are operating correctly and have adequate sensitivity and accuracy to meet method requirements. The details of the initial instrument calibration procedures are included or referenced in the SOP. The manufacturer specifies

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general instrument calibration procedures. Method specific procedures are given in the appropriate analytical method. Instruments are calibrated daily and/or each time they are prepared to run samples. Each instrument is calibrated with standards appropriate to the designated function of the instrument, type of analysis, and the established operating range of the analytical methods. Calibration is always performed prior to analysis. Sample results must be calculated from the initial instrument calibration and may not be calculated from any continuing instrument calibration verification. The lowest calibration standard must be above the detection limit. Calibration standards must include concentrations at or below the regulatory limit or decision level, unless these concentrations are below the demonstrated detection limits determined by the laboratory. Sufficient raw data records must be retained to permit reconstruction of the initial instrument calibration, e.g., calibration date, test method, instrument, analysis date, each analyte name, initials of analyst or signature, concentration and response, calibration curve or response factor. The analyst analyzes a second source after the daily calibration to verify the calibration curve. The second source standard is prepared at a different time and obtained from a different source or different lot number. The second source verification is used to evaluate the calibration and the vendor's product.

The calibration standards must have a correlation coefficient (also referred to as r^2) of 0.995 or better and blanks must meet the method specific criteria for

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acceptance, or the analysis is terminated, and all samples analyzed after the last acceptable calibration are reanalyzed. If the result of an analysis is higher than the highest point on the calibration, the sample is diluted until the result falls within the calibration range. If results are lower than the lowest point on the calibration, which goes through zero, the results are reported Below Reporting Limit (RL).

Continuing Instrument Calibration Verification

The details of the continuing instrument calibration procedure, calculations and associated statistics must be included or referenced in the SOP. A continuing instrument calibration verification must be repeated at the beginning, every ten samples and at the end of every analytical run. For the photometric determination of anions, the continuing instrument calibration standards are analyzed every 15 samples, including 9 daily samples and 6 quality control samples. The concentration of the calibration verification shall be varied within the established calibration range. Sufficient raw data records must be retained to permit reconstruction of the initial instrument calibration, e.g., calibration date, test method, instrument, analysis date, each analyte name, initials of analyst or signature, concentration and response, calibration curve or response factor. The criteria for acceptance of continuing instrument calibration verification is established as ± 10% of the known concentration. If the continuing instrument calibration verification results obtained are outside the established acceptance criteria, corrective actions must be performed. If routine corrective action

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procedures fail to produce second consecutive calibration verification within the acceptance criteria, then either the laboratory must demonstrate performance after corrective action with two consecutive successful calibration verifications or a new initial instrument calibration must be performed.

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Quality Assurance Program Plan

Section 8 Calibration

Effective Date: 9/8/2021	Document Number: CLMN4423-0008	Rev.: 11

MOC	Description of Change	Prepared By	Date
TS0020	Review for 2004	Janna Hardman	09/30/2004
TS00085	Review for 2006	Melissa Olsen	08/03/2006
TS00113	Added statement indicating the frequency of continuing calibration verification checks for the photometric determination of anions every 15 samples.	Melissa Olsen	04/13/2007
	Review for 2008. Minor grammatical changes made.	Melissa Olsen	10/07/2008
	Review for 2009. No changes.	Melissa Olsen	01/21/2009
11532	Revision and review for 2010. Removed water bath from support equipment.	Melissa Olsen	02/22/2010
17479	Added frequency of thermometer calibration.	Melissa Olsen	08/29/2011
23199	2013 review. No changes.	Melissa Olsen	04/24/2013
25673	Added statement to thermometer calibration regarding sending thermometers to an ISO17025 certified service provider. Added statement under support equipment regarding the requirement to meet ISO/IEC 17025 standards.	Melissa Olsen	12/17/2013 and 01/30/2014
26233	Updated branding.	Melissa Olsen	05/22/2014
30091	Review for 2015. No changes.	Melissa Olsen	04/20/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/24/2017
53081	Review for 2018. No changes.	Melissa Olsen	06/19/2018
58723	Review for 2019. No changes.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes.	Melissa Olsen	09/16/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/03/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes.	Melissa Olsen	11/02/2023

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Quality Assurance Program Plan

Section 8 Calibration

Effective Date: 9/8/2021	Document Number: CLMN4423-0008	Rev.: 11

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Quality Assurance Program Plan

Section 9 Preventive Maintenance

Effective Date: 9/8/2021	**Document Number:** CLMN4423-0009	Rev.: 05

PREVENTIVE MAINTENANCE

Preventive maintenance of analytical instrumentation and other traditional equipment is routinely performed on an as needed or on a recommended basis and documented in the instrument maintenance logbooks. One important aspect of the instrument maintenance program is service contracts which cover most of the analytical instrumentation utilized at Kennecott Environmental and Industrial Laboratory (KEIHL). Preventive maintenance procedures specified by the instrument manufacturer or the QA program are included in the method/SOPs relating to the instrument. Instruments requiring service from an authorized service engineer are removed from service until the repair or maintenance is completed. Authorized maintenance personnel service other pieces of equipment such as the balances on a semi-annual basis. Service call maintenance is documented and service records are kept on file. Internal system audits monitor preventive maintenance. Annual systems audits are designed to address any long-standing or recurring problems with the instrumentation and engineering controls.

Records are maintained for each major piece of equipment and all reference materials significant to the test performed. The records shall include the following information:

1. The name of the item of equipment.

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2. The manufacturer's name, type identification, and serial number or unique identifier.
3. Date received and date placed in service.
4. Current location when appropriate.
5. Condition received.
6. Copy of the manufacturer's instructions
7. Details of the maintenance carried out to date.
8. History of any damage, malfunction, modification or repair.

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Quality Assurance Program Plan

Section 9 Preventive Maintenance

Effective Date: 9/8/2021	**Document Number:** CLMN4423-0009	Rev.: 05

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/2004
TS00085	Review for 2006.	Melissa Olsen	08/03/2006
	Review for 2008. No changes made.	Melissa Olsen	10/07/2008
	Review for 2009. No changes made.	Melissa Olsen	01/21/2009
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	08/30/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. No changes.	Melissa Olsen	04/20/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/24/2017
53081	Review for 2018. No changes.	Melissa Olsen	06/19/2018
58723	Review for 2019. No changes.	Melissa Olsen	08/16/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/03/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes.	Melissa Olsen	11/02/2023

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DATA QUALITY ASSESSMENT

The Data Quality Assessment section of the QAPP describes the techniques that are used to assess the precision, accuracy, completeness, and comparability of all data generated under the Quality Assurance Program.

Precision

Precision is defined as the measure of mutual agreement among individual measurements of the same property, usually under similarly prescribed conditions. Precision is best expressed in terms of relative percent difference. The Precision is determined by performing duplicate analyses of a certified reference material or laboratory control sample and graphing the data on a control chart to see if the sample concentrations fall within the statistical limits. Each analyst performs duplicate analysis of certified reference materials or performance evaluation samples for every QC set analyzed in the analytical process.

Accuracy

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property) with the accepted reference value or true value. It is a measure of the bias in a system and will be expressed as the percent recovery in a spiked sample. It can also be assessed using a certified reference

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material (CRM also called a Standard Reference Material (SRM)) with certified values. Accuracy is evaluated through the steps listed below.

- Calculating the average and the standard deviation for the QC check samples for each parameter and graphing the results on control charts to determine if the accuracy is within the statistical acceptance limits.
- Inspecting all blank analysis data for field or laboratory contamination problems.
- Calculating the percent recovery of laboratory fortified samples and laboratory fortified blanks to ascertain the accuracy of the system.

Proper evaluation of precision and accuracy will offer insight into instrument performance and general data quality.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from a measurement system compared to the amount that is expected to be obtained under normal operating conditions. Completeness is evaluated in terms of the amount of valid data obtained compared to the amount that is needed to complete the QA goals. The amount of valid data generated in an analytical sequence can vary due to several causes: laboratory sample handling or preparation errors resulting in the loss or destruction of an analyte, instrumental errors resulting in data rejection, and insufficient QC data (e.g., lack of spike recovery data). If data acquisition targets are not met, the data may be

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determined to be incomplete by the analyst or QA manager and further analysis or repeated sampling may be required.

Comparability

Comparability is defined as the confidence with which one data set can be compared to another. Identifying pertinent data characteristics that may limit comparability to other sets assesses comparability. Comparability will be evaluated using the steps listed below.

- Assuring that measurements obtained during a predetermined time frame are statistically comparable using SOPs and standard analytical procedures.
- Internal performance audits may be initiated by the QA manager. One data set generated by one analyst or instrument can be compared to another.
- Comparison of current data with historical data from the same sampling site.

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Quality Assurance Program Plan

Section 10 Data Quality Assessment

Effective Date: 9/8/2021	Document Number: CLMN4423-0010	Rev 05

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/04
TS00085	Review for 2006	Melissa Olsen	08/03/06
	Review for 2008. No changes were made.	Melissa Olsen	10/07/08
	Review for 2009. No changes were made.	Melissa Olsen	01/23/09
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes were made.	Melissa Olsen	08/30/2011
23199	Review for 2013. No changes made.	Melissa Olsen	04/24/2013
26233	Under "Comparability", modified statement regarding internal performance audits. Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. No changes made.	Melissa Olsen	04/20/2015
31572	Review for 2016. No changes made.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes made.	Melissa Olsen	03/24/2017
	Review for 2018. No changes made.	Melissa Olsen	06/19/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes made.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/03/2021
94373	Review for 2022. No changes made.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes made.	Melissa Olsen	11/02/2023

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DATA REDUCTION, VERIFICATION, AND REPORTING

All data are processed to ensure that the precision, accuracy, completeness, and comparability of the data are of known and documented quality. Data validation includes data reduction, verification, and reporting procedures completed independently by the analyst, QA/QC Officer and Laboratory Director.

Traceability of Measurement

Traceability is the ability to trace the history, application, or location of an entity by means of recorded identifications for a given sample or project. KEIHL's Quality Control Systems strives to provide a program to ensure that measurements made by the laboratory are traceable to national standards of measurement when possible. When traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence or correlation of results by participation in inter-laboratory comparisons, proficiency testing or independent analysis.

Sample Traceability

The traceability begins with the sample numbers being assigned to the samples and then being recorded on the Chain of Custody. The preparation chemist then records the laboratory assigned sample number in the preparation logbook. After the samples have been prepared, the completed samples are placed

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in a sample type designated area. The Analyst then prepares an analytical run from the backlog and types the corresponding number into the analytical sample identification table. This then becomes part of the final record.

Standard, Reagent, and Reference Material Traceability

The KEIHL laboratory only purchases standards that are traceable to national standards. When the laboratory receives new standards, reagents or reference material, the Laboratory records the following information into a Standard/ Reagent Logbook: name of the standard, concentration, vendor, lot number, date of receipt, expiration date and the analyst's initials. The standard is then assigned a unique laboratory number. All standards are received with a Certificate of Analysis. The unique number is recorded on the Certificate of Analysis and the certificate is kept in the QA Manager's office. A sticker is placed on the standard with the information listed above. If a standard is diluted, or added to a working standard, the directions for this are also recorded in the Standard Logbook. The new working standard is given a unique number and labeled accordingly. The working standard number is recorded on each analytical run to provide traceability back to the standards used for the analytical run.

Analyst Data Reduction, Validation, and Reporting

The analyst has primary responsibility for generating data of acceptable,

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known, and documented quality. The analyst reduces instrumental output to concentration values and verifies that all QC results are acceptable by comparing analytical results to statistically generated control charts for accuracy and precision, method specific criteria, and historical control limits.

Peer Review

Peer review of sample data is completed after each analytical batch and is documented on the raw data. Typically, the Group Supervisor, or designee, reviews a minimum of 10% of the data generated by a Laboratory Group. The analyst documents corrective action at the bench level on the raw data or by using the Corrective Action Report Summary maintained by the QA officer.

The analyst inspects standard, blank, sample, duplicate, and matrix spike results during an analytical batch or run and compares results against known control limits and method QC requirements. Results found to be suspect and those that are outside acceptance limits are investigated. The analyst will troubleshoot the problem(s) and restart the batch, beginning with calibration, if necessary. A Supervisor or the QA/QC Officer will be notified if the problem(s) cannot be resolved at the analyst level. The QA/QC Officer will be notified to determine whether further corrective action is required and the analyst will document conclusions. The tools used to determine acceptable results may include control charts for QC and check standard results and historical data for sample results. After the analyst determines that data quality is acceptable and the other aspects related to the data quality are

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known and documented, the analyst will transfer the data into the LIMS (Laboratory Information Management System).

QA/QC Officer Data Reduction, Validation and Reporting

The QA/QC Officer is responsible for ensuring the precision, accuracy, completeness, and comparability of the data are of known and documentable quality. The QA/QC Officer reviews the data only after all requested analyses for a sample or sample set have been completed. The process followed by the QA/QC Officer includes a review of all stages of the sample from receipt and chain-of–custody to data reduction, verification, final reporting and the final archival processes. Data reduction is performed using the QA SQL interface program and the LIMS based Northwest Quality Analyst (NWQA). The QA/QC Officer reviews the data and determines whether corrective action is required. Verification includes an assessment of QC results, confirmation of cation/anion balances and total dissolved solids comparisons measurements for each water sample. The ionic balance check program compares the major cation to major anion results for each water sample along with the electrical conductivity and pH. These data reports are also reviewed using the professional judgment of the QA/QC Officer and corrective action is initiated as needed.

The QA/QC Officer transfers completed data sets to the QA database, reviews the data, and determines whether corrective action is required. If the data is unsatisfactory, the QA/QC Officer submits a rerun sheet to the laboratory group to

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reanalyze the rejected data sets. The QA/QC officer implements corrective actions as needed based on this additional review of the QA statistics and control chart data.

When the QA/QC Officer verifies that all required corrective actions have been implemented and documented, the data is of known and documentable quality. The QA/QC Officer then provides the Laboratory Director with the printouts of the cation anion balance and the final Certificate of Analysis report. The data is not reported to the Laboratory Director until the QA/QC Officer is satisfied that the data are acceptable.

Laboratory Director Data Reduction, Validation and Reporting

The Laboratory Director has the final responsibility to ensure that the precision, accuracy, completeness, and comparability of the data are known and documented. The Laboratory Director reviews all corrective actions taken. The Director reviews sample results that have ion balances that are not comparable. The Director then approves or rejects the data. Any additional corrective actions identified by the Laboratory Director are investigated, documented and reviewed before the Laboratory Director approves the final Certificate of Analysis report.

Electronic Signatures

The Laboratory Director uses an electronic signature for all Certificates of Analysis (COA) generated. This electronic signature is unique to the individual and is secured by a personal log-in identification username and password, which are periodically

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changed.

Certificate of Analysis

KEIHL produces a Certificate of Analysis (COA) for every sample analyzed at the laboratory. The KEIHL report has the following items listed on the report:

1. Report Title.
2. Name and address of the laboratory.
3. Total number of pages.
4. Name of the client (KEL is an in-house lab. Therefore, the address is the same.)
5. Identification of the sample
6. Date of sample Receipt, Collection date, and analysis date.
7. Identification of the test method
8. Any deviations pertaining to the sample.
9. Signature and title of the responsible persons.

KEIHL does not subcontract any samples. Therefore, KEIHL follows the guidance found in NELAC 5.13 b) 2) which states: "The laboratory provides information to another department within the organization for the preparation of regulatory reports". The facility management must ensure the appropriate report items are included in the report to the regulatory authority if such information is required.

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Computers and Electronic Data Requirement

When computers and automated equipment are used for the capture, processing, manipulation, recording, reporting, storage, or retrieval of test data, KEIHL follows an SOP that covers the requirement found in NELAC Chapter 5.10.6 and Good Automated Laboratory Practice of the EPA Document 2185.

Customer Complaints

KEIHL has a Standard Operating Procedure for addressing and resolving customer complaints. Records of complaints and the subsequent actions are maintained in accordance with CLSOP4423-1021.

Record Documentation

All essential information associated with analysis including Chains of Custody, logbooks, laboratory sample ID codes, analysis type, manual calculations, raw instrument data, analysts initials or signatures, and electronic data are kept for a minimum of five years.

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Quality Assurance Program Plan

Section 11 Data Reduction, Verification and Reporting

Effective Date: 9/8/2021	Document Number: CLMN4423-0011	Rev.: 11

MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Review for 2006	Melissa Olsen	08/03/06
	Review for 2008. No changes were made.	Melissa Olsen	10/07/08
	Review for 2009. No changes were made.	Melissa Olsen	01/23/09
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes made.	Melissa Olsen	10/11/2011
23199	Review for 2013. Removed statements regarding the review of sample results against historical means and standard deviations. This work is performed by the Water Resources Group.	Melissa Olsen	04/24/2013
26233	Under Sample Traceability, removed "instrument chemist" and replaced with "analyst" Updated branding.	Melissa Olsen	06/02/2014
30091	Added section on the use of Electronic Signatures for Certificates of Analysis.	Melissa Olsen	04/09/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/08/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/24/2017
	Review for 2018. No changes.	Melissa Olsen	06/19/2018
58723	Review for 2019. No changes.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes.	Melissa Olsen	09/17/2020
79250	Under Certificate of Analysis, removed paragraph about report formats to DEQ. Rev. 9.3 to 10	Melissa Olsen	09/03/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022
102982	Referenced CLSOP4423-1021 in Customer Complaints section. Rev 10 to 11	Melissa Olsen	

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Quality Assurance Program Plan

Section 12 Corrective and Preventive Action

Effective Date: 9/8/2021	Document Number: CLMN4423-0012	Rev.: 16

Corrective and Preventive Action

The Laboratory Director and/or the Quality Manager are responsible for initiating, monitoring and recording non-conformances and corrective actions (Refer to SOP CLSOP4423-1004). Corrective Actions are recorded on the "Corrective Action" form, CLFRM4423-0001 (Appendix A), which can be found in the Bentley document control system.

Examples of **non-conformances** (random events) may include the following:

- Continuing calibration verification (CCV) results not within method-defined control limits
- Sample analyzed outside of maximum holding time limits
- Loss of sample (broken glassware, spill, etc.)
- Erroneous double spiking of sample with surrogate
- Outlier for Proficiency Testing round, Round Robin, or Demonstration of Capability

Examples of **corrective actions** (systematic events) may include the following:

- Internal Quality Audit findings
- External Assessment Deficiencies
- Non-conformances which become systematic events
- Becoming non-proficient with proficiency testing samples
- Customer feedback or complaints

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All Laboratory Employees and members of the QAQC group have the authority, as appropriate, to stop work on samples when any aspect of the process does not conform to laboratory requirements. The employee who stopped the work shall immediately notify laboratory management (Laboratory Director, QA Manager, or designee). Upon investigation of the issue, Laboratory Management will authorize the resumption of work.

The essential steps in the corrective action system are as follows:

- Assign responsibility for investigating the problem.
- Investigate and determine the root cause of the problem (5-Why's).
- Once the root cause has been determined, implement an appropriate corrective action to solve the problem.
- Verify that the corrective action has resolved the problem.
- Complete the documentation of the corrective action.

Additionally, as part of the Groundwater Characterization Monitoring Plan (GCMP), KEIHL reviews the data for ion balance. If any sample fails the criteria for this review, a request to verify the suspected analysis/analyses which is/are contributing to this failure is requested by the QA/QC manager. When these reruns result in changes to the original values, the analyst will enter a comment in the LIMS (Laboratory Information Management System). Likewise, if the sample is

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rerun and the result does not change, a comment is entered indicating the sample was verified. These changes are also tracked through the audit trail in the LIMS.

Customer Complaints

KEIHL is a private technical support facility for Rio Tinto Kennecott. Therefore, the customers receiving KEIHL services are the environmental and industrial hygiene personnel. The Laboratory Director or the QA/QC Manager receive any questions, concerns or issues pertaining to analytical data. Questions and concerns are resolved by following the procedure listed below:

- Review of Field Data Observation Sheets.
- Review of the Chain of Custody request and supplied field data.
- Review of raw analytical data.
- Review of the associated quality assurance data.
- If needed, re-analysis of samples if original sample is available.

Please refer to CLSOP4423-1021 Customer Services and Complaints.

PREVENTIVE ACTION

KEIHL determines action to eliminate the causes of potential nonconformities to prevent their occurrence. Preventive actions are appropriate to the effects of the potential problems and are recorded on a Preventive Action Report, CLFRM4423-0002 (Appendix B). For the procedure on Preventive Action, refer to SOP CLSOP4423-1023.

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Quality Assurance Program Plan

Section 12 Corrective and Preventive Action

Effective Date: 9/8/2021	Document Number: CLMN4423-0012	Rev.: 16

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/04
TS00046	Review for 2005 Procedure change for follow up on the implementation of Corrective Action.	Janna Hardman	03/30/05
TS00085	Review for 2006	Melissa Olsen	08/04/06
9006	Review for 2008. Updated Appendix A corrective action form.	Melissa Olsen	10/10/08
	Review for 2009. No changes.	Melissa Olsen	01/26/09
11532	Revision and review for 2010. Added Preventive Action section to SOP as well as a document reference. Modified report in Appendix A (Non-Conformance and Corrective Action) and added Appendix B (Preventive Action Report). Updated laboratory address in header.	Melissa Olsen	12/17/2010
17479	Review for 2011. No changes made.	Melissa Olsen	10/11/2011
21418	Review for 2012. Inserted updated forms for Corrective and Preventive Actions.	Donna Smith	01/12/2012
	Review for 2013. Removed statements “and limit check programs”, and “historical data check review” as these are not performed by the laboratory personnel. Historical data checks for specific locations are performed by the Water Resources Group.	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
30091	Updated Appendix A and B forms	Melissa Olsen	04/21/2015
31572	Review for 2016. Updated Appendix A with current revision of Corrective Action Report	Melissa Olsen	03/11/2016
43586	Review for 2017. Removed non-conformance from Appendix A header. Rev. 13 to 14.	Melissa Olsen	03/27/2017
53081	Aligned policy with procedure after procedure updates for corrective and preventive action. Rev. 14 to 15	Melissa Olsen	09/17/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/03/2020
67192	Added SOP reference for Customer Complaints CLSOP4423-1021.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/07/2021
94373	Review for 2022. No changes made.	Melissa Olsen	12/02/2022
102982	Review for 2023. No changes made.	Melissa Olsen	11/02/2023

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Appendix A
Corrective Action Report

Corrective Action		
Effective Date: 11/17/2017	Document Number: CLFRM4423-0001	Rev: 3

Corrective Action Number:	
Name of Person Registering the Corrective Action:	**Date:**
Source: (internal audit, external audit, etc.)	
Details of the systematic non-conformance including sample details where appropriate, what actually happened and how it occurred:	
Root Cause Analysis (Five whys). List details of cause and contributing issues.	
Corrective Action Taken	
Review of Corrective Action:	
Corrective action satisfactory?: YES NO	
QA/Technical Manager:	**Date:**
Additional Review Required? YES NO	

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Appendix B
Preventive Action Report

Preventive Action Form

Effective Date: 11/15/2013	Document Number: CLFRM4423-0002	Rev: 0

Date: **Initiator:**

Preventive Action Report number:

Source (Circle One):

Service Request Staff Observation Internal/External Audit

Customer Complaint Control Chart Management Review

Customer Survey Other _____

Identification of Problem and Evidence of Occurence:

Evaluation of Problem (Root Cause):

Action Plan:

Follow-Up

Have all changes been verified for completion? Yes_____ No_____

If yes, please list the date this took place:_____

Steps taken to prevent future occurrence:

Additional Comments:

	Signature	Date
Initiator:		
QA/Technical Manager:		

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Quality Assurance Program Plan

Section 13 Performance and System Audits

Effective Date: 9/8/2021	Document Number: CLMN4423-0013	Rev.: 12

AUDITS AND SYSTEM REVIEWS

Internal System Audits and Managerial Review

The QA/QC Officer will conduct system audits annually. Audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel shall not audit their own activities except when it can be demonstrated that an effective audit will be carried out. Internal audits include a review of documentation, data record checks, logbook inspections, and laboratory inspections conducted by the QA/QC Officer, his or her designee, or external auditors. Internal audits are conducted to verify the staff has the equipment, facilities, engineering controls, and procedures necessary to generate data of acceptable, known, and documented quality. Any deficiencies identified in the audit are documented and addressed as part of the audit process. Corrective actions resulting from a system audit can include revising SOPs, reanalyzing affected samples, or repairing instrumentation. A well-administered system audit may isolate deficiencies regarding inadequate engineering controls within the laboratory, such as an inoperable fume hood. The Laboratory Director conducts independent reviews or audits as needed in response to problems identified through the QA program or performance audit samples (both internal and external). The Laboratory Director addresses safety and compliance problems. Analysts must

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have appropriate controls in place to properly execute their job functions. The QA/QC Officer maintains the system audit schedule.

External System Audits

Auditors from federal, state, and county agencies conduct external system audits. External system audits are conducted as part of the accreditation, licensing, and certification programs identified above and as oversight by government agencies. The QA/QC Officer and Laboratory Director actively participate in the audit. KEIHL responds to all external system audits through corrective action deficiency reporting as required by the agency and by documenting and correcting problems identified during the audit.

Performance Audits

Performance audits are an important component of the QA program. KEIHL implements several types of checks to monitor the quality of analytical activity. A few of these are listed below:

- Internal quality control procedures using statistical techniques.
- Replicate testing using the same or different test methods.
- Use of certified reference materials or secondary reference materials.
- Re-testing of retained samples.
- Ion balance on the major components of water samples.

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- Review the results for different, but related analysis of a sample. i.e. Total vs. Dissolved.
- Participate in proficiency testing or other interlaboratory comparisons.

Performance audits include the analysis of a standard QC set: original, duplicates, matrix spikes, matrix spike duplicates, blanks, and certified reference materials. The performance audits are designed to verify the ability to correctly identify and quantify sample concentrations in reference samples and blind QC samples.

Proficiency Test Studies

The Laboratory participates in several proficiency test studies listed below.

- Environmental Monitoring under SDWA (WS), twice a year and CWA (WP), twice a year, and RCRA (Soil Study) twice a year.
- Laboratory certification program administered by the State of Utah Department of Health, Bureau of Laboratory Services.
- The Proficiency of Analytical Testing (PAT) program jointly administered by AIHA and NIOSH, four times a year.

The information provided through participation in these programs is used to evaluate laboratory performance in each section and to assist the QA/QC Officer, Laboratory Director, and external audit teams in assessing analytical methods that require increased attention to correct any deficiencies. Sample information for external performance evaluation samples is recorded and tracked in the LIMS

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database, including sample identity and reported results. All audit samples are processed through the laboratory in the same manner as routine samples, from sample receipt to final reporting. All results of performance evaluation tests are distributed to the Laboratory Director and/or Technical Services Manager.

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/04
TS00085	Review for 2006	Melissa Olsen	08/04/06
	Review for 2008. No changes were made.	Melissa Olsen	10/07/08
	Review for 2009. Updated the current analyses performed on Toxicology proficiency test studies.	Melissa Olsen	01/26/09
11532	Review for 2010. Removed ELPAT from proficiency testing studies and updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	10/11/2011
23199	Review for 2013. Added RCRA Soil study PT tests and frequency under Proficiency Testing studies	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. No changes.	Melissa Olsen	04/24/2015
31572	Removed clinical proficiency testing studies.	Melissa Olsen	03/11/2016
43586	Removed USGS proficiency testing studies.	Melissa Olsen	03/27/2017
	Review for 2018. No changes made.	Melissa Olsen	09/04/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/03/2020
67192	Review for 2020. No changes made.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes made.	Melissa Olsen	09/07/2021
94373	Review for 2022. No changes made.	Melissa Olsen	12/02/2022
102982	Removed NPDES (DMRQA) from PT studies. Rev. 11 to 12	Melissa Olsen	11/02/2023

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QUALITY ASSURANCE REPORT

A QA/QC activity report may be prepared periodically by the Laboratory Director and distributed to laboratory personnel. These reports may include the points listed below.

- QC Summary reports for the GCMP samples.
- All Performance Evaluation sample results for all accreditations.
- Correspondence for all Performance Evaluation samples.
- Results for the internal and external system audits.
- Corrective action reports.
- Documentation review.
- Control Charts

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Quality Assurance Program Plan

Section 14 Quality Assurance Report

Effective Date: 9/8/2021	Document Number: CLMN4423-0014	Rev.: 10

MOC#	Description of Change	Prepared By	Date
TS00020	Revision and Review for 2004	Janna Hardman	09/30/04
TS00085	Review for 2006	Melissa Olsen	08/04/06
	Review for 2008. No changes were made.	Melissa Olsen	10/07/08
	Review for 2009. No changes were made.	Melissa Olsen	01/26/09
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes were made.	Melissa Olsen	10/11/2011
23199	Review for 2013. Removed statement indicating that the QAQC reports would be submitted to the Manager of Technical Services.	Melissa Olsen	04/24/2013
26233	Removed statement "The Laboratory Director and the Manager of Technical Services may judge the data quality in terms of precision, accuracy and completeness." Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. No changes.	Melissa Olsen	04/24/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/11/2016
43586	Removed statement regarding the generation of control charts for the purpose of generating control limits for the next quarter.	Melissa Olsen	03/27/2017
	Review for 2018. No changes made.	Melissa Olsen	09/04/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/13/2020
67192	Review for 2020. No changes made.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes made	Melissa Olsen	09/07/2021
94373	Review for 2021. No changes made.	Melissa Olsen	12/02/2022
102982	Revised language to say the report may be prepared, but not that it "is" prepared as this is not a requirement under ISO or NELAC guidelines. Rev. 9 to 10	Melissa Olsen	11/03/2023

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GLOSSARY

Commonly used environmental terminology is defined in the Glossary.

Acceptable Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: the process by which an agency or organization evaluates and recognizes a program of study or an institution as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Assessment: the evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audits, performance evaluations, management reviews, peer reviews, inspections, and surveillance.

Accuracy: a data quality indicator. The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components, which are due to sampling and analytical operations.

Analyte: means the substance or thing for which a sample is analyzed to determine its presence or quantity.

Analytical Reagent (AR) Grade: designation for the high purity of certain chemical reagents and solvents given the American Chemical Society.

Audit: A systematic evaluation to determine the conformance to quantitative specifications of some operational function or activity.

Batch: environmental samples, which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples, extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

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Bias: the systematic or persistent distortion of a measurement process that causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample: a subsample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. A blind sample is used to test the analyst's proficiency or the laboratory's proficiency in the execution of the measurement process.

Calibration: comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Method: a defined technical procedure for performing a calibration.

Calibration Standard: a solution prepared from the primary dilution standard solution or stock standard solutions. The Calibration solutions are used to calibrate the instrument response with respect to analyte concentration.

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.

Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples, data and records.

Characteristic: any property or attribute of a data, item, process, or service that is distinct, describable, and/or measurable.

Clean Air Act: the enabling legislation in 42 U.S.C. 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as

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amended, empowering EPA to promulgate air quality standards, monitor and to enforce them.

Client: any individual or organization for which items or services are furnished or work performed in response to defined requirements and expectations. See also Participant and User.

Comparability: a measure of the confidence with which one data set can be compared to another.

Completeness: a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Compromised Samples: those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions compromised samples are not analyzed. If emergency situations require analysis, the results must be appropriately qualified.

Computer program: a sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media, and be referred to as software, or may be stored permanently on computer chips, and be referred to as firm: Draft Final October 1997 EPA QA/R: 5 B: 2ware. Computer programs covered by this Standard are those used for design analysis, data acquisition, data reduction, data storage (data bases), operation or control, and data base or document control registers when used as the controlled source of quality information.

Confirmation: verification of the presence of a component through the use of an analytical technique based on a different scientific principle from the original method. These may include second column confirmation, alternate wavelength derivatization, mass spectral interpretation, alternative detectors, or additional cleanup procedures.

Conformance: an affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

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Consensus standard: a standard established by a group representing a cross section of a particular industry or trade, or a part thereof.

Contractor: any organization or individual that contracts to furnish services or items or perform work.

Corrective Action: action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Data of known quality: data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data quality assessment (DQA): a statistical and scientific evaluation of the data set to determine the validity and performance of the data collection design and statistical test, and to determine the adequacy of the data set for its intended use.

Data quality objectives (DQOs): Qualitative and quantitative statements derived from the DQO process that clarify study, technical, and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data usability: the process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form.

Deficiency: an unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Demonstration of capability: a procedure to establish the ability of the analyst to generate acceptable accuracy.

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Digestion: To decompose by heat, moisture or chemicals. 2 To extract a soluble ingredient by warming with a liquid.

Director (however named): the individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Document: any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Double Blind Sample: a sample submitted to evaluate performance with concentration and identity unknown to the analyst.

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Electronic Signature: symbols or other data in digital form attached to an electronically transmitted document as verification of the sender's intent to sign the document.

Entity: that which can be individually described and considered, such as a process, product, item, organization, or combination thereof.

Environmental conditions: the description of a physical medium (e.g., air, water, soil, sediment) or biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data: any measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology. For EPA, environmental data include information collected directly from measurements, produced from models, and compiled from other sources such as databases or the literature.

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Environmental data operations: work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental monitoring: the process of measuring or collecting environmental data.

Environmental processes: manufactured or natural processes that produce discharges to or that impact the ambient environment.

Environmental programs: activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; laboratory operations on environmental samples; and the design, construction, and operation of environmental technologies.

Environmental technology: an all: inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from or prevent them from entering the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term will apply to hardware: based systems; however, it will also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Evidentiary records: records identified as part of litigation and subject to restricted access, custody, use, and disposal.

Equipment blank: a sample that is known not to contain the target analyte and that is used to check the: cleanliness of sampling devices, collected in a sample container from a clean sample-collection device and returned to the laboratory as a sample.

Extramural agreement: a legal agreement between EPA and an organization outside EPA for items or services to be provided. Such agreements include contracts, work assignments, delivery orders, cooperative agreements, research grants, state and local grants, and EPA: funded Interagency agreements.

Federal Water Pollution Control Act (Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat. 816, that

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empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance.

Field blank: a sample that is known not to contain the target analyte and that is used to check for analytical artifacts or contamination introduced by sampling and analytical procedures, carried to the sampling site, exposed to sampling conditions and returned to the laboratory and treated as an environmental sample.

Finding: an assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Good Laboratory Practices (GLP): either general guidelines or formal regulations for performing basic laboratory operations or activities that are known or believed to influence the quality and integrity of the results.

Guideline: a suggested practice that is not mandatory in programs intended to comply with a standard.

Hazardous waste: any waste material that satisfies the definition of hazardous waste as given in 40 CFR Part 261, Identification and Listing of Hazardous Waste.

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid.

Independent assessment: an assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Initial demonstration of analytical capability: the procedure described in the method 40 CFR Part 136, Appendix A, used to determine a laboratory's accuracy and precision in applying an analytical method.

Inspection: an activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic.

Instrument Blank: a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.

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I**nterference:** means the effect on the final result caused by the sample matrix.

Internal Standard: a known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical method.

Laboratory: a body that calibrates and/or tests.
NOTES:
1. In cases where a laboratory forms part of an organization that carries out other activities besides calibration and testing, the term "laboratory" refers only to those parts of that organization that are involved in the calibration and testing process.
2. As used herein, the term "laboratory" refers to a body that carries out calibration or testing - at or from a permanent location, - at or from a temporary facility, or - in or from a mobile facility.

Laboratory Control Sample (quality control sample): an uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

Management: those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system: a structured non-technical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR): the qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirements determination, the following matrix distinctions shall be used: Aqueous: Any aqueous sample excluded from the definition

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of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater and effluents.
Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.
Non-aqueous liquid: Any organic liquid with <15% settable solids.
Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
Solids: Includes soils, sediments, sludges and other matrices with >15% settable solids.
Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.
Air Samples: Media used to retain the analyte of interest from an air sample such as sorbent tubes or summa canisters. Each medium shall be considered as a distinct matrix.

Matrix Spike (spiked sample, fortified sample): prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample/fortified sample duplicate): a second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

May: denotes permitted action, but not required.

Measurement and testing equipment (M&TE): tools, gauges, instruments, sampling devices or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Method: a body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification) systematically presented in the order in which they are to be executed.

Method Blank: a clean sample processed simultaneously with and under the same conditions as samples containing an analyte of interest through all steps of the analytical procedures.

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Method Detection Limit (Analytical Detection Limit): the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

Mixed waste: hazardous waste material as defined by 40 CFR 261 (RCRA) and mixed with radioactive waste subject to the requirements of the Atomic Energy Act.

Must: denotes a requirement that must be met.

Negative Control: measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate, non-fulfillment of a specified requirement.

Observation: an assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that does not yet cause a degradation of quality.

Organization: a company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure: the responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Participant: when used in the context of environmental programs, an organization, group, or individual that takes part in the planning and design process and provides special knowledge or skills to enable the planning and design process to meet its objective.

Peer review: a documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. The peer review is conducted by qualified individuals (or organization) that are independent of those who performed the work, but are collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. The peer review is conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. The peer review is an in depth assessment of the assumptions, calculations, extrapolations,

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alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Audit: the routine comparison of independently obtained quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Performance Based Measurement System (PBMS): a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner.

Pollution prevention (P2): an organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or there release or discharge to the environment.

Positive Control: measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Preservation: means the temperature control or the addition of a substance to maintain the chemical or biological integrity of the target analyte.

Procedure: a specified way to perform an activity.

Process: a set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Proficiency Testing or Evaluation: determination of the laboratory calibration or testing performance by means of interlaboratory comparisons.

Proficiency Testing Program: the aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results,

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statistical evaluation of the results in comparison to peer laboratories and the collective demographics and results summary of all participating laboratories.

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified performance limits.

Project: an organized set of activities within a program.

Proprietary: belonging to a private person or company.

Protocol: a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis, etc.) which must be strictly followed.

Provisionally approved: a determination by the department that a certified laboratory does not follow the accepted method or has not passed the appropriate proficiency testing audit for the most recent audit for an analyte or interdependent analyte group, but the certified laboratory is still capable of producing valid data.

Provisionally certified a determination by the department that a certified laboratory has deficiencies, but the certified laboratory is still capable of producing valid data.

Pure Reagent Water: shall be ASTM Type I or Type II water in which no target analytes or interferences are detected as required by the analytical method.

Qualified data: any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services: an indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality: the totality of features and characteristics of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user.

Quality assurance officer: the individual designated as the principal manager within the organization having management oversight and responsibilities for planning, coordinating, and assessing the effectiveness of the quality system for the organization.

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Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Assurance (Project) Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.

Quality control (QC): the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality.

Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement: a management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality indicators: measurable attributes of the attainment of the necessary quality for a particular environmental decision. Indicators of quality include precision, bias, completeness, representativeness, reproducibility, comparability, and statistical confidence.

Quality Manual: A document stating the quality policy, quality system and quality practices of an organization. This may be also called a Quality Assurance Plan or a Quality Plan. NOTE - The quality manual may include by reference other documentation relating to the laboratory's quality arrangements.

Quality management: that aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities,

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accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Range: the difference between the minimum and the maximum of a set of values.

Raw Data: any original information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof and that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Record (quality): a document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Remediation: the process of reducing the concentration of a contaminant (or contaminants) in air, waters, or soil media to a level that poses an acceptable risk to human health. Representativeness: a measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

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Replicate Analyses: the measurements of the variable of interest performed identically on two or more subsamples of the same sample within a short time interval.

Reproducibility: the precision, usually expressed as variance that measures the variability among the results of measurements of the same sample at different laboratories.

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the "cradle-to-grave," including its generation, transportation, treatment, storage, and disposal.

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitor, and enforce violations.

Scientific method: the principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis formulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Sample Duplicate: two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Selectivity: means the capability of a method or instrument to respond to the target analyte in the presence of other substances or things.

Self-assessment: assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Service: the result generated by activities at the interface between the supplier and the customer, and by supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and /or field analysis, repair, and installation.

Shall: denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there is no deviation. This does not

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prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should: denotes a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition: any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Specification: a document stating requirements, and which refers to or includes drawings or other relevant documents. Specifications should indicate the means and the criteria for determining conformance.

Spike: a known mass of target analyte added to a blank sample or subsample; used to determine recovery efficiency or for other quality control purposes.

Standard: a protocol established by a recognized authority (such as the American society for Testing Materials, the American National Standards Institute, or the Institute of Electrical and Electronic Engineers).

Standard Operating Procedures (SOPs): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed, and which is accepted as the method for performing certain routine or repetitive tasks.

Standard Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology and characterized for absolute content, independent of analytical method.

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Supplier: any individual or organization furnishing items or services or performing work according to a procurement document or financial assistance agreement. This is an all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

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Surveillance (quality): continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled.

Systems Audit (also Technical Systems Audit): a thorough, systematic on-site, qualitative review of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Target analyte: means the analyte that a test is designed to detect or quantify.

Technical Director: the individual(s) responsible for managing the technical aspects of an organization, and ultimately accountable for the quality of the organization's product(s).

Technical Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent Quality Controls to meet the required level of quality.

Technical review: a documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements are satisfied.

Technical systems audit (TSA): a thorough, systematic, onsite, qualitative audit of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system.

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. NOTE - The result of a test is normally recorded in a document sometimes called a test report or a test certificate.

Test Method: defined technical procedure for performing a test.

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Traceability: the ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for quality for the project.

Trip blank: means a sample known not to contain the target analyte that is carried to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures.
United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (I.e., the air, water, and land) upon which human life depends.

User: when used in the context of environmental programs, an organization, group, or individual that utilizes the results or products from environmental programs. A user may also be the client for whom the results or products were collected or created.

Validation: confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. In design and development, validation concerns the process of examining a product or result to determine conformance to user needs.

Verification: confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, validation concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

Work: the process of performing a defined task or activity (e.g., research and development, field sampling, analytical operations, equipment fabrication).

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Quality Assurance Program Plan

Section 15 Glossary

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/2004
TS00085	Review for 2006	Melissa Olsen	08/04/2006
	Review for 2008. No changes made.	Melissa Olsen	10/07/2008
	Review for 2009. No changes made.	Melissa Olsen	01/26/2009
	Review for 2010. Updated laboratory address in header.	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes made.	Melissa Olsen	10/11/2011
23199	2013 Review. No changes.	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. Added definition for electronic signature. Rev. 7 to 8	Melissa Olsen	04/09/2015
31572	Review for 2016. No changes.	Melissa Olsen	03/11/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/27/2017
	Review for 2018. No changes made.	Melissa Olsen	09/04/2018
58723	Review for 2019. No changes made.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes made.	Melissa Olsen	01/13/2020
67192	Review for 2020. No changes made.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/07/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022

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Quality Assurance Program Plan

Section 16 References

Effective Date: 9/8/2021	Document Number: CLMN4423-0016	Rev.: 10

REFERENCES

1. U.S. Environmental Protection Agency, 1983, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80, February.
2. NELAC Quality Systems Chapter 5, 2016
3. NELAC TNI Standard, 2016
4. R444-14 Rule for the Certification of Environmental Laboratories, by the State of Utah Bureau of Laboratory Improvement.
5. American Industrial Hygiene Association, Laboratory Quality Assurance Program April 2002.
6. Kennecott Utah Copper Chemical and Hygiene Plan
7. Kennecott Safety Policies (most current is in Bentley, a commercial document control system).
8. Kennecott Utah Copper Environmental Laboratory SOP's and manuals, most current revision in Bentley

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Quality Assurance Program Plan

Section 16 References

Effective Date: 9/8/2021	Document Number: CLMN4423-0016	Rev.: 10

MOC#	Description of Change	Prepared By	Date
TS00020	Review for 2004	Janna Hardman	09/30/2004
TS00085	Review for 2006	Melissa Olsen	08/04/2006
	Review for 2008. Updated NELAC revision number and date.	Melissa Olsen	10/07/2008
	Review for 2009. No changes made.	Melissa Olsen	01/26/2009
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17479	Review for 2011. Added reference #3-NELAC TNI Standard, Volume 1-2009	Melissa Olsen	10/11/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/24/2013
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31572	Review for 2016. No changes.	Melissa Olsen	03/11/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/27/2017
	Review for 2018. No changes.	Melissa Olsen	09/04/2018
58723	Review for 2019. Updated #9 to Bentley.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/13/2020
67192	Review for 2020. No changes.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/07/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022
102982	Updated NELAC references. Removed reference to Kennecott Waste manual. This manual is in the Central Lab Manuals which are in Bentley, a commercial document control system. Rev. 9 to 10	Melissa Olsen	11/03/2023

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Quality Assurance Program Plan

Section 17-Control of Documents and Records

Effective Date: 9/8/2021	Document Number: CLMN4423-0017	Rev.: 03

Control of Documents

All documents relating to the Quality Management System (QMS) at Kennecott Environmental Laboratory (KEL) are controlled according to the following document control procedures:

- CLSOP4423-1010 -Preparation of Standard Operating Procedures
- CLSOP4423-1015 -Quality Assurance Manual Maintenance and Updates

Control of Records

Quality records are maintained to provide evidence of conformity to requirements and for the effective operation of the QMS. The records are maintained according to the following procedures:

- CLSOP4423-1027 - Onsite Storage and Control of Records
- CLSOP4423-1029 - Offsite Contracted Data Storage (Iron Mountain)

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MOC#	Description of Change	Prepared By	Date
	Initial Release	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	10/11/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
30091	Review for 2015. No changes.	Melissa Olsen	04/2015
31572	Review for 2016. No changes.	Melissa Olsen	04/11/2016
43586	Review for 2017. No changes.	Melissa Olsen	03/27/2017
	Review for 2018. No changes.	Melissa Olsen	09/04/2018
58723	Review for 2019. No changes.	Melissa Olsen	08/19/2019
60468	Review for 2020. No changes.	Melissa Olsen	01/13/2020
67192	Review for 2020. No changes.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/07/2021
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102982	Review for 2023. No changes.	Melissa Olsen	11/03/2023

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Quality Assurance Program Plan

Section 18-Procurement of Laboratory Supplies and Services

Effective Date: 9/8/2021	Document Number: CLMN4423-0018	Rev.: 03

Procurement of Laboratory Supplies and Services

A documented procedure, CLSOP4423-7013 Procurement of Laboratory Supplies and Services, is followed to ensure purchased products and services conform to specified purchase requirements. The procedure outlines the extent of control and the criteria for the selection and evaluation of the suppliers.

MOC#	Description of Change	Prepared By	Date
	Initial Release	Melissa Olsen	02/22/2010
17479	Review for 2011. No changes.	Melissa Olsen	10/11/2011
23199	Review for 2013. No changes.	Melissa Olsen	04/24/2013
26233	Updated branding.	Melissa Olsen	06/02/2014
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67192	Review for 2020. No changes.	Melissa Olsen	09/17/2020
79250	Review for 2021. No changes.	Melissa Olsen	09/08/2021
94373	Review for 2022. No changes.	Melissa Olsen	12/02/2022
102982	Review for 2022. No changes.	Melissa Olsen	11/03/2023

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GROUND WATER CHARACTERIZATION AND MONITORING PLAN
RIO TINTO KENNECOTT
SOUTH JORDAN, UTAH

Revision 12 - December 2023

Approved By: Cassady Kristensen Date: 1/11/2024
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SUMMARY

Ground water conditions are monitored to evaluate ground water quality and the potential impacts on ground water beneath and near Rio Tinto Kennecott (RTK) facilities. Specific objectives of the ground water monitoring conducted by RTK are to: 1) establish baseline ground water quality and hydrogeologic conditions; 2) identify areas where operations may have impacted ground water conditions; 3) monitor ground water quality in areas impacted by operations; 4) monitor progress of ground water cleanup efforts, 5) provide continued monitoring in the vicinity of current operations to detect ground water quality impacts should they occur; 6) collect data for use in the classification of ground water; and, 7) comply with permit requirements.

The purpose of this Ground Water Characterization and Monitoring Plan is to set forth a project plan which utilizes standardized procedures and methods for the collection and review of ground water monitoring data. The following documents are incorporated within this Plan: 1) Health and Safety Plan; 2) Quality Assurance Project Plan; and 3) Standard Operating Procedures for Ground Water Sampling. The Health and Safety Plan addresses health and safety requirements for the conduct of the field work. The Quality Assurance Project Plan presents: 1) project organization and responsibilities; 2) quality assurance objectives for the collection of data in terms of precision, accuracy, representativeness, comparability, and completeness; 3) analytical procedures; and 4) guidelines for data verification and reporting, internal quality control checks, performance and systems audits, and corrective actions. The Standard Operating Procedures include all field activities associated with ground water sampling. Together these documents provide a systematic approach to be used in the collection of ground water monitoring data and the evaluation of regional baseline conditions when needed. The guidance and standard operating procedures will help to ensure a technically sound and defensible ground water characterization and monitoring program.

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Attachment 2. Quality Assurance Project Plan
Attachment 3. Standard Operation Procedures for Ground Water Sampling

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SECTION 1 OVERVIEW

1.1 Objectives

RTK currently utilizes an extensive ground water monitoring system to monitor the ground water levels and water quality in the vicinity of its facilities.

Specific objectives of the ground water monitoring program conducted by RTK have been to:

- Establish baseline ground water quality and hydrogeologic conditions.
- Identify areas where operations may have impacted ground water quality.
- Monitor ground water quality in areas impacted by operations.
- Monitor progress of ground water cleanup efforts.
- Provide continued monitoring in the vicinity of current operations to detect ground water quality changes should they occur.
- Assess adequacy of source control measures.
- Support the determination of ground water classifications; and
- Comply with permit monitoring requirements.

1.2 Purpose of Plan

The purpose of this Ground Water Characterization and Monitoring Plan (GCMP) is to establish a project plan which standardizes procedures and methods for the collection, analysis and reporting of ground water monitoring data. Therefore, a systematic approach will be used in the collection of monitoring data and the evaluation of ground water quality.

This document identifies the goals and objectives of the program and identifies project tasks. Requirements for data reporting and review, as well as periodic review of this Plan are included, along with the following documents:

- Health and Safety Plan (HSP).
- Quality Assurance Project Plan (QAPP).
- Standard Operating Procedures for Water Sampling (SOP).

The HSP addresses health and safety requirements for conducting fieldwork. The QAPP presents: 1) project organization and responsibilities; 2) quality assurance objectives for the collection of data in terms of precision, accuracy, representativeness, comparability, and completeness; 3) analytical parameters; and 4) guidelines for data verification and reporting, internal quality control checks, performance and systems audits, and corrective actions. The SOP presents standard operating procedures for field activities, including ground water sample collection and field measurements.

Site-specific project plans to evaluate contaminant sources, plume migration, and any need for remedial actions will be developed as necessary, independent of this

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GCMP. However, the procedures presented here will be used to collect the necessary data for such evaluations. As the need for additional field procedures and data evaluation techniques becomes evident during the planning and implementation of such projects, this GCMP will be amended to include those items. Monitoring locations, analytical parameters, and frequency of sampling will also be reviewed and updated regularly (unless specified in permits) as directed in this GCMP. Updates will be based on an analysis of results for each sampling point and the data needs for specific facility areas.

SECTION 2 SITE SETTING AND BACKGROUND

This section provides the site setting as well as background information on operations and monitoring conducted on RTK property. For discussion purposes, the property is subdivided into two areas, the Great Salt Lake Area (GSL) and the Southwest Jordan Valley Area (SWJV). The SWJV area includes all areas associated with the Bingham Mine and the Copperton Concentrator. Features include the Mine, the leach water collection system, the leach and storm water reservoirs and the historic evaporation ponds. The locations of ground water monitoring points for the SWJV Area are shown in Plate 2. The GSL area includes the general area of the Utah Copper facilities associated with the concentrating, tailings disposal, smelting, and refining of metals. The locations of established ground water monitoring points are shown in Plate 1.

RTK has conducted two Remedial Investigation and Feasibility Studies (RI/FS) of mining- related contamination in groundwater. The first RI/FS is the area east of the mine dumps in the southwestern Jordan Valley. The second RI/FS consists of the areas beneath and down-gradient of the Smelter and Refinery.

In addition, other extensive ground water studies completed in these areas have resulted in the acquisition of baseline ground water data. The hydrogeologic setting and current ground water conditions beneath RTK property are described in the "Hydrogeologic Report for the Great Salt Lake Area" (KUC, 1992a) and in "Ground Water Assessment Report the Southwestern Jordan Valley Area" (KUC, 1992b). Ground water impacts may result from natural leaching of mineralized outcroppings, commercial leaching processes, ground water pumping, storage of water in surface water impoundments, seepage from irrigation and water supply canals, and the infiltration of precipitation. In order for RTK to evaluate the potential past and present impacts on ground water beneath and near its facilities, RTK has established a ground water monitoring network to monitor and evaluate ground water conditions. Wells utilized in the ground water monitoring network include RTK monitoring wells, State, City, and County monitoring wells, RTK production wells, and public and residential supply wells.

SECTION 3 INITIAL EVALUATION

3.1 Ground Water

Ground water samples have previously been collected from many of the monitoring wells included in this monitoring program. Samples were predominately collected by

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the RTK Sampling Crews and analyzed by the RTK Environmental Laboratory. The analytical results for samples collected and analyzed by RTK and sampling performed by others are contained in the RTK Environmental Laboratory Information Management System (LIMS) and are summarized in Attachments to the Ground Water Characterization and Monitoring Plan issued in April of 1992. Data collected are presented in the Quarterly Ground Water Characterization and Monitoring Reports and Quarterly Quality Assurance Reports.

SECTION 4 RATIONALE

4.1 Objectives and Approach

The general objective of this monitoring program is to better define and document current ground water quality conditions near RTK's operations. Annual data reviews and evaluations will determine the number and frequency of sampling points monitored to achieve the objectives. This document identifies the procedures to be used to evaluate and modify the number of points sampled and the sampling frequency.

4.2 Monitoring Well Selection

Monitoring well selection is grouped into three categories: 1) Objectives of ground water monitoring in the Great Salt Lake area, 2) Objectives of ground water monitoring in the southwestern Jordan Valley, and 3) Regulatory required sampling in both of these areas.

Detailed information used to define the objectives of the monitoring programs in the GSL area and the SWJV is compiled in two remedial investigations and feasibility studies (RI/FS) of mining-related contamination in groundwater. Both are conducted by RTK.

The following sections identify the sampling points included in this GCMP and the general rationale for their inclusion. Sample point locations are shown on Plates 1 and 2. Ground water monitoring well construction details in Attachment 1. The hydrogeologic conditions and types of operations vary depending on site location and facility use. Therefore, the monitoring programs in each location have different objectives and approaches. Table 1 is an example of a monitoring schedule included in the Annual Report, which summarizes the rationale for the wells, current monitoring frequencies, and monitoring parameters proposed for the current monitoring program. The rationale for selection of the monitoring points is summarized in the following sections.

4.2.1 Great Salt Lake Area

The general objective of the monitoring program for the Great Salt Lake Area is to establish and document current local ground water and surface water conditions and trends and to collect the data required to meet existing, as well as anticipated future, regulatory requirements. A summary of ground water conditions in this area is provided in the "Hydrogeologic Report for the Great Salt Lake Area" (RTK, 1992a.)

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There exists an extensive network of shallow and deep ground water monitoring wells and piezometers in the GSL area. The monitoring wells included in this GCMP were installed near facilities at the north end of RTK property to monitor potential effects resulting from the Tailings Impoundment, Refinery, Smelter, as well as potential effects from other facilities.

These wells were used to establish the areal and vertical distribution of aquifers and aquitards, the direction and velocity of ground water flow in and between each aquifer, and the chemical composition of the water in each aquifer.

State, County, and City monitoring wells were used to investigate ground water conditions near the Tailings Impoundment and in the vicinity of the City and County landfills up-gradient of the Tailings Impoundment (Slam 1989a, 1989b). These wells were included in the monitoring program in 1991 in order to further document the ground water conditions but will no longer be sampled.

4.2.1.1 Baseline Program

In order to accomplish the monitoring objectives identified for the GSL area, a program of baseline monitoring was established. The basis of this program was to collect four quarterly rounds of ground water samples for a comprehensive suite of analytes from each well. After collection of the baseline data, these monitoring data were reviewed to evaluate the need for continued monitoring, the need for expansion of the monitoring system, and the types of analyses required.

4.2.1.2 North Zone Groundwater

The general objective of the monitoring program in the North Zone Groundwater Operation, Maintenance, and Replacement Plan (OM&R Plan) (in preparation) is to track the nature and extent of ground water contamination from the smelter and refinery. Specifically, the program:

1. monitors the natural attenuation of the selenium plume from the refinery.
2. monitors the natural attenuation of the selenium and arsenic plumes at the smelter.
3. monitors the effectiveness of source control actions taken at the smelter and refinery and
4. provides baseline data concerning background water quality.

Oversight for the OM&R Plan is provided by Environmental Protection Agency Region VIII (EPA), Utah Department of Environmental Quality (UDEQ), and a Technical Review Committee (TRC) of various interested parties. The OM&R Plan interfaces with the GCMP in two significant areas. First, all of the data generated and used in the OM&R Plan is collected from monitoring wells that are part of the GCMP.

The second important relationship between the OM&R Plan and the GCMP is that all of the water data collected required for the OM&R Plan is subjected to the quality assurance/quality control (QA/QC) standards established in the GCMP.

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4.2.2.3 Continued Monitoring Program

All baseline data have been reviewed to evaluate additional monitoring requirements. Evaluation of these requirements were based on the following:

- Aberrant data - Graphs of analytical parameters as a function of time were constructed to identify data that appear to be erroneous or deviate significantly from established data trends. If these aberrant data appeared to significantly affect the interpretation of the data for the well, additional frequent monitoring was recommended. This consideration was generally limited to the analytical constituents TDS, As, Se, Cu and Cd.

- Identification of significant temporal data trends - Evaluation of the existing data indicates many current temporal changes in the data. These changes imply that ground water conditions are changing in response to some stimulus. In many cases, these changes appear to be in response to seasonal fluctuation or other observable factors effecting ground water conditions. Where these trends are unusual, unexplained, and or appear to be significant to the understanding of ground water conditions, the wells displaying these changes were selected for additional monitoring at a frequency that would further document the presence or absence of the trend.

- Establishment of a longer or more detailed sampling history - Review of the data showed many wells in which the variation of critical analytes was greater or less than expected and additional analyses are required to identify the nature and extent of the variation. Long-term monitoring of potentially affected wells - In a number of cases, particularly in the vicinity of the Refinery, wells were identified that may have been affected by RTK operations.

Current Wells and sampling frequencies for project plans are based on one or more of the factors identified above and are identified and submitted in the Annual Report Table 1.

4.2.2 Southwest Jordan Valley Area

The general objective of the monitoring program in the Southwest Jordan Valley Area is to monitor groundwater plume containment and cleanup in order to meet RTK monitoring obligations under the South Facilities Groundwater Operations, Maintenance, and Replacement Plan (RTK, 2009). Specifically, the program:

1. monitors the containment and cleanup of the low pH and elevated metals plume.
2. monitors the containment and cleanup of the plume containing elevated sulfate/TDS concentrations.
3. monitors the effectiveness of the leach collection system at the toe of the waste rock dumps.
4. monitors the water quality in the areas near 11800 South Street where municipal, domestic and irrigation water supply wells are located near or down gradient of the elevated sulfate/TDS plume.

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5. meets existing, as well as, anticipated future monitoring requirements; and
6. provides baseline data concerning background water quality. The program will also monitor the effectiveness of source-control actions at the Bingham Reservoir and the Eastside Collection System.

Areas affected by RTK and pre-RTK operations have been defined using the existing database. A summary of the ground water and surface water results provided to date are given in "Ground Water Assessment Report of the Southwestern Jordan Valley Utah" (KUC, 1992b, RIFS KUC 1998, and RD/RA KUC 2002).

The 1998 SWJV RI report documents the field investigations conducted by RTK, presents the site characteristics, assesses the nature and extent of mining-related contamination, provides human health and ecological risk assessments, and offers conclusions regarding the risk to human health and the environment posed by mining related contamination. The study area covered by the RI extends from the RTK waste rock disposal areas on the eastern edge of the Oquirrh Mountains to the Jordan River. It is bounded on the north at approximately 7800 South Street and on the south by the foothills of the Traverse Mountains.

RTK funded and conducted the work for the RI/FS with oversight by the U.S. Environmental Protection Agency (EPA) Region VIII, the State of Utah Department of Environmental Quality (UDEQ) and a Technical Review Committee (TRC). The activities conducted by RTK were consistent with applicable guidance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA also known as Superfund), and with requirements of the National Contingency Plan (NCP).

In addition to the RI report, a well inventory of the SWJV was conducted to determine the existence and use of all wells in the southwest part of the valley. This information has been used to review current GCMP sampling locations and identify changes to be made in future GCMP schedules.

4.2.2.1 Continued Monitoring Program

Sampling of a select group of wells associated with the Bingham Creek Reservoir low-pH, elevated-metals plume will generally occur biannually in order to monitor chemistry changes associated with extraction of the plume. On the leading (eastern) edge of the low-pH plume, monitoring of select wells will occur on a semiannual basis to track advancement of the plume. All samples from these wells will be analyzed for Basic and Major analytical suites plus dissolved iron, aluminum, manganese, and acidity.

Selected wells completed in portions of the aquifer that contain elevated sulfate but not low-pH will be monitored for Basic and Major group analytes. These wells are mostly completed in the halo of elevated sulfate surrounding the Bingham Creek Reservoir low-pH plume.

Key wells located in the areas between and around the B2G1193–BFG1200 and West Jordan City well fields will be sampled on a quarterly, semiannual or annual

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basis to monitor movement of the elevated-sulfate plume. All samples from these wells will be analyzed for Basic group analytes and some for Major group analytes as well. The higher monitoring frequency of these wells over those previously listed is warranted by concerns of potential effects on third party interests. Other wells that are sampled because of third party concerns include privately or municipally owned wells and RTK wells completed near areas where third parties are using water, such as irrigation wells near the elevated-sulfate plume east of the Former RTK Evaporation Ponds.

Many monitoring wells located immediately down-gradient of the leach collection system are included in regulatory monitoring and are listed in the following section. A few wells located in this area but not included in any permit required monitoring program will be sampled annually for Basic and Major analytical suites.

Several wells will be monitored for changes in Basic and Major group analytes as part of approved Drinking Water Source Protection plans, and several production wells will be sampled quarterly or annually to monitor water quality used at various RTK facilities.

4.2.3 Regulatory Monitoring Requirements

RTK has six groundwater discharge permits issued by the State of Utah which require groundwater monitoring for compliance with the permits. Portions of both the SWJV and GSL are under one or more of the following permits:

- Large and Small Bingham Reservoirs - UGW350006
- Smelter – UGW350008
- Bingham Canyon Mine and Water Collection System – UGW350010
- Tailings Impoundment – UGW350011
- Magna Process Water Reservoir Facility – UGW350015
- Copperton Concentrator – UGW350017
- Barneys Canyon – UGW350001

4.3 Selection of Analytical Parameters

Based on the review of the existing data and regulatory (potential as well as existing) requirements, different groups of analytical parameters have been identified as listed below:

- Basic
- Major Ions
- Minor Ions
- Trace Metals 1, Trace Metals 2, Trace Metals 3
- Mercury
- Radionuclides
- Other.

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Basic

The basic group of analyses is comprised of the analytes that are sensitive to changes in ground water quality that could result from RTK's operations. The analytes included in the basic group are listed in Table 2 and include conductivity, pH, TDS, TSS, sulfate, chloride. Arsenic, selenium, copper, lead, zinc, and cadmium are analyzed for dissolved concentrations only unless totals are requested. Significant changes in ground water conditions potentially caused by RTK's operations can be detected early through monitoring of only these analytes.

Major Ions

The Major Ions group, when combined with the Basic Parameter group provides sufficient analyses to allow for the calculation of ionic and mass balances. This list of constituents is required for all wells monitored to satisfy monitoring requirements to meet the conditions of Ground Water Discharge Permits. The analyses included in Major Ion group are listed in Table 2 and include: alkalinity, calcium, potassium, magnesium, and sodium.

Minor Ions

The Minor Ion group adds some minor ions and indicator parameters that provide additional insight into the nature of the water sampled. The primary use of these constituents is for the initial characterization of water chemistry. This group is commonly monitored where the water is believed to be at a reducing potential. The analyses included in the Minor Ion group are listed in Table 2 and include: fluoride, nitrate, nitrite, phosphorus, dissolved oxygen, Eh, ferrous iron, and sulfide.

Trace Metals

The trace metals have been divided into three groups as follows:

Trace Metals 1	This group includes the trace metals barium, chromium, and silver. These metals are the most commonly requested trace metals. These trace metals have MCL's under the Safe Drinking Water Act (SDWA) and with the basic group from above contain the eight RCRA metals.
Trace Metals 2	This group includes the metals iron, manganese, molybdenum, and nickel. These metals are added to include the common trace metals that have only secondary standards under the SDWA.
Trace Metals 3	This group includes the trace metals aluminum, antimony, beryllium, boron, thallium, and titanium, which are rarely requested.
Radionuclides	The radionuclide group includes the analytes: radium 226, radium 228, total uranium, gross alpha and gross beta. This list of constituents is required for wells monitored to satisfy the conditions of the Ground Water Discharge Permit for the Tailings Impoundment in the area near the former Gypsum Tailings Impoundment.

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Mercury	Mercury analysis is done on total metals only. The analysis is to satisfy the requirements of the ground water discharge permits as well as some of the drinking water requirements.
Other	This is used to request additional analytes such as Cyanide (CN), Nitrates, Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, Xylene, and Naphthalene (BTEX-N) et al. In addition, a new category listed in this group as "Balance" will include the trace metals aluminum, iron, manganese, and also acidity. This category when requested on low pH water samples will provide a more complete geochemical analysis to obtain and calculate a charge balance.

4.4 Data Quality Objectives

Data Review

The results of all sampling will be reviewed by the Project Manager (Principal Advisor Water Quality) or his designee upon receipt of analytical results from the laboratory. If based on a timely review of analytical data, any significant questions are raised regarding the quality or representativeness of the results, the well will be re-sampled.

Objectives

The data quality objectives of this Plan are discussed in detail in the Quality Assurance Project Plan (QAPP) and summarized below:

- The precision objectives for analytical and field methods are: 1) within 25% of the relative percent difference or + (4) times the MDL (per 40 CFR Part 136, Ap. B Rev 1.1, July 1, 1992) whichever is greater, for duplicate samples; and 2) 75% to 125% recovery for matrix spike duplicates (70% to 130% for organic compounds). It is recognized that these objectives may not be appropriate for certain parameters and for high TDS water; particularly containing high levels of chloride and sulfate.

- The accuracy objectives for analytical and field methods are: 1) less than the method quantitation limit for blank; and 2) 75% to 125% recovery for spikes if the concentration is 10 times or greater than the MDL, (70% to 130% for organic compounds). These objectives have been identified for relatively low TDS water and will vary with TDS.

- All sample collection and measurements will be performed in accordance with protocols and procedures documented in the QAPP and SOP to assure sample representativeness. All RTK Environmental and Industrial Hygiene Laboratory Procedures are available on the RTK Intranet. These documents are controlled through the Documentum Program.

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- Every effort will be made to achieve data collection completeness.

- Comparability of data will be accomplished through the use of standard operating procedures.

SECTION 5 TASKS

The following tasks have been identified for the Ground Water Characterization and Monitoring Plan:

TASK 1 Project Planning and Quality Assurance
TASK 2 Sample Point Selection
TASK 3 Sampling
TASK 4 Site-wide Water-level Measurements
TASK 5 Verification of Results and Data Evaluation
TASK 6 Well Abandonment
TASK 7 New Well Construction
TASK 8 Annual Ground Water Characterization and Monitoring Reports
TASK 9 Periodic Update of Ground Water Characterization and Monitoring Plan

5.1 TASK 1 - PROJECT PLANNING AND QUALITY ASSURANCE

This task consists of the planning, preparation, quality assurance planning, and coordination required maintaining and fully implementing this Plan. Project planning will continue throughout the project to ensure the achievement of project objectives. The process for reviewing and updating the Ground Water Characterization and Monitoring Plan is discussed in Task 9.

Quality assurance planning is documented in the QAPP. The QAPP lists the quality control samples to be collected in conjunction with routine monitoring in order to measure the precision, accuracy, representativeness, and comparability of field and laboratory techniques. Guidelines for data verification and reduction, internal quality control checks, performance and systems audits, and corrective actions are also presented in the QAPP.

5.2 TASK 2 - SAMPLE POINT SELECTION

Wells considered for sampling were selected from the following groups of wells:

- RTK monitoring wells and piezometer
- RTK production wells
- State, county, and city monitoring wells
- Public and residential wells
- Municipal wells.

The selected wells and sampling frequency for these wells are listed in the current Annual Report in Table 1. The general objectives and rationale for the selection of these wells are discussed in section 4.

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5.2.1 Addition of New Monitoring Points

Additional sampling points may be added to the monitoring program at a future date, provided that the rationale for the addition of a sampling site is documented by submitting a Well Approval Form to the Project Manager for approval prior to inclusion to the network. Potential rationale for expanding the monitoring program includes the identification of sampling points located in critical areas, replacement of existing sampling points which must be abandoned, and the identification of problem areas. Such documentation (to be filed in the Water Quality Data Filing System) will include monitoring parameters, monitoring frequency, and previously collected monitoring data.

5.3 TASK 3 – SAMPLING

Water sampling activities will be conducted in accordance with the Standard Operating Procedures (SOP). Procedures to be used in the collection of water samples include:

DC-01 through DC-07	Sample Documentation and Sample Handling
MD-01 through MD-03	Equipment Maintenance and Decontamination
QC-01 through QC-05	Quality Control Sampling
GF-01 through GF-16	Measurement of Field Parameters
GW-01 through GW-14	Collection of Ground Water Samples
PW-01 through PW-15	Collection of Process Water Samples
DW-01 through DW-09	Collection of Drinking Water Samples
SW-01 through SW-11	Collection of Surface Water Samples
SS-01 through SS-05	Collection of Sediment Samples.

5.4 TASK 4 - SITE-WIDE WATER LEVEL MEASUREMENTS

In addition to the water level or hydraulic head measurements taken prior to each sampling event, annual water level measurements, in select, monitoring wells will be made. These water levels will be completed as required by permit conditions and/or the needs of special projects. The measurements will be taken during the shortest elapsed time period that is feasible.

Site-wide water-level measurements will allow an evaluation of the relationships between surface water and the ground water potentiometric surface. Such determinations are not possible using measurements taken at the time of sampling over several weeks or months.

Potentiometric information is required in order to evaluate the ground water regime with respect to flow velocity and direction. Details of the methods and procedures used to conduct these measurements are provided in the SOP.

5.5 TASK 5 - VERIFICATION OF RESULTS AND DATA EVALUATION

Verification of analytical results will include ion balances (when complete analyses are conducted for major cations and anions), statistical checks against previous results, and spot checks of data transfer. Data management

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is described in Section 5 of the QAPP.

5.6 TASK 6 - WELL ABANDONMENT

A monitoring well must be properly abandoned (i.e., filled or plugged with an "impermeable" material) if it will no longer be used due to the availability of nearby wells, access problems, susceptibility to flooding, lack of water in well, well construction problems, or impending destruction due to construction activities on RTK property. A well must also be abandoned if the integrity of the annulus seal is in question. Lack of proper abandonment may result in a pathway for surface spills or cross-contamination between aquifers of different depth and quality. All monitoring well abandonments will be done in compliance with State of Utah Administrative Rules for Water Well Drillers. Procedures for monitoring well abandonment are provided in the SOP.

5.7 TASK 7 - NEW WELL CONSTRUCTION

The Project Manager assigned to a well installation project will select the appropriate drilling method based on expected subsurface conditions. The auger or vibratory sonic methods are appropriate for wells in lake bottom sediments (unconsolidated materials) to depths of about 100 feet. Vibratory sonic and mud or air rotary and cable tool are appropriate for unconsolidated and consolidated formations of greater depths. The water or mud used with rotary or cable tool methods must be free of contaminants and of a known composition. Procedures for new well construction are provided in the SOP.

5.8 TASK 8 - GROUND WATER CHARACTERIZATION AND MONITORING REPORTS

Brief reports will be written within 90 days after the end of each quarter for internal use to summarize results for the previous three months. An Annual Ground Water Characterization and Monitoring Report will present the results of the previous year's monitoring and the proposed monitoring plan for the current year. This report will be prepared by March 31 for each monitoring year (e.g., January 1 through December 31) to allow a three-month turnaround time for laboratory analyses and report preparation. The report outline will generally adhere to the following:

1.0 Summary
2.0 Introduction
3.0 Quality Assurance Summary
4.0 Summary of Water Quality Analyses
5.0 Ground Water Characterization
6.0 Well Abandonment
7.0 New Well Construction
8.0 Program Changes
9.0 Recommendations for Program Changes

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5.9 TASK 9 - UPDATE OF GROUND WATER CHARACTERIZATION AND MONITORING PLAN

The Ground Water Characterization and Monitoring Plan is a working document. Updates may be made by documenting the change to the file and reporting the change in the quarterly and annual monitoring reports. The Supervisor Sampling will review this Plan in September of each year. After completion of this review, the manager will determine whether or not a formal revision is needed.

The Utah State Division of Water Quality will be notified prior to implementing any changes to this document that will significantly affect the collection and analysis of regulatory required samples.

SECTION 6 SCHEDULE

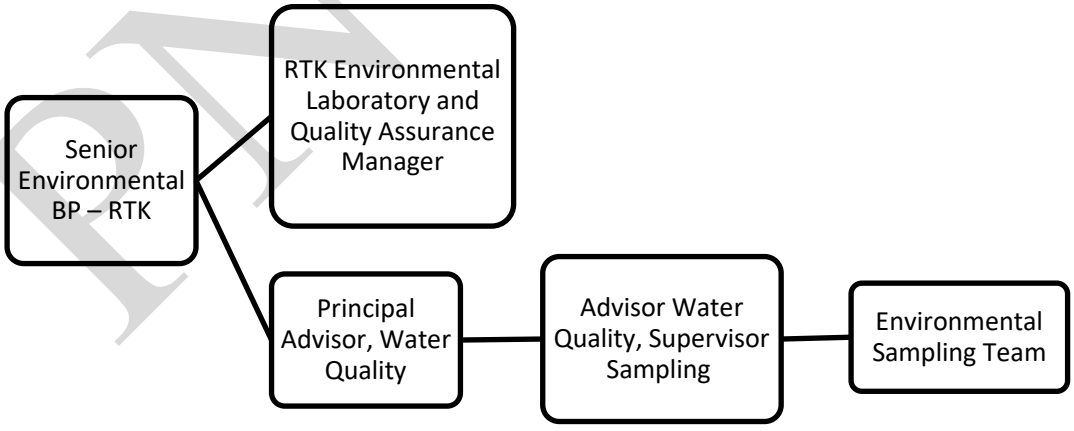
A comprehensive sampling and monitoring schedule of sampling at each point will be included in the Annual Reports Table 1. Water levels are to be measured as required by the sampling schedule in the Table 1.
Annual measurements will be done in the summer or late fall.

SECTION 7 PROJECT MANAGEMENT

7.1 PROJECT ORGANIZATION

The organizational structure for implementing the ground water sampling efforts is shown in Figure 1. Responsibilities of each of the positions are described in Section 2 of the Quality Assurance Project Plan.

FIGURE-GCMP 1. Project Organization Chart for the Ground Water Characterization and Monitoring Program



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SECTION 8 REFERENCES

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TABLE-GCMP 1. RTK GROUND WATER MONITORING PROGRAM

LEGEND

M	Monthly
Q	Quarterly sampling
A	Annual sampling
S	Semi-Annual sampling
E	Every other year
F	Sampled every five years
NS	Not Sampled

NOTE:

- Table lists sample frequency as of 2023. Changes in well status is maintained in a RTK Monitoring Well database which is reviewed and updated as needed.
- Trace metals will be run only for dissolved constituents unless otherwise noted.
- Location coordinates are based on RTK mine coordinates.
- List includes only RTK monitoring wells, State, County, and others are not listed.

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
ADS2560	S				Yes				Yes						
ADS2561	S				Yes				Yes						
B1G1120A	A	Y			Yes			Yes				Yes			Yes
B1G1120B	A	Y			Yes			Yes				Yes			
B1G951	E	Y			Yes			Yes	Yes			Yes			
B2G1157A	S	Y			Yes			Yes				Yes			
B2G1157B	S	Y			Yes			Yes				Yes			
B2G1157C	E	Y			Yes			Yes				Yes			
B2G1176A	E	Y			Yes			Yes				Yes			
B2G1176B	E	Y			Yes			Yes				Yes			
B2G1193	Q	Y		Y	Yes	Yes		Yes				Yes			
B2G1194A	E	Y			Yes			Yes				Yes			
B2G1194B	E	Y			Yes			Yes				Yes			
B3G1197A	E	Y			Yes			Yes				Yes			
B3G1197B	E	Y			Yes			Yes				Yes			
BCG2788A	F	Y	Y		Yes			Yes	Yes						
BCG2788C	F	Y	Y		Yes			Yes	Yes						
BCG281	S	Y	Y		Yes			Yes	Yes						
BCG282	S	Y	Y		Yes			Yes	Yes						
BCG283	S	Y	Y		Yes			Yes	Yes						
BCG284	S	Y	Y		Yes			Yes	Yes						
BCG2846	S	Y	Y		Yes			Yes	Yes						
BCG285	S	Y	Y		Yes			Yes	Yes						
BCG2860A	M	Y	Y	Y	Yes	Yes		Yes	Yes						
BCG2860B	M	Y	Y	Y	Yes	Yes		Yes	Yes						
BCG496	Q	Y	Y		Yes			Yes	Yes						
BCG848	Q	Y	Y		Yes			Yes	Yes						
BCG849	S	Y	Y		Yes			Yes	Yes						
BCG850	S	Y	Y		Yes			Yes	Yes						
BCG851A	Q	Y	Y		Yes			Yes	Yes						
BCG851B	Q	Y	Y		Yes			Yes	Yes						
BCG852	S	Y	Y		Yes			Yes	Yes						
BCP1483	M	Y			Yes	Yes		Yes							Yes
BCP1483A	M														
BCP2738	V				YES			YES							
BCP2739	M				YES			YES							
BCP2741	M				YES			YES							
BCP2743	M				YES			YES							
BCP2750	M				YES			YES							
BCS2730	A	Y	Y		Yes			Yes							
BCS2731	A	Y	Y		Yes			Yes							
BCS2732	A	Y	Y		Yes			Yes	Yes						
BCS2733	A	Y	Y		Yes			Yes							
BCS2734	A	Y	Y		Yes			Yes							
BCS2834	S	Y	Y		Yes			Yes	Yes						
BCS2835	S	Y	Y		Yes			Yes	Yes						
BCS2836	S	Y	Y		Yes			Yes	Yes						
BCS2837	S	Y	Y		Yes			Yes	Yes						
BCS2838	S	Y	Y		Yes			Yes	Yes						
BCS2845A	S	Y	Y		Yes			Yes	Yes						
BCS2845C	S	Y	Y		Yes			Yes	Yes						
BCS2845D	S				Yes			Yes	Yes						
BFG1136B	E	Y			Yes										
BFG1156B	E	Y			Yes			Yes				Yes			
BFG1156C	E	Y			Yes			Yes				Yes			
BFG1156D	E	Y			Yes			Yes				Yes			
BFG1168B	E	Y			Yes			Yes				Yes			
BFG1195A	E	Y			Yes			Yes				Yes			
BFG1195B	E	Y			Yes			Yes				Yes			
BFG1198B	A	Y			Yes			Yes				Yes			
BFG1200	Q	Y		Y	Yes	Yes		Yes				Yes			
BKG1474B	F	Y			Yes			Yes	Yes	Yes					
BMG2571	Q	Y			Yes			Yes	Yes	Yes	Yes				
BMP2712	S				Yes			Yes	Yes						
BMP2869	M			Y	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	
BMS2864	Q	Y			Yes	Yes		Yes			Yes	Yes			
BRG287	S				Yes			Yes	Yes						
BRG921	S	Y			Yes			Yes	Yes						
BRG999	S				Yes			Yes	Yes						

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
BRP1476	S				Yes			Yes	Yes						
BRP292	S	Y			Yes			Yes	Yes						
BSG1119B	S	Y			Yes			Yes				Yes			
BSG1125B	A				Yes			Yes					Yes		
BSG1125C	E				Yes			Yes					Yes		
BSG1130A	E	Y			Yes			Yes				Yes			
BSG1130B	A	Y			Yes			Yes				Yes			
BSG1132A	A	Y			Yes			Yes				Yes			
BSG1132B	A	Y			Yes			Yes				Yes			
BSG1133B	A	Y			Yes			Yes				Yes			
BSG1135B	A	Y			Yes			Yes				Yes			
BSG1137A	A	Y			Yes			Yes				Yes			
BSG1137B	A	Y			Yes			Yes				Yes			
BSG1148A	A	Y			Yes			Yes				Yes			
BSG1148B	A	Y			Yes			Yes				Yes			
BSG1153B	E	Y			Yes			Yes							Yes
BSG1177A	A	Y			Yes			Yes				Yes			
BSG1177B	A	Y			Yes			Yes				Yes			
BSG1177C	A	Y			Yes			Yes				Yes			
BSG1179B	A	Y			Yes			Yes				Yes			
BSG1179C	A	Y			Yes			Yes				Yes			
BSG1180A	E	Y			Yes			Yes				Yes			
BSG1180B	E	Y			Yes			Yes				Yes			
BSG1180C	E	Y			Yes			Yes				Yes			
BSG1196B	E	Y			Yes			Yes				Yes			
BSG1196C	E	Y			Yes			Yes				Yes			
BSG1201	Q	Y			Yes			Yes	Yes			Yes			
BSG2777A	S	Y			Yes			Yes	Yes			Yes			
BSG2777B	E	Y			Yes			Yes				Yes			
BSG2778A	A	Y			Yes			Yes				Yes			
BSG2778B	E	Y			Yes			Yes				Yes			
BSG2779A	S	Y			Yes			Yes				Yes			
BSG2779B	S	Y			Yes			Yes				Yes			
BSG2779C	A	Y			Yes			Yes				Yes			
BSG2782A	A	Y			Yes			Yes				Yes			
BSG2782B	A	Y			Yes			Yes				Yes			
BSG2782C	A	Y			Yes			Yes				Yes			
BSG2783A	E	Y			Yes			Yes				Yes			
BSG2783B	A	Y			Yes			Yes				Yes			
BSG2783C	E	Y			Yes			Yes				Yes			
BSG2784	Q	Y			Yes			Yes				Yes			
BSG2828	Q	Y			Yes			Yes	Yes	Yes					
BYD1090	M			Y										Yes	
BYP2538	M				YES			YES							
CLC452	Q				Yes			Yes	Yes						
COG1112A	E				Yes			Yes							
COG1112B	F				Yes			Yes							
COG1149A	Q		Y		Yes			Yes	Yes						
COG1149B	Q		Y		Yes			Yes	Yes						
COG1152A	E	Y			Yes			Yes				Yes			
COG1172	A				Yes			Yes	Yes						
COG1175B	E	Y			Yes			Yes				Yes			
COG1178B	A	Y			Yes			Yes				Yes			
COG2701	S				Yes			Yes	Yes						
COG2806A	S				Yes			Yes	Yes						Yes
COG2806B	S				Yes			Yes	Yes						Yes
COG2867A	Q		Y		Yes			Yes	Yes						
COG2867B	Q		Y		Yes			Yes	Yes						
COG995A	S				Yes			Yes	Yes						
COG995B	S				Yes			Yes	Yes						
ECG1100A	Q				yes			yes	yes						
ECG1100B	Q				yes			yes	yes						
ECG1106A	S				Yes			Yes	Yes						
ECG1106B	S				Yes			Yes	Yes						
ECG1113A	S				Yes			Yes					Yes		
ECG1114A	E	Y			Yes			Yes							
ECG1114B	E	Y			Yes			Yes							
ECG1115A	E	Y			Yes			Yes				Yes			
ECG1115B	E	Y			Yes			Yes				Yes			

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
ECG1115C	E	Y			Yes			Yes				Yes			
ECG1115D	F	Y			Yes			Yes				Yes			
ECG1116B	E	Y			Yes			Yes				Yes			
ECG1117A	E	Y			Yes			Yes				Yes			
ECG1117B	E	Y			Yes			Yes				Yes			
ECG1118A	A	Y			Yes			Yes				Yes			
ECG1118B	A	Y			Yes			Yes				Yes			
ECG1121A	E	Y			Yes			Yes				Yes			
ECG1121B	F	Y			Yes			Yes				Yes			
ECG1124B	E	Y			Yes			Yes				Yes			
ECG1124C	E	Y			Yes			Yes				Yes			
ECG1128A	E	Y			Yes			Yes				Yes			
ECG1128B	E	Y			Yes			Yes				Yes			
ECG1131A	E	Y													
ECG1131B	E	Y			Yes			Yes							Yes
ECG1131C	E	Y			Yes			Yes							Yes
ECG1144B	E	Y			Yes			Yes				Yes			
ECG1145B	E	Y			Yes			Yes				Yes			
ECG1145C	E	Y			Yes			Yes				Yes			
ECG1146	Q	Y			Yes			Yes				Yes			
ECG1182A	E	Y			Yes			Yes							
ECG1182B	E	Y			Yes			Yes							
ECG1183A	E				Yes			Yes					Yes		
ECG1183B	E				Yes			Yes							
ECG1184	A				Yes			Yes	Yes				Yes		
ECG1185	S				Yes			Yes	Yes				Yes		
ECG1186	Q				Yes			Yes	Yes				Yes		
ECG1187	Q				Yes			Yes	Yes				Yes		
ECG1188	Q				Yes			Yes	Yes				Yes		
ECG1189	Q				Yes			Yes	Yes				Yes		
ECG1190	Q				Yes			Yes	Yes				Yes		
ECG2787	Q	Y			Yes			Yes	Yes						
ECG2833A	A				Yes			Yes							
ECG2833B	A				Yes			Yes							
ECG2833C	A				Yes			Yes							
ECG2833D	A				Yes			Yes							
ECG2853A	S				Yes			Yes							
ECG2853B	S				Yes			Yes							
ECG2859	S				Yes			Yes	Yes						
ECG2866A	Q				Yes			Yes	Yes						
ECG2866B	Q				Yes			Yes	Yes						
ECG299	S				Yes			Yes	Yes						
ECG901	S				Yes			Yes	Yes						
ECG902	S				Yes			Yes	Yes						
ECG905	S				Yes			Yes	Yes						
ECG906	S				Yes			Yes	Yes						
ECG907	Q				Yes			Yes	Yes						
ECG916	S				Yes			Yes	Yes						
ECG917	Q				Yes			Yes	Yes						
ECG922	A				Yes			Yes	Yes						
ECG924	Q				Yes			Yes	Yes						
ECG925	Q				Yes			Yes	Yes						
ECG928	S				Yes			Yes	Yes						
ECG931	S				Yes			Yes	Yes						
ECG932	S				Yes			Yes	Yes						
ECG933	A				Yes			Yes	Yes						
ECG934	S				Yes			Yes	Yes						
ECG935	S				Yes			Yes	Yes						
ECG936	S				Yes			Yes	Yes						
ECG937	S				Yes			Yes	Yes						
ECG938	S				Yes			Yes	Yes						
ECP2562	S	Y			Yes			Yes	Yes						
ECP2599	S	Y			Yes			Yes	Yes	Yes	Yes				
ECP2601	S				Yes			Yes	Yes						
ECP2603A	S				Yes			Yes	Yes						
ECP2603B	S				Yes			Yes							
ECP2605A	S				Yes			Yes	Yes						
ECP2605B	S														
ECP2606	S				Yes			Yes	Yes						

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
ECP2612	S				Yes			Yes	Yes						
ECP2614	S				Yes			Yes	Yes						
ECP2616A	S														
ECP2616B	S				Yes			Yes	Yes						
ECP2618A	S				Yes			Yes							
ECP2618B	S				Yes			Yes							
ECP2624A	S				Yes			Yes							
ECP2624B	S				Yes			Yes							
ECP2627A	S				Yes			Yes							
ECP2627B	S				Yes			Yes							
ECP2629A	S				Yes			Yes							
ECP2629B	S				Yes			Yes							
ECP2631	S				Yes			Yes	Yes						
ECP2648A	S				Yes			Yes							
ECP2648B	S				Yes			Yes							
ECP2651A	S				Yes			Yes							
ECP2651B	S				Yes			Yes							
ECP2654A	S				Yes			Yes							
ECP2654B	S				Yes			Yes							
ECP2662A	S				Yes			Yes							
ECP2662B	S				Yes			Yes							
ECP2664	S				Yes			Yes	Yes						
ECP2668	S				Yes			Yes							
ECP2670	S				Yes			Yes	Yes						
ECP2674	S				Yes			Yes	Yes						
ECP2682	S				Yes			Yes	Yes						
ECP2709	S				Yes			Yes	Yes						
ECP2710	S				Yes			Yes	Yes						
ECP2719	S			Y	Yes	Yes		Yes	Yes						
ECP2740	Q				Yes			Yes				Yes			
ECP2745	S			Y	Yes	Yes		Yes	Yes						
ECP2771	S			Y	Yes	Yes		Yes	Yes						
ECP2772	S			Y	Yes	Yes		Yes	Yes						
ECP2796	M			Y											
ECP2856A	S				Yes			Yes							
ECP2856B	S				Yes			Yes							
ECP2857A	S				Yes			Yes							
ECP2857B	S				Yes			Yes							
ECP2858A	S				Yes			Yes							
ECP2858B	S				Yes			Yes							
ECS2715	S				Yes			Yes	Yes						
EPG1165A	A				Yes			Yes					Yes		
EPG2780B	F	Y			Yes			Yes				Yes			
EPG2781A	A	Y			Yes			Yes				Yes			
EPG2781B	A	Y			Yes			Yes				Yes			
EPG2785A	A				Yes			Yes	Yes						
EPG2785B	A				Yes			Yes	Yes						
EPS2820	A				Yes			Yes	Yes						
EPS2821	A				Yes			Yes	Yes						
EPS2822	A				Yes			Yes	Yes						
EPS2823	A				Yes			Yes	Yes						
EPS2824	A				Yes			Yes	Yes						
EPS2825	A				Yes			Yes	Yes						
EPS2826	A				Yes			Yes	Yes						
EPS2827	A				Yes			Yes	Yes						
HCG2861A	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
HCG2861B	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
HCG2868	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
HMG1122A	E				Yes			Yes							
HMG1123B	A				Yes			Yes					Yes		
HMG1126B	A				Yes			Yes					Yes		
HMG1163A	F				Yes			Yes							
HMG1856	E				Yes			Yes					Yes		
LCS469	Q	Y			Yes			Yes							
LRG910	S	Y			Yes			Yes	Yes			Yes			
LRG911	S	Y			Yes			Yes	Yes			Yes			
LRG912	A	Y			Yes			Yes	Yes			Yes			
LRP1319	Q	Y			Yes			Yes	Yes						
LRP896	Q	Y			Yes			Yes	Yes						

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
LSD1078	Q	Y		Y	Yes	Yes		Yes	Yes	Yes				Yes	
LTG1139	Q	Y		Y	Yes	Yes		Yes	Yes	Yes	Yes			Yes	
LTG1140B	A				Yes			Yes					Yes		
LTG1147	Q	Y		Y	Yes	Yes		Yes				Yes			
LTG1167B	E				Yes			Yes					Yes		
LTG1191	Q	Y			Yes			Yes	Yes				Yes		
LWP2632	Q	Y			Yes			Yes	Yes	Yes	Yes				
LWP2714	V	Y			Yes			Yes	Yes	Yes					
LWS2717	S				Yes			Yes	Yes						
MCP1416	M	Y		Y	Yes	Yes		Yes	Yes						
MCP2533	Q	Y		Y	Yes	Yes		Yes	Yes						
MCP2534	Q	Y		Y	Yes	Yes		Yes	Yes						
MCP2536	M				Yes			Yes	Yes						
MCP2536A	M														
MDP2679	S				Yes			Yes	Yes						
NEA634A	S				Yes			Yes							
NED602A	A				Yes			Yes	Yes						
NED602B	A				Yes			Yes	Yes						
NED604A	S				Yes			Yes	Yes						
NED604B	S				Yes			Yes	Yes						
NEG484	Q				Yes			Yes							
NEL1312	Q			Y	Yes	Yes		Yes							
NEL1313	Q			Y	Yes	Yes		Yes							
NEL1382A	S				Yes			Yes	Yes						
NEL1382B	S				Yes			Yes	Yes						
NEL1382C	Q				Yes			Yes	Yes						
NEL2831	Q	Y		Y	Yes	Yes		Yes						Yes	
NEL2870A	Q				Yes			Yes	Yes						
NEL2870B	Q				Yes			Yes	Yes						
NEL2870C	Q				Yes			Yes	Yes						
NEL448	Q			Y	Yes	Yes		Yes							
NEL532A	S				Yes			Yes	Yes						
NEL532B	Q				Yes			Yes	Yes						
NEL536A	A				Yes			Yes	Yes						
NEL536B	A				Yes			Yes	Yes						
NEL536C	F				Yes			Yes	Yes						
NEM1387	S				Yes			Yes	Yes						
NEM478	Q				Yes			Yes							
NEM637A	S				Yes			Yes							
NEM650A	S		Y		Yes			Yes	Yes						
NEM651A	S		Y		Yes			Yes	Yes						
NEM652A	S		Y		Yes			Yes	Yes						
NEM653A	S				Yes			Yes	Yes						
NEM897	S		Y		Yes			Yes	Yes						
NEM898	S		Y		Yes			Yes	Yes						
NEM899	S				Yes			Yes	Yes						
NEP2847	V														
NEP2848	V														
NEP2849	V														
NEP2850	V														
NEP2851	Weekly														
NER2545A	A				Yes			Yes							
NER2545B	A				Yes			Yes							
NER2546A	Q				Yes			Yes							
NER2546B	Q				Yes			Yes							
NER2546C	Q				Yes			Yes							
NER2547	A				Yes			Yes							
NER2548	A				Yes			Yes							
NER2549A	A				Yes			Yes							
NER2549B	A				Yes			Yes							
NER2554A	A				Yes			Yes							
NER2554B	A				Yes			Yes							
NER2808	A				Yes			Yes							
NER2811A	S				Yes			Yes							
NER2811B	S				Yes			Yes							
NER2812A	A				Yes			Yes							
NER2812B	A				Yes			Yes							
NER2813A	S				Yes			Yes							
NER2813B	S				Yes			Yes							

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
NER2813C	S				Yes			Yes							
NER2816A	V				Yes			Yes							
NER2816C	A				Yes			Yes							
NER606A	A				Yes			Yes							
NER606B	A				Yes			Yes							
NER607A	A				Yes			Yes							
NER607B	A				Yes			Yes							
NER608A	A				Yes			Yes							
NER608B	A				Yes			Yes							
NER609A	A				Yes			Yes							
NER609B	A				Yes			Yes							
NER610A	A				Yes			Yes							
NER610B	A				Yes			Yes							
NER631A	A				Yes			Yes							
NER631B	A				Yes			Yes							
NER632A	A				Yes			Yes							
NER632B	A				Yes			Yes							
NER633A	A				Yes			Yes							
NER633B	A				Yes			Yes							
NER655A	A				Yes			Yes							
NER708	Q				Yes			Yes							
NER709	A				Yes			Yes							
NER710A	S				Yes			Yes							
NER710B	S				Yes			Yes							
NER711	A				Yes			Yes							
NER723	A				Yes			Yes							
NER724	A				Yes			Yes							
NES1363	S				Yes			Yes	Yes						
NES1364	Q				Yes			Yes	Yes						
NES1365	Q				Yes			Yes	Yes						
NES1366	Q				Yes			Yes	Yes						
NES1376	Q				Yes			Yes	Yes	Yes					
NES1472A	A				Yes			Yes							
NES2556	S				Yes			Yes	Yes						
NES2574	S				Yes			Yes	Yes						
NES2589	S				Yes			Yes	Yes						
NES2590	S				Yes			Yes	Yes						
NES2763	A				Yes			Yes	Yes						
NES2764	A				Yes			Yes	Yes						
NES2765	A				Yes			Yes	Yes						
NES2766	A				Yes			Yes	Yes						
NES2767	A				Yes			Yes	Yes						
NES2768	A				Yes			Yes	Yes						
NES2790	NS			Y	Yes	Yes		Yes				Yes			
NES2791	NS				Yes	Yes		Yes				Yes			
NES2792	NS				Yes	Yes		Yes				Yes			
NES2793A	NS	Y		Y	Yes			Yes				Yes			
NES2793B	S				Yes			Yes				Yes			
NES2793C	NS				Yes			Yes				Yes			
NES2794	S	Y		Y	Yes	Yes		Yes	Yes	Yes				Yes	Yes
NES2795	NS	Y		Y	Yes	Yes		Yes		Yes					
NES2797A	S				Yes			Yes	Yes						
NES2797B	S				Yes			Yes	Yes						
NES2797C	S				Yes			Yes	Yes						
NES2797D	S				Yes			Yes	Yes						
NES2797E	A				Yes			Yes	Yes						
NES2798A	S				Yes			Yes	Yes						
NES2798B	S				Yes			Yes	Yes						
NES2798C	S				Yes			Yes	Yes						
NES2798Z	S				Yes			Yes	Yes						
NES2799A	S				Yes			Yes	Yes						
NES2799B	S				Yes			Yes	Yes						
NES2800A	Q				Yes			Yes	Yes						
NES2800B	S				Yes			Yes	Yes						
NES2801	S				Yes			Yes	Yes						
NES2802	S				Yes			Yes	Yes						
NES2803A	S				Yes			Yes	Yes						
NES2803B	S				Yes			Yes	Yes						
NES2804A	Q				Yes			Yes	Yes						

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
NES2804B	S				Yes			Yes	Yes						
NES2804C	S				Yes			Yes	Yes						
NES2805	S				Yes			Yes	Yes						
NES2852	Q				Yes			Yes	Yes						
NES567	Q				Yes			Yes							
NES568	Q				Yes			Yes							
NES620B	S				Yes			Yes	Yes						
NES621A	S				Yes			Yes	Yes						
NES621B	S				Yes			Yes	Yes						
NES622A	S				Yes			Yes	Yes						
NES622B	S				Yes			Yes	Yes						
NES623A	S				Yes			Yes	Yes						
NES623B	S				Yes			Yes	Yes						
NES656A	F				Yes			Yes							
NES672	Q				Yes			Yes							
NES675	Q				Yes			Yes							
NES691	Q				Yes			Yes							
NES693	S				Yes			Yes							
NES694A	S				Yes			Yes							
NES694B	S				Yes			Yes							
NES696	S				Yes			Yes							
NES697A	S				Yes			Yes							
NES697B	S				Yes			Yes							
NES698A	S				Yes			Yes							
NES698B	S				Yes			Yes							
NES700	Q				Yes			Yes							
NES701	S				Yes			Yes	Yes						
NES702	S				Yes			Yes	Yes						
NES703	S				Yes			Yes							
NES705A	S				Yes			Yes							
NES705B	S				Yes			Yes							
NES715A	S				Yes			Yes	Yes						
NES715B	S				Yes			Yes	Yes						
NES716	F				Yes			Yes							
NES718	S				Yes			Yes							
NES725	S				Yes			Yes	Yes						
NES726A	S				Yes			Yes							
NES726B	S				Yes			Yes							
NES728	Q				Yes			Yes	Yes	Yes					
NES729	S				Yes			Yes	Yes						
NET1380A	S				Yes			Yes	Yes						
NET1380B	A				Yes			Yes	Yes						
NET1381A	S				Yes			Yes	Yes						
NET1381B	S				Yes			Yes	Yes						
NET1383A	S				Yes			Yes	Yes						
NET1383B	S				Yes			Yes	Yes						
NET1384A	S				Yes			Yes	Yes						
NET1384B	S				Yes			Yes	Yes						
NET1385A	S				Yes			Yes	Yes						
NET1385B	S				Yes			Yes	Yes						
NET1386A	A				Yes			Yes	Yes						
NET1386B	Q				Yes			Yes	Yes						
NET1393A	S				Yes			Yes	Yes						
NET1393B	S				Yes			Yes	Yes						
NET1490	S				Yes			Yes	Yes						
NET1491	S				Yes			Yes	Yes						
NET1492	S				Yes			Yes	Yes						
NET2596	S				Yes			Yes	Yes	Yes					
NET646A	Q				Yes			Yes	Yes						
NET646B	S				Yes			Yes	Yes						
NEW1495A	A				Yes			Yes							
NEW1495B	A				Yes			Yes							
NEW1495C	A				Yes			Yes							
NEW1496A	A				Yes			Yes							
NEW1496B	A				Yes			Yes							
NEW1496C	A				Yes			Yes							
NEW2569A	A				Yes			Yes	Yes						
NEW2569B	A				Yes			Yes	Yes						
NEW2569C	A				Yes			Yes	Yes						

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
NEW2570	A				Yes			Yes	Yes	Yes	Yes				
NEW2807A	A				Yes			Yes							
NEW2807B	A				Yes			Yes							
NEW2807C	S				Yes			Yes							
NEW2807D	S				Yes			Yes							
NEW2807E	S				Yes			Yes							
NEW2807F	A				Yes			Yes							
NEW2807G	A				Yes			Yes							
NEW2809A	A				Yes			Yes							
NEW2809B	A				Yes			Yes							
NEW2809C	A				Yes			Yes							
NEW2809D	S				Yes			Yes							
NEW2809E	S				Yes			Yes							
NEW2810A	A				Yes			Yes							
NEW2810B	A				Yes			Yes							
NEW2810C	A				Yes			Yes							
NEW2810D	A				Yes			Yes							
NEW2810E	A				Yes			Yes							
NEW2810F	A				Yes			Yes							
NEW2810G	A				Yes			Yes							
NEW2810H	A				Yes			Yes							
NEW2814A	S				Yes			Yes							
NEW2814B	S				Yes			Yes							
NEW2814C	A				Yes			Yes							
NEW2815A	A				Yes			Yes							
NEW2815B	A				Yes			Yes							
NEW2815C	A				Yes			Yes							
NEW2815D	A				Yes			Yes							
NEW2815E	A				Yes			Yes							
NEW2815F	A				Yes			Yes							
NEW612A	A				Yes			Yes							
NEW612B	A				Yes			Yes							
NEW613A	S				Yes			Yes							
NEW613B	S				Yes			Yes							
NEW614A	A				Yes			Yes							
NEW614B	A				Yes			Yes							
NEW615A	A				Yes			Yes							
NEW615B	A				Yes			Yes							
NEW616A	A				Yes			Yes							
NEW616B	A				Yes			Yes	Yes						
NEW617A	A				Yes			Yes							
NEW617B	A				Yes			Yes							
NEW639A	Q				Yes			Yes							
PCG2576	S	Y	Y		Yes			Yes	Yes	Yes					
RTC450	V			Y	Yes	Yes		Yes	Yes	Yes					
SLS2769	A				Yes			Yes	Yes						
SLS2770	A				Yes			Yes	Yes						
SMP2842	Q				Yes			Yes							
SRG946	A	Y			Yes			Yes				Yes			
SRP850	S	Y			Yes			Yes	Yes						
TLP1436	Q				Yes			Yes	Yes						
TLP1469	Q	Y			Yes			Yes	Yes						
TLP1485A	Q														
TLP1486A	Q														
TLP1487A	Q														
TLP1488A	Q														
TLP2593A	Q														
TLS1426	S				Yes			Yes	Yes						
TLT2452	S				Yes			Yes	Yes						
TLT2575A	DRY				Yes			Yes	Yes						
TLT2575B	S				Yes			Yes	Yes						
TLT887	S				Yes			Yes	Yes						
UPD004	Q	Y		Y	Yes	Yes		Yes		Yes	Yes			Yes	
UPD009	S	Y		Y	Yes	Yes		Yes		Yes	Yes			Yes	
UPD010	Q	Y		Y	Yes	Yes		Yes	Yes					Yes	Yes
UPD011	Q	Y		Y	Yes	Yes		Yes	Yes						
USC472	V			Y	Yes	Yes		Yes	Yes	Yes					
VWK120	F				Yes			Yes	Yes						
VWK413	Q	Y		Y	Yes	Yes		Yes	Yes	Yes					

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Site ID	Current Sample Frequency	Hg	CN	Total Metals	Basic	Basic Total Metals	Minor	Major	Trace 1	Trace 2	Trace 3	RA-1	RA-2	Trace 1 - Total Metals	Trace 4
VWK414	Q	Y		Y	Yes	Yes		Yes	Yes	Yes					
VWK421	Q	Y		Y	Yes	Yes		Yes	Yes	Yes					
VWK83	NS	Y			Yes			Yes				Yes			
VWK84	F				Yes			Yes	Yes			Yes			
VWK93	S	Y			Yes			Yes							
VWP190B	E	Y			Yes			Yes				Yes			
VWP192B	A	Y			Yes			Yes				Yes			
VWP193B	F	Y			Yes			Yes				Yes			
VWP194A	E				Yes			Yes							
VWP194B	A	Y			Yes			Yes				Yes			
VWP197B	E	Y			Yes			Yes				Yes			
VWP209B	E	Y			Yes			Yes				Yes			
VWP220	S				Yes			Yes	Yes						
VWP225	S				Yes			Yes	Yes						
VWP228	Q				Yes			Yes	Yes						
VWP241B	E	Y			Yes			Yes				Yes			
VWP241C	A	Y			Yes			Yes				Yes			
VWP242	E	Y			Yes			Yes				Yes			
VWP244B	Q				Yes			Yes	Yes						
VWP244C	S				Yes			Yes	Yes						
VWP248A	Q	Y			Yes			Yes	Yes			Yes			
VWP248B	S	Y			Yes			Yes	Yes			Yes			
VWP248C	S	Y			Yes			Yes	Yes			Yes			
VWP251	F				Yes			Yes							
VWP252A	F				Yes			Yes							
VWP252B	F				Yes			Yes							
VWP252C	F				Yes			Yes							
VWP253A	F				Yes			Yes							
VWP255A	F				Yes			Yes							
VWP257	F				Yes			Yes							
VWP258A	F				Yes			Yes							
VWP259	F				Yes			Yes							
VWP263	E				Yes			Yes							
VWP264	F	Y			Yes			Yes				Yes			
VWP267B	E				Yes			Yes							
VWP272	A				Yes			Yes	Yes						
VWS236	S	Y		Y	Yes	Yes		Yes	Yes	Yes	Yes	Yes		Yes	
VWS314	V			Y	Yes	Yes		Yes	Yes	Yes					
VWS35	V			Y	Yes	Yes		Yes	Yes	Yes					
VWW189	A	Y			Yes			Yes				Yes			
VWW22	A			Y	Yes	Yes		Yes					Yes		
VWW31	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
VWW325	E				Yes			Yes							
VWW363	A	Y			Yes			Yes				Yes			
VWW387	A	Y			Yes			Yes				Yes			
VWW41A	A				Yes			Yes							
VWW420	A	Y			Yes			Yes				Yes			
WJG1154A	A	Y			Yes			Yes				Yes			
WJG1154B	Q	Y			Yes			Yes				Yes			
WJG1154C	A	Y			Yes			Yes				Yes			
WJG1171A	A	Y			Yes			Yes				Yes			
WJG1171B	E				Yes			Yes							
WJG2819A	A	Y			Yes			Yes				Yes			
WJG2819B	A	Y			Yes			Yes				Yes			
WJG2819C	A	Y			Yes			Yes				Yes			
WJG2862A	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
WJG2862B	Q	Y	Y	Y	Yes	Yes		Yes	Yes						
WJG2863	A				Yes			Yes				Yes			
WTS2552	Q				Yes			Yes							
WTS2577	Q			Y	Yes	Yes		Yes							
WTS2578	Q	Y		Y	Yes	Yes		Yes				Yes			
WTS2580	Q				Yes			Yes							
WTS2592	Q				Yes			Yes							

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TABLE-GCMP 2. DEFINITION OF ANALYTE GROUPS

	ANALYTE GROUPS								
	BASIC	MAJOR ION	MINOR ION	TRACE** METALS ONE	TRACE** METALS TWO	TRACE** METALS THREE	MERCURY (Hg) *	RADIONUCLID	OTHER
FIELD									
PH	X								
Temperature									
Conductance	X								
Dissolved Oxygen			X						
Eh			X						
Alkalinity		X							
Carbonate									X
Bi-Carbonate									X
Ferrous Iron			X						
Sulfide			X						
INORGANIC INDICATOR PARAMETERS									
TDS	X								
TSS	X								
MAJOR ANIONS									
Chloride (Cl)	X								
Fluoride (F)			X						
Sulfate (SO4=)	X								
Nitrate (NO_3-N)			X						
Nitrite (NO_2-N)			X						
Total Phosphorus			X						
MAJOR CATIONS									
Calcium (Ca)		X							
Magnesium (Mg)		X							
Potassium (K)		X							
Sodium (Na)		X							
* **TRACE METALS**									
Aluminum (Al)						X			
Antimony (Sb)						X			
Arsenic (As)	X								
Barium (Ba)				X					
Beryllium (Be)						X			

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TABLE-GCMP 2. DEFINITION OF ANALYTE GROUPS

	ANALYTE GROUPS								
	BASIC	MAJOR ION	MINOR ION	TRACE** METALS ONE	TRACE** METALS TWO	TRACE** METALS THREE	MERCURY (Hg) *	RADIONUCLID	OTHER
Boron (B)						X			
Cadmium (Cd)	X								
Chromium (Cr)				X					
Copper (Cu)	X								
Iron (Fe)					X				
Lead (Pb)	X								
Manganese (Mn)					X				
*Mercury (Hg)							X		
Molybdenum (Mo)					X				
Nickel (Ni)					X				
Selenium (Se)	X								
Silver (Ag)				X					
Thallium (Tl)						X			
Titanium (Ti)						X			
Zinc (Zn)	x								
RADIONUCLIDES									
Radium 226								X	
Radium 228								X	
Total Uranium								X	
Gross Alpha								X	
Gross Beta								X	
ORGANICS									
Benzene									X
Toluene									X
Ethylene									X
Naphthalene									X
Total Petroleum Hydrocarbon									X
Balance									X

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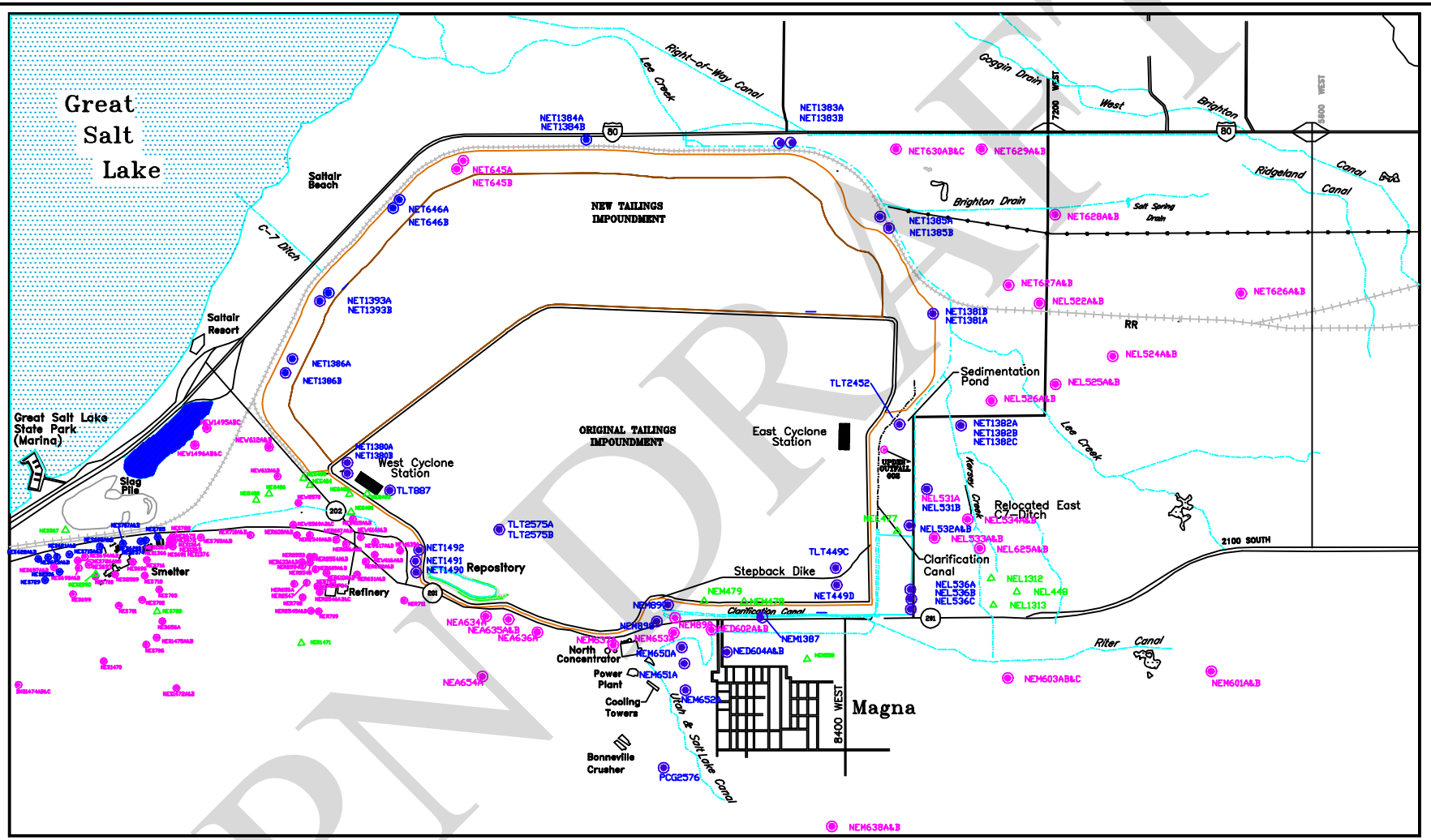
TABLE-GCMP 3. GROUND WATER CHARACTERIZATION AND MONITORING PLAN SCHEDULE

Personnel	Plan Review	Audit Field and Data Management Activities	Issue Revised Plan	Issue Quarterly Reports	Annual Reports	Annual Report Review
Senior Environmental BP – RTK	X					X
Principal Advisor, Water Quality	X					X
Advisor Water Quality, Supervisor Sampling	September each year	Periodic unannounced audits of field sampling. Audit report submitted to Project Manager within 30 days of audit	December 31 each year	Within 90 days	March 31 each year	X
Environmental Laboratory, Quality Assurance Manager	X					X

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PLATES

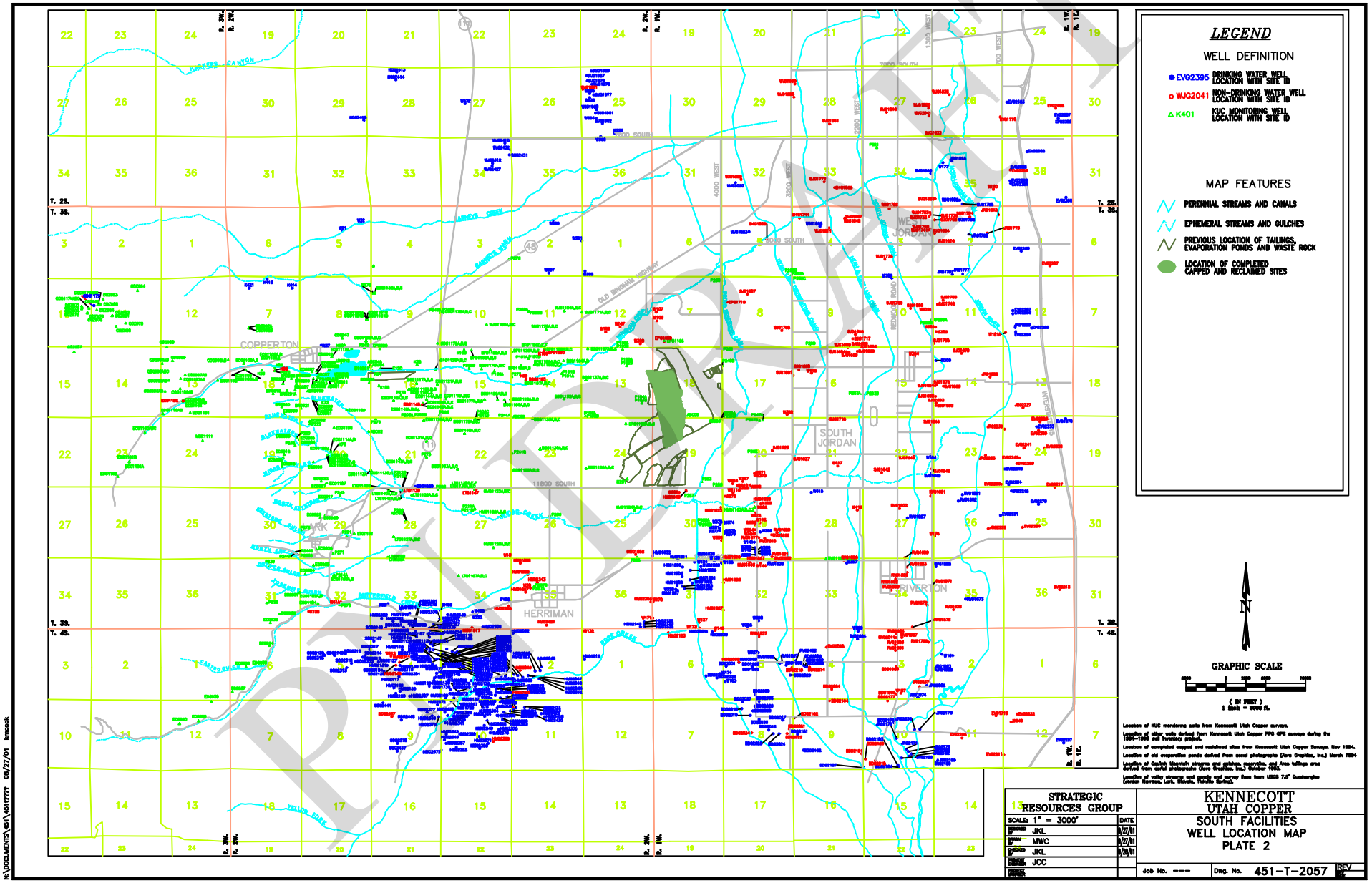
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ENVIRONMENTAL AFFAIRS		KENNECOTT UTAH COPPER
SCALE:	DATE	NORTH FACILITIES WELL LOCATIONS
DRAWN JCC	03/00	PLATE1
CHKD BS	03/00	
APPD JS	01/02	
Job No.	Dwg. No. NONE	REV 1

F:\DWR\NRO\DRAWINGS\DWR1015 03/14/00 BSCOTT



PRELIMINARY DRAFT

LEGEND

WELL DEFINITION

- EVG2395 — DRINKING WATER WELL LOCATION WITH SITE ID
- WJG2041 — NON-DRINKING WATER WELL LOCATION WITH SITE ID
- K401 — KUC MONITORING WELL LOCATION WITH SITE ID

MAP FEATURES

- PERENNIAL STREAMS AND CANALS
- EPHEMERAL STREAMS AND GULCHES
- PREVIOUS LOCATION OF TAILINGS, EVAPORATION PONDS AND WASTE ROCK
- LOCATION OF COMPLETED CAPPED AND RECLAIMED SITES

N

GRAPHIC SCALE

(IN FEET)
1 inch = 3000 ft.

Location of KUC monitoring wells from Kennecott Utah Copper surveys.
Location of other wells derived from Kennecott Utah Copper PPG GPS surveys during the 1994-1995 well inventory project.
Location of completed capped and reclaimed sites from Kennecott Utah Copper Surveys, Nov 1994.
Location of old evaporation ponds derived from aerial photographs (Aero Graphics, Inc.) March 1994
Location of Copper Mountain stingers and gladiator, overburden, and Arco tailings area derived from aerial photographs (Aero Graphics, Inc.) October 1995.
Location of valley streams and canals and survey lines from USGS 7.5' Quadrangles (Jordan Narrows, Lark, Utaville, Tetsville Spring).

STRATEGIC RESOURCES GROUP		
SCALE: 1" = 3000'		DATE
DRAWN	JKL	9/27/01
DESIGN	MWC	9/27/01
CHECKED	JKL	9/28/01
PROJECT MGR.	JCC	
APPROVED		

KENNECOTT
UTAH COPPER

SOUTH FACILITIES
WELL LOCATION MAP
PLATE 2

Job No. ---- Dwg. No. 451-T-2057 REV

N:\DOCUMENTS\451\451T77 09/27/01 kmcook

Attachment 1. Health and Safety Plan

All RTK employees will adhere to the following documents:

RTK's Safety and Facilities Standards Manual and the Safety and Health Policy stated therein; and,

RTK's Environmental Response Health and Safety Plan

The sampling crew will attend site-specific training annually or as required at each plant. In general, crewmembers will wear all required PPE and abide to all safety rules and regulations at each plant Existing site information indicates that heavy metals in the soil are not present at hazardous levels that could pose a significant risk to sampling crew while conducting sampling. Historical ground water and surface water monitoring data do not warrant health concerns related to skin exposure or vapor inhalation. Therefore, no special procedures or protective equipment is required during sampling.

Well abandonment and installation activities pose a potentially higher health and safety risk to on-site personnel. Therefore, site-specific health and safety plans will be developed for each project.

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Attachment 2. Quality Assurance Project Plan

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Attachment 3. Standard Operation Procedures for Ground Water Sampling

PN DRAFT

Standard Operating Procedures for Groundwater Sampling

Rio Tinto Kennecott

South Jordan, Utah

Rev: 10

Rev Date: December 2023

PN DRAFT

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
09	09	October 2023	All	Initial conversion	Arcadis
10	10	December 2023	All	Updated formatting and content	Arcadis

PN DRAFT

APPROVAL SIGNATURES

Approved by:

Cassady Kristensen

Cassady Kristensen
Senior Environmental BP - RTK

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1/11/2024
Date

Approved by:

Erka Naran
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01/11/2024.
Date

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01/08/24
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01/08/24
Date

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PLATE 2. SOUTH FACILITIES WELL LOCATIONS

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1 INTRODUCTION

This set of Standard Operating Procedures contains the protocols to be used for Rio Tinto Kennecott (RTK) sampling of groundwater, process water, surface water, and bottom sediments of surface water bodies.

These procedures will be used to collect data for site investigations and other projects requiring information about water quality. The scope of field activities covered by these procedures include documentation; equipment maintenance, decontamination, and calibration; field measurements; sample container preparation; quality control samples; sample collection; and surveying of sample locations.

Sampling locations will be included in the appropriate Project Work Plan or other document directing the sampling program. The following information, as appropriate, will be specified in such a Plan for each known or planned water sample location:

- Actual or estimated survey location (coordinates in feet, Kennecott Mine Datum) or distance from a landmark for each sample point.
- Actual or estimated elevation of the ground surface above mean sea level (feet).
- Sampling method and measurement requirements.
- Sample identification codes to be used.
- Sampling frequency or schedule.
- Special documentation requirements.
- Requirements for surveying; and,
- Analytical parameters.

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2 GROUNDWATER SAMPLING

The following sections describe the process and documentation required for collecting groundwater samples at RTK.

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2.1 PROCEDURE DC-01 FIELD LOGBOOK

Record appropriate information in a Field Logbook to reconstruct events associated with sampling. Field Logbook entries will be made in indelible ink. Prepare and use Field Logbooks as follows:

1. Obtain a bound book. Consecutively number the pages if they are not already numbered. Store books in Project Files when not in use.
2. Assign a document control number to each book, for example: GCMP-FN-RGM-01, where "GCMP" is an example of a project identification acronym or number, "FN" indicates Field Notebook, "RGM" is an example of owner identification (initials), and "01" is a sequence number for the Book.
3. Enter the following information on the cover of each book:
    - Name of person or organization to whom the Book is assigned.
    - Book
    - Obtain a bound book.
    - Enter the following information on the cover of each book:
    - Name of person or organization to whom the Book is assigned.
    - Book number (sequence number).
    - Site name and number/acronym.
    - Start date.
    - End date.
4. At each sample site, start a new page with the following information:
    - Date and time started.
    - Sample location identification number.
    - Full name of person recording data.
    - Other personnel on site.
    - Sample location identification number (at top of page).
    - Full name of person recording data (at bottom of page).
    - Weather (temperature, wind speed/direction, precipitation).
    - Sample identification numbers which correspond to any samples collected.
    - Sample identification numbers used for duplicates.
    - Equipment maintenance conducted.
    - Equipment problems and how they were corrected.
    - Additional observations about the sampling event or conditions that may affect sample integrity.
    - Identify source and location for any photographs taken.
    - number (sequence number).
    - Site name and number/acronym.

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- Start date.
- End date.

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2.2 PROCEDURE DC-02 SAMPLE IDENTIFICATION

A sample coding system will be used to identify each sample collected. This coding system will ensure unique sample identification and provide a tracking record to allow retrieval of information about a particular sample.

All samples will be identified by a sample identification number utilizing a maximum of eight characters. Within this sample identification number is a unique number identifying the site. Alphabetic characters are used to denote general location and sample depth.

For existing sites, the sample identification number will be designated as identified in Table DC-1. Because of past changes in the well identification coding system, the characters preceding the site number may have varied in the past. All future references to the sampling site should be as identified in Table DC-1.

New sampling locations will be designated as discussed below:

Sample Designation for New Sites:

The sample identification number will consist of the following components for the eight-letter identification code:

Area Sample Location Depth Designation Type

Please refer to Attachments - Table DC-1 below for a list of approved sample locations.

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The components of the sample identification number are a two-letter area identification acronym followed by a single letter identifying the medium sampled, followed by a unique four-digit sampling location identification number and a single letter code identifying the depth of sample collection. All sample identification numbers are unique and must be approved by the Sampling Supervisor. The procedures for obtaining a new well identification number are provided in Procedure GF-14.

All samples collected will be identified using this eight-character sample identification number. A specific sample collected at a location will be identified as unique by the date on which the sample was collected. The date will be identified using the following six-digit number:

__ __ __ __ __ __
Month Day Year

The following sections describe each portion of the sampling point identification number.

Area Designation Acronym

The area designation acronym consists of a two-letter code which identifies a specific area of RTK. Approved area designation codes are identified in Table DC-2.

The locations designated by these codes are shown on Plates 1 through 3. Other letters may be used, with the approval of the Sampling Supervisor, if they are consistent with earlier location names and will create less confusion.

Acronyms and the area represented by the acronym are provided below:

Note: Area locations are shown on Plates 1, 2, and 3

Acronym	Area Represented by Acronym
AN	Anaconda Tailings
AR	Arthur
B1	Bingham Creek Channel - Upper Reach
B2	Bingham Creek Channel - Upper Middle Reach
B3	Bingham Creek Channel - Lower Middle Reach
B4	Bingham Creek Channel - Lower Reach
BC	Barney's Canyon
BD	Bluffdale City
BE	Box Elder
BF	North of Bingham Creek Channel (Bingham Flats)
BM	Bingham Mine
BN	Bonneville
BR	Bluewater Repository
BS	South of Bingham Creek Channel
BW	Butterfield Waste Rock
CF	Carr Fork
CH	Chevron Chemical
CO	Copperton
CP	East of Small Reservoir C-5 - C7 (Cemetery Pond)

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Acronym	Area Represented by Acronym
DV	Davis County
EC	Eastside Collection System
EP	Evaporation Ponds
EV	East Valley - East of Jordan River
GS	Great Salt Lake
HC	Harkers Canyon - West of Hwy 111
HM	Herriman
JR	Jordan River
KC	Kersey Creek
KN	Kearns
KS	Kessler Creek
LC	Lee Creek
LR	Large Reservoir
LS	Landfills
LT	Lark Tailings
LW	Lark Waste Rock
MC	Magna Concentrator
MG	Magna
MD	Mine Dump
MO	Morton Salt
NO	North of I-80
OQ	Oquirrh Mountains
PC	Bonneville Power Plant
RC	Ridgeland Canal
RF	Refinery
RV	Riverton
RT	Ritter Canal
SJ	South Jordan
SL	Slag
SM	Smelter
SO	South Oquirrh Mountains
SR	Small Reservoir
TL	Tailings
TR	Traverse Range
WJ	West Jordan City
WT	Waste Water Treatment Plant
WV	West Valley

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Sample Type

The sample type is a single letter code which identifies the medium sampled. Approved type codes are:

B Samples Collected of Boring

D Drinking Water

P Process Water

S Surface water
Z Piezometers
G Groundwater

Sample Definition

B Sample Collected of Boring = water collected from an uncased boring – not water from a well

D Drinking Water = water collected on RTK property that is currently used for drinking water

G Ground Water = water pulled from a well-constructed of natural materials

P Process Water = water used in RTK's operations

S Surface Water = water contained on the surface to include runoff, natural creeks, and streams,

Z Piezometers = pressure sensing device used only for measurement of water levels

Other letters may be used, with the approval of the Sampling Supervisor, if they are consistent with earlier location names.

Location
The four-digit location number is unique throughout all RTK monitoring areas and identifies a specific sampling location. This number must be obtained from the Sampling Supervisor.

Depth Code
The single letter depth code identifies the relative depth from which the sample was collected. Shallowest samples are assigned an "A" designation with subsequent letters representing greater depths. Field notes must correlate sampling depth with sampling depth code.

Additional Information

Additional information regarding site identification specific to the media being sampled is provided in procedures GW-01, PW-01, SW-01, and DW-01.

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2.3 PROCEDURE DC-03: SAMPLE CONTAINER PRESERVATION

1. Prepare sample containers prior to the sampling event. Use new, laboratory-cleaned sample containers. The containers should be rinsed three times with de-ionized water. Label the containers as directed by Procedure DC-04.
2. Use the proper containers and preservatives for each analytical parameter as specified in Table DC-1
3. Prepare containers for required QC samples.

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2.4 PROCEDURE DC-04: SAMPLE LABELLING

Labeling may be done directly on the sample containers with indelible ink or using a stick-on label. Stick-on labels will be waterproof and written on using only indelible ink. An example label is shown in Figure DC-1. Regardless of the method of labeling used, record the following information on the sample container prior to sampling:

- Sample ID #: Identification number for the water sampling location (usually acronym plus sequence number); and,
- Analysis.

Record the following information on the container at the time of sampling:

- Date and Time of Sampling; and,
- Sampler (Signature of person filling container).

<table>
<tr><td colspan="2">KENNECOTT UTAH COPPER
Environmental Laboratory</td></tr>
<tr><td>Sample I.D. #</td><td rowspan="2">Preservative:</td></tr>
<tr><td>Control #</td></tr>
<tr><td rowspan="2">Analysis:</td><td>Date:</td></tr>
<tr><td>Time:</td></tr>
<tr><td>Comments:</td><td>Sampler:</td></tr>
</table>

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2.5 PROCEDURE DC-05: SAMPLE CUSTODY

The Analytical Request Sheet will serve to document the analytical request and Sample Chain of Custody documentation. Data for this form (Figure DC-02) will be entered into field laptops by the sampler at the time of sample collection as follows:

Sheet Request No.:	Reserved for laboratory use.
Sample Submitted by:	The name of person requesting the sample.
Report Results to:	The name of person receiving results.
Lab I.D. #:	Laboratory I.D # to be entered by laboratory personnel.
Sample ID #:	Sample Identification Number.
Date, Time:	Date and time sampling sheet is completed.
Analyses Requested:	The analyses to be performed for the sample - The standard suite of analyses to be performed on each sample is coded into the laboratory's computer system. If this standard suite of analyses is to be run, the analyses will be specified by writing GCMP in the analyses requested column of the form. If other analyses are requested, they must be explicitly specified.
Sample Preservation:	Samples will be preserved as detailed in Procedure DC-06. The presence of ice in the cooler when shipping will also be noted on the Analytical Request Form.
Surrendered by:	The signature of person delivering the sample or the person who has prepared the sample for to the Laboratory.
Received by:	The signature of the laboratory staff member receiving the samples.
Comments/Special Instructions:	Additional comments or instructions.

After collection, the sample will be stored in a secure manner and packed in ice until delivered to the laboratory cooler.

Laboratory personnel will note any damaged sample containers or discrepancies between the sample label and information on the form. The presence (or absence) of ice in the cooler will be documented on the Analytical Request Form. The manager of KEL will contact the Field Team Leader or the Supervisor of Environmental Sampling to resolve any problems.

Please refer to Attachments - An example of the analytical request sheet is presented in Figure DC-2, below:

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2.6 PROCEDURE DC-06: SAMPLE PRESERVATION AND PACKAGING

Table DC-3 contains the required sample containers, preservatives, and allowable holding times for analytical parameters. Holding times start from the moment that the sample is collected.

1. Place samples in coolers with sufficient ice to ensure the sample will be delivered to the lab with ice in the cooler.
2. Place the Analytical Request/Sample Chain of Custody form (see Procedure DC-05, GW-05, PW-04, SW-05, and SS-04) inside or attached to the cooler (sealed in a Ziploc plastic bag to protect from moisture) for shipment to the laboratory.
3. Packaging of samples to be submitted to an external laboratory require additional measures to prevent breakage of sample containers.

Please refer to Attachments - Table DC-3: Sample Containers, Preservation Techniques, and Holding Times

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2.7 PROCEDURE DC-07: ELECTRONIC FIELD DATA COLLECTION SYSTEM

Laptop/Desktop computers are used for field data documentation. Appropriate information is entered into the computer at each site and regenerated to a hard copy later in the day, at the Environmental Laboratory. Use laptop computers as follows:

1. Obtain a laptop/desktop computer. Be sure it contains the “Groundwater program” by turning on the computer and locating the icon in the Windows program. Re-charge laptop computers when they are not in use.
2. Place the mouse arrow on the icon and double click on the icon with the left mouse button to bring up the main “Groundwater” screen.
3. To enter a sampling site, click on the “New Well” box on the main screen. Scroll down until you find the sample site that you want and then left click on the sample number. You can also enter the Sample site by highlighting the location button and manually typing the site I.D. into the box. You will receive a prompt asking you if you want to “Start a New Well”. Click “Yes”. The date and time will be automatically inserted with the date and time of that exact moment. Date and time may be edited to give a more accurate arrival time.
4. Enter the following information as indicated by labels on the individual boxes:
    - Samplers Initials
    - Depth to water reading
    - Measured or assumed total depth of well
    - Calculated purge volume (if necessary, no purge volume from table)
    - Select the type of pump used (if no pump used select Grab)
    - Pump identification number (if necessary)
5. At the end of each sampling event, calculate the total volume purged by multiplying the calculated flow rate by the total minutes the water was being purged. Enter the calculated volume in the “Total Volume Pumped” box.
6. To activate the remarks window, place the mouse arrow on the “Remarks window” found in the “Remarks” box and double click with the left mouse button. Record the appropriate information such as other samplers on site, well conditions, changes in flow rate, or any other comments that are believed to be necessary. To close the remarks window, click on the “X” in the box at the upper right-hand corner of the “Remarks” window.
7. Record the number of sample bottles filled and submitted for analysis during the sampling event in the “Number of Bottles” box.
8. Record the time the sampling event was completed in the “Completion Time” box.
9. If the sampler leaves the well for any amount of time during the purge of the well, the time spent away from the well must be recorded in the “Time Spent Away from Well” box.

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10. The “Observation” button creates a new data entry line for each field measurement sampling event. When activated a new line will be created with the date, and time automatically inserted. The date and time may be edited to give a more accurate sampling time. The “Observation” pane is a tool bar that contains the functions used for entering field data.

    Click on the “Observation” box and the observation window will appear. Double click anywhere on the window and a window will appear to enter a single sampling observation. The following are entered in this window:

    - Flow
    - Conductivity
    - Temperature
    - pH
    - Sampling Time
    - Date

Once the desired data has been entered, click on the “Done” button. Repeat this procedure until all sampling observations have been entered and then click “Close” on the main observation screen.

11. The “New Well” button creates a new field data entry screen upon the arrival or start of a new sampling event.

12. To generate a hard copy of the field data sheet and the analytical request sheet and chain of custody the sampler must connect the laptop computer to the KEL server by inserting the LAN (RJ-45) cable to the specified slot in the computer. The user must be logged on to their computer using the user name “Ranch” and the current password to be able to log on the KEL server. Once the cable is connected, the computer will automatically detect the computer and will connect to the server. Open the “Groundwater” program, and then click on the “Utilities” button on the main screen. Then click on the “Check In” button. A screen will then appear giving the options to print “Transfer to Server”, “COC (Chain of Custody)”, and “Field Sheets”, then click on the respective document that you need. When the window of the document appears, you will be prompted that a copy has been placed on the server. To print a copy, click on the “Print” and then you will be prompted with a “Print Setup” screen. Once settings are correct, click on “OK” to print document.

13. To export the data to the RTK lab’s server, return to the “Check-in” screen of the “Utilities” section and click on “Transfer to Server”. A bar graph will show the progress of the transfer. The program will then export the data and give a completed transfer message.

14. After the hard copies have been generated and have been reviewed for any anomalous data and the data has been transferred to the RTK lab’s server, delete the data from the computer’s memory. To delete, select “Utilities” from the main “Groundwater” screen and click on the “Check Out” button. You will be prompted several times asking you if you are sure that your data will be deleted. This will remove the data that has been exported and should refresh the screen and clear all samples saved in the memory.

15. Fill in the appropriate information on the field data sheet such as field logbook reference numbers and circling methods of measurements. Fill in the appropriate information on the analytical request sheets such

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as control numbers, sample submitted by, and conformation of sample being turned in on ice. Sign both documents and submit proper personnel. If any problems are found on the field sheet, after the sample has already been exported, alert the Sampling Supervisory for immediate correction.

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3 EQUIPMENT MAINTENANCE AND DECONTAMINATION

This section presents procedures for the activities associated with equipment maintenance and documentation as listed below.

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3.1 PROCEDURE MD-01: EQUIPMENT MAINTENANCE

Equipment and instrument maintenance is required to ensure that accurate data are collected during field investigations with minimal equipment problems. This procedure discusses the required field maintenance. Procedure GF-01 includes equipment calibration steps. In addition to these procedures, consult instrument manuals for the proper preventative maintenance and calibration details for each instrument.

Routine daily maintenance procedures will be conducted in the field to ensure that equipment is operable:

1. Remove surface dirt and debris.
2. Replace disposable parts (e.g., probe membranes) as required by equipment manual.
3. Store equipment in a secure, dry place, protected from dust, wind, and precipitation.
4. Large equipment stored outside will be protected by covering sensitive parts to protect them from dust, wind, and precipitation.
5. Inspect equipment and instruments for possible problems (e.g., cracked or clogged lines or tubing, weak batteries) daily, and
6. Charge battery packs for equipment when not in use and when necessary. All equipment maintenance will be documented in the field logbook.

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3.2 PROCEDURE MD-02: EQUIPMENT DECONTAMINATION

Decontaminate all non-disposable equipment used for the collection, preparation, preservation, and storage of samples prior to their use and after each subsequent use.

The materials needed for decontamination are dependent upon the equipment to be cleaned. The following is a list of equipment to be used during decontamination:

- Cleaning solutions, tap water, and de-ionized/distilled water for the final rinse.
- Storage vessels to transport large volumes of de-ionized/ distilled water to the site.
- Buckets and wash basins for use in the washing and rinsing of equipment.
- Paper or cloth towels and Chemwipes. For use in cleaning all outside surfaces or surfaces that do not come into contact with the sample; and,
- Plastic garbage bags to contain all disposable items (gloves, paper towels, etc.).

Decontaminate meters measuring general field parameters and glassware as described below:

- Rinse equipment for several seconds with de-ionized/distilled water.
- Rinse two times with the water that is being sampled before collecting a sample for the parameters being measured.
- Periodically, at the sampler's discretion, glassware will be immersed in a 10% hydrochloric acid solution, followed by manually scrubbing with a non-phosphate detergent.

Decontaminate non-disposable sampling equipment such as stainless-steel buckets, bailers, pumps, and dippers as described below:

- Manually scrub with a non-phosphate detergent. Hot water if the equipment is used in a petroleum contaminated well.
- Rinse with tap water, and then with de-ionized/distilled water.
- Rinse three times with de-ionized/distilled water.
- If sampling for organic compounds, rinse with pesticide-grade acetone or pesticide-grade methanol.
- Air dry equipment; and,
- Place all disposal items into plastic garbage bags and transport to the appropriate garbage receptacle on RTK property.

Larger pieces of equipment require specialized decontamination procedures. The small-diameter evacuation pumps will be decontaminated by rinsing the exterior of the pump, and the portion of the hose that was immersed, with clean tap water. The interior will be decontaminated by placing the pump intake into a five-gallon container filled with clean tap water and by pumping the water through the pump and hose. After the tap water wash, the pump will be appropriately decontaminated as per the above procedures using de-ionized/ distilled water in the second tank.

The tubing used for the Bennett pump will be decontaminated by pumping de-ionized/distilled water through the tubing. The outside of the tubing will be decontaminated by rinsing with de-ionized/ distilled water.

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A pressure sprayer steam cleaning can be used to effectively decontaminate the outside of the pump and tubing. At locations where a clean tap water source is available, the submersible pump will also be decontaminated by pumping 50 to 75-gallons through it and the discharge tubing. A clean 35-gallon or larger, plastic barrel may be used for this purpose.

All disposal items will be placed in plastic garbage bags and transported to the appropriate garbage receptacle on RTK property.

Rinseate will be disposed of as described in Procedure GW-06.

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3.3 PROCEDURE MD-03: MAINTENANCE AND CALIBRATION OF WATER LEVEL METERS

All water level meters will be calibrated annually or after any repairs to ensure the marks on the tape used for measurement of the water levels are in the correct position, and that the tape has not slipped. The calibration shall be made to a steel tape. If these measurements show the marking to be incorrect or that the tape has stretched more than 0.1 percent of its length, the wire will be repaired or replaced.

The water level probe will be checked, cleaned, and or replaced whenever a clear and distinct signal is not obtained when making water level measurements. If probe wire repair results in the cutting of the water level meters measurement line, the wire beneath the cut will be replaced with wire containing the proper measuring marks and factory-made splice joints.

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4 QUALITY CONTROL SAMPLING

This section presents procedures for general field measurement activities. Quality control (QC) samples will be collected to measure accuracy and precision of analyses as affected by field methodologies. Field QC samples appropriate to water sampling include trip blanks, equipment rinseate blanks, duplicates, and external laboratory duplicates. Rates of QC sample collection is specified in the project plan. QC samples will be documented and handled in the same manner as other samples prior to submittal to the laboratory (see Procedures).

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4.1 PROCEDURES QC-01: BLIND DUPLICATES

Duplicates will be collected at a rate specified in the project plan, generally one duplicate will be collected for every twenty (20) sample points. At least one duplicate sample will be collected from each facility that requires ground water monitoring for a Ground Water Discharge Permit each quarter. The sites selected for the collection of duplicate samples will represent the general quality of water recently sampled. Duplicates should represent the range of water quality sampled throughout the year. Additional duplicates will be collected, if there is a concern that special problems may be encountered in particular samples that are not represented by other duplicate samples.

Duplicates will be collected by alternately filling the primary and duplicate sampling containers to ensure that representative samples are collected. The first three letters of the sample name will be "DUP", and the next three numbers will indicate the sequence number for the duplicate sample. For example, “DUP63", where the number “63" indicates the sixty-third duplicate sample collected. Each year the sequence will start over at 01.

The actual name of the sample duplicated will be recorded in the field logbook, and reported to the laboratory after a final Certificate of Analysis is obtained.

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4.2 PROCEDURE QC-02: EXTERNAL LABORATORY DUPLICATES

When required External laboratory duplicates will be collected by alternately filling the primary and duplicate sample containers to ensure that representative samples are collected. When requested, an internal duplicate will be collected at each sampling site where an external duplicate is collected. The first three letters of the sample name will be "EXL", and the next three numbers will indicate the sequence number for the duplicate sample. For example, "EXL052", where the number "052" indicates the fifty- second external laboratory duplicate collected. For new year the number sequence will start over and begin at "001".

The Project Plan may require the collection of as many as five external laboratory duplicates during a given sampling event. When multiple sampling duplicates are required, the duplicate sample containers should be alternately filled to ensure representative samples. A letter will be appended to the sample identification number to uniquely identify each sample. For example, EXL052c would represent the third external duplicate.

The actual name of the sample duplicated will be recorded in the field logbook, and reported to the laboratory after a final Certificate of Analysis is obtained.

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4.3 PROCEDURE QC-03: MATRIX SPIKE SAMPLES

Matrix spiking will be done at the frequency identified in the Project Plan, generally one (1) a day or one (1) in every twenty (20), whichever is greater. Laboratory personnel will select samples for matrix spiking. Additional samples may be submitted by field personnel for laboratory spiking. Samples collected in the field for laboratory spiking will be assigned a sample identification number starting with the letters "QC" followed by the numeric portion of the sample point identification number and any trailing letters followed by the letters "SK" for the spike sample and "SD" for the spike duplicate. For example, a sample collected from well "NEM478" for spiking would be labeled "QC478SK" and the spike duplicate would be "QC478SD". Any spiking instructions must be clearly identified on the analytical request form. Laboratory personnel will assign control numbers to all spiked samples.

Samples selected for spiking by field personnel will be collected by alternately filling the primary and spike sample containers to ensure that the samples collected are representative of each other.

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4.4 PROCEDURE QC-04: TRIP BLANKS

Trip blanks will be collected at the rate specified in the Project Plan. In general, the collection rate will be one (1) for each day an equipment blank is collected and generally one (1) in every twenty (20) samples. Trip blank samples will be submitted and labeled with a special identification number. The first three letters of the sample name will be "TBK", and the next two or three numbers will indicate the sequence number for the trip blank. For example, “TBK23", where the number “23" indicates the twenty-third trip blank collected. Each new year the number sequence will start over and begin at “01". The sample containers will be prepared using the proper preservatives and filled with ultrapure, deionized (Type II) reagent grade water. The containers will accompany the sampling crew that day and will be delivered to the laboratory along with the other samples.

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4.5 PROCEDURE QC-05: EQUIPMENT RINSEATE BLANKS

For inorganic samples, a set of sample containers will be prepared (labeled and preserved) for approximately one (1) in every twenty (20) sample points by each sampling device. The rate of equipment rinseate blank sampling will be approximately 1 in 10 for sampling events that require organic analyses. The actual rate will be specified in the Project Plan. The sample containers will be prepared using the proper preservatives and filled with the final rinse water used on the sampling device (i.e., non-dedicated pump or bailer). The water used for this final rinse will be reagent grade, ultrapure (Type II) de-ionized water. The first two or three letters of the sample name will be "EQB", and the next three numbers will indicate the sequence number for the equipment rinseate. For example, “EQB41", where the number “41" indicates the forty-first rinseate blank collected. Each new year the number sequence will start over and begin at “01".

The final rinse of sampling equipment shall be collected as the rinseate blank. The rinsing procedure should, to the extent possible, be the same as normally used during the sampling event. A description of the equipment rinsed, and the name of the location sampled will be recorded on the field sampling form.

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5 GENERAL FIELD MEASUREMENTS

This section presents procedures for the general field measurement activities listed below.

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5.1 PROCEDURE GF-01: EQUIPMENT CALIBRATION

This procedure discusses the calibration of field equipment. In addition to these procedures, consult instrument manuals for the proper preventative maintenance and calibration details for each instrument.

Calibration solutions must not be reused and must be renewed prior to expiration dates stamped on the manufacturer's container. Equipment calibration ensures that measurements obtained are accurate in reference to a known standard. A calibration schedule is provided below for field equipment and instruments:

TABLE GF-1. Equipment Calibration Schedule

Instrument	Frequency
pH Meter	Prior to each site
Specific conductance meter	Prior to each site
Dissolved oxygen meter	Prior to each site
Turbidity meter	Prior to each site when requested

5.1.1 CALIBRATION OF A PH METER:

1. Calibrate the pH meter prior to use at each sampling site in the field.
2. Use specific calibration techniques according to the manufacturer's instructions using two of the standard buffer solutions (either 4 and 7 or 7 and 10, depending on the expected range of pH). If the meter does not automatically compensate for temperature, the pH values of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature at which the sample pH was measured will then be used to compensate for temperature on the meter.
3. Document calibration information in the Field Logbook. Information to be recorded includes all calculations and adjustments made to the meter. The time, standard concentrations, and water temperature, when not using a temperature compensating meter, will also be recorded.

5.1.2 CALIBRATION OF TEMPERATURE-COMPENSATING SPECIFIC CONDUCTIVITY METER

1. Calibrate the meter in the field prior to use at each sampling site according to the manufacturer's specifications. Check the calibration according to the manufacturer's recommendation to ensure that proper measurements are taken.
2. In general measure the conductance of the standard using the meter to be calibrated. Make adjustments as directed by the manufacturer's specifications.
3. Record calibration information in the Field Logbook or on the appropriate Field Data Sheet. Information to be recorded includes all calculations, adjustments made to the meter, and accuracy prior to calibration. Documentation will also include time of calibration, standard concentrations, and water temperature.

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5.1.3 CALIBRATION OF SPECIFIC CONDUCTIVITY METER (WITHOUT TEMPERATURE COMPENSATION

1. Calibrate the specific conductance meter prior to use at each sampling site in the field, and document in the Field Logbook. Documentation will include standard concentration(s), time of calibration, water temperature, and all calculations. Check the calibration as necessary to ensure that proper measurements are taken.
2. Calibrate in the field using a 1,000 mhos/cm (KCl) standard solution. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{E}{C}$$

Where:
K = probe cell constant (unitless)
C = measured conductance value of standard (mhos/cm); and
E = expected conductance at observed temperature of standard solution (see Table GF-2).
Using the cell constant calculated above, correct the field specific conductance measurements to 25°C using the following equation:

$$S = \frac{K * C}{1 + [0.02(T - 25)]}$$

Where:
S = specific conductance at 25°C (mhos/cm).
K = cell constant calculated above.
C = specific conductance (mhos/cm) measured in field; and
T = temperature (°C) of sample in which conductance was measured.

3. Document calibration details on the field data sheet. Information to be recorded includes all calculations, adjustments made to meter, and accuracy prior to calibration.

Conductivity Temperature Corrections for 1,000 mhos/com Conductivity Standard

Temperature C	Conductivity (mhos/cm)
0	604
1	616
2	629
3	642
4	655
5	668
6	682
7	696
8	709
9	724
10	739
11	754
12	769
13	785
14	801
15	817
16	834
17	851

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18	868
19	886
20	904
21	922
22	941
23	960
24	980
25	1,000
26	1,020
27	1,040
28	1,061
29	1,082
30	1,104
31	1,126
32	1,148
33	1,171
34	1,194
35	1,218

5.1.4 CALIBRATION OF DISSOLVED OXYGEN METER

Follow this procedure for the air calibration method for a meter with a membrane probe. Be aware that the calibration can be disturbed by physical shock, touching the membrane, or drying out the probe. If the dissolved oxygen meter does not have a membrane probe (or is not an Orion Research O2 on a pH meter), calibrate the dissolved oxygen meter in accordance with the instruction manual.

1. Adjust the "ZERO" reading while in the "OFF" position.
2. Switch to "RED LINE" and adjust the reading to align with the red line.
3. Switch to "ZERO" and adjust to zero with the zero-control knob.
4. Plug in probe and tighten retainer.
5. Insert probe into the calibration chamber making certain the chamber is slightly moist and the rubber plug is watertight. Place the calibration chamber (with probe in place) into the water being sampled and wait 10-15 minutes for the temperature to stabilize.
6. Switch to "TEMPERATURE" and read.
7. Determine the solubility of oxygen at that temperature from the calibration table included with the instrument.
8. Determine the altitude correction factor and multiply this factor by the solubility figure. This is the corrected saturation value (mg/L).
9. Switch to the appropriate scale and adjust the calibration knob to the corrected saturation value.
10. Wait two minutes to verify the stability of the reading and readjust if necessary.
11. Document calibration details in the Field Logbook or on the appropriate Field Data Sheet. Documentation will include time of calibration, water temperature, and all calculations. The condition of the probe will be checked prior to each measurement.

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5.1.5 TURBIDITY METER CALIBRATION

Calibrate the turbidimeter in accordance with this procedure or manufacturer's instructions, as appropriate:

1. Check the zero setting and adjust as necessary with turbidimeter in the "OFF" position.
2. Place the opaque plastic tube into the cell to block all light and allow the zero setting to be calibrated. Calibrate zero at all scale settings.
3. Place a standardized solution (usually provided with the meter) into the cell and cover with light shield. Keep this tube absolutely clean. Wipe with a soft cloth after handling and prior to calibrating. Discard if the tube becomes scratched or etched. Calibrate meter to exactly the reading of the standard solution.
4. Document calibration details in the Field Logbook or on the appropriate Field Data Sheet. Documentation will include time of calibration, water temperature, and all calculations. The condition of the probe will be checked prior to each measurement.

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5.2 PROCEDURE GF-02: PH MEASUREMENT

1. If the measurement cannot be made within the water body, collect a sample in a clean beaker. Record the time the sample is collected.
2. Measure the temperature with a clean thermometer and adjust the temperature knob accordingly (for meters which do not compensate for temperature).
3. Rinse the probe with distilled water prior to immersing into the sample.
4. Allow the meter to stabilize (change less than 0.05 units in a one-minute period with no systemic drift). Read and record the pH value on the Field Data Sheet. Record the time the measurement is taken.
5. Repeat steps 1 through 4 if the results are questionable.
6. Verify the accuracy of the measurement, if necessary, by re-testing a buffer solution. This step need not be performed after each measurement if no drift is detected in the meter after an initial test.
7. Rinse the probe.
8. If a digital pH meter is used, add DI water if the electrolyte is not sufficient to cover the electrode.
9. Store the meter according to the manufacturer's recommendations.

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5.3 PROCEDURE GF-03: EH MEASUREMENT

The ability of a natural environment to bring about an oxidation or reduction process is measured by a quantity called its redox potential and is designated as Eh. Eh is a measure of the ability of an environment to supply electrons to an oxidizing agent or to take up electrons from a reducing agent.

1. Check the accuracy of the Eh probe:
    a. Prepare equipment according to manufacturer's specifications.
    b. Check the accuracy of electrode system with a reference solution of known Eh (ZoBell solution). Record the following information in the Field Logbook.
    c. Bring the reference ZoBell solution to sample temperature and record the temperature.
    d. Measure potential, in millivolts, of the ZoBell solution at sample temperature (Eh ZoBell(obs)) and check against theoretical value at measured temperature. This value should be + 10 millivolts (EH ZoBell + Ref).
    e. Place electrode in Eh cell or water sample container and allow readings to stabilize (after several minutes).
    f. If using a cell, turn off water flow to prevent streaming potential and immediately take reading.
    g. Record data (Eh) and calculate Eh relative to standard hydrogen electrode.
    h. Calculate system Eh as follows: $Eh^{sys} = EH^{obs} + Eh^{ZoBell+Ref} - Eh\,ZoBell(obs)$.
    i. Record Eh to the nearest + 10 millivolts. (Oil and grease in the sample solution may coat the noble-metal electrode and provide erroneous readings. Note any oil in the Field Logbook.)
2. Take Eh measurements in accordance with the manufacturer's specifications in water sample or cell.
3. Record the measurements on the appropriate Field Data Sheet.
4. Recalibrate and check meter accuracy in accordance with the manufacturer's recommendations.

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5.4 PROCEDURE GF-04: SPECIFIC CONDUCTANCE MEASUREMENT

1. If the measurement cannot be made within the water body, collect a sample in a clean beaker. Record the time the sample is collected.
2. Immediately take a temperature measurement and "set" the temperature control if appropriate for the meter used.
3. Immerse the probe into the sample, shake lightly, and allow the reading to stabilize.
4. Record the reading on the Field Data Sheet. Record the time the measurement is taken. If questionable, repeat steps "1" through "3".
5. Rinse the probe thoroughly with distilled water.

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5.5 PROCEDURE GF-05: MEASUREMENT OF CARBONATE AND BICARBONATE

This procedure describes the measurements of carbonate and bicarbonate to be conducted at the Environmental Field Laboratory (the Ranch), and laboratory calculations to be conducted at the RTK Environmental Laboratory to determine carbonate and bicarbonate concentrations in water samples.

When alkalinity is due to carbonate or bicarbonate content, the pH at the equivalence point of the titration is determined by the concentration of CO2 at that stage, which, in turn, depends on the total carbonate species originally present and any losses that may have occurred during titration. The following pH values are suggested as expressed equivalents points for the corresponding alkalinity concentrations in milligrams of CaCO3 per liter:

- Phenolphthalein (pH 8.3)
- Bromocresol green (pH 3.8)

Equipment

- Brinkmann 25 ml Digital Buret
- 250 ml glass beaker
- Water Quality Field Data Sheet

Reagent Needed

- 0.1 normal hydrochloric acid (HCl) or sulfuric acid (H2SO4)

Carbonate

1. Place 100 mL of sample into a borosilicate beaker.
2. If the pH is equal to or greater than 8.3 add phenolphthalein to the sample to obtain a pink color in the sample. If no color is obtained, carbonate is not present. Proceed to the bicarbonate procedure.
3. Slowly titrate using 0.1 normal acid and a Brinkmann 25 ml Digital buret. Add the acid to the sample until the sample becomes clear again.
4. Record molarity and the number of milliliters of acid used to achieve the color change on the Water Quality Field Data Sheet.

Bicarbonate

1. Add bromocresol green to the same 100 ml of sample until it is dark green.
2. Slowly titrate using 0.1 normal acid and the Brinkman 25 ml Digital burette until the color changes to a lime green.
3. Record acid type, molarity, and the number of milliliters of acid added to the sample on the Water Quality Field Data Sheet.

Calculation

The number of milliliters used in both titrations are taken from this sheet in order to calculate milliequivalents of carbonate (CO3=) and bicarbonate (HCO3-) using the following equations1:

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Phenolphthalein

50000 = milliequivalent

A = ml of standard acid used

N = normality of acid used

Carbonate Alkalinity, mg CaCO3/l = $\frac{A \times N \times 50000}{\text{ml of sample}}$

Bromocresol Green

50000 = milliequivalent

A = ml of standard acid used

N = normality of acid used

Bicarbonate Alkalinity, mg CaCO3/l = $\frac{A \times N \times 50000}{\text{ml of sample}}$

[1]*American Public Health Association (APHA). 1989. Standard Methods for the Examination of Water and Wastewater. Seventh Edition. Prepared and published jointly by the American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Washington, D.C.*

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5.6 PROCEDURE GF-06: DISSOLVED OXYGEN MEASUREMENT

1. If a dissolved oxygen meter with membrane probe is not used, use CHEMets ampoules to measure dissolved oxygen.
2. If an ampoule flow-through cell is available, position ampoule in cell2. Divert water flow through the cell. When the cell is filled with water, break the ampoule at the neck. Stop the flow of water and remove the ampoule. Compare the color with the standard ampoules and record the dissolved oxygen concentration by extrapolating between the colors of the standard ampoules to + 0.5 ppm.
3. If a flow-through cell is not available, collect a sample of water in a clean sample cup. Follow the directions provided with the CHEMets ampoules for measuring dissolved oxygen. After waiting the recommended time, but no longer than five minutes, compare the color of the ampoule with the standard ampoules and record oxygen concentration by extrapolating between the colors of the standard ampoules to + 0.5 ppm.
4. Record the value for dissolved oxygen and the test method on the Field Data Sheet. Record the time the sample is collected and the time the measurement is taken.
5. If no color is shown, record the lowest value on the standard ampoule as the detection limit. Do not record zero.

[2]*Reference: Walton-Day, Katherine, Macalady, D.L., Brooks, M.H., and Tate, V.T. 1990. Field Methods for Measurement of Ground Water Redox Chemical Parameters. Ground Water Monitoring Review. Fall issue.*

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5.7 PROCEDURE GF-07: FERROUS IRON MEASUREMENT

1. Use CHEMets ampoules to measure ferrous iron. Follow the same procedures as used for dissolved oxygen ampoules.
2. Extrapolate the concentration of dissolved ferrous iron and record to + 0.05 ppm.
3. If the ampoule color is darker than the range of standard ampoules, dilute a fresh sample of well water one-to-one with de-ionized/distilled water and measure ferrous iron immediately. The tested sample must be one-half well water and one half de-ionized/distilled water. The result should be recorded as twice the value of the selected standard.
4. Record the value of ferrous iron, the method used to include any dilutions done, and the final ferrous iron value on the Field Data Sheet. Record the time the sample is collected and the time the measurement is taken.
5. See preceding procedure.

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5.8 PROCEDURE GF-08: SULFIDE MEASUREMENT

The following procedures describe the methods used to complete field analyses for sulfide. This procedure is completed in two steps. The first step is the identification of sulfide concentration greater than the detection limit, and the second is the quantification of the concentration of sulfide present, if measurable concentrations are detected.

Step 1 - Presence of detectable concentrations of sulfide.

1. Fill a clear glass container with the water to be analyzed. The container should be filled in a manner that minimizes the disturbance of the sample and does not result in aeration of the sample.
2. Insert a lead acetate strip and check the sample for the presence of a black precipitate on the lead acetate strip.
3. If a black precipitate is present, proceed with Step 2, otherwise record the concentration as less than 0.01.

Step 2 - Use CHEMets ampoules to measure sulfide concentrations as described below. This method uses the K-9503 Vacu-vials using the "methylene blue" colorometric test method. Using the equipment provided in the CHEMets test set complete the analyses as follows:

1. Fill the sample cup to the 25 ml mark with your sample.
2. Add 3 drops of A-9500 Activator Solution. Stir quickly with the top of the Vacu-vial ampoule.

   Caution:

   A-9500 Activator Solution to ferric chloride in concentrated hydrochloric acid. Avoid contact. Remove from the glass bottle only when in use. In case of contact, flush skin, or eyes with water. Seek prompt medical attention if swallowed. READ MSDS BEFORE USING.
3. Immediately snap the tip of the Vacu-vial ampoule by placing the tapered tip down in the bottom of the sample cup and pressing the ampoule against the side. The sample will fill the ampoule and begin to mix with the reagent.

   NOTE: A small bubble of inert gas will remain in the ampoule to facilitate mixing.
4. Remove the Vacu-vial ampoule from the cup. Mix the contents of the ampoule by inverting it several times, allowing the bubble to travel from end to end each time, until the solution is uniform in color.
5. Wipe all liquid from the exterior of the ampoule and wait 5 minutes.
6. After 5 minutes, read the transmittance of the Vacu-vial ampoule in your spectrophotometer or filter photometer. Use the correct calibration table to obtain analytical results as mg/l sulfide.

For additional information on the test described above, review the instructions provided in the CHEMetric test kit, contact CHEMeterics, Inc. (Phone 1-800-356-3072) or look up the method in APHA Standard Methods, 17, ed., p.4-192, 1989.

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5.9 PROCEDURE GF-09: TURBIDITY MEASUREMENT

1. Collect a representative, mixed sample of the water to be tested in a clean sample tube. Record the time the sample is collected. Allow sufficient time for bubbles to escape.
2. Carefully wipe the sample tube with a soft cloth to remove water spots and fingerprints. Discard sample tubes if scratched or etched.
3. Place the sample tube into the light cell with the proper orientation. Cover the tube with the light shield.
4. With the scale setting on the highest range (0-100 NTUs), read the meter, and adjust the range setting as needed. Once the reading has stabilized, record the reading on the Field Data Sheet. Record the time the reading is taken.
5. If the reading exceeds 100 NTUs, dilute the sample with distilled water as needed. A 50:50 dilution reflects a reading which is one half the true value.
6. Thoroughly rinse and wipe the sample tube clean after use.

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5.10 PROCEDURE GF-10: MEASUREMENT OF LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL)

This procedure applies to detection and measurement of non-aqueous phase liquids, such as petroleum products, which are less dense than water. Use this procedure at monitoring wells suspected of, but not known to contain such contamination.

1. Immediately after removing the well cap and prior to well evacuation, sample the air in the well head for organic vapors using either a photo ionization analyzer or an organic vapor analyzer. Document the time and reading (including units) of the measurement on the Field Data Sheet. This step may be skipped if the well is known to contain hydrocarbons.
2. Lower the interface probe to determine the presence of an immiscible organic layer above the groundwater.
3. Follow the instructions provided with the meter to determine the depth to the top of the liquid layer and the interface between the liquid and the groundwater. Document the time and reading (including units) of the measurements on the Field Data Sheet.
4. Decontaminate the meter prior to and after each use.

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5.11 PROCEDURE GF-11: MEASUREMENT OF DEPTH TO WATER AND DEPTH TO BOTTOM

The depth to water and depth to bottom of a monitoring well casing are required in order to calculate purge volumes for evacuation prior to sampling, development of new wells, and in preparation for well abandonment. See Procedure GW-09 for site-wide water-level measurements to determine the potentiometric surface. If water levels are taken independent of a sampling event use the field data sheet shown in Figure GF-1.

Depth to Water

Measure the depth to water prior to well evacuation and at other times, as needed, as follows:

1. Lower the meter probe into the casing and measure to the nearest one-hundredth of a foot below the measuring point elevation (top of PVC casing marked with an indelible ink marker or another method to standardize its location If casing is not marked, use the North side of the PVC). In flowing wells, either use a transducer or standpipe to measure head above top of well. (See Procedure GF-12 and GF-13.)
2. If an oily substance is observed on the meter probe, follow Procedure GF-10 to detect the presence of the floating liquid. Record observations and readings on the Field Data Sheet and arrange to sample for organic constituents as directed by the Project Manager or Project Work Plan.
3. Decontaminate the meter prior to each use with three rinses of de-ionized water.

Measure depth to the bottom of the casing in RTK wells without dedicated pumps at least once per year; every two years in wells with small, removable pumps; and, for larger pumps when serviced, as follows:

1. Remove dedicated pump if it will obstruct the measurement.
2. Insert the decontaminated, weighted depth-to-water meter or steel tape into the casing until the bottom is reached.
3. Measure to the nearest one-tenth of a foot below the measuring point evaluation (top of the protective casing previously marked with an indelible ink marker or another method to standardize its location).
4. Record the depth on the Groundwater Quality Field Data Sheet.
5. Decontaminate the outside of the pump. Inspect the pump for a potential maintenance problem and repair, if required, prior to re-installation according to Procedure MD-02. Record inspection and repairs in the Field Logbook.

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Field Data Sheet Used for Water Level Measurements Taken Independent of a Sampling Event.

Date	Time	Depth of Water	Measured By	Remarks

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5.12 PROCEDURE GF-12: MEASUREMENT OF HHYDRAULIC HEAD USING IN-SITU TRANSDUCER

The following operation and calibration procedures apply to the In-Situ Transducer Model No. PTX-161D and the In-Situ Level head Digital Readout Meter Model No. LH10HE. For additional information, refer to the Level head operator's manual.

Use the following operation procedure to measure feet of head in a flowing well:

1. Slip a 1.5-inch or 2-inch flowing well valve adapter, rubber washer, and coupling over the transducer probe. Place the adapter on the probe and position such that the holes in the black tip are just exposed beneath the inside lip of the adapter. (This will align the tip of the probe with the top of the flowing well valve, which is the measuring point of the well.) Tighten the coupling.

   NOTE: Flowing well valves on the older wells (with round, yellow protective casing) accept the 2-inch adapter. Flowing well valves on the newer wells (500 series with square, silver, galvanized protective casing) accept the 1.5-inch adapter.

2. Screw the adapter into the flowing well valve. Attach one end of the connector cable to the Level head meter and the other end of the cable to the faceplate of the transducer reel.

3. Turn on the meter to the proper pressure range indicated on the transducer (10 psi for Model No. PTX-161D). Turn the Zero Adjust Knob until the digital readout equals zero.

   NOTE: The pressure-sensing diaphragm in the probe is extremely sensitive. Therefore, it is difficult to set the meter on a stabilized zero reading. However, it is possible to set the meter within 0.005 to 0.010 inch.

4. Open the well valve. Check for leaks in the connections. (Significant leaks will cause lower than actual head measurements due to pressure losses.)

5. While allowing the head to stabilize, note variations in the readout of the meter.

6. Head will be a positive readout on the meter, representing the potentiometric surface or the actual distance in feet above the measuring point of the well that the water would rise in a manometer tube. Record the positive value when the reading has stabilized.

   NOTE: The 10-psi transducer will not accurately respond to heads greater than +19.6 feet.

7. Close the valve and remove the instruments from the well.

Use one of the following field or in-house calibration methods to check the accuracy of the transducer and meter prior, or after, each use:

<u>Well Method</u>

1. Zero the meter in air.

2. Lower the probe into a well to a predetermined depth (5, 10, or 15 feet) below the water level.

3. Determine if the instrument is reading the correct depth. This method works best in wells where the water level is visible inside the casing and very close to the measuring point of the well.

   NOTE: Because depths are not marked on the transducer cable, accurate calibrations in wells with deeper water levels can be performed by taping the wireline of a water level meter to the transducer cable. The correct depth of the water level and the pre-determined calibration depth can then be read off the wireline.

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4. If the meter requires calibration adjustments, refer to the Level head operator's manual.

Manometer Check

1. Perform head measurements with the transducer and meter using the Operation Procedure described above. Record the stabilized head measurement.
2. Remove the instruments from the well. Install a manometer capable of measuring within the range of the recorded head measurement.
3. Open the valve and allow the water level in the manometer to stabilize.
4. Determine if the instrument readout was the same head measurement as seen in the manometer.
5. If the meter requires calibration adjustments, refer to the Levelhead operator's manual. In-House
6. In the absence of a well or a manometer, a shallow-depth calibration can be performed. Fill a sink or an ice chest with water.
7. Lower the probe to a pre-determined depth. Lower a steel measuring tape to the same depth.

   NOTE: The zero point on the transducer probe is the top of the probe (not the holes where the diaphragm is located).
8. Determine if the instrument is reading the same depth below water level as on the measuring tape.
9. If the meter requires calibration adjustments, refer to the Level head operator's manual.

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5.13 PROCEDURE GF-13: MEASUREMENT OF HYDRAULIC HEAD IN FLOWING WELLS

This procedure describes the use of manometers and standpipes for the measurement of head in flowing (artisan) wells. The use of a pressure transducer is preferred since it does not require the discharge of water.

The standpipe used in the measurement of these heads is a clear plastic pipe that is screwed into the value on top of the well. After the standpipe is installed, the height to which the water rises in the standpipe is measured with a steel tape, read accurate to 0.01 feet. A minimum of at least 2 measurements must be taken at least 5 minutes apart. If the measured water level changes by more than 0.01 feet, additional measurements must be taken until the measurements stabilize. For slowly recharged wells, this may take hours.

The manometer is a small clear plastic hose that is attached to the valve at the top of the well. The plastic tube is elevated, and the water allowed to rise in the tubing. The height of the water in the tubing measured vertically above the well is measured using a steel tape read accurate to 0.01 feet. A minimum of at least 2 measurements must be taken at least 5 minutes apart. If the measured water level changes by more than 0.01 feet, additional measurements must be taken until the measurements stabilize.

The resulting measurements will be recorded in the field notes. Any significant leakage of water from the well prior to, during, or after the measurements will also be recorded in the field records.

No leakage should be allowed, and if it is not corrected should be reported to the field supervisor.

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5.14 PROCEDURE GF-14: REQUESTING NEW SAMPLE LOCATION NUMBER

Each time a new monitoring point is added to the monitoring system, a new sample location number should be requested using the form shown in Figure GF- 2. The request for a new sample location number will be made to the Sampling Supervisor.

Included in this request will be the site location and survey data. If the sampling point is a newly constructed well, the well documentation identified in Procedure GW-11 will be provided to the Sampling Supervisor within 90 days of the well's construction.

Immediately after the first sampling of this site, the site documentation required by Procedures GW-02, SW-02, PW-02, DW-02, or SD-02 will be provided to the Sampling Supervisor.

Example of Form Used to Request Addition of Sample Number to Sample Authorization Table.

SETUP DATA FOR WELL LOCATION AUTHORITY ON TABLE

Division UCD
Program -ID WTR
Region - Area _____
(Refer to SOP-Water Sampling [DC-7] for acronyms)
System -ID _____
Alias _____
Date Installed _____
Status _____
Site Use _____
Sample Type _____
(G=Groundwater, S=Surface, P=Process)
Report to State _____
Priority _____
(1 through 5; 1=Permit site, 5=general)
Total Metals _____
(Yes=Total & Diss: No=Diss only)
Sample Frequency _____
(M=Monthly;Q=Quarterly;S=Semi;A=Annual;E= Every other Year;F=Five Years;NS=No Sample)

Element Group
Basic_____
Minor_____
Major Ions_____
Trace Metals 1_____
Trace Metals 2_____
Trace Metals 3_____
Radionuclides_____
Organics_____
Other_____

Owners Code _____
(K=Kennecott;P=Private)
Owners Name _____
Site Description _____
Northing _ _ _ _ _ _ _ _ _ _
Easting _ _ _ _ _ _ _ _ _ _
Site Elevation (Ground) _ _ _ _ _ _ _ _ _ _
Mark Elevation (PVC) _ _ _ _ _ _ _ _ _ _
Screen Top (Depth from Ground) _ _ _ _ _ _ _ _
Well Depth (Depth from Ground) _ _ _ _ _ _ _ _ _ _

Submitted By:_____ Date:_____
Approved

Sampling Supervisor_____ Lab. Director_____

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5.15 PROCEDURE GF-15: TEMPERATURE MEASUREMENTS

Temperature Measurement

1. For flowing runoff water, select a location where the water is moving (at the section of greatest velocity) and well mixed.
2. Stand in a position such that a shadow is cast upon the area chosen for the temperature determination.
3. Hold the thermometer by the top and immerse it in the water in the shadowed area. Allow at least 60 seconds for the thermometer to stabilize.
4. If the water is too rough or turbid to measure in situ, then fill a container and immediately read the temperature. Use a container large enough to allow full immersion of the thermometer. Bring the container to the same temperature as the stream prior to filling with water.
5. Without removing the thermometer from the water, position the thermometer such that the scale can be read. Read the temperature to the nearest 0.5oC and record on the Field Data Sheet.

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5.16 PROCEDURE GF-16: PURGE AND RINSEATE WATER HANDLING

Prevent removed water from entering natural surface water bodies.

Use containers to store water until it may be properly disposed of if it has any of the following characteristics:

1. Oil on the water surface.
2. Concentrations of organic and metal constituents at or above the RCRA Characteristic Hazardous Waste threshold values.
3. A pH value of less than 4.0.

Waters that meet the above criteria must be collected and disposed of by the following protocols:

4. Waters containing elevated metal concentrations are to be disposed of in the smelter East Process Water Pond.
5. Waters with a pH below 4.0 are to be collected and disposed of in the Zone 1 Desilting Basin.

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6 GROUNDWATER

This section presents procedures for activities associated with ground water sampling as listed below. These procedures generally follow the recommendations given by the EPA in the RCRA Ground Water Monitoring Enforcement Guidance Document (1986).

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6.1 PROCEDURE GW-01: PIEZOMETER AND WELL IDENTIFICATION

All RTK ground water sampling locations are identified utilizing a three- or four-letter identification acronym followed by a unique number ranging between 0001 and 0999, and a final letter code. No dashes and/or spaces are used in the well name. Special identification numbers for QC samples are described in Procedures QC-01 through QC-05.

Well names for new wells will be assigned and approved by the Sampling Supervisor. The information listed at the end of Procedure GW-11 must accompany requests for new names.

The procedure for naming new sampling locations is provided in Procedure DC-02. The following sections describe, in general, conventions used in identifying well locations prior to the present system.

Site Identification Acronym

The identification acronym consists of a two-letter code identifying the general location of the sample and a third letter identifying a facility and/or type of well. For example, the acronym "NES" identifies a north end well (NE) located at the Smelter (S).

General location acronyms used to date include:

VW - Valley Well, a well located on the east valley side of the Oquirrh Mountains.

NE - North End, a well located along the north end of the Oquirrh Mountains.

TV - Tooele Valley, a well located along the west end of the Oquirrh Mountains.

TLL - Tailings Lysimeter

Well type and/or facility acronyms used to date include:

A - A well located in the general vicinity of the old Arthur Concentrator.

D - Diving Board Area.

K - A monitoring or production well owned by RTK.

L - RTK well located in the landfill area near Magna.

M - A well located in the general vicinity of the Magna Concentrator or the City of Magna.

P - A large-diameter piezometer.

R - A well located in the general vicinity of the Refinery.

S - A well located in the general vicinity of the Smelter.

T - A well located in the general vicinity of the tailings impoundment.

W - A well located in the general vicinity of the Wastewater Treatment Plant or a privately-owned monitoring or production well. The use of this acronym to identify privately-owned wells is restricted to use in conjunction with the identification acronym "VW".

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Sample Location Number

A sequence number or character is associated with each sampling point. That number is unique to the sampling point and will not be used in other well names. Many of the sequence numbers are also reserved for surface water sampling locations.

Final Character

An optional final character may be attached to the well name to indicate well depth. This final character will be assigned to wells installed in a well nest which are drilled to evaluate aquifer changes as a function of depth. The shallowest well will be assigned the letter "A". Successively deeper wells will be assigned sequentially higher alphabetic letters. For example, well VWP272C is the third deepest well at well site VWP272.

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6.2 PROCEDURE GW-02: WELL INSPECTION

This procedure describes a general well inspection to be conducted each time a well is sampled and a comprehensive well inspection to be completed once for each well and after any major modification or problem with the well.

General Well Inspection

Each time the well is sampled a general well inspection is to be completed. As a minimum, the following items should be checked to determine if a problem exists:

- General condition of the well and well pad.
- Recent damage to the well.
- Well locked on arrival.
- Water flowing from the well.
- Broken or missing well caps; and
- Broken valves on flowing wells.

If this inspection indicates a problem, the problem should be noted and recorded in the Field Logbook. Any serious problems should be reported directly to the Sampling Supervisor.

Comprehensive

The comprehensive well inspection is to be completed at least once for each well. This inspection should be done immediately on all wells for which it has not previously been done and after any major modifications or problems with the well. Inspect the well for all items listed on the Well Inspection Report (see Figure GW-1). Unless previously done, prepare a well location map and photographs to document the well location and elevation marker point.

Map and Photograph

1. Draw a sketch on the Well Inspection Report, including field-measured distances to permanent or semi-permanent landmarks (natural features and/or man-made structures) and a north arrow.
2. Attach a copy of an existing map, if possible, with notations on distances from map features.
3. Once a map has been sketched for a given well, do not redraw unless landmarks have changed, disappeared, or new landmarks have appeared in the area which would be beneficial in locating the wells.
4. Shoot at least two photographs at each well site for all wells included in the monitoring network. Shoot one photograph with the well in the foreground, and landmarks (shown on the well location map) in the background. Shoot another photograph with the location of the marker point (used to measure depth to water and depth to bottom in the well) clearly visible.
5. Attach photographs to the Well Inspection Report which will be filed in the Water Quality Data Filing System. For domestic and production wells, also provide the Well Inspection Report to the Project Manager or Field Team Leader to attach to these procedures for use in the field.

Well Inspection

1. Inspect the locking cap on the protective external casing. Check that the locking hasp is not broken and that the shackle of the lock will not fall out of the hasp. Check the lock for smooth operation. Lubricate if necessary.

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2. Examine the external casing if present. Note its outside diameter and construction material. Check the condition of the paint. Make sure the Well I.D. # is marked on the external casing. Note if the external casing is badly corroded or weathered.
3. Examine the well pad if present. Note its construction material, thickness, and Well I.D.# markings.
4. Inspect the inner casing. Note its outside and inside diameters. Note construction material and type of adapter if present. If no adapter, inspect condition of top of casing for smoothness. Check to see if marker point is present and if it is labeled. Inspect the annular seal for fill height and condition of material.
5. Measure the depth to the bottom of the casing in accordance with Procedure GF-11.
6. Note whether a pump is present. Indicate type of pump if present.
7. If the well is a flowing well, inspect the condition of the shut off valve. Indicate if a head measurement is possible.
8. Note any other pertinent items about the condition of the well, special sampling considerations, or its surroundings not included in the above information.

Please refer to Attachments - Figure GW-1. Example Well Inspection Report

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6.3 PROCEDURE GW-03: WELL EVACUATION

Determine purge volume using this procedure prior to removing water and measuring field parameters (See Procedure GW-04). Purge volume is calculated as the standing well and sand pack porosity. If an immiscible phase is detected for the first time, collect an immiscible phase sample (Procedure GW-9) prior to any purging activities (see Procedure GF-10).

Purging Well

For monitoring wells of known construction, evacuate a minimum of three (3) standing well casings and sand pack porosity volumes to help ensure the collection of a sample which is representative of the surrounding aquifer. The removal of at least three volumes is believed to result in a sample which is not influenced by stagnant water remaining in the well casing. Limiting the evacuation to five volumes, given that the indicator parameters have stabilized, prevents the pumping of diluted or more concentrated ground water from another area within the aquifer. If the well goes dry during evacuation, allow the water level to recover and re-evacuate, if possible, until at least one and one-half (1.5) volumes are purged. When organic constituents will be analyzed, do not pump or bail the well to dryness if the recharge rate causes formation water to cascade vigorously down the sides of the screen. The pumping rate during the sampling of the well will, to the extent possible, be lowered to provide the lowest possible turbidity achievable at the time of sampling.

Determine Purge Water Volume

The volume of porosity is calculated as follows:

1. Measure the inside diameter of the well casing if not known.
2. Determine the depth to water as described in Procedure GF-11. Enter the measured value at "Measured Initial Depth to Water" on the Ground Water Quality Field Data Sheet. If the well is flowing or the depth cannot be measured, enter the value at "Assumed Initial Depth to Water" on the Sheet. Assume the depth to water for flowing wells is 0.0 ft. Use the previous measurement for the well if conditions do not permit measurement. Decontaminate the water level indicator prior to use in each well as described in Procedure MD-02.
3. Determine the total depth to the bottom of the well from the measuring point at least once per year (see Procedure GF-11). Enter the measured value at "Measured Depth to Bottom of Casing" on the Ground Water Quality Field Data Sheet. If the depth is not measured, enter the previous measurement at "Assumed Depth to Bottom of Casing" on the Sheet.
4. Calculate the number of linear feet of standing water by subtracting the depth to water (WL) from the depth to bottom (WD). Record this value on the Ground Water Quality Field Data Sheet.

$$V = 1.872r[(WD-WL)(D2C)+ 0.3(L)(D2-D2)]$$

5. Calculate the standing water volume in gallons as follows:

Where:
V = Volume of standing water (gallons)

L = Length of screened interval (ft)

0.3 = Assumed porosity of sand pack

WD = Depth to bottom of screen (ft)

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WL = Depth to water (ft)

DB = Diameter of borehole (ft)

DC = Diameter of casing (ft)

$$V = [1.872r(WD-WL)(D2C)]+ V_{SP}$$

If the sand pack volume, V_{sp}, is known, calculate the standing water volume as follows:

6. Multiply the standing water volume by three (3) to obtain the minimum purge volume.

The volume of water to be purged from the well may be calculated as indicated above. Record the value for water purged on the Ground Water Quality Field Data Sheet.

Standardize the purging method, flow rate, and purge volume per foot of standing water in well casing for each well, when possible, to ensure that the monitoring results will be comparable from one sampling event to the next.

Pump Operation

In high-yielding, non-flowing wells without dedicated pumps, place the pump near the top of the water column rather than in the screened area. This will ensure evacuation of the standing water above the screen. If well yield is low to moderate, place the pumps at the bottom of the screened interval. For flowing wells, install a spigot to allow measurement of flow rate or volume during purging.

The following procedures describe pump operation:

Dedicated Grundfos (Submersible) Pumps

1. Remove the electric cord and discharge tubing coiled within the well casing.
2. Connect the electric cord from the submersible pump to the power supply. Turn the pump on. When pumping commences, note the time and flow rate on the Ground Water Quality Field Data Sheet. Calculate the time to run the pump using this flow rate and the calculated purge water volume. Measure parameters as per Procedure GW-04.
3. After purging and sampling, turn off the pump. Recoil the electric cord and discharge tubing and place them inside the protective casing. Replace the locking cap and lock the well.

Non-dedicated Grundfos Pumps

1. Rinse the exterior of the pump and tubing with deionized water prior to lowering down the casing. Do not allow rinse water to enter the well casing. Lower the pump and tubing into the well to the desired depth.
2. Follow steps No. 1 and No. 2 for dedicated Grundfos pumps above.
3. After purging and sampling, remove the pump from the well. Rinse with de-ionized water any portion of the tubing that has come in contact with well water.
4. Decontaminate the pump following Procedure MD-02. Shut off the compressor and generator. Replace the locking cap and lock the well.

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Bennett Pump

1. Start the generator and allow it to warm up until the generator is idling at a constant RPM. Plug the air compressor and reel motor into the receptacle outlets. Connect the compressor to the pump and allow the air pressure to build until there is sufficient pressure to activate the pumping action of the Bennett pump.
2. Rinse the exterior of the pump and tubing with deionized water prior to lowering down the casing. Do not allow rinse water to enter the well casing. Lower the pump and tubing into the well to the desired depth.
3. Monitor the discharge of the pump. When pumping commences, note the time and flow rate on the Ground Water Quality Field Data Sheet. Calculate the time to run the pump using this flow rate and the calculated purge water volume. Measure parameters as per Procedure GW-04.
4. After purging and sampling, remove the pump from the well. Rinse with de-ionized water any portion of the tubing that has come in contact with well water.
5. Decontaminate the pump following Procedure MD-02. Shut off the compressor and generator. Replace the locking cap and lock the well.

Peristaltic Pump

1. If a dedicated discharge hose is not present, rinse the new tubing with de-ionized water. Lower the tubing into the well to the desired depth. Do not allow rinse water to enter the well casing.
2. Connect the tubing to the intake side of the peristaltic pump. Connect the peristaltic pump control box to a power source (12-volt battery or 115-volt generator).
3. Turn the control box on. When pumping commences, note the time and flow rate on the Ground Water Quality Field Data Sheet. Calculate the time to run the pump using this flow rate and the calculated purge water volume. Measure parameters as per Procedure GW-04.
4. After purging and sampling, remove the tubing from the well unless the tubing is dedicated to the well. Purge and spray the tubing with de-ionized water. Store the tubing in a clean plastic bag.
5. Decontaminate the pump following Procedure MD-02. Replace the locking cap and lock the well.

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6.4 PROCEDURE GW-04: FIELD MEASUREMENTS

Measure temperature, pH, and specific conductivity during the pumping for well evacuation. Measure dissolved oxygen, and ferrous iron at the end of pumping, when required.

1. Collect samples in new, laboratory-cleaned or decontaminated containers for measurement with meters.
2. Take readings of temperature, pH, Eh (if required), and specific conductivity immediately upon the start of pumping, and periodically thereafter (e.g., every one-half to one well volume). As the total pumped volume approaches three well volumes, record the readings more frequently. When the pH has stabilized to within 0.05 pH units and other parameters have stabilized to within + 10% for four sequential readings, the well evacuation is complete. Record readings on the laptop Ground Water Quality Field Data Sheet, including comments regarding unsuccessful stabilization of parameters after the removal of five well volumes.
3. Record a physical description of the sample, noting turbidity and general appearance.
4. If required, measure Eh, dissolved oxygen, ferrous iron, and sulfide just before pumping is ceased.
5. If a dissolved oxygen meter with membrane probe is not used, use CHEMets ampoules to measure dissolved oxygen (see Procedure GF-06).
6. Use CHEMets ampoules to measure ferrous iron Procedure GF-07.

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6.5 PROCEDURE GW-05: GROUNDWATER QUALITY FIELD DATA SHEETS

A sample Ground Water Quality Field Data Sheet is shown in Figure GW-2. All blanks at the top of the sheet will be filled in (or marked "NA" if the item is not applicable). Each item is described below:

Continued on Sheet Number: Additional Sheets used to record measurements during well evacuation for a particular visit.

Well ID #: Identification number for the well which is being sampled.

Date, Time: Date and time that work began at the well.

Meter ID Numbers and Calibration: Record a reference to a field logbook and page where serial or other numbers and calibration details for the meters used to measure all field parameters has been recorded.

Method of Evacuation: Method of pumping water used to evacuate well.

Measured Initial

Depth to Water: Measured depth to water prior to pumping (when measured).

Measured Depth to Bottom of Casing: Measured depth to the bottom of casing (when measured).

Calculated Standing Water Volume: The volume of standing water calculated by Procedure GW-03.

Required Purge Volume (Standing Volume X 3): The calculated standing water volume (above) multiplied by 3.

Total Volume Pumped: The total volume of water pumped when purging was ceased prior to sample collection.

Body of Table: Time, flow rate, and readings for periodic conductivity, temperature, pH, Eh, and dissolved oxygen measurements during or after well excavation. Enter the method used to measure dissolved oxygen below the table.

Carbonate, Bicarbonate, Time: The titration amounts, acid types, acid molarity, and the time that the work was conducted in the field or the Field Office.

Ferrous Iron Measurements: Measurements of iron, including dilutions and method used.

Sulfide Measurements: Measurements of sulfide and method used.

A copy of the Ground Water Quality Field Data Sheet is filed in the Water Quality Data Filing System.

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Example Groundwater Quality Field Data Sheet

KENNECOTT UTAH COPPER

Page of_____

GROUNDWATER QUALITY
FIELD DATA SHEET

Meter ID Numbers
and Calibration See:
Field Log Book
_____
Page_____

Well ID #:_____
Date:_____ Arrival Time: _____
Sampler(s) Initials: _____

Measured Initial Depth to Water: _____ (ft)

Measured Depth to Bottom of Casing: _____(ft)

Calculated Standing Water Volume: _____ (gal)
Required Purge Volume (Standing Volume X 3): ____ _____(gal)
Total volume pumped: _____gal

Time	Flow Rate gal/min	Conductivity umhos/cm	Temperature OC	pH	Eh	Diss. Oxygen

(Continue on a second sheet if needed.)

Dissolved Oxygen Method Used: Colormetric/Probe
Carbonate (CO_3): ml H_2SO_4 titrate, .1N mg/l Time:_____ am/pm
Bicarbonate (HCO_3):ntl H_2SO_4 titrate, .1N mg/1 Time: _____ am/pm
Ferrous Iron Measurements (Color Metric): _____mg/1_____ am/pm
Time: _____ am/pm
Remarks:_____

_____

_____

_____

_____

_____ _____
Sampler Signature Time Sampling Complete

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6.6 PROCEDURE GW-06: BAILING

Bailers will be constructed of Teflon or stainless steel. A wire or single untwisted synthetic filament (such as nylon) line will be used*. The following procedure will be followed for bailer use:

1. Lower the bailer into the well, retrieve and empty it once to ensure that the bailer has been rinsed of any decontamination fluids.

2. When collecting the ground water needed for filling the sample bottles, gently lower the bailer sufficiently into the water column to collect a sample unaffected by equilibration with the atmosphere (approximately ten feet, if possible), jerk the bailer gently to ensure that the ball valve is closed, and retrieve the bailer at a steady rate to the surface.

3. When transferring the water from the bailer to the sample containers, take care to avoid agitation to the sample which will promote the loss of volatile constituents and promote chemical oxidation.

4. Do not allow the bailer line or wire to touch the ground or come into contact with any other equipment. Roll up the line or wire on a spool or feed it into a bucket lined with clean plastic.

   *For inorganic samples, the use of a braided or twisted cord is allowed if the used cord is disposed of after each use, and if leachate tests of the cord show no potential to affect the quality of the sample.

6. Decontaminate all equipment and materials coming into contact with the inside casing of the wells or the ground water (Procedure MD-02). Handle rinseate water as described in Procedure GF-16.

7. When sampling for organic constituents only bottom spigot bailers will be used.

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6.7 PROCEDURE GW-07: HYDRASLEEVE SAMPLING

Collecting samples from monitoring, domestic, or production wells via HydraSleeve (HS) is described below. Follow the general procedures for documentation, sample handling, and quality control (DC, MD, and QC series procedures).

HydraSleeve Deployment

1. Acquire specific well data such as total depth and screen interval.
2. Decontaminate a calibrated water level meter.
3. Measure the depth to water (DTW) of well in a manner that minimizes disturbance to the water column.
4. Document DTW and screen interval.
5. The HS will be placed so that the top of the sleeve is the length of the HS below the midpoint of the screen interval.
6. With clean nitrile gloves, measure out the necessary tether length. Account for the length of tether that will be securing the HS above the well head.
7. With clean nitrile gloves, open the HS from its packaging and acquire new or decontaminated clips and weight.
8. Attach the weight clip to the bottom of the HS.
9. Attach the weight to the bottom clip.
10. Attach the tether top clip to the top of the HS through the inside of the HS tether clip holes by bending out the reinforcing HS top strips.
11. Secure the premeasured tether to the top clip.
12. Slowly lower the HS down the well in a manner that minimizes disturbance to the water column while ensuring it does not get stuck and tension is felt once completely lowered, indicating it has reached the desired depth.
13. Anchor the tether either through the cap on the well or a secure location near the well head.
14. The HS should be deployed for at least 5 minutes before retrieval for the sleeve to reach equilibrium with groundwater.

HydraSleeve Retrieval

1. Prepare the tether for retrieval.
2. In one smooth motion, pull the tether up the distance of the HS at a rate of about one foot per second or faster. The motion will open the top check valve and allow the HS to fill.
3. Continue to retrieve the HS to the surface.
4. Once the HS has been taken out of the well, squeeze the top near the reinforced strips to remove excess water that is captured above the closed check valve. This water is not part of the sample.
5. Suspend the full HS in a manner that allows for the transfer of sample water to appropriate sample containers.

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6. Use the provided straw to puncture the bottom of the HS and collect the sample. Be careful not to pierce both sides of the sleeve.
7. Collect and document required field parameters.
8. Decontaminate the clips and weight for future use.
9. Replace the locking cap and lock the well.
10. Complete final documentation of the sampling event.

Refer to step by step photo log.

For additional detailed HS instructions, reference; Standard Operating Procedure: Sampling Groundwater with a HydraSleeve, 2016 GeoInsight.

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6.8 PROCEDURE GW-08: SAMPLE COLLECTION – GENERAL IONS AND METALS

General Protocol

Collect samples from monitoring wells, domestic wells, or production wells as described below, also following the general procedures for documentation, sample handling, and quality control (DC, MD, and QC series procedures).

Complete well documentation and inspection as required by Procedure GW-02.

Sample Collection from Monitoring Wells

1. Measure the water level in accordance with Procedure GF-11.
2. If an immiscible organic layer is detected above the ground water for the first time, samples will be analyzed for organic constituents using Procedure GW-09 for sampling.
3. Evacuate the well in accordance with Procedure GW-03.
4. Collect samples in prepared containers with the proper preservatives. If required, measure carbonate and bicarbonate in the Environmental Field Sampling Room (Bucking Room) according to Procedure GF-05.
5. Attach the in-line filtering device with a 0.45-micron filter to collect samples which require filtering. Install a peristaltic pump in flowing wells as necessary to provide the pressure for in-line filtering. Follow the manufacturer's instructions for filter use. If field filtering is impossible, fill extra containers (labeled with the Well ID # in indelible ink) for transport to the Field Office for filtering and filling of containers on the same day as sample collection. Note this variance in the field form, Procedure GW-05.
6. If any preservative is lost prior to or during the filling of a sample container (i.e., spilling or overflow), use another prepared container.
7. Thoroughly decontaminate all equipment and instruments used to sample and check the depth to water (Procedure MD-02).

Sample Collection from Domestic Wells

Purge domestic wells in accordance with Procedure GW-03 unless photographs and specific instructions for the well are available. Generally, use the same equipment used for monitoring wells with the exception of pumps and bailers. Use the following procedure in the sampling of domestic wells:

1. Contact the owners or operators of the wells to determine what tools, valves, hoses, etc., will be needed. Wrenches may be needed for opening and closing faucets or spigots.
2. Obtain information about the size of the fittings required and accessibility of the sampling spigot. It may be convenient to attach a section of inert plastic (such as Teflon) tubing to the spigot, especially under very cramped quarters.
3. Collect residential samples from a sampling port or spigot which is positioned as close to the well head as possible, and prior to any type of treatment system, such as a water softener, chlorination or granular activated carbon unit. Residential wells generally have a spigot located at the base of the pressure tank. This is usually the closest tap to the actual well head.

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4. When collecting raw samples from the tap off the pressure tank, turn on the cold-water faucet and run a minimum of five minutes and/or until temperature stabilization (two readings within + 10%). Measurements of pH and/or conductivity also can be used to indicate that fresh water is entering the pressure tank.
5. After stabilization has been achieved, continue to run the cold-water faucet, and collect samples from the tap off the pressure tank. This will ensure collection of a representative sample.
6. For most residential wells, collect the samples directly into the sample bottles. Use in-line filters where possible for the appropriate inorganic samples. Use a peristaltic pump to provide the pressure for in-line filtering. Follow the manufacturer's instructions for filter use. If field filtering is impossible, fill extra containers (labeled with the Well ID # in indelible ink) for transport to the Field Office for filtering and filling of containers on the same day as sample collection. Note this variance in the field data sheet.

Sample Collection from Production Wells

Generally, use the same equipment used for monitoring wells with the exception of the pumps and the bailer. Since production wells are high volume water producers, there is no necessity for evacuating the well when the well is in operation. Use the following procedure in the sampling of production wells:

1. Contact the operators of the wells to determine what tools, valves, hoses, etc., will be needed. Wrenches may be needed for opening and closing faucets or spigots. Often spigots on production wells may be too large, resulting in a high-volume flow which will make sampling difficult. In this case, it will be necessary to reduce the flow by using appropriate fittings.
2. Sample production wells during a pumping cycle to ensure that stagnant water is not sampled.
3. Clear the lines between the well and the spigot.
4. Collect samples from a sampling port or spigot which is positioned as close to the well head as possible, and prior to any type of treatment system, such as a water softener, chlorination, or granular activated carbon unit.
5. For most production wells, collect directly into the sample bottles. Use in-line filters where possible for the appropriate inorganic samples. Use a peristaltic pump to provide the pressure for in-line filtering. Follow the manufacturer's instructions for filter use. If field filtering is impossible, fill extra containers (labeled with the Well ID # in indelible ink) for transport to the Field Office for filtering and filling of containers on the same day as sample collection. Note this variance on the Field Data Sheet.

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6.9 PROCEDURE GW-09: SAMPLE COLLECTION – ORGANIC COMPOUNDS

1. Measure the water level in accordance with procedure GF-11.
2. If an immiscible organic layer is detected above the ground water for the first time:
   a) Measure the thickness of the immiscible layer according to Procedure GF-10 if not already done.
   b) If a sample of the immiscible phase is to be collected, conduct the sampling as follows:

      If the thickness of the immiscible phase is two feet or greater, collect the immiscible phase sample using a bottom-valve bailer. Lower the bailer slowly into the well until it contacts the surface of the immiscible phase. Continue lowering the bailer to a depth less than the pre-determined thickness of the immiscible layer.

      If the thickness of the immiscible layer is less than two feet, a top filling bailer must be used. The bailer can be weighted with a length of small-diameter stainless steel pipe. Lower the bailer slowly into the well until the top of the bailer is level with the pre-determined top of the immiscible layer. Lower the bailer an additional one-half thickness of the immiscible layer and retrieve the sample.
4. Evacuate the well in accordance with Procedure GW-03.
5. Prior to sample collection, allow the water level in non-flowing wells to recover in order to produce the necessary sample volume. Thoroughly decontaminate instruments used to check the depth to water prior to use in the well and between purging and sampling (Procedure MD-02).
6. When collecting organic samples for VOC analyses with a pump, do not exceed 100 milliliters per minute in pumping rate. If these rates are unattainable, use a bailer for sample collection (see Procedure GW-06). Fill sample containers completely, leaving no head space.
7. Collect samples in prepared containers with the proper preservatives. If required, measure carbonate and bicarbonate according to Procedure GF-05.
8. If any preservative is lost prior to or during the filling of a sample container (i.e., spilling or overflow), use another prepared container.

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6.10 PROCEDURE GW-10: SITE-WIDE WATER-LEVEL MEASUREMENTS

In order to determine the potentiometric surface for a given aquifer or to determine the gradient between aquifers, take water-level measurements during a relatively short period of time.

1. Measure the depth to water in non-flowing wells using Procedure GF-11.
2. If an oily substance is observed on the meter probe, follow Procedure GF-10 to measure the depth to the immiscible layer and the depth to the oil/water interface.
3. Determine the hydraulic head of flowing wells using a manometer (for heads a few feet above the casing) or transducer Procedures GF-12 and GF-13.
4. If using a manometer, measure the head above the marker point to the nearest 0.10 ft.

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6.11 PROCEDURE GW-11: NEW MONITORING WELL CONSTRUCTION

This group of procedures provides a protocol for installing new monitoring wells, including preparation for drilling, installation using various drilling methods (auger, air rotary, mud rotary, and cable tool), surveying, geophysical borehole logging, well development, and well documentation.

Preparation For Monitoring Well Installation

Follow these steps prior to a drilling and well installation project, including preparation of a drilling permit, preparation of a statement of work for the drilling contractor, locating underground utilities, and obtaining necessary field equipment. The regulatory requirements are based on the "State of Utah Administrative Rules for Water Well Drillers", adopted July 15, 1987, which remain in effect as of June 1, 1999. The Water Rights Division at 538-7240 may be contacted for updates.

1. For wells over 30 feet, submit an application for a drilling permit to the Utah Division of Water Rights and allow at least 30 days for a reply. Mail the application to: State Engineer (currently Mr. Robert L. Morgan), Division of Water Rights1594 West North Temple, Suite 220, P.O. Box 146300 Salt Lake City, Utah 84114-6300. The written request must include the following information using the form provided in Figure GW-3:

a) Name, address, and phone number of RTK contact.

b) Current property owner.

c) Total anticipated number of wells to be installed.

d) Diameters, approximate depths, and type of completions (materials to be used for casing, screen, pack and grout).

e) Name, address, and telephone number of Project Manager.

f) General location or common description of the monitoring project.

g) Name and license number of driller contracted to install the wells.

h) Projected start and completion dates.

i) Specific course and distance locations of all requested locations or location by 1/4, 1/4 section.

Upon written approval from Division of Water Rights, the project will be assigned an approved authorization number to be referenced by the licensed driller on all start cards and well drillers reports as required by Sections 4.1.1 and 4.3 of the "State of Utah Administrative Rules for Water Well Drillers".

2. Request a sampling point identification number from the Sampling Supervisor.

3. Prepare a statement of work for a licensed drilling contractor including schedule, the number of wells, type of each well, approximate depths, size of boreholes, expected subsurface materials, requirements for borehole geophysical logging, required drilling and decontamination equipment, soil and water sampling requirements, specifications for well construction materials, requirements for self-contained water or power, water source criteria, tanks for recirculation methods, and labor support necessary to complete the wells. Use the appropriate technical specifications, depending on drilling method selected

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by the Project Manager or Field Team Leader. Drilling personnel must have current 40-hour OSHA Hazardous Materials training.

4. After the general location for the monitoring well has been determined, check the area for buried utilities using existing site maps and knowledgeable RTK personnel. Contact Bluestakes at 532-5000 at least 48 hours prior to anticipated drilling. Provide Bluestakes with a description of the area to be staked, the drilling company name and address, and your name. Obtain a request number from Bluestakes and record it in the Field Logbook for the project.

5. Acquire necessary equipment for fieldwork as follows:

· Personal protective equipment, including hard hat, safety boots, ear plugs, safety glasses, leather gloves, rubber gloves, and two-way radio.

· Field Logbook, waterproof indelible ink markers, pens, pencils.

· Borehole Log forms, 10X hand lens.

· Plastic bags, sample jars, sample labels.

· Knife, spade, screwdriver or other similar devices to probe split spoon samples.

· Strainer to catch cuttings (rotary drilling).

· Grain size and color charts.

· Buckets (calibrated in gallons or liters).

· Decontamination bucket, wash water, laboratory detergent solution, de-ionized rinse water.

· Steel tape, blue chalk, engineer's tape, or electronic water meter.

· pH meter, conductivity meter, litmus paper.

· Available nearby lithologic or well data.

· Dilute HCl acid (5-10%).

· Map.

Please refer to Attachments - Figure GW-03. Request for Monitor Well Construction

Oversight of Drilling and Installation

Follow this procedure when serving as field geologist during installation of ground water monitoring wells. Select the appropriate drilling method based on subsurface materials (unconsolidated or consolidated), requirements for sampling (disturbed or undisturbed), and depth of borehole. Log and sample only the deepest borehole in nested well installations. The drilling of deep boreholes will be interrupted to install a temporary casing and seal in the confining layer (see "Deep Monitoring Well Installation" below). Continue sampling and formation logging upon the resumption of drilling.

1. Use a Borehole Log (see Figure GW-4) during drilling and well construction to record information as discussed below. Also use a Field Logbook to record activities each day (date, time, personnel on site, problems/solutions, drilling conditions).

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2. For drilling techniques which require the collection of undisturbed samples, use a Shelby tube, a split-spoon sampler, or a core barrel to collect soil samples at least every five (5.0) feet and at major changes in material. Record the number of blows required to advance the split spoon one-half (0.5) ft.

3. When drilling through contaminated soils, arrange for the proper containment and disposal of cuttings, regardless of drilling method.

4. If contamination by organic compounds is suspected, place some of the drill cuttings or soil samples into a clean glass jar and cover with aluminum foil. Allow the temperature of the soil to equilibrate with ambient temperature. Insert the probe of a photoionization detector (PID) through the foil and into the glass jar. Record the PID measurement on the Borehole Log at the appropriate depth.

5. Collect soil samples for laboratory analyses in sample jars or leave intact in stainless steel sleeves as directed by the Project Manager or Project Work Plan. Place sample containers in a sealed Ziplock plastic bag. Place the sample in a cooler with ice if organic analyses are planned. Record sample numbers at the depth sampled on the Borehole Log and on the sample label. Include on the sample label and Borehole Log the following:

    - Well I.D.#;
    - Time and date.
    - Depth of sample.
    - Analyses to be done; and
    - The person collecting the sample.

6. Record on the Borehole Log the project name, borehole location, well I.D.#, date and time drilling began, weather conditions (i.e., temperature, wind direction and speed, precipitation), drilling company, drilling method, drilling crew names and your name. Provide a sketch of the well location noting measured distances (approximate) from established landmarks and indicate the north direction.

7. During drilling, collect drill cuttings and record descriptions of soil samples using the Unified Soil Classification System on the Borehole Log. Use standard geologic terminology to classify rock materials. Note the color, moisture, texture, sorting, roundness/angularity, degree of cementation/consolidation, fabric, bedding, orientation, depositional environment, formation name, and any evidence of contamination or other characteristics related to hydrogeologic conditions.

8. Decontaminate the sampling device prior to collecting another sample (see Procedure MD-02).

9. Record the total borehole depth and drilled diameter per depth interval at the top of the Borehole Log. Enter the approximate surface elevation.

Well Construction Oversight

Document well construction activities for each well installed, including all wells in nested sets.

Shallow Monitoring Well Installation

A "shallow" well is one which is drilled to less than 25 ft below the water table.

1. Upon drilling to the desired depth, select the screened interval based on anticipated annual water table fluctuation at the site. Inform the driller of the lengths and intervals of casing and screen to be installed. Measure the slot size and length of each section of screen and casing. Record the length, diameter, type of casing used and screen slot size at the top of the Borehole Log. Locate a single centralizer in the

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middle of the screen to ensure an evenly distributed sand pack. Ensure that the casing and screen are sealed in contaminant-resistant wrappers prior to use and are handled and stored in a manner which prevents contamination.

2. Ensure that the driller installs the PVC screen and casing through the augers or temporary casing, and that care is taken not to contaminate the casing and screen. If an immiscible organic layer is presumed to be present above the potentiometric surface, the top of the screen must be positioned in the well above the potentiometric surface to allow sampling of the immiscible layer. Where well clusters are installed, one well may be screened where the immiscible layer is expected, and another well may be screened in the uppermost portion of the aquifer.
3. The sand must be added slowly to avoid "bridging" in the annulus between the PVC casing and borehole wall. Preferably, use a tremie pipe for sand installation.
4. Confirm the depth to the sand pack ("tag the pack") periodically using a measuring tape with a weight attached.
5. Ensure that the augers or temporary casing are slowly pulled as sand is added to the bottom of the borehole.
6. Tag the pack to see how much sand is lost to the formation.
7. Repeat steps 3 through 6 until sand pack has been installed to two feet above the uppermost slot of the well screen. Record on the Borehole Log the sand grain size and gradation, sand pack interval (depth to top and bottom), and total amount of sand used (volume or weight).
8. Instruct the driller to add bentonite pellets or chips to form a bentonite seal at least two (2.0) feet thick. Record the bentonite seal interval (depth to top and bottom) and the total amount of bentonite pellets or chips used.
9. If the borehole is dry at the top of the sand pack, ensure that the driller adds approximately one gallon of distilled water to swell the bentonite. Record the volume of water added to the borehole.
10. Instruct the driller to grout or concrete the annulus to the surface. Re-fill annulus as necessary to replace concrete lost to porosity in the formation. Record the total amount of grout or concrete used.
11. Instruct the driller to install a protective casing (minimum of two feet above the ground surface, and a locking cap) or manhole cover (sealed with an O-ring gasket) as detailed in the driller's statement of work and specifications. Ensure that a vent hole in the well casing and a drain hole in the protective casing are drilled as per specifications. Arrange for the installation of a grounding rod for pump generators.
12. Ensure that a locking cap is installed on the protective casing. Record key number on the Borehole Log. The driller will also install a concrete pad (with an elevation marker point on the north side of the well) and steel barricades (in high traffic areas) according to specifications.
13. Measure the water level inside the well and record at the top of the Borehole Log. At a minimum, return to the well site in 24 hours to obtain another water level and record it on the Borehole Log.
14. Ensure that the driller steam cleans all down-hole equipment prior to beginning each new borehole. Decontaminate water-level measurement equipment prior to use.
15. Complete the Borehole Log and submit it to the Project Manager or Field Team Leader. File a copy in the Water Quality Data Filing System.

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Monitoring Well Installation in Confined Aquifers

A "deep" well is a borehole in which the screened interval must not receive flow from an overlying perched water zone or aquifer. Deep wells are typically drilled through a confining layer in order to sample the confined aquifer and may result in a flowing well.

1. Select temporary casing large enough to allow smaller drill bits or augers to pass through to complete the well. Larger augers may be used in place of temporary casing when the auger method is used.
2. Ensure that the driller installs the temporary casing at least one foot into the confining layer, although not into the confined aquifer.
3. Instruct the driller to check the seal by pulling the drill rods and bailing the temporary casing or augers dry.
4. Ensure that the driller adds a small quantity of bentonite to ensure the viability of the seal.
5. Instruct the driller to allow the temporary casing or augers to sit overnight.
6. Check the water level to ensure the integrity of the seal.
7. If the seal is intact, continue drilling through the confining layer to the desired depth.
8. Inform the driller of the lengths and intervals of casing and screen to be installed. Measure the slot size and length of each section of screen and casing. Record the length, diameter, type of casing used and screen slot size at the top of the Borehole Log. Locate a single centralizer in the middle of the screen to ensure an evenly distributed sand pack. Ensure that the casing and screen are sealed in contaminant-resistant wrappers prior to use and are handled and stored in a manner which prevents contamination.
9. Ensure that the driller installs the PVC screen and casing through the temporary casing or augers, and that care is taken not to contaminate the screen and casing. If an immiscible organic layer is presumed to be present above the potentiometric surface, the top of the screen must be positioned in the well above the potentiometric surface to allow sampling of the immiscible layer. Where well clusters are installed, one well may be screened where the immiscible layer is expected, and another well may be screened in the uppermost portion of the aquifer.
10. The sand must be added slowly to avoid "bridging" in the annulus between the casing and borehole wall. The use of a tremie pipe is mandatory.
11. Confirm the depth to the sand pack ("tag the pack") periodically using a measuring tape with a weight attached or a wire line with a depth counter. Allow the sand to settle (approximately five minutes) to ensure a more accurate top-of-sand measurement.
12. Ensure that you don’t pull the temporary casing until you have a good seal at the bottom of confining layer.
13. Tag the pack to see how much sand is lost to the formation.
14. Repeat steps 10 through 13 until sand pack has been installed to two feet above the uppermost slot of the well screen. Record on the Borehole Log the sand grain size and gradation, sand pack interval (depth to top and bottom), and total amount of sand used (volume or weight).
15. Instruct the driller to add bentonite pellets or chips to form a bentonite seal at least two (2.0) feet thick. Record the bentonite seal interval (depth of top and depth of bottom) and the total amount of bentonite

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pellets or chips used. If the bentonite seal must be installed through a column of water greater than 20 feet, install the bentonite seal as a slurry using a tremie pipe.

16. If the borehole is dry at the top of the sand pack, ensure that the driller adds approximately one gallon of distilled water to swell the bentonite. Record the volume of water added to the borehole.

17. Instruct the driller to grout or concrete the annulus to the surface. If the column of water above the top of the bentonite is greater than 20 feet, install the grout using a tremie pipe. Install concrete in lifts of no more than approximately 50 feet to avoid melting of PVC casing during curing. Re-fill annulus as necessary to replace concrete lost to porosity in the formation. Record the total amount of grout or concrete used. If the temporary casing is to be extracted, assure that the grout or concrete seal is at least 1 foot above the bottom of the confining layer before the temporary casing is extracted. This will ensure that no water flows from the upper or perched aquifer into the underlying aquifer.

18. Instruct the driller to install a protective casing (minimum of two feet above the ground surface, and a locking cap) or manhole cover (sealed with an O-ring gasket) as detailed in the driller's statement of work and specifications. Ensure that a vent hole in the well casing and a drain hole in the protective casing are drilled as per specifications. Arrange for the installation of a grounding rod for pump generators.

19. Ensure that a locking cap is installed on the protective casing. Record key number on the Borehole Log. The driller will also install a concrete pad (with an elevation marker point on the north side of the well) and steel barricades (in high traffic areas) according to specifications.

20. Measure the water level inside the well and record at the top of the Borehole Log. At a minimum, return to the well site to obtain another water level 24 hours from the first reading and record on the Borehole Log.

21. Ensure that the driller steam cleans all down-hole equipment prior to beginning each new borehole. Decontaminate water-level measurement equipment prior to use.

22. Complete the Borehole Log and submit it to the Project Manager or Field Team Leader. File a copy in the Water Quality Data Filing System.

Please refer to Attachments - Figure GW-4. Example Borehole Log

Surveying

1. Prepare a statement of work for a licensed surveying contractor to determine the location and elevation of the ground surface and the top of the protective casing. The horizontal control will be Kennecott Mine Datum to within + 3 ft (+ 1 meter). The elevation of the monument marker will be surveyed to within + 0.01 foot (+ 0.3 cm) using the National Geodetic Vertical Datum of 1929. Corrected survey data will include loop closure for survey accuracy within these limits.

2. The surveyor's report will include a list of coordinates, elevations, and system used. The report must also include a map, and a description and location of all permanent and semipermanent reference points used for horizontal and vertical control. This report will be filed in the Water Quality Data Filing System.

Geophysical Borehole Logging

Borehole geophysical techniques provide an efficient and cost-effective means to collect lithologic and hydrologic information from wells and borings. These methods provide continuous measurements of physical properties along the entire length of the borehole, supplementing the discrete information gathered by coring.

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1. Calibrate and field-check all logging probes each day prior to beginning work at the site. Conduct testing and calibration according to the manufacturer's recommendations. Document calibration and field-check information for each particular logging probe on the borehole Log Header for that instrument. The required Log Header information is provided in Figure GW-5. An example Log Header is presented in Figure GW-6.
2. When borehole logs will be used for quantitative analyses, check each probe with the field standard before and after the probe is run in the hole. Record the type of field standard used and the field check values on the appropriate Log Header.
3. Choose an appropriate logging speed for each borehole technique based on the type of probe used, noise conditions, and data resolution requirements. Record the logging speed on the Log Header.
4. Choose a vertical log scale based on appropriate resolution requirements, but not greater than 20 feet per inch, or 2.5 meters per centimeter. Choose a horizontal scale to accommodate a reasonable range of signal variation.
5. Reference log starting depth to a surveyed surface point.
6. When probes are used in combination, ensure that no probe shall interfere with the performance of another probe in the same combination. Document the combinations used on the Log Header. Correct the borehole measurements for difference measuring depths between probes. Note the correct logs as such.

Procedures for Specific Borehole Geophysical Techniques

1. Electrical Logs: Measure and record the temperature of a sample of the drilling fluid on the Log Header. If the logs are used in an augured hole, measure a sample of the borehole fluid immediately after logging.
2. SP Logs: Do not use SP logs for quantitative analysis except for the special case of no log response. Do not adjust the shale baseline on an SP log while the log is being recorded.
3. Resistivity Logs: When resistivity logs will be used for quantitative analysis, apply the corrections to the analyzed intervals. Make corrections appropriate to the type and make of probe used and document the corrections. For short-normal resistivity logs, use probes with measurement electrode spacings of no greater than 16 inches. For long-normal resistivity logs, use probes with measurement electrode spacings of no greater than 64 inches.
4. Caliper Logs: Use a caliper probe with a minimum of three measuring arms. The arms should be of the finger type and possess sufficient length to record the entire range of diameter change within a given borehole.
5. Nuclear Logs: The logging supervisor will ensure that the individual performing the borehole geophysical logging with probes containing radioisotopes shall be in compliance with all state and federal regulations for handling, storing, and using radioactive sources. Run all other borehole logs chosen as part of the logging suite prior to running any nuclear probes containing a radioisotope source. Use SPI units of measurement on all nuclear logs. When using analog equipment, choose a time constant appropriate to the data needs and site conditions, but which does not exceed 15 seconds. Choose a logging speed appropriate to the data needs and site conditions which does not exceed 30 feet per minute. Correct the data from the nuclear log for lag effects. Record the time constant, logging speed, and correction method on the log header.

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6. Acoustic Televiewer Logs: When an ATV log is deeper than 100 feet and will be quantitatively analyzed, correct the ATV log using the data obtained from a borehole deviation log of the same borehole.

REQUIRED LOG READER INFORMATION

- WELL INFORMATION
- Well Name/Number
- Location/Site Name
- Surface Elevation
- Casing Height (above surface)
- Depth Reference (description)
- Borehole Diameter
- Casing Information (Type, Diameter, Location)
- Drilling Fluid Description (Type, Resistivity, Temperature)
- Construction Information (Locations cement, perforations, screen)
- Drilling Information (Date Drilled, Name of Driller, Drilling
- Methods, Drilled Depth
- LOG INFORMATION
- Type of Log
- Run Number
- Name(s) of Operators, Observers
- Date Logged
- Probe Description (Name, Serial Number)
- Logging Speed
- Recorder Scale
- Module/Panel Settings
- Calibration Data
- Listing of all other logs run on same date.
- Miscellaneous Information
- Additional comments (e.g., adverse weather, logging conditions, any irregularities in calibration, logging procedure)

Note: Log header information required for all borehole geophysical logs. Header information must be as complete as possible. Missing information must be so noted on the header form (Keys, 1989).

Please refer to Attachments - Figure GW-6. Example Log Header

Monitoring Well Documentation

The following information will be documented for all wells used in the monitoring network. This information will be published in the GCMP upon its next revision. Supporting documentation for this information, as well as Well Inspection Reports (Procedure GW-02), will be filed in the Water Quality Data Filing System.

- Well Identification Number.
- Alias Well Identification Number.
- Survey location (Kennecott Mine Coordinates, feet) and elevation of collar (feet).

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- Elevation of the ground surface above mean sea level (feet).
- Elevation of protective casing (feet).
- Location of marker point used to measure depth to water (feet).
- Elevation of marker point.
- Depth to water (feet), a recent measurement.
- Total depth to the bottom of the casing (feet).
- Borehole diameter (feet).
- Casing diameter (feet).
- Depth to top of screen (feet).
- Depth to bottom of screen (feet).
- Depth to top of sand (feet).
- Depth to pump setting for dedicated or portable pumps (feet).
- Pack purge volume (gallons).
- One purge volume (gallons).
- Sampling frequency (per year).
- Frequency of site-wide water-level measurements for potentiometric surface (per year)
- Analytical suite.
- Slug test permeability (ft/day).

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6.12 PROCEDURE GW-12: WELL ABANDONMENT

Follow this procedure for permanent abandonment of monitoring wells which have been determined to be no longer useable or will be destroyed due to construction activities.

Preparation

Prepare a statement of work for a licensed drilling contractor to completely fill the well in a manner to prevent vertical movement of water within the borehole and annular space surrounding the well casing. Include the following requirements3 in the specifications:

1. The following materials may be used:

a) Neat Cement conforming to ASTM standard C150-94 of sufficient weight (not less than 15 lbs/gallon) to prevent the flow of any water into the hole from any aquifer penetrated.

b) Cement grout consisting of equal parts of cement conforming to ASTM standard C150 and sand/aggregate with no more than six (6) gallons of water per 94lb sack of cement.

c) Bentonite-based products specifically designed for permanent well abandonment, which are mixed and placed according to manufacturer's recommended procedures (i.e., Plug-Gel, Shur-Gel, Benseal etc.).

d) The uppermost ten feet of the abandoned well casing or borehole shall consist of neat cement or cement grout.

e) The liquid phase of the abandonment fluid shall be non-saline water containing no chemicals or toxic materials or other substances which may decompose or possibly contaminate the ground water supply.

f) Abandonment materials placed opposite any non-water bearing intervals shall be at least as impervious as the formation prior to penetration during the drilling process.

2. The casing will be pulled, if feasible and possible, while neat cement and cement grout are introduced at the bottom of the wells and placed progressively upward using a grout pipe, tremie line or dump bailer in order to avoid segregation, dilution, or bridging of materials. If the casing cannot be pulled and the seal is of questionable integrity, the casing should be perforated. The screened and perforated intervals will be pressure grouted. Bentonite-based products shall be mixed and placed according to manufacturer's recommended procedures.

3. In flowing wells, a cement or grout plug will be placed in the confining stratum overlying the artesian zone. The remainder of the well will be filled with cement grout, concrete, or bentonite products.

4. The casing, if left in place, shall be severed a minimum of two (2.0) feet below either the natural ground surface adjacent to the well or at the collar of the hole, whichever is lower. A minimum of two feet of compacted native material shall be placed above the abandoned well upon completion.

5. Upon completion, the site will be cleaned, and waste materials will be disposed of properly.

[3]This list is based on the "State of Utah Administrative Rules for Water Wells Drillers", adopted July 15, 1987. As of January 25, 1991, these rules remain in effect. Contact the Water Rights Division at 538-7240 for updates.

6. A report will be submitted to the Division of Water Rights by the driller within 30 days of completion of well abandonment activities in accordance with Section 12.7 of the "State of Utah Administrative Rules For Water Well Drillers".

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7. If wells are to be abandoned in areas that may encounter hazardous materials, all personnel must have current 40-hour OSHA Hazardous Materials training.

Oversight

An on-site engineer or geologist will:

1. Verify the water level and depth to the bottom of the well prior to abandonment activities using Procedure GF-11.
2. Observe and verify all abandonment activities performed by the driller and document the information as listed in the next section, "Documentation".
3. Twenty-four hours after abandonment is completed, check the borehole for settlement. Arrange for the addition of grout and check in 24 hours, repeating until grout remains firm up to a point two (2.0) feet below the surface. Arrange for the placement of two (2.0) feet of compacted native soil above the abandoned borehole. Alternatively, if so directed by the Project Manager or Project Work Plan, arrange for the installation of a concrete plug with a metal marker such that the borehole may be located in the future.

Documentation

1. Document all field events for the well abandonment process in a Field Logbook, including the following information:

a) Well I.D.# and Water Right or Drilling Permit Number.

b) Location with respect to the replacement well or to the nearest landmark.

c) Water level and depth to bottom prior to grouting and date measured.

d) Date, time and duration of each field event associated with the abandonment.

e) Description and amount of grout used initially and for each interval.

f) Description and daily quantities of grout used to compensate for settlement.

g) Drilling method.

h) Names of all on-site personnel and licensed drillers.

i) Explicit descriptions of problems encountered and/or any deviations from the planned approach.

j) Casing and materials (e.g., tremie pipes) left in hole (depth, composition, and size).

2. File a copy of the above field notes, as well as a diagram of the abandoned well column (materials/depth), with the original borehole log in the Water Quality Filing System.
3. Ensure that the driller submits the required report to the Division of Water Rights within 30 days of completion of well abandonment procedures.

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6.13 PROCEDURE GW-13: WELL DEVELOPMENT

Well development is necessary to restore the natural hydraulic conductivity of the surrounding formation and remove all foreign sediment. All new wells will be developed prior to sampling. Existing wells producing turbid samples may also require development. Use this procedure after the monitoring well has been constructed.

1. Develop monitoring wells within 48 hours after well installation.
2. Measure the depth to water and the depth to the bottom of the well according to Procedure GF-11.
3. Subtract the depth to water from the depth to bottom to obtain the number of linear feet of standing water. For flowing wells, the depth to water used in this calculation will be 0.0 ft. Calculate the volume of standing water (casing and sand pack volume) as described in Procedure GW-03. Remove at least five volumes by pumping. Development will be considered complete when the turbidity has substantially decreased and the pH, temperature, and specific conductivity have stabilized.
4. Contain purged waters in the proper drums if contamination is suspected (see also Procedure GW-06).
5. Decontaminate the pump or bailer (if a non-disposable bailer is used) prior to developing another well.
6. Document all measurements and activities in the Field Logbook. The method of development, pH, conductivity of casing water, removed volume of water during development, and length of time spent developing the well will be recorded.

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6.14 PROCEDURE GW-14: SAMPLE COLLECTION - RADIONUCLIDES

This procedure is for the collection of radionuclides to include Gross Alpha, Gross Beta, Radium 226, Radium 228, and Uranium.

Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, MD-01, and MD-02.

1. Prepare all sample containers in accordance with Procedure DC-03.
2. Label the sample containers in accordance with Procedure DC-04.
3. The prepared sample containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following container directly from the pump discharge hose:
4. 1 - half gallon plastic container
5. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.
5. Since all of these, except for Uranium, must be shipped to an outside laboratory for analysis, the following MDL's have been set:

- Gross Alpha Dependent on TDS
- Gross Beta Dependent on TDS
- Radium 226 2 pCi/L
- Radium 228 1 pCi/L
- Uranium 0.005 mg/L

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6.15 PROCEDURE GW-15: SAMPLE COLLECTION - LYSIMETER

LYSIMETER IDENTIFICATION

All RTK soil moisture lysimeter sampling locations are identified utilizing a three-letter identification acronym followed by a unique number ranging between 4100 and 4199. The site letter acronym identifies the general location of the lysimeter as outlined in the procedures in GW-01.

LYSIMETER INSPECTION

Each time a lysimeter is to be sampled the inspection procedures outlined in GW-02 are to be followed. However, additional troubleshooting may be required. For instance, if there is no remaining suction and no sample, follow-up corrective action may be required. The status of the lysimeter is to be recorded as described in GW-02, as well as on the lysimeter record keeping field form, using the appropriate lysimeter status number outlined in the troubleshooting section.

TROUBLESHOOTING

The following is a troubleshooting guide for suction lysimeter field sampling:

Lysimeter Status No.

1. Lysimeter has vacuum remaining that ranges from 20 to 50 centibar, sample volume is greater than 100ml. Meaning: Lysimeter is operating properly, if soil matrix potential is much less than applied suction. Correction Action: None.
2. Lysimeter has vacuum remaining that ranges from 20 to 50 centibars, sample volume collected is 10 to 100ml. Meaning: Lysimeter is operating properly, if soil matrix potential is near applied suction. Corrective Action: None; however, special precautions are needed to be observed in the analysis of low volume samples. Prioritize analytical request.
3. Lysimeter has vacuum remaining that is greater than 20 centibars, no sample. Meaning: Lysimeter is operating properly, if soil matrix potential is greater than the applied suction. Corrective Action: None.
4. Lysimeter has no vacuum remaining, no sample. Meaning: Soil matrix potential is less than the air entry value or the lysimeter leaks. Corrective Action: Compare to water content records and to other lysimeters at the same depth to see if it possible for the suction to be less than -2 bars. If not, inject 50ml of deionized water and reapply vacuum. If vacuum is gone within an hour, replace lysimeter.

FIELD MEASUREMENTS

Field measurements will be collected during the procedure outlined in GW-04, including pH, specific conductance, temperature, dissolved oxygen, ferrous iron, and sulfide (see CHEMets ampoules due to limited sampling volume). Also, nitrites and nitrates are required for field measurements, using CHEMets ampoules specified for these analyses. Follow the instructions provided with these CHEMets sample kits. A sample volume estimation is also required after sample collection (0-700ml).

SAMPLING PROCEDURES - SAMPLE CONTAINER PREPARATION

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1. Prepare sample containers prior to the sampling event. Use new laboratory-cleaned sample containers. The containers should be rinsed three times with deionized water. Label the containers as directed by procedure DC-04.
2. Use the proper containers and preservatives for each analytical parameter as specified in lysimeter analysis priority table. Note: Due to the small amount of sample available, smaller containers are sufficient for collection.

APPLYING VACUUM

1. Remove the cap from the PVC casing. Lightly pull on the two tubings found inside of casing. Be careful to not pull the connected end of the tubings out of the lysimeter. Remove the plastic O-rings from the free ends of the tubing.
2. Connect the hose of the nitrogen bottle regulator to the black tubing of the lysimeter. Open the regulator valve, allowing no more than 15 lbs. pressure through the lysimeter. Purge lysimeter with nitrogen gas until all stagnant water is evacuated and the gas is coming out of the white tubing.
3. Disconnect the regulator tubing from the lysimeter, bend the black neoprene end of the white tubing and replace the O-ring--this restricts any inflow of air into the lysimeter.
4. Connect the black tubing of the lysimeter to the pressure-vacuum hand pump (Model 1920K1) on the vacuum valve (valve must have vacuum dial gauge) at the bottom of the pump. Apply a vacuum to the lysimeter until a stable 60 centibars is read on the vacuum dial gauge. Observe the gauge for a few seconds to make sure lysimeter is holding the vacuum. Record the time, date, and the vacuum applied (centibars) as indicated on the record keeping field form.
5. Before removing the black tubing from the hand pump, bend the neoprene end of the black tubing, and replace the O-ring so it restricts any inflow of air. This will maintain the vacuum inside the lysimeter.
6. Replace both tubing’s back into the PVC casing. Replace cap on the casing head. Wait 24 hours to let lysimeter collect a sufficient sample.

COLLECTING SAMPLE

1. Remove PVC cap from the head of the lysimeter casing. Lightly pull on the tubing, being careful to not pull the connected ends out of the lysimeter.
2. Before removing the O-rings from the tubing, connect the black tubing to the vacuum valve of the pressure-vacuum hand pump. Remove the O-ring and record the remaining value in the indicated space on the record keeping field form.
3. Remove the O-ring from the white tubing. Thoroughly rinse the black neoprene endings of both tubes with deionized water.
4. Connect the hose of the nitrogen bottle regulator to the end of the black tubing. Open the regulator valve, allowing no more than 15 lbs. pressure through the lysimeter. Purge the lysimeter with nitrogen gas until all the sample water is evacuated. Collect the sample in the pre-washed bottles required. Fill the unpreserved bottle first. This will provide the fluid for field measurements. Be sure to take the samples temperature upon purging the lysimeter to ensure it is a representative reading. NOTE: Take the temperature from the sample in the unpreserved bottle--chemical reactions can affect the temperature reading, giving an incorrect number.

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5. When all the sample water is evacuated and collected, turn the nitrogen pressure off and remove the hose from the black tubing. Replace the O-rings on the neoprene ends of the tubing, bending the ends to prevent contamination of the lysimeter.
6. Replace both tubing back into the lysimeter PVC casing and replace cap on the casing head.

Please refer to Attachments - FIGURE GW-7: EXAMPLE LYSIMETER RECORD KEEPING FIELD FORM

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7 PROCESS WATER SAMPLING

This section presents procedures associated with process water sampling activities.

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7.1 PROCEDURE PW-01: SAMPLE POINT IDENTIFICATION

New process water sampling locations are identified utilizing a three- or four-letter identification acronym followed by a unique number ranging between 0001 and 9999, and a final letter code. No dashes and/or spaces are used in the well name. Special identification numbers for QC samples are described in Procedures QC-01 through QC-05.

Names for new process water sampling points will be assigned or approved by the Sampling Supervisor. The requirements for naming new sampling sites are identified in Procedure DC-02.

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7.2 PROCEDURE PW-02: SITE INSPECTION

This procedure describes sampling site inspections. Two types of site inspections are to be completed at each site, one a general site investigation to be conducted each time a sample is collected and the other a comprehensive inspection to be performed when the site is first designated, or for existing sites, as soon as possible. These inspections are to be done in addition to other inspections that may be required by specific procedures.

General Site Inspection

Upon arrival at each process water sampling site, the site will be inspected. The purpose of this inspection is to document the sampling point is functional, the sampling equipment dedicated to the site (if any) is operating correctly, and that the sampling point and/or equipment has not been tampered with. Any problems identified at the site will be noted in the Field Logbook or designated Field Data Sheet and any equipment problems corrected. Any major equipment problems or evidence of tampering will be reported to the Sampling Supervisor.

Comprehensive Inspection

The purpose of the comprehensive inspection is to document the sampling site. Sufficient detail and description is to be provided to allow the exact location of the sampling site and the identification of sampling equipment present at the site. A map of the site is to be drawn that locates all major features related to the sampling point. Photographs of the site and sampling equipment will be taken to show sampling points, all measuring points, and permanent sampling equipment. Any pertinent items concerning the condition of the sampling point, sampling equipment, special sampling considerations, or its surroundings not included in the above information will be noted.

For open water or seeps, the documentation required by Procedure SW-02 will also be provided. Process water samples collected from wells will be documented as described in Procedure GW-02.

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7.3 PROCEDURE PW-03: FIELD MEASUREMENTS

Field measurements will be collected using Procedure SW-03 or GW-04 as indicated by media type. The specific sampling procedure for the process water sampling point will be reviewed to ensure that any modifications to the above procedures are noted and followed. Field measurements will be conducted according to the specific procedure requirements.

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7.4 PROCEDURE PW-04: FIELD DATA SHEETS

A Field Data Sheet will be completed for each process water sample collected. This sheet is described in Procedure GW-05, if the sample is collected from a well or well like device, as identified in procedure SW-05 for an open water, and/or as indicated on the specific sampling procedures and/or plans.

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7.5 PROCEDURE PW-05: SAMPLE COLLECTION - SMALL RESERVOIR AND LEAK DETECTION SUMPS

This procedure is for the collection of water samples representative of the Small Reservoir and the Small Reservoir leak detection sumps. These sites will be sampled to fulfill the requirements of the Small Reservoir groundwater discharge permit and associated water quality sampling plan.

Follow Procedure DC-01 to keep a Field Logbook of all sampling activities conducted at the Small Reservoir. The following sample identification numbers will be used for the Small Reservoir sampling sites:

Sample Site	**Sample Identification**
Small Reservoir	SRP850
Lower Leak Detection Sump (east sump)	SRP851
Pressure Relief Sump (west sump)	SRP852

Follow general procedures for sample container preparation, DC-03; sample labeling, DC-04; sample custody, DC-05; sample preservation and packaging, DC-06; equipment maintenance, MD-01; equipment decontamination, MD-02; quality control sampling, QC-01 through QC-05; equipment calibration, GF-01; pH measurement, GF-02; specific conductance measurement, GF-04; carbonate and bicarbonate measurement, GF-05.

Small Reservoir Sampling

1. Prepare sample containers in accordance with Procedure DC-03.
2. Coordinate sample collection with the South Area Water Services (SAWS) personnel.
3. SAWS personnel will accompany the samplers during sample collection to ensure the best possible represented sample is collected.
4. Label sample containers in accordance with Procedure DC-04.
5. The prepared containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following sample containers directly from the tap:

- 1 - half gallon plastic containers for major ions analyses,
- 1-8oz plastic container for total metal analyses; and,
- 1–16-oz plastic container for sulfate when pH is less than 4.5.

6. Collect an additional sample in either a stainless-steel bucket or a clean plastic bottle for the field measurements of temperature, pH, and electrical conductivity, and for preparing a filtered sample for dissolved metal analyses.
7. Collect the dissolved metal sample from the stainless-steel bucket using a peristaltic pump and an in-line filtering device with a 0.45-micron filter. The peristaltic pump will provide the pressure for in-line filtering. Fill 8 ounces into a plastic container for dissolved metal analyses.
8. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

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9. Collect QA/QC samples in accordance with the GCMP. Name the duplicate as described in Procedure QC-01.

10. Close the sample tap securely.

Lower Leak Collection Sump and Pressure Relief Sump Sampling

1. Prepare sample containers in accordance with Procedure DC-03.

2. Obtain access to the Small Reservoir area from Mine Personnel.

3. Obtain a confined space entry permit from the Mine Safety Officer. Turn on the down hole fan and lights and wait for at least 5 minutes. Do not enter the sump until air quality has been verified. A watch person must always be stationed at the surface of the sump during all sampling activities.

4. If the sumps are full and liquid is flowing through the v-notch weir(s) in the sump, catch a water sample as water flows out the weir. If water is not flowing out the weir, sample using a peristaltic pump with either new clean vinyl tubing or vinyl tubing dedicated to the sump. Pump enough water through the tubing to rinse it thoroughly before collecting a sample. In cases where a peristaltic pump is not available, a clean dipper can be used; the dipper will be rinsed three times with sump water before filling the sample bottles.

5. Label sample containers in accordance with Procedure DC-04.

6. The prepared sample containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following sample containers:

- 1-half gallon plastic containers for major ions analyses,

  At least 8-ounces into a plastic container for total metal analyses,

- at least 8-ounces into a plastic container for dissolved metal analyses; and

- at least 8 ounces into a plastic container for sulfate when pH is less than 4.5.

7. Collect additional samples in either a stainless-steel bucket or a clean plastic bottle for the field measurements of temperature, pH, and electrical conductivity, when necessary, for filtering for dissolved metals.

8. Collect the dissolved metal sample from the stainless-steel bucket using a peristaltic pump and an in-line filtering device with an 0.45-micron filter. The peristaltic pump will be used to provide the pressure for in-line filtering. If a peristaltic pump is already being used, collect the sample directly from the end of vinyl tubing and filtering device. Fill at least 8 ounces into a plastic container for dissolved metal analyses.

9. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

10. Collect QA/QC samples in accordance with the GCMP. Name the duplicate as described in Procedure QC-01.

11. Take precautions in bringing the samples and equipment out of the sump.

12. Secure the lid to the sump and turn off the down hole fan and lights.

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7.6 PROCEDURE PW-06: SAMPLE COLLECTION - LARGE RESERVOIR (DESILTING BASIN, ZONE 1 AND ZONE 2 RESERVOIR AND LEAK DETECTION SUMPS)

This procedure is for the collection of representative samples of the Desilting Basin, Zone 1, and Zone 2 Reservoirs and Zone 1 and Zone 2 leak detection sumps. These sites will be sampled to fulfill the requirements of the Large Reservoir Groundwater Discharge Permit and the associated water quality sampling plan.

There are three chambers located within the Desilting Basin and there are five leak detection sumps located within the Zone 1 Reservoir liner system and five leak detection sumps located within the Zone 2 Reservoir liner system. Each individual sump has a dedicated monitoring pipe set that extends between the liners and emerges above the surface of the Divider Dike crest. Sump samples will be collected via the monitoring pipe sets, generally with the use of a Grundfos pump.

Follow Procedure DC-01 to keep a Field Logbook of all sampling activities conducted at the Desilting Basin, Zone 1, and Zone 2 Reservoirs. The following sample identification numbers will be used for the Desilting Basin, Zone 1, and Zone 2 Reservoir sampling sites:

Sample Site	**Sample Identification**
Desilting Basin No. 1 (west pond)	LRP1320
Desilting Basin No. 2 (north pond)	LRP1321
Desilting Basin No. 3 (south pond)	LRP1322
Zone 1 Reservoir	LRP896
Sump 01 (north sump)	LRP891
Sump 02	LRP892
Sump 03	LRP893

Sample Site	**Sample Identification**
Sump 04	LRP894
Sump 05 (south sump)	LRP895
Zone 2 Reservoir	LRP1319
Sump 01 (north sump)	LRP1314
Sump 02	LRP1315
Sump 03	LRP1316
Sump 04	LRP1317
Sump 05	LRP1318

Follow general procedures for sample container preparation, DC-03; sample labeling, DC-04; sample custody, DC-05; sample preservation and packaging, DC-06; equipment maintenance, MD-01; equipment decontamination, MD-02; quality control sampling, QC-01 through QC-05; equipment calibration, GF-01; pH

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measurement, GF-02; specific conductance measurement, GF-04; carbonate and bicarbonate measurement, GF-05.

Desilting Basin, Zone 1, and Zone 2 Reservoirs

1. Prepare all sample containers in accordance with Procedure DC-03.

   Coordinate sample collection with South Area Water services (SAWS) personnel.

2. SAWS personnel will accompany the samplers during sample collection to ensure the best possible represented sample is collected.

3. Label the sample containers in accordance with Procedure DC-04.

4. The prepared containers should already be rinsed and contain appropriate preservations, if not, rinse three times with sample water and preserve according to Table DC-3. The following containers will be filled:

- 1- half gallon plastic containers for major ions analyses,
- At least 8 ounces into a plastic container for total metal analyses,
- At least 8 ounces into a plastic container for dissolved metal analyses.

5. Collect the dissolved metal sample from the stainless-steel bucket using a peristaltic pump and an in-line filtering device with an 0.45-micron filter. The peristaltic pump will provide the pressure for in-line filtering. Fill 1–8-ounce plastic containers for dissolved metal analyses.

Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

Leak Detection Sumps

1. Prepare sample containers in accordance with Procedure DC-03.

2. Water quality samples will be collected from the pumping device used to conduct the sump pump test. A sample will be collected if a 3.5 gpm (5000 gallons per day) pumping rate is maintained for one hour.

3. Label the sample containers in accordance with Procedure DC-04.

4. The prepared sample containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following containers directly from the pump discharge hose:

- 1/2 gal. plastic containers for major ions analyses,
- At least 8 ounces into a plastic container for total metal analyses,
- At least 8 ounces into a plastic container for dissolved metal analyses.

5. Collect additional samples in either a stainless-steel bucket or clean plastic bottles for the field measurements of temperature, pH, and electrical conductivity and possibly for the dissolved metal sample.

6. Collect the dissolved metal sample by attaching an in-line filtering device with an 0.45-micron filter attached to the end of the Grundfos discharge line. Fill at least 8 ounces into a plastic container for dissolved metal analyses. If desired, a dissolved metal sample can alternately be collected from a stainless-steel bucket as described in Step 6 of Zone 1 Reservoir Sampling.

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7. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

7.7 PROCEDURE PW-07: SAMPLE COLLECTION - SMELTER INTERIM PROCESS WATER POND

This procedure is for the collection of a representative sample of the Smelter Interim Pond. Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, MD-01, and MD-02.

1. Prepare all sample containers in accordance with Procedure DC-03.
2. Collect water samples quarterly from the Interim Pond by lowering either a Grundfos or Bennett pump down the pond liner until the pump is submerged and begin pumping.
3. Allow the water to flow freely for several minutes to ensure adequate flushing of the pump hoses.
4. Label sample containers in accordance with Procedure DC-04 prior to sampling.
5. The prepared sample containers should already be rinsed and contain appropriate preservatives, if not, rinse three times and preserve according to Table DC-3. Fill the following containers:

- 1/2 gal. plastic containers for major ions analyses,
- At least 8 ounces into a plastic container for total metal analyses,
- An 8-ounce amber glass bottle for mercury analyses.

6. Collect additional samples in either a stainless-steel bucket or clean plastic bottles for the field measurements of temperature, pH, and electrical conductivity and for filtering for dissolved metals. Collect the dissolved metal sample from the stainless-steel bucket using a peristaltic pump to provide pressure for an in-line filtering device. The filtering device will contain an 0.45-micron filter.
7. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

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7.8 PROCEDURE PW-08: SAMPLE COLLECTION - BLUEWATER REPOSITORY SUMP

This procedure is for the collection of water samples representative of the Bluewater Repository sump to fulfill requirements of the Bluewater Repository Groundwater Discharge Permit and associated water quality sampling plan.

Follow Procedure DC-01 to keep a Field Logbook of all sampling activities conducted at the Bluewater Repository. The sample identification number for the Bluewater sump is BRP292.

Follow general procedures for sample container preparation, DC-03; sample labeling, DC-04; sample custody, DC-05; sample preservation and packaging, DC-06; equipment maintenance, MD-01; equipment decontamination, MD-02; quality control sampling, QC-01 through QC-05; equipment calibration, GF-01; pH measurement, GF-02; specific conductance measurement, GF-04; carbonate and bicarbonate measurement, GF-05.

1. Prepare sample containers in accordance with Procedure DC-03.
2. When it has been determined that flow is present in the sump, a sample will be collected from the bucket in the sump which is located at the end of the seepage collection pipe.
3. Label containers in accordance with Procedure DC-04.
4. The prepared containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following sample containers directly from the sump bucket:

- 1 - half gallon plastic container for major ions analyses,
- At least 8 ounces into a plastic container for total metal analyses,
- At least 8 ounces into a plastic container for sulfate when pH is less than 4.5.

5. Collect an additional sample for field measurements of temperature, pH, and electrical conductivity.
6. Collect the dissolved metal sample directly from the dedicated sump bucket using a peristaltic pump and an in-line filtering device with an 0.45-micron filter. The peristaltic pump will provide the pressure for the in-line filtering. Fill at least 8 ounces into a plastic container for dissolved metal analyses.
7. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.
8. Collect QA/QC samples in accordance with the GCMP. Name the duplicate as described in Procedure QC-01.
9. Empty the bucket, rinse it with de-ionized water, and return it to collect any water from the seepage collection pipe.
10. Secure the man-hole lid.

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7.9 PROCEDURE PW-09: SAMPLE COLLECTION - UPDES (GENERAL)

This procedure is for the collection of water samples at permitted UPDES outfalls to C-7 Ditch and drainages to the Great Salt Lake and Bingham Creek.

1. Prepare sample containers in accordance with Procedure DC-03.
2. Complete UPDES Field Data Sheet (Figure PW-1).
3. Place sample containers on flat, stable surfaces for receiving samples.
4. Remove the large sample container from the automatic sampling unit and shake to mix the composite sample. Continue to agitate the composite sample to ensure a homogeneous sample is collected.
5. Rinse the sample containers at least three times using the water to be sampled (unless previously prepared with preservatives).
6. Transfer the sample until the containers are completely filled.
7. For samples to be submitted to an external laboratory, secure the cap tightly.
8. If sample site does not have an identification number, assign a sample identification number in accordance with Procedure PW-01.
9. Label samples in accordance with Procedure DC-04.
10. Handle the sample as described in Procedures DC-05 and DC-06.
11. Collect QA samples and process in the same manner as other samples with respect to documentation and handling.

Please refer to Attachments - Figure PW-1. UPDES Field Log Sheet

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7.10 PROCEDURE PW-10: SAMPLE COLLECTION - UPDES (ORGANIC)

The following procedure will be followed to collect process water samples for organics (VOC). Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, DC-06, MD-01, and MD-02.

1. Prepare sampling equipment and sample containers, (Procedure DC-03) prior to visiting sample site.
2. Remove the acid vial, transfer pipette and one sample vial from the kit. Avoid contamination of any part of the collection kit from petroleum products or cleaning solvents.
3. Remove the cap on the first sample vial keeping the cap away from any sources of contamination.
4. Fill the sample vial to overflowing but take care not to flush out the preservative. No air bubbles should pass through the sample as the bottle is filled or be trapped in the sample when the vial is sealed.
5. The pH of the sample must be adjusted to a pH of <2 by carefully adding two drops of acid from the acid vial. Highly buffered water may require more acid. Samples received are tested for pH prior to testing and will be discarded for a pH of 2 or greater.
6. Following the addition of acid, the vial must be sealed with the Teflon face down, shaken vigorously for one (1) minute, and store at 4EC (40EF) until received by the Division of Laboratory Services.
7. The process is repeated for the remaining three sample vials.

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7.11 PROCEDURE PW-11: SAMPLE COLLECTION – BARGE

1. Prepare all sampling equipment and sample containers, including QC samples (Procedure DC-03), prior to visiting the station.
2. Place sample containers on flat, stable surfaces for receiving samples.
3. Remove the large sample container from the automatic sampling unit and shake in order to mix the composite sample.
4. Rinse the sample container at least three times using the water to be sampled (unless previously prepared with preservatives).
5. Transfer the sample until the container is completely filled.
6. For samples to be submitted to an external laboratory, secure the cap tightly.
7. Assign a sample identification number in accordance with Procedure PW-01.
8. Label samples in accordance with Procedure DC-04.
9. Handle the sample as described in Procedures DC-05 and DC-06.
10. Collect QA samples and process in the same manner as other samples with respect to documentation and handling.

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7.12 PROCEDURE PW-12: SAMPLE COLLECTION - TAILINGS POND RETURN

Follow general procedures for sample documentation, and sample handling as directed in Procedures PW-01, DC-04, DC-05, and DC-06.

1. Prepare sample containers in accordance with DC-04 prior to visiting the sample site.
2. Samples can be collected as needed directly from the return canal at the Southeast corner of the tailings impoundment using a sample dipper.
3. The dipper should be rinsed three times with the sample water prior to collecting the sample.

   The prepared containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following sample containers directly from the dipper:

   - 1 - half gallon plastic container for major ions analyses,
   - At least 8 ounces into a plastic container for total metal analyses,
   - At least 8 ounces into a plastic container for sulfate when pH is less than 4.5.
4. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

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7.13 PROCEDURE PW-13: SAMPLE COLLECTION - TAILINGS POND SEEPS

The following procedure will be followed to collect samples of seeps and drainage water from the tailings pond, or samples of similar type elsewhere on RTK property (i.e., tunnels).

1. Perform site inspection described in Procedure SW-02.
2. Prior to sample collection, review the general sampling protocol presented in Procedure SW-06.
3. Draw a sketch of the sampling point (to scale, if possible) on the Surface Water Quality Field Data Sheet and complete the field sheet as required in Procedure SW-05. Note distances from fixed landmarks such that the site may be located again.
4. Collect and record field measurements as required in Procedure SW-05.
5. Collect sample by holding the sample container under the flowing seep as described in Procedure SW-07. If the flowing seep is not exposed, sample the standing water in accordance with Procedure SW-06.
6. Assign a sample identification number in accordance with Procedure DW-01.
7. Label samples in accordance with Procedure DC-04.
8. Handle the sample as described in Procedure DC-05 and DC-06.
9. Collect QC samples as directed by Procedures QC-01 through QC-05. Process these samples in the same manner as other samples with respect to documentation and handling.
10. Arrange for the surveying of new sample locations if required by the Project Work Plan or the Project Manager (see Procedure DW-01).

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7.14 PROCEDURE PW-14: SAMPLE COLLECTION - TAILINGS POND DRAINS

The following procedure will be followed to collect samples of seeps and drainage water from the tailings pond, or samples of similar type elsewhere on RTK property (i.e., tunnels).

1. Perform site inspection described in Procedure SW-02.
2. Prior to sample collection, review the general sampling protocol presented in Procedure SW-03.
3. Draw a sketch of the sampling point (to scale, if possible) on the Surface Water Quality Field Data Sheet and complete the field sheet as required in Procedure SW-05. Note distances from fixed landmarks such that the site may be located again.
4. Collect and record field measurements as required in Procedure SW-05.
5. Collect sample by holding the sample container under the flowing drainpipe.
6. Assign a sample identification number in accordance with Procedure DW-01.
7. Label samples in accordance with Procedure DC-04.
8. Handle the sample as described in Procedures DC-05 and DC-06.
9. Collect QC samples as directed by Procedures QC-01 through QC-05. Process these samples in the same manner as other samples with respect to documentation and handling.
10. Arrange for the surveying of new sample locations, if required, by the Project Work Plan or the Project Manager (see Procedure DW-01).

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7.15 PROCEDURE PW-15: SAMPLE COLLECTION - SMELTER PROCESS WATER SUMPS

This procedure is for the collection of water samples representative of the Smelter Process Water sumps to fulfill requirements of the Smelter Ground Water Discharge Permit and associated water quality sampling plan.

Follow Procedure DC-01 to keep a Field Logbook of all sampling activities conducted at the Smelter Process Water sumps.

Follow general procedures for sample container preparation, DC-03; sample labeling, DC-04; sample custody, DC-05; sample preservation and packaging, DC-06; equipment maintenance, MD-01; equipment decontamination, MD-02; quality control sampling, QC-01 through QC-05; equipment calibration, GF-01; pH measurement, GF-02; specific conductance measurement, GF-04.

1. Prepare sample containers in accordance with Procedure DC-03.
2. Smelter operations will determine when there is sufficient water present in the sump for a sample to be collected.
3. Procure a sample by removing water from the sump with a portable pump or a dedicated pump if provided.
4. Label containers in accordance with Procedure DC-04.
5. The prepared containers should already be rinsed and contain appropriate preservatives, if not, rinse three times with sample water and preserve according to Table DC-3. Fill the following sample containers from the pump discharge hose:

- 1/2-gallon plastic container for major ions analyses,
- At least 8 ounces into a plastic container for total metal analyses,
- 1-gallon stainless steel bucket for procuring a dissolved metal sample and for field measurements of temperature, pH, and electrical conductivity.

6. Collect the dissolved metal sample directly from the stainless-steel bucket using a peristaltic pump and an in-line filtering device with an 0.45-micron filter. A peristaltic pump will provide the pressure for the in-line filtering. Fill at least 8 ounces into a plastic container for dissolved metal analyses.
7. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.
8. Collect QA/QC samples in accordance with the GCMP. Name the duplicate as described in Procedure QC-01.

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8 DRINKING WATER SAMPLING

This section presents procedures associated with drinking water sampling activities.

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8.1 PROCEDURE DW-01: SAMPLE POINT IDENTIFICATION AND LOCATION

Drinking water sampling locations are identified utilizing acronyms listed below:

Sample Identification	Number Location
- BMD1009	Freeman Culinary Tank After Chlorination
- BMD1010	Mine 6290 Office Janitor's Mop Sink
- BMD1011	Mine Visitor Center Men's Restroom Wash Basin
- BMD1012	Mine 6290 Change House Washroom Sink
- BMD1013	Mine 6190 Truck Shop Washroom
- BMD1014	Mine 6190 Truck Shop Foreman's Restroom
- BMD1015	Copperfield Tire Shop Sink
- BMD1016	Mine 6190 Bull Gang Restroom Wash Basin
- BMD1017	Mine 6190 Redi Room Men's Restroom Wash Basin
- BMD1018	Mine 6190 Redi Room Women's Restroom Wash Basin
- BMD1019	Mine 6190 Office Building Lunchroom Wash Basin
- BMD1020	Mine 6190 Office Building Ladies Restroom Wash Basin
- BMD1021	Markum Shop Kitchen Sink
- BMD1022	Mine Safety Office Janitor's Mop Sink
- BMD1023	Mine Dry Fork Shops Women's Restroom Wash Basin
- BMD1024	Mine Dry Fork Shops Electrical Foreman's Restroom Wash Basin
- BMD1025	Mine Dry Fork Shops Welding Shop West Sink
- BMD1026	Mine Dry Fork Shops Electrical Office Test Area Wash Room
- BMD1027	Mine Dry Fork Shops Lineman Trailer Wash Basin
- BMD1028	Mine Dry Fork Shops Dozer Repair Lunchroom Wash Basin
- BMD1029	Mine Dry Fork Shops Car Shop Lunchroom Wash Basin
- BMD1036	Bingham Mine Safety Office Rest Room Wash Basin
- BMD1037	6190 Admin Conference Room Kitchen Sink
- BMD1038	6190 Admin Office Women's Rest Room Wash Basin
- BMD1039	6190 Admin Office Men’s Rest Room Wash Basin
- BMD1040	6190 Admin Office Kitchen Sink Faucet
- ECD1030	SAWs Plant Control Room Mop Sink
- ECD1031	SAWS Plant Foreman's Washroom Wash Basin
- ECD1032	SAWS Plant Janitor's Mop Sink
- ECD1033	Mine Car Whacker Restroom Wash Basin
- ECD1034	Mine Copperton Tower Restroom Wash Basin
- ECD1035	Barney Tunnel Culinary Tank
- SMD1045	Smelter Environmental Monitoring Center
- SMD1046	Smelter #8 Acid Plant Repair Building Mop Sink

Sample Identification	Number Location
- SMD1047	Smelter Change house Downstairs Mop Sink
- SMD1048	Smelter Central Warehouse Outside Tap Dock
- SMD1049	Smelter Mechanic Shop Wash Basin

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- SMD1068 Smelter #8 Acid Plant Field Repair Restroom Wash Basin
- SMD1069 Smelter Safety Office Exam Room Wash Basin
- SMD1070 Smelter Environmental Office Restroom Wash Basin
- SMD1071 Refinery Administration Building. Men's Rest Room Wash Basin
- SMD1075 Smelter Engineering Kitchen Sink
- SMD1095 Smelter Upstairs Lunch Room in Maintenance Building Kitchen Sink
- SMD1096 Smelter EDX Building Men’s Rest Room Wash Basin
- SMD1097 Smelter Flash Furnace Building Level 3 Men’s Rest Room Wash Basin
- SMD1098 Smelter Filter Plant Maintenance Building Women’s Rest Room Wash Basin
- RFD1051 Refinery Administration Building Janitor's Room Mop Sink
- RFD1052 Refinery Maintenance Shops Foreman's Restroom Wash Basin
- RFD1053 Refinery Warehouse Wash Basin
- RFD1054 Refinery Field Repair Foreman's Office Sink
- RFD1055 Refinery Boiler Plant Upstairs Restroom Wash Basin
- RFD1094 Refinery P.M. Building Women’s Rest Room Wash Basin
- MCD1056 Magna Pipe Shop Shower
- MCD1057 Magna Central Garage Washroom
- MCD1058 Magna Safety Office Rear Washroom Wash Basin
- MCD1059 Magna Flotation Sample Department Storage Room Wash Basin
- MCD1060 Magna Central Change Building Women's Washroom Wash Basin
- MCD1073 Magna Pipe Shop Lunchroom Sink
- PCD1041 Power Plant 3rd Floor Rest Room Wash Basin
- PCD1042 Power Plant 5th Floor Rest Room Wash Basin
- PCD1061 Bonneville Grind Building Control Room Restroom
- PCD1062 Bonneville Dumper Building Furnace Room Mop Sink
- PCD1067 Bonneville Dumper Building. Control Washroom
- ARD1063 Arthur Carpenters Shop Shower
- ARD1064 Arthur Administration Building Furnace Room Mop Sink
- ARD1066 Arthur Administration Downstairs Women's Washroom Basin
- ARD1074 Arthur Central Shop Restroom Wash Basin
- LSD1078 Section 21 Pump House Combined After Chlorination
- BYD1080 Copperton Concentrator Changehouse Janitor's Sink
- BYD1081 Copperton Concentrator Outside Services Kitchen Tap
- BYD1082 Copperton Concentrator Grinding Plant Millwrights Kitchen Tap
- BYD1083 Copperton Concentrator Grinding Plant Operations Kitchen Tap
- BYD1084 Copperton Concentrator Moly Plant Systems Kitchen Tap
- BYD1085 Copperton Concentrator Grinding Plant Electrical Kitchen Sink
- BYD1086 Copperton Concentrator Met Lab Kitchen Sink
- BYD1087 Copperton Concentrator Moly Operations Kitchen Sink
- BYD1088 Copperton Concentrator Flotation Plant Millwright Kitchen Sink
- BYD1089 Copperton Concentrator Recordkeeping Center Bathroom Wash Sink
- BYD1090 Copperton Concentrator Culinary Tank After Chlorination
- WTD1065 Garfield Security Restroom Wash Basin
- ECP2796 Zone A RO Product Water

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Sample identification names for new drinking water sampling points will be assigned and approved by the Sampling Supervisor.

*Not Valid Points

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8.2 PROCEDURE DW-02: SITE INSPECTION

The purpose of the inspection is to document the sampling site. Sufficient detail and description is to be provided to allow identification of the exact sampling site. A map of the site is to be drawn that locates all major features related to the sampling point. Photographs of the site should be taken to show the sampling point. Note any pertinent items concerning the condition of the sampling point, special sampling considerations, or its surroundings.

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8.3 PROCEDURE DW-03: FIELD MEASUREMENTS

The following procedure will be followed for field measurements of pH, temperature, and specific conductivity for drinking water.

1. Begin written documentation as appropriate (see Procedure DC-01, and DW-04).
2. Allow water to flow for at least 5 to 10 minutes from the designated sample point to ensure adequate flushing of the immediate supply pipes.
3. Collect samples in new, laboratory-cleaned, or decontaminated containers for measurement with meters.
4. Follow Standard Operating Procedures GF-01, GF-02, and GF-04 for calibrating and measuring pH and specific conductance.

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8.4 PROCEDURE DW-04: FIELD DATA SHEETS

A Drinking Water Field Data Sheet will be completed for each sample collected that is analyzed for drinking water parameters only. A sample Drinking Water Field Data Sheet is shown in Figure DW-01.

For samples collected from a well for the purpose of monitoring drinking water sources, Procedure GW-05 will be followed for the completion of a Field Data Sheet.

Please refer to Attachments - Figure DW-1. Drinking Water Field Data Sheet

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8.5 PROCEDURE DW-05: SAMPLE COLLECTION - DRINKING WATER

BACTERIOLOGICAL EXAMINATION

The following procedure will be followed to test drinking water samples for residual chlorine, and to collect samples for bacterial counts:

1. Begin written documentation as appropriate (see Procedure DC-01 and Figure DW-02).
2. Assign a sample identification number in accordance with Procedure DW-01.
3. Decontaminate tap using antibacterial wipes and holding an open flame under the tap. Allow cold water to run freely for five to ten minutes prior to sampling. While water is flowing, the sampler should wash hands in a separate sink, if possible, to help minimize sample contamination.
4. Collect a sample for bacterial count by filling two sterile plastic bottles from the tap. Prevent contact by any object (including sampler's hands) on the bottle opening or interior.
5. Label and handle samples in accordance with Procedures DC-01 through DC-05.
6. Measure residual free chlorine by following instructions provided in a Chlorine Colorimetric sample kit. Record the residual chlorine concentration on the Utah State Department of Health Form (Figure DW-02) and in the Sample Logbook in the Field Office.
7. Place samples in coolers with ice for immediate shipment to KEL and the State Health Laboratory for analysis.

Please refer to Attachments - Figure DW-2. Example Utah State Form for Bacteriological Examination

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8.6 PROCEDURE DW-06: SAMPLE COLLECTION - DRINKING WATER

The following procedure will be followed to collect drinking water samples with the exception of samples collected for first draw analyses of lead and copper and samples collected for organic analyses.

Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, DC-06, MD-01, and MD-02.

1. Prepare all sampling equipment and sample containers, (Procedure DC-03) prior to visiting sample site.
2. Samples should be collected at the well, or at a point in the system where different water sources blend. Sample point will be prior to any water treatment process (does not include chlorination) and before entry into the distribution line.

3 Sample should be collected directly from spigot or sample port. If a hose is attached, it should be removed prior to collecting sample.

3. Allow water to flow freely from the designated sample point for at least 5-10 minutes to ensure adequate flushing of the immediate pipes. This is necessary in order to procure a representative sample.
4. Label sample containers in accordance to Procedure DC-04 prior to sampling.
5. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

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8.7 PROCEDURE DW-07: SAMPLE COLLECTION - DRINKING WATER LEAD AND COPPER FIRST DRAW TAP SAMPLING

The following procedure will be followed to collect drinking water samples for lead and copper first draw tap sampling:

Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, DC-06, MD-01, and MD-02.

1. Arrange sampling schedule with appropriate plant supervisor prior to the day of sampling.
2. At least six hours prior to sample collection, locate each site to be sampled and thoroughly flush the lines by turning on the faucet for a minimum of 5 minutes.
3. After sufficient flushing of the supply line, post each individual site by securely attaching a DO NOT USE tag to the faucet.
4. Prepare all sample containers in accordance with Procedure DC-03) prior to visiting the sites. Sample containers will be acidified with 4 mL of HN03 to ensure sample preservation.
5. Label sample containers in accordance with Procedure DC-04.
6. After the six hour "minimum" waiting period, remove the tag from each location immediately prior to collecting a sample.
7. Always collect the first water coming from the tap and always collect a one-liter sample in one container only.
8. Handle the samples and documentation in accordance with Procedures DC-05 and DC-06.

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8.8 PROCEDURE DW-08: SAMPLE COLLECTION - COLIFORM BACTERIA

8.8.1 INTRODUCTION

This plan is for the collection of coliform bacteria samples for KUC drinking water systems as required by U.A.C. R309-104-4.5.4.d.

RTK has five (5) public drinking water systems. All are classified as non-community, non-transient systems. The following table lists the system name and identification number, bacteriological sample frequency, and area served for each system.

SYSTEM ID AND NAME	FREQUENCY	SERVICE AREA
18003 Section 21	Monthly	All North End Facilities
18136 Copperton Concentrator	Quarterly	Copperton Concentrator Area
18141 Utah Metals Tunnel	Quarterly	Bingham Canyon
18152 Lark System	Quarterly	Mine Entrance
18161 Zone A RO	Monthly	Municipal

8.8.2 PROJECT RESPONSIBILITIES

The KUC Environmental Sampling Supervisor will have overall responsibility for the sampling and compliance program, quality control, and reporting. The KUC Environmental Technicians will have the responsibility of collecting, handling, and documenting of all water samples.

8.8.3 WATER QUALITY SAMPLING LOCATIONS

Sample sites and sample identifications are listed for the five systems in the attached KUC Standard Operating Procedure DW-01. Sample site locations shall be rotated within each system according to the sampling frequency for each water system. Sample identification numbers beginning in: "BMD" applies to the Utah Metals Tunnel System; “BYD” to the Copperton Concentrator System LTG to the Lark System; ECP to the Zone A RO and all others apply to Section 21 System.

8.8.4 WATER QUALITY SAMPLING PROCEDURES

All bacteriological water samples will be taken in accordance with the attached KUC Standard Operating Procedures DW-02, DW-04, and DW-05.

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8.9 PROCEDURE DW-09: SAMPLE COLLECTION - ORGANICS (VOC)

The following procedure will be followed to collect drinking water samples for organics (VOC). Follow general procedures for sample documentation, sample handling, and equipment decontamination as directed in Procedures DC-01, DC-03, DC-04, DC-05, DC-06, MD-01, and MD-02.

1. Prepare sampling equipment and sample containers, (Procedure DC-03) prior to visiting sample site.
2. Allow water to flow freely from the designated sample point for at least 5-10 minutes to ensure adequate flushing of the immediate pipes. This is necessary in order to procure a representative sample.
3. Remove the acid vial, transfer pipet and one sample vial from the kit. Avoid contamination of any part of the collection kit from petroleum products or cleaning solvents.
4. Remove the cap on the first sample vial keeping the cap away from any source of contamination.
5. Fill the sample vial to overflowing but take care not to flush out the preservative. No air bubbles should pass through the sample as the bottle is filled or be trapped in the sample when the vial is sealed.
6. The pH of the sample must be adjusted to a pH of <2 by carefully adding two drops of acid from the acid vial. Highly buffered water may require more acid. Samples received are tested for pH prior to testing and will be discarded for a pH of 2 or greater.
7. Following the addition of the acid, the vial must be sealed with the Teflon face down, shaken vigorously for one (1) minute, and store at 4EC (40EF) until received by the Division of Laboratory Services.
8. The process is repeated for the remaining three sample vials.

For all other organic sampling, bottles should be procured from an independent laboratory and their sampling procedures should be followed for sample collection.

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8.10 PROCEDURE SW-01: SAMPLE POINT IDENTIFICATION

All permanent surface water sampling locations are identified utilizing a three-letter identification acronym followed by a unique number ranging between 0001 and 9999. No dashes and/or spaces are to be used in the sample name. Special identification numbers for QC samples are described in Procedures QC-01 through QC-03.

Names for new sampling points will be assigned and approved by the Sampling Supervisor. The information listed in Procedure SW-02 will accompany requests for new names.

Procedures to be used for naming new sampling points are provided in Procedure DC-02. A sample point identification must be obtained for all new sampling points, whether permanent or not, to assure that if this site is ever sampled again in the future the data from past sampling events can be identified. Prior to the selection of a new sampling point, consideration should be given to the use of an existing sampling point. Existing sampling points are identified in Table DC-01.

The following sections describe the general conventions used in identifying surface water sampling points prior to the implementation of the present system.

Site Identification Acronym

The identification acronym consists of a three-letter code identifying the general location of the sample. For example, the acronym "LCS" identifies a surface sampling point on Lee Creek.

General location acronyms used to date include:

VWS - Surface water sampling point located on the valley side of the Oquirrh Mountains.

LCS - Lee Creek.

RTC - Riter Canal.

BDC - Brighton Drain.

RWC - Right-of-Way Canal.

SZS - Spitz Spring

CSC - C-7 Ditch

CWC - C-7 Ditch (west)

KCS - Kersey Creek

RSC - Ridgeway South Canal

CLC - Clarification Canal

Sample Location Number

A sequence number or character is associated with each sampling point. That number is unique to the sampling point and will not be used in other points.

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8.11 PROCEDURE SW-02: SAMPLE POINT DESCRIPTION

Mark and survey each sample point for the first time. Follow this procedure to enable surveying. As directed by the specific Project Work Plan, some points may require permanent markers.

1. Drive a pre-painted, orange wooden stake (2x2x24 inches) 12 to 14 inches into the ground. Use a waterproof, indelible ink pen or place a metal label on the stake containing the sample identification number.
2. Measure the location of the stake using a compass and range finder or surveying equipment. Record the location in coordinates or a compass bearing and distance from a permanent object or from a section corner on a USGS map. For non-permanent sampling points, locate the site on a USGS topographic or another suitable map.
3. Document the sample point location on the Surface Water Quality Field Data Sheet.
4. Use a camera with date and time indicator if possible. Check current date and time to ensure accuracy.
5. Shoot a picture of the stake with reference points in the background. Reference points include stationary objects used in locating the point. Shoot a picture of the stake relative to the overall site if site conditions are relevant to the study.
6. Shoot a picture of the gauge used in measuring water level, as well as the location at which samples are collected.
7. Record the picture numbers and roll number on the Surface Water Quality Field Data Sheet, as well as the direction facing when taken.
8. Take other pictures as deemed necessary and record the above information on the Field Data Sheet.
9. Arrange for the installation of a temporary marker or permanent marker at the sampling location, depending on the type of sampling point, as directed by the Project Work Plan.
10. If survey coordinates are to be obtained, prepare a statement of work for a licensed surveying contractor to determine the location and elevation of the ground surface and permanent monument marker. The horizontal control will be Kennecott Mine Datum to within + 3 ft (+ 1 meter). The elevation of the monument marker will be surveyed to within + 0.01 foot (+ 0.3 cm) using the National Geodetic Vertical Datum of 1929. Corrected survey data will include loop closure for survey accuracy within these limits.
11. The surveyor's report will include a list of coordinates, elevations, and system used. The report must also include a map, and a description and location of all permanent and semipermanent reference points used for horizontal and vertical control. This report will be filed in the Water Quality Data Filing System.

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8.12 PROCEDURE SW-03: GENERAL PROTOCOL

1. Record pertinent site observations. Include a sketch and photographic documentation for first-time visits to the site (Procedure SW-02). Identify sample location on the Surface Water Quality Field Data Sheet.
2. Measure the water levels relative to the monument marker described in Procedure SW-02. Measurement should be accurate to 0.01 feet.
3. Thoroughly decontaminate instruments used in the sampling process. (Procedure MD-02).
4. Place sample containers on flat, stable surfaces for receiving samples.
5. Plan to collect samples first from those areas suspected of being the least contaminated to minimize the risk of cross contamination.
6. Measure field parameters (pH, temperature, conductivity, etc.) as required by the Project Work Plan. Measure these parameters at the source rather than in containers when possible. Record the time the sample is collected and the time the field measurements are measured.
7. Collect samples in prepared containers with the proper preservatives. If required, measure carbonate and bicarbonate according to Procedure GF-05.
8. Collect sample and securely close containers as quickly as feasible, eliminating any air space.
9. Attach the in-line filtering device with a 0.45-micron filter to collect samples which require filtering. Follow the manufacturer's instructions for filter use. If field filtering is impossible, fill extra containers (labeled with the Well ID # in indelible ink) for transport to the Field Office for filtering and filling of containers on the same day as sample collection.
10. If any preservative is lost prior to or during the filling of a sample container (i.e., spilling or overflow), use another prepared container.

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8.13 PROCEDURE SW-04: FLOW MEASUREMENT

Flow Measurement Using Floats

The measurement of discharge volumes using floats can be performed within an accuracy range of + 10 percent under good conditions. The estimate may be as much as 25 percent in error if a poor reach is selected and an inadequate number of float runs are conducted.

1. Prepare a surface float by partially filling a bottle with water. A rod float may also be used (ie., a wooden rod with a weighted end) if the water is deep enough such that the rod will not touch the stream bed.
2. Select two cross sections in the channel which are separated by a travel time of approximately two (2.0) seconds. Shorter travel times may be used if a straight stretch is not available.
3. Measure the float time between the two cross sections several times at several sections across the stream width.
4. Calculate the mean velocity of a given section as follows:

VS = VF (0.85)

where: VS = Mean velocity of section (feet per second);

VF= Float velocity (feet per second); and

0.85 = Coefficient to allow for the vertical velocity profile and relative depth of immersion.

5. Calculate the area of each section (AS) as shown in Figure 1. This requires the measurement of depth at each section center (i.e.., the location at which the float was placed).
6. Measure the water level relative to the monument marker.
7. Calculate the discharge for each section as follows:

DS = AS (VS)

Dg = Ds (60) (7.485)

where: DS = Discharge of section (cubic feet per second);

AS = Area of section (square feet); and

VS = Velocity in section (feet per second).

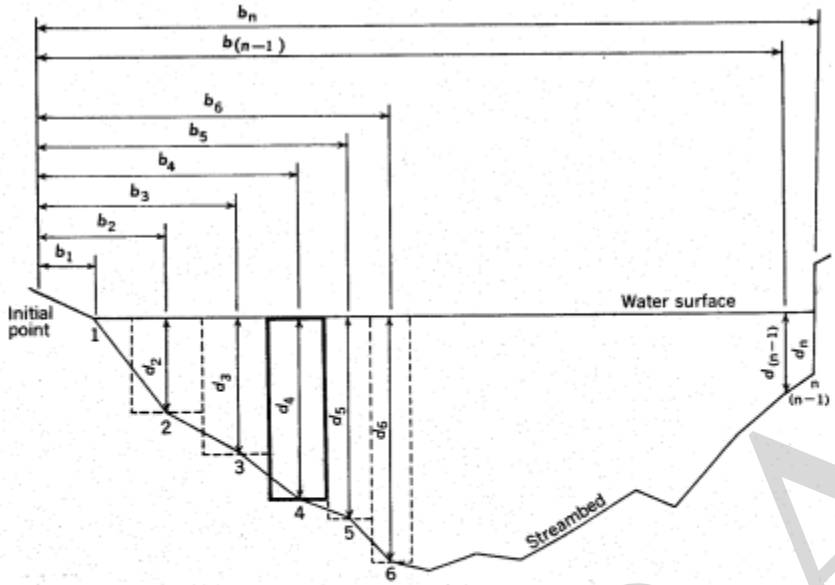
Dg = Discharge in gallons per minute

8. Calculate the total discharge rate for the channel by summing all sectional discharge rates.

Flow Measurement Using a Container

1. Calibrate container (e.g., 5-gallon bucket, 2-liter beaker, graduated cylinder)

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Measurements (Buchanan and Somers. 1976).

2. Place container opening under the entire flow stream, if possible.
3. Record the time to fill container using a stopwatch or wristwatch with second hand.
4. Calculate the flow rate (Q) where:

$$Q = VT$$

Q = flow rate, gpm

V = captured volume, gallons

T = time required to capture V, minutes

Measurement of Surface Water Flow Velocity with A Pygmy Water Current Meter

The Pygmy Water Current Meter measures velocities between 0.5 and 3.0 feet/second (ft/sec) and is recommended for use in shallow streams, flumes, and canals where low velocities and/or shallow water are encountered. Options for use include a earphone and battery for counting bucket wheel revolutions or digital readout for determining velocity. Velocity in ft/sec equals the revolutions of the bucket wheel per second.

1. Assemble the current meter and test for proper operation in accordance with the manufacturer's instructions.
2. Partition stream into sections (with tagline or bridge railing), visually observing the velocity and general flow of the stream. Establish enough stations to prevent more than 10 percent of the total discharge from

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passing through any individual partial section. Check the measurements and if necessary, readjust the partitioned sections to upgrade the quality of the readings. Where possible, try to use the same cross section throughout the study period and during all stream calibrations. However, the number and position of stations within the cross section may be changed, if necessary, to accommodate changing flow conditions.

3. Record stream gauge as indicated by one of the staff gauges (mark monument described in Procedure SW-02) and record this value on the water level recorder chart at the point of pen contact.

4. Record a minimum of the following items on the data form or in the Field Logbook:

· Sample Identification Number.

· Site

· Date

· Time at start of measurements

· Stream stage at start of measurements

· Approximate wind direction and speed

· General stream condition (e.g., turbid, clear, low level, floating debris, water temperature, type of streambed material, etc.)

· Other factors having a bearing on discharge measurements

· Location of initial point

· Total width of stream to be measured

· Type of current meter and conversion factor, if applicable; and

· Name of field staff taking above reading

5. Determine the depth and mean velocity at the first station or "initial point" if possible and record this information. Always hold the wading rod vertical. When practical, make all measurements standing behind and well to the side of the meter. Avoid disturbing or standing along the streambed beneath the cross-sectional measuring points.

6. Measure the depth at the second station from initial point and record. Record the observed velocity at a point 0.6 (60%) of the total depth below the surface as the mean velocity for the vertical. This method (six-tenths depth method) works best for depths between 0.3 to 2.5 feet and is the measurement of choice when measurements must be made quickly.

7. Perform the same procedure at each successive station as rapidly as possible.

8. Determine the depth and mean velocity at the last station, or endpoint, and record.

9. Record the ending time of this series of measurements and the stage.

10. Enter the ending stage value on the recorder chart at the point of pen contact. This information will illustrate the interval of time and stage variations during the cross-sectional measurements. Also enter the date and indicate that a calibration has taken place over this interval.

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11. Remove the tagline (if used); rinse the current meter in clean water, if necessary; allow the current meter to dry; then pack it away in its carrying case.

12. To determine the volumetric flow through each subsection per unit of time, multiply the mean velocity of each stream subsection by the area of that subsection. To determine the total discharge rate, sum all the volumetric flows for each subsection across the entire cross section of the stream. To determine average stream velocity, divide the total discharge rate by the total cross-sectional area.

Measurement of Surface Water Flow Velocity Using Pitot Tubes

Pitot tubes can be used to measure flow velocities in open channels because the difference in pressure between an upstream reading and a downstream reading is directly related to flow velocity at the point of measurement. Pitot tubes should be used where velocities are high enough to generate readable differences in pressure. They are inaccurate at velocities less than one ft/sec. They are not reliable for streams carrying high concentrations of suspended matter because the tube inlet plugs easily. Measurements are best made when the upstream straight section is 15 to 20 times the channel width.

1. Partition the stream into subsections and position the Pitot tubes according to manufacturer's specifications.
2. Determine the upstream pressure at the first station and record the value as P2.
3. Determine the downstream pressure at the first station and record the value as P1.
4. Repeat Steps No. 2 and 3 for each subsection of the stream.
5. To calculate the discharge rate:

   $Q = AV$

   Where Q is flow in ft3/sec, A is cross-sectional area of separate subsections of the channel in ft2, and V is flow velocity in ft/sec.
6. To calculate V:

   $V = [2g(P2-P1)/d]0.5$

   Where g = 32.2 ft/sec, P2-P1 is the change in pressure in lb/ft2, and d is 62.4 in lb/ft3 (the density of water). Substituting values for the two constants gives:

   $V = 1.02 (P2-P1)0.5$
7. To determine the total discharge rate for the entire cross-sectional area, sum the discharge rates of the individual subsections.

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8.14 PROCEDURE SW-05: SURFACE WATER QUALITY FIELD DATA SHEET

An example Surface Water Quality Field Data Sheet is shown in Exhibit 8. Each item is described below:

Sample Location ID #:	Identification number for the water sampling location (acronym plus sequence number).
Date and Time:	Date and time work began at site.
Sampling Personnel:	Names of sampling personnel on site.
Site Sketch:	A sketch of the site with a map showing major features and landmarks in the area. Note north direction.
Site Description:	A description of the site with sufficient details such that the site may be located again.
Photograph:	Roll number, photograph (frame) number and direction faced while photograph was taken.
Sample Description:	Identification number for the sample, time of collection, depth of collection, reference point used to measure depth, and disturbances of sediment during sampling.
Sampling Method:	Sampling device and method or procedure used.
Field Parameters:	Meter I.D. # and readings for all field measurements, including temperature, pH, conductivity, dissolved oxygen (method used in determining) and turbidity. Titration amounts, titrate type, and molarity for carbonate and bicarbonate analyses. Include time of titration. Include time readings were made.
Ferrous Iron Measurements:	Measurements of iron, including dilutions and method used.
Sulfide:	Measurements of sulfide including dilutions.
Discharge Measurement:	Method or procedure used, and measurements and calculations made to arrive at discharge rate (including units).
Signature:	The sampler or samplers will sign the Sheet prior to submittal of the samples to the laboratory.

A copy of the Surface Water Quality Field Data Sheet will be submitted to the laboratory with the Chain of Custody form (see Procedure DC-05). A copy is also filed in the Water Quality Data Filing System.

Please refer to Attachments - Figure SW-2. Example Surface Water Quality Field Data Sheet

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8.15 PROCEDURE SW-06: SAMPLE COLLECTION - STANDING WATER

1. Prior to sample collection, review the general sampling protocol presented in Procedure SW-03.
2. Locate non-permanent sample sites on a parcel map and aerial photograph.
3. Travel to the site and mark the sample point in accordance with Procedure SW-01 if the sample site is to be surveyed.
4. Begin written and photographic (for first-time visits) documentation as directed in Procedure SW-02.
5. Note distances from fixed landmarks such that site may be located again.
6. Avoid surface scum, and sample far enough from the shoreline to avoid variations from inflowing tributaries or waste discharges.
7. Measure the water level relative to a permanent gauge if available.
8. If wading, minimize disturbance in the area to be sampled. Do not wade in greater than 3.0 feet of water.
9. Rinse the bottle (to be used with the sampling device) at least three times using the water to be sampled.
10. Submerge a stainless-steel dipper or other suitable device with minimal surface disturbance. Do not disturb bottom sediments. Record the approximate depth and location of the sample source on the Surface Water Quality Field Data Sheet.
11. Allow the device to fill slowly and continuously.
12. Retrieve the dipper or device from the surface water with minimal disturbance.
13. Remove the cap from the prepared sample container and slightly tilt the mouth of the bottle below the dipper or device edge.
14. Empty the dipper or device slowly, allowing the sample stream to flow gently down the side of the container with minimal entry turbulence.
15. Continue delivery of the sample until the container is completely filled.
16. Secure the cap tightly.
17. Assign a sample identification number in accordance with Procedure SW-01.
18. Label samples in accordance with Procedure DC-04.
19. Place the properly labeled sample container in an appropriate carrying case or cooler. Pack with ice when required as a preservative.
20. Dismantle the sampler. Follow Procedure MD-02 for proper decontamination of equipment.
21. Handle the sample as described in Procedure DC-05 and DC-06.
22. Collect QA samples, as described in Procedures QC-01 through QC-05, and process in the same manner as other samples with respect to documentation and handling.

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8.16 PROCEDURE SW-07: SAMPLE COLLECTION - SPRINGS

1. Prior to sample collection, review the general sampling protocol presented in Procedure SW-03.
2. Locate non-permanent sample sites on a parcel map and aerial photograph.
3. Travel to the site and mark the sample point in accordance with Procedure SW-02 if the sample site is to be surveyed.
4. Begin written and photographic (for first-time visits) documentation as directed in Procedure SW-02.
5. Note distances from fixed landmarks such that site may be located again.
6. Collect samples by holding the sample container under the flowing spring if possible. If the spring is not exposed, sample the standing water in accordance with Procedure SW-06. Use a shovel to carefully deepen the pond if necessary. Allow sediments to settle and clear prior to sampling.
7. Assign a sample identification number in accordance with Procedure SW-01.
8. Label samples in accordance with Procedure DC-04.
9. Handle the sample as described in Procedures DC-05 and DC-06.
10. Collect QA samples, as described in Procedures QC-01 through QC-05, and process in the same manner as other samples with respect to documentation and handling.
11. Arrange for the surveying of new sample locations if required by the Project Work Plan or the Project Manager.

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8.17 PROCEDURE SW-08: SAMPLE COLLECTION - RUN-OFF

Follow this procedure to collect run-off water samples from stockpiled tailings, soil and/or waste rock with a sampling device which allows the transfer of samples into prepared sample containers.

1. Prior to sample collection, review the general sampling protocol presented in Procedure SW-03.
2. Locate non-permanent sample sites on a parcel map and aerial photograph.
3. Travel to the site and mark the sample point in accordance with Procedure SW-01 if the sample site is to be surveyed.
4. Begin written and photographic (for first-time visits) documentation as directed in Procedure SW-02.
5. Note distances from fixed landmarks such that site may be located again.
6. Select a sampling location where run-off water is in direct contact with subject material, i.e. tailings, waste rock etc.
7. Measure and record the appropriate field parameters (e.g., temperature, pH, dissolved oxygen and estimated flow rate) of the runoff discharge at the time the first flush sample is collected as described in Procedure SW-04.
8. Collect a first flush grab sample within thirty minutes of the initiation of runoff discharge (storm event). If possible, collect grab samples directly from the downstream end of the runoff into the storage bottles. If this is not possible due to sampling access, collect the sample using a sampling device such as a beaker with a long handle and transfer the sample into the storage bottle.
9. Submerge the storage bottle or other suitable sample collection device with minimal surface disturbance. Do not disturb surface sediments. Record the approximate location of the sample source on the Surface Water Quality Field Data Sheet.
10. Allow the device to fill slowly and continuously.
11. Retrieve the sample bottle or device from the runoff water with minimal disturbance.
12. If transferring the sample, remove the cap from the prepared sample container and slightly tilt the mouth of the bottle below the sampling devices edge.
13. Empty the device slowly, allowing the sample stream to flow gently down the side of the container with minimal entry turbulence.
14. Continue delivery of the sample until the container is completely filled.
15. Secure the cap tightly.
16. Assign a sample identification number in accordance with Procedure SW-01.
17. Label samples in accordance with Procedure DC-04.
18. Place the properly labeled sample container in an appropriate carrying case or cooler. Pack with ice when required as a preservative and handle the sample as described in Procedures DC-05 and DC-06.

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19. Collect one grab sample and take a flow measurement every 20 minutes during the first three hours of the discharge, with the first portion of sample collected 20 minutes after initiation of discharge. (If the discharge ceases before three hours, sampling will end with the end of discharge).

20. At the end of sampling, prepare a table including time intervals and flow rate information to determine the volume of sample which will be taken each from each 20-minute sampling interval to make up the flow-proportional composite. A sample procedure and work sheet for determining composite volume are presented in Figure SW-3.

20. Remove the appropriate volume of preserved sample from each preservative bottle into an unpreserved bottle of identical type (e.g. amber glass, plastic) to yield the composite sample for analysis. Do not attempt to composite samples collected in VOA vials for volatile organic analysis in the field. This must be done in the laboratory under controlled conditions. Do not mix samples that have been preserved with different preservatives.

22. Collect QA samples, as identified in Procedures QC-01 through QC-05, and process in the same manner as other samples with respect to documentation and handling.

23. Dismantle the sampler and wipe. Follow Procedure MD-02 for proper decontamination of equipment.

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8.18 PROCEDURE SW-09: SAMPLE COLLECTION - FLOWING WATER

The following procedure will be used to collect water samples from streams and canals with a sampling device which allows the transfer of samples into prepared sample containers.

1. Prior to sample collection, review the general sampling protocol presented in Procedure SW-03.
2. Locate non-permanent sample sites on a parcel map and aerial photograph.
3. Travel to the site and mark the sample point in accordance with Procedure SW-01 if the sample site is to be surveyed.
4. Begin written and photographic (for first-time visits) documentation as directed in Procedure SW-02.
5. Note distances from fixed landmarks such that site may be located again.
6. Select a sampling location where stream flow is well-mixed and away from inflow tributaries.
7. Measure the water level relative to a permanent gauge if available. Measure the flow (discharge rate) according to Procedure SW-04.
8. Collect samples upstream of the area to be walked through. Be aware of the disturbances upstream which may affect the sediment concentrations at the sampling location. Note

   any disturbances on the Surface Water Quality Field Data Sheet.
9. Collect the sample by wading if the estimated product of depth (ft) and velocity (ft/sec) is less than 10.0 and the depth is less than 3.0 feet. Wear a suitable flotation device while wading.
10. Use a depth-integrating sampler, if possible. Use the dip sampling procedure, as follows, if: 1) the stream velocity is too high for the sampler to integrate; 2) the stream is less than six inches deep; and 3) large floating and submerged debris are present.
11. Rinse the bottle (to be used with the sampling device) at least three times using the water to be sampled.
12. Submerge a stainless-steel dipper or other suitable device with minimal surface disturbance. Do not disturb bottom sediments. Record the approximate depth and location of the sample source on the Surface Water Quality Field Data Sheet.
13. Allow the device to fill slowly and continuously.
14. Retrieve the dipper or device from the surface water with minimal disturbance.
15. Remove the cap from the prepared sample container and slightly tilt the mouth of the bottle below the dipper or device edge.
16. Empty the dipper or device slowly, allowing the sample stream to flow gently down the side of the container with minimal entry turbulence.
17. Continue delivery of the sample until the container is completely filled.
18. Secure the cap tightly.
19. Assign a sample identification number in accordance with Procedure SW-01.

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20. Label the sample container in accordance with Procedure DC-04.
21. Place the properly labeled sample container in an appropriate carrying case or cooler. Pack with ice when required as a preservative.
22. Dismantle the sampler. Follow Procedure MD-02 for proper decontamination of equipment.
23. Handle the sample as described in Procedures DC-05 and DC-06.
24. Collect QA samples, as identified in Procedures QC-01 through QC-05, and process in the same manner as other samples with respect to documentation and handling.

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9 SEDIMENT SAMPLING

This section presents procedures associated with sediment sampling done in conjunction with water quality sampling.

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9.1 PROCEDURE SS-01: SAMPLE POINT IDENTIFICATION

Sediment can be defined as any matter which settles to the bottom of a liquid, ie; water body. All sediment sampling locations are identified utilizing a three-letter identification acronym followed by a unique number ranging from 0001 and 9999. No dashes and/or spaces are to be used in the sample name. Special identification numbers for QC samples are described in Procedures QC-01 through QC-03.

Names for new sampling points will be assigned and approved by the Sampling Supervisor. The information listed in Procedure SW-02 will accompany requests for new names.

Procedures to be used for naming new sampling points are provided in Procedure DC-02. A sample point identification must be obtained for all new sampling points, whether permanent or not, to assure that if this site is ever sampled again in the future the data from past sampling events can be identified. Prior to the selection of a new sampling point, consideration should be given to the use of an existing sampling point. Existing sampling points are identified in Table DC-02.

The following sections describe the general conventions used in identifying sediment sampling points prior to the implementation of the present system.

Site Identification Acronym

The identification acronym consists of a three-letter code identifying the general location of the sample. For example, the acronym "LCS" identifies a surface sampling point on Lee Creek.

General location acronyms used to date include:

VWS - Surface water sampling point located on the valley side of the Oquirrh Mountains.

LCS - Lee Creek.

RTC - Riter Canal.

BDC - Brighton Drain.

RWC - Right-of-Way Canal.

SZS - Spitz Spring

CSC - C-7 Ditch

CWC - C-7 Ditch (west)

KCS - Kersey Creek

RSC - Ridgeway South Canal

Sample Location Number

A sequence number or character is associated with each sampling point. That number is unique to the sampling point and will not be used in other points.

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9.2 PROCEDURE SS-02: SAMPLE POINT DESCRIPTION

Marking and surveying each sample point for the first time, follow this procedure to enable surveying. As directed by the specific Project Work Plan, some points may require permanent markers.

1. Drive a pre-painted, orange wooden stake (2x2x24 inches) 12 to 14 inches into the ground. Use a waterproof, indelible ink pen or place a metal label on the stake containing the sample identification number.
2. Measure the location of the stake using a compass and range finder or surveying equipment. Record the location in coordinates or a compass bearing and distance from a permanent object or from a section corner on a USGS map. For non-permanent sampling points, locate the site on a USGS topographic or another suitable map.
3. When using a compass, avoid interferences from massive metal objects (steel towers, tanks, drums etc.).
4. Document the sample point location on the Surface Water Quality Field Data Sheet.
5. Use a camera with date and time indicator if possible. Check current date and time to ensure accuracy.
6. Shoot a picture of the stake with reference points in the background. Reference points include stationary objects used in locating the point. Shoot a picture of the stake relative to the overall site if site conditions are relevant to the study.
7. Shoot a picture of the gauge used in measuring water level, as well as the location at which samples are collected.
8. Record the picture numbers and roll number on the Surface Water Quality Field Data Sheet, as well as the direction facing when taken.
9. Take other pictures as deemed necessary and record the above information in the Field Log Book.
10. Arrange for the installation of a temporary marker or permanent marker at the sampling location, depending on the type of sampling point, as directed by the Project Work Plan.
11. Prepare a statement of work for a licensed surveying contractor to determine the location and elevation of the ground surface and the monument marker. The horizontal control will be Kennecott Mine Datum to within + 3 ft (+ 1 meter). The elevation of the permanent monument marker will be surveyed to within + 0.01 foot (+ 0.3 cm) using the National Geodetic Vertical Datum of 1929. Corrected survey data will include loop closure for survey accuracy within these limits.
12. The surveyor's report will include a list of coordinates, elevations, and system used. The report must also include a map, and a description and location of all permanent and semipermanent reference points used for horizontal and vertical control. This report will be filed in the Water Quality Data Filing System.

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9.3 PROCEDURE SS -03: FIELD EQUIPMENT AND GENERAL PROTOCOL

General Sampling Protocol

1. Record pertinent site observations. Include a sketch and photographic documentation for first-time visits to the site (Procedure SS-02). Identify sample location on the Surface Water Quality Field Data Sheet.
2. Place sample containers on flat, stable surfaces for receiving samples.
3. Plan to collect samples first from those areas suspected of being the least contaminated to minimize the risk of cross contamination.
4. Collect sample and securely close containers as quickly as feasible.
5. Measure field parameters (pH, temperature, etc.) as required by the Project Work Plan. Measure these parameters at the source rather than in containers when possible. Record the time the sample is collected and the time the field measurements are measured.

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9.4 PROCEDURE SS-04: SEDIMENT SAMPLE FIELD DATA SHEET

An example Sediment Sample Field Data Sheet is shown in Figure SS-01. Each item is described below:

Sample Location ID #: Identification number for the sediment sampling location (usually acronym plus sequence number).

Date, Time: Date and time that sample was collected.

Sampling Personnel: Names of sampling personnel on site.

Photograph: File name and direction faced while photograph was taken of the staked sampling point with a reference object in the background.

Sediment Description: Identify sampling intervals and provide a physical description of the sediment. The textural description of sediments will be based on the

Unified Soil Classification System: Use standard geologic terminology to classify rock materials. Note the color, moisture, texture, sorting, roundness/angularity, degree of cementation/consolidation, fabric, bedding, orientation, depositional environment, formation name, and any evidence of contamination or other characteristics related to hydrogeologic conditions.

Site Description: A description of the site. The description must have sufficient details such that the site may be located again. The description will also include vegetative conditions nearby, as well as any features or conditions which may impact the study.

Site Sketch/Cross Section: A sketch of the site with a map showing major features and landmarks in the area. Reference an existing site map by number or document. Note north direction. Include a cross section showing horizons on the sediment face of surface sediment hole or trench.

Signature: The Field Team Leader or the Supervisor, Environmental Sampling will sign the Sheet.

The Sediment Sample Field Data Sheet (Figure SS-1) will be filed in the project file.

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Example Sediment Sample Field Data Sheet

KENNECOTT UTAH COPPER

Sheet ___ of ___

SEDIMENT SAMPLE
FIELD DATA SHEET

SAMPLE LOCATION ID #: _____

DATE: _____ TIME: _____am/pm

SAMPLING PERSONNEL: _____
_____
_____

WATER QUALITY SAMPLING COMPLETED ON: _____
SAMPLING METHOD: _____
SAMPLE DESCRIPTION: _____
_____
_____

PHOTOGRAPH: Roll #: ___ Photo #: ___ Direction Faced: _____

SITE SKETCH/CROSS SECTION:

Existing Site Map Number: _____
SITE DESCRIPTION _____
_____
REMARKS _____

SIGNATURE _____

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9.5 PROCEDURE SS-05: SAMPLE COLLECTION – GENERAL IONS AND METALS

1. For samples not collected in stainless steel sleeves, use glass containers with Teflon-lined lids if sample will be submitted for chemical analyses.
2. First, collect sediment samples in areas expected to be the least contaminated and up-gradient from any suspected contaminant source. Then, collect samples furthest down-gradient of the suspected source. Finally, collect samples from the area closest to any suspected sources of contamination.
3. Avoid cross-contamination during sediment sampling. Sediment samples for laboratory analyses will contact only stainless-steel sleeves, sleeve caps, the instruments used to extrude the sediment, glass sample containers, or sampling devices. Decontaminate these and other sampling equipment between samples and sampling locations according to Procedure 6.
4. Extrude the sediment from the sampler and quickly seal the sample containers (filled completely) to minimize exposure of the sample and container to potential airborne contaminants and to minimize volatilization of organic constituents and moisture.

Collection of Sediment Samples

Use the following procedure to collect samples of sediment from stream beds or the bottom of standing water bodies.

1. Prior to sample collection, review the general sampling protocol presented above in Procedure SW-03.
2. Locate non-permanent sample sites on a parcel map and aerial photograph.
3. Travel to the site and mark the sample point in accordance with Procedure SS-02.
4. Collect shallow samples using a hand corer. (This device consists of a two-inch diameter vertical PVC tube approximately 24 to 36 inches long. Attached to the upper end is a handle used when applying downward force in collecting the sample. Attached to the lower end of the tube is a tapered nosepiece to ease penetration into the sediment. Inside the nosepiece are teeth or slips to retain the sample inside the tube when retrieving the core.) Force the corer into the sediment using a smooth continuous motion. Twist the core and withdraw with a single smooth motion. Semi-solid sediments near the shore or above the water line may be sampled using polypropylene scoops, trowels or dippers.
5. Collect samples from down-stream to up-stream locations to minimize sediment disturbance.
6. Collect sediments from deep (large streams or lakes) with a specialized sampler (e.g., Eckman or Ponar dredge). Attach the necessary length of sample line. Measure and mark the distance to the top of the sediment on the sample line. Open sampler jaws until latched. Support the sampler by its lift line. Tie the free end of sampler to fixed support to prevent accidental loss of the sampler. Lower the sampler until the depth mark is reached. Slowly descend the sampler through the last three feet until contact is felt. Allow sample line to slack several inches. Slowly raise dredge.
7. Collect sediments from sumps using a very small sampling utensil, e.g., a suction pipette. If the sediment is stratified, sample equal portions of all identifiable layers.
8. Collect four samples at each sample location.

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9. Describe color, texture, consistency, moisture content, and pH using indicator paper.
10. Allow time for settling to occur. Decant the free water. Homogenize the samples in a stainless-steel bowl to composite the sample.
11. Transfer the composite sample into an appropriate sample bottle with a stainless-steel laboratory spoon, scoop, or spatula.
12. Label samples in accordance with Procedure DC-04.
13. Handle the sample as described in Procedures DC-05 and DC-06.
14. Collect QC samples, as discussed in Procedures QC-01 to QC-04, and process in the same manner as other samples with respect to documentation and handling.

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10 REFERENCES

EPA (1986). RCRA Ground Water Monitoring Technical Enforcement Guidance Document (Final), September 1986.

GeoInsight (2016). Standard Operating Procedure: Sampling Groundwater with a HydraSleeve

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Tables

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TABLE DC-1

APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
ABC1	W491	WTR	VW	LR	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD1		WTR			UPDES PERMIT	NA	---	Yes	---	---
VWS1	S1	WTR	VW	JR	JORDAN RIVER AT 9000 So.	OK	---	Yes	---	---
ABC2	W492	WTR	VW	EC	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD2		WTR			UPDES PERMIT	OK	---	Yes	---	---
VWS2	S2	WTR	VW	JR	JORDAN RIVER AT 12300 SOUTH	OK	---	Yes	---	---
ABC3	W493	WTR	VW	EP	South end Adrian Brown Consultants	OK	Yes	---	---	---
ABC4	W494	WTR	VW	B1	South end Adrian Brown Consultants	OK	Yes	---	---	---
ABC4A	W495	WTR	VW	B1	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD4		WTR	NE		UPDES PERMIT	OK	---	---	---	Yes
VWW4	W4	WTR	VW	WJ	1420 WEST 7800 SOUTH	D	Yes	---	---	---
ABC5	W496	WTR	VW	BS	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD5		WTR			UPDES PERMIT	D	---	Yes	---	---
VWW5	W5	WTR	VW	BF	9130 SOUTH 4330 WEST	D	Yes	---	---	---
ABC6	W497	WTR	VW	LT	South end Adrian Brown Consultants	OK	Yes	---	---	---
VWW6		WTR	VW		9299 SOUTH 4000 WEST	NA	Yes	---	---	---
ABC7	W498	WTR	VW	EC	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD7		WTR			UPDES PERMIT	OK	---	Yes	---	---
VWW7	W7	WTR	VW	B4	3590 WEST 9000 SOUTH	D	Yes	---	---	---
ABC8	W499	WTR	VW	EP	South end Adrian Brown Consultants	OK	Yes	---	---	---
UPD8		WTR			UPDES PERMIT	OK	---	Yes	---	---
VWW8	W8	WTR	VW	EP	9800 SOUTH 4000 WEST - GLENMOORE GOLF	D	Yes	---	---	---
RM8M		WTR	BC		Ground water well located in barneys canyon		Yes	---	---	---
UPD9		WTR			UPDES PERMIT	OK	---	---	---	Yes
VWW9	W9	WTR	VW	SJ	10607 SOUTH 2700 WEST	NU	Yes	---	---	---
UPD10		WTR	VW		UPDES PERMIT	OK	---	---	---	Yes
UPD11		WTR	NE		UPDES PERMIT	OK	---	---	---	Yes
VWW11	W11	WTR	VW	SJ	9860 SOUTH 2700 WEST	NU	Yes	---	---	---
UPD12		WTR	NE		UPDES PERMIT	OK	---	---	---	Yes
VWW15	W15	WTR	VW	HM	8215 SOUTH 1800 WEST (SLCWCD)	C	Yes	---	---	---
VWW16	W16	WTR	VW	HM	8215 SOUTH 1800 WEST (SLCWCD)	NU	Yes	---	---	---
VWW17	W17	WTR	VW	HM	11946 SOUTH 3600 WEST	NU	Yes	---	---	---
VWW18	W18	WTR	VW	HM	12600 SOUTH 6400 WEST	NU	Yes	---	---	---
VWW19	W19	WTR	VW	HM	12800 SOUTH 6000 WEST	NU	Yes	---	---	---
VWW20	W20	WTR	VW	HM	12960 SOUTH 6210 WEST	NU	Yes	---	---	---
VWS21	S21	WTR	VW	HM	BUTTERFIELD CREEK	OK	Yes	Yes	---	---
VWS21A	S21A	WTR	VW	HM	BINGHAM MINE PORTAL	C	---	Yes	---	---
VWS21B	S21B	WTR	VW	HM	BUTTERFIELD CREEK & BINGHAM PORTAL	C	---	Yes	---	---
VWS22A	S22A	WTR	VW	EC	LARK TOWN SPRING	OK	---	Yes	---	---
VWS22B	S22B	WTR	VW	EC	BUTTERFIELD CREEK SPRING	OK	---	Yes	---	---
VWW22	W22	WTR	VW	HM	13055 SOUTH 7756 WEST	OK	Yes	---	---	---
VWS23		WTR	VW		Dumont (Lark)	D	---	Yes	---	---
VWW23	W23	WTR	VW	EC	12075 SOUTH HIGHWAY 111	D	Yes	---	---	---
VWW24	W24	WTR	VW	LT	11980 SOUTH 7650 WEST	D	Yes	---	---	---
VWS25	S25	WTR	VW	SJ	Same as VWW321	OK	---	Yes	---	---
VWK26	K26	WTR	VW	B1	Below Proler Steel	CB	Yes	---	---	---
VWW27	W27	WTR	VW	CO	501 WEST STATE HIGHWAY 48	OK	Yes	---	---	---
VWS29	S29	WTR	VW	EC		NU	---	Yes	---	---
VWS31		WTR	VW	BC	NO S31, WAS VWW31		---	Yes	---	---
VWW31	W31	WTR	VW	BY	8300 W 8850 S (BARNEYS CREEK) COPP IMPR	OK	Yes	---	---	---
VWS32	S32		VW		8100 W 8800 S COPPERTON IMPROVEMENT DIST	OK	---	Yes	---	---
VWW32	W32	WTR	VW	BC		OK	Yes	Yes	---	---
VWS33	S33	WTR	VW	BD	PROVO RESERVOIR CANAL - 16150 SO.	OK	---	Yes	---	---
VWS34	S34	WTR	VW	BD	UTAH LAKE DISTRICT CANAL	OK	---	Yes	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWS35	S35	WTR	VW	BD	UTAH AND SALT LAKE CANAL	OK	---	Yes	---	---
VWS36	S36	WTR	VW		SOUTH JORDAN CANAL	OK	---	Yes	---	---
VWS37	S37	WTR	VW	SJ	BECKSTEAD DITCH	OK	---	Yes	---	---
VWS38	S38	WTR	VW	JR	JORDAN RIVER - 10600 SO.	OK	---	Yes	---	---
VWS39	S39	WTR	VW		Old Trip Blank No.	OK	---	Yes	---	---
VWS40	S40	WTR	VW	EC	BUTT. CANYON SPRING - OLD SCOUT CAMP	OK	---	Yes	---	---
VWS41		WTR	VW	EC			---	Yes	---	---
VWW41	S41	WTR	VW	HM		OK	Yes	---	---	---
VWW41A	W41A	WTR	VW	EC	WEST LARK - 13200 SOUTH 8300 WEST	D	Yes	---	---	---
VWW42	W42	WTR	VW	SJ	8312 S. 2700 WEST (TURF FARM ASSOC)	NU	Yes	---	---	---
VWW43	W43	WTR	VW	RV	13325 SOUTH 3600 WEST	NU	Yes	---	---	---
VWW44	W44	WTR	VW	WJ	9200 SOUTH 3400 WEST	NU	Yes	---	---	---
VWS45		WTR	VW	AR	Old C-7 Ditch Sample	NU	---	Yes	---	---
VWS45A	S45A		VW		ARTHUR ADVERSE WATER	NU	---	Yes	---	---
VWS45B	S45B		VW		MAGNA ADVERSE WATER	NU	---	Yes	---	---
VWS45C	S45C		VW		TAILING RETURN (TPR)	OK	---	Yes	---	---
VWS46	S46	WTR	VW	MC	REFINERY DRAIN	NU	---	Yes	---	---
VWS47	S47	WTR	VW	MD		D	---	Yes	---	---
VWS48	S48	WTR	VW	MD		D	---	Yes	---	---
VWS49	S49	WTR	VW	MD		D	---	Yes	---	---
VWS50	S50	WTR	VW	MD		D	---	Yes	---	---
VWS52	S52	WTR	VW	MD		D	---	Yes	---	---
VWS52A	S52A	WTR	VW	MD		D	---	Yes	---	---
VWS53		WTR	VW	EC	BUTTERFIELD PORTAL (UPDES010)	OK	---	Yes	---	---
VWS54	S54	WTR	VW	EV	JORDAN RIVER - 6400 South	OK	---	Yes	---	---
VWS55	S55	WTR	VW	JR	JORDAN RIVER - 10600 SO.	OK	---	Yes	---	---
VWS56	S56	WTR	VW	WJ	NORTH BINGHAM CREEK	OK	---	Yes	---	---
VWS57	S57	WTR	VW	B4	SO. BINGHAM CREEK - 8393 S. 1300 W.	OK	---	Yes	---	---
VWS58	S58	WTR	VW	B4	Wilkinson Drain	OK	---	Yes	---	---
VWS59	S59	WTR	VW	CO	CARROLL DRAIN	OK	---	Yes	---	---
VWK60	K60	WTR	VW	B2	COPPERTON MAKE-UP WATER (Now B2G1193)	OK	Yes	---	---	---
VWK61	K61	WTR	VW	CO		D	Yes	---	---	---
VWK62	K62	WTR	VW	BR		D	Yes	---	---	---
VWK63	K63	WTR	VW	EC		D	Yes	---	---	---
VWK64	K64	WTR	VW	EC		D	Yes	---	---	---
VWK65	K65	WTR	VW	MD		D	Yes	---	---	---
VWK66	K66	WTR	VW	EC		D	Yes	---	---	---
VWK67	K67	WTR	VW	MD		D	Yes	---	---	---
VWK67A	K67A	WTR	VW	MD		D	Yes	---	---	---
VWK67R	K67R	WTR	VW	EC		D	Yes	---	---	---
VWK68	K68	WTR	VW	EC		D	Yes	---	---	---
VWK69	K69	WTR	VW	MD		D	Yes	---	---	---
VWK70	K70	WTR	VW	EC		OK	Yes	---	---	---
VWK71	K71	WTR	VW	EC		OK	Yes	---	---	---
VWK72	K72	WTR	VW	EC		OK	Yes	---	---	---
VWK73	K73	WTR	VW	EC	South end monitor well	OK	Yes	---	---	---
VWK74	K74	WTR	VW	EC		P	Yes	---	---	---
VWK75	K75	WTR	VW	EC		OK	Yes	---	---	---
VWK76	K76	WTR	VW	EC		P	Yes	---	---	---
VWK77	K77	WTR	VW	EC		P	Yes	---	---	---
VWK78	K78	WTR	VW	CO		P	Yes	---	---	---
VWK79	K79	WTR	VW	CO		AB	Yes	---	---	---
VWK80	K80	WTR	VW	CO		OK	Yes	---	---	---
VWK81	K81	WTR	VW	BC		OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWK82	K82	WTR	VW	EC		OK	Yes	---	---	---
VWK83	K83	WTR	VW	EC		OK	Yes	---	---	---
VWK84	K84	WTR	VW	B1		OK	Yes	---	---	---
VWK85	K85	WTR	VW	B1		OK	Yes	---	---	---
VWK86	K86	WTR	VW	AN		R	Yes	---	---	---
VWK87	K87	WTR	VW	B2		OK	Yes	---	---	---
VWK88	K88	WTR	VW	CP	PROLLER STEEL	G	Yes	---	---	---
VWK89	K89	WTR	VW	EC		P/R	Yes	---	---	---
VWK90	K90	WTR	VW	CO		P	Yes	---	---	---
VWK91	K91	WTR	VW	EC		P	Yes	---	---	---
VWK92	K92	WTR	VW	B1		B	Yes	---	---	---
VWK93	K93	WTR	VW	EC		P	Yes	---	---	---
VWK94	K94	WTR	VW	B1		AB	Yes	---	---	---
VWK95	K95	WTR	VW	CO		G	Yes	---	---	---
VWW95		WTR	VW			OK	---	---	---	---
VWK96	K96	WTR	VW	B1		AB	Yes	---	---	---
VWK97	K97	WTR	VW	CO		B	Yes	---	---	---
VWK98	K98	WTR	VW	MD		D	Yes	---	---	---
VWK99	K99	WTR	VW	EP		R,G	Yes	---	---	---
VWK100	K100	WTR	VW	B1		AB	Yes	---	---	---
VWK101	K101	WTR	VW	CP		P	Yes	---	---	---
VWK102	K102	WTR	VW	CO		G	Yes	---	---	---
VWK103	K103	WTR	VW	CP		G	Yes	---	---	---
VWK104	K104	WTR	VW	B1		AB	Yes	---	---	---
VWK105	K105	WTR	VW	EC		OK	Yes	---	---	---
VWK106	K106	WTR	VW	BF	Deep Well East of Proler Steel	OK	Yes	---	---	---
VWW107	W107	WTR	VW	B3	9800 S. 4000 W.-GLENMOORE GOLF COURSE	NU	Yes	---	---	---
VWW108	W108	WTR	VW	EP	9800 S. 4000 W.-GLENMOORE GOLF COURSE	OK	Yes	---	---	---
VWK109	K109	WTR	VW	BF	COPPERTON MAKEUP WATER replaced with BFG1200	OK	Yes	---	---	---
VWK110	K110	WTR	VW	CP		AB	Yes	---	---	---
VWK111	K111	WTR	VW	AN		C	Yes	---	---	---
VWK112	K112	WTR	VW	AN		OK	Yes	---	---	---
VWK113	K113	WTR	VW	B1		AB	Yes	---	---	---
VWK114	K114	WTR	VW	AN		OK	Yes	---	---	---
VWK115	K115	WTR	VW	B1		AB	Yes	---	---	---
VWK116	K116	WTR	VW	B1		AB	Yes	---	---	---
VWK117	K117	WTR	VW	B1		AB	Yes	---	---	---
VWK117A	K117A	WTR	VW	B1		C	Yes	---	---	---
VWK118	K118	WTR	VW	B1		OK	Yes	---	---	---
VWK119	K119	WTR	VW	B1		AB	Yes	---	---	---
VWK120	K120	WTR	VW	B1		OK	Yes	---	---	---
VWS121	S121		VW			OK	---	Yes	---	Yes
VWK122	K122	WTR	VW	EC		OK	Yes	---	---	---
VWK123	K123	WTR	VW	MD		D	Yes	---	---	---
VWW124	W124	WTR	VW	BC	8825 SOUTH 7350 WEST	D	Yes	---	---	---
VWK125	W125	WTR	VW	SO	8650 WEST BUTTERFIELD CANYON	D	Yes	---	---	---
VWW126	W126	WTR	VW	HM	7756 WEST 13055 SOUTH	D	Yes	---	---	---
VWW127	W127	WTR	VW	LT	12300 SOUTH 8350 WEST (LARK)	CF	Yes	---	---	---
VWW128	W128	WTR	VW	B4	9299 SOUTH 4000 WEST	NU	Yes	---	---	---
VWW129	W129	WTR	VW	SJ	11625 SOUTH 3175 WEST	D	Yes	---	---	---
VWW130	W130	WTR	VW	HM	7400 WEST HIGHWAY 111	NU	Yes	---	---	---
VWW131A	W131A	WTR	VW	HM	5140 WEST 12800 SOUTH	D	Yes	---	---	---
VWW131B	W131B	WTR	VW	HM	5140 WEST 12800 SOUTH	D	Yes	---	---	---
VWW131C	W131C	WTR	VW	HM	5140 WEST 12800 SOUTH	C	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWW132	W132	WTR	VW	HM	13400 SOUTH 5600 WEST	NU	Yes	---	---	---
VWW133	W133	WTR	VW	WJ	8940 SOUTH 4167 WEST	OK	Yes	---	---	---
VWW134	W134	WTR	VW	RV	4311 WEST 12600 SOUTH	OK	Yes	---	---	---
VWW135	W135	WTR	VW	RV	4091 WEST 12600 SOUTH	OK	Yes	---	---	---
VWW136	W136	WTR	VW	RV	12765 SOUTH 1400 WEST	OK	Yes	---	---	---
VWW137	W137	WTR	VW	HM	4585 WEST 13400 SOUTH	OK	Yes	---	---	---
VWW138	W138	WTR	VW	WJ	8700 SOUTH 3650 WEST	NU	Yes	---	---	---
VWW139	W139	WTR	VW	WJ	8390 SOUTH OLD BINGHAM HIGHWAY	NU	Yes	---	---	---
VWW140	W140	WTR	VW	WJ	8525 SOUTH OLD BINGHAM HIGHWAY	OK	Yes	---	---	---
VWW141	W141	WTR	VW	RV	12408 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW142	W142	WTR	VW	RV	12191 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW143	W143	WTR	VW	RV	12484 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW144	W144	WTR	VW	RV	12653 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW145	W145	WTR	VW	RV	4091 WEST 13400 SOUTH	OK	Yes	---	---	---
VWW146	W146	WTR	VW	BD	14400 SOUTH 3598 WEST	OK	Yes	---	---	---
VWW147	W147	WTR	VW	WJ	8600 SOUTH 2400 WEST	OK	Yes	---	---	---
VWW148	W148	WTR	VW	WJ	9000 SOUTH 2550 WEST	OK	Yes	---	---	---
VWW149	W149	WTR	VW	WJ	9380 SOUTH 2200 WEST	OK	Yes	---	---	---
VWW150	W150	WTR	VW	RV	13400 SOUTH 3000 WEST	OK	Yes	---	---	---
VWW151	W151	WTR	VW	WJ	9120 SOUTH REDWOOD ROAD	NU,AB	Yes	---	---	---
VWW152	W152	WTR	VW	SJ	10826 SOUTH 1300 WEST	D	Yes	---	---	---
VWW153	W153	WTR	VW	SJ	11558 SOUTH 1700 WEST	D	Yes	---	---	---
VWW154	W154	WTR	VW	RV	11400 SOUTH 1327 WEST	OK	Yes	---	---	---
VWW155	W155	WTR	VW	RV	12600 SOUTH 1700 WEST	G	Yes	---	---	---
VWW156	W156	WTR	VW	RV	13592 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW157	W157	WTR	VW	BD	14129 SOUTH 1700 WEST	OK	Yes	---	---	---
VWW158	W158	WTR	VW	RV	14590 SOUTH 1690 WEST	NU	Yes	---	---	---
VWW159	W159	WTR	VW	KN	5300 SOUTH 3650 WEST	D	---	Yes	---	---
VWW160	W160	WTR	VW	KN	6200 SOUTH 3200 WEST	CF	Yes	---	---	---
VWW161	W161	WTR	VW	KN	6115 SOUTH 1300 WEST	CF	Yes	---	---	---
VWW162	W162	WTR	VW	SJ	10153 SOUTH 1000 WEST	D	Yes	---	---	---
VWW163	W163	WTR	VW	SJ	10357 SOUTH 1000 WEST	D	Yes	---	---	---
VWW164	W164	WTR	VW	RV	13650 SOUTH 1200 WEST	OK	Yes	---	---	---
VWW165	W165	WTR	VW	EV	14270 SOUTH 700 WEST	OK	Yes	---	---	---
VWS166	S166	WTR	VW	JR	JORDAN RIVER - 14600 SOUTH	OK	---	Yes	---	---
VWW167	W167	WTR	VW	B3	MULCH PLANT AT9850 SOUTH 5300 WEST	OK	Yes	---	---	---
VWW170	W170	WTR	VW	HM	4358 WEST 13400 SOUTH	NU	Yes	---	---	---
VWW171	W171	WTR	VW	HM	4258 WEST 13400 SOUTH	OK	Yes	---	---	---
VWW172	W172	WTR	VW	RV	13000 SOUTH 3380 WEST (OAKDALE EGG FARM)	OK	Yes	---	---	---
VWW173	W173	WTR	VW	RV	4258 WEST 13400 SOUTH	OK	Yes	---	---	---
VWW174	W174	WTR	VW	BD	13850 SOUTH 4000 WEST	DA	Yes	---	---	---
VWW175	W175	WTR	VW	BD	3301 WEST 13800 SOUTH	OK	Yes	---	---	---
VWW176	W176	WTR	VW	RV	12347 SOUTH 1300 WEST	OK	Yes	---	---	---
VWK177			VW		SEE VWW177	OK	Yes	---	---	---
VWW177	W177	WTR	VW	B4	8065 SOUTH 1300 WEST	NU	Yes	---	---	---
VWW178	W178	WTR	VW	WJ	8446 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW179	W179	WTR	VW	JR	8700 SOUTH 700 WEST - FUR BREEDERS	OK	Yes	---	---	---
VWW180	W180	WTR	VW	JR	8700 SOUTH 700 WEST - FUR BREEDERS	OK	Yes	---	---	---
VWW181	W181	WTR	VW	EV	10200 SOUTH 300 WEST	D	Yes	---	---	---
VWW182	W182	WTR	VW	WJ	10200 SOUTH 455 WEST	NU	Yes	---	---	---
VWW183	W183	WTR	VW	RV	14401 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW184	W184	WTR	VW	RV	12600 SOUTH 2577 WEST	OK	Yes	---	---	---
VWW185	W185	WTR	VW	HM	12400 SOUTH 6400 WEST	OK	Yes	---	---	---
VWW186	W186	WTR	VW	HM	1166 W. MAIN, HERRIMAN	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWW187	W187	WTR	VW	B4	9100 SOUTH 3590 WEST	OK	Yes	---	---	---
VWW188	W188	WTR	VW	HM	12640 SOUTH 3975 WEST	NA	Yes	---	---	---
VWW189	W189	WTR	VW	BF	INTERSTATE BRICK9780 SOUTH 5200 WEST	OK	Yes	---	---	---
VWP190A	P190A	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWP190B	P190B	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWP191A	P191A	WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP191B	P191B	WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP192A	P192A	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP192B	P192B	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP193A	P193A	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP193B	P193B	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP194A	P194A	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP194B	P194B	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP195	P195	WTR	VW	EP	REPLACED BY P210	AB	Yes	---	---	---
VWP196		WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP196A	P196A	WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP196B	P196B	WTR	VW	B2	valley monitoring well	G	Yes	---	---	---
VWP197A	P197A	WTR	VW	BF	valley monitoring well	OK	Yes	---	---	---
VWP197B	P197B	WTR	VW	BF	valley monitoring well	OK	Yes	---	---	---
VWP198	P198	WTR	VW	EP	valley monitoring well	D	Yes	---	---	---
VWP199	P199	WTR	VW	EP	valley monitoring well	G	Yes	---	---	---
VWS200	S200	WTR	VW	LR	valley monitoring well	OK	---	Yes	---	---
VWK201	K201	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP202A	P202A	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWP202B	P202B	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWP202C	P202C	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWK203	K203	WTR	VW	BR	valley monitoring well	AB	Yes	---	---	---
VWK204	K204	WTR	VW	BR	valley monitoring well	D	Yes	---	---	---
VWK205	K205	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWK206	K206	WTR	VW	BR	valley monitoring well	D	Yes	---	---	---
VWP207A	P207A	WTR	VW	EP	valley monitoring well	D	Yes	---	---	---
VWP207B	P207B	WTR	VW	EP	valley monitoring well	D	Yes	---	---	---
VWP208A	P208A	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP208B	P208B	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP209A		WTR	VW	B2	valley monitoring well	G	Yes	---	---	---
VWP209B	P209B	WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP210B	P210B	WTR	VW	EP	valley monitoring well	AB	Yes	---	---	---
VWP211	P211	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP211A	P211A	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP211B	P211B	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP212A	P212A	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP212B	P212B	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP213		WTR	VW	B1	valley monitoring well	OK	Yes	---	---	---
VWP213A	P213A	WTR	VW	B1	valley monitoring well	DRY	Yes	---	---	---
VWP213B	P213B	WTR	VW	B1	valley monitoring well	D	Yes	---	---	---
VWP213C	P213C	WTR	VW	B1	valley monitoring well	D	Yes	---	---	---
VWP214A	P214A	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP214B	P214B	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWP215	P215	WTR	VW	EP	valley monitoring well	D	Yes	---	---	---
VWP216	P216	WTR	VW	EC	valley monitoring well	AB	Yes	---	---	---
VWP217		WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP218	P218	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWP219	P219	WTR	VW	EC	valley monitoring well	AB	Yes	---	---	---
VWP220	P220	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWP221	P221	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWP222	P222	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWP223	P223	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP224	P224	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP225	P225	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP226		WTR	VW	BR	valley monitoring well	AB	Yes	---	---	---
VWP227	P227	WTR	VW	BR	valley monitoring well	AB	Yes	---	---	---
VWP228	P228	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP229		WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP231	P231	WTR	VW	LW	valley monitoring well	OK	Yes	---	---	---
VWP233	P233	WTR	VW	EC	valley monitoring well	D	Yes	---	---	---
VWP234	P234	WTR	VW	EC	valley monitoring well	G	Yes	---	---	---
VWP235	P235	WTR	VW	MD	valley monitoring well	D	Yes	---	---	---
VWS236	S236	WTR	VW	LR	LEACH FLUID	OK	---	Yes	---	---
VWS237	S237	WTR	VW	BM	PIT WATER	OK	---	Yes	---	---
VWS238	S238	WTR	VW	B2	evap ponds inlet same as S354	C	---	Yes	---	---
VWP239	P239	WTR	VW	EC	REPLACEMENT NEAR OLD K67R	OK	Yes	---	---	---
VWP240A	P240A	WTR	VW	EP	REPLACEMENT NEAR OLD P198A	OK	Yes	---	---	---
VWP240B	P240B	WTR	VW	EP	REPLACEMENT NEAR OLD P198B	OK	Yes	---	---	---
VWP241A	P241A	WTR	VW	BS	REPLACEMENT NEAR OLD P202A	OK	Yes	---	---	---
VWP241B	P241B	WTR	VW	BS	REPLACEMENT NEAR OLD P202B	OK	Yes	---	---	---
VWP241C	P241C	WTR	VW	BS	REPLACEMENT NEAR OLD P202C	OK	Yes	---	---	---
VWP242	P242	WTR	VW	SR	valley monitoring well	OK	Yes	---	---	---
VWP243	P243	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP244A	P244A	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP244B	P244B	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP244C	P244C	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP245	P245	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP246	P246	WTR	VW	EC	valley monitoring well	DRY	Yes	---	---	---
VWP247A	P247A	WTR	VW	SJ	valley monitoring well	AB	Yes	---	---	---
VWP247B	P247B	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP248A	P248A	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP248B	P248B	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP248C	P248C	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP249A	P249A	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP249B	P249B	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP250A	P250A	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP250B	P250B	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP251	P251	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP252A	P252A	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP252B	P252B	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP252C	P252C	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP253A	P253A	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP253B	P253B	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP254A	P254A	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP254B	P254B	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
NEB2557		WTR	NE		Brovo Gate	OK	Yes	---	---	---
VWP255A	P255A	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP255B	P255B	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP256	P256	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP257	P257	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP258A	P258A	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP258B	P258B	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP259	P259	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWP260	P260	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP261	P261	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP262	P262	WTR	VW	SJ	valley monitoring well	OK	Yes	---	---	---
VWP263	P263	WTR	VW	EP	valley monitoring well	OK	Yes	---	---	---
VWP264	P264	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP265	P265	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP266	P266	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP267A	P267A	WTR	VW	HM	valley monitoring well	DRY	Yes	---	---	---
VWP267B	P267B	WTR	VW	HM	valley monitoring well	OK	Yes	---	---	---
VWP268	P268	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP269	P269	WTR	VW	LT	valley monitoring well	OK	Yes	---	---	---
VWP270	P270	WTR	VW	SO	valley monitoring well	P	Yes	---	---	---
VWP270A	P270A	WTR	VW	HM	valley monitoring well	C	Yes	---	---	---
VWP271	P271	WTR	VW	LU	valley monitoring well	OK	Yes	---	---	---
VWP272	P272	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP273	P273	WTR	VW	BS	valley monitoring well	OK	Yes	---	---	---
VWP274	P274	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
VWP275	P275	WTR	VW	CO	valley monitoring well	OK	Yes	---	---	---
VWP276	P276	WTR	VW	WJ	valley monitoring well	OK	Yes	---	---	---
VWP277	P277	WTR	VW	B2	valley monitoring well	OK	Yes	---	---	---
VWP278A		WTR	VW		valley monitoring well	OK	Yes	---	---	---
VWP278B	P278B	WTR	VW	BC	valley monitoring well	OK	Yes	---	---	---
VWP279	P279	WTR	VW	EC	valley monitoring well	OK	Yes	---	---	---
BCG280	BC280	WTR	VW	BC	BARNEY CANYON PRODUCTION WELL	OK	Yes	---	---	---
BCG281	BC281	WTR	VW	BC	OLD BC148	OK	Yes	---	---	---
BCG282	BC282	WTR	VW	BC	Barneys canyon monitoring well	OK	Yes	---	---	---
BCG283	BC283	WTR	VW	BC	Barneys canyon monitoring well	OK	Yes	---	---	---
BCG284	BC284	WTR	VW	BC	Barneys canyon monitoring well	OK	Yes	---	---	---
BCG285	BC285	WTR	VW	BC	Barneys canyon monitoring well	OK	Yes	---	---	---
BRG286	VWBR286	WTR	VW	BR	REPOSITORY WELL - OLD BR-1	OK	Yes	---	---	---
BRG287	VWBR287	WTR	VW	BR	REPOSITORY WELL - OLD BR-2	OK	Yes	---	---	---
BRG288	VWBR288	WTR	VW	BR		OK	Yes	---	---	---
BRG289	VWBR289	WTR	VW	BR		OK	Yes	---	---	---
BRG290	VWBR290	WTR	VW	BR		OK	Yes	---	---	---
BRG291		WTR	VW	BR		OK	Yes	---	---	---
BRG291A	BRG291	WTR	VW	BR		OK	Yes	---	---	---
BRP292	BRG292	WTR	VW	BR	BLUEWATER NORTH REPOSITORY SUMP	OK	---	Yes	---	Yes
ECG293	EC293	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG294	EC294	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG295B	EC295B	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG296	EC296	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG297	EC297	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG298A	EC298A	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG298B	EC298B	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG299	ES299	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
VWW300	W300	WTR	VW	WJ	10353 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW301	W301	WTR	VW	WJ	9945 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW302	W302	WTR	VW	WJ	9786 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW303	W303	WTR	VW	WJ	9381 SOUTH 1300 WEST	D	Yes	---	---	---
VWW304	W304	WTR	VW	SJ	10315 SOUTH 1540 WEST	OK	Yes	---	---	---
VWW305	W305	WTR	VW	SJ	1795 WEST 9400 SOUTH	OK	Yes	---	---	---
VWW306	W306A	WTR	VW	SJ	10025 SOUTH 1300 WEST	OK	Yes	---	---	---
VWW307	W307	WTR	VW	SJ	10806 SOUTH 2700 WEST	OK	Yes	---	---	---
VWW308	W308	WTR	VW	EP	10150 SOUTH 4975 WEST	NU	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWW309	W309	WTR	VW	RV	4475 WEST 11800 SOUTH	OK	Yes	---	---	---
VWS310	S310		VW		3842 WEST 11800 SOUTH	OK	---	Yes	---	---
VWW310	W310	WTR	VW	RV	3842 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW311	W311	WTR	VW	RV	3883 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW312	W312	WTR	VW	EP	11168 SOUTH 3800 WEST	OK	Yes	---	---	---
VWS313	S313	WTR	VW	SJ	JORDON RIVER - 4800 SOUTH	OK	---	Yes	---	---
VWS314	S314	WTR	VW	KN	NORTH JORDON CANAL - 5800 S. 1300 W.	OK	---	Yes	---	---
VWS315	S315	WTR	VW	JP	BUTTERFIELD CREEK	OK	---	Yes	---	---
VWS316	S316	WTR	VW	BC	CRYSTAL SPRINGS	OK	---	Yes	---	---
VWS317	S317	WTR	VW	EC	DRAINAGE SO. MINE DUMPS	OK	---	Yes	---	---
VWS318	S318	WTR	VW	BC	BARNEY'S SPRING	OK	---	Yes	---	---
VWS319	S319	WTR	VW	HC	MAPLE SPRING	OK	---	Yes	---	---
VWS320	S320	WTR	VW	RV	BUTTERFIELD CREEK	OK	---	Yes	---	---
VWS321	S321	WTR	VW	SJ	MIDAS CREEK- 11500 S.1300 W.	OK	---	Yes	---	---
VWW322	W322	WTR	VW	HM	1105 WEST MAIN ST., HERRIMAN	OK	Yes	---	---	---
VWW323	W323	WTR	VW	HM	5626 WEST 14200 SOUTH	OK	Yes	---	---	---
VWS324	S324	WTR	VW	HM	ROSE CREEK - 6400 W. 14000 S.	OK	---	Yes	---	---
VWW325	W325	WTR	VW	HM	12948 S. 4400 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW326	W326	WTR	VW	RV	13400 S. 3800 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW327	W327	WTR	VW	RV	13600 S. 3600 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW328	W328	WTR	VW	RV	13400 S. 2290 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW329	W329	WTR	VW	BD	14847 SOUTH CAMP WILLIAMS ROAD	OK	Yes	---	---	---
VWS330	S330	WTR	VW	TV	JORDAN RIVER - 9400 S. 1200 W.	OK	---	Yes	---	---
VWW331	W331	WTR	VW	RV	12256 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW332	W332	WTR	VW	CO	7400 SOUTH STATE HIGHWAY 110	OK	Yes	---	---	---
VWW333	W333	WTR	VW	WV	5892 SOUTH HIGHWAY 111	OK	Yes	---	---	---
VWW334	W334	WTR	VW	WJ	7551 SOUTH 5490 WEST	OK	Yes	---	---	---
VWW335	W335	WTR	VW	WJ	7374 SOUTH 5490 WEST	OK	Yes	---	---	---
VWW336	W336	WTR	VW	WJ	7800 SOUTH 5250 WEST	G	Yes	---	---	---
VWW337	W337	WTR	VW	SJ	3564 WEST 11010 SOUTH	OK	Yes	---	---	---
VWW338	W338	WTR	VW	SJ	11000 SOUTH 3500 WEST - EAGLE RANCH	NU	Yes	---	---	---
VWW339	W339	WTR	VW	HM	12009 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW340	W340	WTR	VW	RV	634 WEST 14600 SOUTH - UTAH ROSES	OK	Yes	---	---	---
VWW341	W341	WTR	VW	EV	50 EAST 5050 SOUTH - MURRAY CITY	OK	Yes	---	---	---
VWW342	W342	WTR	VW	EV	30 EAST 5150 SOUTH - MURRAY FAIRGROUNDS	OK	Yes	---	---	---
VWS343	S343	WTR	VW	WJ	1300 WEST 7353 SOUTH	OK	Yes	Yes	---	---
VWS344	S344	WTR	VW	WJ	NORTH JORDAN CANAL 7560 S. 1200 W.	OK	---	Yes	---	---
VWW345	W345	WTR	VW	EV	10400 SOUTH 300 WEST	NU	Yes	---	---	---
VWW346	W346	WTR	VW	EV	PINE HOLLOW TREE FARM-7500 S. 720 E.	OK	Yes	---	---	---
VWW347	W347	WTR	VW	WJ	5060 SOUTH 1250 WEST	OK	Yes	---	---	---
VWW348	W348	WTR	VW	WJ	2906 WEST 7000 SOUTH	OK	Yes	---	---	---
VWK349	K349	WTR	VW	HC	KENNECOTT ENVIRONMENTAL RANCH	OK	Yes	---	---	---
VWS350	S350	WTR	VW	ED	EVAP PONDS #3, #4, #5	C	---	Yes	---	---
VWS351	S351	WTR	VW	EP	4000 W. POND	C	---	Yes	---	---
VWS352	S352	WTR	VW	EP	SOUTH EVAP PONDS	C	---	Yes	---	---
VWS353	S353	WTR	VW	CP	SMALL RESEROVIR	OK	---	Yes	---	---
VWS354	S354	WTR	VW	AN	TREATED MINE STREAM	C	---	Yes	---	---
VWS355	S355	WTR	VW	EC	NOSE & MINE COMBO STREAM	C	---	Yes	---	---
VWS356	S356	WTR	VW	EP	80 ACRE CLAY LINED POND	C	---	Yes	---	---
VWS357	S357	WTR	VW	TV	JORDAN RIVER EFF.	OK	---	Yes	---	---
VWS358	S358	WTR	VW	CO	CEMETARY POND	C	---	Yes	---	---
VWS359	S359	WTR	VW	??	HERCLUES EAGLE ROCK	OK	---	Yes	---	---
VWW360	W360	WTR	VW	WJ	5388 WEST 7800 SOUTH	OK	Yes	---	---	---
VWW361	W361	WTR	VW	WJ	5600 WEST 9000 SOUTH - W. JORDAN CITY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWW362	W362	WTR	VW	SJ	1340 WEST 11030 SOUTH	NU	Yes	---	---	---
VWW363	W363	WTR	VW	WJ	5595 WEST 9351 SOUTH - W. JORDAN CITY	OK	Yes	---	---	---
VWW364	W364	WTR	VW	EP	3892 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW365	W365	WTR	VW	EP	3864 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW366	W366	WTR	VW	RV	3807 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW367	W367	WTR	VW	RV	11723 SOUTH 3800 WEST	OK	Yes	---	---	---
VWW368	W368	WTR	VW	RV	3668 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW369	W369	WTR	VW	RV	11766 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW370	W370	WTR	VW	RV	11676 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW371	W371	WTR	VW	SJ	11630 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW372	W372	WTR	VW	HM	11887 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW373	W373	WTR	VW	HM	12090 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW374	W374	WTR	VW	HM	12211 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW375	W375	WTR	VW	HM	12210 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW376	W376	WTR	VW	HM	12256 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW377	W377	WTR	VW	HM	12260 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW378	W378	WTR	VW	HM	12299 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW379	W379	WTR	VW	HM	12311 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW380	W380	WTR	VW	HM	12395 SOUTH 4000 WEST	OK	Yes	---	---	---
VWW381	W381	WTR	VW	B4	8200 SOUTH 2150 WEST - W. JORDAN CITY	OK	Yes	---	---	---
VWW382	W382	WTR	VW	HM	12012 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW383	W383	WTR	VW	HM	12222 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW384	W384	WTR	VW	HM	12400 SOUTH 3600 WEST	NU	Yes	---	---	---
VWW385	W385	WTR	VW	HM	12464 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW386	W386	WTR	VW	HM	12554 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW387	W387	WTR	VW	WJ	6000 WEST 9350 SOUTH - W. JORDAN CITY	OK	Yes	---	---	---
VWW388	W388	WTR	VW	RV	11977 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW389	W389	WTR	VW	HM	12502 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW390	W390	WTR	VW	HM	12518 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW391	W391	WTR	VW	RV	12241 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW392	W392	WTR	VW	HM	11980 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW393	W393	WTR	VW	RV	12191 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW394	W394	WTR	VW	HM	12262 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW395	W395	WTR	VW	RV	12281 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW396	W396	WTR	VW	HM	12536 SOUTH 3600 WEST	OK	Yes	---	---	---
VWW397	W397	WTR	VW	RV	12750 SO. 2550 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW398	W398	WTR	VW	RV	13325 SO. 3600 W. - RIVERTON CITY	OK	Yes	---	---	---
VWW399	W399	WTR	VW	WJ	7322 SOUTH 5490 WEST	OK	Yes	---	---	---
VWS400	S400	WTR	VW		BINGHAM TUNNEL CULINARY WATER	C	---	Yes	---	---
VWK401	K401	WTR	VW		KMC - OLD RANCH	OK	Yes	---	---	---
VWW402	W402	WTR	VW	HM	13600 SOUTH 6000 WEST - (SLCWCD)	OK	Yes	---	---	---
VWW403	W403	WTR	VW	HM	13400 SOUTH 6000 WEST - (SLCWCD)	OK	Yes	---	---	---
VWK404		WTR	VW		SEE VWW404	OK	---	---	---	---
VWW404	W404	WTR	VW	HM	13055 SOUTH 7756 WEST	OK	Yes	---	---	---
VWK405		WTR	VW		SEE VWW405	OK	---	---	---	---
VWW405	W405	WTR	VW	HM	7198 WEST 13090 SOUTH	OK	Yes	---	---	---
VWW406	W406	WTR	VW		13200 SOUTH 7200 WEST (DANSIE)	OK	Yes	---	---	---
VWW407	W407	WTR	VW	HM	12800 SOUTH 7900 WEST (DANSIE)	OK	Yes	---	---	---
VWW408	W408	WTR	VW	HM	1166 WEST MAIN STREET (DANSIE)	OK	Yes	---	---	---
VWW409	W409	WTR	VW	HM	13500 SOUTH 7200 WEST (DANSIE)	OK	Yes	---	---	---
VWW410	W410	WTR	VW	HM	12875 SOUTH 6620 WEST (DANSIE)	OK	Yes	---	---	---
VWW411	W411	WTR	VW	HM	13025 SOUTH 6610 WEST (DANSIE)	OK	Yes	---	---	---
VWW412	W412	WTR	VW	HM	13710 SOUTH 7750 WEST (DANSIE)	OK	Yes	---	---	---
VWK413	W413	WTR	VW	BC	MODERNIZATION WELL #1 Middle	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
VWK414	W414	WTR	VW	BC	MODERNIZATION WELL #2 East	OK	Yes	---	---	---
VWW415	W415	WTR	VW	RV	2893 WEST 11800 SOUTH	OK	Yes	---	---	---
VWW416	W416	WTR	VW	RV	12064 SOUTH 2240 WEST	OK	Yes	---	---	---
VWW417	W417	WTR	VW	SJ	11563 SOUTH 2570 WEST	OK	Yes	---	---	---
VWW418	W418	WTR	VW	SJ	2917 WEST 10460 SOUTH	OK	Yes	---	---	---
VWW419	W419	WTR	VW	SJ	3192 WEST 10400 SOUTH	OK	Yes	---	---	---
VWW420	W420	WTR	VW	WJ	5950 WEST 8750 SOUTH - W. JORDAN CITY	OK	Yes	---	---	---
VWK421	K421	WTR	VW	BC	MODERNIZATION WELL #3 West	OK	Yes	---	---	---
NEL448	Well 11	WTR	NE	LS	Sec 21 Well #11	CERT	Yes	---	---	---
NET449D	NETL449D	WTR	NE	TL	Tailings Water	OK	Yes	---	---	---
TLT449A	DH911065C	WTR	NE	TL	Tailings Water	OK	---	---	---	Yes
TLT449B	DH911065B	WTR	NE	TL	Tailings Water	OK	---	---	---	Yes
TLT449C	DH911065A	WTR	NE	TL	Tailings Water	OK	---	---	---	Yes
TLT449E	NETL449P	WTR	NE	TL	Tailings Water	OK	---	---	---	Yes
RTC450	RTCN450	WTR	VW	MG	RITTER CANAL AT 8000 WEST	OK	---	Yes	---	---
RTC451		WTR	VW	MG	RITTER CANAL	OK	---	Yes	---	---
CLC452	CLCN452	WTR	VW	TL	CLARIFICATION CANAL NEAR 001 OUTFALL	OK	---	Yes	---	Yes
CSC453	CSCH453	WTR	VW	LS		OK	---	Yes	---	---
CSC454	CSCN454	WTR	VW	TL		OK	---	Yes	---	---
CSC455	CSCN455	WTR	VW	MO		OK	---	Yes	---	---
CSC456		WTR	VW	MO		OK	---	Yes	---	---
CSC457	CSCN457	WTR	VW	MO	WEST C-7 NORTH OF I-80	OK	---	Yes	---	---
KCS458	KCSW458	WTR	VW	LS	KERSEY CREEK AT 7800 WEST NORTH OF 201	OK	---	Yes	---	---
KCS459	KCSW459	WTR	VW	LS	KERSEY CREEK	OK	---	Yes	---	---
KCS460	KCSW460	WTR	VW	LS	KERSEY CREEK	OK	---	Yes	---	---
LCS461	LCSW461	WTR	VW	LS	LEE CREEK	OK	---	Yes	---	---
LCS462	LCSW462	WTR	VW	LS	LEE CREEK	OK	---	Yes	---	---
RSC463	RXCN463	WTR	VW	LS	WEST OF 5600 W. CANAL CROSSING LANDFILL	OK	---	Yes	---	---
LCS464	LCSW464	WTR	VW	MO	Lee Creek	OK	---	Yes	---	---
BDC465	BDCN465	WTR	VW	RC	EAST OF 7200 WEST AT BRIGHTON DRAIN CROS	OK	---	Yes	---	---
SZS466	SZSP466	WTR	VW	WT	SPITZ SPRINGS SOUTHEAST OF #4 P.S.	OK	---	Yes	---	---
RWC467	RWCN467	WTR	VW	NO	WEST SIDE OF RADIO STAT. ACCESS ~8900 W.	OK	---	Yes	---	---
LCS468	LCSW468	WTR	VW	NO	Lee creek	OK	---	Yes	---	---
LCS469	LCSW469	WTR	VW	GS	LEE CREEK	OK	---	Yes	---	---
ADS470	ADSP470	WTR	VW	TL	ADAMSON SPRING EAST OF #1 P.S. ROAD	OK	---	Yes	---	Yes
CWS471	CWSW471	WTR	VW	TL	C-7 WEST NORTH EAST OF GYPSTACK	OK	---	Yes	---	---
USC472	USCN472	WTR	VW	MG	UTAH/SALT LAKE CANAL S.E. 201 8100 W.	OK	---	Yes	---	---
CSC473	CSCN473	WTR	VW	LS	TWO WITH SAME NUMBER 473	OK	---	Yes	---	---
BDC474	BDCN474		VW		EAST END BRIGHTON DRAIN 7200 WEST CROSSI	OK	---	Yes	---	---
BDC474Z		WTR	VW	LS	OLD BIOWEST BDCN474. JAN95 PUT NEL474	OK	---	Yes	---	---
NEL476	Well 8	WTR	NE		Well #8	AB	Yes	---	---	---
NEL477	Well 9	WTR	NE	LS	WELL #9	OK	Yes	---	---	---
NEM478	Well 10	WTR	NE	TL	WELL #10	OK	Yes	---	---	---
NEM479	Well 12	WTR	NE	TL	WELL #12	OK	Yes	---	---	---
NEG481	GF1	WTR	NE	WT	GARFIELD WELL	OK	Yes	---	---	---
NEG482	GF2	WTR	NE	WT	GARFIELD WELL	OK	Yes	---	---	---
NEG483	GF3	WTR	NE	WT	GARFIELD WELL	OK	Yes	---	---	---
NEG484	GF4	WTR	NE	WT	GARFIELD WELL	OK	Yes	---	---	---
NEG485	GF5	WTR	NE	WT	GARFIELD WELL	AB	Yes	---	---	---
NEG486	GF6	WTR	NE	WT	GARFIELD WELL	AB	Yes	---	---	---
NEG487	GF7	WTR	NE	WT	GARFIELD WELL	AB	Yes	---	---	---
NEG488	GF6A	WTR	NE	WT	GARFIELD WELL	AB	Yes	---	---	---
NEG489	GF5(OLD)	WTR	NE	WT	GARFIELD WELL	C	Yes	---	---	---
NEG490	GF3(OLD)	WTR	NE	WT	GARFIELD WELL	C	Yes	---	---	---

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TABLE DC-1

APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BCG496		WTR	VW	BY	South end Adrian Brown Consultants	OK	Yes			
NET500A		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET500B		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET501A		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET501B		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET502A		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET502B		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET502C		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET503A		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET503B		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET504A		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET504B		WTR	NE	TL	Old tailings perimiter	AB	Yes	---	---	---
NET505	CHVR10A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET506	CHVR11A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET507	CHVR12A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET508	CHVR13A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET509	CHVR14A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET510	CHVR15A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET511	CHVR16A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET512	CHVR17A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET513	CHVR1A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET514	CHVR3A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET515	CHVR	WTR	NE	CH	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NET516	CHVR4A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET517	CHVR6A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET518	CHVR7A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET519	CHVR8A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET520	CHVR9A	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL521A	CH1A	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL521B	CH1B	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL522A	CH2A	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL522B	CH2B	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL523A	CH3A	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL523B	CH3B	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL523C	CH3C	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL524A	CH4A	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL524B	CH4B	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL525A	CH5A	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL525B	CH5B	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL526A	CH6A	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NEL526B	CH6B	WTR	NE	LS	CHEVRON MONITORING WELL	OK	Yes	---	---	---
NET527	CHVRP1	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET528	CHVRP2	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL529A	CH9A	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL529B	CH9B	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL529C	CH9C	WTR	NE	LS	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NET530	CHVRP3?	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL531A	CH11A	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL531B	CH11B	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL532A	CH12A	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL532B	CH12B	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL533A	CH13A	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL533B	CH13B	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL534A	CH14A	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NEL534B	CH14B	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL536A	CH16A	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL536B	CH16B	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NEL536C	CH16C	WTR	NE	LS	North End east of tailings impoundment	OK	Yes	---	---	---
NET537	CHVRP4	WTR	NE	CH	CHEVRON MONITORING WELL	AB	Yes	---	---	---
NEL538	MKLNDFA	WTR	NE	LS	MACKAY LANDFILL	OK	Yes	---	---	---
NEL539	MKLNDFB	WTR	NE	LS	MACKAY LANDFILL	OK	Yes	---	---	---
NEL540	MKLNDFC	WTR	NE	LS	MACKAY LANDFILL	OK	Yes	---	---	---
NEL541	A	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL542	B	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL543	C	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL544	D	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL545	E	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL546	F	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL547	G	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL548	H	WTR	NE	LS	COUNTY LANDFILL	AB	Yes	---	---	---
NEL549	I	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL550	J	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL551	K	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL552	L	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL553	M	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL554	N	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL555	O	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL556	P	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEL557	Q	WTR	NE	LS	COUNTY LANDFILL	OK	Yes	---	---	---
NEM558	MGOLFC	WTR	NE	MG	MAGNA GOLF COURSE	OK	Yes	---	---	---
NEM559		WTR	NE	MG		OK	Yes	---	---	---
NEM560		WTR	NE	MG		OK	Yes	---	---	---
NES567	Sec17E	WTR	NE	SL	SECTION 17-E	OK	Yes	---	---	---
NES568	Sec17W	WTR	NE	SL	SECTION 17-W	OK	---	Yes	---	---
NEL569	SEC16	WTR	NE	LS	SECTION 16	OK	Yes	---	---	---
NEM570	MGB1	WTR	NE	MG		OK	Yes	---	---	---
NEM571	MGB2	WTR	NE	MG		OK	Yes	---	---	---
NEM572	MGB3	WTR	NE	MG		OK	Yes	---	---	---
NEM573	MGB4	WTR	NE	MG		OK	Yes	---	---	---
NEM574	MGH1	WTR	NE	MG		OK	Yes	---	---	---
NEM575	MGH2	WTR	NE	MG		OK	Yes	---	---	---
NEM576	MGH3	WTR	NE	MG		OK	Yes	---	---	---
NEM577	MGH4	WTR	NE	MG		OK	Yes	---	---	---
NEM578	MGH5	WTR	NE	MG		OK	Yes	---	---	---
NEM579	MGH6	WTR	NE	MG		OK	Yes	---	---	---
NEM580	MGH7	WTR	NE	MG		OK	Yes	---	---	---
NEM581	MGH8	WTR	NE	MG		OK	Yes	---	---	---
NET582	MORT1	WTR	NE	MO	mortan salt	OK	Yes	---	---	---
NET583	OTH1	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET584	OTH2	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET585	OTH3	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET586		WTR	NE	NO			Yes	---	---	---
NET587	OTH5	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET588	OTH6	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET589	OTH7	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NET591	OTH9	WTR	NE	LS	ortho plant under tails	Abandon	Yes	---	---	---
NET592	OTH10	WTR	NE	MG	ortho plant under tails	Abandon	Yes	---	---	---
NET593	OTH11	WTR	NE	MG	ortho plant under tails	Abandon	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NET594	OTH12	WTR	NE	MG	ortho plant under tails	Abandon	Yes	---	---	---
NET595	OTH13	WTR	NE	MG	ortho plant under tails	Abandon	Yes	---	---	---
NET596	OTH14	WTR	NE	RC	ortho plant under tails	Abandon	Yes	---	---	---
NET597	OTH15	WTR	NE	NO	ortho plant under tails	Abandon	Yes	---	---	---
NEM601A	NEMG601A	WTR	NE	MG	North End (south of Rocks café)	OK	Yes	---	---	---
NEM601B	NEMG601B	WTR	NE	MG	North End (south of Rocks café)	OK	Yes	---	---	---
NED602A	NEDB602A	WTR	NE	TL	North end diving doard	OK	Yes	---	---	---
NED602B	NEDB602B	WTR	NE	TL	North end diving doard	OK	Yes	---	---	---
NEM603A	NEMG603A	WTR	NE	MG	North End near Dan Lewis' house	Abandon	Yes	---	---	---
NEM603B	NEMG603B	WTR	NE	MG	North End near Dan Lewis' house	Abandon	Yes	---	---	---
NEM603C	NEMG603C	WTR	NE	MG	North End near Dan Lewis' house	Abandon	Yes	---	---	---
NED604A	NEDB604A	WTR	NE	TL	North end diving doard	OK	Yes	---	---	---
NED604B	NEDB604B	WTR	NE	TL	North end diving doard	OK	Yes	---	---	---
NED605A	NEDB605A	WTR	NE	TL	North end diving doard	AB	Yes	---	---	---
NED605B	NEDB605B	WTR	NE	TL	North end diving doard	AB	Yes	---	---	---
NER606A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER606B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER607A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER607B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER608A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER608B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER609A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER609B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER610A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER610B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NEW611A		WTR	NE	WT	North end Tailings admin	AB	Yes	---	---	---
NEW611B		WTR	NE	WT	North end Tailings admin	AB	Yes	---	---	---
NEW612A		WTR	NE	WT	North end Tailings admin	OK	Yes	---	---	---
NEW612B		WTR	NE	WT	North end Tailings admin	OK	Yes	---	---	---
NEW613A		WTR	NE	WT	North end Tailings admin	OK	Yes	---	---	---
NEW613B		WTR	NE	WT	North end Tailings admin	OK	Yes	---	---	---
NEW614A		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW614B		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW615A		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW615B		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW616A		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW616B		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW617A		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NEW617B		WTR	NE	WT	North end waste water	OK	Yes	---	---	---
NES618A		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES618B		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES619A		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES619B		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES620A		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES620B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES621A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES621B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES622A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES622B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES623A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES623B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES624A		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES624B		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NEL625A	NET625A	WTR	NE	LS	North end near magna water	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NEL625B	NET625B	WTR	NE	LS	North end near magna water	OK	Yes	---	---	---
NET626A		WTR	NE	RC	North end tailings monitor well	OK	Yes	---	---	---
NET626B		WTR	NE	RC	North end tailings monitor well	OK	Yes	---	---	---
NET627A		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET627B		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET628A		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET628B		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET629A		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET629B		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET630A		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET630B		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NET630C		WTR	NE	MO	North end tailings monitor well	OK	Yes	---	---	---
NER631A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER631B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER632A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER632B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER633A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER633B		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NEA634A		WTR	NE	AR	North End Arthur	OK	Yes	---	---	---
NEA635A		WTR	NE	AR	North End Arthur	OK	Yes	---	---	---
NEA635B		WTR	NE	AR	North End Arthur	OK	Yes	---	---	---
NEA636A		WTR	NE	AR	North End Arthur	OK	Yes	---	---	---
NEM637A		WTR	NE	MC	North end east of central lab	OK	Yes	---	---	---
NEM638A	NET638A	WTR	NE	MG	North End monitor well near Mcdonalds	AB	Yes	---	---	---
NEM638B	NET638B	WTR	NE	MG	North End monitor well near Mcdonalds	AB	Yes	---	---	---
NEW639A		WTR	NE	WT	North end waste water (dead mans cave)	OK	Yes	---	---	---
NET640A		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET640B		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET641A		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET641B		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET642A		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET642B		WTR	NE	CH	Tailings impoundment monitor well	AB	Yes	---	---	---
NET643A		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET643B		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET644A		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET644B		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET645A		WTR	NE	MO	Tailings impoundment monitor well	OK	Yes	---	---	---
NET645B		WTR	NE	MO	Tailings impoundment monitor well	OK	Yes	---	---	---
NET645C		WTR	NE	MO	Tailings impoundment monitor well	OK	Yes	---	---	---
NET646A		WTR	NE	MO	Tailings impoundment monitor well	OK	Yes	---	---	---
NET646B		WTR	NE	MO	Tailings impoundment monitor well	OK	Yes	---	---	---
NET647A		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET647B		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET648A		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET648B		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET649A		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NET649B		WTR	NE	MO	Tailings impoundment monitor well	AB	Yes	---	---	---
NEM650A		WTR	NE	MC	North End monitor well near diving doard	OK	Yes	---	---	---
NEM651A		WTR	NE	MC	North End monitor well near diving doard	OK	Yes	---	---	---
NEM652A		WTR	NE	MC	North End monitor well near diving doard	OK	Yes	---	---	---
NEM653A		WTR	NE	MC	North end east of central lab	OK	Yes	---	---	---
NEA654A		WTR	NE	AR	North end east of central lab	OK	Yes	---	---	---
NER655A		WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NES656A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NET657A		WTR	NE	M0	Tailings impoundment	AB	Yes	---	---	---
NET657B		WTR	NE	M0	Tailings impoundment	AB	Yes	---	---	---
NEA658	PA1	WTR	NE	AR	North end piezo	OK	Yes	---	---	---
NEA659	PA2	WTR	NE	AR	North end piezo	OK	Yes	---	---	---
NEB660	PB1	WTR	NE	PC	North end piezo	AB	Yes	---	---	---
NEB661	PB2	WTR	NE	PC	North end piezo	OK	Yes	---	---	---
NEB662	PB3	WTR	NE	PC	North end piezo	AB	Yes	---	---	---
NEM663	PM1	WTR	NE	MC	North end piezo	OK	Yes	---	---	---
NER664	PR1	WTR	NE	RF	North end piezo	OK	Yes	---	---	---
NER665	PR2	WTR	NE	RF	North end piezo	OK	Yes	---	---	---
NES666	PS1	WTR	NE	SM	North end piezo	OK	Yes	---	---	---
NES667	PS2	WTR	NE	SM	North end piezo	B	Yes	---	---	---
NEM668	S1A	WTR	NE	MG	North end piezo	OK	Yes	---	---	---
NEM669	S2A	WTR	NE	MG	North end piezo	OK	Yes	---	---	---
NET670	S3A	WTR	NE	TL	North end piezo	OK	Yes	---	---	---
NET671	S4A	WTR	NE	TL	North end piezo	AB	Yes	---	---	---
NES672	B10W	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES673	B14W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES674	B15W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES675	B16W	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES676	B17W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES677	B20W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES678	B21W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES679	B22W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES680	B23W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES681	B24W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES682	B25W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES683	B26W	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES684	SH&B2A	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES685	TF-1	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES686	TF-2	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES687	TF-3	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES688	TF-4	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES689	TF-5	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES690	TF-6	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES691	TF-7	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES692	TF-LS1	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES693	LS-8	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES694A	LS-7	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES694B	LS-9	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES695A	AP-1	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES695B	AP-2	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES696	AP-3	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES697A	SC-1	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES697B	SC-2	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES698A	SC-3	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES698B	SC-4	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES699	SC-5	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES700	SW-1	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES701	SW-2	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES702	SW-3	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES703	SW-4	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES704	SW-5	WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES705A	SW-6	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NES705B	SW-7	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES706	SW-8	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES707A	AP-4	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES707B	AP-5	WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NER708	SW-8	WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER709	SW-8	WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER710A	SW-8	WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER710B	SW-8	WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NER711	SW-8	WTR	NE	RF	REFINERY MONITORING WELL	OK	Yes	---	---	---
NES712		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES713		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES714		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES715A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES715B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES716		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES718		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES719		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES720		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES721		WTR	NE	SM	SMELTER MONITORING WELL	AB	Yes	---	---	---
NES722		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NER723		WTR	NE	RF	Refinery MONITORING WELL	OK	Yes	---	---	---
NER724		WTR	NE	RF	Refinery MONITORING WELL	OK	Yes	---	---	---
NES725		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES726A		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
NES726B		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
SMP727		WTR	NE	SM	SMELTER INTERIM PROCESS WATER POND	OK	---	---	---	Yes
NES728		WTR	NE	SM	SMELTER PRODUCTION WELL	OK	Yes	---	Yes	---
NES729		WTR	NE	SM	SMELTER MONITORING WELL	OK	Yes	---	---	---
SMP730	Seep		NE	SM		OK	---	---	---	Yes
SMP731	Pump		NE	SM		OK	---	Yes	---	Yes
SMP732	West		NE	SM	WEST PROCESS POND (WEST CELL SUMP)	OK	---	Yes	---	Yes
SMP733	East		NE	SM	WEST PROCESS POND (EAST CELL SUMP)	OK	---	Yes	---	Yes
NEL815	V	WTR	NE		Salt lake county well	OK	Yes	---	---	---
NEL816	W	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL817	X	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL818	Y	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL821	R	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL822	S	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL823	T	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL824	U	WTR	NE	LS	Salt lake county well	OK	Yes	---	---	---
NEL825	BW-5A	WTR	NE	LS		OK	Yes	---	---	---
NEL826	BW-5B	WTR	NE	LS		OK	Yes	---	---	---
NEL827	BW-5C	WTR	NE	LS		OK	Yes	---	---	---
NEW828	BW-6A	WTR	NE	WT		OK	Yes	---	---	---
NEW829	BW-6B	WTR	NE	WT		OK	Yes	---	---	---
NEW830	BW-7A	WTR	NE	WT		OK	Yes	---	---	---
NEW831	BW-7B	WTR	NE	WT		OK	Yes	---	---	---
NET832	BW-8A	WTR	NE	MO		AB	Yes	---	---	---
NET833	BW-8B	WTR	NE	MO		AB	Yes	---	---	---
NET834	BW-8C	WTR	NE	MO		AB	Yes	---	---	---
NEL835	BW-4A	WTR	NE	LS		OK	Yes	---	---	---
NEL836	BW-4B	WTR	NE	LS		OK	Yes	---	---	---
NEL837	BW-4C	WTR	NE	LS		OK	Yes	---	---	---
NET838	BW-2A	WTR	NE	MO		OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NET839	BW-2B	WTR	NE	MO		OK	Yes	---	---	---
NET840	BW-2C	WTR	NE	MO		OK	Yes	---	---	---
NET841	BW-3A	WTR	NE	MO		OK	Yes	---	---	---
NET842	BW-3B	WTR	NE	MO		OK	Yes	---	---	---
NET843	BW-1A	WTR	NE	RC		OK	Yes	---	---	---
NET844	BW-1B	WTR	NE	RC		OK	Yes	---	---	---
NET845	BW-1C	WTR	NE	RC		OK	Yes	---	---	---
NET846	BW-9A	WTR	NE	NO		OK	Yes	---	---	---
NET847	BW-9B	WTR	NE	NO		OK	Yes	---	---	---
BCG848	BCG474	WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
BCG849	BCG475	WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
BCG850		WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
SRP850	SMRES	WTR	VW	SR	SMALL RESERVOIR	OK	---	---	---	Yes
BCG851A		WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
BCG851B		WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
SRP851	SMRESLLDS	WTR	VW	SR	SMALL RESERVOIR-leak detection sump	OK	---	---	---	Yes
BCG852		WTR	VW	BC	BARNEY CANYON MONITORING WELL	OK	Yes	---	---	---
SRP852	SMRESPRS	WTR	VW	SR	SMALL RESERVOIR-leak detection sump	OK	---	---	---	Yes
TLT860	NETL860	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT861	NETL861	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT862	NETL862	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT863	NETL863	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT864	NET864	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT865A	TLT865A	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT865B	TLT865B	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT865C	TLT865C	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT866	TLT866	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT867	TLT867	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT868	TLT868	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT869	TLT869	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT870	TLT870	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT871	TLT871	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT872	TLT872	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT873	TLT873	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT874	TLT874	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT875	TLT875	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT876	TLT876	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT877	TLT877	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT878	TLT878	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT879	TLT879	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT880	TLT880	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT881	TLT881	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT882	TLT882	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT883	TLT883	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT884	TLT884	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT885	TLT885	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT886	TLT886	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT887	TLT887	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT888	TLT888	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT889	TLT889	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT890	TLT890	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
LRP891	LRP0891	WTR	VW	LR	ZONE 1-LARGE RESERVOIR (SUMP NO. 1)	OK	---	---	---	Yes
LRP892	LRP0892	WTR	VW	LR	ZONE 1-LARGE RESERVOIR (SUMP NO. 2)	OK	---	---	---	Yes
LRP893	LRP0893	WTR	VW	LR	ZONE 1-LARGE RESERVOIR (SUMP NO. 3)	OK	---	---	---	Yes

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
LRP894	LRP0894	WTR	VW	LR	ZONE 1-LARGE RESERVOIR (SUMP NO. 4)	OK	---	---	---	Yes
LRP895	LRP0895	WTR	VW	LR	ZONE 1-LARGE RESERVOIR (SUMP NO. 5)	OK	---	---	---	Yes
LRP896	LRP0896	WTR	VW	LR	ZONE 1-LARGE RESERVOIR	OK	---	---	---	Yes
NEM897	NEM897	WTR	NE	MC	Magna area	OK	Yes	---	---	---
NEM898	NEM898	WTR	NE	MC	Magna area	OK	Yes	---	---	---
NEM899	NEM899	WTR	NE	MC	Magna area	OK	Yes	---	---	---
ECG900	ES900	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG901	ES901	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG902	EC902	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG903	EC903	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG904	EC904	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG905	EC905	WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG906		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG907		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG908		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG909		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
LRG910		WTR	VW	LR	LARGE RESERVOIR	OK	Yes	---	---	---
LRG911		WTR	VW	LR	LARGE RESERVOIR	OK	Yes	---	---	---
LRG912		WTR	VW	LR	LARGE RESERVOIR	OK	Yes	---	---	---
LRG914		WTR	VW	LR	LARGE RESERVOIR	OK	Yes	---	---	---
ECG915		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG916		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG917		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
COG918		WTR	VW	CO	COPPERTON CITY	OK	Yes	---	---	---
BRG919		WTR	VW	BR	BLUEWATER REPOSITORY	OK	Yes	---	---	---
BRG920		WTR	VW	BR	BLUEWATER REPOSITORY	OK	Yes	---	---	---
BRG921		WTR	VW	BR	BLUEWATER REPOSITORY	OK	Yes	---	---	---
ECG922		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG923		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG924		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG925		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG926		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG928		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
LTG929A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG929B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG930B		WTR	VW		LARK TAILINGS	OK	Yes	---	---	---
ECG931		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG932		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG933		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG934		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG935		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG936		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG937		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG938		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG939		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG940		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
SRG945		WTR	VW	SR	SMALL RESERVOIR	OK	Yes	---	---	---
SRG946		WTR	VW	SR	SMALL RESEROVIR	OK	Yes	---	---	---
COG947		WTR	VW	CO	COPPERTON CITY	OK	Yes	---	---	---
CPG950		WTR	VW	CP	CEMETERY POND	OK	Yes	---	---	---
B1G951	BIG951	WTR	VW	B1	BINGHAM CREEK SEGMENT #1	OK	Yes	---	---	---
ECG952		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
COZ971			VW	CO	DRYFORK	OK	---	---	---	---
COZ972			VW	CO	DRYFORK	OK	---	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
COZ973			VW	CO	GW UPGRADIENT OF PROPOSED CUMPS	OK	---	---	---	---
COZ974			VW	CO	DRYFORK	OK	---	---	---	---
COZ975			VW	CO	DRYFORK	OK	---	---	---	---
COZ976			VW	CO	DRYFORK	OK	---	---	---	---
COZ977			VW	CO	DRYFORK	OK	---	---	---	---
COZ978			VW	CO	DRYFORK	OK	---	---	---	---
COZ979			VW	CO	DRYFORK	OK	---	---	---	---
COZ980			VW	CO	DRYFORK	OK	---	---	---	---
COZ981			VW	CO	DRYFORK	OK	---	---	---	---
COZ982			VW	CO	DRYFORK	OK	---	---	---	---
COZ983			VW	CO	DRYFORK	OK	---	---	---	---
COZ984			VW	CO	DRYFORK	OK	---	---	---	---
COZ985			VW	CO	MELCO DUMP INFLUENCE	OK	---	---	---	---
COZ986			VW	CO	MELCO DUMP INFLUENCE	OK	---	---	---	---
COZ987			VW	CO	REGIONAL DRYFORK WATER LEVEL	OK	---	---	---	---
COG988			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG989			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG990A			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG990B			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG990C			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG991A			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG991B			VW	CO	LOWER DRYFORK	OK	---	---	---	---
COG992A			VW	CO	RANGE FRONT MONITORING	OK	---	---	---	---
COG992B			VW	CO	RANGE FRONT MONITORING	OK	---	---	---	---
COG993A			VW	CO	UPGRADIENT DRYFORK PUMPS	OK	---	---	---	---
COG993B			VW	CO	UPGRADIENT DRYFORK PUMPS	OK	---	---	---	---
COZ994			VW	CO	REGIONAL DRYFORK WATER LEVEL	OK	---	---	---	---
COG995A			VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
COG995B			VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
ECG996A		WTR	VW		BINGHAM CREEK/DRYFORK MONITORING	OK	Yes	---	---	---
ECG996B		WTR	VW		BINGHAM CREEK/DRYFORK MONITORING	OK	Yes	---	---	---
COG997A		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
COG997B		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
COG998A		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
COG998B		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	Yes	---	---	---
BRG999		WTR	VW	BR	BLUEWATER REPOSITORY	OK	Yes	---	---	---
CFG1001	CF#1		VW		CARR FORK	OK	Yes	---	---	---
CFG1002	CF#2		VW		CARR FORK	OK	Yes	---	---	---
CFG1003	CF#3		VW		CARR FORK	OK	Yes	---	---	---
CFG1004	CF#4		VW		CARR FORK	OK	Yes	---	---	---
CFS1005	BIG SPG		VW		CARR FORK	OK	---	Yes	---	---
CFS1006	AD TNL		VW		CARR FORK	OK	---	Yes	---	---
BMD1009	Pb & Cu	WSD	VW	BM	Freeman CLNRY TNK AFTER CHLOR	ACTIV	---	---	Yes	---
BMD1010	Pb & Cu	WSD	VW	BM	MINE 6290 OFFICE, JANITORS MOP SINK	Gone	---	---	Yes	---
BMD1011	Pb & Cu	WSD	VW	BM	MINE VISITOR CNTR, MENS ROOM BASIN	Gone	---	---	Yes	---
BMD1012	Pb & Cu	WSD	VW	BM	MINE 6290 OFFICE, MENS ROOM BASIN	Gone	---	---	Yes	---
BMD1013	Pb & Cu	WSD	VW	BM	MINE 6190 CHANGE HOUSE WASHROOM	ACTIV	---	---	Yes	---
BMD1014	Pb & Cu	WSD	VW	BM	MINE 6190 TRUCK SHOP FOREMENS RESTRM	Gone	---	---	Yes	---
BMD1015	Pb & Cu	WSD	VW	BM	MINE 6190 COPPERFIELD Tire shop SINK	ACTIV	---	---	Yes	---
BMD1016	Pb & Cu	WSD	VW	BM	MINE 6190 BULLGANG RESTROOM BASIN	Gone	---	---	Yes	---
BMD1017	Pb & Cu	WSD	VW	BM	MINE 6190 REDI ROOM MENS RSTRM BASIN	ACTIV	---	---	Yes	---
BMD1018	Pb & Cu	WSD	VW	BM	MINE 6190 REDI ROOM WOMN RSTRM BASIN	ACTIV	---	---	Yes	---
BMD1019	Pb & Cu	WSD	VW	BM	MINE 6190 OFFICE BLD LUNCH ROOM BASIN	ACTIV	---	---	Yes	---
BMD1020	Pb & Cu	WSD	VW	BM	MINE OFFICE BLD LADIES RSTROOM BASIN	ACTIV	---	---	Yes	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BMD1021	Pb & Cu	WSD	VW	BM	MINE CODE 80 MARKHAM SHOP SINK	ACTIV	---	---	Yes	---
BMD1022	Pb & Cu	WSD	VW	BM	MINE SAFETY OFFICE JANITORS MOP SINK	Gone	---	---	Yes	---
BMD1023	Pb & Cu	WSD	VW	BM	MINE DRYFORK SHOP FOREMEN RSTRM BASIN	Gone	---	---	Yes	---
BMD1024	Pb & Cu	WSD	VW	BM	MINE DRYFORK SHOP ELT FRMR RSTRM BASN	Gone	---	---	Yes	---
BMD1025	Pb & Cu	WSD	VW	BM	MINE DRYFORK WELDING SHOP WEST SINK	Gone	---	---	Yes	---
BMD1026	Pb & Cu	WSD	VW	BM	MINE DRYFORK ELCT OFF RST ARRA BASIN	Gone	---	---	Yes	---
BMD1027	Pb & Cu	WSD	VW	BM	MINE DRYFORK LINEMAN TRAILER BASIN	Gone	---	---	Yes	---
BMD1028	Pb & Cu	WSD	VW	BM	MINE DRYFORK DOZER LUNCH ROOM BASIN	Gone	---	---	Yes	---
BMD1029	Pb & Cu	WSD	VW	BM	MINE DRYFORK CAR LUNCH ROOM BASIN	Gone	---	---	Yes	---
ECD1030	Pb & Cu	WSD	VW	EC	MINE SAWS CONTROL ROOM MOP SINK	INACT	---	---	Yes	---
ECD1031	Pb & Cu	WSD	VW	EC	MINE SAWS FOREMAN WASHROOM BASIN	INACT	---	---	Yes	---
ECD1032	Pb & Cu	WSD	VW	EC	MINE SAWS JANITORS MOP SINK	INACT	---	---	Yes	---
ECD1033	Pb & Cu	WSD	VW	EC	MINE CAR WHACKER RESTROOM WASH BASIN	INACT	---	---	Yes	---
ECD1034	Pb & Cu	WSD	VW	EC	MINE COPPERTON TOWER RESTROOM BASIN	Gone	---	---	Yes	---
ECD1035	Pb & Cu	WSD	VW	EC	BARNEY TUNNEL CULINARY TNK AFTER CHLO	Gone	---	---	Yes	---
BMD1036	Pb & Cu	WSD	VW	BM	MINE SAFETY OFFICE RESTROOM BASIN	Gone	---	---	Yes	---
BMD1037	Pb & Cu	WSD	VW	BM	6190 admin.CNFRNCE RM KITCHEN SINK	ACTIV	---	---	Yes	---
BMD1038	Pb & Cu	WSD	VW	BM	6190 Admin WOMENS RESTROOM BASIN	ACTIV	---	---	Yes	---
BMD1039				BM	6190 Admin mens Rest Room	ACTIV	---	---	Yes	---
BMD1040				BM	6190 Admin Kitchen sink	ACTIV	---	---	Yes	---
PCD1041	Pb & Cu	WSD	NE	UPP	Power plant 3rd floor RR wash basin	ACTIV	---	---	Yes	---
PCD1045	Pb & Cu	WSD	NE	UPP	Power plant 5th floor RR wash basin	ACTIV	---	---	Yes	---
SMD1045	Pb & Cu	WSD	NE	SM	SMELTER ENVRNMNTL MONITORING CENTER	ACTIV	---	---	Yes	---
SMD1046	Pb & Cu	WSD	NE	SM	SMLTR #8 ACID REPAIR BLDG MOP SINK	ACTIV	---	---	Yes	---
SMD1047	Pb & Cu	WSD	NE	SM	SMLTR CHANGE HOUSE DOWNSTRS MOP SINK	ACTIV	---	---	Yes	---
SMD1048	Pb & Cu	WSD	NE	SM	SMLTR CNTRL WRHSE OUTSIDE TAP DOCK	ACTIV	---	---	Yes	---
SMD1049	Pb & Cu	WSD	NE	SM	SMLTR MECHANIC SHOP WASH BASIN	ACTIV	---	---	Yes	---
RFD1051	Pb & Cu	WSD	NE	RF	REFN ADMIN BLDG JANITORS RM MOP SINK	ACTIV	---	---	Yes	---
RFD1052	Pb & Cu	WSD	NE	RF	REFN MAINT SHOP FOREMAN RESTRM BASIN	ACTIV	---	---	Yes	---
RFD1053	Pb & Cu	WSD	NE	RF	REFN WAREHOUSE WASH BASIN	ACTIV	---	---	Yes	---
RFD1054	Pb & Cu	WSD	NE	RF	REFN MTC lunchroom sink	ACTIV	---	---	Yes	---
RFD1055	Pb & Cu	WSD	NE	RF	REFN BOILER PLT UPSTAIRS RESTRM SINK	ACTIV	---	---	Yes	---
LTD1056	Pb & Cu	WSD	SE	LT	IS&T mens rest room sink	ACTIV	---	---	Yes	---
LTD1057	Pb & Cu	WSD	SE	LT	Lark security office kicthen	ACTIV	---	---	Yes	---
LTD1058	Pb & Cu	WSD	SE	LT	Lark security outside womans rest room	ACTIV	---	---	Yes	---
LTD1059	Pb & Cu	WSD	SE	LT	Crusher re-locate office womans RR sink LARK	ACTIV	---	---	Yes	---
LTD1060	Pb & Cu	WSD	SE	LT	Lark contractor trailer kicthen sink	ACTIV	---	---	Yes	---
PCD1061	Pb & Cu	WSD	NE	PC	BNVL GRIND BLDG CONTROL ROOM RESTROOM	Gone	---	---	Yes	---
PCD1062	Pb & Cu	WSD	NE	PC	BNVL DUMP BLDG FURNACE ROOM MOP SINK	Gone	---	---	Yes	---
ARD1063	Pb & Cu	WSD	NE	AR	ARTHR CARPENTERS SHOP SHOWER	Gone	---	---	Yes	---
ARD1064	Pb & Cu	WSD	NE	AR	ARTHR ADMN BLDG FURNACE ROOM MOP SINK	Gone	---	---	Yes	---
WTD1065	Pb & Cu	WSD	NE	WT	GARFLD SECURITY RESTROOM WASH BASIN	ACTIV	---	---	Yes	---
ARD1066	Pb & Cu	WSD	NE	AR	ARTHR ADMN DOWNSTR WOMEN WASHRM BASIN	Gone	---	---	Yes	---
PCD1067	Pb & Cu	WSD	NE	PC	BNVL DUMPER BLDG CONTROL WASHROOM	Gone	---	---	Yes	---
SMD1068	Pb & Cu	WSD	NE	SM	SMLT #8 ACID FIELD REPAIR RSTRM BASIN	ACTIV	---	---	Yes	---
SMD1069	Pb & Cu	WSD	NE	SM	SMLT SAFETY OFFICE EXAM ROOM BASIN	ACTIV	---	---	Yes	---
SMD1070	Pb & Cu	WSD	NE	SM	SMLT ENVR OFFICE RESTROOM WASH BASIN	ACTIV	---	---	Yes	---
SMD1071	Pb & Cu	WSD	NE	SM	REFN ADMN BLDG MEN RESTROOM BASIN	ACTIV	---	---	Yes	---
MCD1073	Pb & Cu	WSD	NE	MC	MAGNA PIPE SHOP LUNCHROOM SINK	Gone	---	---	Yes	---
ARD1074	Pb & Cu	WSD	NE	AR	ARTHR CENTRAL SHOP RESTROOM WSH BASIN	Gone	---	---	Yes	---
SMD1075	Pb & Cu	WSD	NE	SM	SMLTR ENGINEERING KITCHEN SINK	ACTIV	---	---	Yes	---
LSD1078	Pb & Cu	WSD	NE	LS	SEC21 PUMP HOUSE COMBINED AFTER CHLOR	ACTIV	---	---	Yes	---
BYD1080	Pb & Cu	WSD	VW	BY	CPPRTN CONC CHNG HOUSE JAINITOR SINK	ACTIV	---	---	Yes	---
BYD1081	Pb & Cu	WSD	VW	BY	CPPRTN CONC PLANNING GROUP KITCHEN TAP	ACTIV	---	---	Yes	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BYD1082	Pb & Cu	WSD	VW	BY	CPPRTN CONC GRIND MILLWRGHT REST ROOM	ACTIV	---	---	Yes	---
BYD1083	Pb & Cu	WSD	VW	BY	CPPRTN CONC GRIND OPERATION KTCHN TAP	ACTIV	---	---	Yes	---
BYD1084	Pb & Cu	WSD	VW	BY	CPPRTN CONC MOLY PLT SYSTEM REST ROOM TAP	ACTIV	---	---	Yes	---
BYD1085	Pb & Cu	WSD	VW	BY	CPPRTN CONC GRIND ELECTRICL KTCHN TAP	ACTIV	---	---	Yes	---
BYD1086	Pb & Cu	WSD	VW	BY	CPPRTN CONC MET LAB KITCHEN SINK	ACTIV	---	---	Yes	---
BYD1087	Pb & Cu	WSD	VW	BY	CPPRTN CONC MOLY OPERATION KTCHN SINK	ACTIV	---	---	Yes	---
BYD1089	Pb & Cu	WSD	VW	BY	CPPRTN CONC RECORD CENTER RSTRM SINK	ACTIV	---	---	Yes	---
BYD1090		WSD	VW	BY	CPPRTN CONC CULINARY TANK AFTER CHLOR	ACTIV	---	---	Yes	---
ECG1092	BW#2	WTR	VW	EC	BARRIER WELL PW#2 IN BINGHAM CREEK	ABAND	Yes	---	---	---
ECG1093	BW#3	WTR	VW	EC	BARRIER WELL PW#3 IN BINGHAM CREEK	ABAND	Yes	---	---	---
RFD1094	Pb & Cu	WTR	NE	RF	Refinery PM building womans RR sink	ACTIV	---	---	Yes	---
SMD1095	Pb & Cu	WTR	NE		Smelter admin. 2nd floor day pay kicten	ACTIV	---	---	Yes	---
SMD1096	Pb & Cu	WTR	NE		Smelter EDX mens RR sink	ACTIV	---	---	Yes	---
SMD1097	Pb & Cu	WTR	NE		Smelter flash furnace 3rd floor RR sink	Activ	---	---	Yes	---
SMD1098	Pb & Cu	WTR	NE		Smelter filter plant maintenance Bldg. womans RR sink		---	---	Yes	---
ECG1100A		WTR	VW		BINGHAM CANYON MOUTH	OK	---	---	---	---
ECG1100B		WTR	VW		BINGHAM CANYON MOUTH	OK	---	---	---	---
MDG1101		WTR	VW		BINGHAM CREEK/DRYFORK MONITORING	OK	---	---	---	---
ECG1102		WTR	VW		BINGHAM CREEK ALLUVIAL	OK	---	---	---	---
ECG1103		WTR	VW		BINGHAM CREEK ALLUVIAL	OK	---	---	---	---
ECG1104		WTR	VW		BINGHAM CREEK ALLUVIAL	OK	---	---	---	---
ECG1105A		WTR	VW		BINGHAM CREEK ALLUVIAL	OK	---	---	---	---
ECG1105B		WTR	VW		BINGHAM CREEK BEDROCK	OK	---	---	---	---
ECG1106A		WTR	VW		BINGHAM CREEK BEDROCK	OK	---	---	---	---
ECG1106B		WTR	VW		BINGHAM CREEK BEDROCK	OK	---	---	---	---
COG1107A		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	---	---	---	---
COG1107B		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	---	---	---	---
ECG1108A		WTR	VW		BINGHAM CREEK/DRYFORK MONITORING	OK	---	---	---	---
ECG1108B		WTR	VW		BINGHAM CREEK/DRYFORK MONITORING	OK	---	---	---	---
COG1109A		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	---	---	---	---
COG1109B		WTR	VW	CO	LOWER DRYFORK MONITORING	OK	---	---	---	---
ECG1110A		WTR	VW		BINGHAM CREEK BEDROCK	OK	---	---	---	---
ECG1110B		WTR	VW		BINGHAM CREEK BEDROCK	OK	---	---	---	---
MDZ1111		WTR	VW		EASTSIDE DUMP GROUND WATER LEVEL	OK	---	---	---	---
COG1112A		WTR	VW	CO	COPPERTON ALLUVIAL	OK	---	---	---	---
COG1112B		WTR	VW	CO	COPPERTON ALLUVIAL	OK	---	---	---	---
ECG1113A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1113B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1113C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1114A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1114B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1115A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1115B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1115C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1115D		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1115E		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1116A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1116B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1116C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1117A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1117B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1117C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1118A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1118B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
ECG1118C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
BSG1119A		WTR	VW	BS	BASTIAN SINK	CB	Yes	---	---	---
BSG1119B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1119C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
B1G1120A		WTR	VW	B1	BINGHAM CREEK SEGMENT #1	OK	Yes	---	---	---
B1G1120B		WTR	VW	B1	BINGHAM CREEK SEGMENT #1	OK	Yes	---	---	---
B1G1120C		WTR	VW	B1	BINGHAM CREEK SEGMENT #1	OK	Yes	---	---	---
ECG1121A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1121B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1121C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
HMG1122A		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1122B		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1122C		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1123A		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1123B		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1123C		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
ECG1124A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1124B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1124C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
BSG1125A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1125B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1125C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
HMG1126A		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1126B		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1126C		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
LTG1127A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1127B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1127C		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
ECG1128A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1128B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1128C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
LTG1129A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1129B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1129C		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
BSG1130A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1130B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1130C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
ECG1131A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1131B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1131C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
BSG1132A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1132B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1132C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1133A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1133B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1133C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
HMG1134A		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1134B		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
HMG1134C		WTR	VW	HM	HERRIMAN	OK	Yes	---	---	---
BSG1135A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1135B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1135C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BFG1136A		WTR	VW	BS	BASTIAN FLATS	OK	Yes	---	---	---
BFG1136B		WTR	VW	BS	BASTIAN FLATS	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BFG1136C		WTR	VW	BS	BASTIAN FLATS	OK	Yes	---	---	---
BSG1137A		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1137B		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
BSG1137C		WTR	VW	BS	BASTIAN SINK	OK	Yes	---	---	---
LTG1138A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1138B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1138C		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1138D		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1138E		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1138F		WTR	VW	LT	LARK TAILINGS	AB	Yes	---	---	---
LTG1139		WTR	VW	LT	Clean water Well/LARK TAILINGS	OK	Yes	---	---	---
LTG1140A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1140B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1140C		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1140D		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1141A		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1141B		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
LTG1141C		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
ECG1142A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1142B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1142C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1143A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1143B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1143C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1144A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1144B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1144C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1145A		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1145B		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1145C		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
ECG1146		WTR	VW	EC	EASTSIDE COLLECTION	OK	Yes	---	---	---
LTG1147		WTR	VW	LT	LARK TAILINGS	OK	Yes	---	---	---
BSG1148A		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1148B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1148C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BCG1149A		WTR	VW			OK	Yes	---	---	---
BCG1149B		WTR	VW			OK	Yes	---	---	---
BCG1149C		WTR	VW			OK	Yes	---	---	---
BCG1150A		WTR	VW			OK	Yes	---	---	---
BCG1150B		WTR	VW			OK	Yes	---	---	---
BCG1150C		WTR	VW			OK	Yes	---	---	---
COG1151A		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1151B		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1151C		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1151D		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1152A		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1152B		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1152C		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
BSG1153A		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1153B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1153C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
WJG1154A		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1154B		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1154C		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BFG1155A		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1155B		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1155C		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1155D		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1155E		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1155F		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156A		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156B		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156C		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156D		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156E		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1156F		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
B2G1157A		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B2G1157B		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B2G1157C		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
BCG1158A		WTR	VW			OK	Yes	---	---	---
BCG1158B		WTR	VW			OK	Yes	---	---	---
BCG1158C		WTR	VW			OK	Yes	---	---	---
BCG1159		WTR	VW			OK	Yes	---	---	---
HMG1163A		WTR	VW	HM	Herriman area ground water	OK	Yes	---	---	---
HMG1163B		WTR	VW	HM	Herriman area ground water	OK	Yes	---	---	---
HMG1163C		WTR	VW	HM	Herriman area ground water	OK	Yes	---	---	---
RVG1164A		WTR	VW	RV	Herriman area ground water	AB	Yes	---	---	---
RVG1164B		WTR	VW	RV	Herriman area ground water	AB	Yes	---	---	---
RVG1164C		WTR	VW	RV	Herriman area ground water	OK	Yes	---	---	---
EPG1165A		WTR	VW	EP	Day break area	OK	Yes	---	---	---
EPG1165B		WTR	VW	EP	Day break area	OK	Yes	---	---	---
EPG1165C		WTR	VW	EP	Day break area	OK	Yes	---	---	---
EPG1166		WTR	VW	EP	Day break area	OK	Yes	---	---	---
LTG1167A		WTR	VW	LT	Day break area	OK	Yes	---	---	---
LTG1167B		WTR	VW	LT	Day break area	OK	Yes	---	---	---
LTG1167C		WTR	VW	LT	Day break area	OK	Yes	---	---	---
BFG1168A		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1168B		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1168C		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
WJG1169A		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1169B		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1169C		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1170A		WTR	VW	WJ	West Jordan ground water	AB	Yes	---	---	---
WJG1170B		WTR	VW	WJ	West Jordan ground water	AB	Yes	---	---	---
WJG1170C		WTR	VW	WJ	West Jordan ground water	AB	Yes	---	---	---
WJG1171A		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1171B		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
WJG1171C		WTR	VW	WJ	West Jordan ground water	OK	Yes	---	---	---
COG1172		WTR	VW	CO	Upper Dry Fork (PICNIC FLATS)	ok	Yes	---	---	---
COG1173A		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1173B		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1173C		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1174A		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1174B		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1174C		WTR	VW	CO	Upper Dry Fork	ok	Yes	---	---	---
COG1175A		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1175B		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---
COG1175C		WTR	VW	CO	south area ground water plume	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
B2G1176A		WTR	VW	B2	Bingham creek (south ground water	OK	Yes	---	---	---
B2G1176B		WTR	VW	B2	Bingham creek (south ground water	OK	Yes	---	---	---
B2G1176C		WTR	VW	B2	Bingham creek (south ground water	OK	Yes	---	---	---
BSG1177B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1177C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
COG1178A		WTR	VW	CO		OK	Yes	---	---	---
COG1178B		WTR	VW	CO		OK	Yes	---	---	---
COG1178C		WTR	VW	CO		OK	Yes	---	---	---
BSG1179A		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1179B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1179C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1180A		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1180B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1180C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
ECX1181		WTR					Yes	---	---	---
ECG1182A		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1182B		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1183A		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1183B		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1184		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1185		WTR	VW	EC	Copperton Channel Extraction Well	OK	Yes	---	---	---
ECG1186		WTR	VW	EC	Eastside collection monitoring	OK	Yes	---	---	---
ECG1187		WTR	VW	EC	East Side Collection	OK	Yes	---	---	---
ECG1188		WTR	VW	EC	East Side Collection	OK	Yes	---	---	---
ECG1189		WTR	VW	EC	East Side Collection	OK	Yes	---	---	---
ECG1190		WTR	VW	EC	East Side Collection	OK	Yes	---	---	---
LTG1191		WTR	VW	EC	Lark Tailings Area	OK	Yes	---	---	---
ECG1192		WTR	VW	EC	Dry Fork Extraction Well	OK	Yes	---	---	---
B2G1193	K 60	WTR	VW	B2	New well for well 60	OK	Yes	---	---	---
B2G1194A		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B2G1194B		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B2G1195A		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B2G1195B		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
BSG1196A		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1196B		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
BSG1196C		WTR	VW	BS	Bastian sink area (south area ground Water)	OK	Yes	---	---	---
B3G1197A		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B3G1197B		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
B3G1197C		WTR	VW		Bingham creek (south ground water	OK	Yes	---	---	---
BFG1198A		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1198B		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
BFG1198C		WTR	VW	BF	Bingham flat south of old hwy	OK	Yes	---	---	---
ECG1199B		WTR	WV	EC	Sonic Drilled Monitoring	OK	Yes	---	---	---
ECG1199A		WTR	VW	EC	Sonic drilled monitoring well	OK	Yes	---	---	---
ECG1199C		WTR	VW	EC	Sonic Drilled Well	OK	Yes	---	---	---
ECG1199D		WTR	VW	EC	Sonic drilled well	OK	Yes	---	---	---
ECG1199E		WTR	VW	EC	Sonic drilled well	OK	Yes	---	---	---
ECG1199F		WTR	VW	EC	Sonic drilled well	OK	Yes	---	---	---
ECG1199G		WTR	VW	EC	Sonic drilled well	OK	Yes	---	---	---
BFG1200	K109	WTR	VW		Bingham flat south of old hwy	OK	Yes	---	---	---
BSG1201		WTR	VW		Bastian sink area (south area ground Water)	OK	Yes	---	---	---
ECG1203		WTR	VW			OK	Yes	---	---	---
COG1204A		WTR	VW		south area ground water plume	OK	Yes	---	---	---
COG1204B		WTR	VW		south area ground water plume	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NET1300	NET1300	WTR	NE	CH	TAILINGS WATER	AB	Yes	---	---	---
NET1300B	NET1300	WTR	NE	CH	TAILINGS WATER	AB	Yes	---	---	---
NET1300C	NET1300	WTR	NE	CH	TAILINGS WATER	AB	Yes	---	---	---
CHT1301	CHT1301	WTR	NE	CH	TAILINGS WATER	OK	Yes	---	---	Yes
CHT1302	CHT1302	WTR	NE	CH	TAILINGS WATER	OK	Yes	---	---	Yes
CHT1303	CHT1303	WTR	NE	CH	TAILINGS WATER	OK	Yes	---	---	Yes
TLT1304	TLT891	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT1305	TLT892	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT1306	TLT893	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT1307	TLT894	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
TLT1308	TLT895	WTR	NE	TL	TAILINGS WATER	OK	---	---	---	Yes
NEL1309	MNN	WTR	NE	LS	TAILINGS WATER	OK	Yes	---	---	---
NEL1310	MNS	WTR	NE	LS	TAILINGS WATER	OK	Yes	---	---	---
NET1311	off morton	WTR	NE	MO	1 MILE W OF 7200 W ON ACCESS ROAD	OK	Yes	---	---	---
NEL1312	Well 15	WTR	NE	LS	ALIAS NEL474-NORTH END LANDFILL	OK	Yes	---	---	---
NEL1313	Well 14	WTR	NE	LS	ALIAS NEL475-NORTH END LANDFILL M	OK	Yes	---	---	---
LRP1314		WTR	VW	LR	ZONE II-LARGE RESERVOIR (SUMP NO. 1)	NEW	---	---	---	Yes
LRP1315		WTR	VW	LR	ZONE II-LARGE RESERVOIR (SUMP NO. 2)	NEW	---	---	---	Yes
LRP1316		WTR	VW	LR	ZONE II-LARGE RESERVOIR (SUMP NO. 3)	NEW	---	---	---	Yes
LRP1317		WTR	VW	LR	ZONE II-LARGE RESERVOIR (SUMP NO. 4)	NEW	---	---	---	Yes
LRP1318		WTR	VW	LR	ZONE II-LARGE RESERVOIR (SUMP NO. 5)	NEW	---	---	---	Yes
LRP1319		WTR	VW	LR	ZONE II-LARGE RESERVOIR	NEW	---	---	---	Yes
LRP1320		WTR	VW	LR	DESILTING BASIN #1-CHAMBER 1 (W POND)	NEW	---	---	---	Yes
LRP1321		WTR	VW	LR	DESILTING BASIN #2-CHAMBER 2 (N POND)	NEW	---	---	---	Yes
LRP1322		WTR	VW	LR	DESILTING BASIN #3-CHAMBER 3 (S POND)	NEW	---	---	---	Yes
NOG1323		WTR	NE	NO	WETLANDS PROJECT SOUTH WELL	OK	Yes	---	---	---
NOG1324		WTR	NE	NO	WETLANDS PROJECT CENTRAL WELL	OK	Yes	---	---	---
NOG1325	b1219aca1	WTR	NE	NO	WETLANDS PROJECT	OK	Yes	---	---	---
NOS1326		WTR	NE	NO	WETLANDS PROJECT NORTH POINT CONSOLIDA	OK	---	Yes	---	---
NOS1327		WTR	NE	NO	WETLANDS PROJECT BLACKHAWK POND	OK	---	Yes	---	---
NOS1328		WTR	NE	NO	WETLANDS PROJECT GOGGINS DRAIN	OK	---	Yes	---	---
ECS1329		WTR	VW	EC	BINGHAM CREEK, 1ST EMERGENCE OF WATER	OK	---	Yes	---	---
ECS1330		WTR	VW	EC	AMSTERDAM TUNNEL	OK	---	Yes	---	---
ECS1331		WTR	VW	EC	FREEMAN DUMP COLLECTION BOX	OK	---	Yes	---	---
ECS1332		WTR	VW	EC	LION HEAD GULCH COLLECTION BOX	OK	---	Yes	---	---
ECS1333		WTR	VW	EC	MARKHAM TUNNEL	OK	---	Yes	---	---
ECS1334		WTR	VW	EC	SMELTER GULCH COLLECTION BOX	OK	---	Yes	---	---
ECS1335		WTR	VW	EC	TIEWAUKEE COLLECTION BOX	OK	---	Yes	---	---
ECS1336		WTR	VW	EC	AMSTERDAM TUNNEL BOX	OK	---	Yes	---	---
SMP1337		WTR	NE	SM	SMELTER EAST PROCESS POND	OK	---	---	---	Yes
BFS1338		WTR	VW	BF	PROVO RESERVOIR CANAL-9000 S BING HWY	OK	---	Yes	---	---
EPS1339		WTR	VW	EP	PROVO RESERVOIR CANAL-10400 S 3800 W	OK	---	Yes	---	---
HMS1340		WTR	VW	HM	PROVO RESERVOIR CANAL-12300 S	OK	---	Yes	---	---
BDS1341		WTR	VW	BD	PROVO RESERVOIR CANAL-15100 S 3200 W	OK	---	Yes	---	---
WJS1342		WTR	VW	WJ	UTAH LAKE DIST CANAL-9000 S 3400 W	OK	---	Yes	---	---
SJS1343		WTR	VW	SJ	UTAH LAKE DIST CANAL-10400 S 2710 W	OK	---	Yes	---	---
RVS1344		WTR	VW	RV	UTAH LAKE DIST CANAL-12600 S	OK	---	Yes	---	---
BDS1345		WTR	VW	BD	UTAH LAKE DIST CANAL-14980 S 2200 W	OK	---	Yes	---	---
WJS1346		WTR	VW	WJ	UTAH & SALT LAKE CANAL-9000 S 2050 W	OK	---	Yes	---	---
SJS1347		WTR	VW	SJ	UTAH & SALT LAKE CANAL-10400 S 1300 W	OK	---	Yes	---	---
RVS1348		WTR	VW	RV	UTAH & SALT LAKE CANAL-12600 S	OK	---	Yes	---	---
BDS1349		WTR	VW	BD	UTAH & SALT LAKE CANAL-14645 S CAMP W	OK	---	Yes	---	---
WJS1350		WTR	VW	WJ	SOUTH JORDAN CANAL-9000 S 1800 W	OK	---	Yes	---	---
SJS1351		WTR	VW	SJ	SOUTH JORDAN CANAL-10420 S 1200 W	OK	---	Yes	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
RVS1352		WTR	VW	RV	SOUTH JORDAN CANAL-12600 S	OK	---	Yes	---	---
BDS1353		WTR	VW	BD	SOUTH JORDAN CANAL-14660 S 1690 W	OK	---	Yes	---	---
BYS1354	BCSPC	WTR	VW	BY	BARNEY'S CANYON PIT WTR TO COPPERTON	OK	---	Yes	---	---
BMS1355		WTR	VW	BM	CARR FORK EXHAUST SHAFT	OK	Yes	Yes	---	---
BMS1356		WTR	TV	CF	CARR FORK FRESH AIR SHAFT	OK	Yes	Yes	---	---
NOS1357		WTR	NE	NO	BHP CENTRAL (WETLANDS PROJECT)	OK	Yes	Yes	---	---
NOS1358		WTR	NE	NO	BHP EAST (WETLANDS PROJECT)	OK	Yes	Yes	---	---
WTS1359		WTR	NE	WT	CORRIGATED PIPE DISCHARGING TO SM RTN CL	OK	Yes	Yes	---	---
WTS1360		WTR	NE	WT	HDPE PIPE DISCHARGTING TO CANAL	OK	Yes	Yes	---	---
WTS1361		WTR	NE	WT	CORREGATED PIPE DISCHARGING TO CANAL	OK	Yes	Yes	---	---
WTS1362		WTR	NE	WT	DISCHARGE THROUGH DIKE	OK	Yes	Yes	---	---
NES1363		WTR	NE	SM	PRAXAIR O2 PLANT	OK	Yes	---	---	---
NES1364		WTR	NE	SM	PRAXAIR 0X PLANT	OK	Yes	---	---	---
NES1365		WTR	NE	SM	PRAXAIR O2 PLANT	OK	Yes	---	---	---
NES1366		WTR	NE	SM	PRAXAIR O2 PLANT	OK	Yes	---	---	---
NEM1367	ARTESIAN 1	WTR	NE	MG	ARTESIAN WELL - SECTION 21	OK	Yes	---	Yes	---
NEM1368	ARTESIAN 2	WTR	NE	MG	ARTESIAN WELL - SECTION 21	OK	Yes	---	Yes	---
MGD1369	SEC 21 ADT	WTR	NE	MG	PART OF ARETESIAN WELL SYSTEM - SEC 21	OK	---	---	Yes	---
WTS1370		WTR	NE	WT	CORRIGATED PIPE DISC TO SM RETURN CANAL	OK	---	Yes	---	---
WTS1371		WTR	NE	WT	CORRIGATED PIPE DISC TO SM RETURN CANAL	OK	---	Yes	---	---
SLS1372		WTR	NE	SL	SPRING DISH AFTER PASSING THRU CULVERT	OK	---	Yes	---	---
WTS1373		WTR	NE	WT	SPRING AT BASE OF OUTLET WORKS	OK	---	Yes	---	---
WTS1374		WTR	NE	WT	OLD UPDES DISCHARGE WEIR 006	OK	---	Yes	---	---
TLS1375		WTR	NE	TL		OK	---	Yes	---	---
NES1376		WTR	NE	SM	PRAXAIR O2 PLANT	OK	Yes	---	---	---
SLS1377		WTR	NE	SM	WEST POND-BRIDGE	OK	---	Yes	---	---
SLS1378		WTR	NE	SM	WEST POND - HAZLETON PUMP	OK	---	Yes	---	---
SLS1379		WTR	NE	SM	WEST POND - FENCE POST	OK	---	Yes	---	---
NET1380A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1380B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1381A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1381B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NEL1382A		WTR	NE	LS	ground water well (tailings area	OK	Yes	---	---	---
NEL1382B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NEL1382C		WTR	NE	LS	ground water well (tailings area	OK	Yes	---	---	---
NET1383A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1383B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1384A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1384B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1385A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1385B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1386A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1386B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NEM1387		WTR	NE	MG	Ground water well magna golf	OK	Yes	---	---	---
SMS1388		WTR	NE	SM	KESSLER CREEK NORTH	OK	---	Yes	---	---
SMS1389		WTR	NE	SM	SMELTER STROM DRAINAGE	OK	---	Yes	---	---
SMS1390		WTR	NE	SM	JAP SPRINGS NO. 1	OK	---	Yes	---	---
SMS1391		WTR	NE	SM	JAP SPRINGS NO. 2	OK	---	Yes	---	---
SMS1392		WTR	NE	SM	JAP SPRINGS NO. 3	OK	---	Yes	---	---
NET1393A		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
NET1393B		WTR	NE		ground water well (tailings area	OK	Yes	---	---	---
ARD1394		WTR	NE		New process lab drinking fountian	OK	---	---	Yes	---
ARD1395		WTR	NE		New process lab kitchen sink	OK	---	---	Yes	---
SMP1396		WTR	NE	SM	SMELTER WEST PROCESS POND - WEST CELL	OK	---	---	---	Yes

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
SMP1397		WTR	NE	SM	WEST PROCESS POND - EAST CELL	OK	---	---	---	Yes
SMP1398		WTR	NE	SM	EAST PRCOESS POND - NORTH CELL	OK	---	---	---	Yes
SMP1399		WTR	NE	SM	EAST PROCESS POND - SOUTH CELL	OK	---	---	---	Yes
SMP1400		WTR	NE	SM	EAST PROCESS POND - NORTH CELL SUMP	OK	---	---	---	Yes
SMP1401		WTR	NE	SM	EAST PROCESS POND - SOUTH CELL SUMP	OK	---	---	---	Yes
SMP1402		WTR	NE	SM	EAST PROCESS POND SUMP	OK	---	---	---	Yes
SMP1403		WTR	NE	SM	GRANULATION COOLING TOWER-LEAK DET. SUMP	OK	---	---	---	Yes
SMP1404		WTR	NE	SM	ACID PLANT COOLING TWR - LEAK DET. SUMP	OK	---	---	---	Yes
SMP1405		WTR	NE	SM	POWERHOUSE COOLING WATER BASIN	OK	---	---	---	Yes
SMP1406		WTR	NE	SM	ACID PLANT PUMPHOUSE-LEAK DETECTION SUMP	OK	---	---	---	Yes
SMP1407		WTR	NE	SM	POWERHOUSE PUMPHOUSE LEAK DETECTION SUMP	OK	---	---	---	Yes
SMP1408		WTR	NE	SM	GRANULATION PUMPHOUSE LEAK DETECT SUMP	OK	---	---	---	Yes
SMP1409		WTR	NE	SM	WATER JACKET PUMPHOUSE LEAK DETECT SUMP	OK	---	---	---	Yes
SMP1410		WTR	NE	SM	VEHICLE WASH LEAK DETECTION SUMP	OK	---	---	---	Yes
SMP1411		WTR	NE	SM	VEHICLE REPAIR SHOP LEAK DETECTION SUMP	OK	---	---	---	Yes
CFS1412		WTR	TV	CF	TROUT POND (BIG SPRINGS)	OK	---	Yes	---	---
CFS1413		WTR	TV	CF	CARR FORK DRAINAGE (PROPERTY LINE)	OK	---	Yes	---	---
NOG1414	b1219aca3	WTR	NE	NO	WETLANDS PROJECT	OK	Yes	---	---	---
NOG1415	b1219aca2	WTR	NE	NO	WETLANDS PROJECT	OK	Yes	---	---	---
MCP1416		WTR	NE	MC	Magna process water reservoir #3 ps infl	OK	---	---	---	Yes
BNP1417		WTR	NE	BN	BONNEVILLE PROCESS WATER RESERVOIR	OK	---	---	---	Yes
BNP1418		WTR	NE	BN	LAST CHANCE DITCH PUMP STATION - BONNEVI	OK	---	---	---	Yes
BNS1419		WTR	NE	BN	FINAL CATCH POND - BONNEVILLE (LV)	OK	---	Yes	---	---
PCP1420		WTR	NE	PC	POWER PLANT COOLING TOWER NO. 1	OK	---	---	---	Yes
PCP1421		WTR	NE	PC	POWER PLANT COOLING TOWER NO. 2	OK	---	---	---	Yes
PCP1422		WTR	NE	PC	POWER PLANT COOLING TOWER NO. 3	OK	---	---	---	Yes
PCP1423		WTR	NE	PC	POWER PLANT COOLING TOWER NO. 4	OK	---	---	---	Yes
PCP1424		WTR	NE	PC	POWER PLANT SERVICE STATION COOLING TWR	OK	---	---	---	Yes
MDP1425		WTR	VW	MD	MIDAS POND-LEACH WATER COLLECTION POND	OK	---	---	---	Yes
TLS1426	1	WTR	NE	TL	TPS #1 - TAILINGS POND SEEP	OK	---	Yes	---	---
TLS1427	2	WTR	NE	TL	TPS #2 - TAILINGS POND SEEP	DRY	---	yes	---	---
TLS1428	3	WTR	NE	TL	TPS #3 - TAILINGS POND SEEP	DRY	---	yes	---	---
TLS1429	4	WTR	NE	TL	TPS #4 - TAILINGS POND SEEP	DRY	---	yes	---	---
TLS1430	5	WTR	NE	TL	TPS #5 - TAILINGS POND SEEP	DRY	---	yes	---	---
TLS1431	6	WTR	NE	TL	TPS #6 - TAILINGS POND SEEP	OK	---	Yes	---	---
TLS1432	7	WTR	NE	TL	TPS #7 - TAILINGS POND SEEP	DRY	---	yes	---	---
TLS1433	8	WTR	NE	TL	TPS #8 - TAILINGS POND SEEP	Burried	---	yes	---	---
TLS1434	9	WTR	NE	TL	TPS #9 - TAILINGS POND SEEP	Burried	---	yes	---	---
TLS1435	10	WTR	NE	TL	TPS #10 - TAILINGS POND SEEP		---	yes	---	---
TLP1436		WTR	NE	TL	TOE COLLECTION DITCH NEAR 007 OUTFALL	OK	---	---	---	Yes
SMP1437		WTR	NE	SM	HYDROMET PLANT-LIME STORAGE AREA SUMP	OK	---	---	---	Yes
SMP1438		WTR	NE	SM	HYDROMET PLANT-LIME AREA SUMP	OK	---	---	---	Yes
SMP1439		WTR	NE	SM	HYDROMET PLANT-COPPER PRECIP. AREA SUMP	OK	---	---	---	Yes
SMP1440		WTR	NE	SM	HYDROMET PLANT-NAHS STORAGE AREA SUMP	OK	---	---	---	Yes
SMP1441		WTR	NE	SM	HYDROMET PLANT-ACID LEACH AREA SUMP	OK	---	---	---	Yes
SMP1442		WTR	NE	SM	HYDRO PL-BISMUTH PRECIP FILTER AREA SUMP	OK	---	---	---	Yes
SMP1443		WTR	NE	SM	HYDRO PLT-BISUMTH PRECIP THICKENER SUMP	OK	---	---	---	Yes
SMP1444		WTR	NE	SM	HYDROMET PLT-CU PRECIP FILTER AREA SUMP	OK	---	---	---	Yes
SMP1445		WTR	NE	SM	HYDROMET PLT-AS/CD PRECIP THICKENER SUMP	OK	---	---	---	Yes
SMP1446		WTR	NE	SM	HYDRO PLT-IRON PRECIP REACTOR AREA SUMP	OK	---	---	---	Yes
SMP1447		WTR	NE	SM	HYDRO PLT-REFINERY BLEEDS STORAGE SUMP	OK	---	---	---	Yes
SMP1448		WTR	NE	SM	HYDROMET PLANT-LIME SLAKING AREA SUMP	OK	---	---	---	Yes
SMP1449		WTR	NE	SM	HYDROMET PLANT-LIME UNLOADING AREA SUMP	OK	---	---	---	Yes
SMP1450		WTR	NE	SM	HYDROMET PLANT-CAUSTIC TANK AREA SUMP	OK	---	---	---	Yes

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
SMP1451		WTR	NE	SM	HYDRO PLT-SULFURIC ACID TRK UNLOAD SUMP	OK	---	---	---	Yes
SMP1453		WTR	NE	SM	HYDRO PLT-SODIUM BISULFATE TRUCK UNLOAD	OK	---	---	---	Yes
SMP1454		WTR	NE	SM	ANODE CASTING AREA-ANODE COOLING WATER	OK	---	---	---	Yes
SMP1455		WTR	NE	SM	NEW ACID PLANT-FSG AREA SUMP	OK	---	---	---	Yes
SMP1456		WTR	NE	SM	NEW ACID PLANT-FCG AREA SUMP	OK	---	---	---	Yes
SMP1457		WTR	NE	SM	NEW ACID PLANT-STRONG ACID AREA SUMP	OK	---	---	---	Yes
SMP1458		WTR	NE	SM	NEW ACID PLANT-ESP AREA SUMP	OK	---	---	---	Yes
PCP1459		WTR	NE	PC	POWER PLANT MAKEUP WATER STORAGE	OK	---	---	---	Yes
NEL1460		WTR	NE	LS	OLD ABANDONED WELL THAT WAS DUG UP	AB	Yes	---	---	---
SMP1461		WTR	NE	SM	GRANULATION CLARIFIER	OK	---	---	---	Yes
SMP1462		WTR	NE	SM	GRANULATION TANKS	OK	---	---	---	Yes
SMP1463		WTR	NE	SM	GRANULATION COOLING TOWER BASIN	OK	---	---	---	Yes
SMP1464		WTR	NE	SM	SLAG COOLING AREA (DRAINAGE TROUGH)	OK	---	---	---	Yes
SMP1465		WTR	NE	SM	POWERHOUSE COOLING BASIN-NONCONTACT SYS	OK	---	---	---	Yes
SMP1466		WTR	NE	SM	FRESH WATER RESERVOIRS (TWO WEST CELLS)	OK	---	---	---	Yes
SMP1467		WTR	NE	SM	SMELTER FIRE WATER POND	OK	---	---	---	Yes
NEL1468		WTR	NE	TL	3" Well Abandoned (landfill)	ABAND	---	---	---	---
TLP1469		WTR	NE	TL	Tailings toe drain	OK	---	---	---	Yes
NES1470		WTR	NE	SM	Old provo shoreline	OK	Yes	---	---	---
NER1471		WTR	NE	RF	Old provo shoreline	OK	Yes	---	---	---
NES1472A		WTR	NE	SM	SW corner of kessler cyn.	OK	Yes	---	---	---
NES1472B		WTR	NE	SM	SW corner of kessler cyn.	OK	Yes	---	---	---
SMP1473		WTR	NE	SM	East process pump collection	OK	---	---	---	Yes
BKG1474A		WTR	NE	BK	West side of black rk.cyn.	OK	Yes	---	---	---
BKG1474B		WTR	NE	BK	West side of black rk.cyn.	OK	Yes	---	---	---
BKG1474C		WTR	NE	BK	West side of black rk.cyn.	OK	Yes	---	---	---
NES1475A		WTR	NE	SM	kessler cyn. so. of landfill	OK	Yes	---	---	---
NES1475B		WTR	NE	SM	kessler cyn. so. of landfill	OK	Yes	---	---	---
BRP1476		WTR	VW	BR	Bluewater south rep. collection	OK	---	---	---	Yes
SMS1477		WTR	NE	SM	Smelter Slag Seep	OK	---	Yes	---	---
NEA1478		WTR	NE	AR	South of Arthur Central Shops	OK	Yes	---	---	---
NEA1479		WTR	NE	AR						
MCP1480	Fly Ash	EPA	NE	MC	FLY ASH DISPOSAL	OK	---	---	---	Yes
MCP1480A	Fly Ash	EPA	NE	MC	FLY ASH DISPOSAL -SOLIDS	OK	---	---	---	Yes
MCP1480S	Fly Ash	EPA	NE	MC	FLY ASH DISPOSAL -SOLIDS	OK	---	---	---	Yes
MCP1480T	Fly Ash	EPA	NE	MC	FLY ASH DISPOSAL -SOLIDS	OK	---	---	---	Yes
SMP1481	Slag Tails	EPA	NE	MC	SLAG TAILINGS	OK	---	---	---	Yes
SMP1481A	Slag Tails	EPA	NE	MC	SLAG TAILINGS -SOLIDS	OK	---	---	---	Yes
SMP1481S	Slag Tails	EPA	NE	MC	SLAG TAILINGS -SOLIDS	OK	---	---	---	Yes
SMP1481T	Slag Tails	EPA	NE	MC	SLAG TAILINGS -SOLIDS	OK	---	---	---	Yes
SMP1482		EPA	NE	MC	SMELTER HYDROMET TAILS	OK	---	---	---	Yes
SMP1482A		EPA	NE	MC	SMELTER HYDROMET TAILS-SOLIDS	OK	---	---	---	Yes
SMP1482S		EPA	NE	MC	SMELTER HYDROMET TAILS-SOLIDS	OK	---	---	---	Yes
SMP1482T		EPA	NE	MC	SMELTER HYDROMET TAILS-SOLIDS	OK	---	---	---	Yes
BCP1483		EPA	NE	MC	COPPERTAON TAILINGS	OK	---	---	---	Yes
BCP1483A		EPA	NE	MC	COPPERTAON TAILINGS-SOLIDS	OK	---	---	---	Yes
BCP1483S		EPA	NE	MC	COPPERTAON TAILINGS-SOLIDS	OK	---	---	---	Yes
BCP1483T		EPA	NE	MC	COPPERTAON TAILINGS-SOLIDS	OK	---	---	---	Yes
MCP1484		EPA	NE	MC	MAGNA TAILINGS	OK	---	---	---	Yes
MCP1484A		EPA	NE	MC	MAGNA TAILINGS-SOLIDS	OK	---	---	---	Yes
MCP1484S		EPA	NE	MC	MAGNA TAILINGS-SOLIDS	OK	---	---	---	Yes
MCP1484T		EPA	NE	MC	MAGNA TAILINGS-SOLIDS	OK	---	---	---	Yes
TLP1485		EPA	NE	MC	EAST CYCLONE UNDERFLOW	OK	---	---	---	Yes
TLP1485A		EPA	NE	MC	EAST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
TLP1485S		EPA	NE	MC	EAST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1485T		EPA	NE	MC	EAST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1486		EPA	NE	MC	EAST CYCLONE OVERFLOW	OK	---	---	---	Yes
TLP1486A		EPA	NE	MC	EAST CYCLONE OVERFLOW-SOLIDS	OK	---	---	---	Yes
TLP1486S		EPA	NE	MC	EAST CYCLONE OVERFLOW-SOLIDS	OK	---	---	---	Yes
TLP1486T		EPA	NE	MC	EAST CYCLONE OVERFLOW-SOLIDS	OK	---	---	---	Yes
TLP1487		EPA	NE	MC	WEST CYCLONE UNDERFLOW	OK	---	---	---	Yes
TLP1487A		EPA	NE	MC	WEST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1487S		EPA	NE	MC	WEST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1487T		EPA	NE	MC	WEST CYCLONE UNDERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1488		EPA	NE	MC	WEST CYCLONE OVERFLOW	OK	---	---	---	Yes
TLP1488A		EPA	NE	MC	WEST CYCLONE OVERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1488S		EPA	NE	MC	WEST CYCLONE OVERFLOW -SOLIDS	OK	---	---	---	Yes
TLP1488T		EPA	NE	MC	WEST CYCLONE OVERFLOW -SOLIDS	OK	---	---	---	Yes
SMP1489		WTR	NE	SM	Acid plant cooling tower	OK	---	---	---	Yes
NET1490		WTR	NE	TL	West of Arthur Stepback Repository	OK	Yes	---	---	---
NET1491		WTR	NE	TL	West of Arthur Stepback Repository	OK	Yes	---	---	---
NET1492		WTR	NE	TL	West of Arthur Stepback Repository	OK	Yes	---	---	---
NEW1495A		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NEW1495B		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NEW1495C		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NEW1496A		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NEW1496B		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NEW1496C		EPA	NE	WT	Between sludge pond A & 120ac. pond	OK	Yes	---	---	---
NES1497A		EPA	NE	SM	Between slag lagoon & 120ac. pond	OK	Yes	---	---	---
NES1497B		EPA	NE	SM	Between slag lagoon & 120ac. pond	OK	Yes	---	---	---
NES1498		EPA	NE	SM	Between slag lagoon & 120ac. pond	OK	Yes	---	---	---
NES1499		EPA	NE	SM	Between slag lagoon & 120ac. pond	OK	Yes	---	---	---
HMG1500		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1501		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1502		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1503		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1504		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1505		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1506		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1507		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1508		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1509		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1511		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1512		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1514		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1527		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1528		WTR	VW	RV	WELL INVENTORY	OK	Yes	---	---	---
RVG1532		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1535		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1536		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1537		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1539		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1540		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1546		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1547		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1548		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1550		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1551		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
RVG1553		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1555		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
BSG1560		WTR	VW	BS	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1569		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG1570		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1572		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1573		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1576		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1582		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1587		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1588		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1591		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1592		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1597		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1601		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1602		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1609		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1616		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1620		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1621		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1622		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1623		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1632		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1635		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1637		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1642		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1643		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1644		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1645		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1648		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1649		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1654		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1655		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1662		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1663		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1666		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1668		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1669		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1670		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1677		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1679		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1684		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1687		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1688		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
EPG1689		WTR	VW	EP	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1691		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1694		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1698		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1699		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1700		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1708		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1717		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1718		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1719		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
RVG1726		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1729		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1730		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1733		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1736		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1740		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1744		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1748		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1753		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1765		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1768		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1773		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1775		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1777		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1781		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1782		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1788		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1790		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1793		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1798		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1802		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
B4G1803		WTR	VW	B4	SJ WELL INVENTORY	OK	Yes	---	---	---
SJG1808		WTR	VW	SJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1811		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1815		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1828		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1833		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1840		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1843		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1851		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1853		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG1856		WTR			Herriman irrigation well	OK	yes	---	---	---
WJG1866		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1952		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1957		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1961		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1963		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1968		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1969		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1974		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1976		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1977		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1979		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG1985		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1986		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG1989		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG1992		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1994		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1996		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
RVG1997		WTR	VW	RV	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG1998		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG1999		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2000		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG2000		WTR	VW	WJ		OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BDG2001		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2002		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2005		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2006		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2009		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2016		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2017		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2018		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2019		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG2020		WTR	VW	WJ	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2025		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2026		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2027		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2028		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2029		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2032		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2034		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2035		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2036		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2038		WTR	VW	HM		OK	Yes	---	---	---
HMG2038		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2039		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2040		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2041		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2042		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2043		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2044		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2046		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2047		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2051		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2052		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2053		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2055		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2056		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2057		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2058		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2061		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2062		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2063		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2064		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2065		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2066		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2067		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2068		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2070		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2071		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2072		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2073		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2074		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2076		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2077		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2078		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2079		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2080		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
HMG2081		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2082		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2083		WTR	VW	20	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2084		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2085		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2086		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2087		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2088		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2090		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2093		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2094		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2095		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2097		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2098		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2099		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2100		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2101		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2103		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2105		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2106		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2107		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2108		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2109		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2110		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2111		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2112		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2113		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2114		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2115		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2116		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2117		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2118		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2119		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2120		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2122		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2123		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2124		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2127		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2129		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2130		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2131		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2133		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2135		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2136		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2137		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2138		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2139		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2140		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2141		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2142		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2143		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2144		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2145		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2147		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
HMG2148		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2149		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2151		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2157		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2160		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2162		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2164		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2168		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2170		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2171		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2172		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2175		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2177		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2178		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2180		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2182		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2183		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2198		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2199		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2205		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2211		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2213		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2214		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2215		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2216		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
BDG2218		WTR	VW	BD	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2222		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2225		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2227		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2230		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2231		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2232		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2233		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2234		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2239		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2241		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2242		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2248		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
JRG2253		WTR	VW	JR	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2257		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2259		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2276		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2284		WTR	VW	EV	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2301		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2302		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2303		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2304		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2307		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2309		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2310		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2311		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2313		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2314		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2315		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
SOG2317		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2318		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2319		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2320		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2321		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
SOG2322		WTR	VW	SO	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2323		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2326		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2327		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2328		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2329		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2330		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2331		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2332		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2333		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2335		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2336		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2337		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2339		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2340		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2341		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2344		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2345		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2346		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2348		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2349		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2350		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2353		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2355		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2356		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2359		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2360		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2361		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2362		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2363		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2364		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2367		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2370		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2371		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2372		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
HMG2373		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2385		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2387		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2388		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2391		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2395		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG2401		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
EVG2403		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
WJG2412		WTR	VW	HM	SJ WELL INVENTORY	OK	Yes	---	---	---
TLT2452	Relief wel	WTR			Dewatering well near east cyclone pad	OK	Yes	---	---	Yes
TVS2514		EPA	NE	TL	Mud Flat in Tooele County	OK	Yes	Yes	---	---
TVS2515		EPA	NE	TV	Fishing Creek in Tooele County at Termin	OK	Yes	Yes	---	---
TVS2516		EPA	NE	TV	Six Mile Creek in Tooele County at Termi	OK	Yes	Yes	---	---
BES2517		EPA	NE	BE	Bear River in Box Elder Co. near Terminu	OK	Yes	Yes	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BES2518		EPA	NE	BE	Weber River in Box Elder Co. @ Terminus	OK	Yes	Yes	---	---
DVS2519		EPA	NE	DV	Pond east of Farmington Bay, North bank	OK	Yes	Yes	---	---
DVS2520		EPA	NE	DV	Oil Drain near refinery in Davis Co.	OK	Yes	Yes	---	---
DVS2521		EPA	NE	DV	Jordan River @ Redwood Rd.	OK	Yes	Yes	---	---
LSC2522		EPA	NE	LS	Lee Creek @ 13th South.	OK	Yes	Yes	---	---
TVS2524		EPA	NE	TV	Timpie springs pond inlet	OK	Yes	Yes	---	---
TVS2525		EPA	NE	TV	Timpie springs pond on the west side	OK	Yes	Yes	---	---
TVS2526		EPA	NE	TV	Timpie Springs, small pool north of pond	OK	Yes	Yes	---	---
TVS2527		EPA	NE	TV	Drainage, north of Timpie Spring pond	OK	Yes	Yes	---	---
TVS2528		EPA	NE	TV	Timpie Springs, Northeast bank of pond	OK	Yes	Yes	---	---
TVS2529		EPA	NE	TV	Mill Pond in Tooele County South of I-80	OK	Yes	Yes	---	---
USC2530		EPA	NE	US	Utah Salt Lake canal at 3500 south	OK	Yes	Yes	---	---
SLP2531		EPA	NE	SL	Main line to smelter from s17 ps, fm val	OK	Yes	---	---	Yes
SMP2532		EPA	NE	SM	Hazelton pump discharge at return canal	OK	Yes	---	---	Yes
MCP2533		EPA	NE	MC	#1 pumpstat. discharge at magna reservoi	OK	---	---	---	Yes
MCP2534		EPA	NE	MC	#4 pump station. discharge at magna reservoi	OK	---	---	---	Yes
BYP2535A		EPA	NE	BY	tailings collection box NP6?	removed	---	---	---	Yes
MCP2536		EPA	NE	MC	Copp tails at drop box, above Arthur	OK	---	---	---	Yes
MCP2536A		tails	NE		Copperton tails at splitter box	OK	---	---	---	yes
BYP2537		EPA	NE	BY	31.5" mine H2O discharge @ copp tail dis	OK	---	---	---	Yes
BYP2538		EPA	NE	BY	WDPS discharge @ copp. NP5	OK	---	---	---	Yes
NOS2539		EPA	NE	NO	South A pond on mitigation site	OK	---	Yes	---	---
NOS2540		EPA	NE	NO	South B pond on mitigation site	OK	---	Yes	---	---
NOS2541		EPA	NE	NO	West A pond on mitigation site	OK	---	Yes	---	---
NOS2542		EPA	NE	NO	West B pond on mitigation site	OK	---	Yes	---	---
CFG2543		EPA	TV	CF	Carr Fork Production Shaft	OK	Yes	---	---	---
WTP2544	WWTPefflue	EPA	NE	WT	Waste Water Treatment Plant effluent	OK	---	---	---	Yes
NER2545A		EPA	NE	RF	South of Refinrey East of EP pond	OK	Yes	---	---	---
NER2545B		EPA	NE	RF	South of Refinrey East of EP pond	OK	Yes	---	---	---
NER2546A		EPA	NE	RF	Refinry, South of PM building	OK	Yes	---	---	---
NER2546B		EPA	NE	RF	Refinry, South of PM building	OK	Yes	---	---	---
NER2546C		EPA	NE	RF	Refinry, South of PM building	OK	Yes	---	---	---
NER2547		EPA	NE	RF	Refinery, West of PM building	OK	Yes	---	---	---
NER2548		EPA	NE	RF	Refinry, Garfield Townsite	OK	Yes	---	---	---
NER2549A		EPA	NE	RF	North of refinery near highway 201	OK	Yes	---	---	---
NER2549B		EPA	NE	RF	North of refinery near highway 201	OK	Yes	---	---	---
CFS2550	Adamsontun	WTR	TV	CF	Adamson Tunnel Portal, Pine Canyon	OK	---	Yes	---	---
RVG2551	Riverton C	WTR	RV	VW	Rivert city well at 13760 so. 3250 we. h	OK	Yes	---	Yes	---
WTS2552	smel ret c	WTR	NE	WT	Smelter Return Canal @ Hwy 202	OK	Yes	Yes	---	---
NER2553		WTR	NE	RF	Fromer Garfield townsite south end	OK	Yes	---	---	---
NER2554A		WTR	NE	RF	Fromer Garfield townsite south end	OK	Yes	---	---	---
NER2554B		WTR	NE	RF	Fromer Garfield townsite south end	OK	Yes	---	---	---
SMP2555	Slag crush		NE	SM	Drainage on north east corner of slag cr	OK	Yes	---	---	Yes
NES2556	slag crush	WTR	NE	SM	WELL on north east corner of slag cr	OK	Yes	---	---	---
TLP2558	W C-7 ditc	WTR	NE	TL	West C-7 ditch northeast of #4 pumpstati	OK	---	---	---	Yes
NOS2559	We Cul C-7	WTR	NE	NO	West Culvert (C-7 ditch) Northeast I-80	OK	---	Yes	---	---
ADS2560	Adamson No	WTR	NE	AD	Adamson Spring North Sump (Gland seal H2O)	OK	---	Yes	---	---
ADS2561	Adamson So	WTR	NE	AD	Adamson Spring South Sump	OK	---	Yes	---	---
ECP2562	Cutoff Wal	WTR	VW	EC	Bingham Cutoff Wall	OK	---	---	---	Yes
NOS2563	Wetlands M	WTR	NE	NO	South West Pond-South Outlet	OK	---	Yes	---	---
NOS2564	Wetlands M	WTR	NE	NO	South West Pond-West Outlet	OK	---	Yes	---	---
NOS2565	Wetlands M	WTR	NE	NO	East Pond-Outlet	OK	---	Yes	---	---
NOS2566	Wetlands M	WTR	NE	NO	North West Pond-West Outlet	OK	---	Yes	---	---
NOS2567	Wetlands M	WTR	NE	NO	North West Pond-North Outlet	OK	---	Yes	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NOS2568	Wetlands M	WTR	NE	NO	South Goggin-Outlet	OK	---	Yes	---	---
NEW2569A		WTR	NE	WT	North of Kessler Springs	OK	Yes	---	---	---
NEW2569B		WTR	NE	WT	North of Kessler Springs	OK	Yes	---	---	---
NEW2569C		WTR	NE	WT	North of Kessler Springs	OK	Yes	---	---	---
NEW2570		WTR	NE	WT	North of Kessler Springs	OK	Yes	---	---	---
BMG2571	North Ore	WTR	VW	BM	Mine-North Ore Shoot	OK	Yes	---	---	---
ECP2572			EC		RO concentrate	OK	---	---	---	Yes
BYP2573			SE	BY		OK	---	Yes	---	Yes
NES2574		WTR	NE	SM	REPLACEMENT FOR WELL NES620A	OK	Yes	---	---	---
TLT2575A		WTR	NE	TL	South east corner of the Tailing Impound	OK	Yes	---	---	---
TLT2575B		WTR	NE	TL	South east corner of the Tailing Impound	OK	Yes	---	---	---
PCG2576		WTR	PC	PC	West of Bonneville Gate	OK	Yes	---	---	---
WTS2577		WTR	NE	WT	Kessler Springs	OK	---	Yes	---	---
WTS2578		WTR	NE	WT	wetlands drain to outfall 008	---	---	---	---	---
WTS2579		WTR	NE	WT	side channel discharge to outfall 008	---	---	---	---	---
WTS2580	No name spring	WTR	NE		side channel discharge into smelter return canal near praxair	OK		YES		
CFG2581	Bingham W	WTR	TV	CF	Bingham West Dip Tun	OK	Yes	---	---	---
TVS2582		WTR	CF	TV	Factory Creek Spng S	OK	---	---	---	Yes
TVS2583		WTR	CF	TV	Factory Creek Spng N	OK	---	---	---	Yes
BNP2584		WTR	NE		Bonneville first chance pump ststion	gone	---	---	---	Yes
BNP2585		WTR	NE		Bonneville last chance pond	gone	---	---	---	Yes
PCP2586		WTR	NE		old power house cooling tower	gone	---	---	---	Yes
MCP2587		WTR	NE		Magna flotation plant	gone	---	---	---	Yes
NES2589		WTR	NE			OK	Yes	---	---	---
NES2590		WTR	NE		smelter parking lot arsnic well (grab sample)	OK	Yes	---	---	---
WTS2591		WTR	NE		Spitz spring (base of dead mans cave)	OK	yes	---	---	---
WTS2592		WTR	NE		Jones spring (east of SR 202)	OK	yes	---	---	---
TLP2593A		EPA	NE		New pond west point discharge	OK	---	---	---	Yes
TLP2593S		EPA	NE		New pond west point discharge	OK	---	---	---	Yes
TLP2593T		EPA	NE		New pond west point discharge	OK	---	---	---	Yes
NER2594		WTR	NE	RF	North of sewage plant 300 yards	OK	Yes	---	---	---
NER2595		WTR	NE	OK	North of sewage plant 300 yards	ok	yes	---	---	---
NET2596		WTR	NE		Tailings pond dewatering well TLT449C replacement	OK	Yes	---	---	---
ECP2599		WTR	VW		combined acid wells pipeline	OK	---	---	---	Yes
HMG2600		WTR	VW		12828 So. 4400 W. (A. Johnson)	OK	---	---	Yes	---
ECP2601		WTR	VW	EC	Queens Cut-off Wall	OK	---	---	---	Yes
ECP2603		WTR	VW	EC	Olsen Cut-off Wall	OK	---	---	---	Yes
ECP2605		WTR	VW	EC	Butterfield 1 Cut-off Wall	OK	---	---	---	Yes
ECP2606		WTR	VW	EC	Castro Flume	OK	---	---	---	Yes
ECP2612		WTR	VW	EC	South Saints Rest Cut-off Wall	OK	---	---	---	Yes
ECP2614		WTR	VW	EC	Saints Rest Cut-off Wall	OK	---	---	---	Yes
ECP2616		WTR	VW	EC	Yosemite Cut-off Wall	OK	---	---	---	Yes
ECP2618A		WTR	VW	EC	Copper Flume east side collection	OK	---	---	---	Yes
ECP2618B		WTR	VW	EC	Copper Flume east side collection	OK	---	---	---	Yes
ECP2624A		WTR	VW	EC	North Copper Flume east side collection	OK	---	---	---	Yes
ECP2624B		WTR	VW	EC	North Copper Flume east side collection	OK	---	---	---	Yes
ECP2627A		WTR	VW	EC	Lost Creek Flume east side collection	OK	---	---	---	Yes
ECP2627B		WTR	VW	EC	Lost Creek Flume east side collection	OK	---	---	---	Yes
ECP2629A		WTR	VW	EC	Keystone Flume east side collection	OK	---	---	---	Yes
ECP2629B		WTR	VW	EC	Keystone Flume east side collection	OK	---	---	---	Yes
ECP2631		WTR	VW	EC	Mascott Tunnel	OK	---	---	---	Yes
LWP2632		WTR	VW	LW	Bingham Tunnel	OK	---	---	---	Yes
ECP2648A		WTR	VW	EC	North Keystone Flume east side collection	OK	---	---	---	Yes
ECP2648B		WTR	VW	EC	North Keystone Flume east side collection	OK	---	---	---	Yes

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
ECP2651		WTR	VW	EC	Crapo Flume	gone	---	---	---	Yes
ECP2651A		WTR			Crapo east side collection	OK	---	---	---	Yes
ECP2651B		WTR			Crapo east side collection	OK	---	---	---	Yes
ECP2654A		WTR	VW	EC	South Conger 1&2 Flume east side collection	OK	---	---	---	Yes
ECP2654B		WTR	VW	EC	South Conger 1&2 Flume east side collection	OK	---	---	---	Yes
ECP2662A		WTR	VW	EC	Conger 1&2 Flume east side collection	OK	---	---	---	Yes
ECP2662B		WTR	VW	EC	Conger 1&2 Flume east side collection	OK	---	---	---	Yes
ECP2663		WTR			Old Bingham Tunnel at portal surface	OK	---	---	---	Yes
ECP2664		WTR	VW	EC	Old Bingham Tunnel collection box	OK	---	---	---	Yes
ECP2668		WTR	VW	EC	Midas 2 Flume	OK	---	---	---	Yes
ECP2670		WTR	VW	EC	Midas 1 Flume	OK	---	---	---	Yes
ECP2674		WTR	VW	EC	Bluewater 3 Flume	OK	---	---	---	Yes
MDP2679		WTR	VW	MD	Bluewater 1 Flume @ dump toe	OK	---	---	---	Yes
ECP2682		WTR	VW	EC	Bluewater 1/2 Collection Box	OK	---	---	---	Yes
ECP2689		WTR	VW	EC	Dry Fork Tunnel	OK	---	---	---	Yes
COP2701		WTR	VW		Midvalley well	OK	Yes	---	---	---
ECP2709		WTR	VW	EC	Bluewater 2 Flume	OK	---	---	---	Yes
ECP2710		WTR	VW	EC	5490 Tunnel	OK	---	---	---	Yes
BMP2711		WTR				OK	---	---	---	Yes
BMP2712		WTR	VW	EC	Utah Metals Tunnel Pit	OK	---	---	---	Yes
TVP2713		WTR	TV	BM	Utah Metals Tunnel Middle Cny.	OK	---	---	---	Yes
LWP2714		WTR	VW	LW	Lark Tunnel	OK	Yes	---	---	Yes
ECS2715		WTR	VW	EC	Butterfield 1 Seep	OK	---	Yes	---	---
ECS2716		WTR	VW	EC	Upper Keystone Seep	gone	---	Yes	---	---
LWS2717		WTR	VW	LW	Lower Keystone Seep	OK	---	Yes	---	---
ECS2718		WTR	VW	EC	Crapo Seep	gone	---	Yes	---	---
ECP2719		WTR			RO plant east rack Permeate	OK	---	---	Yes	---
BSG2723		WTR	VW	BS	Trans Jordan Landfill	OK	Yes	---	---	---
B2G2724		WTR	VW	B2	Trans Jordan Landfill	OK	Yes	---	---	---
BCS2730		WTR	VW	BC	Barneys Tunnel	OK	---	Yes	---	---
BCS2731		WTR	VW	BC	Alluvial inflow to Barneys Pit	OK	---	Yes	---	---
BCS2732		WTR	VW	BC	seep composites entering Barneys Cr	OK	---	Yes	---	---
BCS2733		WTR			Barneys canyon pit lake	OK	---	Yes	---	---
BCS2734		WTR			East barneys pit lake	OK	---	Yes	---	---
BCP2738		WTR			24" line from pit	OK	---	---	---	Yes
BCP2739		WTR			Copperton reservoir Sampled inside the concentrator	OK	---	---	---	Yes
ECP2740		WTR			Pit pumping	OK	---	---	---	Yes
BCP2741		WTR			Moly clairifyer	OK	---	---	---	Yes
BCP2743		WTR			Copperton clarifyer overflow	OK	---	---	---	Yes
ECP2745		WTR			RO Plant con rack #4 (east new one)	OK	---	---	---	Yes
BCP2750		WTR			Copperton clarifyer underflow	OK	---	---	---	Yes
BCP2751		WTR			Copperton Conc. No. side copper thickner	OK	---	---	---	Yes
BCP2752		WTR			Copperton Conc. Zone 1 retention pond	OK	---	---	---	Yes
BCP2753		WTR			Copperton Conc. Zone 2 retention reservoir	OK	---	---	---	Yes
BCP2754					Copperton Conc. Zone 3 retentoin reservoir	OK	---	---	---	Yes
BCP2755		WTR			Copperton Conc. Zone 4 retention pond	OK	---	---	---	Yes
BCP2756		WTR			Copperton Conc. Thickner overflow pump ststion	OK	---	---	---	Yes
BCP2757		WTR			Copperton Conc. West flotation sump	OK	---	---	---	Yes
BCP2758		WTR			Copperton Conc. East flotation sump	OK	---	---	---	Yes
BCP2759		WTR			Copperton Conc. Grind basement main sump	OK	---	---	---	Yes
BCP2760		WTR			Copperton Conc. Moly sump 350 PP 57	OK	---	---	---	Yes
BCP2761		WTR			Copperton Conc. Moly sump 2350 PP 165	OK	---	---	---	Yes
BCP2762		WTR			Copperton Conc. Moly sump 350 PP 46	OK	---	---	---	Yes
NES2763		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NES2764		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---
NES2765		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---
NES2766		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---
NES2767		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---
NES2768		WTR			Slag pond S.W. slag pile well	OK	Yes	---	---	---
SLS2769		WTR			Slag pond Hansen spring	OK	Yes	---	---	---
SLS2770		WTR			Slag pond combined spring waterflow	OK	Yes	---	---	---
ECP2771		WTR			R.O. plant west rack concentrate #3	OK	Yes	---	---	---
ECP2772		WTR			R.O. plant west rack permeate #3	OK	Yes	---	---	---
BSG2777A		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2777B		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2778A		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2778B		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2779A		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2779B		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2779C		WTR			Bastian sink well	OK	Yes	---	---	---
EPG2780A		WTR			Day break property	OK	Yes	---	---	---
EPG2780B		WTR			Day break property	OK	Yes	---	---	---
EPG2781A		WTR			Day break property	OK	Yes	---	---	---
EPG2781B		WTR			Day break property	OK	Yes	---	---	---
BSG2782A		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2782B		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2782C		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2783A		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2783B		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2783C		WTR			Bastian sink well	OK	Yes	---	---	---
BSG2784		WTR			Bastian sink well	OK	Yes	---	---	---
EPG2785A		WTR			Day break property	OK	Yes	---	---	---
EPG2785B		WTR			Day break property	OK	Yes	---	---	---
ECS2786		WTR			East side collection seep	OK	Yes	---	---	---
ECG2787		WTR			Bingham canyon well base of dump	OK	Yes	---	---	---
BCG2788A		WTR				OK	Yes	---	---	---
BCG2788B		WTR				OK	Yes	---	---	---
BCG2788C		WTR				OK	Yes	---	---	---
ECG2789A		WTR			East side collection toe of dump (**abandon in 2020**)	OK	Yes	---	---	---
ECG2789B		WTR			East side collection toe of dump **(abandon in 2020)**	OK	Yes	---	---	---
NES2790		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2791		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2792		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2793A		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2793B		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2793C		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2794		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
NES2795		WTR			Smelter flush mount (Arcadis well)	OK	Yes	---	---	---
ECP2796		WTR	SE		RO Plant Product Water	OK	Yes	---	---	---
NES2797A		WTR	NE		Smelter west of slag bluff, south of hwy 201	OK	Yes	---	---	---
NES2797B		WTR	NE		Smelter west of slag bluff, south of hwy 201	OK	Yes	---	---	---
NES2797C		WTR	NE		Smelter west of slag bluff, south of hwy 201	OK	Yes	---	---	---
NES2797D		WTR	NE		Smelter west of slag butt	OK	Yes	---	---	---
NES2797E		WTR	NE		SmelterWest of slag butt	OK	Yes	---	---	---
NES2798A		WTR	NE		Smelter east of east smelter gate	OK	Yes	---	---	---
NES2798B		WTR	NE		Smelter east of east smelter gate	OK	Yes	---	---	---
NES2798C		WTR	NE		Smelter east of east smelter gate	OK	Yes	---	---	---
NES2798Z		WTR	NE		Smelter east of east smelter gate	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
NES2799A		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2799B		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2800A		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2800B		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2801		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2802		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2803A		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2803B		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2804A		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2804B		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2804C		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NES2805		WTR	NE		smelter acid tank farm	OK	Yes	---	---	---
NEW2807A		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807B		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807C		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807D		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807E		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807F		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2807G		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NER2808		WTR	NE		Charlie / Refinery gate	OK	Yes	---	---	---
NEW2809A		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2809B		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2810A		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2810B		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NEW2810C		WTR	NE		Garfield wetlands	OK	Yes	---	---	---
NER2811A		WTR	NE		Refinery PM Cap	OK	Yes	---	---	---
NER2811B		WTR	NE		Refinery PM Cap	OK	Yes	---	---	---
NER2812A	NA	WTR	NE		Refinery North of MAP	OK	Yes	---	---	---
NER2812B	NA	WTR	NE		Refinery North of MAP	OK	Yes	---	---	---
NER2813A	NA	WTR	NE		KUC south west of refinery	OK	Yes	---	---	---
NER2813B	NA	WTR	NE		KUC south west of refinery	OK	Yes	---	---	---
NER2813C	NA	WTR	NE		KUC south west of refinery	OK	Yes	---	---	---
NER2814A	NA	WTR	NE		KUC at Kesler springs	OK	Yes	---	---	---
NER2814B	NA	WTR	NE		KUC at Kesler springs	OK	Yes	---	---	---
NER2814C	NA	WTR	NE		KUC at Kesler springs	OK	Yes	---	---	---
NEW2815A	NA	WTR	NE		wetlands garfield area	OK	Yes	---	---	---
NEW2815B	NA	WTR	NE		wetlands garfield area	OK	Yes	---	---	---
NEW2815C	NA	WTR	NE		wetlands garfield area	OK	Yes	---	---	---
NER2816A	NA	WTR	NE		KUC Hillside west of refinery	OK	Yes	---	---	---
NER2816B	NA	WTR	NE		KUC Hillside west of refinery	OK	Yes	---	---	---
NER2816C	NA	WTR	NE		KUC Hillside west of refinery	OK	Yes	---	---	---
MPC2817	#1 magna Res	WTR	NE		Leak detection sump located at the new magna res.	OK	---	---	---	Yes
MPC2818	#2 magna res	WTR	NE		Leak detection sump located at the origional magna res.	OK	---	---	---	Yes
WJG2819A	NA	WTR	SE		Ground water well replacement for WJG1170A	OK	Yes	---	---	---
WJG2819B	NA	WTR	SE		Ground water well replacement for WJG1170B	OK	Yes	---	---	---
WJG2819C	NA	WTR	SE		Ground water well replacement for WJG1170C	OK	Yes	---	---	---
EPS2820	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2821	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2822	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2823	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2824	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2825	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2826	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---
EPS2827	NA	WTR	daybreak		Acid rock drainage surface sites at daybreak	OK	---	Yes	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
BSG2828	NA	WTR	Mine		2012 new sulfate well. Water is shipped to the RO plant	OK	Yes	---	Yes	---
BMP2829	NA	WTR	Mine		North well drainage gallery composite @ portal bingham pit	OK	---	Yes	---	---
NEL2831		WTR	Sec 21		New Section 21 Well	OK	Yes	---	Yes	---
BMS2832	NA	WTR	Mine		Cottonwood drainage composite sample @ flume	OK	---	Yes	---	---
ECG2833A	NA	WTR	Mine		Adjacent to Saints rest drainage	OK	Yes	---	---	---
ECG2833B	NA	WTR	Mine		Adjacent to Saints rest drainage	OK	Yes	---	---	---
ECG2833C	NA	WTR	Mine		Adjacent to Saints rest drainage	OK	Yes	---	---	---
ECG2833D	NA	WTR	Mine		Adjacent to Saints rest drainage	OK	Yes	---	---	---
BCS2834	NA	WTR	Barneys		BC1 Drain down. Sample collected in sump	OK	---	---	---	Yes
BCS2835	NA	WTR	Barneys		BC2 drain down Sample collected in sump	OK	---	---	---	Yes
BCS2836	NA	WTR	Barneys		BC 3 Drain down. Sample collected in sump	OK	---	---	---	Yes
BCS2837	NA	WTR	Barneys		BC 4 drain down Sample collected in sump	OK	---	---	---	Yes
BCS2838	NA	WTR	Barneys		BC 5 Drain down. Sample collected in sump	OK	---	---	---	Yes
BMP2839		WTR	Mine		Pit dewatering well 5490 east wall (2014)	ok	---	---	---	---
BMP2840		WTR	Mine		Pit dewatering well 5490 east wall (2014)	ok	---	---	---	---
BMP2841		WTR	Mine		East wall depressurization adjacent to crusher (2014)	OK	---	---	---	---
SMP2842	Sec. 17	WTR	smelter		Section 17 blended from smelter reseviour (smelter wash down water) S.W.corner of hydromet	OK	---	Yes	---	---
SMP2843	KLB-2	WTR	tailings		Monitor wells drilled to monitor horizonal drain water	OK	Yes	---	---	---
SMP2844	SE2-3	WTR	Tailings		Monitor wells drilled to monitor horizonal drain water	OK	Yes	---	---	---
BCS2845A		WTR	Barneys		Upper North Fork Barneys creek seep	OK		---	---	---
BCS2845B		WTR	Barneys		Upper Mid North Fork Barneys creek seep	OK		---	---	---
BCS2845C		WTR	Barneys		Lower mid North Fork Barneys creek seep	OK		---	---	---
BCS2845D		WTR	Barneys		Lower North Fork Barneys creek seep	OK		---	---	---
BCG2846		WTR	Barneys		Barneys canyon ground water monitor well	OK	Yes	---	---	---
NEP2847		WTR	NE		North end se plant (Influent) sample port on north side of skid	OK	---	---	---	Yes
NEP2848		WTR	NE		North end se plant (Effluent) off train #1 at south most sample spigot **bioreactor 1120**	OK	---	---	---	Yes
NEP2849		WTR	NE		North end se plant (Effluent) off train #2 middle sample port **Bioreactor 1220**	OK	---	---	---	Yes
NEP2850		WTR	NE		North end se plant Effluent off train #3 north sample port **bioreactor 1320**	OK	---	---	---	Yes
NEP2851A		WTR	NE		Effluentfrom all three trains sample port directly below sample site NEP2847	OK	---	---	---	Yes
NEP2851B		WTR	NE		Effluentfrom all three trains sample port directly below sample site NEP2847	OK	---	---	---	Yes
NES2852					Praxair Capture Trench sampled	OK	---	---	---	Yes
ECG2853A		WTR	South end		Bingham canyon ground water well	OK	Yes	---	---	---
ECG2853B		WTR	South end		Bingham canyon ground water well	OK	Yes	---	---	---
ECG2854		WTR	South End		Bingham canyon dumps well	OK	Yes	---	---	---
BCS2855	Bass pond	WTR	Barneys		01-03 pond collection formaly (Bas pond)	OK	---	Yes	---	---
ECP2856A	copper 4	WTR	South end		East side collection weir box (copper 4) sample water from the sump this is a combo of ECP2856 A&B	OK	---	Yes	---	---
ECP2856B	copper 4	WTR	South end		East side collection weir box (copper 4) sump sample labled ECP2856A	OK	---	Yes	---	---
ECP2857A	copper 2	WTR	South end		East side collection weir box (copper 2)	OK	---	Yes	---	---
ECP2857B	copper 2	WTR	South end		East side collection weir box (copper 2)	OK	---	Yes	---	---
ECP2858A	South crapo	WTR	south end		East side collection weir box (south crapo)	OK	---	Yes	---	---
ECP2858B	South crapo	WTR	south end		East side collection weir box (south crapo)	OK	---	Yes	---	---
ECG2859	Keystone	WTR	south end		Keystone drainage ground water well	OK	Yes	---	---	---
ECG2859	Keystone	WTR	south end		Keystone drainage ground water well	OK	Yes	---	---	---
BCG2860A	Barneys	WTR	south end		Barneys ground water east of well #32	OK	Yes	---	---	---
BCG2860B	Barneys	WTR	south end		Barneys ground water east of well #32	OK	Yes	---	---	---
HCG2861A	Harkers	WTR	south end		Harkers creek below PS 3B	OK	Yes	---	---	---

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APPROVED SAMPLE LOCATIONS

Site ID	Alias	Program	Region ID	Area ID	Location/Description	Status	Ground	Surface	Drinking	Process
HCG2861B	Harkers	WTR	south end		Harkers creek below PS 3B	OK	Yes	---	---	---
WJG2862A	West Jordan	WTR	south end		Near 7800 so. Backus hwy	OK	Yes	---	---	---
WJG2862B	West Jordan	WTR	south end		Near 7800 so. Backus hwy	OK	Yes	---	---	---
WJG2863	West Jordan	WTR	south end		Production well near 2862 / 8600 west	OK	Yes	---	---	---
BMS2864	Mine / Pit	WTR			Replacement for BMS1356 (Located in the PIT	OK	Yes	---	---	---
COG2865	Mine / Pit	WTR	South end		Replacement for picnic flats well (COG 1172)	OK	Yes	---	---	---
ECG2866A	bingham cyn	WTR	south end		Replacement for ECG2789 A Base vof bingham canyon	OK	Yes	---	---	---
ECG2866B	bingham cyn	WTR	south end		Replacement for ECG2789 B Base of bingham canyon	OK	Yes	---	---	---
COG2867A		WTR	south end		East of Retention Pond 4 Copperton Concentrator	OK	Yes	---	---	---
COG2867B		WTR	south end		East of Retention Pond 4 Copperton Concentrator	OK	Yes	---	---	---
HCG2868	WR5468	WTR			Private well, Strang Excavating, about 5500 South HWY 111	OK	Yes	---	---	---
BMP2869	Mine/Pit	WTR	South end		High quality sump at 6190 pump station	OK	---	---	---	Yes
NEL2870A		WTR	NE	LS	East Tailings Impoundment expansion	OK	Yes	---	---	---
NEL2870B		WTR	NE	LS	East Tailings Impoundment expansion	OK	Yes	---	---	---
NEL2870C		WTR	NE	LS	East Tailings Impoundment expansion	OK	Yes	---	---	---
BCG2871		WTR	South end		East of Copperton Concentrator	OK	Yes	---	---	---
TLL4100	LY94100	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4100	LY94100	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4101	LY94101	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4101	LY94101	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4102	LY94102	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4102	LY94102	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4103	LY94103	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4103	LY94103	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4124	LY94124	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4124	LY94124	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4125	LY94125	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4125	LY94125	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4126	LY94126	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4126	LY94126	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4127	LY94127	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4127	LY94127	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4128	LY94128	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4128	LY94128	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4129	LY94129	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4129	LY94129	WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4133		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4133		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4134		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4134		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4135		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4135		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4136		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4136		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4137		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4137		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4138		WTR	NE	TL	Lysimeter	OK	---	---	---	---
TLL4138		WTR	NE	TL	Lysimeter	OK	---	---	---	---
USGS8A	B1236BAA3		NE	NO		OK	---	---	---	---
USGS8B	B1236BAA2		NE	NO		OK	---	---	---	---
USGS8C	B1236BAA1		NE	NO		OK	---	---	---	---

PN DRAFT

KENNECOTT
ENVIRONMENTAL LABORATORY
9600 West 2100 South Magna, Utah 84044

ANALYTICAL REQUEST SHEET
Sample Chain of Custody

_____-_____-_____
Sheet Request No.
Lab Use Only

Lab Use Only ID#	LOCATION Control #	FIELD DATA										Analyses Requested
		Time	Date	pH	Cond	Temp	Depth	# of Cont				
	EXAMPLE		01/01/01	0.00	0	0.0	0.00					**GCMP**

Sample Submitted by:_____ Telephone No. _____ Fax No. _____

Report Results to: _____ Telephone No. _____ Fax No. _____

Samples submitted on Ice: Yes / No

Surrendered By:_____ Date:_____ Time:_____ Received By:_____ Date: _____ Time: _____

Surrendered By:_____ Date:_____ Time:_____ Received By:_____ Date: _____ Time: _____

Comments / Special Instructions: _____

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TABLE DC-3

SAMPLE CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

ANALYTE	CONTAINER[1]	PRESERVATION	MAXIMUM HOLDING TIME
Alkalinity	P,G	*Store on ice	14 Days
BOD	P	*Store on ice	48 Hours
Chloride	P,G	None	28 Days
Coliform	P	*Store on ice	6 Hrs-UPDES 12 Hrs-Drinking
Cyanide	P,G	*Store on ice, NaOH to pH>12, store in dark	14 Days
Fluoride	P	None	28 Days
Hydrogen Ion (pH)	P,G	None	Analyze Immediately
Mercury	P,G	HNO_3 to pH<2	28 Days
Metals, except Mercury	P,G	HNO_3 to pH<2	6 Months
Nitrate	P,G	*Store on ice, H_2SO_4	48 Hours 28 Days/once acidified
Nitrite	P,G	*Store on ice, H_2SO_4	48 Hours
Oil & Grease	G	*Store on ice, H_2SO_4 to PH<2	28 Days
Organics			
PCB	VOA	*Store on ice, pH 5-9	7 Days
Pesticides	VOA	*Store on ice, pH 5-9	7 Days
PHC	G	*Store on ice	7 Days
SEM	VOA	*Store on ice	7 Days
VOL	VOA	*Store on ice	7 Days
Phenolics	G	*Store on ice, H_2SO_4 to pH<2	28 Days
Phosphate	G	*Store on ice	48 Hours
Radionuclides	P,G	pH<2, HNO_3	6 Months
Silica	P	*Store on ice	28 Days
Sulfate	P,G	*Store on ice, if pH is < 4.5, use HCL	28 Days
TDS	P,G	*Store on ice	7 Days

*Or refrigerate.

[1]Polyethylene (P), or Glass (G)

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Figures

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WELL INSPECTION REPORT

GENERAL

Well I.D. # : _____ Date of Inspection: _____
Name of Inspector: _____

SITE CONDITIONS

Attach photograph of site showing general site conditions.
Attach photograph showing inside of protective casing and well casing.
Attach any additional maps and/or aerial photographs.

Was site cleaned up and refuse removed after well constructions? Yes ____ No ____
Is site cleanup required? Yes ____ No ____

PROTECTIVE CASING

Description of Protective Casing

Is casing present? Yes ____ No ____
Nominal Casing Diameter: _____ inches
Casing Material: PVC ____ Steel ____ Other: _____
If "Other" describe: _____
Paint Condition: None ____ Good ____ Poor ____
Is painting recommended? Yes ____ No ____
Is Well I.D. # painted on casing? Yes ____ No ____
Is Well I.D. # stamped on casing? Yes ____ No ____
Other markings: _____
Is there a weep hole in the protective casin? Yes ____ No ____

Well Pad Condition

Does a concrete pad surround the protective casing? Yes ____ No ____
Was the concrete formed when it was poured? Yes ____ No ____
Is the pad thickness greater than 6 inches? Yes ____ No ____
Is replacement of the pad recommended? Yes ____ No ____
Is the Well I.D. # inscribed in the pad? Yes ____ No ____

Lock

Is the protective casing locked? Yes ____ No ____
Can the protective casing be locked? Yes ____ No ____
If not, identify cause of problem: Missing Lock ____ Locking Hasp ____ No Lid on Casing ____

WELL CONSTRUCTION

Well Casing

Inside Diameter: _____ inches
Casing Material: PVC ____ Steel ____ Other: _____
If "Other" describe: _____
Is a casing adapter used to terminate the casing? Yes ____ No ____
Type of casing adapter: Male ____ Female ____
Is the casing top smooth and even? Yes ____ No ____
Is there a cap or plug for the well casing? Yes ____ No ____
Is there a hole in the top of the well cap? Yes ____ No ____
Is the marker point for measuring the depth to water present? Yes ____ No ____
How is it identified? _____
Is annular cement/grout present? Yes ____ No ____
Is the grout in good condition? Yes ____ No ____
Is grout filled to near the top of the well casing? Yes ____ No ____
Is grout filled to within 1/2 inch of the protective casing weep hole? Yes ____ No ____

PN DRAFT

DIVISION OF WATER RIGHTS
REQUEST FOR MONITOR WELL CONSTRUCTION

APPLICANTS NAME Kennecott Utah Copper

APPLICANTS ADDRESS P. O. Box 525, Bingham Canyon, Utah 84006-0525

INDIVIDUAL CONTACT _____ _____
Name Phone

CURRENT PROPERTY OWNER _____

PROPOSED NUMBER OF WELLS _____ DIAMETERS _____ APPROX. DEPTHS _____

TYPE OF COMPLETIONS _____
(Casing, intake, _____
gravel pack, grout, _____
etc.)

PROJECT ENGINEER/MANAGER _____
Name

_____ _____
Address Phone

GENERAL LOCATION DESCRIPTION _____ COUNTY _____

WELLS IN CONJUNCTION WITH (LEAKING) UNDERGROUND STORAGE TANKS _____ _____
YES NO

NAME OF LICENSED DRILLER _____ LICENSE # _____

PROPOSED CONSTRUCTION DATE _____ ANTICIPATED COMPLETION DATE _____

LOCATION OF WELLS:

1. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
2. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
3. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
4. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
5. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
6. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
7. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
8. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
9. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM
10. N/S _____ FT. & E/W _____ FT. FRM _____ COR. or ___ 1/4 ___ 1/4 of SEC. ___ T ___ N/S R ___ E/W SLBM/USM

Comments or explanation _____

_____

For office use only

DATE OF REQUEST _____ APP/REJ DATE BY _____
AREA OFFICE _____ AUTHORIZATION # _____

PN DRAFT

KENNECOTT UTAH COPPER

Borehole Log

Project _____ Location _____
Well I.D. # _____ Weather _____
Total Depth _____ Diameter/Interval _____
Surface Elevation _____ Initial Depth to Water _____ 24-hrs _____
Screen: Dia. _____ Length _____ Slot Size _____
Casing: Dia. _____ Length _____ Type _____
Sand _____ Seal _____
Grout _____ Key Number _____
Drilling Company _____ Drilling Method _____
Driller _____ Log By _____ Date Drilled _____

Sketch Map

Notes

Depth (feet)	Graphic Log	Well Const.	Sample Number	Description/Soil Classification (Color, Texture, Structures)

DRAFT

KENNECOTT UTAH COPPER SOIL MOISTURE LYSIMETERS

Site	Depth (ft)	Date/Time Vacuum Applied	Date/Time Sample Taken	Remaining Vacuum (centibars)	Volume Collected (ml)	pH	Temp	EC (ms)	Eh (mV)	Fe+2 (mg/L)	Sulfide (mg/L)	NO2 (mg/L)	NO3 (mg/L)	D.O. (mg/L)
LINDDUP														
TLL4100	4													
TLL4101	8													
TLL4102	12													
TLL4103	20													
TLL4124	2													
TLL4125	5													
TLL4126	2													
TLL4127	5													
TLL4128	2													
TLL4129	5													
TLL4133	3													
TLL4134	5													
TLL4135	8													
TLL4136	2													
TLL4137	2													
TLL4138	2													

PN DRAFT

KENNECOTT UTAH COPPER
UPDES FIELD DATA SHEET

OUTFALL No._____

DATE: _____ARRIVAL TIME:_____

METER ID FIELD CALIBRATION

pH_____ pH Buffers (1)____ (2)____ Final Readings (1)____ (2)____

SC_____ Standard_____ Final Reading_____

FIELD MEASUREMENTS/OBSERVATIONS

pH_____ Conductivity_____ Temp_____

Visible Sheen (oil/grease)?_____ Floating Solids or Visible Foam?_____

ANALYSES

Nutrient_____
Total _____
Diss _____
Hg _____
Phenol _____
CN _____

Bio Sample_____
O+G _____
Coliform _____

COMMENTS:_____

_____

_____

If this is a split sample with the State, please put (G) on the sample ID.

Sampler(s) Signature(s)_____

_____

Departure Time_____

PN DRAFT

FIGURE DW-1 **KENNECOTT UTAH COPPER**

DRINKING WATER
FIELD DATA SHEET

Sample ID #:_____ **Meter ID Numbers and Calibration**

See:
Date:_____ **Arrival Time** _____ **Field Log Book:** _____

Sampler(s) Initials:_____ **Page** _____

Field Measurements

Ph_____

Cond_____

Temp._____

Sample Containers

Nutrients (1/2 gal.)_____
Total Metals (8 oz.)_____
Diss. Metals (8 oz.)_____
Mercury (Hg)-(8 oz. glass)_____
Nitrates ($N0_x$)-(8 oz. glass)_____
Coliform yes_____ **no**_____

Remarks:_____

Sampler(s) Signature _____

Time Sampling Completed_____

PN DRAFT

UTAH DEPARTMENT OF HEALTH

Water Bacteriological Analysis Test Request Form
Utah Public Health

4431 S 2700 W Taylorsville, UT 84129-8600

801 965 2400 Fax 801 969 3238

http://health.utah.gov/lab/chemistry

Please fill out this form using block letters and with a black or blue pen.
Do not attach this form to the sample.

LAB USE SECTION

LAB NUMBER

Received Date and Time Stamp

Analyzed Date and Time Stamp

Customer Number

Public Water System U T A H

Facility ID

Sampling Point ID

System/Agency Name

Collection Point Description / Project Name (if applicable)

Collection Point Description (Continued)

Sample Receipt Conditions ☐ Health Department Investigative

Temperature . Ice ○ Yes ○ No

Contact Numbers

USL: Public Health - Environmental Microbiology (801) 965-2400

State Division of Drinking Water (801) 536-4200

Contact Your Local Health Department for Pool, Spa, and Hot Tub Information

Please fill in the circles or check boxes next to the appropriate option.
DO NOT make any other marks. If you need assistance with this form call 801 965 2405.

Reporting Options

○ State Drinking Water Compliance Samples
○ Private Investigative
○ Repeat
- ○ Downstream Within 5 Of Original Sample
- ○ Near First Service Connection
- ○ Original Site
- ○ Upstream Within 5 Of Original Sample

Original Sample Number

Original Sample Collection Date 2 0 (M M D D Y Y Y Y)

Complete this section for repeat samples.

Unsatisfactory Sample

☐ Exceeded Holding Time
☐ Out of Date Container
☐ Not State Lab Container
☐ Container is Broken/Leaking
☐ Incomplete Documentation
☐ Other

Please Submit a New Sample

○ TCR Repeat ONLY
○ TCR Repeat AND GW Source
○ Other

Chlorine Residual ppm

Type of Water
○ Drinking Water
○ Pool/Spa
○ Raw Water
○ Deionized or RO
○ Other

Matrix Testing
☐ Well 51
☐ Well 51 and HPC
☐ Well 97
☐ HPC ☐ Well 51

Additional Testing

LAB USE SECTION

LAB USE SECTION

GWR Trigger Source Sample(s)

Facility ID (Source #): W S

Representative Site: SSG001

Sample # of source(s)

☐ Sampled all sources in use at time of positive
☐ Other source(s) not in use

Name of Wholesaler

Date Wholesaler notified (M M D D Y Y Y Y)

Collector's First Name

Collector's Last Name

Collection Date 2 0 (M M D D Y Y Y Y)

Collection Time ○ AM ○ PM

Collector's Comments

First Name **REPORTING/CONTACT** Last Name

Address City

State Zip Email

Phone Fax

☐ New Information Update Account

First Name **BILLING** ☐ **SAME AS REPORTING** Last Name

Address City

State Zip Email

Phone Fax

DRAFT

FIGURE SW-2 EXAMPLE SURFACE WATER QUALITY FIELD DATA SHEET

KENNECOTT UTAH COPPER

Sheet ____ of ____

SURFACE WATER QUALITY
FIELD DATA SHEET

SITE SKETCH:

SAMPLE LOCATION ID #: _____

DATE: _____ TIME: _____am/pm

SAMPLING PERSONNEL: _____

_____ _____

SITE DESCRIPTION:

PHOTOGRAPH: Roll #: _____ Photo #: _____ Direction Faced: _____
Roll #: _____ Photo #: _____ Direction Faced: _____

SAMPLE DESCRIPTIONS:

TIME: DEPTH:

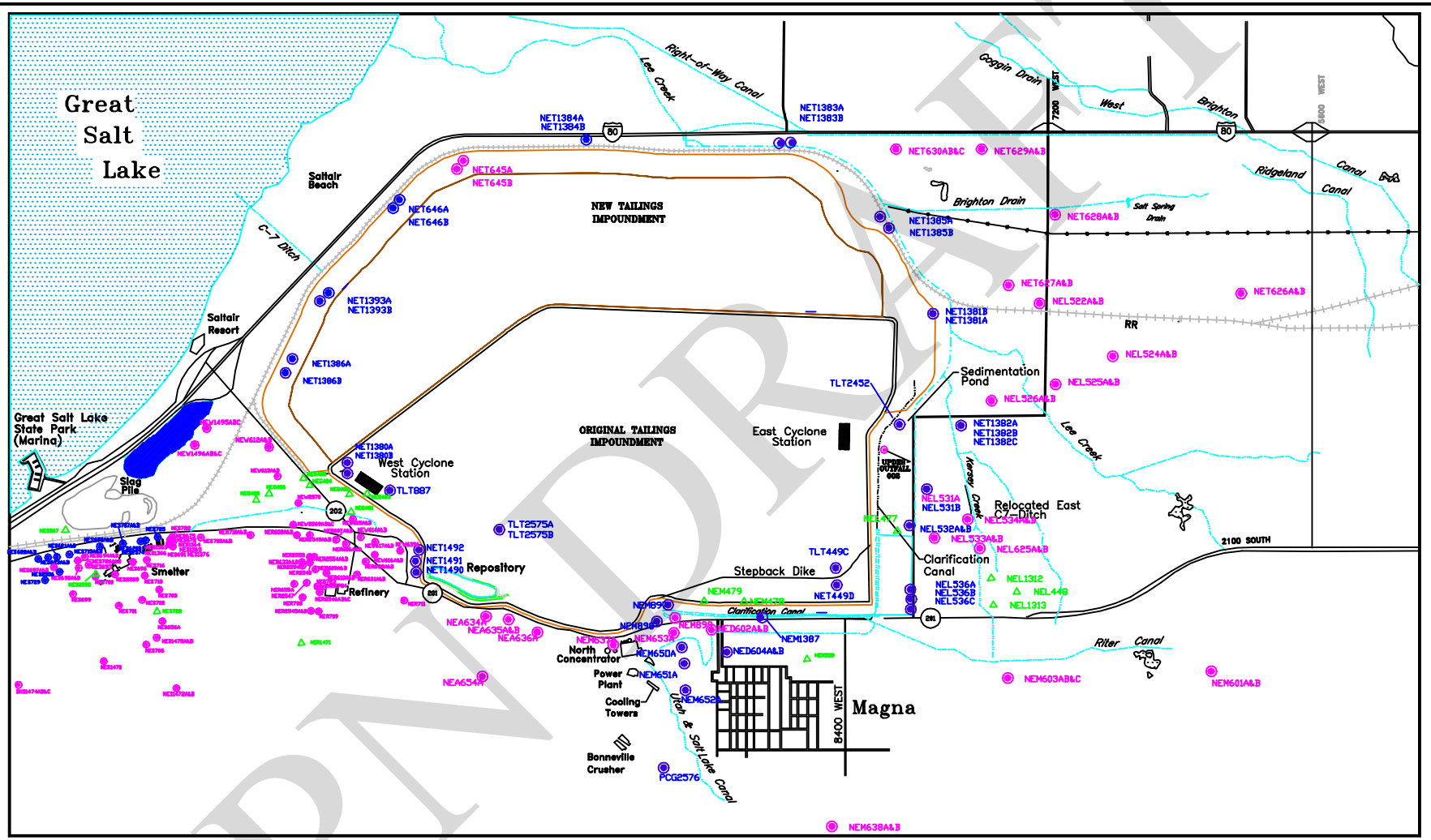
METER NUMBERS: pH CONDUCTIVITY Eh D.O.
CALIBRATION
CONCENTRATON: pH CONDUCTIVITY Eh D.O.
SAMPLING METHOD:
NUMBER OF COMPOSITE SAMPLES: FIELD
PARAMETERS:
METER ID #: TITRATION:
Carbonate (CO_3): _____ml _____titrate _____M _____mg/l _____time
Bicarbonate (HCO_3): _____ml _____titrate _____M _____mg/l _____time
Time: _____ a.m./p.m.
Ferrous Iron:
Sulfide: Paper mg/l Colormetric mg/l time

TIME	TEMP.(C)	pH	COND.	D.O./METHOD	TURB.(NTU)

PN DRAFT

Plates

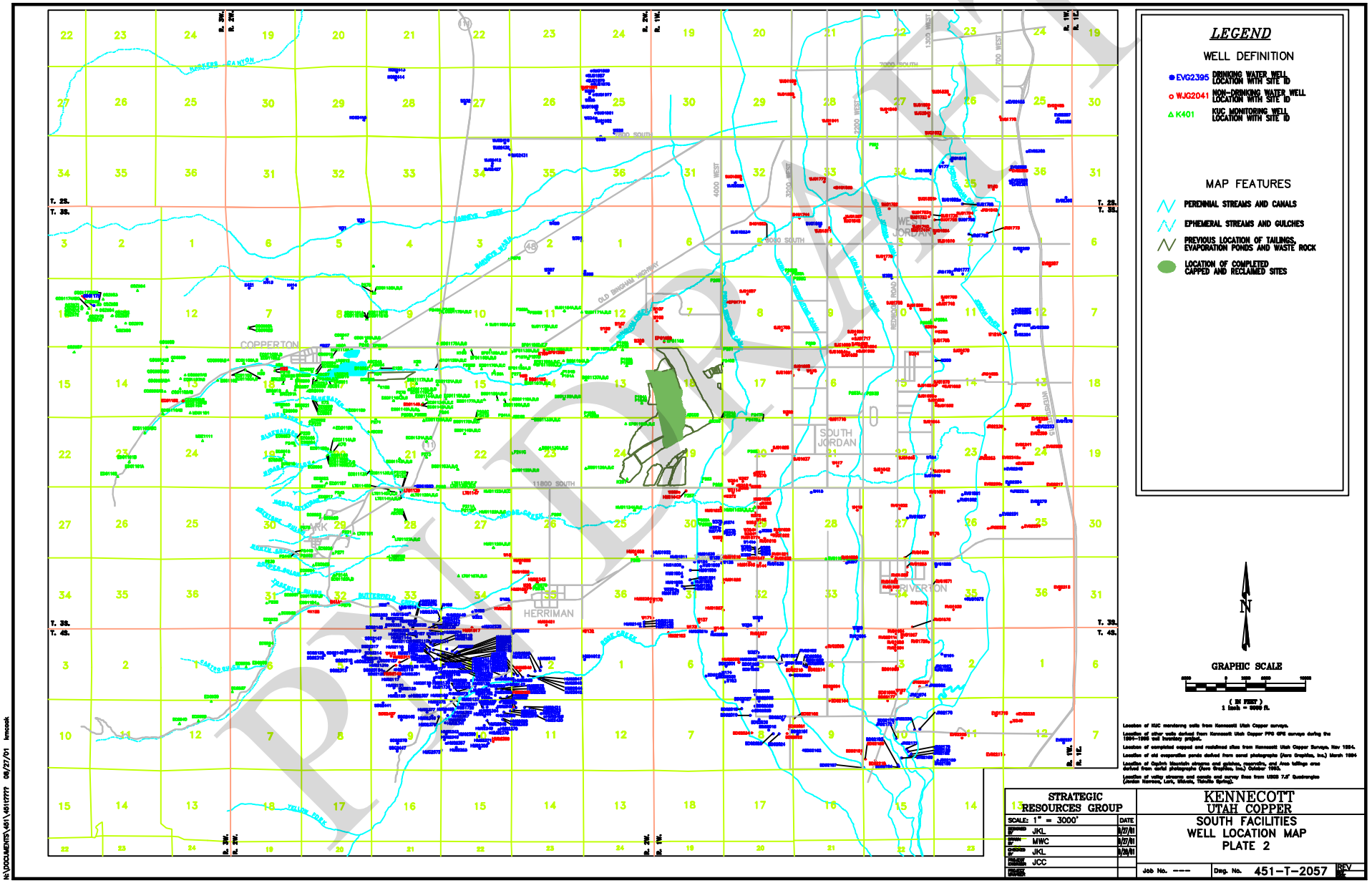
PN DRAFT



PNDRAFT

ENVIRONMENTAL AFFAIRS		KENNECOTT UTAH COPPER
SCALE:	DATE	NORTH FACILITIES WELL LOCATIONS
DRAWN JCC	03/00	PLATE1
CHKD BS	03/00	
APPD JS	01/02	
Job No.	Dwg. No. NONE	REV 1

F:\DWR\NRO\DRAWINGS\DWR1015 03/14/00 BSCOTT



PRELIMINARY DRAFT

LEGEND

WELL DEFINITION

- EVG2395 — DRINKING WATER WELL LOCATION WITH SITE ID
- WJG2041 — NON-DRINKING WATER WELL LOCATION WITH SITE ID
- K401 — KUC MONITORING WELL LOCATION WITH SITE ID

MAP FEATURES

- PERENNIAL STREAMS AND CANALS
- EPHEMERAL STREAMS AND GULCHES
- PREVIOUS LOCATION OF TAILINGS, EVAPORATION PONDS AND WASTE ROCK
- LOCATION OF COMPLETED CAPPED AND RECLAIMED SITES

N

GRAPHIC SCALE

(IN FEET)
1 inch = 3000 ft.

Location of KUC monitoring wells from Kennecott Utah Copper surveys.
Location of other wells derived from Kennecott Utah Copper PPG GPS surveys during the 1994-1995 well inventory project.
Location of completed capped and reclaimed sites from Kennecott Utah Copper Surveys, Nov 1994.
Location of old evaporation ponds derived from aerial photographs (Aero Graphics, Inc.) March 1994
Location of Copper Mountain stingers and gladiator, overburden, and Arco tailings area derived from aerial photographs (Aero Graphics, Inc.) October 1995.
Location of valley streams and canals and survey lines from USGS 7.5' Quadrangles (Jordan Narrows, Lark, Utaville, Tetsville Spring).

STRATEGIC RESOURCES GROUP		
SCALE: 1" = 3000'		DATE
DRAWN	JKL	9/27/01
DESIGN	MWC	9/27/01
CHECKED	JKL	9/28/01
PROJECT MGR.	JCC	
APPROVED		

KENNECOTT
UTAH COPPER

SOUTH FACILITIES
WELL LOCATION MAP
PLATE 2

Job No. ---- Dwg. No. 451-T-2057 REV

N:\DOCUMENTS\451\451T77 09/27/01 kmcook