Montana Department of
ENVIRONMENTAL QUALITY
Brian Schweitzer, Governor
P. O. Box 200901 Helena, MT 59620-0901 (406) 444-2544 Website: www.deq.mt.gov

October 6, 2009

Eric Klepfer
Klepfer Mining Service, LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Dear Mr. Klepfer:

Montana Air Quality Permit #4449-00 is deemed final as of October 6, 2009, by the Department of Environmental Quality (Department). This permit is for an underground exploration project. All conditions of the Department's Decision remain the same. Enclosed is a copy of your permit with the final date indicated.

For the Department,

Vickie Walsh
Air Permitting Program Supervisor
Air Resources Management Bureau
(406) 444-9741

Ed Warner
Environmental Engineer
Air Resources Management Bureau
(406) 444-2467

VW:EW
Enclosure

Montana Department of Environmental Quality
Permitting and Compliance Division

Montana Air Quality Permit #4449-00

Timberline Resources Corporation
101 E. Lakeside Avenue
Coeur d'Alene, ID 83814

October 6, 2009

MONTANA AIR QUALITY PERMIT

Issued To:	Timberline Resources Corporation Butte Highlands Project 101 East Lakeside Avenue Coeur d'Alene, Idaho 83814	Montana Air Quality Permit: #4449-00 Application Complete: 7/22/09 Preliminary Determination Issued: 8/31/09 Department's Decision Issued: 9/18/09 Permit Final: 10/06/09 AFS #: 093-0020

A Montana Air Quality Permit (MAQP), with conditions, is hereby granted to Timberline Resources Corporation (TRC), pursuant to Sections 75-2-204 and 211 of the Montana Code Annotated (MCA), as amended, and Administrative Rules of Montana (ARM) 17.8.740, *et seq*., as amended, for the following:

SECTION I: Permitted Facilities

A. Permitted Equipment

The TRC Butte Highlands Project (BHP) is an underground exploration project consisting of drifting, ore recovery for bulk sampling, and development rock removal and storage. A complete list of the permitted equipment is included in the Permit Analysis.

B. Plant Location

The BHP will be located on Sections 31 and 32, Township 1 North, Range 7 West, in Silver Bow County, Montana.

SECTION II: Conditions and Limitations

A. Emission Limitations

1. TRC shall operate and maintain a fabric filter baghouse on the cement storage silo exhaust stack for controlling particulate matter (PM) emissions (ARM 17.8.752).

2. The maximum ore and development rock production shall be limited to 182,500 tons per any 12-month rolling period (ARM 17.8.749).

3. TRC may only operate the following diesel engines (ARM 17.8.749):

   a. One Caterpillar DM9081 diesel engine/generator set with a maximum rated engine design capacity of 924 hp.

   b. One emergency backup diesel engine/generator with a maximum rated engine design capacity not to exceed 475 hp that is compliant with Environmental Protection Agency (EPA) nonroad diesel engine Tier 2 emission standards.

   c. One diesel engine for an air compressor with a maximum rated engine design capacity not to exceed 275 hp that is compliant with EPA nonroad diesel engine Tier 1 emission standards.

   d. One diesel engine for a welder with a maximum rated engine design capacity not to exceed 26 hp that is compliant with EPA nonroad diesel engine Tier 2 emission standards.

4. TRC shall not cause or authorize emissions to be discharged into the outdoor atmosphere from any sources installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes (ARM 17.8.304 and ARM 17.8.752).

5. TRC shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter (ARM 17.8.308).

6. TRC shall treat all unpaved portions of the haul roads, access roads, parking lots, or general plant area with water and/or chemical dust suppressant as necessary to maintain compliance with the reasonable precautions limitation in Section II.A.5 (ARM 17.8.749 and ARM 17.8.752).

7. TRC shall comply with all applicable standards and limitations, and the reporting, recordkeeping, and notification requirements contained in 40 Code of Federal Regulations (CFR) 60, Subpart IIII, *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines* and 40 CFR 63, Subpart ZZZZ, *National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines*, for any applicable diesel engine (ARM 17.8.340; 40 CFR 60, Subpart IIII; ARM 17.8.342 and 40 CFR 63, Subpart ZZZZ).

B. Testing Requirements

1. All compliance source tests shall conform to the requirements of the Montana Source Test Protocol and Procedures Manual (ARM 17.8.106).

2. The Department of Environmental Quality (Department) may require further testing (ARM 17.8.105).

C. Operational Reporting Requirements

1. TRC shall supply the Department with annual production information for all emission points, as required by the Department in the annual emission inventory request. The request will include, but is not limited to, all sources of emissions identified in the emission inventory contained in the permit analysis.

   Production information shall be gathered on a calendar-year basis and submitted to the Department by the date required in the emission inventory request. Information shall be in the units required by the Department. This information may be used to calculate operating fees, based on actual emissions from the facility, and/or to verify compliance with permit limitations (ARM 17.8.505).

2. TRC shall notify the Department of any construction or improvement project conducted, pursuant to ARM 17.8.745, that would include ***the addition of a new emissions unit***, change in control equipment, stack height, stack diameter, stack flow, stack gas temperature, source location, or fuel specifications, or would result in an increase in source capacity above its permitted operation. The notice must be submitted to the Department, in writing, 10 days prior to startup or use of the proposed de minimis change, or as soon as reasonably practicable in the event of an unanticipated circumstance causing the de minimis change, and must include the information requested in ARM 17.8.745(l)(d) (ARM 17.8.745).

3. All records compiled in accordance with this permit must be maintained by TRC as a permanent business record for at least 5 years following the date of the measurement, must be available at the plant site for inspection by the Department, and must be submitted to the Department upon request (ARM 17.8.749).

4. TRC shall document, by month, the amount of ore and development rock production. By the 25th day of each month, TRC shall total the ore and development rock production for the previous month. The monthly information will be used to verify compliance with the rolling 12-month limitation in Section II.A.2. The information for each of the previous months shall be submitted along with the annual emission inventory (ARM 17.8.749).

5. TRC shall have available onsite at all times documentation for the diesel engines that verifies their compliance with EPA nonroad diesel engine Tier 1 or Tier 2 emission standards as described in Section II.A.3 (ARM 17.8.749).

D. Notification

TRC shall supply the Department the following notification (ARM 17.8.749).

1. Anticipated date of initial start-up of operations postmarked not more than 60 days nor less than 30 days prior to such date.

2. Actual date of initial start-up of operations postmarked within 15 days of such date (ARM 17.8.340, 40 CFR Part 60).

SECTION III: General Conditions

A. Inspection – TRC shall allow the Department's representatives access to the source at all reasonable times for the purpose of making inspections or surveys, collecting samples, obtaining data, auditing any monitoring equipment or observing any monitoring or testing, and otherwise conducting all necessary functions related to this permit.

B. Waiver – The permit and the terms, conditions, and matters stated herein shall be deemed accepted if TRC fails to appeal as indicated below.

C. Compliance with Statutes and Regulations – Nothing in this permit shall be construed as relieving TRC of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*. (ARM 17.8.756).

D. Enforcement – Violations of limitations, conditions and requirements contained herein may constitute grounds for permit revocation, penalties, or other enforcement action as specified in Section 75-2-401, *et seq*., MCA.

E. Appeals – Any person or persons jointly or severally adversely affected by the Department's decision may request, within 15 days after the Department renders its decision, upon affidavit setting forth the grounds therefor, a hearing before the Board of Environmental Review (Board). A hearing shall be held under the provisions of the Montana Administrative Procedures Act. The filing of a request for a hearing does not stay the Department's decision, unless the Board issues a stay upon receipt of a petition and a finding that a stay is appropriate under Section 75-2-211(11)(b), MCA. The issuance of a stay on a permit by the Board postpones the effective date of the Department's decision until conclusion of the hearing and issuance of a final decision by the Board. If a stay is not issued by the Board, the Department's decision on the application is final 16 days after the Department's decision is made.

F. Permit Inspection – As required by ARM 17.8.755, Inspection of Permit, a copy of the air quality permit shall be made available for inspection by the Department at the location of the source.

G. Permit Fee – Pursuant to Section 75-2-220, MCA, failure to pay the annual operation fee by TRC may be grounds for revocation of this permit, as required by that section and rules adopted thereunder by the Board.

H. Duration of Permit – Construction or installation must begin or contractual obligations entered into that would constitute substantial loss within 3 years of permit issuance and proceed with due diligence until the project is complete or the permit shall expire (ARM 17.8.762).

Permit Analysis
Timberline Resources Corporation – Butte Highlands Project
Montana Air Quality Permit #4449-00

I. Introduction/Process Description

Timberline Resources Corporation (TRC) proposes to operate an underground exploration project. The facility is located in Sections 31 and 32 in Township 1 North, Range 7 West, and is known as the Butte Highlands Project (BHP).

A. Permitted Equipment

The equipment covered by this Montana Air Quality Permit (MAQP) consists of:

- Cement storage silo with a baghouse on the silo exhaust
- Shotcrete cement plant
- Cement Rock Fill plant
- 924 horsepower (hp) diesel-fired generator as primary electrical supply
- 475 hp emergency back up diesel-fired generator
- 275 hp diesel-fired engine for an air compressor
- 26 hp diesel-fired engine for a welder.

B. Source Description

The TRC BHP is an underground exploration project consisting of drifting, ore recovery for bulk sampling, and development rock removal and storage. Emissions-generating activities at the BHP include wet drilling and blasting using an emulsion blasting agent underground to liberate 10,000 tons of gold ore and 150,000 tons of development rock. These materials will be loaded and transported to the surface. On the surface, the raw ore will be stored in a temporary stockpile for loading with a front-end-loader to haul trucks for transport off-site. Development rock will be unloaded to a permanent development rock stockpile, and the active area of that pile would be subject to wind erosion.

The emissions associated with the underground activities will initially be vented to the outside atmosphere via the primary portal. Once the development advances under the BHP patented claims, a ventilation raise will be developed to the surface. The majority of the mine air, including the air emissions from the underground activities, will exhaust out of the ventilation raise.

During mine development, there will be a need for the use of cement for various underground activities. A cement rock fill (CRF) plant and a shotcrete plant will supply CRF and shotcrete to underground operations, and will require concrete, aggregate (sand for shotcrete plant, development rock for CRF plant), and water. A silo will be located at the site to store bulk cement to be used either in the CRF plant and/or shotcrete plant. The cement silo will be equipped with a baghouse to reduce emissions during cement loading and unloading activities. The silo, CRF plant, and shotcrete plant will be located near the mine portal. Sand and aggregate will be loaded into hoppers using a front-end-loader. The end products will be transported underground via truck.

A Caterpillar DM9081 diesel-fired generator set with a maximum rated engine design capacity of 924 hp will supply power to the site. Other diesel-fired combustion equipment will include an emergency backup generator (475 hp), an air compressor (275 hp), and a welder (26 hp).

Two diesel fuel storage tanks will be present at the site, one 8,000 gallon (diesel) and one 6,000 gallon (bio-diesel).

The exploration project may persist up to two years. It is estimated that the ore transport process of hauling bulk samples to the surface and off-site will occur within a 1-2 month period.

II. Applicable Rules and Regulations

The following are partial explanations of some applicable rules and regulations that apply to the facility. The complete rules are stated in the Administrative Rules of Montana (ARM) and are available, upon request, from the Department of Environmental Quality (Department). Upon request, the Department will provide references for location of complete copies of all applicable rules and regulations or copies where appropriate.

A. ARM 17.8, Subchapter 1 – General Provisions, including but not limited to:

1. ARM 17.8.101 Definitions. This rule includes a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.105 Testing Requirements. Any person or persons responsible for the emission of any air contaminant into the outdoor atmosphere shall, upon written request of the Department, provide the facilities and necessary equipment (including instruments and sensing devices) and shall conduct tests, emission or ambient, for such periods of time as may be necessary using methods approved by the Department.

3. ARM 17.8.106 Source Testing Protocol. The requirements of this rule apply to any emission source testing conducted by the Department, any source or other entity as required by any rule in this chapter, or any permit or order issued pursuant to this chapter, or the provisions of the Clean Air Act of Montana, 75-2-101, *et seq*., Montana Code Annotated (MCA).

   TRC shall comply with the requirements contained in the Montana Source Test Protocol and Procedures Manual, including, but not limited to, using the proper test methods and supplying the required reports. A copy of the Montana Source Test Protocol and Procedures Manual is available from the Department upon request.

4. ARM 17.8.110 Malfunctions. (2) The Department must be notified promptly by telephone whenever a malfunction occurs that can be expected to create emissions in excess of any applicable emission limitation or to continue for a period greater than 4 hours.

5. ARM 17.8.111 Circumvention. (1) No person shall cause or permit the installation or use of any device or any means that, without resulting in reduction of the total amount of air contaminant emitted, conceals or dilutes an emission of air contaminant that would otherwise violate an air pollution control regulation. (2) No equipment that may produce emissions shall be operated or maintained in such a manner as to create a public nuisance.

B. ARM 17.8, Subchapter 2 – Ambient Air Quality, including, but not limited to the following:

1. ARM 17.8.204 Ambient Air Monitoring
2. ARM 17.8.210 Ambient Air Quality Standards for Sulfur Dioxide
3. ARM 17.8.211 Ambient Air Quality Standards for Nitrogen Dioxide
4. ARM 17.8.212 Ambient Air Quality Standards for Carbon Monoxide
5. ARM 17.8.213 Ambient Air Quality Standard for Ozone

6. ARM 17.8.214 Ambient Air Quality Standard for Hydrogen Sulfide
7. ARM 17.8.220 Ambient Air Quality Standard for Settled Particulate Matter
8. ARM 17.8.221 Ambient Air Quality Standard for Visibility
9. ARM 17.8.222 Ambient Air Quality Standard for Lead
10. ARM 17.8.223 Ambient Air Quality Standard for PM_{10}

TRC must maintain compliance with the applicable ambient air quality standards.

C. ARM 17.8, Subchapter 3 – Emission Standards, including, but not limited to:

1. ARM 17.8.304 Visible Air Contaminants. This rule requires that no person may cause or authorize emissions to be discharged into the outdoor atmosphere from any source installed after November 23, 1968, that exhibit an opacity of 20% or greater averaged over 6 consecutive minutes.

2. ARM 17.8.308 Particulate Matter, Airborne. (1) This rule requires an opacity limitation of less than 20% for all fugitive emission sources and that reasonable precautions be taken to control emissions of airborne particulate matter. (2) Under this rule, TRC shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter.

3. ARM 17.8.309 Particulate Matter, Fuel Burning Equipment. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter caused by the combustion of fuel in excess of the amount determined by this rule.

4. ARM 17.8.310 Particulate Matter, Industrial Process. This rule requires that no person shall cause, allow, or permit to be discharged into the atmosphere particulate matter in excess of the amount set forth in this rule.

5. ARM 17.8.322 Sulfur Oxide Emissions--Sulfur in Fuel. This rule requires that no person shall burn liquid, solid, or gaseous fuel in excess of the amount set forth in this rule.

6. ARM 17.8.324 Hydrocarbon Emissions--Petroleum Products. (3) No person shall load or permit the loading of gasoline into any stationary tank with a capacity of 250 gallons or more from any tank truck or trailer, except through a permanent submerged fill pipe, unless such tank is equipped with a vapor loss control device as described in (1) of this rule.

7. ARM 17.8.340 Standard of Performance for New Stationary Sources and Emission Guidelines for Existing Sources. This rule incorporates, by reference, 40 Code of Federal Regulations (CFR) Part 60, Standards of Performance for New Stationary Sources (NSPS). TRC may be considered an NSPS affected facility under 40 CFR Part 60 and subject to the requirements of the following subparts.

   a. 40 CFR 60, Subpart A – General Provisions apply to all equipment or facilities subject to an NSPS Subpart as listed below:

   b. 40 CFR 60, Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. This subpart may apply to the proposed diesel engines because they may have been manufactured after July 11, 2005.

8. ARM 17.8.342 Emission Standards for Hazardous Air Pollutants for Source Categories. The source, as defined and applied in 40 CFR Part 63, may be required to comply with the requirements of 40 CFR Part 63, as listed below:

a. 40 CFR 63, Subpart A – General Provisions apply to all equipment or facilities subject to a National Emission Standard for Hazardous Air Pollutants (NESHAP) Subpart as listed below:

b. 40 CFR 63, Subpart ZZZZ - National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines. As an area source, the diesel engines will be subject to this rule. However, although diesel engines are an affected source, per 40 CFR 63.6590(b)(3) they do not have any requirements unless they are new or reconstructed after June 12, 2006. Therefore, any diesel engine operated by TRC that is new or reconstructed after June 12, 2006, may be subject to the area source provisions of this Subpart.

D. ARM 17.8, Subchapter 5 – Air Quality Permit Application, Operation, and Open Burning Fees, including, but not limited to:

1. ARM 17.8.504 Air Quality Permit Application Fees. This rule requires that an applicant submit an air quality permit application fee concurrent with the submittal of an air quality permit application. A permit application is incomplete until the proper application fee is paid to the Department. TRC submitted the appropriate permit application fee for the current permit action.

2. ARM 17.8.505 Air Quality Operation Fees. An annual air quality operation fee must, as a condition of continued operation, be submitted to the Department by each source of air contaminants holding an air quality permit (excluding an open burning permit) issued by the Department. The air quality operation fee is based on the actual or estimated actual amount of air pollutants emitted during the previous calendar year.

   An air quality operation fee is separate and distinct from an air quality permit application fee. The annual assessment and collection of the air quality operation fee, described above, shall take place on a calendar-year basis. The Department may insert into any final permit issued after the effective date of these rules, such conditions as may be necessary to require the payment of an air quality operation fee on a calendar-year basis, including provisions that prorate the required fee amount.

E. ARM 17.8, Subchapter 7 – Permit, Construction, and Operation of Air Contaminant Sources, including, but not limited to:

1. ARM 17.8.740 Definitions. This rule is a list of applicable definitions used in this chapter, unless indicated otherwise in a specific subchapter.

2. ARM 17.8.743 Montana Air Quality Permits--When Required. This rule requires a person to obtain an air quality permit or permit modification to construct, modify, or use any air contaminant sources that have the potential to emit (PTE) greater than 25 tons per year of any pollutant. TRC has a PTE greater than 25 tons per year of particulate matter (PM), oxides of nitrogen (NO_x), and carbon monoxide (CO); therefore, an air quality permit is required.

3. ARM 17.8.744 Montana Air Quality Permits--General Exclusions. This rule identifies the activities that are not subject to the Montana Air Quality Permit program.

4. ARM 17.8.745 Montana Air Quality Permits--Exclusion for De Minimis Changes. This rule identifies the de minimis changes at permitted facilities that do not require a permit under the Montana Air Quality Permit Program.

5. ARM 17.8.748 New or Modified Emitting Units--Permit Application Requirements. (1) This rule requires that a permit application be submitted prior to installation, modification, or use of a source. TRC submitted the required permit application for the current permit action. (7) This rule requires that the applicant notify the public by means of legal publication in a newspaper of general circulation in the area affected by the application for a permit. TRC submitted an affidavit of publication of public notice for the July 16, 2009 issue of the *Montana Standard*, a newspaper of general circulation in the Town of Butte in Silver Bow County, as proof of compliance with the public notice requirements.

6. ARM 17.8.749 Conditions for Issuance or Denial of Permit. This rule requires that the permits issued by the Department must authorize the construction and operation of the facility or emitting unit subject to the conditions in the permit and the requirements of this subchapter. This rule also requires that the permit must contain any conditions necessary to assure compliance with the Federal Clean Air Act (FCAA), the Clean Air Act of Montana, and rules adopted under those acts.

7. ARM 17.8.752 Emission Control Requirements. This rule requires a source to install the maximum air pollution control capability that is technically practicable and economically feasible, except that Best Available Control Technology (BACT) shall be utilized. The required BACT analysis is included in Section III of this permit analysis.

8. ARM 17.8.755 Inspection of Permit. This rule requires that air quality permits shall be made available for inspection by the Department at the location of the source.

9. ARM 17.8.756 Compliance with Other Requirements. This rule states that nothing in the permit shall be construed as relieving TRC of the responsibility for complying with any applicable federal or Montana statute, rule, or standard, except as specifically provided in ARM 17.8.740, *et seq*.

10. ARM 17.8.759 Review of Permit Applications. This rule describes the Department's responsibilities for processing permit applications and making permit decisions on those permit applications that do not require the preparation of an environmental impact statement.

11. ARM 17.8.762 Duration of Permit. An air quality permit shall be valid until revoked or modified, as provided in this subchapter, except that a permit issued prior to construction of a new or modified source may contain a condition providing that the permit will expire unless construction is commenced within the time specified in the permit, which in no event may be less than 1 year after the permit is issued.

12. ARM 17.8.763 Revocation of Permit. An air quality permit may be revoked upon written request of the permittee, or for violations of any requirement of the Clean Air Act of Montana, rules adopted under the Clean Air Act of Montana, the FCAA, rules adopted under the FCAA, or any applicable requirement contained in the Montana State Implementation Plan (SIP).

13. ARM 17.8.764 Administrative Amendment to Permit. An air quality permit may be amended for changes in any applicable rules and standards adopted by the Board of Environmental Review (Board) or changed conditions of operation at a source or stack that do not result in an increase of emissions as a result of those changed conditions. The owner or operator of a facility may not increase the facility's emissions beyond permit limits unless the increase meets the criteria in ARM 17.8.745 for a de minimis change not requiring a permit, or unless the owner or operator applies for and receives another permit in accordance with ARM 17.8.748, ARM 17.8.749, ARM 17.8.752, ARM 17.8.755, and ARM 17.8.756, and with all applicable requirements in ARM Title 17, Chapter 8, Subchapters 8, 9, and 10.

14. ARM 17.8.765 Transfer of Permit. This rule states that an air quality permit may be transferred from one person to another if written notice of intent to transfer, including the names of the transferor and the transferee, is sent to the Department.

F. ARM 17.8, Subchapter 8 – Prevention of Significant Deterioration of Air Quality, including, but not limited to:

1. ARM 17.8.801 Definitions. This rule is a list of applicable definitions used in this subchapter.

2. ARM 17.8.818 Review of Major Stationary Sources and Major Modifications--Source Applicability and Exemptions. The requirements contained in ARM 17.8.819 through ARM 17.8.827 shall apply to any major stationary source and any major modification, with respect to each pollutant subject to regulation under the FCAA that it would emit, except as this subchapter would otherwise allow.

This facility is not a major stationary source because this facility is not a listed source and the facility's PTE is below 250 tons per year (TPY) of any pollutant (excluding fugitive emissions).

G. ARM 17.8, Subchapter 12 – Operating Permit Program Applicability, including, but not limited to:

1. ARM 17.8.1201 Definitions. (23) Major Source under Section 7412 of the FCAA is defined as any source having:

a. PTE > 100 TPY of any pollutant;

b. PTE > 10 TPY of any one hazardous air pollutant (HAP), PTE > 25 TPY of a combination of all HAPs, or lesser quantity as the Department may establish by rule; or

c. PTE > 70 TPY of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}) in a serious PM_{10} nonattainment area.

2. ARM 17.8.1204 Air Quality Operating Permit Program. (1) Title V of the FCAA amendments of 1990 requires that all sources, as defined in ARM 17.8.1204(1), obtain a Title V Operating Permit. In reviewing and issuing MAQP #4449-00 for TRC, the following conclusions were made:

a. The facility's PTE is less than 100 TPY for any pollutant.

b. The facility's PTE is less than 10 TPY for any one HAP and less than 25 TPY for all HAPs.

c. This source is not located in a serious PM_{10} nonattainment area.

d. This facility may be subject to a current NSPS (40 CFR 60, Subpart IIII).

e. This facility may be subject to area source provisions of a current NESHAP (40 CFR 63, Subpart ZZZZ).

f. This source is not a Title IV affected source, or a solid waste combustion unit.

g. This source is not an EPA designated Title V source.

Based on these facts, the Department determined that TRC will be a minor source of emissions as defined under Title V. However, if minor sources subject to NSPS are required to obtain a Title V Operating Permit, TRC may be required to obtain a Title V Operating Permit.

III. BACT Determination

A BACT determination is required for each new or modified source. TRC shall install on the new or modified source the maximum air pollution control capability which is technically practicable and economically feasible, except that BACT shall be utilized.

A BACT analysis was submitted by TRC in permit application #4449-00, addressing some available methods of controlling emissions from the sources that would be used at the mine. The Department reviewed these methods, as well as previous BACT determinations. The following control options have been reviewed by the Department in order to make the following BACT determination.

Diesel Engines BACT Analysis

The control options required for the diesel engines are consistent with other recently permitted similar sources and are capable of achieving the appropriate emission standards. NO_x emissions were analyzed, as NO_x is the primary pollutant emitted from this type of source. The following options were examined during the NO_x BACT analysis for the diesel engines:

1. Combustion modifications, such as injection timing retard, preignition chamber combustion, air-to-fuel ratio adjustment. This type of control technology helps reduce NO_x formation in the combustion zone.

2. Selective Catalytic Reduction (SCR), which is a post-combustion gas treatment technique that uses a catalyst to reduce NO and NO_2 to molecular nitrogen, water and oxygen (O_2). Ammonia (NH_3) is commonly used as the reducing agent.

3. Non-selective Catalytic Reduction (NSCR) uses a three-way catalyst to promote the decomposition of NO_x to nitrogen and water. Exhaust carbon monoxide and hydrocarbons are simultaneously oxidized to carbon dioxide (CO_2) and water in this process. NSCR is applicable only to engines with exhaust O_2 concentrations below approximately 1% (such as rich-burn natural gas-fired engines); and

4. Proper design and operation can reduce NO_x by controlling the combustion temperature, residence time, and available O_2. Normal combustion practices involve maximizing the heating efficiency of the fuel in an effort to minimize fuel usage. Increasing the efficiency of fuel combustion also minimizes NO_x formation.

<u>Technical Feasibility</u>

NSCR is only applicable to rich-burn engines and diesel-fueled engines can not be operated as rich-burn. Consequently, NSCR is technically infeasible for the diesel engines. An SCR unit requires that the combustion unit operate on a continuous basis for optimal NO_x control. SCR is considered technically infeasible for the emergency generator, air compressor, and welder engines. The emergency generator engine will only be operated in relatively small increments during emergencies, back-up, or monthly inspections. The air compressor and welder engines are permitted to operate continuously; however, actual practice will most likely result in intermittent operations on an as-needed basis. SCR is technically feasible for the primary generator because it is expected to operate continuously.

Environmental Feasibility

The primary environmental concern from any of the proposed options is the on-site storage and usage of urea for an SCR system. Although this type of system is in operation at many facilities, it is an additional environmental liability.

Economic Feasibility

Due to the relatively short 2-year duration of the exploratory project, the cost of implementing and maintaining an SCR system represents an adverse economic impact that is disproportionately high relative to control costs required of similar facilities. It is therefore eliminated from consideration as BACT for this application.

TRC proposes proper engine design and combustion with no add-on controls to meet the EPA nonroad diesel Tier 1 or 2 emission standards and good operating practices as BACT. The proposed NO_x BACT conforms with previous BACT determinations made by the Department for diesel-fired engines.

The Department determined that additional controls for particulate matter (PM), PM_{10}, volatile organic compounds (VOC), CO, and oxides of sulfur (SO_x) are technically or economically infeasible. Therefore, the Department determined that proper operation and maintenance with no additional controls for PM, PM_{10}, VOC, CO, and SO_x would constitute BACT for the diesel generators/engines.

CRF and Shotcrete Plant BACT Analysis

The exploratory project will include a CRF and shotcrete plant, associated material handling equipment, and a dry cement storage silo. Emissions associated with these plants occur as a result of transferring materials from one system to another. These transfers occur, for example, when material is transferred from the storage silo to a feed auger or from a feed auger to a mixing tank.

Emissions from these sources consist of PM and PM_{10}. The amount of condensable species in the PM_{10} is inconsequential, so filterable PM_{10} effectively equals total PM_{10}. The available technologies considered for controlling PM/PM_{10} emissions from the proposed CRF and shotcrete plants are as follows:

1. Fabric Filter Baghouses direct air flow through tightly woven or felted fabric, causing particulate matter in the air stream to be collected on the fabric by sieving and other mechanisms. As particulate matter collects on the filter, collection efficiency increases while pressure drop through the system increases. Bags are intermittently cleaned by shaking the bag, pulsing air through the bag, or temporarily reversing the airflow direction. Particulate-laden air must be able to be collected and ducted to the baghouse.

2. An Electrostatic Precipitator (ESP) uses electrical forces to move entrained particles onto a collection surface. To remove dust cake from the collection surface, the collection surface is periodically “rapped” by a variety of means to dislodge the particulate, which drops down into a hopper. Particulate-laden air must be able to be collected and ducted to the ESP.

3. Wet Dust Suppression Including Retained or Inherent Moisture cause emissions to be reduced through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. Moisture retained from water sprays upstream in the process or moisture inherent in the material provides a similar emission reducing effect.

4. Enclosure technology employs structures or underground placement to shelter material from wind entrainment. Enclosures can either fully or partially surround the source.

5. Best Operational Practices (BOPs) include a variety of techniques such as reducing transfer point drop heights, limiting disturbance frequency of storage piles, and making use of natural hygroscopic properties of the mined material.

6. No Add-on Control is the base case for proposed new sources.

Fabric filter baghouse dust collector control is technically feasible for the proposed material transfer sources. However, controlling a significant number of sources with a single baghouse would require extensive lengths of ducting. In that case, multiple baghouses would be required, and the cost effectiveness of this option would rise significantly, deeming the fabric filter baghouse control economically infeasible for the capturing emissions from all of the CRF and shotcrete plant emission sources. The cement storage silo; however, is equipped with a fabric filter baghouse located at the silo exhaust to control emissions resulting from the filling and dispensing of the dry cement powder.

Although ESP units are theoretically capable of controlling particulate emissions at levels similar to baghouses, they are generally not feasible for the applications considered here. ESP's are considered technically infeasible because they are usually not suited for use on processes which are highly variable, since frequent changes in operating conditions are likely to degrade ESP performance.

Wet dust suppression works by causing fine particles to agglomerate through the introduction of moisture into the material stream. The agglomerated particles resist entrainment by wind. The effects of wet suppression can be achieved by high moisture levels inherent in the material. Water is mixed with the materials as part of the production process for CRF and shotcrete. Because use of wet suppression can achieve a control efficiency of approximately 90% or greater, wet dust suppression was evaluated for the proposed new sources.

For the proposed material transfer particulate sources from the CRF and shotcrete plants, wet dust suppression or suppression due to inherent moisture has been deemed technically and economically feasible. Because wet dust suppression provides the highest level of control of the remaining alternatives (enclosures, BOPs, and no additional control), no further analyses are necessary. The Department determined that TRC's proposal of wet dust suppression and/or inherent moisture constitutes BACT for the transfer sources associated with the CRF and shotcrete plant.

The cement storage silo is equipped with a fabric filter baghouse with a manufacturer grain loading design of 0.01 grains per dry standard cubic feet. The Department considers operation and maintenance of the fabric filter baghouse on the cement storage silo to be BACT for controlling particulate emissions associated with the filling and emptying of the silo because these emission control systems constitute highly effective methods for the control of PM. This control technology is utilized as BACT on other similar sources permitted by the Department.

Fugitive Emissions BACT Analysis

The exploratory project will have several non-point sources of fugitive emissions such as unloading development rock to storage piles, loading ore with a front-end loader to a haul truck, or wind erosion of storage piles. Two types of emissions controls are readily available and used for dust suppression of these fugitive emissions. These two control methods are water and chemical dust suppressant. Chemical dust suppressant could be used to control the fugitive emissions; however, because water is more readily available, is less expensive, is equally effective as chemical dust suppressant, and is more environmentally friendly, water has been identified as BACT for particulate emissions for the general plant area. In addition, water suppression has been required of recently permitted similar sources. TRC may use chemical dust suppressant to assist in controlling

particulate emissions from the surrounding plant area. Several facility processes incorporate the introduction of water to the materials or naturally occurring high moisture content of the material, both of which achieve the desired control of particulate emissions from storage or transfer operations.

TRC must also take reasonable precautions to limit the fugitive emissions of airborne particulate matter from haul roads, access roads, parking areas, and the general area of operation. TRC is required to have water spray bars and water available on site (at all times) and to apply the water, as necessary, to maintain compliance with the opacity and reasonable precaution limitations. TRC may also use chemical dust suppression in order to maintain compliance with emission limitations in Section II.A of MAQP #4449-00. The Department determined that using water and/or chemical dust suppressant to maintain compliance with the opacity requirements and reasonable precaution limitations constitutes BACT for the fugitive emission sources.

IV. Emission Inventory

Non-Fugitive Sources	**TPY**						
Emission Source	**PM**	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**CO**	**VOC**	**SO_2**
Cement Silo loading	0.14	0.14	0.14				
Shotcrete Plant Cement Feed Auger to Mix Tank	1.09	0.27	0.05				
CRF Plant Cement Feed Auger to Mix Hopper	10.42	2.57	0.51				
Diesel Generator - Primary 924 hp (Caterpillar Emission Factors)	1.05	1.05	1.05	54.40	6.53	0.96	0.16
Diesel Generator - Backup 475 hp (EPA Tier II)	0.04	0.04	0.04	1.18	0.68	0.08	0.24
Diesel Engine - Compressor 275 hp (EPA Tier I)	1.06	1.06	1.06	18.32	22.57	2.66	2.47
Diesel Engine - Welder 26 hp (EPA Tier II)	0.08	0.08	0.08	1.31	0.93	0.10	0.23
Total Emissions	**13.89**	**5.21**	**2.94**	**75.21**	**30.71**	**3.80**	**3.11**

NOTES:

PM	Particulate matter
PM_{10}	PM with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	PM with an aerodynamic diameter of 2.5 microns or less
*	$PM_{2.5}$ estimations are for filterable fractions only
NO_x	Oxides of nitrogen
CO	Carbon monoxide
VOC	Volatile organic compounds
SO_2	Sulfur dioxide

Fugitive Sources	**TPY**						
Emission Source	**PM**	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**CO**	**VOC**	**SO_2**
Ore Unloading	0.11	0.05	0.01				
Development Rock Unloading	0.11	0.05	0.01				
Ore Haul Truck Loading	0.11	0.05	0.01				
Ore Haul Truck Travel	7.92	2.21	0.22				
Unloading Sand to Storage Area	0.03	0.01	0.00				
Shotcrete Plant Sand Transfer to Mixing Pit w/FEL	0.03	0.01	0.00				
CRF Plant Aggregate Hopper loading w/ FEL	1.89	0.90	0.18				
FEL travel	34.68	9.66	0.97				
Shotcrete truck transport to underground	0.57	0.16	0.02				
CRF Plant truck transport to underground	9.36	2.61	0.26				
8,000 gallon diesel tank						0.00	
6,000 gallon diesel tank						0.00	
Development Rock Stockpile Wind Erosion	5.59	1.68	0.25				

Fugitive Sources	TPY						
Emission Source	**PM**	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**CO**	**VOC**	**SO_2**
Total Emissions	**60.39**	**17.40**	**1.92**	**0.00**	**0.00**	**0.00**	**0.00**

NOTES:

* $PM_{2.5}$ estimations are for filterable fractions only

Underground Mine Sources	TPY						
Emission Source	**PM**	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**CO**	**VOC**	**SO_2**
Wet Drilling	0.01	0.01	0.01				
Blasting	0.02	0.01	0.00	0.05	2.46		
Underground Ore Loading	0.02	0.01	0.00				
Underground Development Rock Loading	0.02	0.01	0.00				
Total Emissions	**0.08**	**0.04**	**0.01**	**0.05**	**2.46**	**0.00**	**0.00**

NOTES:

* $PM_{2.5}$ estimations are for filterable fractions only

Facility-Wide Emissions	TPY						
	PM	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**CO**	**VOC**	**SO_2**
Total Emissions	**74.36**	**22.65**	**4.87**	**75.26**	**33.17**	**3.80**	**3.11**

NOTES:

* $PM_{2.5}$ estimations are for filterable fractions only

CALCULATIONS

Non-fugitive Sources

Cement Silo
Flow Capacity = 375 cubic feet per minute (cfm) (Vendor information)
Maximum Hours of Operation = 8,760 hrs/yr

Total PM Emissions:
Emission Factor = 0.01 gr/dscf (Vendor information)
Calculation:
(375 cfm) * (8760 hrs/yr) * (0.01 gr/dscf) * (lb/7000 gr) * (ton/2000 lb) * (60 min/hr) = 0.14 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.01 gr/dscf (Vendor information)
Calculation:
(375 cfm) * (8760 hrs/yr) * (0.01 gr/dscf) * (lb/7000 gr) * (ton/2000 lb) * (60 min/hr) = 0.14 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.01 gr/dscf (Vendor information, assume $PM_{2.5}$ = PM_{10})
Calculation:
(375 cfm) * (8760 hrs/yr) * (0.01 gr/dscf) * (lb/7000 gr) * (ton/2000 lb) * (60 min/hr) = 0.14 ton/yr

Shotcrete Plant Cement Feed Auger to Mix Tank
Maximum Process Rate = 0.92 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Transfers = 1 transfer (Company Information)

Total PM Emissions:
Emission Factor = 0.544 lb/ton (AP 42, Table 11.12-2, 6/06)

Control Efficiency = 50% (Water Spray)
Calculation: (0.92 ton/hr) * (8760 hrs/yr) * (0.544 lb/ton) * (ton/2000 lb) * (1 transfer) * (1 - 50/100) = 1.09 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.134 lb/ton (AP 42, Table 11.12-2, 6/06)
Control Efficiency = 50% (Water Spray)
Calculation: (0.92 ton/hr) * (8760 hrs/yr) * (0.134 lb/ton) * (ton/2000 lb) * (1 transfer) * (1 - 50/100) = 0.27 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.0268 lb/ton (assume $PM_{2.5}$ = 20% * PM_{10}, AP 42, Table 11.12-2, 6/06)
Control Efficiency = 50% (Water Spray)
Calculation: (0.92 ton/hr) * (8760 hrs/yr) * (0.0268 lb/ton) * (ton/2000 lb) * (1 transfer) * (1 - 50/100) = 0.05 ton/yr

CRF Plant Cement Feed Auger to Mix Hopper
Maximum Process Rate = 4.38 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Transfers = 1 transfer (Company Information)

Total PM Emissions:
Emission Factor = 0.544 lb/ton (0.544 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (4.38 ton/hr) * (8760 hrs/yr) * (0.544 lb/ton) * (ton/2000 lb) * (1 transfer) = 10.42 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.134 lb/ton (0.134 uncontrolled, AP 42, Table 11.12-2, 6/06)
Control Efficiency = 0% (Uncontrolled)
Calculation: (4.38 ton/hr) * (8760 hrs/yr) * (0.134 lb/ton) * (ton/2000 lb) * (1 transfer) = 2.57 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.0268 lb/ton (assume $PM_{2.5}$ = 20% * PM_{10}, AP 42, Table 11.12-2, 6/06)
Calculation: (4.38 ton/hr) * (8760 hrs/yr) * (0.0268 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.51 ton/yr

Diesel Generator – Primary 924 hp
Operational Capacity of Engine = 924 hp
Hours of Operation = 8,760.00 hours

PM Emissions:
PM Emissions = 1.05 ton/yr (Assume PM = PM_{10})

PM_{10} Emissions:
Emission Factor = 0.24 lbs/hr Largest Caterpillar "Not To Exceed" Emission Factor
Calculation: (8,760 hours) * (0.24 lbs/hr) * (ton/2000 lb) = 1.05 ton/yr

NO_x Emissions:
Emission Factor = 12.42 lbs/hr Largest Caterpillar "Not To Exceed" Emission Factor
Calculation: (8,760 hours) * (12.42 lbs/hr) * (ton/2000 lb) = 54.40 ton/yr

CO Emissions:
Emission Factor = 1.49 lbs/hr Largest Caterpillar "Not To Exceed" Emission Factor
Calculation: (8,760 hours) * (1.49 lbs/hr) * (ton/2000 lb) = 6.53 ton/yr

VOC Emissions:
Emission Factor = 0.22 lbs/hr Largest Caterpillar "Not To Exceed" Emission Factor
Calculation: (8,760 hours) * (0.22 lbs/hr) * (ton/2000 lb) = 0.96 ton/yr Assume HC = VOC

SO_x Emissions:
Emission Factor = 0.00004045 lbs/hp-hr (AP-42, Sec. 3.4, Table 3.4-1, S=0.05%, 10/96)
Calculation: (8,760 hours) * (924 hp) * (0.00004045 lbs/hp-hr) * (ton/2000 lb) = 0.164 ton/yr

Diesel Generator – Backup 475 hp Tier 2 Compliant
Operational Capacity of Engine = 475 hp
Hours of Operation = 500 hours

PM Emissions:
PM Emissions = 0.04 ton/yr (Assume PM = PM_{10})

PM_{10} Emissions:
Emission Factor = 3.31E-04 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (500 hours) * (475 hp) * (3.31E-04 lbs/hp-hr) * (ton/2000 lb) = 0.04 ton/yr

NO_x Emissions:
Emission Factor = 9.92E-03 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (500 hours) * (475 hp) * (9.92E-03 lbs/hp-hr) * (ton/2000 lb) = 1.18 ton/yr

CO Emissions:
Emission Factor = 5.73E-03 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (500 hours) * (475 hp) * (5.73E-03 lbs/hp-hr) * (ton/2000 lb) = 0.68 ton/yr

VOC Emissions:
Emission Factor = 6.61E-04 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (500 hours) * (475 hp) * (6.61E-04 lbs/hp-hr) * (ton/2000 lb) = 0.08 ton/yr

SO_x Emissions:
Emission Factor = 0.00205 lbs/hp-hr (AP-42, Sec. 3.3, Table 3.3-1, 10/96)
Calculation: (500 hours) * (475 hp) * (0.00205 lbs/hp-hr) * (ton/2000 lb) = 0.243 ton/yr

Diesel Engine – 275 hp air compressor Tier 1 Compliant
Operational Capacity of Engine = 275 hp
Hours of Operation = 8,760.00 hours

PM Emissions:
PM Emissions = 1.06 ton/yr (Assume PM = PM_{10})

PM_{10} Emissions:
Emission Factor = 8.82E-04 lbs/hp-hr (EPA Tier 1 emissions standards)
Calculation: (8,760 hours) * (275 hp) * (8.82E-04 lbs/hp-hr) * (ton/2000 lb) = 1.06 ton/yr

NO_x Emissions:
Emission Factor = 1.52E-02 lbs/hp-hr (EPA Tier 1 emissions standards)
Calculation: (8,760 hours) * (275 hp) * (1.52E-02 lbs/hp-hr) * (ton/2000 lb) = 18.32 ton/yr

CO Emissions:
Emission Factor = 1.87E-02 lbs/hp-hr (EPA Tier 1 emissions standards)
Calculation: (8,760 hours) * (275 hp) * (1.87E-02 lbs/hp-hr) * (ton/2000 lb) = 22.57 ton/yr

VOC Emissions:
Emission Factor = 2.20E-03 lbs/hp-hr (EPA Tier 1 emissions standards)
Calculation: (8,760 hours) * (275 hp) * (2.20E-03 lbs/hp-hr) * (ton/2000 lb) = 2.66 ton/yr

SO_x Emissions:
Emission Factor = 0.00205 lbs/hp-hr (AP-42, Sec. 3.3, Table 3.3-1, 10/96)
Calculation: (8,760 hours) * (275 hp) * (0.00205 lbs/hp-hr) * (ton/2000 lb) = 2.47 ton/yr

Diesel Engine – 26 hp welder Tier 2 Compliant
Operational Capacity of Engine = 26 hp
Hours of Operation = 8,760.00 hours

PM Emissions:
PM Emissions = 0.08 ton/yr (Assume PM = PM_{10})

PM_{10} Emissions:
Emission Factor = 6.61E-04 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (8,760 hours) * (26 hp) * (6.61E-04 lbs/hp-hr) * (ton/2000 lb) = 0.08 ton/yr

NO_x Emissions:
Emission Factor = 1.15E-02 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (8,760 hours) * (26 hp) * (1.15E-02 lbs/hp-hr) * (ton/2000 lb) = 1.31 ton/yr

CO Emissions:
Emission Factor = 8.16E-03 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (8,760 hours) * (26 hp) * (8.16E-03 lbs/hp-hr) * (ton/2000 lb) = 0.93 ton/yr

VOC Emissions:
Emission Factor = 8.82E-04 lbs/hp-hr (EPA Tier 2 emissions standards)
Calculation: (8,760 hours) * (26 hp) * (8.82E-04 lbs/hp-hr) * (ton/2000 lb) = 0.10 ton/yr

SO_x Emissions:
Emission Factor = 0.00205 lbs/hp-hr (AP-42, Sec. 3.3, Table 3.3-1, 10/96)
Calculation: (8,760 hours) * (26 hp) * (0.00205 lbs/hp-hr) * (ton/2000 lb) = 0.23 ton/yr

Fugitive Sources

Ore Unloading
Maximum Process Rate = 21 ton/hr (Maximum plant process rate)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 pile

PM Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00119 lb/ton
Where: k = particle size multiplier = 0.74 (Value for PM < 30 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00119 lb/ton) * (ton/2000 lb) * (1 piles) = 0.11 ton/yr

PM_{10} Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00056 lb/ton

Where: k = particle size multiplier = 0.35 (Value for PM < 10 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00056 lb/ton) * (ton/2000 lb) * (1 piles) = 0.05 ton/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00009 lb/ton
Where: k = particle size multiplier = 0.053 (Value for PM < 2.5 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00009 lb/ton) * (ton/2000 lb) * (1 piles) = 0.01 ton/yr

Development Rock Unloading
Maximum Process Rate = 21 ton/hr (Maximum plant process rate)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 pile

PM Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00119 lb/ton
Where: k = particle size multiplier = 0.74 (Value for PM < 30 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00119 lb/ton) * (ton/2000 lb) * (1 piles) = 0.11 ton/yr

PM_{10} Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00056 lb/ton
Where: k = particle size multiplier = 0.35 (Value for PM < 10 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00056 lb/ton) * (ton/2000 lb) * (1 piles) = 0.05 ton/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00009 lb/ton
Where: k = particle size multiplier = 0.053 (Value for PM < 2.5 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00009 lb/ton) * (ton/2000 lb) * (1 piles) = 0.01 ton/yr

Ore Haul Truck Loading
Maximum Process Rate = 21 ton/hr (Maximum plant process rate)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 pile

PM Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00119 lb/ton
Where: k = particle size multiplier = 0.74 (Value for PM < 30 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00119 lb/ton) * (ton/2000 lb) * (1 piles) = 0.11 ton/yr

PM_{10} Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00056 lb/ton
Where: k = particle size multiplier = 0.35 (Value for PM < 10 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00056 lb/ton) * (ton/2000 lb) * (1 piles) = 0.05 ton/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00009 lb/ton
Where: k = particle size multiplier = 0.053 (Value for PM < 2.5 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 6.2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00009 lb/ton) * (ton/2000 lb) * (1 piles) = 0.01 ton/yr

Ore Haul Truck Travel
Vehicle Miles Traveled (VMT) per Day = 8 VMT/day (Company info)
VMT per hour = (7.95 VMT/day) * (day/24 hrs) = 0.33 VMT/hr
Hours of Operation = 8,760 hrs/yr

PM Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 10.92 lb/VMT
Where: k = constant = 4.9 lbs/VMT (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 37 tons (Company info)
a = constant = 0.7 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.33 VMT/hr) * (10.92 lb/VMT) * (ton/2000 lb) * (1-50/100) = 7.92 tons/yr

PM_{10} Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 3.04 lb/VMT
Where: k = constant = 1.5 lbs/VMT (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 37 tons (Company info)

a = constant = 0.9 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.33 VMT/hr) * (3.04 lb/VMT) * (ton/2000 lb) * (1-50/100) = 2.21 tons/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 0.30 lb/VMT
Where: k = constant = 0.15 lbs/VMT (Value for $PM_{2.5}$, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 37 tons (Company info)
a = constant = 0.9 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.33 VMT/hr) * (0.30 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.22 tons/yr

Unloading Sand to Storage Area
Maximum Process Rate = 3.13 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Transfers = 1 transfer (Company Information)

Total PM Emissions:
Emission Factor = 0.0021 lb/ton (0.0021 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (3 ton/hr) * (8760 hrs/yr) * (0.0021 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.03 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.00099 lb/ton (0.00099 uncontrolled, AP 42, Table 11.12-2, 6/06)
Control Efficiency = 0% (Uncontrolled)
Calculation: (3 ton/hr) * (8760 hrs/yr) * (0.00099 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.01 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.000198 lb/ton (assume $PM_{2.5}$ = 20% * PM_{10}, AP 42, Table 11.12-2, 6/06)
Calculation: (0 %) * (0.02874375 ton/yr) * (0.000198 lb/ton) * (ton/2000 lb) * (0.02874375 ton/yr) = 0.00 ton/yr

Shotcrete Plant Sand Transfer to Mixing Pit with Front End Loader
Maximum Process Rate = 3.13 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Transfers = 1 transfer (Company Information)

Total PM Emissions:
Emission Factor = 0.0021 lb/ton (0.0021 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (3 ton/hr) * (8760 hrs/yr) * (0.0021 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.03 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.00099 lb/ton (0.00099 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (3 ton/hr) * (8760 hrs/yr) * (0.00099 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.01 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.000198 lb/ton (assume $PM_{2.5}$ = 20% * PM_{10}, AP 42, Table 11.12-2, 6/06)
Calculation: (0 %) * (0.02874375 ton/yr) * (0.000198 lb/ton) * (ton/2000 lb) * (0.02874375 ton/yr) = 0.00 ton/yr

CRF Plant Aggregate Hopper Loading with Front End Loader
Maximum Process Rate = 62.50 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Transfers = 1 transfer (Company Information)

Total PM Emissions:
Emission Factor = 0.0069 lb/ton (0.0069 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (63 ton/hr) * (8760 hrs/yr) * (0.0069 lb/ton) * (ton/2000 lb) * (1 transfer) = 1.89 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.0033 lb/ton (0.0033 uncontrolled, AP 42, Table 11.12-2, 6/06)
Calculation: (63 ton/hr) * (8760 hrs/yr) * (0.0033 lb/ton) * (ton/2000 lb) * (1 transfer) = 0.90 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.00066 lb/ton (assume $PM_{2.5}$ = 20% * PM_{10}, AP 42, Table 11.12-2, 6/06)
Calculation: (0 %) * (1.888875 ton/yr) * (0.00066 lb/ton) * (ton/2000 lb) * (1.888875 ton/yr) = 0.18 ton/yr

Front End Loader Travel
Vehicle Miles Traveled (VMT) per Day = 39 VMT/day (Company info)
VMT per hour = (39.45 VMT/day) * (day/24 hrs) = 1.64 VMT/hr
Hours of Operation = 8,760 hrs/yr

PM Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 9.63 lb/VMT
Where: k = constant = 4.9 lbs/VMT (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 28 tons (Company info)
a = constant = 0.7 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (1.64 VMT/hr) * (9.63 lb/VMT) * (ton/2000 lb) * (1-50/100) = 34.68 tons/yr

PM_{10} Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 2.68 lb/VMT
Where: k = constant = 1.5 lbs/VMT (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 28 tons (Company info)
a = constant = 0.9 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (1.64 VMT/hr) * (2.68 lb/VMT) * (ton/2000 lb) * (1-50/100) = 9.66 tons/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 0.27 lb/VMT
Where: k = constant = 0.15 lbs/VMT (Value for $PM_{2.5}$, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 28 tons (Company info)
a = constant = 0.9 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (1.64 VMT/hr) * (0.27 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.97 tons/yr

Shotcrete Truck Transport to Underground
Vehicle Miles Traveled (VMT) per Day = 1 VMT/day (Company info)
VMT per hour = (0.582 VMT/day) * (day/24 hrs) = 0.02 VMT/hr
Hours of Operation = 8,760 hrs/yr

PM Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 10.65 lb/VMT
Where: k = constant = 4.9 lbs/VMT (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.7 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.02 VMT/hr) * (10.65 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.57 tons/yr

PM_{10} Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 2.97 lb/VMT
Where: k = constant = 1.5 lbs/VMT (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.9 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM10, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.02 VMT/hr) * (2.97 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.16 tons/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 0.30 lb/VMT
Where: k = constant = 0.15 lbs/VMT (Value for $PM_{2.5}$, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)

W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.9 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.02 VMT/hr) * (0.30 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.02 tons/yr

CRF Plant Truck Transport to Underground
Vehicle Miles Traveled (VMT) per Day = 10 VMT/day (Company info)
VMT per hour = (9.63 VMT/day) * (day/24 hrs) = 0.40 VMT/hr
Hours of Operation = 8,760 hrs/yr

PM Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 10.65 lb/VMT
Where: k = constant = 4.9 lbs/VMT (Value for PM_{30}/TSP, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.7 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM30/TSP, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.40 VMT/hr) * (10.65 lb/VMT) * (ton/2000 lb) * (1-50/100) = 9.36 tons/yr

PM_{10} Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 2.97 lb/VMT
Where: k = constant = 1.5 lbs/VMT (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.9 (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for PM_{10}, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.40 VMT/hr) * (2.97 lb/VMT) * (ton/2000 lb) * (1-50/100) = 2.61 tons/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor for unpaved roads at industrial sites provided per AP 42, Ch. 13.2.2, 11/06.
Emission Factor = k * (s / 12)^a * (W / 3)^b = 0.30 lb/VMT
Where: k = constant = 0.15 lbs/VMT (Value for PM2.5, AP 42, Table 13.2.2-2, 11/06)
s = surface silt content = 7.5 % (Mean value, sand/gravel processing, material storage area, AP 42, Table 13.2.2-1, 11/06)
W = mean vehicle weight = 35 tons (Company info)
a = constant = 0.9 (Value for $PM_{2.5}$, AP 42, Table 13.2.2-2, 11/06)
b = constant = 0.45 (Value for $PM_{2.5}$, AP 42, Table 13.2.2-2, 11/06)
Control Efficiency = 50% (Water spray or chemical dust suppressant)
Calculation: (8760 hrs/yr) * (0.40 VMT/hr) * (0.30 lb/VMT) * (ton/2000 lb) * (1-50/100) = 0.26 tons/yr

Diesel Storage Tanks
TANKS 4.0.9d Report
Distillate fuel oil No. 2

8,000 gallon tank
Total Emissions = 4.69 lbs/yr = 0.0023 tons/yr

6,000 gallon tank
Total Emissions = 3.53 lbs/yr = 0.0018 tons/yr

Development Rock Stockpile Wind Erosion
Exposed Area = 29 acres (Company Information)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 pile(s) (Company Information)

Total PM Emissions:
Emission Factor = 0.38 tons/acre-yr (TSP, AP 42, Table 11.9-4, 7/98)
Control Efficiency = 50% (Water spray)
Calculation: (29 acres) * (0.38 tons/acre-yr) * (1 - 50/100) = 5.59 ton/yr

Total PM_{10} Emissions:
Emission Factor = 0.114 tons/acre-yr (Company Information, assume PM_{10} = 30% total PM)
Control Efficiency = 50% (Water spray)
Calculation: (29 acres) * (0.114 tons/acre-yr) * (1 - 50/100) = 1.68 ton/yr

Total $PM_{2.5}$ Emissions:
Emission Factor = 0.0171 tons/acre-yr (Company Information, assume $PM_{2.5}$ = 15% PM10)
Control Efficiency = 50% (Water spray)
Calculation: (29 acres) * (0.0171 tons/acre-yr) * (1 - 50/100) = 0.25 ton/yr

Underground Mine Sources

Wet Drilling
Production Rate = 20.83 ton/hr (Company Information based on max daily short-term throughput)
Maximum Hours of Operation = 8,760 hrs/yr

PM Emissions:
Emission Factor = 0.00008 lb/ton (no AP-42 PM data, assume PM=PM_{10})
Calculation: (8760 hrs/yr) * (20.83 ton/hr) * (0.00008 lb/ton) * (ton/2000 lb) = 0.01 ton/yr

PM_{10} Emissions:
Emission Factor = 0.00008 lb/ton (Wet Drilling, AP-42, Table 11.19.2-2, 8/04)
Calculation: (8760 hrs/yr) * (20.83 ton/hr) * (0.00008 lb/ton) * (ton/2000 lb) = 0.01 ton/yr

$PM_{2.5}$ Emissions:
Emission Factor = 0.00008 lb/ton (no AP-42 $PM_{2.5}$ data, assume $PM_{2.5}$ = PM_{10})
Calculation: (8760 hrs/yr) * (20.83 ton/hr) * (0.00008 lb/ton) * (ton/2000 lb) = 0.01 ton/yr

Blasting
Maximum Process Rate = 2 blasts/day (Application information)
Area blasted = 240 sq. ft. (Application information)
Maximum Daily Explosive Usage = 1 tons/day (Application information)

PM Emissions:
Emission Factor = 0.000014 * (240 sq. ft.)^1.5 = 0.0521 lb/blast (AP-42, Table 11.9-1,7/98)
Calculation: (2 blasts/day) * (0.05 lb/blast) * (365 days/year) * (ton/2000 lb) = 0.0190 ton/yr

PM_{10} Emissions:
Emission Factor = 0.000014 * (240 sq. ft.)^1.5 * 0.52 = 0.026 lb/blast (AP-42, Table 11.9-1,7/98)
Calculation: (2 blasts/day) * (0.03 lb/blast) * (365 days/year) * (ton/2000 lb) = 0.0099 ton/yr

$PM_{2.5}$ Emissions:
Based on AP-42
Emission Factor = 0.000014 * (240 sq. ft.)^1.5 * 0.03 = 0.0015 lb/blast (AP-42, Table 11.9-1,7/98)
Calculation: (2 blasts/day) * (0.0016 lb/blast) * (365 days/year) * (ton/2000 lb) = 0.0006 ton/yr

CO Emissions:
Emission Factor = 27 lb/ton (Dyno Nobel North America information)
Calculation: (0.5 tons/day) * (27 lb/ton) * (365 days/year) * (ton/2000 lb) = 2.46375 ton/yr

NO_x Emissions:
Emission Factor = 0.5 lb/ton (Dyno Nobel North America information)
Calculation: (0.5 tons/day) * (0.5 lb/ton) * (365 days/year) * (ton/2000 lb) = 0.045625 ton/yr

Underground Ore Loading
Maximum Process Rate = 21 ton/hr (Maximum plant process rate)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 piles

PM Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00027 lb/ton
Where: k = particle size multiplier = 0.74 (Value for PM < 30 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00027 lb/ton) * (ton/2000 lb) * (1 piles) = 0.02 ton/yr

PM_{10} Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00013 lb/ton
Where: k = particle size multiplier = 0.35 (Value for PM < 10 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00013 lb/ton) * (ton/2000 lb) * (1 piles) = 0.01 ton/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00002 lb/ton
Where: k = particle size multiplier = 0.053 (Value for PM < 2.5 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00002 lb/ton) * (ton/2000 lb) * (1 piles) = 0.00 ton/yr

Underground Development Rock Loading
Maximum Process Rate = 21 ton/hr (Maximum plant process rate)
Maximum Hours of Operation = 8,760 hrs/yr
Number of Piles = 1 piles

PM Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00027 lb/ton
Where: k = particle size multiplier = 0.74 (Value for PM < 30 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00027 lb/ton) * (ton/2000 lb) * (1 piles) = 0.02 ton/yr

PM_{10} Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00013 lb/ton
Where: k = particle size multiplier = 0.35 (Value for PM < 10 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00013 lb/ton) * (ton/2000 lb) * (1 piles) = 0.01 ton/yr

$PM_{2.5}$ Emissions:
Predictive equation for emission factor provided per AP 42, Sec. 13.2.4.3, 11/06.
Emission Factor = k (0.0032) * (U/5)^1.3 * (M / 2)^-1.4 = 0.00002 lb/ton
Where: k = particle size multiplier = 0.053 (Value for PM < 2.5 microns per AP 42, Sec. 13.2.4.3, 11/06)
U = mean wind speed = 2 mph (Provided by company for average Butte windspeed)
M = material moisture content = 4% (Provided by company)
Calculation: (21 ton/hr) * (8760 hrs/yr) * (0.00002 lb/ton) * (ton/2000 lb) * (1 piles) = 0.00 ton/yr

V. Existing Air Quality

The existing air quality of the proposed project location is considered in attainment for all regulated air pollutants. Within Silver Bow County is the Butte PM_{10} nonattainment area; however, the proposed project in not located within the boundaries of this designated area.

VI. Ambient Air Impact Analysis

In the view of the Department, the amount of controlled emissions generated by this project will not cause concentrations of any regulated pollutant in the ambient air that exceed any set ambient standard. Any potential impacts will be minimized by the conditions and limitations established in MAQP #4449-00.

VII. Taking or Damaging Implication Analysis

As required by 2-10-105, MCA, the Department conducted the following private property taking and damaging assessment.

YES	NO	
X		1. Does the action pertain to land or water management or environmental regulation affecting private real property or water rights?
	X	2. Does the action result in either a permanent or indefinite physical occupation of private property?
	X	3. Does the action deny a fundamental attribute of ownership? (ex.: right to exclude others, disposal of property)
	X	4. Does the action deprive the owner of all economically viable uses of the property?
	X	5. Does the action require a property owner to dedicate a portion of property or to grant an easement? [If no, go to (6)].
		5a. Is there a reasonable, specific connection between the government requirement and legitimate state interests?
		5b. Is the government requirement roughly proportional to the impact of the proposed use of the property?
	X	6. Does the action have a severe impact on the value of the property? (consider economic impact, investment-backed expectations, character of government action)
	X	7. Does the action damage the property by causing some physical disturbance with respect to the property in excess of that sustained by the public generally?
	X	7a. Is the impact of government action direct, peculiar, and significant?
	X	7b. Has government action resulted in the property becoming practically inaccessible, waterlogged or flooded?
	X	7c. Has government action lowered property values by more than 30% and necessitated the physical taking of adjacent property or property across a public way from the property in question?
	X	Takings or damaging implications? (Taking or damaging implications exist if YES is checked in response to question 1 and also to any one or more of the following questions: 2, 3, 4, 6, 7a, 7b, 7c; or if NO is checked in response to questions 5a or 5b; the shaded areas)

Based on this analysis, the Department determined there are no taking or damaging implications associated with this permit action.

VIII. Environmental Assessment

An environmental assessment, required by the Montana Environmental Policy Act, was completed for this project. A copy is attached.

DEPARTMENT OF ENVIRONMENTAL QUALITY
Permitting and Compliance Division
Air Resources Management Bureau
P.O. Box 200901, Helena, Montana 59620
(406) 444-3490

FINAL ENVIRONMENTAL ASSESSMENT (EA)

Issued To: Timberline Resources Corporation

Montana Air Quality Permit Number: 4449-00

Preliminary Determination Issued: August 31, 2009
Department Decision Issued: September 18, 2009
Permit Final: October 6, 2009

1. *Legal Description of Site*: The TRC BHP will be located in Sections 31 and 32, Township 1 North, Range 7 West, in Silver Bow County.

2. *Description of Project*: The TRC BHP is an underground exploration project consisting of drifting, ore recovery for bulk sampling, and development rock removal and storage.

3. *Objectives of Project*: The objective of the BHP is for TRC to gain a better understanding of the resources through underground drilling, technical investigations to support mine planning, and bulk sampling for metallurgical testing. The project could persist for up to two years and may eventually transition to a fully operational mine project.

4. *Alternatives Considered*: In addition to the proposed action, the Department also considered the "no-action" alternative. The "no-action" alternative would deny issuance of the air quality preconstruction permit to the proposed facility. However, the Department does not consider the "no-action" alternative to be appropriate because TRC demonstrated compliance with all applicable rules and regulations as required for permit issuance. Therefore, the "no-action" alternative was eliminated from further consideration.

5. *A Listing of Mitigation, Stipulations, and Other Controls*: A list of enforceable conditions, including a BACT analysis, would be included in MAQP #4449-00.

6. *Regulatory Effects on Private Property*: The Department considered alternatives to the conditions imposed in this permit as part of the permit development. The Department determined that the permit conditions are reasonably necessary to ensure compliance with applicable requirements and demonstrate compliance with those requirements and do not unduly restrict private property rights.

7. *The following table summarizes the potential physical and biological effects of the proposed project on the human environment. The "no-action" alternative was discussed previously.*

		Major	Moderate	Minor	None	Unknown	Comments Included
A	Terrestrial and Aquatic Life and Habitats			X			Yes
B	Water Quality, Quantity, and Distribution			X			Yes
C	Geology and Soil Quality, Stability and Moisture			X			Yes
D	Vegetation Cover, Quantity, and Quality			X			Yes
E	Aesthetics			X			Yes
F	Air Quality			X			Yes
G	Unique Endangered, Fragile, or Limited Environmental Resources			X			Yes
H	Demands on Environmental Resource of Water, Air and Energy			X			Yes
I	Historical and Archaeological Sites			X			Yes
J	Cumulative and Secondary Impacts			X			Yes

SUMMARY OF COMMENTS ON POTENTIAL PHYSICAL AND BIOLOGICAL EFFECTS: The following comments have been prepared by the Department.

A. Terrestrial and Aquatic Life and Habitats

This permitting action would have a minor effect on terrestrial and aquatic life and habitats in the project area. The project would be located on private land owned by TRC. The current land use is agricultural. The Department has determined that any impacts from emissions or deposition of pollutants would be minor due to dispersion characteristics of the pollutants, the atmosphere, and the conditions that would be placed in MAQP #4449-00.

B. Water Quality, Quantity and Distribution

This project would have a minor effect on the water quality, water quantity, and distribution; however, there would be no discharge to groundwater or surface water associated with this project. Water for the project is planned to come from several sources. TRC currently holds five water rights that were originally part of the historic Highlands Mine and Pony Placer Claim. These water rights are current and may be used for mining purposes.

It is expected that the underground development work will encounter groundwater. The proposed underground workings are predicted to produce between 10 and 110 gallons per minute of groundwater inflow. The produced water is not anticipated to be acidic. Water being produced at the nearby historic Highland Mine Adit is nonacidic and sampling indicates that this mine water is in compliance with water quality standards for all parameters tested. Further geochemical testing is being conducted to confirm the low potential for acid rock drainage to develop as a result of the mining activity. If the new exploration decline intercepts historic workings underground, there is the potential for water in the new workings to drain via the historic Highland Mine Adit which flows to the Basin Creek Reservoir that is a water supply for the city of Butte. Discharge from the Highland Mine Adit would be monitored to determine whether exploration activities result in changes of flow or quality of this adit discharge.

Water from the underground workings would be pumped through a series of underground sumps to settle out sediment from mine activities. The water from the underground sumps would be pumped to the mine ponds located below the development rock storage area. Two ponds would be built with a combined capacity of approximately 2.5 million gallons.

Water from the mine and waste rock stockpile area would report to the sediment pond, which would have a capacity of approximately 1.5 million gallons. Run-off from the waste pile would be gravity fed to the ponds while the mine water would be pumped up the decline through a pipe to the pond. The pond would be the secondary sediment removal process in the circuit. Water would decant from the sediment pond and flow to the recycle water pond, which would have a capacity of approximately 1.0 million gallons.

The ponds would be lined and would be connected together with either a decant pipe and/or an overflow/spillway structure constructed between the two ponds. Flocculent or other similar chemicals may be added in the ponds and/or the sumps to assist in settling sediment. Pond levels would be maintained to ensure an available capacity for a 25-year 24-hour storm event at all times.

Water from the recycle pond would either be sent to the land application disposal (LAD) areas or returned to a re-circulated water tank for re-use. Water from the underground sumps could also be pumped up the ventilation raise and sent directly to the LAD area located on patented land. LAD methods would involve the application of the water via a drip irrigation system. The irrigation system would rotate the application of water between the different cells of the LAD area to minimize surface pooling. If it becomes necessary, a spray irrigation system would be installed during the warmest months to maximize evaporation.

Two 10,000 gallon capacity water tanks are planned for the project. One tank would be used for potable water and make-up water when needed. A second tank would be re-circulated water from the mine pond that would be used for mine activities such as dust control and drill water.

An on-site wastewater system would be constructed to manage wastewater generated from the office trailer and mine dry. The location may change slightly based on field leach tests and the final design approved. The sewage treatment system would be sized to meet the full operational project staffing levels of the project.

C. Geology and Soil Quality, Stability and Moisture

The project would have a minor affect on the geology and soil quality, stability, and moisture. The project would be entirely located on patented private land owned by TRC. Similar types of exploration and mining activities have been occurring at the location for many years.

D. Vegetation Cover, Quantity, and Quality

The project would have a minor affect on the local vegetation. The impacts from emissions or deposition of pollutants would be minor due to dispersion characteristics of the pollutants, the atmosphere, and the conditions that would be placed in MAQP #4449-00. Reclaimed areas would be seeded with native seed mixture and would be applied in the late fall or early spring to reduce the invasion of noxious weeds.

Clearing and grubbing of the vegetation in the disturbance area would be completed prior to construction activities. This would include the removing of trees, shrubs, and other similar vegetation. Merchantable timber would be salvaged and sold as appropriate. The remaining limbs and other similar material would be piled as appropriate in slash piles. The facility locations would be selected to minimize tree removal where possible. Slash piles would be burned or disposed of in accordance with applicable laws and/or used for sediment control as sediment filter material.

E. Aesthetics

The project would have a minor affect on the local aesthetics. Similar types of exploration and mining activities have been occurring at the location for many years. The project would be entirely located on patented private land owned by TRC. The project area is located on the Continental Divide about 20 miles southwest of Butte in a rural setting. It is shielded from view from the north by a ridge running east to west along the divide. The surface activities on Nevin Hill are visible from Red Mountain in the Butte Highlands, but the portal location itself would not be visible from this vantage point. The majority of the exploration activities would take place underground and would not be audible. Noise from the generators may be audible to passersby from the Fish Creek road and the Highlands road, but there are no houses close enough that noise from these power plants would be a disturbance.

F. Air Quality

The area surrounding the proposed project is unclassifiable/attainment for the National Ambient Air Quality Standards (NAAQS) for all criteria air pollutants. The proposed site location is not within the Butte PM_{10} nonattainment area. The Department believes that concentrations of the criteria pollutants in the area are at or near background levels and well below any NAAQS levels. Emissions of air pollutants would occur as a result of the current permit action. MAQP #4449-00 would contain conditions limiting opacity and diesel generator operations and require, as necessary, the use of water, chemical dust suppressants, or water spray bars to control dust from vehicle traffic and process equipment. If the facility operates in compliance with all applicable permit requirements, then the effects would be minor.

G. Unique Endangered, Fragile, or Limited Environmental Resources

The development of the BHP would impact the unique endangered, fragile, or limited environmental resources because emissions of PM_{10}, NO_x, CO, VOC, and SO_x would increase in the area because of the operation of the facility. However, the Department believes that any impacts would be minor due to the relatively small amount of the above listed pollutants emitted, dispersion characteristics of the pollutants and the atmosphere, and conditions placed in MAQP #4449-00, including, but not limited to, BACT requirements discussed in Section V of the permit analysis for this permit.

The Montana Natural Heritage Program (MNHP) identified occurrences of 12 plant and animal species of concern within the vicinity of the proposed project location. The Canada lynx is a threatened species of concern identified by the MNHP with the remaining species of concern being classified as sensitive or without classification. Sensitive animal species of concern are the Brewer's Sparrow, Westslope Cutthroat Trout, Gray Wolf, and Wolverine. Sensitive plant species of concern are the Sapphire Rockcress, Small-flowered Pennycress, Lemhi Beardtongue, and Hall's Rush. Unclassified animals are the Grasshopper Sparrow and Black Rosy-Finch. The unclassified plant is the Slender Fleabane.

H. Demands on Environmental Resource of Water, Air and Energy

The BHP would have a minor impact on the environmental resources of water, air, and energy. As discussed in Section 7.B. of this EA, the project would utilize water from local water rights and encountered groundwater. Energy for the project would be provided by diesel-fired generator/engines. Line power is available near the site; however, this line does not have sufficient power to support all the exploration activities.

I. Historical and Archaeological Sites

The Department contacted the Montana Historical Society, State Historical Preservation Office (SHPO) in an effort to identify any historical and archaeological sites that may be present in the area of operation. Search results concluded that there are several previously recorded sites near the designated project area. The proposed site is in the area of the historic Highland Mine; however, few if any of the original structures remain and the proposed new portal and waste rock dump would not be located near the historic shafts and adits.

J. Cumulative and Secondary Impacts

Overall, the cumulative and secondary impacts from this project on the physical and biological environment in the immediate area would be minor due to the abundant mining activity that has occurred there in the past century. The Department believes that this facility could be expected to operate in compliance with all applicable rules and regulations as outlined in MAQP #4449-00. From an air quality perspective, the potential emissions expected from operating the facility at its maximum throughput on a continuous basis would not violate ambient air quality standards. Therefore, the MAQP is written to reflect the expected emissions from operating continuously at the maximum rate. TRC may be restricted on annual throughput by other government jurisdictions which would limit ore production to a level less than described in the MAQP.

8. *The following table summarizes the potential economic and social effects of the proposed project on the human environment. The "no-action" alternative was discussed previously.*

		Major	Moderate	Minor	None	Unknown	Comments Included
A	Social Structures and Mores			X			Yes
B	Cultural Uniqueness and Diversity				X		Yes
C	Local and State Tax Base and Tax Revenue			X			Yes
D	Agricultural or Industrial Production			X			Yes
E	Human Health			X			Yes
F	Access to and Quality of Recreational and Wilderness Activities			X			Yes
G	Quantity and Distribution of Employment			X			Yes
H	Distribution of Population			X			Yes
I	Demands for Government Services			X			Yes
J	Industrial and Commercial Activity			X			Yes
K	Locally Adopted Environmental Plans and Goals				X		Yes
L	Cumulative and Secondary Impacts			X			Yes

SUMMARY OF COMMENTS ON POTENTIAL ECONOMIC AND SOCIAL EFFECTS: The following comments have been prepared by the Department.

A. Social Structures and Mores

The project would result in minor, if any, disruption to the local social structures and mores. The property on which the project will occur is private land owned by TRC. While the proposed location is near several historic mine sites, few if any of the original structures remain and the proposed new portal and waste rock dump would not be located near the historic shafts and adits.

B. Cultural Uniqueness and Diversity

The Department believes that the proposed project will have no impact to the cultural uniqueness and diversity of the surrounding area because the project would be located on private land and the activities occurring there would be similar to previous exploratory adits and mines that have been located in the area.

C. Local and State Tax Base and Tax Revenue

The project would have a minor effect on the local and state tax base and revenue due to the taxes generated from the purchase of supplies and the mine payroll (see Section G – Quantity and Distribution of Employment).

D. Agricultural or Industrial Production

The project would result in a minor impact to the agricultural production because potential grazing land will be cleared for the project. A fence would also be constructed around the ventilation raise to secure this mine entry consistent with mining safety regulations. In addition to providing security, this would also prevent cattle from grazing in the enclosed area. Industrial production of the local community would not be affected by the proposed project.

E. Human Health

There would be minor effects on human health due to the slight increase in emissions of air pollutants. However, MAQP #4449-00 incorporates conditions to ensure that the facility would be operated in compliance with all applicable rules and standards. These rules and standards are designed to be protective of human health. In addition, the project would occur in a remote area with limited population; therefore, effects on human health would be minor.

F. Access to and Quality of Recreational and Wilderness Activities

The project would not have an impact to the access to recreational and wilderness activities because no road closures will occur and the site would be located on private property. The project would have a minor impact on the quality of recreational and wilderness activities due to the slight increase in emissions of air pollutants and the noise generated by the equipment.

G. Quantity and Distribution of Employment

The project would employ an estimated 50 to 55 employees full time. The planned work schedule would consist of two 12-hour shifts, seven days per week, with four crews. Additional personnel would include the project engineer, site superintendent, chief geologist, field geologists, environmental technician, head mechanic, head electrician, drillers, and surface labor.

H. Distribution of Population

There are no plans to house workers onsite. Workers would be expected to stay in Butte, Anaconda, Whitehall, Divide, and surrounding communities using available housing, rental units, campgrounds, and trailer parks without the need to construct additional houses or apartments. Therefore, the effect on the distribution of population would be minor.

I. Demands for Government Services

Government services would be required for acquiring the appropriate permits from government agencies. In addition, the permitted source of emissions would be subject to periodic inspections by government personnel. The project would use existing roads to access the site. Access to the site would be via Highway 2, Roosevelt Road, Highlands Road, and Fish Creek Road. To minimize potential conflicts with road use through the residential areas, TRC would restrict vendor use and deliveries to daylight hours and weekdays whenever possible. Under this restriction, deliveries and vendors would be required to pre-schedule trips to the site and would be limited to 8 A.M. to 3 P.M. during weekdays and emergency deliveries only on the weekends. Demands for government services would be minor.

J. Industrial and Commercial Activity

Operation of the project would result in a minor increase in the industrial activity in the area. The exploratory adit would create some additional industrial activity in the area. However, the Department believes the impacts would be minor because of the relatively small size of the project.

K. Locally Adopted Environmental Plans and Goals

The Department is not aware of any locally adopted environmental plans or goals. The state standards would protect the proposed site and the environment surrounding the site. The proposed project location is outside of the Butte PM_{10} nonattainment area and no effects to the nonattainment area are expected from this project.

L. Cumulative and Secondary Impacts

Overall, cumulative and secondary impacts from this project would result in minor impacts to the economic and social environment in the immediate area. As previously stated, the proposed permit would result in a slight increase in employment in the area, and a slight increase in industrial process in the area. The Department believes that TRC would be expected to operate in compliance with all applicable rules and regulations as outlined in MAQP #4449-00.

Recommendation: No Environmental Impact Statement (EIS) is required.

If an EIS is not required, explain why the EA is an appropriate level of analysis: The current permitting action is for the construction and operation of an underground exploration project. MAQP #4449-00 includes conditions and limitations to ensure the facility will operate in compliance with all applicable air quality rules and regulations. In addition, there are no significant impacts associated with this proposal.

Other groups or agencies contacted or which may have overlapping jurisdiction: Montana Historical Society – State Historic Preservation Office, Natural Resource Information System – Montana Natural Heritage Program, Montana Department of Environmental Quality – Hard Rock Program.

Individuals or groups contributing to this EA: Department of Environmental Quality – Air Resources Management Bureau, Montana Historical Society – State Historic Preservation Office, Natural Resource Information System – Montana Natural Heritage Program, Montana Department of Environmental Quality – Hard Rock Program.

EA prepared by: Ed Warner
Date: August 13, 2009

Hydrogeologic Characterization Report

Butte Highlands Mine Project
Montana

Prepared for:

Timberline Resources
101 East Lakeside
Coeur d'Alene, Idaho 83814
(208) 664-4859

Prepared by:

AMEC Geomatrix, Inc.
1824 North Last Chance Gulch
Helena, Montana 59601
(406) 442-0860

January 2009
Project No. 014716

TABLE OF CONTENTS

INTRODUCTION 1

PROJECT LOCATION 1

CLIMATE 1

GEOLOGIC SETTING 2

SURFACE WATER RESOURCES 2
- Monitoring Sites 3
- Surface Water Flow 4
- Surface Water Sampling and Analysis 4

GROUNDWATER RESOURCES 6
- Borehole Drilling and Casing Installation 6
- Groundwater Yield 6
- Groundwater Sampling and Analysis 7

CONCEPTUAL HYDROLOGIC MODEL 8

MINE ADIT INFLOW CALCULATIONS 11

REFERENCES 14

TABLE OF CONTENTS – continued

FIGURES

Figure 1. Project Area and Monitoring Sites
Figure 2. Precipitation Map
Figure 3. Surface Geology

TABLES

Table 1. Surface Water Monitoring Data
Table 2. Laboratory Parameters for Water Samples
Table 3. Groundwater Monitoring Data
Table 4. Lithologic and Water Observations from Borehole

APPENDICES

Appendix A. Figures
Appendix B. Tables
Appendix C. Site Photographs
Appendix D. Laboratory Water Quality Data
Appendix E. Mine/Adit Inflow Calculations

INTRODUCTION

The purpose of this report is to present results of a hydrogeological investigation completed in October and November 2008 at the Butte Highlands Mine area near Butte, Montana. Field activities included drilling a 1,167-feet deep test borehole; installing casing to a depth of 600 feet in the borehole; measuring groundwater flow rates during borehole drilling; collecting and analyzing two groundwater samples from the borehole for chemical characteristics; measuring surface water flow in the project area; and collecting and analyzing surface water samples from six sites in the project area for chemical characteristics. AMEC Geomatrix, Inc. (AMEC) provided field oversight on behalf of Timberline Resources and Klepfer Mining Services. This report also includes a conceptual hydrologic model of the Butte Highlands project site.

All figures and tables are presented in **Appendices A** and **B**, respectively. Site photographs are shown in **Appendix C**, and laboratory water quality data are summarized in **Appendix D**.

PROJECT LOCATION

The Butte Highlands project site is located approximately 13 miles south of Butte along the Continental Divide in the Highland Mountains within the Deerlodge National Forest (**Figure 1**). The project area is located in Sections 31 & 32, Township 01 North, Range 07 West. The recently drilled borehole (BHMW08-01) is at an elevation of approximately 8000 feet (**Figure 1**). The project area covers the headwaters of three drainage basins: Fish Creek, Basin Creek, and Moose Creek.

One of the primary features of the Butte Highlands project site is the 600-ft level Highland Mine adit, which discharges water to upper Basin Creek in the northwest part of the project area (near surface water station WS-1; **Figure 1**). The elevation of this portal is approximately 7300 feet. Other small adits and shafts are located throughout the project area.

CLIMATE

Climate of the project area is characterized by four seasons, with warm summers and cold, snowy winters. **Figure 2** is a map showing average annual PRISM precipitation contour lines, indicating that precipitation in the Butte Highlands project area is approximately 24 to 26 inches per year (in/yr). A SNOTEL station located in the upper Basin Creek watershed at an elevation of 7180 feet shows a 30-year annual average precipitation of about 24.5 inches, with about 10 inches occurring as snow-water equivalent during the period of October through April (Natural Resources Conservation Service (NRCS), 2008).

GEOLOGIC SETTING

The Butte Highlands project area is located in the Nevin Hill area of the Highland Mountains which is part of the Boulder Batholith geologic region. Gold mineralization occurs primarily in lower Paleozoic-age Meagher Dolomite (including marble) and Wolsey Shale (including skarn and hornfels), with higher-grade mineralization occurring within sediments proximal to diorite sills and dikes. The first lode workings in the area followed narrow veins and pipes in dolomitic limestone (Meagher Dolomite) above what was later to become the productive Highland ore body (Montana Bureau of Mines and Geology (MBMG) 1998). By 1937, all production was coming from the 600-ft level Highland adit until it was shut down in 1942. The ore body was primarily a replacement zone in the Meagher Dolomite that was localized by the intersection of a due east 60°N fault and the hinge of a fold (MBMG, 1998). The workings consisted of a 2,300-ft long crosscut adit to the ore body, where the replacement zone was mined-out over a 550-ft vertical extent (MBMG, 1998).

Figure 3 is a general surface geology map of the Butte Highlands project area. Although the ore body is hosted by the Meagher Dolomite and Wolsey Shale, other rocks including granite, gabbro, and pegmatite are exposed in the underground workings (MBMG, 1998). The Pilgrim Dolomite, Park Shale, and Flathead Sandstone also are found at the project site. The geologic map shows several faults that extend through the project site, including the Thompson and Only Chance faults.

According to MBMG (1998), historical mining at the Butte Highlands Mine encountered quartz, pyrite, pyrrhotite, and gold, with minor galena, sphalerite, and chalcopyrite. The sulfides were oxidized and leached by groundwater in the upper zone, leaving an open sponge of quartz enriched in residual gold which then slumped to fill open spaces and formed a breccia. At lower levels where oxidation has not occurred, pyrite and pyrrhotite are abundant, and the gold is found in complex silicates (MBMG, 1998).

SURFACE WATER RESOURCES

The Butte Highlands project site is located within three separate watersheds: (1) Fish Creek on the east side; (2) Basin Creek to the north; and (3) Moose Creek on the west side. Basin Creek flows north into the Basin Creek Reservoir which is a water supply for the city of Butte. The project site is located on the Continental Divide; therefore, surface water from this area flows either west-northwest to the Clark Fork River basin (Basin Creek) or east-northeast to the Missouri River basin (Fish Creek and Moose Creek). Prior to joining the Clark Fork River, Basin Creek joins Silver Bow Creek near Butte. Prior to joining the Missouri River, Moose Creek is tributary to the Big Hole River, and Fish Creek flows into the Jefferson River.

Two of the streams in the project area (Fish Creek and Moose Creek) are classified as B-1, which means that the water is to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment, as well as other purposes (ARM 17.30.607&610&623). Basin Creek is classified as A-Closed because it is a water supply source for the city of Butte; this classification means that the water is to be maintained suitable for drinking, culinary, and food processing purposes after simple disinfection, as well as other purposes (ARM 17.30.607&621). Streams classified as A-Closed also typically have access restrictions to protect the water for public health. Only one of the streams in the project area (Fish Creek) is considered "impaired" by the 2006 Section 303(d) List of impaired water bodies in Montana (USEPA, 2008). Fish Creek is impaired only for sediment.

As previously mentioned, the Highland Mine adit discharges water to upper Basin Creek near surface water station WS-1 (**Figure 1**). This 600-ft level portal is at an elevation of about 7300 feet. Other mine-related features noted by MBMG in 1998 in the vicinity of the portal were a small shaft, several pits, a waste-rock pile, two tailings piles, two small garbage dumps, and the remnants of several cabins and a mill. Seeps were observed down-gradient from the tailings piles, garbage dumps, and waste rock pile (MBMG, 1998).

Monitoring Sites

For the 2008 study, six surface water monitoring locations were established along creeks that drain from the proposed mine area (**Figure 1**):

1. WS-1: Adit discharge from Highland Mine draining to Basin Creek on northwest side of project site.
2. WS-2: Southern channel of upper Fish Creek on southeast side of project site.
3. WS-3: Combined channels of upper Fish Creek on northeast side of project site.
4. WS-4: Middle channel of upper Fish Creek on east side of project site.
5. WS-5: Northern channel of upper Fish Creek on northeast side of project site.
6. WS-6: Upper Middle Fork of Moose Creek on southwest side of project site.

Photographs of the six surface water stations are shown in **Appendix C**.

Flow rate and some chemical parameters were measured in the field at all six stations on November 25-26, 2008. During the same period, AMEC collected water samples from stations WS-4, WS-5, and WS-6 for laboratory analysis. Timberline Resources and Klepfer Mining Services collected samples for laboratory analysis from the other three stations (WS-1, -2, and-3) on September 3, 2008 and November 25, 2008. Field monitoring and sampling results are described below.

In August 1993, the MBMG collected water samples from the following three sites in the vicinity of the Highland Mine portal: (1) adit discharge – sample no. BHIS10H; (2) seep area flow in small channel down-gradient of tailings piles and garbage dumps – sample no. BHIS20L; and (3) Basin Creek downstream of confluence of adit discharge and small channel that contains flow from the tailings piles and garbage dumps – sample no. BHID10H (MBMG, 1998). The MBMG measured flow rates at these three sites in August 1993 and submitted water samples for laboratory analysis.

Surface Water Flow

In late November 2008, surface water flow was measured by AMEC at all six WS-locations. A portable flume was used at all sites, except WS-2 and WS-6 due to flows that were too low for the flume or within coarse-grained stream-bed material. Calibrated containers and a stopwatch were used to estimate flow at WS-2 and WS-6. Stream flow values measured by AMEC for each station are listed in **Table 1**. As previously mentioned, MBMG (1998) measured flow at three sites in August 1993: Highland Mine adit discharge; seep area flow in small channel below the tailings piles and garbage dumps; and Basin Creek downstream of confluence of adit discharge and small channel.

The following summarizes these flow measurements from November 2008 and August 1993:

- Highland Mine adit discharge at WS-1 (11-26-08) = 90 gallons per minute (gal/min)
- Highland Mine adit discharge (8-20-93) = 110 gal/min
- Seep area flow below Highland Mine tailings piles & garbage dumps (8-20-93) = 12 gal/min
- Basin Creek below adit discharge (8-20-93) = 300 gal/min
- Fish Creek, southern channel at WS-2 (11-25-08) = 48 gal/min
- Fish Creek, middle channel at WS-4 (11-25-08) = 8 gal/min
- Fish Creek, northern channel at WS-5 (11-25-08) = 64 gal/min
- Fish Creek, combined channels at WS-3 (11-25-08) = 92 gal/min
- Moose Creek, middle fork at WS-6 (11-26-08) = 0.4 gal/min

Surface Water Sampling and Analysis

Field Parameters

Field parameters were measured by AMEC at each of the six surface water monitoring stations in November 2008. Water temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), and oxidation-reduction potential (ORP) were measured in the field using a YSI, Inc. Model 556 MPS meter. Turbidity was measured using an Oakton Instruments Model T-100 meter. Both meters were calibrated prior to use on each day of field work. **Table 1** summarizes field parameter results for each station.

In November 2008, the five stream stations had temperatures of about 2 degrees Celsius (°C) or less. The Highland Mine adit discharge had the highest temperature of 5.5 °C. All six surface water samples had circum-neutral pH ranging from 6.75 to 7.67. Electrical conductivity was in the range of 272 to 363 microSiemens per centimeter (µS/cm) at all stations, except for 61 µS/cm at WS-2 (southern channel of Fish Creek) and 425 µS/cm at WS-6 (Middle Fork Moose Creek). Turbidity was low at all stations, ranging from approximately 1 to 4 nephelometric turbidity units (NTU). Dissolved oxygen ranged from 11 to 15 milligrams per liter (mg/L) at the five stream stations, and was 7.2 mg/L from the adit discharge (WS-1).

Laboratory Analysis

In November 2008, surface water samples were collected from the six sites directly into sampling containers, and preserved as necessary. Those samples collected by AMEC (WS-4, WS-5, and WS-6) were sent under chain-of-custody procedures to Energy Laboratories, Inc. in Helena, Montana. Samples collected by Timberline Resources and Klepfer Mining Services (WS-1, WS-2, and WS-3) were submitted to Northern Analytical Laboratories in Billings, Montana. Each sample was analyzed for metals (total recoverable and/or dissolved), common ions, nutrients, and general parameters listed in **Table 2**.

Results of laboratory analyses for surface water samples collected at WS-1 through WS-6 in September and November 2008 are summarized in **Appendix D**. The spreadsheet in this appendix also includes laboratory results of the three surface water samples collected by MBMG in August 1993. These data show the following range in values for selected constituents analyzed by the laboratory:

- pH = 7.3 – 8.3
- EC = 266 – 514 µS/cm, except 69 µS/cm at WS-2 (south channel of Fish Creek)
- Total Dissolved Solids (TDS) = 148 – 278 mg/L, except 36 mg/L at WS-2
- Total Suspended Solids (TSS) = <10 mg/L
- Alkalinity = 139 – 260 mg/L, except 37 mg/L at WS-2
- Sulfate = <5 to 61 mg/L
- Ammonia = <0.1 mg/L
- Nitrate+Nitrite = <0.01 – 0.9 mg/L

Metals at low concentrations were detected for most of the metals, although the following metals were detected in only one sample: antimony, lead, molybdenum, and uranium. The following metals were below laboratory detection limits for all surface water samples: beryllium, cadmium, chromium, cobalt, mercury, nickel, platinum, selenium, silver, thallium, and vanadium. All of the detected metal concentrations are low and do not exceed any of Montana's acute and chronic aquatic life standards as presented in **Appendix D** (Circular DEQ-7; Montana Department of Environmental Quality (DEQ), 2006).

GROUNDWATER RESOURCES

Groundwater in the project area flows primarily in bedrock formations, with some flow in unconsolidated alluvial deposits along the stream channels. Little information is available regarding groundwater quantity and quality in the Butte Highlands project area. AMEC provided field oversight for completing a 1,167-feet deep borehole, with steel casing installed to a depth of 600 feet. This borehole was used to obtain information about groundwater quantity and quality in the vicinity of the defined ore body.

According to Montana regulations, groundwater at the Butte Highlands project site is considered Class I because natural specific conductance is less than or equal to 1,000 µS/cm (ARM 17.30.1006(1)). In accordance with these regulations, a person may not cause a violation of the human health standards for groundwater listed in Circular DEQ-7 (Montana DEQ, 2006). These standards are included on the groundwater quality spreadsheet in **Appendix D**.

Borehole Drilling and Casing Installation

One borehole (BHMW08-01) was drilled in November and December 2008 to a total depth of 1,167 feet (**Figure 1**). Timberline Resources selected the location of this borehole to extend through rock units that would be intercepted by the proposed exploration decline. O'Keefe Drilling Company of Butte, Montana drilled the borehole using air rotary techniques. After first drilling a 12-inch diameter borehole to a depth of 600 feet, an 8-inch diameter steel casing was installed and cemented in the borehole. After the cement hardened, a 6-inch diameter borehole was drilled below the 600-ft depth to a total depth of 1,167 feet. This 6-inch diameter borehole not cased (i.e., open hole in bedrock).

Groundwater Yield

At changes in lithology or apparent water yield during drilling, the borehole was developed by airlifting for at least 30 minutes, followed by measuring water yield and some chemical parameters (**Table 3**) as water was discharging from the cyclone attached to the drill rig. Depths for these measurements were 685, 805, 1065, 1085, and 1167 feet below ground surface. Measured water yield during drilling at these depths was: 685 feet = 0.3 gal/min; 805 feet = 8 gal/min; 1,065 feet = 12 gal/min; 1,085 feet = 12 gal/min; and 1,167 feet (total depth) = 12 gal/min. The water inflow rate did not increase below a depth of about 900 feet. The Highland adit that discharges near surface water station WS-1 is located at a depth of about 685 feet below ground surface in the vicinity of the borehole.

Additional geologic observations at these depths are presented in **Table 4**. Core samples were previously collected by others from a nearby borehole (BHDDH08-01) completed in August 2008; this information was used to help determine lithology at this general location. In

general, geologic units encountered in the new borehole were Meagher Dolomite to a depth of about 1,040 feet, and metamorphosed Wolsey Shale (skarn and hornfels) from 1,040 feet to the total depth at 1,167 feet. No significant fault/fracture zones were noted during drilling. Based on the geology map (**Figure 3**), it is possible that the new borehole (BHMW08-01) is located just east of the nearly vertical Only Chance Fault.

The Highland adit apparently discharges at a relatively constant rate of about 100 gal/min based on two known measurements: 90 gal/min in November 2008, and 110 gal/min in August 1993. This adit extends approximately 2,300 feet to the ore body, with additional underground workings in the ore zone over a 550-ft vertical extent (MBMG 1998). As shown on the geology map (**Figure 3**), the main Highland adit crosses several faults which could be the primary conduits of groundwater flow that discharge from the portal.

After review of borehole water yield and lithology, water samples from depths of 805 and 1,085 feet were selected for laboratory analysis. The 805-ft depth represents the first encountered water yield greater than 1 gal/min in the Meagher Dolomite ("upper aquifer"), and the 1,085-ft depth is just below the geologic contact for the Wolsey Shale ("lower aquifer"). The deeper sample also represents nearly all groundwater from the entire uncased interval from 600 to 1,167 feet.

Groundwater Sampling and Analysis

Groundwater samples were collected from the end of the cyclone unit attached to the drill rig; water from the cyclone was collected in calibrated containers used for flow measurement, then transferred into sampling containers, filtered, and preserved as necessary. Samples from four borehole depths were collected and analyzed in the field for selected parameters. AMEC sent two of the groundwater samples under chain-of-custody procedures to Energy Laboratories in Helena, Montana. These two samples were analyzed for metals (dissolved and total recoverable), common ions, nutrients, and general parameters listed in **Table 2**.

Field Parameters

Results of field parameters (turbidity, temperature, pH, EC, DO, and ORP) measured at the five depths (685, 805, 1065, 1085, and 1167 feet) are presented in **Table 3**. The five groundwater samples had temperatures in the range of 9 to 11 °C. The measured pH values were basic, ranging from 8.35 to 8.55, with the exception of a higher pH of 10.42 for the 685-ft sample. Electrical conductivity was in the range of 370 to 395 µS/cm for the four deepest samples, with a lower EC of 127 µS/cm for the 685-ft sample. Turbidity was relatively high for all samples, ranging from approximately 150 to 680 NTU, because the samples were collected during the drilling process. Dissolved oxygen ranged from 6.4 to 9.3 mg/L for the five groundwater samples.

Laboratory Analysis

Laboratory analyses of the two groundwater samples collected in December 2008 from the borehole (depths of 805 and 1,085 feet) are summarized in **Appendix D**. Also included in the groundwater quality data spreadsheet are results of samples collected from the Highland Mine adit in September and November 2008 because the adit discharge water represents groundwater from a portion of the underground mine area.

The groundwater quality data show the following range in values for selected constituents analyzed by the laboratory:

- pH = 7.6 – 8.5
- EC = 339 – 378 µS/cm
- Total Dissolved Solids (TDS) = 180 – 212 mg/L
- Total Suspended Solids (TSS) = <1 – 408 mg/L
- Alkalinity = 186 – 200 mg/L
- Sulfate = 6 to 21 mg/L
- Ammonia = <0.1 mg/L
- Nitrate+Nitrite = 0.13 – 0.98 mg/L

Metals at low concentrations were detected for most of the metals, although the following metals were detected in only one sample: antimony, boron, cobalt, molybdenum, nickel, and tin. The following metals were below laboratory detection limits for all groundwater samples: beryllium, cadmium, mercury, platinum, selenium, silver, thallium, titanium, and vanadium. All of the detected metal concentrations are low and do not exceed any of Montana's human health standards for groundwater as presented in **Appendix D** (Circular DEQ-7; Montana DEQ, 2006) with the exception of aluminum, iron, and manganese. The standards for these three metals are "secondary", which indicates that they are based on aesthetics (e.g., taste, odor, and staining) rather than human health.

CONCEPTUAL HYDROLOGIC MODEL

A conceptual model of the physical groundwater flow system is presented in this section for the Butte Highlands project area. The project area as shown on **Figures 1** and **2** encompasses a relatively small area around the ore body zone of approximately one square mile. Due to the site location being on the Continental Divide, this small project area is used for the conceptual model study area because groundwater recharge and discharge is expected to be localized.

One key element of a conceptual model is the water budget, including recharge and discharge. A generalized groundwater balance equation is:

Inflow = Outflow ± Change in Storage

A steady-state groundwater balance is developed using a set of hydrologic inputs that represent annual average values. The steady-state groundwater balance equation can be expressed in terms of the sources of recharge and discharge:

$$R + GW_{in} = ET + GW_{out} + BF$$

Where:

R	=	recharge due to infiltrating precipitation and runoff
GW_{in}	=	groundwater flow into the study area
ET	=	evapotranspiration directly from groundwater
GW_{out}	=	groundwater flow out of the study area
BF	=	groundwater discharged to streams, springs, and adits as baseflow

Areal recharge (R) to groundwater beneath the Butte Highlands project area from precipitation can be estimated using a percentage of total annual precipitation. As previously mentioned, average annual precipitation for this area is about 24 to 26 in/yr (**Figure 2**). Studies of mountain region recharge in the western U.S. typically show recharge rates in the range of about 8 to 12 percent of precipitation. For an annual precipitation rate of 25 in/yr, this would equate to 2.0 to 3.0 in/yr of recharge (0.17 to 0.25 ft/yr). Over an area of 1 square mile, this amounts to 4,700,000 to 7,000,000 cubic feet per year (ft^3/yr) (13,000 to 19,000 ft^3/day) (70 to 100 gal/min).

Groundwater inflow to the study area (GW_{in}) is assumed to be minor because the project site is located on the Continental Divide. However, some of the major fault zones that extend through the area (**Figure 3**) could transmit groundwater from outside the study area. For purposes of this water balance, it is assumed that 2,000 to 7,000 ft^3/day (10 to 35 gal/min) of groundwater inflow occurs in the study area.

Evapotranspiration (ET) in the groundwater balance includes only the ET that occurs directly from groundwater; thus, it is limited to ET from surface and/or near-surface expressions of groundwater. For the Butte Highlands project area, it is assumed that ET from groundwater expressions is minor. Therefore, ET is deemed insignificant and assumed to be zero for this water balance.

Some groundwater probably exits the study area as underflow (GW_{out}), most of which likely occurs in the fault and fracture zones. Using a common range of values for hydraulic conductivity of lithified rock (10^{-7} to 10^{-5} centimeters per second (cm/sec) or $3x10^{-4}$ to $3x10^{-2}$ ft/day), a cross-sectional area of 2,000,000 ft^2, and a hydraulic gradient of 0.01, groundwater underflow can be estimated using Darcy's Law:

$$Q = K \times I \times A$$

Where:

Q = groundwater flux
K = hydraulic conductivity
I = hydraulic gradient
A = cross-sectional area of flow

Using the values mentioned above in Darcy's equation, the resulting estimate of groundwater outflow from the Butte Highlands study area is approximately 6 to 600 ft^3/day (0.03 to 3.0 gal/min). This is a minor component of discharge in the overall water balance.

Baseflow discharging from streams, springs, and adits (BF) in the study area is estimated using flow measurements of project area streams (Basin Creek, Fish Creek, and Middle Fork Moose Creek) and the Highland adit. No springs with measureable flow were observed in the study area. Baseflow for upper Basin Creek is essentially the Highland adit discharge. For Fish Creek and Middle Fork Moose Creek, it is assumed that half of the measured flows is actually groundwater discharge to the streams. Total baseflow discharge (BF), therefore, is estimated as:

Upper Basin Creek/Highland adit at WS-1 (100 gal/min) + Middle Fork Moose Creek at WS-6 (<1 gal/min) + upper Fish Creek at WS-4 and WS-5 (36 gal/min) = 136 gal/min (26,000 ft^3/day)

Using all of the estimated values discussed above, the following steady-state groundwater balance is developed for the Butte Highlands project area ($R + GW_{in} = ET + GW_{out} + BF$):

Low estimate (ft^3/day): 13,000 + 2,000 = 0 + 6 + 26,000
15,000 ≈ 26,000

High estimate (ft^3/day): 19,000 + 7,000 = 0 + 600 + 26,000
26,000 = 26,600

These results show that the "high estimate" nearly balances, indicating that about 12 percent of average annual precipitation (19,000 ft^3/day) probably recharges groundwater in the project area. In addition, it is likely that some groundwater inflow (approximately 7,000 ft^3/day) occurs into the project area along the fault zones.

MINE ADIT INFLOW CALCULATIONS

This section provides some estimates of adit inflow for the Butte Highlands mine. The existing Highland adit, which extends approximately 2,300 feet into the ore zone, produces an average groundwater inflow of about 100 gal/min. The following are calculations using several analytical methods for an assumed tunnel length of 10,000 feet and tunnel radius of 15 feet for the proposed exploration adit. The calculations are presented in **Appendix E**.

Analytical Equation (USFS et al., 1992)

Adit inflow rates can be calculated using the following equation cited in USFS et al. (1992):

$$Qo = [(2\pi KH) \div (2.3\log(2H \div R))] \times 7.48$$

Where,
Qo = groundwater inflow per unit length of tunnel (gal/min/ft);
K = hydraulic conductivity (ft/min);
R = tunnel radius (ft); and
H = hydraulic head (ft) measured as vertical distance from adit to overlying water table.

Based on observations during drilling, hydraulic conductivity (K) is assumed to be low for overall bedrock conditions at the Butte Highlands site; 1×10^{-7} to 1×10^{-6} cm/sec (2×10^{-7} to 2×10^{-6} ft/min) are the K-values used for the calculations. Hydraulic head is assumed to be variable due the decline, starting at 200 feet and extending to 800 feet of head. The exploration adit at Butte Highlands is assumed to have a radius of 15 feet and a total length of 10,000 feet. Results using the above equation and estimated values show that groundwater inflow would be approximately <u>10 to 100 gal/min</u>.

Analytical Equation (Goodman et al., 1965)

One analytical solution for steady-state inflow during tunnel driving is:

$$Q = 0.707L\ (KH^3S_y/t)^{1/2}$$

where:
Q = inflow (m^3/day)
L = length of drift (m)
K = hydraulic conductivity (m/day)
H = depth of drift below initial water table (m)
S_y = specific yield of aquifer (dimensionless)
t = time since water level reached top of drift (days)

The following values were used for this Butte Highlands adit analysis:

L = 10,000 ft or 3,050 m;
K = for bedrock:
1×10^{-6} cm/sec or 8.6×10^{-4} m/day
1×10^{-7} cm/sec or 8.6×10^{-5} m/day
H = 200 to 800 feet or 61 to 244 m, depending on adit location
S_y = 0.05 (assumed as representative for an unconfined bedrock aquifer)
t = 5 yrs or 1,825 days (assumed time to reach steady-state)

Using the values presented above for the variables, steady-state inflow to the Butte Highlands adit is predicted to be approximately 35 to 110 gal/min.

Analytical Equation (Lei, 1998)

Another analytical solution for estimating steady-state inflow during tunnel driving is:

$$q = 2\pi K(d + P_a - Ø) \div \ln(D/R + \sqrt{[(D/R)^2 - 1]})$$

where:
q = flow per unit length of tunnel (m^2/sec)
K = hydraulic conductivity (m/sec)
D = distance from ground surface to axis of tunnel (m)
R = tunnel radius (m)
Ø = hydraulic head at tunnel's perimeter (m)
d = height of free-standing water above ground (m)
P_a = atmospheric pressure head (generally assumed to be 0 m)

The following values were used for this Butte Highlands adit analysis:

K = for bedrock:
1×10^{-6} cm/sec or 1×10^{-8} m/sec
1×10^{-7} cm/sec or 1×10^{-9} m/sec
D = 600 to 1200 feet (183 to 366 m), depending on adit section
R = 15 ft or 4.5 m
Ø = 200 to 800 feet or 61 to 244 m, depending on adit location
d = 0 m
P_a = 0 m

Using the values presented above for the variables, steady-state inflow to the Butte Highlands adit is predicted to be approximately 10 to 90 gal/min.

Summary of Mine Adit Inflow Calculations

The following is a summary of results for the three analytical equations presented above, which are predicted ranges of groundwater inflow to a 15-ft radius exploration adit at Butte Highlands that extends down for a total distance of 10,000 feet in bedrock with an overall hydraulic conductivity of 10^{-7} to 10^{-6} cm/sec:

Uniform Hydraulic Conductivity (K) of Bedrock	Cumulative Inflow (gal/min) at Specified Adit Lengths			
	Adit Length = 1000 feet	Adit Length = 2000 feet	Adit Length = 5000 feet	Adit Length = 10,000 feet
	Analytical Equation (USFS et al., 1992)			
K = 10^{-7} cm/sec	0.6	1	34	10
K = 10^{-6} cm/sec	6	12	36	104
	Analytical Equation (Goodman et al., 1965)			
K = 10^{-7} cm/sec	1	2	8	34
K = 10^{-6} cm/sec	3	6	25	109
	Analytical Equation (Lei, 1998)			
K = 10^{-7} cm/sec	0.4	1	3	9
K = 10^{-6} cm/sec	4	8	29	88

These results do not take into account zones of higher permeability, such as faults and fractures, that would increase long-term inflow rates if they are present and interconnected over a large area. If such fault/fracture zones do not extend over large areas or are poorly interconnected, short-term increases in inflow may occur, but would decrease after groundwater held is storage is drained. Borehole BHMW08-01 that was drilled in November-December 2008 to a total depth of 1,167 feet did not appear to intercept any major fault/fracture zones; additional test-holes drilled in other areas of the proposed exploration adit would help define the potential for intercepting structural zones that may yield more groundwater, including the faults shown on **Figure 3**.

Based on measurements of flow from the existing 2,300-ft long Highland adit (90 to 110 gal/min), it is evident that fault/fracture zones encountered by the adit are contributing water to this opening. Therefore, assuming that a 10,000-ft long adit would encounter additional fault/fracture zones, the predicted upper range of inflow rates (90 to 110 gal/min) may be higher. Increases of 25 percent and 50 percent to the predicted inflow rates would result in total inflows of approximately 110 to 140 gal/min and 135 to 165 gal/min, respectively.

REFERENCES

Goodman et al., 1965. in http://www.eco.gov.yk.ca/dap/pdf/Section_06_Underground_Mine_FINAL.pdf.

Lei, 1998. in http://www.ainc-inac.gc.ca/nu/nuwork/pi/dng/eis/DPPGIS_e.pdf.

Montana Bureau of Mines and Geology (MBMG), 1998. Abandoned – Inactive Mines Program, Deerlodge National Forest, Volume IV, Upper Clark Fork River Drainage. Open-file Report 346. J.P. Madison (MBMG); J.D. Lonn (MBMG); R.K. Marvin (MBMG); J.J. Metesh (MBMG); and R. Wintergerst (USFS). March 1998.

Montana Department of Environmental Quality, 2006. Circular DEQ-7, Montana Numeric Water Quality Standards. February 2006.

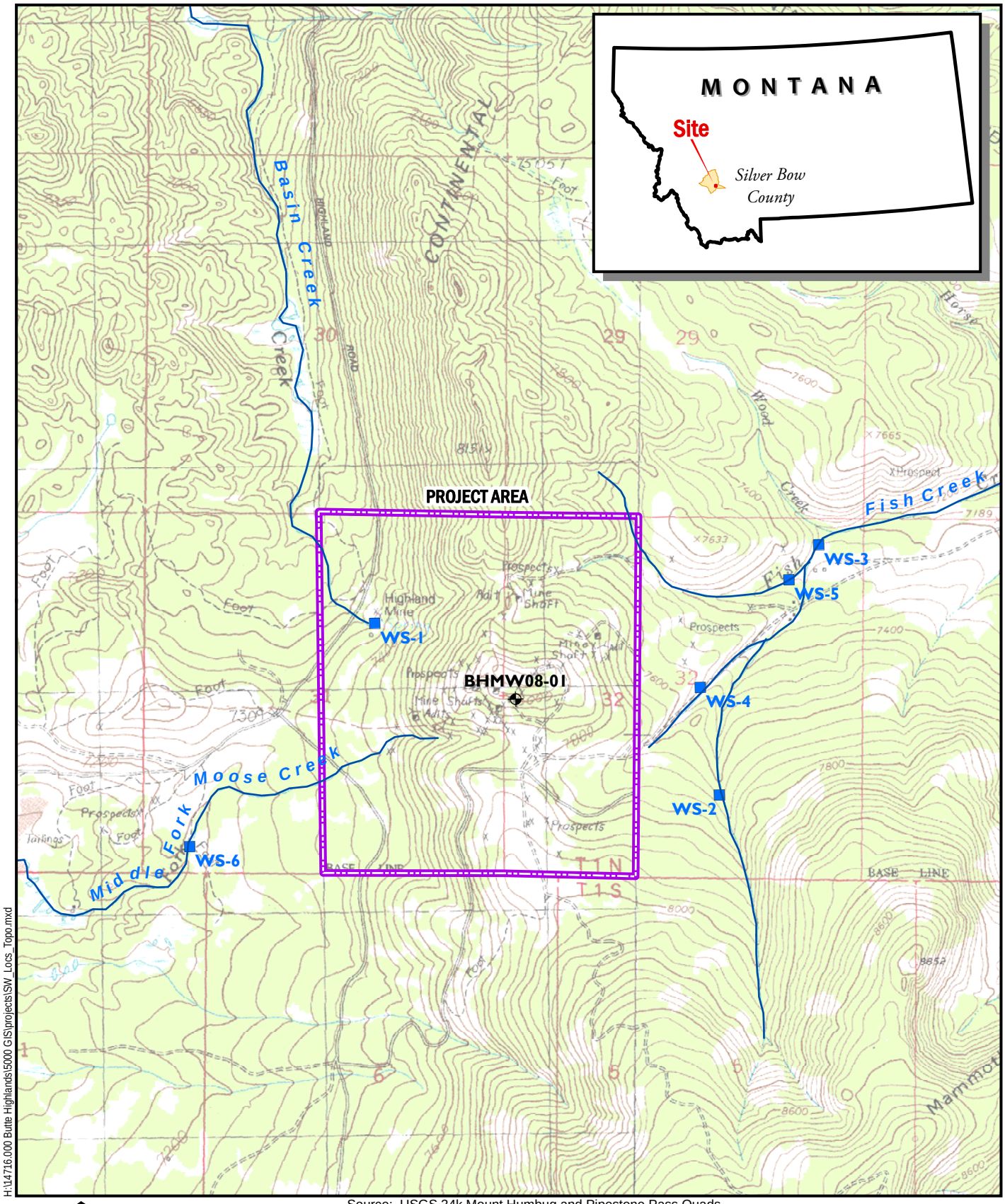
Natural Resources Conservation Service (NRCS), 2008. SNOTEL Site Information and Reports for Basin Creek, Site Number 315, Station ID 12d09s, Montana. http://www.wcc.nrcs.usda.gov/snotel.

U.S. Environmental Protection Agency (USEPA), 2008. Listed Water Information, Cycle: 2006, Waterbody Name: Fish Creek, Montana. http://iaspub.epa.gov/tmdl_waters10.

U.S. Forest Service, Montana Department of State Lands, Montana Department of Health and Environmental Sciences, and Montana Department of Natural Resources and Conservation (USFS et al.), 1992. Final Environmental Impact Statement, Noranda Minerals Corp., Montana Reserves Company, Joint Venture, Montanore Project. October 1992.

APPENDIX A

FIGURES



H:\14716.000 Butte Highlands\5000 GIS\projects\SW_Locs_Topo.mxd

Source: USGS 24k Mount Humbug and Pipestone Pass Quads

N

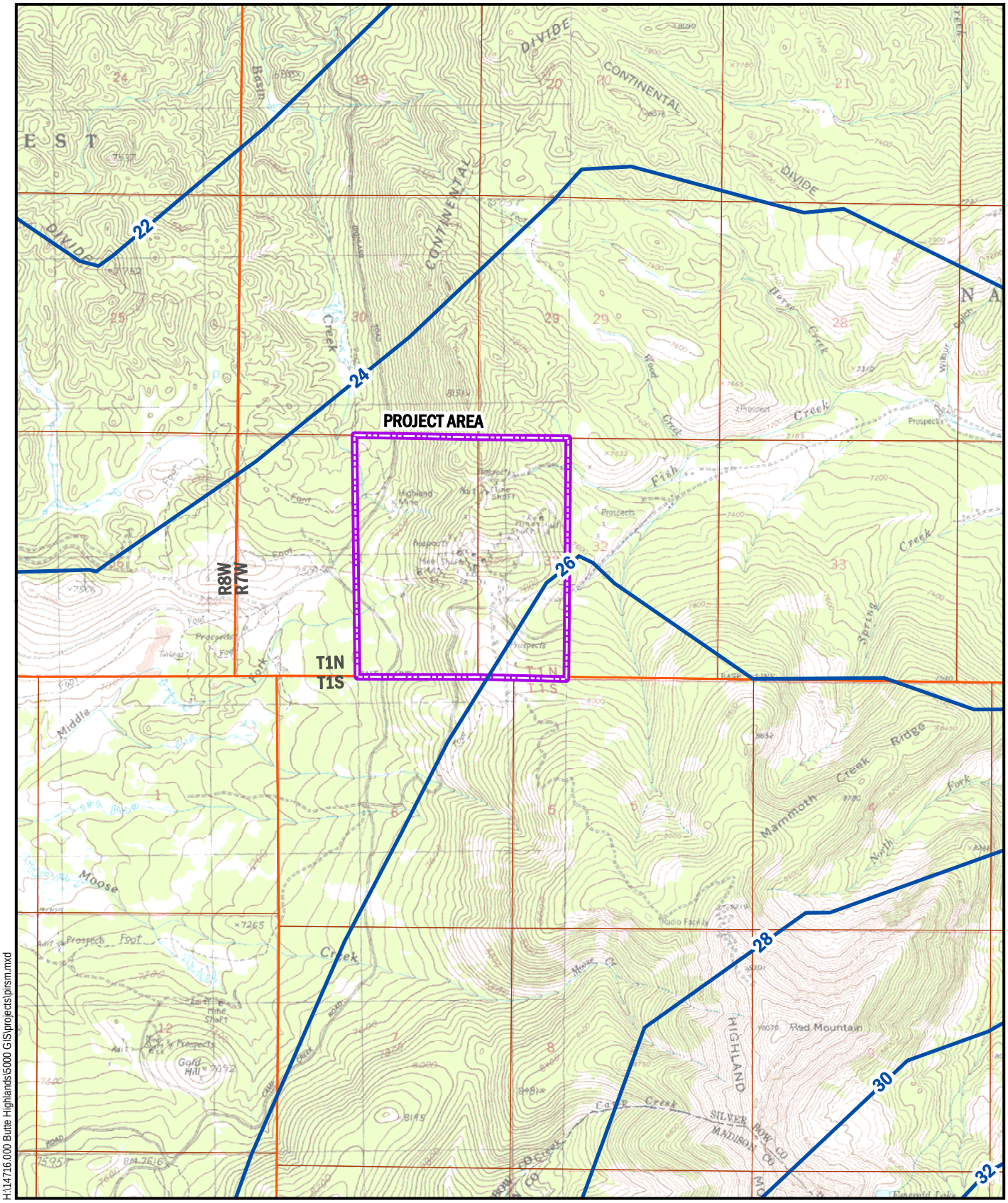
0 Feet 2,000

AMEC Geomatrix

Surface Water Sampling Location

Groundwater Monitoring Well

Project Area and Monitoring Sites
Butte Highlands Project
Silver Bow County, Montana
FIGURE 1



H:\14716.000 Butte Highlands\5000 GIS\projects\prism.mxd

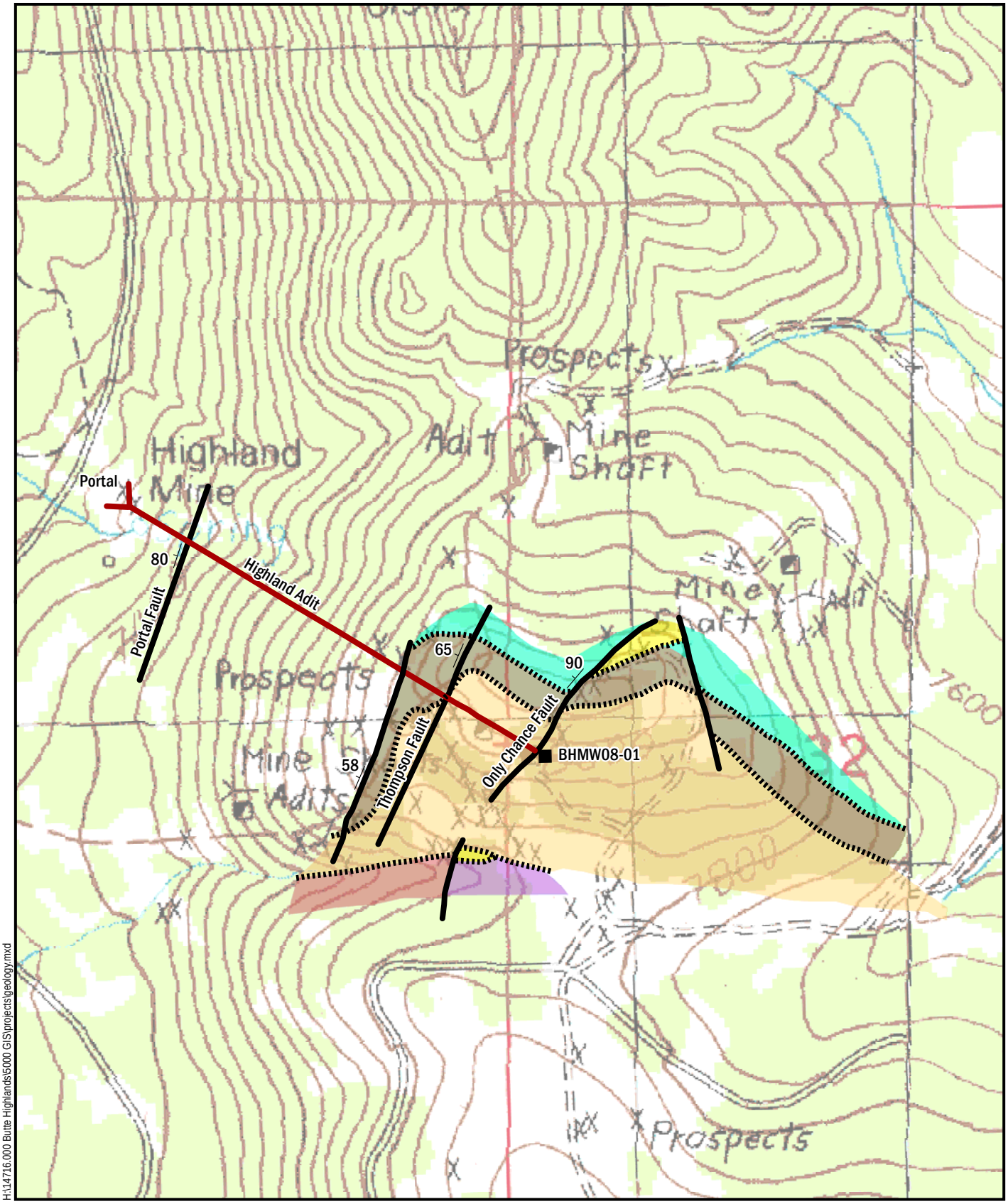
N

0 Feet 3,000

AMEC Geomatrix

Average Annual Precipitation (inches)
Data estimated by the Oregon Climate Service for the period 1961-1990 using the PRISM model.

Precipitation Map
Butte Highlands Project
Silver Bow County, Montana
FIGURE 2



H:\14716.000 Butte Highlands\5000 GIS\projects\geology.mxd

N

0 Feet 800

AMEC Geomatrix

Surface Geology

- Gabbro Intrusive
- Pilgrim Dolomite, Upper Marble
- Park Shale, Metamorphosed
- Meagher Dolomite, Lower Marble
- Flathead Sandstone, Quartzite
- Wolsey Shale, Metamorphosed
- Geologic Unit Contact
- Faults

Surface Geology
Butte Highlands Project
Silver Bow County, Montana
FIGURE 3

APPENDIX B

TABLES

TABLE 1
SURFACE WATER MONITORING DATA
BUTTE HIGHLANDS PROJECT

Station No.	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6
Station Description	Adit Discharge from Highland Mine; drains to Basin Creek	Fish Creek (southern channel)	Fish Creek (combined channels)	Fish Creek (middle channel)	Fish Creek (northern channel)	Middle Fork of Moose Creek
Sample Date	11/26/2008	11/25/2008	11/25/2008	11/25/2008	11/25/2008	11/26/2008
Flow Rate (gal/min)	90	48	92	8.3	64	0.4
Temperature (°C)	5.45	0.25	1.34	2.14	1.66	0.07
pH (s.u.)	7.67	6.75	7.65	7.09	7.44	7.49
Electrical Conductivity (µS/cm)	335	61	272	363	282	425
Dissolved Oxygen (mg/L)	7.18	14.89	12.24	11.1	14.22	11.52
ORP (mV)	175.4	202.6	202.0	199.7	199.6	206.3
Turbidity (NTU)	3.11	0.97	3.86	2.62	2.91	4.11

Note: See Figure 1 for surface water station locations. gal/min = gallons per minute; ^{o}C = degrees Celsius; s.u. = standard units; µS/cm = microSiemens per centimeter; mg/L = milligrams per liter; ORP = oxidation-reduction potential; mV = millivolts; NTU = nephelometric turbidity units.

TABLE 2
LABORATORY PARAMETERS FOR WATER SAMPLES
BUTTE HIGHLANDS PROJECT

Analyte Category	Analytical Parameters
Metals	Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Platinum, Selenium, Silver, Strontium, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc
Common Ions	Calcium, Magnesium, Sodium, Potassium, Hardness, Alkalinity, Chloride, Fluoride, Sulfate
Nutrients	Nitrogen (Total Kjeldahl, Ammonia, Nitrate+Nitrite), Phosphorus (Total, Orthophosphate)
General Parameters	pH, Electrical Conductivity, Total Dissolved Solids, Total Suspended Solids, Turbidity

TABLE 3
GROUNDWATER MONITORING DATA
BUTTE HIGHLANDS PROJECT

Depth Below Ground Surface in Borehole (feet)	685	805	1065	1085	1167
Location	Adit Elevation	First Water Encountered >1 gal/min	Vicinity of Observed Marble-Skarn Contact	Anticipated Contact Between Marble-Skarn*	Total Depth of Drilled Borehole
Sample Date	12/3/2008	12/4/2008	12/9/2008	12/9/2008	12/10/2008
Lithology	Meagher Dolomite	Meagher Dolomite	Wolsey Shale	Wolsey Shale	Wolsey Shale
Flow Rate (gal/min)	0.3	8	12	12	12
Temperature (°C)	10.62	9.65	10.05	9.12	10.64
pH (s.u.)	10.42	8.35	8.43	8.44	8.55
Electrical Conductivity (µS/cm)	127	395	373	370	371
Dissolved Oxygen (mg/L)	6.4	6.7	8.7	8.1	9.3
ORP (mV)	153	129.4	190.2	NM	NM
Turbidity (NTU)	NM	198	152	647	681

Note: See Figure 1 for borehole location (BHMW08-01). gal/min = gallons per minute; ^{o}C = degrees Celsius; s.u. = standard units; µS/cm = microSiemens per centimeter; mg/L = milligrams per liter; ORP = oxidation-reduction potential; mV = millivolts; NTU = nephelometric turbidity units; NM = not measured. *Thin (5 ft) shale unit encountered from 1080 to 1085 ft.

TABLE 4
LITHOLOGIC AND WATER OBSERVATIONS FROM BOREHOLE
BUTTE HIGHLANDS PROJECT

Borehole Depth of Observation (feet)	Water Yield (gal/min)	Lithology
685	0.3*	Not recorded - probably Meagher Dolomite. Relatively soft compared to mafic material below 1040 feet.
805	8**	Not recorded - probably Meagher Dolomite. Relatively soft compared to mafic material below 1040 feet.
1065	12***	905-1040 feet: dolomitic rocks including marble (Meagher Dolomite) 1040-1080 feet: mafic, hard material[1] (Wolsey Shale)
1085	12	1080-1085 feet: softer, clayey material (Wolsey Shale) Below 1085 feet: mafic, hard material[1] (Wolsey Shale); white marble vein at 1150 ft.

Note:

*First water encountered at 597 ft.

**Flow rate increased from <1 up to 8 gpm at approx. 805 ft.

***Flow rate increased from 8 to 12 gpm at approx. 910 ft., then stayed constant to total depth of 1167 ft.

[1] Carbonate-rich metamorphosed shale (skarn/hornfels). No garnet or reddish brown color observed. Interspersed fragments of lighter rock are slightly reactive to HCl. Slow rate of penetration (13 ft/hour or less). Metallic crystals (pyrrhotite?) observed at 1150 ft, and muscovite observed below 1150 ft.

Cuttings samples retained at 1060, 1090, 1150, and 1165 ft.

APPENDIX C

SITE PHOTOGRAPHS

SURFACE WATER LOCATION WS-1

Near Historical Adit

SURFACE WATER LOCATION WS-2

Southern fork of Fish Creek at Culvert East of Project Site

SURFACE WATER LOCATION WS-3

Combined forks of Fish Creek

SURFACE WATER LOCATION WS-4

Middle fork of Fish Creek

SURFACE WATER LOCATION WS-5

Northern fork of Fish Creek

SURFACE WATER LOCATION WS-6

Single Channel of Moose Creek

DRILL PAD IN WINTER CONDITIONS

Location BHMW08-01

ERODING LOGGING ROAD

Middle fork of Fish Creek running onto road

between Station WS-4 and WS-3

APPENDIX D

LABORATORY WATER QUALITY DATA

SURFACE WATER QUALITY AT BUTTE HIGHLANDS MINE SITE - TIMBERLINE RESOURCES
1993 and 2008 Monitoring Results

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	Surface Water Station																	
			WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/25/08	WS-1 / BH-1 11/25/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 11/25/08	WS-2 / BH-2 11/25/08	WS-3 / BH-3 09/03/08	WS-3 / BH-3 09/03/08	WS-3 / BH-3 11/25/08	WS-3 / BH-3 11/25/08	WS-4 11/25/08	WS-5 11/25/08	WS-6 11/26/08	BHIS10H 08/20/93	BHIS20L 08/20/93	BHIS30M 08/20/93
Location			**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Fish Creek - south channel**	**Fish Creek - south channel**	**Fish Creek - south channel**	**Fish Creek - south channel**	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - middle channel**	**Fish Creek - north channel**	**Moose Creek - Middle Fork**	**Highland Mine Adit Discharge**	**Seep in Small Channel Upper Basin Creek**	**Basin Creek - Upper**
Lab pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	7.6	---	---	---	7.8	---	---	---	8.3	---	---	---	8.0	8.1	7.8	7.35	7.70	8.05
Lab EC (µhmos/cm)	---	---	378	---	---	---	69	---	---	---	266	---	---	---	390	304	513	392	514	345
Turbidity (NTU)	---	---	---	---	---	---	0.18	---	---	---	<0.2	---	---	---	---	---	---	---	---	---
TSS (mg/l)	---	---	<3.	---	<1.	---	7	---	<5.	---	2	---	<5.	---	<10.	<10.	<10.	---	---	---
TDS (mg/l)	---	500 s*	212	---	---	---	36	---	---	---	148	---	---	---	203	167	278	---	---	---
Alkalinity, total (mg CaCO3/l)	---	---	186	---	---	---	37	---	---	---	139	---	---	---	200	150	260	---	---	---
Bicarbonate (mg CaCO3/l)	---	---	227	---	---	---	45	---	---	---	169	---	---	---	240	180	320	---	---	---
Carbonate (mg CaCO3/l)	---	---	0	---	---	---	0	---	---	---	0	---	---	---	<4.	<4.	<4.	---	---	---
Chloride (mg/l)	230*	250 s*	1	---	---	---	<1.	---	---	---	<1.	---	---	---	<1.	<1.	1	1.6	1.75	1.2
Sulfate (mg/l)	---	250 s*	21	---	---	---	<5.	---	---	---	8	---	---	---	5	9	8	13.8	60.8	13.4
Fluoride (mg/l)	---	4		---	---	---	---	---	---	---	---	---	---	---	<0.1	<0.1	<0.1	0.17	0.11	0.19
Hardness (mg CaCO3/l)	---	---	210	---	---	---	29	---		---	145	---	---	---	197	147	264	---	---	---
Ammonia, as N (mg/l)	---	---	<0.05	---	---	---	<0.05	---	---	---	<0.05	---	---	---	<0.1	<0.1	<0.1	---	---	---
Total Kjeldahl Nitrogen (mg/l)	---	---	0.2	---	---	---	<0.2	---	---	---	0.2	---	---	---	<0.5	<0.5	<0.5	---	---	---
Nitrate+Nitrite, as N (mg/l)	---	10	0.18	---	0.133	---	<0.01	---	<0.01	---	0.09	---	0.123	---	0.37	0.9	<0.05	0.24	0.13	0.14
Nitrate, as N (mg/l)	---	10	0.18	---	<0.1	---	<0.01	---	<0.01	---	0.09	---	0.123	---	---	---	---	---	---	---
Nitrite, as N (mg/l)	---	1	<0.1	---	0.133	---	<0.01	---	<0.01	---	<0.01	---	0.123	---	---	---	---	---	---	---
Orthophosphate (mg/l)	---	---	<0.001	---	---	---	0.017	---	---	---	0.006	---	---	---	<0.1	<0.1	<0.1	---	---	---
Phosphorus, total (mg/l)	---	---	0.009	---	<0.1	---	0.025	---	<0.05	---	0.016	---	<0.1	---	<0.1	<0.1	0.01	---	---	---
			Dissolved Cations	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Dissolved Cations**	**Dissolved Cations**	**Cations**	**Cations**	**Cations**
Calcium (mg/l)	---	---	43	44	37.1	---	10	10	8.65	8.6	35	35	33.6	33.6	47	33	66	---	---	---
Magnesium (mg/l)	---	---	25	27	24.8	22	1	1	1.49	1.46	14	15	15.6	14.0	20	16	24	---	---	---
Potassium (mg/l)	---	---	3	4	2.95	3.05	1	1	0.654	0.954	2	2	1.58	1.73	2	2	1	---	---	---
Sodium (mg/l)	---	---	3	4	---	3.01	2	2	1.66	1.13	2	2	1.95	2.37	<1.	2	2	---	---	---
			Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Metals**	**Metals**	**Metals**
Aluminum (mg/l)	0.087	0.2 s	<0.03	0.04	<0.01	<0.01	<0.03	<0.03	0.0162	<0.01	<0.03	<0.03	<0.01	0.0176	0.04	0.04	0.04	<0.03	<0.03	<0.03
Antimony (mg/l)	---	0.006	<0.003	<0.003	<0.001	0.00152	<0.003	<0.003	<0.001	<0.001	<0.003	<0.003	<0.001	<0.001	<0.003	<0.003	<0.003	---	---	---
Arsenic (mg/l)	0.15	0.01	0.005	0.007	0.00525	0.00428	0.01	0.011	0.0109	0.0105	<0.003	0.003	0.00242	0.00246	<0.003	<0.003	<0.003	---	---	---
Barium (mg/l)	---	2	0.015	0.017	0.0147	0.0137	<0.005	<0.005	0.00163	0.00185	0.007	0.008	0.0071	0.00842	0.014	0.009	0.022	0.017	0.016	0.016
Beryllium (mg/l)	---	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Boron (mg/l)	---	---	---	---	<0.01	0.0425	---	---	0.0324	<0.01	---	---	<0.01	<0.01	<0.1	<0.1	<0.1	---	---	---
Cadmium (mg/l)	0.000365 h	0.005	<0.00008	<0.00008	<0.001	<0.001	<0.00008	<0.00008	<0.001	<0.001	<0.00008	<0.00008	<0.001	<0.001	<0.00008	<0.00008	<0.00008	<0.002	<0.002	<0.002
Chromium (mg/l)	0.1201 h	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002
Cobalt (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.01	<0.01	<0.01	---	---	---
Copper (mg/l)	0.01319 h	1.3	0.001	0.003	0.00131	0.00108	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.002	<0.002	0.0025
Iron (mg/l)	1.0	0.3 s	<0.05	0.22	0.115	0.0972	<0.05	<0.05	<0.01	<0.01	<0.05	0.05	0.0177	0.0274	0.04	0.05	0.07	0.007	0.024	0.015
Lead (mg/l)	0.005331 h	0.015	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.002	<0.002	0.0025
Manganese (mg/l)	---	0.05 s	0.016	0.017	0.0112	0.00927	<0.005	<0.005	<0.001	<0.001	<0.005	<0.005	<0.001	0.00218	<0.005	<0.005	0.018	0.005	0.008	0.002
Mercury (mg/l)	0.00091	0.002	<0.00001	<0.00001	<0.001	<0.0001	<0.00001	<0.00001	<0.001	<0.0001	<0.00001	<0.00001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001
Molybdenum (mg/l)	---	---	---	---	0.00137	0.00109	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.005	<0.005	<0.005	---	---	---
Nickel (mg/l)	0.0735 h	0.1	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	<0.002	<0.002	<0.002
Platinum (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.1	<0.1	<0.1	---	---	---
Selenium (mg/l)	0.005	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Silver (mg/l)	0.008152 h	0.1	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.001
Strontium (mg/l)	---	4.0	---	---	0.082	0.0945	---	---	0.0123	0.0113	---	---	0.0347	0.0394	<0.1	<0.1	<0.0002	---	---	---
Thallium (mg/l)	---	0.002	<0.0002	<0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.0002	---	---	---
Tin (mg/l)	---	---	---	---	<0.001	0.00122	---	---	0.00113	0.00209	---	---	0.0011	0.00351	<0.1	<0.1	<0.1	---	---	---
Titanium (mg/l)	---	---	---	---	<0.001	<0.001	---	---	0.00113	<0.001	---	---	0.0011	0.00132	<0.1	<0.1	<0.1	---	---	---
Uranium (mg/l)	---	0.03	---	---	0.00131	0.00116	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Vanadium (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001	---	---	<0.001	<0.001	<0.1	<0.1	<0.1	---	---	---
Zinc (mg/l)	0.037 h	2.0	<0.01	<0.01	0.00108	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	0.0045	0.0027	0.0022

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	Surface Water Station																	
			WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/26/08	WS-1 / BH-1 11/26/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 11/25/08	WS-2 / BH-2 11/25/08	WS-3 / BH-3 09/03/08	WS-3 / BH-3 09/03/08	WS-3 / BH-3 11/25/08	WS-3 / BH-3 11/25/08	WS-4 11/25/08	WS-5 11/25/08	WS-6 11/26/08	BHIS10H 08/20/93	BHIS20L 08/20/93	BHIS30M 08/20/93
Field pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	---	---	7.67	---	---	---	6.75	---	---	---	7.65	---	7.09	7.44	7.49	8.37	8.10	8.50
Field Temperature (C)	---	---	---	---	5.45	---	---	---	-0.25	---	---	---	1.34	---	2.1	1.7	0.1	6.3	9.5	8.9
Field DO (mg/l)	---	---	---	---	7.18	---	---	---	14.89	---	---	---	12.24	---	11.1	14.2	11.5	---	---	---
Field ORP (mV)	---	---	---	---	175	---	---	---	203	---	---	---	202	---	200	200	206	---	---	---
Field Turbidity (NTU)	---	---	---	---	3.11	---	---	---	0.97	---	---	---	3.86	---	2.6	2.9	4.1	---	---	---
Field EC (µS/cm)	---	---	---	---	335	---	---	---	61	---	---	---	272	---	363	282	425	391	515	338

NOTE:

s.u. = standard units; EC = electrical conductance; µS/cm = microsiemens per centimeter; mg/l = milligrams per liter; TDS = total dissolved solids; TSS = total suspended solids;

NTU = nephelometric turbidity units; CaCO3 = calcium carbonate; C = Celsius; mV = millivolts.

s = secondary standard; h = hardness dependent (for this table, values presented are based on a hardness of 150 mg/L).

* = federal U.S. EPA standard. --- = no standard or not analyzed.

Aquatic life standards are the lowest reported for acute and chronic standards; and groundwater standards are the human health values, both from Montana Circular DEQ-7 (February 2006).

GROUNDWATER QUALITY AT BUTTE HIGHLANDS MINE SITE - TIMBERLINE RESOURCES
2008 Monitoring Results

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	Groundwater Sample Site							
			BHMW08-01 805 ft 12/04/08	BHMW08-01 805 ft 12/04/08	BHMW08-01 1085 ft 12/09/08	BHMW08-01 1085 ft 12/09/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/25/08	WS-1 / BH-1 11/25/08
Location			Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Highland Mine Adit Discharge	Highland Mine Adit Discharge	Highland Mine Adit Discharge	Highland Mine Adit Discharge
Lab pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.4	---	8.5	---	7.6	---	---	---
Lab EC (µhmos/cm)	---	---	339	---	344	---	378	---	---	---
Turbidity (NTU)	---	---	97.3	---	276	---	---	---	---	---
TSS (mg/l)	---	---	115	---	408	---	<3.	---	<1.	---
TDS (mg/l)	---	500 s*	185	---	180	---	212	---	---	---
Alkalinity, total (mg CaCO3/l)	---	---	200	---	200	---	186	---	---	---
Bicarbonate (mg CaCO3/l)	---	---	240	---	230	---	227	---	---	---
Carbonate (mg CaCO3/l)	---	---	<4.	---	<4.	---	0	---	---	---
Chloride (mg/l)	230*	250 s*	<1.	---	<1.	---	1	---	---	---
Sulfate (mg/l)	---	250 s*	6	---	7	---	21	---	---	---
Fluoride (mg/l)	---	4	<0.1	---	0.1	---		---	---	---
Hardness (mg CaCO3/l)	---	---	194	---	194	---	210	---	---	---
Ammonia, as N (mg/l)	---	---	<0.1	---	<0.1	---	<0.05	---	---	---
Total Kjeldahl Nitrogen (mg/l)	---	---	<0.5	---	<0.5	---	0.2	---	---	---
Nitrate+Nitrite, as N (mg/l)	---	10	0.98	---	0.54	---	0.18	---	0.133	---
Orthophosphate (mg/l)	---	---	0.02	---	1.03	---	<0.001	---	---	---
Phosphorus, total (mg/l)	---	---	0.01	---	0.96	---	0.009	---	<0.1	---
			Dissolved Cations		**Dissolved Cations**		**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**
Calcium (mg/l; dissolved)	---	---	40	---	37	---	43	44	37.1	---
Magnesium (mg/l; dissolved)	---	---	23	---	25	---	25	27	24.8	22
Potassium (mg/l; dissolved)	---	---	2	---	4	---	3	4	2.95	3.05
Sodium (mg/l; dissolved)	---	---	1	---	1	---	3	4	---	3.01
			Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**
Aluminum (mg/l)	0.087	0.2 s	<0.03	0.22	0.28	12.11	<0.03	0.04	<0.01	<0.01
Antimony (mg/l)	---	0.006	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.001	0.00152
Arsenic (mg/l)	0.15	0.01	<0.003	<0.003	<0.003	<0.003	0.005	0.007	0.00525	0.00428
Barium (mg/l)	---	2	0.017	0.022	0.011	0.062	0.015	0.017	0.0147	0.0137
Beryllium (mg/l)	---	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (mg/l)	---	---	<0.1	<0.1	<0.1	<0.1	---	---	<0.01	0.0425
Cadmium (mg/l)	0.000097 h	0.005	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.001	<0.001
Chromium (mg/l)	0.0277 h	0.1	<0.001	0.003	0.001	0.024	<0.001	<0.001	<0.001	<0.001
Cobalt (mg/l)	---	---	<0.01	<0.01	<0.01	0.01	---	---	<0.001	<0.001
Copper (mg/l)	0.00285 h	1.3	<0.001	0.005	<0.001	0.037	0.001	0.003	0.00131	0.00108
Iron (mg/l)	1.0	0.3 s	<0.03	3.28	0.67	20.52	<0.05	0.22	0.115	0.0972
Lead (mg/l)	0.000545 h	0.015	<0.0005	0.0016	<0.0005	0.0032	<0.0005	<0.0005	<0.001	<0.001
Manganese (mg/l)	---	0.05 s	0.011	0.089	0.056	0.208	0.016	0.017	0.0112	0.00927
Mercury (mg/l)	0.00091	0.002	<0.00005	<0.001	<0.00005	<0.001	<0.00001	<0.00001	<0.0001	<0.0001
Molybdenum (mg/l)	---	---	<0.005	<0.005	<0.005	<0.005	---	---	0.00137	0.00109
Nickel (mg/l)	0.0161 h	0.1	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.001	<0.001
Platinum (mg/l)	---	---	---	---	---	---	---	---	<0.001	<0.001
Selenium (mg/l)	0.005	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver (mg/l)	0.000374 h	0.1	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.001	<0.001
Strontium (mg/l)	---	4.0	<0.1	<0.1	<0.1	0.1	---	---	0.082	0.0945
Thallium (mg/l)	---	0.002	<0.0002	<0.0002	<0.0002	<0.0002	---	---	<0.001	<0.001
Tin (mg/l)	---	---	---	---	---	---	---	---	<0.001	0.00122
Titanium (mg/l)	---	---	---	---	---	---	---	---	<0.001	<0.001
Uranium (mg/l)	---	0.03	<0.001	<0.001	0.003	0.004	---	---	0.00131	0.00116
Vanadium (mg/l)	---	---	<0.1	<0.1	<0.1	<0.1	---	---	<0.001	<0.001
Zinc (mg/l)	0.037 h	2.0	<0.01	0.01	<0.01	0.02	<0.01	<0.01	0.00108	<0.001
Field pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.35	---	8.44	---	---	---	7.67	---
Field Temperature (C)	---	---	9.7	---	9.1	---	---	---	5.45	---
Field DO (mg/l)	---	---	6.7	---	8.1	---	---	---	7.18	---
Field ORP (mV)	---	---	129	---	---	---	---	---	175	---
Field Turbidity (NTU)	---	---	198	---	647	---	---	---	3.1	---
Field EC (µmhos/cm)	---	---	395	---	370	---	---	---	335	---

NOTE:
s.u. = standard units; EC = electrical conductance; µmhos/cm = micromhos per centimeter; mg/l = milligrams per liter; TDS = total dissolved solids; TSS = total suspended solids;
NTU = nephelometric turbidity units; CaCO3 = calcium carbonate; C = Celsius; mV = millivolts.
s = secondary standard; h = hardness dependent (for this table, MT values presented are based on a hardness of 25 mg/L).
* = federal U.S. EPA standard. --- = no standard or not analyzed.
Aquatic life standards are the lowest reported for acute and chronic standards; and groundwater standards are the human health values, both from Montana Circular DEQ-7 (February 2006).

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Client: AMEC Geomatrix
Report Date: 12/18/08
Project: Butte Highlands
Collection Date: 11/25/08 14:38
Lab ID: H08120007-001
DateReceived: 12/01/08
Client Sample ID: WS-4
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.0	s.u.		0.1		A4500-H B	12/01/08 17:14 / hm
Conductivity	390	umhos/cm		1		A2510 B	12/03/08 10:48 / hm
Solids, Total Suspended TSS @ 105 C	ND	mg/L		10		A2540 D	12/01/08 15:29 / hm
Solids, Total Dissolved TDS @ 180 C	203	mg/L		10		A2540 C	12/01/08 15:23 / hm
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	12/02/08 14:14 / hm
Bicarbonate as HCO3	240	mg/L		4		A2320 B	12/02/08 14:14 / hm
Carbonate as CO3	ND	mg/L		4		A2320 B	12/02/08 14:14 / hm
Chloride	ND	mg/L		1		E300.0	12/03/08 20:13 / hm
Sulfate	5	mg/L		1		E300.0	12/03/08 20:13 / hm
Fluoride	ND	mg/L		0.1	4	A4500-F C	12/04/08 10:00 / kjw
Hardness as CaCO3	197	mg/L		1		A2340 B	12/08/08 10:45 / sld
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	12/08/08 17:20 / stp
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	12/04/08 12:31 / eli-b
Nitrogen, Nitrate+Nitrite as N	0.37	mg/L		0.05		E353.2	12/04/08 13:30 / stp
Phosphorus, Orthophosphate as P	ND	mg/L	H	0.01		E365.1	12/11/08 16:58 / stp
Phosphorus, Total as P	ND	mg/L		0.01		E365.1	12/01/08 17:48 / stp
METALS, DISSOLVED							
Calcium	47	mg/L		1		E200.7	12/08/08 09:30 / sld
Magnesium	20	mg/L		1		E200.7	12/08/08 09:30 / sld
Potassium	2	mg/L		1		E200.7	12/08/08 09:30 / sld
Sodium	ND	mg/L		1		E200.7	12/08/08 09:30 / sld
METALS, TOTAL RECOVERABLE							
Aluminum	0.04	mg/L		0.03		E200.8	12/04/08 21:30 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/04/08 21:30 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/04/08 21:30 / eli-b
Barium	0.014	mg/L		0.005		E200.7	12/04/08 19:08 / eli-b
Beryllium	ND	mg/L		0.001		E200.8	12/04/08 21:30 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/04/08 19:08 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/04/08 21:30 / eli-b
Chromium	ND	mg/L		0.001		E200.8	12/04/08 21:30 / eli-b
Cobalt	ND	mg/L		0.01		E200.7	12/04/08 19:08 / eli-b
Copper	ND	mg/L		0.001		E200.8	12/05/08 23:32 / eli-b
Iron	0.04	mg/L		0.03		E200.7	12/04/08 19:08 / eli-b
Lead	ND	mg/L		0.0005		E200.8	12/04/08 21:30 / eli-b
Manganese	ND	mg/L		0.005		E200.7	12/04/08 19:08 / eli-b
Mercury	ND	mg/L		0.001		E245.1	12/04/08 12:36 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Client: AMEC Geomatrix
Report Date: 12/18/08
Project: Butte Highlands
Collection Date: 11/25/08 14:38
Lab ID: H08120007-001
DateReceived: 12/01/08
Client Sample ID: WS-4
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL RECOVERABLE							
Molybdenum	ND	mg/L		0.005		E200.8	12/04/08 21:30 / eli-b
Nickel	ND	mg/L		0.01		E200.7	12/04/08 19:08 / eli-b
Selenium	ND	mg/L		0.001		E200.8	12/04/08 21:30 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/04/08 21:30 / eli-b
Strontium	ND	mg/L		0.1		E200.7	12/04/08 19:08 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/05/08 23:32 / eli-b
Uranium	ND	mg/L		0.001		E200.8	12/04/08 21:30 / eli-b
Vanadium	ND	mg/L		0.1		E200.8	12/04/08 21:30 / eli-b
Zinc	ND	mg/L		0.01		E200.7	12/04/08 19:08 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Client: AMEC Geomatrix
Report Date: 12/18/08
Project: Butte Highlands
Collection Date: 11/25/08 15:35
Lab ID: H08120007-002
DateReceived: 12/01/08
Client Sample ID: WS-5
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.1	s.u.		0.1		A4500-H B	12/01/08 17:15 / hm
Conductivity	304	umhos/cm		1		A2510 B	12/03/08 10:49 / hm
Solids, Total Suspended TSS @ 105 C	ND	mg/L		10		A2540 D	12/01/08 15:30 / hm
Solids, Total Dissolved TDS @ 180 C	167	mg/L		10		A2540 C	12/01/08 15:23 / hm
INORGANICS							
Alkalinity, Total as CaCO3	150	mg/L		4		A2320 B	12/02/08 14:18 / hm
Bicarbonate as HCO3	180	mg/L		4		A2320 B	12/02/08 14:18 / hm
Carbonate as CO3	ND	mg/L		4		A2320 B	12/02/08 14:18 / hm
Chloride	ND	mg/L		1		E300.0	12/03/08 20:33 / hm
Sulfate	9	mg/L		1		E300.0	12/03/08 20:33 / hm
Fluoride	ND	mg/L		0.1	4	A4500-F C	12/04/08 10:00 / kjw
Hardness as CaCO3	147	mg/L		1		A2340 B	12/08/08 10:45 / sld
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	12/08/08 17:22 / stp
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	12/04/08 12:32 / eli-b
Nitrogen, Nitrate+Nitrite as N	0.09	mg/L		0.05		E353.2	12/04/08 13:36 / stp
Phosphorus, Orthophosphate as P	ND	mg/L	H	0.01		E365.1	12/17/08 15:40 / sld
Phosphorus, Total as P	ND	mg/L		0.01		E365.1	12/01/08 17:49 / stp
METALS, DISSOLVED							
Calcium	33	mg/L		1		E200.7	12/08/08 09:33 / sld
Magnesium	16	mg/L		1		E200.7	12/08/08 09:33 / sld
Potassium	2	mg/L		1		E200.7	12/08/08 09:33 / sld
Sodium	2	mg/L		1		E200.7	12/08/08 09:33 / sld
METALS, TOTAL RECOVERABLE							
Aluminum	0.04	mg/L		0.03		E200.8	12/04/08 21:37 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/04/08 21:37 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/04/08 21:37 / eli-b
Barium	0.009	mg/L		0.005		E200.7	12/04/08 19:12 / eli-b
Beryllium	ND	mg/L		0.001		E200.8	12/04/08 21:37 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/04/08 19:12 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/04/08 21:37 / eli-b
Chromium	ND	mg/L		0.001		E200.8	12/04/08 21:37 / eli-b
Cobalt	ND	mg/L		0.01		E200.7	12/04/08 19:12 / eli-b
Copper	0.001	mg/L		0.001		E200.8	12/05/08 23:40 / eli-b
Iron	0.05	mg/L		0.03		E200.7	12/04/08 19:12 / eli-b
Lead	ND	mg/L		0.0005		E200.8	12/04/08 21:37 / eli-b
Manganese	ND	mg/L		0.005		E200.7	12/04/08 19:12 / eli-b
Mercury	ND	mg/L		0.001		E245.1	12/04/08 12:39 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Report Date: 12/18/08
Collection Date: 11/25/08 15:35
DateReceived: 12/01/08
Matrix: Aqueous

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120007-002
Client Sample ID: WS-5

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL RECOVERABLE							
Molybdenum	ND	mg/L		0.005		E200.8	12/04/08 21:37 / eli-b
Nickel	ND	mg/L		0.01		E200.8	12/04/08 21:37 / eli-b
Selenium	ND	mg/L		0.001		E200.8	12/04/08 21:37 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/04/08 21:37 / eli-b
Strontium	ND	mg/L		0.1		E200.7	12/04/08 19:12 / eli-b
Thallium	ND	mg/L	L	0.0002		E200.8	12/04/08 21:37 / eli-b
Uranium	ND	mg/L		0.001		E200.8	12/04/08 21:37 / eli-b
Vanadium	ND	mg/L		0.1		E200.8	12/04/08 21:37 / eli-b
Zinc	ND	mg/L		0.01		E200.7	12/04/08 19:12 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
L - Lowest available reporting limit for the analytical method used.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Client: AMEC Geomatrix
Report Date: 12/18/08
Project: Butte Highlands
Collection Date: 11/26/08 10:05
Lab ID: H08120007-003
DateReceived: 12/01/08
Client Sample ID: WS-6
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	7.8	s.u.		0.1		A4500-H B	12/01/08 17:18 / hm
Conductivity	513	umhos/cm		1		A2510 B	12/03/08 10:52 / hm
Solids, Total Suspended TSS @ 105 C	ND	mg/L		10		A2540 D	12/01/08 15:30 / hm
Solids, Total Dissolved TDS @ 180 C	278	mg/L		10		A2540 C	12/01/08 15:23 / hm
INORGANICS							
Alkalinity, Total as CaCO3	260	mg/L		4		A2320 B	12/02/08 14:25 / hm
Bicarbonate as HCO3	320	mg/L		4		A2320 B	12/02/08 14:25 / hm
Carbonate as CO3	ND	mg/L		4		A2320 B	12/02/08 14:25 / hm
Chloride	1	mg/L		1		E300.0	12/03/08 20:52 / hm
Sulfate	8	mg/L		1		E300.0	12/03/08 20:52 / hm
Fluoride	ND	mg/L		0.1	4	A4500-F C	12/04/08 10:00 / kjw
Hardness as CaCO3	264	mg/L		1		A2340 B	12/08/08 10:45 / sld
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	12/08/08 17:24 / stp
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	12/04/08 12:33 / eli-b
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	12/04/08 13:38 / stp
Phosphorus, Orthophosphate as P	ND	mg/L	H	0.01		E365.1	12/11/08 17:02 / stp
Phosphorus, Total as P	0.01	mg/L		0.01		E365.1	12/01/08 17:50 / stp
METALS, DISSOLVED							
Calcium	66	mg/L		1		E200.7	12/08/08 09:41 / sld
Magnesium	24	mg/L		1		E200.7	12/08/08 09:41 / sld
Potassium	1	mg/L		1		E200.7	12/08/08 09:41 / sld
Sodium	2	mg/L		1		E200.7	12/08/08 09:41 / sld
METALS, TOTAL RECOVERABLE							
Aluminum	0.04	mg/L		0.03		E200.8	12/04/08 21:43 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/04/08 21:43 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/04/08 21:43 / eli-b
Barium	0.022	mg/L		0.005		E200.7	12/04/08 19:16 / eli-b
Beryllium	ND	mg/L		0.001		E200.8	12/04/08 21:43 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/04/08 19:16 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/04/08 21:43 / eli-b
Chromium	ND	mg/L		0.001		E200.8	12/04/08 21:43 / eli-b
Cobalt	ND	mg/L		0.01		E200.7	12/04/08 19:16 / eli-b
Copper	0.001	mg/L		0.001		E200.8	12/05/08 23:48 / eli-b
Iron	0.07	mg/L		0.03		E200.7	12/04/08 19:16 / eli-b
Lead	ND	mg/L		0.0005		E200.8	12/04/08 21:43 / eli-b
Manganese	0.018	mg/L		0.005		E200.7	12/04/08 19:16 / eli-b
Mercury	ND	mg/L		0.001		E245.1	12/04/08 12:41 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Revised Date: 01/07/09
Report Date: 12/18/08
Collection Date: 11/26/08 10:05
DateReceived: 12/01/08
Matrix: Aqueous

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120007-003
Client Sample ID: WS-6

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, TOTAL RECOVERABLE							
Molybdenum	ND	mg/L		0.005		E200.8	12/04/08 21:43 / eli-b
Nickel	ND	mg/L		0.01		E200.7	12/04/08 19:16 / eli-b
Selenium	ND	mg/L		0.001		E200.8	12/04/08 21:43 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/04/08 21:43 / eli-b
Strontium	ND	mg/L		0.1		E200.7	12/04/08 19:16 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/04/08 21:43 / eli-b
Uranium	ND	mg/L		0.001		E200.8	12/04/08 21:43 / eli-b
Vanadium	ND	mg/L		0.1		E200.8	12/04/08 21:43 / eli-b
Zinc	ND	mg/L		0.01		E200.7	12/04/08 19:16 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120098-001
Client Sample ID: Butte Highlands, 1085

Report Date: 01/02/09
Collection Date: 12/09/08 11:40
DateReceived: 12/10/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.5	s.u.		0.1		A4500-H B	12/10/08 13:15 / kjw
Conductivity	344	umhos/cm		1		A2510 B	12/10/08 13:57 / kjw
Turbidity	276	NTU		0.01		E180.1	12/10/08 14:21 / kjw
Solids, Total Suspended TSS @ 105 C	408	mg/L		10		A2540 D	12/10/08 16:14 / hm
Solids, Total Dissolved TDS @ 180 C	180	mg/L		10		A2540 C	12/10/08 16:18 / hm
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	12/12/08 14:12 / hm
Bicarbonate as HCO3	230	mg/L		4		A2320 B	12/12/08 14:12 / hm
Carbonate as CO3	ND	mg/L		4		A2320 B	12/12/08 14:12 / hm
Chloride	ND	mg/L		1		E300.0	12/15/08 16:57 / hm
Sulfate	7	mg/L		1		E300.0	12/15/08 16:57 / hm
Fluoride	0.1	mg/L		0.1	4	A4500-F C	12/10/08 15:15 / kjw
Hardness as CaCO3	194	mg/L		1		A2340 B	12/30/08 15:20 / abb
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	12/18/08 13:58 / stp
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	12/24/08 09:29 / eli-b
Nitrogen, Nitrate+Nitrite as N	0.54	mg/L		0.05		E353.2	12/11/08 11:15 / stp
Phosphorus, Orthophosphate as P	1.03	mg/L		0.01		E365.1	12/11/08 17:23 / stp
Phosphorus, Total as P	0.96	mg/L		0.01		E365.1	12/22/08 17:30 / stp
METALS, DISSOLVED							
Aluminum	0.28	mg/L		0.03		E200.8	12/22/08 16:52 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/22/08 16:52 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/22/08 16:52 / eli-b
Barium	0.011	mg/L		0.005		E200.7	12/19/08 12:51 / eli-b
Beryllium	ND	mg/L		0.001		E200.7	12/19/08 12:51 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/19/08 12:51 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/22/08 16:52 / eli-b
Calcium	37	mg/L		1		E200.7	12/19/08 12:51 / eli-b
Chromium	0.001	mg/L		0.001		E200.8	12/22/08 16:52 / eli-b
Cobalt	ND	mg/L		0.01		E200.7	12/19/08 12:51 / eli-b
Copper	ND	mg/L		0.001		E200.8	12/22/08 16:52 / eli-b
Iron	0.67	mg/L		0.03		E200.7	12/19/08 12:51 / eli-b
Lead	ND	mg/L		0.0005		E200.8	12/22/08 16:52 / eli-b
Magnesium	25	mg/L		1		E200.7	12/19/08 12:51 / eli-b
Manganese	0.056	mg/L		0.005		E200.7	12/19/08 12:51 / eli-b
Mercury	ND	mg/L		0.00005		E245.1	12/22/08 13:33 / eli-b
Molybdenum	ND	mg/L		0.005		E200.8	12/22/08 16:52 / eli-b
Nickel	ND	mg/L		0.01		E200.7	12/19/08 12:51 / eli-b
Potassium	4	mg/L		1		E200.7	12/19/08 12:51 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120098-001
Client Sample ID: Butte Highlands, 1085

Report Date: 01/02/09
Collection Date: 12/09/08 11:40
DateReceived: 12/10/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, DISSOLVED							
Selenium	ND	mg/L		0.001		E200.8	12/22/08 16:52 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/22/08 16:52 / eli-b
Sodium	1	mg/L		1		E200.7	12/19/08 12:51 / eli-b
Strontium	ND	mg/L		0.1		E200.7	12/19/08 12:51 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/22/08 16:52 / eli-b
Uranium	0.003	mg/L		0.001		E200.8	12/22/08 16:52 / eli-b
Vanadium	ND	mg/L		0.1		E200.7	12/19/08 12:51 / eli-b
Zinc	ND	mg/L		0.01		E200.7	12/19/08 12:51 / eli-b
METALS, TOTAL RECOVERABLE							
Aluminum	12.11	mg/L		0.03		E200.7	12/23/08 15:28 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/22/08 17:54 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/22/08 17:54 / eli-b
Barium	0.062	mg/L		0.005		E200.8	12/22/08 17:54 / eli-b
Beryllium	ND	mg/L		0.001		E200.8	12/22/08 17:54 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/23/08 15:28 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/22/08 17:54 / eli-b
Chromium	0.024	mg/L		0.001		E200.8	12/22/08 17:54 / eli-b
Cobalt	0.01	mg/L		0.01		E200.8	12/22/08 17:54 / eli-b
Copper	0.037	mg/L		0.001		E200.8	12/22/08 17:54 / eli-b
Iron	20.52	mg/L		0.03		E200.7	12/23/08 15:28 / eli-b
Lead	0.0032	mg/L		0.0005		E200.8	12/22/08 17:54 / eli-b
Manganese	0.208	mg/L		0.005		E200.8	12/22/08 17:54 / eli-b
Mercury	ND	mg/L		0.001		E245.1	12/19/08 15:40 / eli-b
Molybdenum	ND	mg/L		0.005		E200.8	12/22/08 17:54 / eli-b
Nickel	0.02	mg/L		0.01		E200.8	12/22/08 17:54 / eli-b
Selenium	ND	mg/L		0.001		E200.8	12/22/08 17:54 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/22/08 17:54 / eli-b
Strontium	0.1	mg/L		0.1		E200.8	12/22/08 17:54 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/22/08 17:54 / eli-b
Uranium	0.004	mg/L		0.001		E200.8	12/22/08 17:54 / eli-b
Vanadium	ND	mg/L		0.1		E200.8	12/22/08 17:54 / eli-b
Zinc	0.02	mg/L		0.01		E200.8	12/22/08 17:54 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120098-002
Client Sample ID: Butte Highlands, 805

Report Date: 01/02/09
Collection Date: 12/04/08 15:15
DateReceived: 12/10/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
pH	8.4	s.u.		0.1		A4500-H B	12/10/08 13:16 / kjw
Conductivity	339	umhos/cm		1		A2510 B	12/10/08 13:58 / kjw
Turbidity	97.3	NTU	H	0.01		E180.1	12/10/08 14:24 / kjw
Solids, Total Suspended TSS @ 105 C	115	mg/L		10		A2540 D	12/10/08 16:15 / hm
Solids, Total Dissolved TDS @ 180 C	185	mg/L		10		A2540 C	12/10/08 16:18 / hm
INORGANICS							
Alkalinity, Total as CaCO3	200	mg/L		4		A2320 B	12/12/08 14:26 / hm
Bicarbonate as HCO3	240	mg/L		4		A2320 B	12/12/08 14:26 / hm
Carbonate as CO3	ND	mg/L		4		A2320 B	12/12/08 14:26 / hm
Chloride	ND	mg/L		1		E300.0	12/15/08 17:16 / hm
Sulfate	6	mg/L		1		E300.0	12/15/08 17:16 / hm
Fluoride	ND	mg/L		0.1	4	A4500-F C	12/10/08 15:15 / kjw
Hardness as CaCO3	194	mg/L		1		A2340 B	12/30/08 15:20 / abb
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	12/18/08 14:00 / stp
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	12/24/08 09:30 / eli-b
Nitrogen, Nitrate+Nitrite as N	0.98	mg/L		0.05		E353.2	12/11/08 11:17 / stp
Phosphorus, Orthophosphate as P	0.02	mg/L	H	0.01		E365.1	12/11/08 17:05 / stp
Phosphorus, Total as P	0.01	mg/L		0.01		E365.1	12/22/08 17:31 / stp
METALS, DISSOLVED							
Aluminum	ND	mg/L		0.03		E200.7	12/19/08 13:03 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/22/08 18:02 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/22/08 18:02 / eli-b
Barium	0.017	mg/L		0.005		E200.7	12/19/08 13:03 / eli-b
Beryllium	ND	mg/L		0.001		E200.7	12/19/08 13:03 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/19/08 13:03 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/22/08 18:02 / eli-b
Calcium	40	mg/L		1		E200.7	12/19/08 13:03 / eli-b
Chromium	ND	mg/L		0.001		E200.8	12/22/08 18:02 / eli-b
Cobalt	ND	mg/L		0.01		E200.7	12/19/08 13:03 / eli-b
Copper	ND	mg/L		0.001		E200.8	12/22/08 18:02 / eli-b
Iron	ND	mg/L		0.03		E200.7	12/19/08 13:03 / eli-b
Lead	ND	mg/L		0.0005		E200.8	12/22/08 18:02 / eli-b
Magnesium	23	mg/L		1		E200.7	12/19/08 13:03 / eli-b
Manganese	0.011	mg/L		0.005		E200.7	12/19/08 13:03 / eli-b
Mercury	ND	mg/L		0.00005		E245.1	12/19/08 15:42 / eli-b
Molybdenum	ND	mg/L		0.005		E200.8	12/22/08 18:02 / eli-b
Nickel	ND	mg/L		0.01		E200.7	12/19/08 13:03 / eli-b
Potassium	2	mg/L		1		E200.7	12/19/08 13:03 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
H - Analysis performed past recommended holding time.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

ENERGY LABORATORIES, INC. * 3161 E Lyndale (59604) * PO Box 5688 * Helena, MT 59601
Toll Free 877.472.0711 * 406.442.0711 * FAX 406.442.0712 * helena@energylab.com

LABORATORY ANALYTICAL REPORT

Client: AMEC Geomatrix
Project: Butte Highlands
Lab ID: H08120098-002
Client Sample ID: Butte Highlands, 805

Report Date: 01/02/09
Collection Date: 12/04/08 15:15
DateReceived: 12/10/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
METALS, DISSOLVED							
Selenium	ND	mg/L		0.001		E200.8	12/22/08 18:02 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/22/08 18:02 / eli-b
Sodium	1	mg/L		1		E200.7	12/19/08 13:03 / eli-b
Strontium	ND	mg/L		0.1		E200.7	12/19/08 13:03 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/22/08 18:02 / eli-b
Uranium	ND	mg/L		0.001		E200.8	12/22/08 18:02 / eli-b
Vanadium	ND	mg/L		0.1		E200.7	12/19/08 13:03 / eli-b
Zinc	ND	mg/L		0.01		E200.7	12/19/08 13:03 / eli-b
METALS, TOTAL RECOVERABLE							
Aluminum	0.22	mg/L		0.03		E200.8	12/22/08 18:10 / eli-b
Antimony	ND	mg/L		0.003		E200.8	12/22/08 18:10 / eli-b
Arsenic	ND	mg/L		0.003		E200.8	12/22/08 18:10 / eli-b
Barium	0.022	mg/L		0.005		E200.8	12/22/08 18:10 / eli-b
Beryllium	ND	mg/L		0.001		E200.8	12/22/08 18:10 / eli-b
Boron	ND	mg/L		0.1		E200.7	12/23/08 15:32 / eli-b
Cadmium	ND	mg/L		0.00008		E200.8	12/22/08 18:10 / eli-b
Chromium	0.003	mg/L		0.001		E200.8	12/22/08 18:10 / eli-b
Cobalt	ND	mg/L		0.01		E200.8	12/22/08 18:10 / eli-b
Copper	0.005	mg/L	D	0.003		E200.8	12/22/08 18:10 / eli-b
Iron	3.28	mg/L		0.03		E200.7	12/23/08 15:32 / eli-b
Lead	0.0016	mg/L		0.0005		E200.8	12/22/08 18:10 / eli-b
Manganese	0.089	mg/L		0.005		E200.8	12/22/08 18:10 / eli-b
Mercury	ND	mg/L		0.001		E245.1	12/19/08 15:45 / eli-b
Molybdenum	ND	mg/L		0.005		E200.8	12/22/08 18:10 / eli-b
Nickel	ND	mg/L		0.01		E200.8	12/22/08 18:10 / eli-b
Selenium	ND	mg/L		0.001		E200.8	12/22/08 18:10 / eli-b
Silver	ND	mg/L		0.0005		E200.8	12/22/08 18:10 / eli-b
Strontium	ND	mg/L		0.1		E200.8	12/22/08 18:10 / eli-b
Thallium	ND	mg/L		0.0002		E200.8	12/22/08 18:10 / eli-b
Uranium	ND	mg/L		0.001		E200.8	12/22/08 18:10 / eli-b
Vanadium	ND	mg/L		0.1		E200.8	12/22/08 18:10 / eli-b
Zinc	0.01	mg/L		0.01		E200.8	12/22/08 18:10 / eli-b

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

APPENDIX E

MINE/ADIT INFLOW CALCULATIONS

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (Jan. 20, 2009)

1992 Montanore Project Final EIS Equation

$Q = [(2\pi KH) \div (2.3\log(2H \div R))] \times 7.48$

where: Q = mine tunnel inflow per unit length; K = rock hydraulic conductivity;
H = hydraulic head from adit to water table; R = tunnel radius.

Constant (none)	K (ft/min)	H (feet)	R (feet)	q (gal/min/ft)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:						
6.28	0.000002	200	15	0.0057	11	0-2000 ft
6.28	0.000002	300	15	0.0076	15	2000-4000 ft
6.28	0.000002	400	15	0.0095	19	4000-6000 ft
6.28	0.000002	600	15	0.0129	26	6000-8000 ft
6.28	0.000002	800	15	0.0161	32	8000-10,000 ft
				Total =	**104**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:						
6.28	0.0000002	200	15	0.0006	1	0-2000 ft
6.28	0.0000002	300	15	0.0008	2	2000-4000 ft
6.28	0.0000002	400	15	0.0009	2	4000-6000 ft
6.28	0.0000002	600	15	0.0013	3	6000-8000 ft
6.28	0.0000002	800	15	0.0016	3	8000-10,000 ft
				Total =	**10**	**gal/min**

Cumulative Inflow (gal/min) for Specified Tunnel Lengths (feet)

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
K = 10^{-6} cm/sec	5.7	11.5	19.1	26.8	36.2	45.7	58.6	71.4	87.5	104
K = 10^{-7} cm/sec	0.6	1.1	1.9	2.7	3.6	4.6	5.9	7.1	8.8	10

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (Jan. 20, 2009)

Goodman (1965) Equation

$Q = 0.707L(KH^3S_y/t)^{1/2}$

where: Q = mine tunnel inflow; L = length of drift; K = rock hydraulic conductivity;
H = depth of drift below initial water table; Sy = specific yield of aquifer;
t = time since water level reached top of drift.

For this Butte Highlands Adit analysis, Sy is assumed constant at 0.05; and t is assumed constant at 1,825 days (5 yrs).

Constant (none)	L (meters)	K (m/day)	H (meters)	Sy (none)	t (days)	Q (m3/day)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:								
0.707	610	0.00086	61	0.05	1825	32	6	0-2000 ft
0.707	610	0.00086	91	0.05	1825	57	11	2000-4000 ft
0.707	610	0.00086	122	0.05	1825	89	16	4000-6000 ft
0.707	610	0.00086	182	0.05	1825	163	30	6000-8000 ft
0.707	610	0.00086	244	0.05	1825	252	46	8000-10,000 ft
					Total =	**593**	**109**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:								
0.707	610	0.000086	61	0.05	1825	10	2	0-2000 ft
0.707	610	0.000086	91	0.05	1825	18	3	2000-4000 ft
0.707	610	0.000086	122	0.05	1825	28	5	4000-6000 ft
0.707	610	0.000086	182	0.05	1825	51	9	6000-8000 ft
0.707	610	0.000086	244	0.05	1825	80	15	8000-10,000 ft
					Total =	**188**	**34**	**gal/min**

Cumulative Inflow (gal/min) at Specified Tunnel Lengths (feet)

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
K = 10^{-6} cm/sec	2.9	5.8	11.1	16.3	24.5	32.7	47.6	62.5	85.7	109
K = 10^{-7} cm/sec	0.9	1.8	3.5	5.2	7.8	10.3	15.1	19.8	27.1	34

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (Jan. 20, 2009)

Lei (1998) Equation

$q = [2\pi K(d+P_a-Ø)] / \ln(D/R + \sqrt{[(D/R)^2 - 1]})$

where: q = flow per unit length of mine tunnel; K = rock hydraulic conductivity;
D = distance from ground surface to axis of tunnel; R = tunnel radius;
Ø = hydraulic head at tunnel's perimeter; d = height of free-standing water above ground;
Pa = atmospheric pressure head (usually assumed to be 0).

Constant (none)	K (m/sec)	d (meters)	Pa (meters)	Ø (meters)	D (meters)	R (meters)	q (m2/sec)	Q (m3/sec)	Q (gal/min)	dit Segmen
Using bedrock K of 10^{-6} cm/sec:										
6.28	0.00000001	0	0	61	183	4.5	-8.7095E-07	0.0005	8	0-2000 ft
6.28	0.00000001	0	0	91	213	4.5	-1.2559E-06	0.0008	12	000-4000 ft
6.28	0.00000001	0	0	122	244	4.5	-1.6349E-06	0.0010	16	000-6000 ft
6.28	0.00000001	0	0	182	305	4.5	-2.3281E-06	0.0014	23	000-8000 ft
6.28	0.00000001	0	0	244	366	4.5	-3.0095E-06	0.0018	29	00-10,000 ft
							Total =	**0.0056**	**88**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:										
6.28	1E-09	0	0	61	183	4.5	-8.7095E-08	0.0001	1	0-2000 ft
6.28	1E-09	0	0	91	213	4.5	-1.2559E-07	0.0001	1	000-4000 ft
6.28	1E-09	0	0	122	244	4.5	-1.6349E-07	0.0001	2	000-6000 ft
6.28	1E-09	0	0	182	305	4.5	-2.3281E-07	0.0001	2	000-8000 ft
6.28	1E-09	0	0	244	366	4.5	-3.0095E-07	0.0002	3	00-10,000 ft
							Total =	**0.0006**	**9**	**gal/min**

Cumulative Inflow (gal/min) at Specified Tunnel Lengths (feet)

	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
K = 10^{-6} cm/sec	4.2	8.4	14.5	20.6	28.5	36.4	47.6	58.9	73.4	88
K = 10^{-7} cm/sec	0.4	0.8	1.4	2.1	2.8	3.6	4.8	5.9	7.3	9

Water Quality Data and Summary Report
For the Butte Highlands Project

Prepared by:

Savor Environmental Services
648 Frog Pond Road
Staunton, VA 24401
540-885-1551

and

Klepfer Mining Services
13058 Sherwood Court
Hayden Lake, ID 83835
208-772-6993

March 2010

Contents

Introduction 3

Table 1 Surface Water Monitoring Sites for the Butte Highlands Project 4

Table 2 Exploration and Groundwater Monitoring Holes at Butte Highlands Project Site 4

Table 3 Exploration Drillhole and Monitoring Well Static Water Level Measurements (in Feet) 5

Table 4 Water Quality Parameters and Detection Limits 6

Water Quality Results and Summary Information 7

Introduction

The following report was prepared in order to present and summarize the results of water quality monitoring that has taken place for the Butte Highlands Project, in Silver Bow County, Montana. The Butte Highlands project is located on the Continental Divide approximately 15 miles south of Butte, Montana. The project is situated on patented lands surrounded by the Deer Lodge National Forest within Sections 31 and 32, Township 1 North Range 7 West; Sections 5 and 6 Township 1 South Range 7 West; and Section 1 Township 1 South Range 8 West, Montana Principal Meridian. Timberline Resources Corp (TRC) of Coeur d'Alene, Idaho is currently permitted by the Montana Department of Environmental Quality to undertake exploration activities in pursuit of eventually turning the project into a full scale mine operation. TRC and Highland Mining, LLC are equal partners of the Butte Highlands Joint Venture (BHJV) which is now pursuing a Hard Rock Mining Operating Permit with the State of Montana.

The baseline water monitoring program at the Butte Highlands Project began in the fall of 2008 and continues as a part of the exploration program. Seven surface water sites have been established and include sample stations in Basin Creek, Fish Creek, and Middle Fork Moose Creek, as well as a sampling location just below the historic Highlands Mine adit discharge in Basin Creek. The surface water sampling sites are listed below in Table 1. The surface water monitoring program for the exploration program requires monthly monitoring of the surface water sites.

Since December of 2008, six test wells (five vertical and one angle) have been installed in the proposed mine area at the project site. The angular drill hole has since been abandoned. Three additional water monitoring wells have been drilled to monitor groundwater quality near the LAD areas, and one additional well has been drilled as a water supply source. The groundwater monitoring program for the exploration program requires quarterly monitoring of static water level from the exploration drill holes. Information on the exploration wells can be found in Table 2. Static water level measurements are shown in Table 3.

Pace Analytical Labs in Billings, MT was used for analysis purposes. Table 4 shows the parameters that were analyzed and their detection or reporting limits. Information in MDEQ Circular DEQ-7 (February 2008) was used to develop the minimum reporting values. Each sample was analyzed for metals (total recoverable and/or dissolved), common ions, nutrients and general parameters listed in the table.

This report will display analytical results for each sample site, as well as summary information (minimum, maximum, average) calculated for individual parameters by site. Surface water stations will be displayed first, followed by ground water.

Table 1 Surface Water Monitoring Sites for the Butte Highlands Project

Stream	Site Description	Site ID
Basin Creek	Highland Mine Adit Discharge, northwest side of project	WS-1
Fish Creek	Upper Fish Creek, southern channel, southeast side of project	WS-2
Fish Creek	Upper Fish Creek, combined channels, northeast of project	WS-3
Fish Creek	Upper Fish Creek, middle channel, east side of project	WS-4
Fish Creek	Upper Fish Creek, northern channel, northeast of project	WS-5
Middle Fork Moose Creek	Middle Fork Moose Creek, upper middle fork, southwest of project	WS-6
Basin Creek	Basin Creek, downstream of Highlands Mine adit	WS-7

Table 2 Exploration and Groundwater Monitoring Holes at Butte Highlands Project Site

Drill Hole ID and Type	Northing & Easting Coordinates	Surface Elevation (ft)	Total Depth Drilled (ft bgs)	Total Depth Cased (ft bgs)	Water Quality Sample Depth (ft bgs)	Date Drilled
BHMW08-01 (Exploration)	N: 16640905 E: 1255915	7977 ft	1,167 ft (vertical)	600 ft (8-in steel)	805 ft 1,085 ft	Dec. 2008
BHMW09-01 (Exploration)	N: 16640255 E: 1255940	7823 ft	820 ft (vertical)	5 ft (6-in steel)	820 ft	July 2009
BHMW09-02 (Exploration)	N: 16640633 E: 1255565	7849 ft	980 ft (vertical)	545 ft (6-in steel)	600 ft	Aug. 2009
BHMW09-03 (Exploration)	N: 16640546 E: 1253985	7444 ft	500 ft* (45° angle)	Abandoned	No Sample	Aug. 2009
BHMW09-04 (Exploration)	N: 16641078 E: 1255059	7897 ft	1,120 ft (vertical)	620 ft (6-in steel)	1,120 ft	Oct.-Nov. 2009
BHMW09-05 (Exploration)	N: 16641125 E: 1255897	8048 ft	1,285 ft (vertical)	680 ft (6-in steel)	No Sample	Dec. 2009 – Jan. 2010
Water Supply Well	N: 1254049 E: 16640538	7445 ft	480 ft (vertical)	480 ft	Not Reported	Oct. 2009
LAD1MW (Monitoring)	N: 1252333 E: 16639704	7298 ft	65 ft	60 ft (4-in slotted pvc)	Est 03/10	9/17-9/21/2009
LAD2MW (Monitoring)	N: 16638530 E: 1251159	7190 ft	60 ft	60 ft (2-in slotted pvc)	Est 03/10	01/2010
LAD3MW (Monitoring)	N: 16640229 E: 1255375	7791 ft	67 ft	60 ft (2-in slotted pvc)	Est 03/10	9/22-9/23/2009

Note: ft = feet; bgs = below ground surface; btc = below top of casing; gpm = gallons per minute. *Angle hole depth is drilled depth and not feet below ground surface

Table 3 Exploration Drillhole and Monitoring Well Static Water Level Measurements (in Feet)

DATE	BHMW08 -01	BHMW09 -01	BHMW09 -02	BHMW09 -04	BHMW09 -05	LAD1MW	LAD2MW	LAD3MW
08/17/09	618.80	- - -	- - -	- - -	- - -	- - -	- - -	- - -
09/01/09	618.50	- - -	428.00	- - -	- - -	- - -	- - -	- - -
09/11/09	618.70	- - -	428.20	- - -	- - -	- - -	- - -	- - -
12/10/09	- - -	- - -	433.40	560.85	*	21.90	- - -	- - -
12/11/09	620.10	- - -	- - -	- - -	- - -	- - -	- - -	- - -
02/23/10	- - -	265.70	- - -	- - -	697.40	- - -	8.27	- - -
03/16/10	620.55	274.20	442.33	586.80	*	23.56	8.21	64.85
3/22/2010						23.53	8.02	65.22
4/12/2010	621.20	279.80	439.05	568.40	697.60	23.49	7.85	65.30

Note: All measurements were taken from top of casing and are displayed in feet. - - - no measurement taken. * An obstruction exists at 720 ft for test hole BHMW09-05. Water depth was below 720 ft.

Table 4 Water Quality Parameters

Parameter (1)	Aquatic Life Standard (2)		Human Health Standard (2)		Required Reporting Value	Project Laboratory Detection Limit
	Acute	Chronic	Surface Water	Ground Water		
Lab & Field pH (s.u.)	---	6.5 - 9.0*	6.5 - 8.5* s	6.5 - 8.5* s	---	0.1
Field Temperature (C)	---	---	---	---	---	0.1
Lab & Field EC (µmhos/cm)	---	---	---	---	---	5
Lab & Field Turbidity (NTU)	---	---	---	---	1.0	0.05
Field DO (mg/l)	>4.0 - 9.5	>4.0 - 9.5	---	---	0.05	---
TSS (mg/l)	---	---	---	---	---	0.5
TDS (mg/l)	---	---	---	500* s	---	5.0
Alkalinity, total (mg/l CaCO3)	---	---	---	---	---	2.5
Bicarbonate (mg/l CaCO3)	---	---	---	---	---	2.5
Carbonate (mg/l CaCO3)	---	---	---	---	---	2.5
Chloride (mg/l)	860*	230*	250 s	250 s	---	0.086
Sulfate (mg/l)	---	---	250 s	250 s	---	0.19
Fluoride (mg/l)	---	---	4.0	4.0	0.1	0.023
Hardness (mg/l CaCO3)	---	---	---	---	---	0.18
Ammonia, as N (mg/l)	---	---	---	---	0.05	0.008
Total Kjeldahl Nitrogen (mg/l)	---	---	---	---	---	0.038
Nitrate+Nitrite, as N (mg/l)	---	---	10	10	0.01	0.0042
Nitrate, as N (mg/l)	---	---	10	10	0.01	0.0050
Nitrite, as N (mg/l)	---	---	1.0	1.0	0.01	0.00047
Orthophosphate (mg/l)	---	---	---	---	---	0.00050
Phosphorus, total (mg/l)	---	---	---	---	0.001	0.00016
Calcium (mg/l)	---	---	---	---	---	0.025
Magnesium (mg/l)	---	---	---	---	---	0.012
Potassium (mg/l)	---	---	---	---	---	0.0051
Sodium (mg/l)	---	---	---	---	---	0.012

NOTES:

(1) s.u. = standard units of pH; C = degrees Celsius; EC = electrical conductivity; µmhos/cm = micromhos per centimeter; NTU = nephelometric turbidity units; DO = dissolved oxygen; mg/l = milligrams per liter; TSS = total suspended solids; TDS = total dissolved solids; CaCO3 = calcium carbonate; N = nitrogen.

(2) Standards from Circular DEQ-7: Montana Numeric Water Quality Standards (August 2010); s = secondary standard; h = hardness dependent (for this table, values are presented based on hardness of 150 mg/l)

* federal USEPA standard. --- no standard or reporting limit.
MT aquatic life standards apply to total recoverable metals in surface water (except for aluminum). Human health standards apply to dissolved metals in groundwater and to total recoverable metals in surface water.

Table 4 continued Water Quality Parameters

Parameter (1)	Aquatic Life Standard (2)		Human Health Standard (2)		Required Reporting Value	Project Laboratory Detection Limit
	Acute	Chronic	Surface Water	Ground Water		
Aluminum (mg/l)	0.75	0.087	---	---	0.03	0.002
Antimony (mg/l)	---	---	0.0056	0.006	0.003	0.00016
Arsenic (mg/l)	0.34	0.15	0.01	0.01	0.003	0.000062
Barium (mg/l)	---	---	1.0	1.0	0.005	0.000043
Beryllium (mg/l)	---	---	0.004	0.004	0.001	0.000069
Boron (mg/l)	---	---	---	---	---	0.00018
Cadmium (mg/l)	0.00322 h	0.000365 h	0.005	0.005	0.00008	0.000020
Chromium (mg/l)	0.016 (VI)	0.011 (VI)	0.1	0.1	0.001	0.00024
Cobalt (mg/l)	---	---	---	---	---	---
Copper (mg/l)	0.02051 h	0.01319 h	1.3	1.3	0.001	0.0002
Iron (mg/l)	---	1.0	0.3 s	0.3 s	0.05	0.0045
Lead (mg/l)	0.1368 h	0.005331 h	0.015	0.015	0.0005	0.00002
Manganese (mg/l)	---	---	0.05 s	0.05 s	0.005	0.00005
Mercury (mg/l)	0.0017	0.00091	0.00005	0.002	0.00001	0.000021
Molybdenum (mg/l)	---	---	---	---	---	---
Nickel (mg/l)	0.661 h	0.0735 h	0.1	0.1	0.01	0.00019
Platinum (mg/l)	---	---	---	---	---	---
Selenium (mg/l)	0.02	0.005	0.05	0.05	0.001	0.00010
Silver (mg/l)	0.008152	---	0.1	0.1	0.0005	0.000071
Strontium (mg/l)	---	---	4.0	4.0	---	0.000078
Thallium (mg/l)	---	---	0.00024	0.002	0.0002	0.000050
Tin (mg/l)	---	---	---	---	---	---
Titanium (mg/l)	---	---	---	---	---	---
Uranium (mg/l)	---	---	0.03	0.03	---	0.00025
Vanadium (mg/l)	---	---	---	---	---	---
Zinc (mg/l)	0.169 h	0.169 h	2.0	2.0	0.01	0.0013

NOTES:

(1) s.u. = standard units of pH; C = degrees Celsius; EC = electrical conductivity; µmhos/cm = micromhos per centimeter; NTU = nephelometric turbidity units; DO = dissolved oxygen; mg/l = milligrams per liter; TSS = total suspended solids; TDS = total dissolved solids; CaCO3 = calcium carbonate; N = nitrogen.

(2) Standards from Circular DEQ-7: Montana Numeric Water Quality Standards (August 2010); s = secondary standard; h = hardness dependent (for this table, values are presented based on hardness of 150 mg/l)

* federal USEPA standard. --- no standard or reporting limit.
MT aquatic life standards apply to total recoverable metals in surface water (except for aluminum). Human health standards apply to dissolved metals in groundwater and to total recoverable metals in surface water.

Water Quality Results and Summary Information

The following tables will display the results of water quality analysis completed for the Project. See the above tables for information on site identifiers. Groundwater test well results (BHMW08-01 through BHMW09-05) will be displayed first, followed by surface water results (WS-1 through WS-7). Each sample site will show summary information (average, minimum, maximum) based on the results of all samples collected, followed by a display of the results of each individual sample analysis. Due to their large size, final laboratory reports will be included with this report on a compact disk.

BHMW08-01

Sample ID	BHMW08-01				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.45	8.4	8.5	2	
Lab SC	341.5	339	344	2	
TDS	182.50	180	185	2	0
TSS	261.50	115	408	2	0
Turbidity	276.00	276	276	1	0
Oil & Grease				0	0

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH				0
SC				0
DO				0
Temp				0

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	BHMW08-01									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	38.5		37		40		2	0	0	0
Mg, Diss	24.0		23		25		2	0	0	0
K, Diss	3.0		2		4		2	0	0	0
Na, Diss	1.0		1		1		2	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	235.0	230	240	2	0
Alk., Carb.	4.0	<4	<4	2	2
Alk., Total	200.0	200	200	2	0
Hardness	194.0	194	194	2	0
Chloride	1.00	<1	<1	2	2
Fluoride	0.10	<0.1	0.1	2	1
Sulfate	6.50	6	7	2	0
Ammonia	0.100	<0.1	<0.1	2	2
Nitrate				0	0
N + N	0.76	0.54	0.98	2	0
Nitrite				0	0
T.I.N.				0	0
TKN	0.50	<0.5	<0.5	2	2
Ortho Phos	0.525	0.02	1.03	2	0
Phos., Total	0.485	0.01	0.96	2	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	BHMW08-01									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.16	6.17	<0.03	0.22	0.28	12.11	2	1	2	0
Antimony	0.003	0.003	<0.003	<0.003	<0.003	<0.003	2	2	2	2
Arsenic	0.003	0.003	<0.003	<0.003	<0.003	<0.003	2	2	2	2
Barium	0.014	0.042	0.011	0.022	0.017	0.062	2	0	2	0
Beryllium	0.001	0.001	<0.001	<0.001	<0.001	<0.001	2	2	2	2
Bismuth							0	0	0	0
Boron	0.100	0.100	<0.1	<0.1	<0.1	<0.1	2	2	2	2
Cadmium	0.00008	0.00008	<0.00008	<0.00008	<0.00008	<0.00008	2	2	2	2
Chromium	0.001	0.014	<0.001	0.003	0.001	0.024	2	1	2	0
Cobalt	0.010	0.010	<0.01	<0.01	<0.01	0.01	2	2	2	1
Copper	0.001	0.021	<0.001	0.005	<0.001	0.037	2	2	2	0
Iron	0.35	11.90	<0.03	20.52	0.67	3.28	2	1	2	0
Lead	0.0005	0.0024	<0.0005	0.0016	<0.0005	0.0032	2	2	2	0
Manganese	0.034	0.149	0.011	0.089	0.056	0.208	2	0	2	0
Mercury	0.00005	0.00100	<0.00005	<0.001	<0.00005	<0.001	2	2	2	2
Molybdenum	0.005	0.005	<0.005	<0.005	<0.005	<0.005	2	2	2	2
Nickel	0.01	0.02	<0.01	<0.01	<0.01	0.02	2	2	2	1
Selenium	0.001	0.001	<0.001	<0.001	<0.001	<0.001	2	2	2	2
Silver	0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	2	2	2	2
Strontium	0.10	0.10	<0.1	<0.1	<0.1	0.1	2	2	2	1
Thallium	0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	2	2	2	2
Vanadium	0.10	0.10	<0.1	<0.1	<0.1	<0.1	2	2	2	2
Zinc	0.01	0.02	<0.01	0.01	<0.01	0.02	2	2	2	0

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

BHMW08-01

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	BHMW08-01	BHMW08-01
Date	12/4/2008	12/9/2008
Field Param.		
pH		
SC		
DO		
ORP		
Turbidity		
Temp		
Flow		
Stat Lvl		620.1
Lab Param.		
Lab pH	8.4	8.5
Lab SC	339	344
TDS	185	180
TSS	115	408
Turbidity		276

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	BHMW08-01		BHMW08-01	
Date	12/4/2008		12/9/2008	
	Dissolved	*Total*	*Dissolved*	*Total*
Calcium	40		37	
Magnesium	23		25	
Potassium	2		4	
Sodium	1		1	
Alk., Bicarb	240		230	
Alk., Carb.	<4		<4	
Alk., Total	200		200	
Hardness	194		194	
Chloride	<1		<1	
Fluoride	<0.1		0.1	
Sulfate	6		7	
Ammonia	<0.1		<0.1	
Nitrate				
N + N	0.98		0.54	
Nitrite				
T.I.N. *				
TKN	<0.5		<0.5	
Ortho Phos	0.02		1.03	
Phos., Total	0.01		0.96	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	BHMW08-01		BHMW08-01	
Date	12/4/2008		12/9/2008	
	Dissolved	*Total*	*Dissolved*	*Total*
Aluminum	<0.03	0.22	0.28	12.11
Antimony	<0.003	<0.003	<0.003	<0.003
Arsenic	<0.003	<0.003	<0.003	<0.003
Barium	0.017	0.022	0.011	0.062
Beryllium	<0.001	<0.001	<0.001	<0.001
Bismuth				
Boron	<0.1	<0.1	<0.1	<0.1
Cadmium	<0.00008	<0.00008	<0.00008	<0.00008
Chromium	<0.001	0.003	0.001	0.024
Cobalt	<0.01	<0.01	<0.01	0.01
Copper	<0.001	0.005	<0.001	0.037
Iron	<0.03	3.28	0.67	20.52
Lead	<0.0005	0.0016	<0.0005	0.0032
Manganese	0.011	0.089	0.056	0.208
Mercury	<0.00005	<0.001	<0.00005	<0.001
Molybdenum	<0.005	<0.005	<0.005	<0.005
Nickel	<0.01	<0.01	<0.01	0.02
Selenium	<0.001	<0.001	<0.001	<0.001
Silver	<0.0005	<0.0005	<0.0005	<0.0005
Strontium	<0.1	<0.1	<0.1	0.1
Thallium	<0.0002	<0.0002	<0.0002	<0.0002
Uranium	<0.001	<0.001	0.003	0.004
Vanadium	<0.1	<0.1	<0.1	<0.1
Zinc	<0.01	0.01	<0.01	0.02

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

BHMW09-01

Sample ID	BHMW09-01				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.50	8.5	8.5	1	
Lab SC	334.0	334	334	1	
TDS	172.00	172	172	1	0
TSS	663.00	663	663	1	0
Turbidity	215.00	215	215	1	0
Oil & Grease				0	0

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	8.24	8.24	8.24	1
SC	288.00	288	288	1
DO				0
Temp	11.7	11.7	11.7	1

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	BHMW09-01									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	25.0		25		25		1	0	0	0
Mg, Diss	22.0		22		22		1	0	0	0
K, Diss	3.0		3		3		1	0	0	0
Na, Diss	4.0		4		4		1	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	230.0	230	230	1	0
Alk., Carb.	4.0	<4	<4	1	1
Alk., Total	190.0	190	190	1	0
Hardness	154.0	154	154	1	0
Chloride	1.00	<1	<1	1	1
Fluoride	0.20	0.2	0.2	1	0
Sulfate	20.00	20	20	1	0
Ammonia	0.100	<0.1	<0.1	1	1
Nitrate				0	0
N + N	0.54	0.54	0.54	1	0
Nitrite				0	0
T.I.N.				0	0
TKN	0.50	<0.5	<0.5	1	1
Ortho Phos	0.020	0.02	0.02	1	0
Phos., Total	0.400	0.4	0.4	1	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	BHMW09-01									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.05	96.64	0.05	96.64	0.05	96.64	1	0	1	0
Antimony	0.006	0.044	0.006	0.044	0.006	0.044	1	0	1	0
Arsenic	0.005	0.499	0.005	0.499	0.005	0.499	1	0	1	0
Barium	0.076	0.258	0.076	0.258	0.076	0.258	1	0	1	0
Beryllium	0.001	0.002	<0.001	0.002	<0.001	0.002	1	1	1	0
Bismuth							0	0	0	0
Boron	0.100	0.100	<0.1	0.1	<0.1	0.1	1	1	1	0
Cadmium	0.00008	0.00162	<0.00008	0.00162	<0.00008	0.00162	1	1	1	0
Chromium	0.001	0.163	<0.001	0.163	<0.001	0.163	1	1	1	0
Cobalt	0.010	0.020	<0.01	<0.02	<0.01	<0.02	1	1	1	1
Copper	0.004	0.411	0.004	0.411	0.004	0.411	1	0	1	0
Iron	0.07	123.20	0.07	123.2	0.07	123.2	1	0	1	0
Lead	0.0005	0.0314	<0.0005	0.0314	<0.0005	0.0314	1	1	1	0
Manganese	0.041	2.743	0.041	2.743	0.041	2.743	1	0	1	0
Mercury	0.00005	0.00100	<0.00005	<0.001	<0.00005	<0.001	1	1	1	1
Molybdenum	0.007	0.065	0.007	0.065	0.007	0.065	1	0	1	0
Nickel	0.01	0.07	<0.01	0.07	<0.01	0.07	1	1	1	0
Selenium	0.001	0.003	<0.001	0.003	<0.001	0.003	1	1	1	0
Silver	0.0005	0.0006	<0.0005	<0.0006	<0.0005	<0.0006	1	1	1	1
Strontium	0.10	0.60	<0.1	0.6	<0.1	0.6	1	1	1	0
Thallium	0.0002	0.0043	<0.0002	0.0043	<0.0002	0.0043	1	1	1	0
Vanadium	0.10	0.20	<0.1	0.2	<0.1	0.2	1	1	1	0
Zinc	0.02	0.29	0.02	0.29	0.02	0.29	1	0	1	0

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

BHMW09-01

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	BHMW09-01
Date	7/28/2009
Field Param.	
pH	8.24
SC	288
DO	
ORP	
Turbidity	
Temp	11.7
Flow	
Stat Lvl	
Lab Param.	
Lab pH	8.5
Lab SC	334
TDS	172
TSS	663
Turbidity	215

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	BHMW09-01	
Date	7/28/2009	
	Dissolved	*Total*
Calcium	25	
Magnesium	22	
Potassium	3	
Sodium	4	

Alk., Bicarb	230	
Alk., Carb.	<4	
Alk., Total	190	
Hardness	154	
Chloride	<1	
Fluoride	0.2	
Sulfate	20	

Ammonia	<0.1	
Nitrate		
N + N	0.54	
Nitrite		
T.I.N. *		
TKN	<0.5	
Ortho Phos	0.02	
Phos., Total	0.4	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	BHMW09-01	
Date	7/28/2009	
	Dissolved	*Total*
Aluminum	0.05	96.64
Antimony	0.006	0.044
Arsenic	0.005	0.499
Barium	0.076	0.258
Beryllium	<0.001	0.002
Bismuth		
Boron	<0.1	0.1
Cadmium	<0.00008	0.00162
Chromium	<0.001	0.163
Cobalt	<0.01	<0.02
Copper	0.004	0.411
Iron	0.07	123.2
Lead	<0.0005	0.0314
Manganese	0.041	2.743
Mercury	<0.00005	<0.001
Molybdenum	0.007	0.065
Nickel	<0.01	0.07
Selenium	<0.001	0.003
Silver	<0.0005	<0.0006
Strontium	<0.1	0.6
Thallium	<0.0002	0.0043
Uranium	<0.001	0.027
Vanadium	<0.1	0.2
Zinc	0.02	0.29

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

BHMW09-02

Sample ID	BHMW09-02				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.30	8.3	8.3	1	
Lab SC	325.0	325	325	1	
TDS	184.00	184	184	1	0
TSS	938.00	938	938	1	0
Turbidity	75.50	75.5	75.5	1	0
Oil & Grease				0	0

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.94	7.94	7.94	1
SC	261.00	261	261	1
DO				0
Temp	12.0	12	12	1

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	BHMW09-02									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	27.0		27		27		1	0	0	0
Mg, Diss	21.0		21		21		1	0	0	0
K, Diss	5.0		5		5		1	0	0	0
Na, Diss	2.0		2		2		1	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	230.0	230	230	1	0
Alk., Carb.	4.0	<4	<4	1	1
Alk., Total	190.0	190	190	1	0
Hardness	151.0	151	151	1	0
Chloride	1.00	<1	<1	1	1
Fluoride	0.10	0.1	0.1	1	0
Sulfate	15.00	15	15	1	0
Ammonia	0.100	<0.1	<0.1	1	1
Nitrate				0	0
N + N	0.49	0.49	0.49	1	0
Nitrite				0	0
T.I.N.				0	0
TKN	0.50	<0.5	<0.5	1	1
Ortho Phos	0.020	0.02	0.02	1	0
Phos., Total	0.120	0.12	0.12	1	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	BHMW09-02									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.03		<0.03		<0.03		1	1	0	0
Antimony	0.003		<0.003		<0.003		1	1	0	0
Arsenic	0.004		0.004		0.004		1	0	0	0
Barium	0.011		0.011		0.011		1	0	0	0
Beryllium	0.001		<0.001		<0.001		1	1	0	0
Bismuth							0	0	0	0
Boron	0.100		<0.1		<0.1		1	1	0	0
Cadmium	0.00008		<0.00008		<0.00008		1	1	0	0
Chromium	0.001		<0.001		<0.001		1	1	0	0
Cobalt	0.010		<0.01		<0.01		1	1	0	0
Copper	0.005		0.005		0.005		1	0	0	0
Iron	0.03		<0.03		<0.03		1	1	0	0
Lead	0.0005		<0.0005		<0.0005		1	1	0	0
Manganese	0.034		0.034		0.034		1	0	0	0
Mercury	0.00005		<0.00005		<0.00005		1	1	0	0
Molybdenum	0.007		0.007		0.007		1	0	0	0
Nickel	0.01		<0.01		<0.01		1	1	0	0
Selenium	0.001		<0.001		<0.001		1	1	0	0
Silver	0.0005		<0.0005		<0.0005		1	1	0	0
Strontium	0.10		<0.1		<0.1		1	1	0	0
Thallium	0.0002		<0.0002		<0.0002		1	1	0	0
Vanadium	0.10		<0.1		<0.1		1	1	0	0
Zinc	0.01		<0.01		<0.01		1	1	0	0

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

BHMW09-02

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	BHMW09-02
Date	8/4/2009
Field Param.	
pH	7.94
SC	261
DO	
ORP	
Turbidity	
Temp	12
Flow	
Stat Lvl	
Lab Param.	
Lab pH	8.3
Lab SC	325
TDS	184
TSS	938
Turbidity	75.5

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	BHMW09-02	
Date	8/4/2009	
	Dissolved	*Total*
Calcium	27	
Magnesium	21	
Potassium	5	
Sodium	2	

Alk., Bicarb	230	
Alk., Carb.	<4	
Alk., Total	190	
Hardness	151	
Chloride	<1	
Fluoride	0.1	
Sulfate	15	

Ammonia	<0.1	
Nitrate		
N + N	0.49	
Nitrite		
T.I.N. *		
TKN	<0.5	
Ortho Phos	0.02	
Phos., Total	0.12	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	BHMW09-02	
Date	8/4/2009	
	Dissolved	*Total*
Aluminum	<0.03	
Antimony	<0.003	
Arsenic	0.004	
Barium	0.011	
Beryllium	<0.001	
Bismuth		
Boron	<0.1	
Cadmium	<0.00008	
Chromium	<0.001	
Cobalt	<0.01	
Copper	0.005	
Iron	<0.03	
Lead	<0.0005	
Manganese	0.034	
Mercury	<0.00005	
Molybdenum	0.007	
Nickel	<0.01	
Selenium	<0.001	
Silver	<0.0005	
Strontium	<0.1	
Thallium	<0.0002	
Uranium	0.005	
Vanadium	<0.1	
Zinc	<0.01	

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

BHMW09-04

Sample ID	BHMW09-04				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.30	8.3	8.3	1	
Lab SC	355.0	355	355	1	
TDS	119.00	119	119	1	0
TSS	184.00	184	184	1	0
Turbidity	62.50	62.5	62.5	1	0
Oil & Grease				0	0

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.92	7.92	7.92	1
SC	336.00	336	336	1
DO				0
Temp	7.9	7.9	7.9	1

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	BHMW09-04									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	32.0		32		32		1	0	0	0
Mg, Diss	24.0		24		24		1	0	0	0
K, Diss	3.0		3		3		1	0	0	0
Na, Diss	2.0		2		2		1	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	210.0	210	210	1	0
Alk., Carb.	4.0	<4	<4	1	1
Alk., Total	170.0	170	170	1	0
Hardness	178.0	178	178	1	0
Chloride	1.00	<1	<1	1	1
Fluoride	0.10	<0.1	<0.1	1	1
Sulfate	16.00	16	16	1	0
Ammonia	0.100	<0.1	<0.1	1	1
Nitrate				0	0
N + N	0.34	0.34	0.34	1	0
Nitrite				0	0
T.I.N.				0	0
TKN	0.50	<0.5	<0.5	1	1
Ortho Phos	0.020	0.02	0.02	1	0
Phos., Total	0.150	0.15	0.15	1	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	BHMW09-04									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.03	3.58	<0.03	3.58	<0.03	3.58	1	1	1	0
Antimony	0.014	0.014	0.014	0.014	0.014	0.014	1	0	1	0
Arsenic	0.003	0.018	<0.003	0.018	<0.003	0.018	1	1	1	0
Barium	0.007	0.018	0.007	0.018	0.007	0.018	1	0	1	0
Beryllium	0.001	0.001	<0.001	<0.001	<0.001	<0.001	1	1	1	1
Bismuth							0	0	0	0
Boron	0.100	0.100	<0.1	<0.1	<0.1	<0.1	1	1	1	1
Cadmium	0.00008	0.00014	<0.00008	0.00014	<0.00008	0.00014	1	1	1	0
Chromium	0.001	0.005	<0.001	0.005	<0.001	0.005	1	1	1	0
Cobalt	0.010	0.010	<0.01	<0.01	<0.01	<0.01	1	1	1	1
Copper	0.001	0.041	<0.001	0.041	<0.001	0.041	1	1	1	0
Iron	0.03	10.90	<0.03	10.9	<0.03	10.9	1	1	1	0
Lead	0.0005	0.0027	<0.0005	0.0027	<0.0005	0.0027	1	1	1	0
Manganese	0.021	0.430	0.021	0.43	0.021	0.43	1	0	1	0
Mercury	0.00005	0.00100	<0.00005	<0.001	<0.00005	<0.001	1	1	1	1
Molybdenum	0.005	0.005	<0.005	<0.005	<0.005	<0.005	1	1	1	1
Nickel	0.01	0.01	<0.01	<0.01	<0.01	<0.01	1	1	1	1
Selenium	0.002	0.002	0.002	0.002	0.002	0.002	1	0	1	0
Silver	0.0005	0.0005	<0.0005	<0.0005	<0.0005	<0.0005	1	1	1	1
Strontium	0.10	0.10	<0.1	<0.1	<0.1	<0.1	1	1	1	1
Thallium	0.0008	0.0011	0.0008	0.0011	0.0008	0.0011	1	0	1	0
Vanadium	0.10	0.10	<0.1	<0.1	<0.1	<0.1	1	1	1	1
Zinc	0.01	0.06	<0.01	0.06	<0.01	0.06	1	1	1	0

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

BHMW09-04

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	BHMW09-04
Date	11/3/2009
Field Param.	
pH	7.92
SC	336
DO	
ORP	
Turbidity	
Temp	7.9
Flow	
Stat Lvl	
Lab Param.	
Lab pH	8.3
Lab SC	355
TDS	119
TSS	184
Turbidity	62.5

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	BHMW09-04	
Date	11/3/2009	
	Dissolved	*Total*
Calcium	32	
Magnesium	24	
Potassium	3	
Sodium	2	

Alk., Bicarb	210	
Alk., Carb.	<4	
Alk., Total	170	
Hardness	178	
Chloride	<1	
Fluoride	<0.1	
Sulfate	16	

Ammonia	<0.1	
Nitrate		
N + N	0.34	
Nitrite		
T.I.N. *		
TKN	<0.5	
Ortho Phos	0.02	
Phos., Total	0.15	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	BHMW09-04	
Date	11/3/2009	
	Dissolved	*Total*
Aluminum	<0.03	3.58
Antimony	0.014	0.014
Arsenic	<0.003	0.018
Barium	0.007	0.018
Beryllium	<0.001	<0.001
Bismuth		
Boron	<0.1	<0.1
Cadmium	<0.00008	0.00014
Chromium	<0.001	0.005
Cobalt	<0.01	<0.01
Copper	<0.001	0.041
Iron	<0.03	10.9
Lead	<0.0005	0.0027
Manganese	0.021	0.43
Mercury	<0.00005	<0.001
Molybdenum	<0.005	<0.005
Nickel	<0.01	<0.01
Selenium	0.002	0.002
Silver	<0.0005	<0.0005
Strontium	<0.1	<0.1
Thallium	0.0008	0.0011
Uranium	0.005	0.009
Vanadium	<0.1	<0.1
Zinc	<0.01	0.06

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-1

Sample ID	WS-1				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	7.75	7.6	8	6	
Lab SC	373.7	365	379	6	
TDS	217.17	164	388	6	0
TSS	1.70	0.51	5	7	3
Turbidity	1.61	0.57	2.1	5	0
Oil & Grease	2.3	<2.5	1.3J	5	4

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.62	7.55	7.67	4
SC	382.25	335	399	4
DO	7.2	7.18	7.18	1
Temp	34.0	5.45	45.8	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-1									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	38.5	44.0	36.6		43	44	7	0	1	0
Mg, Diss	24.1	24.5	22.7		25.7	27	7	0	2	0
K, Diss	2.9	3.5	2.8		3	4	7	0	2	0
Na, Diss	2.9	3.5	2.7		3.3	4	6	0	2	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	190.8	152	227	6	0
Alk., Carb.	0.7	<0.26	0	6	5
Alk., Total	184.0	152	195	6	0
Hardness	195.5	189	210	6	0
Chloride	1.17	1J	2	6	0
Fluoride				0	0
Sulfate	16.23	15.3	21	6	0
Ammonia	0.017	<0.008	0.02	6	5
Nitrate	0.183	<0.1	0.24	7	1
N + N	0.17	0.19	0.19	4	0
Nitrite	0.035	<0.003	0.133	7	5
T.I.N.	0.20	0.19	0.26	5	0
TKN	0.20		0.2	1	0
Ortho Phos	0.002	0.0019	0.0044	6	2
Phos., Total	0.025	<0.1	0.022	7	1

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-1									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.01	0.01	<0.002	<0.002	0.0066	0.04	9	4	9	2
Antimony	0.001	0.001	<0.00025	<0.00025	0.00025J	0.00152	9	4	9	8
Arsenic	0.004	0.007	0.0038	0.00428	0.00525	0.009	9	0	9	0
Barium	0.016	0.017	0.0147	0.0137	0.019	0.019	9	0	9	0
Beryllium	0.000	0.000	<0.0001	<0.0001	<0.001	0.00011J	9	9	9	8
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	6	6	6	6
Boron	0.007	0.011	0.007	0.0034J	0.0078	0.0425	7	1	7	0
Cadmium	0.00015	0.00015	<0.00004	<0.00004	<0.001	0.000043J	9	9	9	8
Chromium	0.001	0.000	<0.00025	<0.00025	0.00066	0.0004J	9	6	9	8
Cobalt	0.001	0.001			<0.001	<0.001	1	1	1	1
Copper	0.001	0.001	0.00033J	0.0007	0.00131	0.003	9	0	9	0
Iron	0.04	0.19	<0.025	0.0972	0.115	0.28	9	8	9	0
Lead	0.0002	0.0002	<0.00005	<0.00005	0.000052J	0.00011	9	8	9	8
Manganese	0.009	0.011	0.0017	0.0069	0.018	0.02	9	0	9	0
Mercury	0.00012	0.00003	<0.00001	<0.00001	0.000015J	0.00006J	9	8	9	6
Molybdenum	0.001	0.001			0.00137	0.00109	1	0	1	0
Nickel	0.00	0.00	<0.00025	<0.00025	0.0005	<0.01	9	4	9	9
Selenium	0.000	0.000	<0.00025	<0.00025	0.0003J	0.0003J	9	4	9	4
Silver	0.0004	0.0004	<0.00025	<0.00025	0.00033J	<0.001	9	8	9	9
Strontium	0.08	0.09	0.082	0.0945	0.082	0.0945	1	0	1	0
Thallium	0.0003	0.0003	<0.0002	<0.0002	0.000078J	0.000092J	9	7	9	7
Vanadium	0.00	0.00			<0.001	<0.001	1	1	1	1
Zinc	0.00	0.00	<0.0025	<0.001	0.0042J	0.0036J	9	3	9	7

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-1

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-1	WS-1	WS-1	WS-1	WS-1	WS-1	WS-1	WS-1	WS-1
Date	9/3/2008	11/25/2008	6/12/2009	9/28/2009	10/26/2009	11/24/2009	12/16/2009	1/27/2010	2/24/2010
Field Param.									
pH		7.67		7.6	7.67	7.55			
SC		335		399	397	398			
DO		7.18							
ORP		175							
Turbidity		3.11							
Temp		5.45		45.8	43.3	41.4			
Flow				37	60	40			
Stat Lvl									
Lab Param.									
Lab pH	7.6		8	7.7	7.7	7.8	7.7	7.7	7.8
Lab SC	378		365	376	367	377	379	368	372
TDS	212		164	178	165	388	196	187	198
TSS	<3	<1	<5	0.87 J	0.78 J	0.51 J	0.71 J	0.63 J	1.5
Turbidity			0.57	1.4	2	2	2.1	3.5	3.2

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-1		WS-1		WS-1		WS-1		WS-1		WS-1		WS-1		WS-1		WS-1	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	43	44	37.1		36.6		39.1		37.1		38.5		38.3		37.4		35.9	
Magnesium	25	27	24.8	22	23		24.7		22.9		22.7		25.7		24.5		23.7	
Potassium	3	4	2.95	3.05	3		3		2.9		2.8		2.9		2.9		2.8	
Sodium	3	4		3.01	2.5		2.9		2.8		2.7		3.3		2.7		2.7	
Alk., Bicarb	227				190		195		189		152		192		179		187	
Alk., Carb.	0				<2.5		<0.52		<0.52		<0.52		<0.26		10U		5U	
Alk., Total	186				190		195		189		152		192		179		187	
Hardness	210				186		199		187		189		202		194		187	
Chloride	1				1J		1		1		1J		2		0.86J		0.67J	
Fluoride																		
Sulfate	21				14.6		15.4		15		16.1		15.3		15.3		12.9	
Ammonia	<0.05				<0.008		<0.008		0.02		<0.008		<0.008		0.02		0.008U	
Nitrate	0.18		<0.1		0.18		0.2		0.24		0.19		0.19		0.15		0.18	
N + N	0.18		0.133		0.18								0.19		0.15		0.18	
Nitrite	<0.1		0.133		<0.005		<0.003		<0.003		<0.003		0.001J		0.0008J		0.003U	
T.I.N. *					0.18		0.2		0.26		0.19		0.19		0.17		0.18	
TKN	0.2																	
Ortho Phos	<0.001				0.0019		<0.0005		0.0044		0.0032		0.0019		0.0014		0.0005U	
Phos., Total	0.009		<0.1		0.022		0.0091		0.0048		0.01		0.018		0.0059		0.0072	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-1		WS-1		WS-1		WS-1		WS-1		WS-1		WS-1		WS-1	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum	<0.03	0.04	<0.01	<0.01	0.0066	0.0076	<0.002	0.013	<0.002	<0.002	0.002J	0.0027J	0.0026J	0.0029J	0.0027J	0.0058
Antimony	<0.003	<0.003	<0.001	0.00152	0.00014	<0.00025	<0.0003	<0.00025	<0.00025	<0.00025	0.00025J	<0.00025	0.00025J	<0.00025	0.00025J	0.00025U
Arsenic	0.005	0.007	0.00525	0.00428	0.0042	0.0049	0.0048	0.0064	0.0045	0.0073	0.0038	0.0067	0.0038	0.009	0.0038	0.0076
Barium	0.015	0.017	0.0147	0.0137	0.015	0.017	0.019	0.017	0.017	0.018	0.017	0.017	0.016	0.019	0.018	0.018
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001U	0.0001U
Bismuth							<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Boron			<0.01	0.0425			0.0076	0.0097	0.0078	0.0072	0.0074	0.0073	0.0075	0.0081	0.007	0.0034J
Cadmium	<0.00008	<0.00008	<0.001	<0.001	<0.00005	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00004U	0.00004U
Chromium	<0.001	<0.001	<0.001	<0.001	0.00042J	0.0004J	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00053	0.00025U
Cobalt			<0.001	<0.001												
Copper	0.001	0.003	0.00131	0.00108	0.00046J	0.00076	0.00092	0.0012	0.00034J	0.00079	0.00069	0.00082	0.00046J	0.0012	0.00033J	0.00071
Iron	<0.05	0.22	0.115	0.0972	<0.025	0.12	<0.025	0.19	<0.025	0.18	<0.025	0.18	<0.025	0.28	0.025U	0.22
Lead	<0.0005	<0.0005	<0.001	<0.001	0.000052J	<0.00005	<0.00005	0.00011	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005U	0.00005U
Manganese	0.016	0.017	0.0112	0.00927	0.0017	0.0069	0.0083	0.013	0.0074	0.01	0.0052	0.0074	0.005	0.02	0.0071	0.0078
Mercury	<0.00001	<0.00001	<0.001	<0.0001	<0.000014	<0.000014	<0.000014	0.000019J	0.000015J	0.00004J	<0.000014	<0.000014	<0.000014	0.00006J	0.000014U	0.000014U
Molybdenum			0.00137	0.00109												
Nickel	<0.01	<0.01	<0.001	<0.001	<0.00025	<0.00025	0.00033J	<0.00025	0.00025J	<0.00025	0.0005	<0.00025	<0.00025	<0.00025	0.00047J	0.00025U
Selenium	<0.001	<0.001	<0.001	<0.001	0.0003J	0.00037J	0.00027J	0.00034J	0.00029J	<0.00025	0.00026J	<0.00025	0.00033J	0.00027J	0.00025U	0.00026J
Silver	<0.0005	<0.0005	<0.001	<0.001	0.00033J	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Strontium			0.082	0.0945												
Thallium	<0.0002	<0.0002	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.000078J	0.000091J
Uranium			0.00131	0.00116			0.0007	0.0013	0.0012	0.0012	0.0012	0.0012	0.0012	0.0014	0.0013	0.0013
Vanadium			<0.001	<0.001												
Zinc	<0.01	<0.01	0.00108	<0.001	<0.0025	<0.0025	0.0031J	0.0036J	0.0042J	0.0026J	0.0028J	<0.0025	<0.0025	<0.0025	0.0035J	0.0025U

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-1	
Date	2/24/2010	
	Dissolved	*Total*
Aluminum	0.0022J	0.0064
Antimony	0.00025J	0.00025U
Arsenic	0.0039	0.0076
Barium	0.016	0.017
Beryllium	0.0001U	0.00011J
Bismuth	0.00025U	0.00025U
Boron	0.0067	0.011
Cadmium	0.00004U	0.000043J
Chromium	0.00066	0.00025U
Cobalt		
Copper	0.00039J	0.0007
Iron	0.025U	0.24
Lead	0.00005U	0.00005U
Manganese	0.018	0.01
Mercury	0.000014U	0.000014U
Molybdenum		
Nickel	0.00042J	0.00025U
Selenium	0.00025U	0.0003J
Silver	0.00025U	0.00025U
Strontium		
Thallium	0.000075J	0.000092J
Uranium	0.0012	0.0013
Vanadium		
Zinc	0.0026J	0.0025U

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-2

Sample ID	WS-2				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	7.52	6.9	7.8	6	
Lab SC	61.0	50	69	6	
TDS	37.83	5	83	6	1
TSS	3.90	0.81	7	7	2
Turbidity	0.41	0.18	0.66	6	0
Oil & Grease	2.4	<2.6	1.9J	5	4

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.37	6.75	7.58	4
SC	64.82	61	69.9	4
DO	14.9	14.89	14.89	1
Temp	26.5	-0.25	41.3	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-2									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	8.3	9.3	10		8.65	8.6	7	0	2	0
Mg, Diss	1.2	1.2	0.88		1.6	1.46	7	0	2	0
K, Diss	0.8	1.0	0.654		1	1	7	0	2	0
Na, Diss	1.7	1.6	1.3		2.1	2	7	0	2	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	31.2	26.6	45	6	0
Alk., Carb.	0.6	<0.26	0	6	5
Alk., Total	29.9	27	37	6	0
Hardness	25.2	25.7	29	6	0
Chloride	0.80	1J	1J	6	1
Fluoride				0	0
Sulfate	4.00	4.7J	4.7J	6	1
Ammonia	0.017	<0.008	0.02	6	5
Nitrate	0.022	<0.01	0.068	7	2
N + N	0.01	0.02	0.02	4	2
Nitrite	0.007	<0.003	0.009J	7	5
T.I.N.	0.04	<0.03	0.09	5	3
TKN	0.20		<0.2	1	1
Ortho Phos	0.019	0.021	0.023	6	0
Phos., Total	0.033	<0.05	0.039	7	1

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-2									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.02	0.03	<0.03	<0.01	0.029	0.066	8	1	8	2
Antimony	0.001	0.001	<0.001	<0.00025	0.00025	<0.003	8	2	8	8
Arsenic	0.010	0.010	0.0089	0.0084	0.012	0.011	8	0	8	0
Barium	0.002	0.002	<0.005	<0.005	0.0034	0.0019	8	1	8	1
Beryllium	0.000	0.000	<0.0001	<0.0001	0.00011J	<0.001	8	7	8	8
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	5	5	5	5
Boron	0.003	0.004	<0.0025	<0.0025	0.0324	0.0038J	6	4	6	3
Cadmium	0.00017	0.00017	<0.00004	<0.00004	<0.001	<0.001	8	8	8	8
Chromium	0.001	0.000	<0.00025	<0.00025	0.00084	0.00033J	8	5	8	4
Cobalt	0.001	0.001			<0.001	<0.001	1	1	1	1
Copper	0.001	0.001	<0.00025	<0.00025	0.00077	0.00054	8	4	8	4
Iron	0.03	0.04	<0.01	<0.01	<0.05	0.049J	8	8	8	4
Lead	0.0002	0.0002	<0.00005	<0.00005	<0.001	0.00015	8	8	8	5
Manganese	0.002	0.002	<0.001	<0.001	0.0019	0.0035	8	2	8	2
Mercury	0.00014	0.00004	<0.00001	<0.000014	0.000026J	0.000056J	8	7	8	5
Molybdenum	0.001	0.001			<0.001	<0.001	1	1	1	1
Nickel	0.00	0.00	<0.00025	<0.00025	0.00045J	<0.01	8	4	8	8
Selenium	0.000	0.000	<0.00025	<0.00025	<0.001	<0.001	8	8	8	8
Silver	0.0004	0.0004	<0.00025	<0.00025	<0.001	<0.001	8	8	8	8
Strontium	0.01	0.01	0.0123	0.0113	0.0123	0.0113	1	0	1	0
Thallium	0.0003	0.0003	<0.00005	<0.00005	<0.001	<0.001	8	8	8	8
Vanadium	0.00	0.00			<0.001	<0.001	1	1	1	1
Zinc	0.00	0.00	<0.001	<0.001	0.0028J	<0.01	8	7	8	8

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-2

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-2	WS-2	WS-2	WS-2	WS-2	WS-2	WS-2	WS-2
Date	9/3/2008	11/25/2008	6/12/2009	9/28/2009	10/26/2009	11/24/2009	12/16/2009	2/24/2010
Field Param.								
pH		6.75		7.58	7.56	7.58		
SC		61		63.2	65.2	69.9		
DO		14.89						
ORP		203						
Turbidity		0.97						
Temp		-0.25		41.3	32.8	32		
Flow				45	50	45		
Stat Lvl								
Lab Param.								
Lab pH	7.8		7.5	7.6	7.7	7.6	6.9	7.6
Lab SC	69		50	64	59	62	62.1	69
TDS	36		< 5	31	26	46	83	54
TSS	7	<5	<5	6.4	0.81 J	1.9	1.2	3.2
Turbidity	0.18		0.24	0.66	0.26	0.63	0.49	1

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-2		WS-2		WS-2		WS-2		WS-2		WS-2		WS-2		WS-2	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	10	10	8.65	8.6	6.4		8.2		7.8		8.6		8.6		8.4	
Magnesium	1	1	1.49	1.46	0.88		1.6		1		1		1.2		1.4	
Potassium	1	1	0.654	0.954	0.81		0.88		0.84		0.8		0.82		0.85	
Sodium	2	2	1.66	1.13	1.3		2.1		1.5		1.6		1.4		1.4	
Alk., Bicarb	45				23.5		28.7		28.2		26.6		35		27.5	
Alk., Carb.	0				<2.5		<0.52		<0.26		<0.26		<0.26		5U	
Alk., Total	37				23.5		28.7		28.2		27		35		27.5	
Hardness	29				19.5		27.1		23.7		25.7		26.4		27	
Chloride	<1				0.5J		0.28J		1J		1J		1J		0.24J	
Fluoride																
Sulfate	<5				2.7J		3.3J		3.6J		4.7J		4.7J		3.4J	
Ammonia	<0.05				<0.008		<0.008		0.02		<0.008		<0.008		0.008U	
Nitrate	<0.01		<0.01		0.01		0.009J		0.068		0.03		0.02		0.056	
N + N	<0.01		<0.01		0.01								0.02		0.056	
Nitrite	<0.01		<0.01		0.009J		<0.003		<0.003		<0.003		0.008J		0.003U	
T.I.N. *					<0.03		<0.03		0.09		0.03J		<0.03		0.06	
TKN	<0.2															
Ortho Phos	0.017				0.016		0.018		0.02		0.023		0.021		0.02	
Phos., Total	0.025		<0.05		0.039		0.026		0.024		0.028		0.037		0.029	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-2		WS-2		WS-2		WS-2		WS-2		WS-2		WS-2		WS-2	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum	<0.03	<0.03	0.0162	<0.01	0.029	0.024	0.0044	0.014	0.029	0.02	0.0055	0.066	0.0068	0.023	0.0054	0.066
Antimony	<0.003	<0.003	<0.001	<0.001	0.0001	<0.00025	0.00025	<0.00025	0.00025	<0.00025	0.00025	<0.00025	0.00025	<0.00025	0.00025	0.00025U
Arsenic	0.01	0.011	0.0109	0.0105	0.0094	0.0084	0.012	0.011	0.011	0.011	0.01	0.011	0.0089	0.01	0.01	0.011
Barium	<0.005	<0.005	0.00163	0.00185	0.002	0.0016	0.0034	0.0017	0.0016	0.0016	0.0028	0.0018	0.0015	0.0017	0.0018	0.0019
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00011J	0.0001U
Bismuth							<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Boron			0.0324	<0.01			0.0049J	0.0033J	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0026J	0.0025U	0.0038J
Cadmium	<0.00008	<0.00008	<0.001	<0.001	<0.00005	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00004U	0.00004U
Chromium	<0.001	<0.001	<0.001	<0.001	0.00084	0.00028J	<0.00025	0.00028J	0.00028J	0.00026J	<0.00025	<0.00025	<0.00025	0.00033J	0.00041J	0.00025U
Cobalt			<0.001	<0.001												
Copper	<0.001	<0.001	<0.001	<0.001	0.00036J	0.00034J	0.00077	<0.00025	<0.00025	0.00054	0.00032J	0.00038J	<0.00025	<0.00025	0.00025J	0.00034J
Iron	<0.05	<0.05	<0.01	<0.01	<0.025	0.038J	<0.025	0.039J	<0.025	<0.025	<0.025	0.044J	<0.025	<0.025	0.025U	0.049J
Lead	<0.0005	<0.0005	<0.001	<0.001	<0.00005	<0.00005	<0.00005	0.000055J	<0.00005	<0.00005	<0.00005	0.00015	<0.00005	<0.00005	0.00005U	0.000083J
Manganese	<0.005	<0.005	<0.001	<0.001	0.00067	0.00062	0.0017	0.00092	0.00035J	0.0013	0.0019	0.0035	0.00098	0.00094	0.00066	0.002
Mercury	<0.00001	<0.0001	<0.001	<0.0001	<0.000014	<0.000014	<0.000014	0.000025J	0.000026J	0.000033J	<0.000014	<0.000014	<0.000014	0.000056J	0.000014U	0.000014U
Molybdenum			<0.001	<0.001												
Nickel	<0.01	<0.01	<0.001	<0.001	0.00037J	<0.00025	0.00038J	<0.00025	<0.00025	<0.00025	0.0003J	<0.00025	<0.00025	<0.00025	0.00045J	0.00025U
Selenium	<0.001	<0.001	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Silver	<0.0005	<0.0005	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Strontium			0.0123	0.0113												
Thallium	<0.0002	<0.0002	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00005U	0.00005U
Uranium			<0.001	<0.001			<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Vanadium			<0.001	<0.001												
Zinc	<0.01	<0.01	<0.001	<0.001	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0028J	<0.0025	<0.0025	<0.0025	0.0025U	0.0025U

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-3

Sample ID	WS-3				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.23	8	8.4	6	
Lab SC	243.3	163	295	6	
TDS	108.17	63	148	6	0
TSS	2.86	1.5	5	7	2
Turbidity	0.72	0.2	1.5	6	1
Oil & Grease	2.4	<2.6	1.5J	5	4

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	8.09	7.65	8.31	4
SC	268.25	258	279	4
DO	12.2	12.24	12.24	1
Temp	28.5	1.34	44.3	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-3									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	31.1	34.3	18.9		38.3	35	7	0	2	0
Mg, Diss	13.0	14.5	11.9		7.8	15	7	0	2	0
K, Diss	1.7	1.9	1.3		2	2	7	0	2	0
Na, Diss	1.9	2.2	1.5		2.5	2.37	7	0	2	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	132.6	133	82.7	6	0
Alk., Carb.	0.6	<0.26	0	6	5
Alk., Total	127.6	133	82.7	6	0
Hardness	128.4	133	79.3	6	0
Chloride	0.92	0.5J	1J	6	1
Fluoride				0	0
Sulfate	8.28	11	9.3	6	0
Ammonia	0.019	<0.008	0.02	6	3
Nitrate	0.118	0.06	0.16	7	0
N + N	0.11	0.16	0.16	4	0
Nitrite	0.021	<0.003	0.123	7	5
T.I.N.	0.13	0.16	0.17	5	0
TKN	0.20		0.2	1	0
Ortho Phos	0.007	0.0059	0.0082	6	0
Phos., Total	0.019	0.0091	0.04	6	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-3									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.01	0.03	<0.002	<0.03	0.011	0.054	7	3	7	1
Antimony	0.001	0.001	<0.00025	<0.00025	0.00025J	<0.003	7	3	7	7
Arsenic	0.003	0.003	<0.003	<0.003	0.0051	0.0047	7	1	7	1
Barium	0.007	0.007	0.0046	0.0049	0.0094	0.0085	7	0	7	0
Beryllium	0.000	0.000	<0.0001	<0.0001	<0.001	<0.001	7	7	7	7
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	4	4	4	4
Boron	0.005	0.006	0.0037J	0.0044J	0.0047J	0.0058	5	1	5	1
Cadmium	0.00018	0.00018	<0.00004	<0.00004	<0.001	<0.001	7	7	7	7
Chromium	0.001	0.001	<0.00025	<0.00025	0.00065	0.00048J	7	4	7	4
Cobalt	0.001	0.001			<0.001	<0.001	1	1	1	1
Copper	0.001	0.001	<0.001	<0.001	0.0011	0.0015	7	2	7	1
Iron	0.03	0.05	<0.025	0.0274	0.0177	0.09	7	6	7	0
Lead	0.0003	0.0003	<0.00005	<0.00005	0.000069J	0.000093J	7	6	7	3
Manganese	0.002	0.004	<0.001	<0.005	0.0023	0.0063	7	2	7	1
Mercury	0.00016	0.00003	<0.00001	<0.00001	0.000041J	0.000032J	7	6	7	3
Molybdenum	0.001	0.001			<0.001	<0.001	1	1	1	1
Nickel	0.00	0.00	<0.00025	<0.00025	0.00065	<0.01	7	4	7	7
Selenium	0.000	0.000	<0.00025	<0.00025	<0.001	<0.001	7	7	7	7
Silver	0.0004	0.0004	<0.00025	<0.00025	<0.001	<0.001	7	7	7	7
Strontium	0.03	0.04	0.0347	0.0394	0.0347	0.0394	1	0	1	0
Thallium	0.0004	0.0004	<0.0002	<0.0002	<0.001	<0.001	7	7	7	7
Vanadium	0.00	0.00			<0.001	<0.001	1	1	1	1
Zinc	0.00	0.00	<0.001	<0.001	0.0034J	<0.01	7	6	7	7

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-3

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-3	WS-3	WS-3	WS-3	WS-3	WS-3	WS-3
Date	9/3/2008	11/25/2008	6/12/2009	9/28/2009	10/26/2009	11/24/2009	12/16/2009
Field Param.							
pH		7.65		8.31	8.17	8.24	
SC		272		258	264	279	
DO		12.24					
ORP		202					
Turbidity		3.86					
Temp		1.34		44.3	35	33.5	
Flow				80	100	80	
Stat Lvl							
Lab Param.							
Lab pH	8.3		8	8.2	8.2	8.3	8.4
Lab SC	266		163	239	247	250	295
TDS	148		63	122	109	143	64
TSS	2	<5	<5	2.4	1.5	1.5	2.6
Turbidity	<0.2		0.23	1.5	0.45	0.72	1.2

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-3		WS-3		WS-3		WS-3		WS-3		WS-3		WS-3	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	35	35	33.6	33.6	18.9		30.7		29		32		38.3	
Magnesium	14	15	15.6	14	7.8		12.4		11.9		12.8		16.5	
Potassium	2	2	1.58	1.73	1.3		1.6		1.6		1.6		2	
Sodium	2	2	1.95	2.37	1.5		2		1.6		1.8		2.5	
Alk., Bicarb	169				82.7		134		129		133		148	
Alk., Carb.	0				<2.5		<0.52		<0.26		<0.26		<0.26	
Alk., Total	139				82.7		134		129		133		148	
Hardness	145				79.3		128		122		133		163	
Chloride	<1				1		1J		1J		1		0.5J	
Fluoride														
Sulfate	8				6.6		6.6		9.3		8.2		11	
Ammonia	<0.05				0.02		<0.008		0.02		0.01J		<0.008	
Nitrate	0.09		0.123		0.06		0.1		0.13		0.16		0.16	
N + N	0.09		0.123		0.06								0.16	
Nitrite	<0.01		0.123		<0.005		<0.003		<0.003		<0.003		0.002J	
T.I.N. *					0.08		0.1		0.15		0.17		0.16	
TKN	0.2													
Ortho Phos	0.006				0.0078		0.0059		0.0075		0.0059		0.0082	
Phos., Total	0.016				0.04		0.013		0.0084		0.0091		0.026	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-3		WS-3		WS-3		WS-3		WS-3		WS-3		WS-3	
Date	9/3/2008		11/25/2008		6/12/2009		9/28/2009		10/26/2009		11/24/2009		12/16/2009	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum	<0.03	<0.03	<0.01	0.0176	0.011	0.032	0.0022J	0.02	<0.002	0.025	0.0033J	0.031	0.0023J	0.054
Antimony	<0.003	<0.003	<0.001	<0.001	0.00014	<0.00025	0.00025J	<0.00025	<0.00025	<0.00025	0.00025J	<0.00025	0.00025J	<0.00025
Arsenic	<0.003	<0.003	0.00242	0.00246	0.0051	0.0047	0.0039	0.0037	0.0033	0.0032	0.0026	0.0027	0.0017	0.0021
Barium	0.007	0.008	0.0071	0.00842	0.0046	0.0049	0.0094	0.0071	0.0064	0.0064	0.0064	0.0062	0.0072	0.0085
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth							<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Boron			<0.01	<0.01			0.0037J	0.0044J	0.0037J	0.0032J	0.0025J	0.0028J	0.0047J	0.0058
Cadmium	<0.00008	<0.00008	<0.001	<0.001	<0.00005	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004
Chromium	<0.001	<0.001	<0.001	<0.001	0.00065	0.00048J	0.00026J	0.00028J	0.00029J	<0.00025	<0.00025	<0.00025	<0.00025	0.00031J
Cobalt			<0.001	<0.001										
Copper	<0.001	0.001	<0.001	<0.001	0.0011	0.0015	0.0011	0.0011	0.00044J	0.0011	0.00059	0.00081	0.00039J	0.00052
Iron	<0.05	0.05	0.0177	0.0274	<0.025	0.066	<0.025	0.057	<0.025	0.043J	<0.025	0.039J	<0.025	0.09
Lead	<0.0005	<0.0005	<0.001	<0.001	<0.00005	0.000087J	0.000069J	0.000093J	<0.00005	<0.00005	<0.00005	0.000054J	<0.00005	0.00007J
Manganese	<0.005	<0.005	<0.001	0.00218	0.00056	0.0027	0.0011	0.0063	0.00066	0.0024	0.002	0.0024	0.0023	0.0038
Mercury	<0.00001	<0.00001	<0.001	<0.0001	<0.000014	0.00002J	<0.000014	0.000014J	0.000041J	0.000032J	<0.000014	<0.000014	<0.000014	0.000022J
Molybdenum			<0.001	<0.001										
Nickel	<0.01	<0.01	<0.001	<0.001	0.00028J	<0.00025	0.00056	<0.00025	<0.00025	<0.00025	0.00065	<0.00025	<0.00025	<0.00025
Selenium	<0.001	<0.001	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Silver	<0.0005	<0.0005	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Strontium			0.0347	0.0394										
Thallium	<0.0002	<0.0002	<0.001	<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Uranium			<0.001	<0.001			0.00033J	0.00033J	0.0003J	0.0003J	0.00034J	0.00033J	0.00073	0.0008
Vanadium			<0.001	<0.001										
Zinc	<0.01	<0.01	<0.001	<0.001	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0034J	<0.0025	<0.0025	<0.0025

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-4

Sample ID	WS-4				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	7.74	7.6	8	5	
Lab SC	128.2	61.3	390	5	
TDS	73.40	31	203	5	0
TSS	5.14	0.51	12.6	5	1
Turbidity	0.87	0.54	1.1	4	0
Oil & Grease	2.5	<2.6	2.3J	4	3

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.52	7.09	7.67	4
SC	142.77	68.2	363	4
DO	11.1	11.1	11.1	1
Temp	27.0	2.1	41.8	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-4									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	16.5		47		9.6		5	0	0	0
Mg, Diss	5.0		1.2		20		5	0	0	0
K, Diss	1.1		0.8		2		5	0	0	0
Na, Diss	1.4		<1		1.6		5	1	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	71.5	240	31	5	0
Alk., Carb.	1.1	<0.26	<4	5	5
Alk., Total	63.5	200	31	5	0
Hardness	61.3	197	29.2	5	0
Chloride	0.76	<1	1J	5	1
Fluoride	0.10		<0.1	1	1
Sulfate	3.96	3.3J	5	5	0
Ammonia	0.029	<0.008	0.02	5	4
Nitrate	0.043	0.01	0.098	4	0
N + N	0.19	0.01	0.37	2	0
Nitrite	0.006	0.005J	0.014	4	2
T.I.N.	0.06	<0.03	0.12	4	2
TKN	0.50		<0.5	1	1
Ortho Phos	0.018	<0.01	0.022	5	1
Phos., Total	0.025	<0.01	0.041	5	1

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-4									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.01	0.03		0.0094	0.0082	0.051	5	0	6	0
Antimony	0.000	0.001		<0.00025	0.00025	<0.003	5	0	6	6
Arsenic	0.010	0.009		<0.003	0.011	0.011	5	0	6	1
Barium	0.002	0.004		0.0016	0.0029	0.014	5	0	6	0
Beryllium	0.000	0.000		<0.0001	<0.0001	<0.001	5	5	6	6
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	5	5	5	5
Boron	0.003	0.004		<0.0025	0.0032J	0.0039J	5	4	6	3
Cadmium	0.00004	0.00005		<0.00004	<0.00004	<0.00008	5	5	6	6
Chromium	0.000	0.001		<0.00025	0.00065	0.0014	5	2	6	5
Cobalt		0.010		<0.01		<0.01	0	0	1	1
Copper	0.001	0.000		<0.00025	0.0052	0.00053	5	3	6	3
Iron	0.03	0.03		<0.025	<0.025	0.04	5	5	6	3
Lead	0.0001	0.0001		<0.00005	<0.00005	0.000078J	5	5	6	4
Manganese	0.001	0.002		<0.005	0.0041	0.0015	5	1	6	1
Mercury	0.00001	0.00018		<0.000014	<0.000014	0.000036J	5	5	6	3
Molybdenum		0.005		<0.005		<0.005	0	0	1	1
Nickel	0.00	0.00		<0.00025	0.00088	0.00035J	5	3	6	5
Selenium	0.000	0.000		<0.00025	<0.00025	<0.001	5	5	6	6
Silver	0.0003	0.0003		<0.00025	<0.00025	<0.0005	5	5	6	6
Strontium		0.10		<0.1		<0.1	0	0	1	1
Thallium	0.0002	0.0002		<0.00005	<0.00025	<0.00025	5	5	6	6
Vanadium		0.10		<0.1		<0.1	0	0	1	1
Zinc	0.00	0.00		<0.0025	0.0035J	0.0033J	5	3	6	5

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-4

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-4	WS-4	WS-4	WS-4	WS-4	WS-4
Date	11/25/2008	9/28/2009	10/26/2009	11/24/2009	12/16/2009	2/24/2010
Field Param.						
pH	7.09	7.65	7.66	7.67		
SC	363	68.2	70.2	69.7		
DO	11.1					
ORP	200					
Turbidity	2.6					
Temp	2.1	41.8	32.5	31.8		
Flow		40	50	40		
Stat Lvl						
Lab Param.						
Lab pH	8	7.6	7.8	7.6	7.7	7.6
Lab SC	390	64	62.9	63	61.3	69
TDS	203	32	31	40	61	37
TSS	<10	1.4	0.51 J	1.2	12.6	3.2
Turbidity		1.1	0.54	0.93	0.91	1.6

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-4		WS-4		WS-4		WS-4		WS-4		WS-4	
Date	11/25/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	47		9.6		8		8.9		8.9		8.4	
Magnesium	20		1.2		1.2		1.2		1.5		1.4	
Potassium	2		0.8		0.84		0.8		0.83		0.85	
Sodium	<1		1.6		1.5		1.5		1.5		1.5	
Alk., Bicarb	240		28.7		31		30.3		27.6		29.3	
Alk., Carb.	<4		<0.52		<0.26		<0.26		<0.26		5U	
Alk., Total	200		28.7		31		30.3		27.6		29.3	
Hardness	197		29.2		24.8		27		28.3		26.9	
Chloride	<1		1J		1		0.38J		0.44J		0.24J	
Fluoride	<0.1											
Sulfate	5		3.3J		3.7J		3.8J		4J		3.4J	
Ammonia	<0.1		<0.008		0.02		<0.008		<0.008		0.008U	
Nitrate			0.012		0.098		0.053		0.01		0.056	
N + N	0.37								0.01		0.056	
Nitrite			<0.003		<0.003		0.014		0.005J		0.003U	
T.I.N. *			<0.03		0.12		0.07		<0.03		0.06	
TKN	<0.5											
Ortho Phos	<0.01		0.018		0.017		0.022		0.021		0.021	
Phos., Total	<0.01		0.025		0.024		0.023		0.041		0.026	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-4		WS-4		WS-4		WS-4		WS-4		WS-4	
Date	11/25/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum		0.04	0.0044	0.016	0.0043	0.0094	0.0047	0.022	0.0082	0.034	0.0058	0.051
Antimony		<0.003	0.00025	<0.00025	0.00025	<0.00025	0.00025	<0.00025	0.00025	<0.00025	0.00025	0.00025U
Arsenic		<0.003	0.011	0.01	0.011	0.0099	0.01	0.011	0.009	0.01	0.01	0.011
Barium		0.014	0.0029	0.0019	0.0016	0.0016	0.0017	0.0016	0.0016	0.0017	0.0016	0.0019
Beryllium		<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001U	0.0001U
Bismuth			<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Boron		<0.1	0.0032J	0.0027J	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	0.0035J	0.0025U	0.0039J
Cadmium		<0.00008	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00004U	0.00004U
Chromium		<0.001	0.00065	<0.00025	0.00036J	<0.00025	<0.00025	0.0014	<0.00025	<0.00025	0.00029J	0.00025U
Cobalt		<0.01										
Copper		<0.001	<0.00025	<0.00025	<0.00025	<0.00025	0.0052	0.00053	<0.00025	0.00026J	0.00045J	0.00031J
Iron		0.04	<0.025	0.033J	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.025U	0.038J
Lead		<0.00005	<0.00005	0.000078J	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005U	0.000071J
Manganese		<0.005	0.00094	0.0011	0.00026J	0.00055	0.00093	0.0014	<0.00025	0.00098	0.0041	0.0015
Mercury		<0.001	<0.000014	0.000014J	<0.000014	0.000036J	<0.000014	<0.000014	<0.000014	0.000031J	0.000014U	0.000014U
Molybdenum		<0.005										
Nickel		<0.01	0.00088	<0.00025	<0.00025	<0.00025	0.0006	0.00035J	<0.00025	<0.00025	0.00025U	0.00025U
Selenium		<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Silver		<0.0005	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Strontium		<0.1										
Thallium		<0.0002	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00005U	0.00005U
Uranium		<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U
Vanadium		<0.1										
Zinc		<0.01	<0.0025	<0.0025	<0.0025	<0.0025	0.0035J	<0.0025	<0.0025	<0.0025	0.0029J	0.0033J

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-5

Sample ID	WS-5				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.24	8.1	8.4	5	
Lab SC	304.4	295	312	5	
TDS	164.40	145	185	5	0
TSS	4.06	1.7	10	5	1
Turbidity	1.17	0.86	1.6	4	0
Oil & Grease	2.0	<2.6	0.4J	4	3

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	8.00	7.44	8.21	4
SC	307.00	282	324	4
DO	14.2	14.2	14.2	1
Temp	28.7	1.7	44.5	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-5									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	34.0		31.3		36.6		5	0	0	0
Mg, Diss	16.6		16		17.5		5	0	0	0
K, Diss	1.8		1.6		2		5	0	0	0
Na, Diss	2.2		1.9		2.6		5	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	160.2	149	180	5	0
Alk., Carb.	1.1	<0.26	<4	5	5
Alk., Total	154.2	149	163	5	0
Hardness	153.0	144	161	5	0
Chloride	1.20	<1	2	5	1
Fluoride	0.10		<0.1	1	1
Sulfate	10.62	11.3	9.5	5	0
Ammonia	0.029	<0.008	0.02	5	3
Nitrate	0.193	0.16	0.24	4	0
N + N	0.13	0.16	0.16	2	0
Nitrite	0.004	0.0046J	0.006J	4	2
T.I.N.	0.20	0.17	0.26	4	0
TKN	0.50		<0.5	1	1
Ortho Phos	0.006	<0.01	0.0089	5	1
Phos., Total	0.013	<0.01	0.027	5	1

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-5									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.00	0.04	0.0026J	0.015	0.0041	0.1	4	0	5	0
Antimony	0.000	0.001	0.00025	<0.00025	0.00025J	<0.003	4	0	5	5
Arsenic	0.002	0.002	0.0013	<0.003	0.0018	0.0022	4	0	5	1
Barium	0.009	0.009	0.0073	0.009	0.011	0.0099	4	0	5	0
Beryllium	0.000	0.000	<0.0001	<0.0001	<0.0001	<0.001	4	4	5	5
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	4	4	4	4
Boron	0.005	0.007	0.0036J	<0.1	0.0049J	0.0065	4	0	5	1
Cadmium	0.00005	0.00006	<0.00004	<0.00004	0.00006J	0.000063J	4	1	5	2
Chromium	0.000	0.000	<0.00025	<0.00025	0.00035J	0.00027J	4	3	5	3
Cobalt		0.010				<0.01	0	0	1	1
Copper	0.001	0.001	0.00043J	0.00071	0.00082	0.0011	4	0	5	0
Iron	0.03	0.08	<0.025	0.049J	<0.025	0.17	4	4	5	0
Lead	0.0001	0.0002	<0.00005	<0.0005	<0.00005	0.00015	4	4	5	1
Manganese	0.004	0.005	0.00027J	<0.005	0.013	0.0077	4	0	5	1
Mercury	0.00001	0.00022	<0.000014	<0.000014	0.000015J	0.000047J	4	3	5	2
Molybdenum		0.005				<0.005	0	0	1	1
Nickel	0.00	0.00	<0.00025	<0.00025	0.0005	<0.01	4	2	5	5
Selenium	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.001	4	4	5	5
Silver	0.0003	0.0003	<0.00025	<0.00025	<0.00025	<0.0005	4	4	5	5
Strontium		0.10		<0.1		<0.1	0	0	1	1
Thallium	0.0003	0.0002	<0.00025	<0.0002	<0.00025	<0.00025	4	4	5	5
Vanadium		0.10				<0.1	0	0	1	1
Zinc	0.00	0.00	<0.0025	<0.0025	0.0029J	0.0026J	4	3	5	4

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-5

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-5	WS-5	WS-5	WS-5	WS-5
Date	11/25/2008	9/28/2009	10/26/2009	11/24/2009	12/16/2009
Field Param.					
pH	7.44	8.21	8.17	8.17	
SC	282	324	310	312	
DO	14.2				
ORP	200				
Turbidity	2.9				
Temp	1.7	44.5	35	33.6	
Flow		40	45	35	
Stat Lvl					
Lab Param.					
Lab pH	8.1	8.2	8.2	8.3	8.4
Lab SC	304	306	305	312	295
TDS	167	154	145	171	185
TSS	<10	3.1	1.7	2	3.5
Turbidity		1.3	0.86	0.91	1.6

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-5		WS-5		WS-5		WS-5		WS-5	
Date	11/25/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	33		32.7		31.3		36.6		36.6	
Magnesium	16		17.5		16.1		16.5		16.9	
Potassium	2		1.8		1.7		1.6		2	
Sodium	2		2.2		2.3		2.6		1.9	
Alk., Bicarb	180		163		150		159		149	
Alk., Carb.	<4		<0.52		<0.26		<0.26		<0.26	
Alk., Total	150		163		150		159		149	
Hardness	147		154		144		159		161	
Chloride	<1		1J		2		1J		1J	
Fluoride	<0.1									
Sulfate	9		8.8		9.5		11.3		14.5	
Ammonia	<0.1		<0.008		0.02		<0.008		0.01J	
Nitrate			0.15		0.24		0.22		0.16	
N + N	0.09								0.16	
Nitrite			<0.003		<0.003		0.0046J		0.006J	
T.I.N. *			0.15		0.26		0.22		0.17	
TKN	<0.5									
Ortho Phos	<0.01		0.0032J		0.0015		0.0069		0.0089	
Phos., Total	<0.01		0.0096		0.0075		0.012		0.027	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-5		WS-5		WS-5		WS-5		WS-5	
Date	11/25/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum		0.04	0.0041	0.023	0.0026J	0.015	0.0028J	0.035	0.0028J	0.1
Antimony		<0.003	0.00025	<0.00025	0.00025J	<0.00025	0.00025J	<0.00025	0.00025J	<0.00025
Arsenic		<0.003	0.0018	0.0019	0.0016	0.0016	0.0013	0.0015	0.0017	0.0022
Barium		0.009	0.011	0.0099	0.0093	0.0091	0.0093	0.0091	0.0073	0.0091
Beryllium		<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bismuth			<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Boron		<0.1	0.0045J	0.005	0.0042J	0.0037J	0.0036J	0.0034J	0.0049J	0.0065
Cadmium		<0.00008	0.00006J	0.000063J	0.000041J	0.000049J	0.000061J	0.000046J	<0.00004	<0.00004
Chromium		<0.001	0.00035J	<0.00025	<0.00025	0.00026J	<0.00025	<0.00025	<0.00025	0.00027J
Cobalt		<0.01								
Copper		0.001	0.00082	0.0011	0.0007	0.00071	0.0008	0.00096	0.00043J	0.00083
Iron		0.05	<0.025	0.072	<0.025	0.049J	<0.025	0.06	<0.025	0.17
Lead		<0.0005	<0.00005	0.00011	<0.00005	0.000077J	<0.00005	0.000062J	<0.00005	0.00015
Manganese		<0.005	0.0023	0.0057	0.0011	0.0038	0.013	0.0045	0.00027J	0.0077
Mercury		<0.001	0.000015J	0.000019J	<0.000014	0.000028J	<0.000014	<0.000014	<0.000014	0.000047J
Molybdenum		<0.005								
Nickel		<0.01	0.00033J	<0.00025	<0.00025	<0.00025	0.0005	<0.00025	<0.00025	<0.00025
Selenium		<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Silver		<0.0005	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Strontium		<0.1								
Thallium		<0.0002	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025
Uranium		<0.001	0.00051	0.00051	0.00044J	0.00043J	0.00043J	0.00044J	0.00073	0.00079
Vanadium		<0.1								
Zinc		<0.01	<0.0025	<0.0025	<0.0025	<0.0025	0.0029J	<0.0025	<0.0025	0.0026J

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-6

Sample ID	WS-6				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.00	7.7	8.3	5	
Lab SC	440.0	407	513	5	
TDS	240.60	213	278	5	0
TSS	8.98	0.49	15.6	5	2
Turbidity	4.14	0.05	12.6	4	1
Oil & Grease	2.4	<2.8	1.8J	4	3

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	7.91	7.49	8.31	4
SC	449.00	425	464	4
DO	11.5	11.5	11.5	1
Temp	30.3	0.1	51	4

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-6									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	58.4		51.3		66		5	0	0	0
Mg, Diss	21.6		19.6		24		5	0	0	0
K, Diss	1.5		1		1.7		5	0	0	0
Na, Diss	2.4		2		2.7		5	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	245.8	219	320	5	0
Alk., Carb.	1.7	<0.26	3.6J	5	4
Alk., Total	234.6	219	260	5	0
Hardness	234.8	209	264	5	0
Chloride	1.40	1	2	5	0
Fluoride	0.10		<0.1	1	1
Sulfate	8.94	10.2	9	5	0
Ammonia	0.029	<0.008	0.02	5	3
Nitrate	0.037	0.03	0.06	4	0
N + N	0.04	0.03	0.03	2	1
Nitrite	0.004	<0.003	0.007J	4	3
T.I.N.	0.05	0.04J	0.07	4	1
TKN	0.50		<0.5	1	1
Ortho Phos	0.007	<0.0005	0.017	5	2
Phos., Total	0.017	0.0044	0.04	5	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-6									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.01	0.12	0.0025J	<0.002	0.026	0.38	6	2	7	1
Antimony	0.000	0.001	0.00025	<0.00025	0.00025J	0.00032J	6	2	7	6
Arsenic	0.002	0.002	0.0018	<0.003	0.0025	0.0029	6	0	7	1
Barium	0.030	0.030	0.028	0.022	0.033	0.034	6	0	7	0
Beryllium	0.000	0.000	<0.0001	<0.0001	<0.0001	0.00011J	6	6	7	6
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	6	6	6	6
Boron	0.004	0.007	<0.0025	<0.0025	0.0047J	0.0067	6	1	7	2
Cadmium	0.00005	0.00005	<0.00004	<0.00004	0.000092	<0.00008	6	5	7	7
Chromium	0.000	0.000	<0.00025	<0.00025	0.0003J	0.00059	6	3	7	4
Cobalt		0.010				<0.01	0	0	1	1
Copper	0.012	0.012	0.00091	0.00066	0.067	0.078	6	0	7	0
Iron	0.03	0.16	<0.025	0.034J	<0.025	0.42	6	6	7	0
Lead	0.0001	0.0003	<0.00005	<0.00005	0.0004	0.00089	6	5	7	2
Manganese	0.009	0.018	0.00063	0.0017	0.047	0.044	6	0	7	0
Mercury	0.00002	0.00016	<0.000014	<0.000014	0.000021J	0.000028J	6	4	7	4
Molybdenum		0.005				<0.005	0	0	1	1
Nickel	0.00	0.00	<0.00025	<0.01	0.0013	0.00057	6	1	7	1
Selenium	0.000	0.000	<0.00025	<0.00025	0.00025J	0.00041J	6	5	7	5
Silver	0.0003	0.0003	<0.00025	<0.00025	<0.00025	<0.0005	6	6	7	7
Strontium		0.10		<0.1		<0.1	0	0	1	1
Thallium	0.0002	0.0002	<0.00005	<0.00005	<0.00025	<0.00025	6	6	7	7
Vanadium		0.10				<0.1	0	0	1	1
Zinc	0.01	0.00	<0.0025	<0.0025	0.022	0.0066	6	3	7	5

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-6

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-6	WS-6	WS-6	WS-6	WS-6	WS-6	WS-6
Date	11/26/2008	9/28/2009	10/26/2009	11/24/2009	12/16/2009	1/27/2010	2/24/2010
Field Param.							
pH	7.49	8.06	8.31	7.78			
SC	425	457	450	464			
DO	11.5						
ORP	206						
Turbidity	4.1						
Temp	0.1	51	35.5	34.5			
Flow		3	10	2			
Stat Lvl							
Lab Param.							
Lab pH	7.8	8.2	8.3	8	7.7	7.5	7.6
Lab SC	513	425	416	407	439	412	394
TDS	278	225	213	231	256	223	242
TSS	<10	8	<0.49	10.8	15.6	1.4	34.7
Turbidity		0.7	<0.05	3.2	12.6	0.94	1.6

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-6		WS-6		WS-6		WS-6		WS-6		WS-6		WS-6	
Date	11/26/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	66		57.1		51.3		62		55.8		55.2		51.4	
Magnesium	24		21.6		19.6		20.8		22.1		20.8		20	
Potassium	1		1.7		1.6		1.6		1.6		1.6		1.5	
Sodium	2		2.6		2.2		2.7		2.4		2.6		2.6	
Alk., Bicarb	320		243		221		219		226		212		215	
Alk., Carb.	<4		<0.52		3.6J		<0.26		<0.26		5U		5U	
Alk., Total	260		243		225		219		226		212		215	
Hardness	264		231		209		240		230		223		211	
Chloride	1		2		1		2		1		1.1		1.1	
Fluoride	<0.1													
Sulfate	8		6.8		9		10.7		10.2		9.8		9.2	
Ammonia	<0.1		<0.008		0.02		<0.008		0.01J		0.008U		0.008U	
Nitrate			0.008J		0.049		0.06		0.03		0.02		0.019	
N + N	<0.05								0.03		0.02		0.019J	
Nitrite			<0.003		<0.003		<0.003		0.007J		0.00047U		0.003U	
T.I.N. *			<0.03		0.07		0.06		0.04J		0.03U		0.02J	
TKN	<0.5													
Ortho Phos	<0.01		0.0024J		<0.0005		0.0051		0.017				0.0015	
Phos., Total	0.01		0.0078		0.0044		0.022		0.04		0.01		0.0084	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-6		WS-6		WS-6		WS-6		WS-6		WS-6		WS-6	
Date	11/26/2008		9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum		0.04	<0.002	0.011	<0.002	<0.002	0.026	0.38	0.0025J	0.051	0.0029J	0.099	0.0037J	0.27
Antimony		<0.003	<0.00025	<0.00025	<0.00025	<0.00025	0.00025	<0.00025	0.00025J	<0.00025	0.00025J	0.00025U	0.00025J	0.00032J
Arsenic		<0.003	0.0024	0.0024	0.002	0.0019	0.0025	0.0029	0.0021	0.0025	0.0018	0.002	0.0019	0.0024
Barium		0.022	0.032	0.034	0.028	0.029	0.033	0.03	0.028	0.032	0.03	0.031	0.028	0.031
Beryllium		<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001U	0.0001U	0.0001U	0.00011J
Bismuth			<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U	0.00025U	0.00025U
Boron		<0.1	0.0046J	0.0056	0.0044J	0.0039J	0.0041J	0.0035J	0.0047J	0.0057	0.0025U	0.0025U	0.0035J	0.0067
Cadmium		<0.00008	<0.00004	<0.00004	<0.00004	<0.00004	0.000092	<0.00004	<0.00004	<0.00004	0.00004U	0.00004U	0.00004U	0.00004U
Chromium		<0.001	0.0003J	0.00044J	<0.00025	<0.00025	<0.00025	0.0004J	<0.00025	<0.00025	0.00038J	0.00025U	0.00032J	0.00059
Cobalt		<0.01												
Copper		0.001	0.0018	0.00099	0.00074	0.00066	0.067	0.078	0.0011	0.0015	0.00091	0.0014	0.0013	0.0026
Iron		0.05	<0.025	0.16	<0.025	0.034J	<0.025	0.42	<0.025	0.074	0.025U	0.093	0.025U	0.27
Lead		<0.0005	<0.00005	0.000054J	<0.00005	<0.00005	0.0004	0.00089	<0.00005	0.00022	0.00005U	0.00019	0.00005U	0.00041
Manganese		0.018	0.0012	0.0072	0.00063	0.0017	0.047	0.044	0.0012	0.019	0.00063	0.01	0.00079	0.028
Mercury		<0.001	0.000018J	0.000015J	0.000021J	0.000028J	<0.000014	<0.000014	<0.000014	0.000017J	0.000014U	0.000014U	0.000014U	0.000014U
Molybdenum		<0.005												
Nickel		<0.01	0.00045J	0.00046J	0.00029J	0.00025J	0.0013	0.00056	<0.00025	0.0003J	0.00031J	0.00029J	0.00028J	0.00057
Selenium		<0.001	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00026J	0.00025J	<0.00025	0.00025U	0.00025U	0.00025U	0.00041J
Silver		<0.0005	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U	0.00025U	0.00025U
Strontium		<0.1												
Thallium		<0.0002	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00005U	0.00005U	0.00005U	0.00005U
Uranium		<0.001	0.0012	0.0012	0.0012	0.0012	0.00068	0.0014	0.0014	0.0014	0.0016	0.0016	0.0017	0.0019
Vanadium		<0.1												
Zinc		<0.01	<0.0025	<0.0025	<0.0025	<0.0025	0.022	0.0066	<0.0025	<0.0025	0.0025J	0.0025U	0.0026J	0.0033J

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

WS-7

Sample ID	WS-7				
	Lab Param.				
	Avg	**Min**	**Max**	**# Samples**	**# N.D.**
Lab pH	8.40	8.3	8.5	4	
Lab SC	368.5	364	372	4	
TDS	192.75	170	225	4	0
TSS	29.08	8	81.4	4	0
Turbidity	10.73	2.7	33.2	4	0
Oil & Grease	2.1	<2.5	0.61J	4	3

	Field Param.			
	Avg	**Min**	**Max**	**# Samples**
pH	8.39	8.31	8.46	3
SC	391.67	390	394	3
DO				0
Temp	43.2	39.3	47.8	3

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Tuesday, March 30, 2010

Sample ID	WS-7									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Ca, Diss	37.1		34.9		38.6		4	0	0	0
Mg, Diss	23.2		21.6		25.6		4	0	0	0
K, Diss	2.9		2.7		3		4	0	0	0
Na, Diss	2.8		2.8		2.9		4	0	0	0

	Avg	Min	Max	# Samples	# N.D.
Alk., Bicarb	190.5	186	199	4	0
Alk., Carb.	2.0	<0.26	5.5	4	2
Alk., Total	144.8	0	199	4	0
Hardness	187.8	176	197	4	0
Chloride	1.25	1	2	4	0
Fluoride				0	0
Sulfate	15.78	14.7	17.1	4	0
Ammonia	0.012	<0.008	0.02	4	2
Nitrate	0.178	0.16	0.2	4	0
N + N	0.16	0.16	0.16	1	0
Nitrite	0.004	<0.003	0.005J	4	3
T.I.N.	0.20	0.17	0.25	4	0
TKN				0	0
Ortho Phos	0.002	<0.0005	0.0043	4	1
Phos., Total	0.014	0.0088	0.02	4	0

T.I.N. = Total Inorganic Nitrogen is defined as the sum of Ammonia and Nitrite plus Nitrate.

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

Sample ID	WS-7									
	Avg		Min		Max		# Samples	# N.D.	# Samples	# N.D.
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*		*Total*	
Aluminum	0.00	0.33	0.0024J	0.038	0.0065	1.6	6	0	6	0
Antimony	0.000	0.000	0.00025	<0.00025	0.00025J	0.0003J	6	0	6	5
Arsenic	0.004	0.011	0.0041	0.0062	0.0052	0.031	6	0	6	0
Barium	0.017	0.021	0.016	0.017	0.017	0.035	6	0	6	0
Beryllium	0.000	0.000	<0.0001	<0.0001	<0.0001	<0.0001	6	6	6	6
Bismuth	0.000	0.000	<0.00025	<0.00025	<0.00025	<0.00025	6	6	6	6
Boron	0.007	0.009	0.0058	<0.0025	0.0078	0.23	6	0	6	1
Cadmium	0.00004	0.00006	<0.00004	<0.00004	<0.00004	0.00014	6	6	6	5
Chromium	0.000	0.000	<0.00025	<0.00025	0.00061	0.0015	6	3	6	5
Cobalt							0	0	0	0
Copper	0.002	0.008	0.00026J	0.00088	0.0059	0.022	6	0	6	0
Iron	0.03	0.69	<0.025	0.16	<0.025	2.9	6	6	6	0
Lead	0.0001	0.0013	<0.00005	0.000096J	<0.00005	0.0067	6	6	6	0
Manganese	0.002	0.038	0.00069	0.0057	0.0048	0.17	6	0	6	0
Mercury	0.00002	0.00004	<0.000014	<0.000014	0.000025J	0.000079J	6	4	6	2
Molybdenum							0	0	0	0
Nickel	0.00	0.00	<0.00025	<0.00025	0.0008	0.0018	6	4	6	5
Selenium	0.000	0.000	<0.00025	<0.00025	0.00028J	0.00041J	6	4	6	3
Silver	0.0003	0.0003	<0.00025	<0.00025	<0.00025	<0.00025	6	6	6	6
Strontium							0	0	0	0
Thallium	0.0002	0.0002	<0.00025	<0.00025	0.000071J	J0.0003J	6	4	6	4
Vanadium							0	0	0	0
Zinc	0.00	0.01	<0.0025	<0.0025	0.0095	0.021	6	3	6	3

#N.D. = Number of Non-Detect samples (parameter was not detected above laboratory method detection levels).

WS-7

Butte Highlands Project Water Quality Data

Field and General Parameters

Sample ID	WS-7	WS-7	WS-7	WS-7	WS-7	WS-7
Date	9/28/2009	10/26/2009	11/24/2009	12/16/2009	1/27/2010	2/24/2010
Field Param.						
pH	8.4	8.46	8.31			
SC	394	390	391			
DO						
ORP						
Turbidity						
Temp	47.8	42.5	39.3			
Flow	40	50	40			
Stat Lvl						
Lab Param.						
Lab pH	8.3	8.4	8.5	8.4	8.4	8.3
Lab SC	364	366	372	372	369	357
TDS	182	170	194	225	167	196
TSS	81.4	8	12.5	14.4	6.9	2.7
Turbidity	33.2	3	4	2.7	2.5	2

All units other than those listed below are shown in mg/L

Temp = °C (degrees Celcius)

pH results in s.u. (Standard Units)

ORP = Oxidation Reduction Potential in mV (millivolts)

SC = Specific Conductance in µS/cm (microsiemens/cm)

Turbidity in NTU (Nephelometric Turbidity Units)

TDS = total dissolved solids; TSS = total suspended solids; DO = Dissolved Oxygen

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008). Standards for metals in groundwater are based on the dissolved portion of the sample.

Butte Highlands Project Water Quality Data

Common Ions

Sample ID	WS-7		WS-7		WS-7		WS-7		WS-7		WS-7	
Date	9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Calcium	38.6		34.9		38		36.8		37.7		36.1	
Magnesium	23.8		21.6		21.6		25.6		24.4		24.1	
Potassium	3		2.9		2.7		2.9		2.9		2.9	
Sodium	2.9		2.8		2.8		2.8		2.7		2.8	
Alk., Bicarb	199		186		189		188		182		182	
Alk., Carb.	<0.52		5.5		<0.26		1.8J		5U		5U	
Alk., Total	199		191		189		0		182		182	
Hardness	194		176		184		197		195		189	
Chloride	2		1J		1		1J		0.58J		0.54J	
Fluoride												
Sulfate	15.4		14.7		15.9		17.1		15.2		12.7	
Ammonia	<0.008		0.02		<0.008		0.01J		0.008U		0.008U	
Nitrate	0.2		0.18		0.17		0.16		0.15		0.14	
N + N							0.16		0.15		0.14	
Nitrite	<0.003		<0.003		<0.003		0.005J		0.00047U		0.003U	
T.I.N. *	0.2		0.25		0.17		0.17		0.15		0.14	
TKN												
Ortho Phos	0.0014J		<0.0005		0.0043		0.0029		0.0025		0.0005U	
Phos., Total	0.012		0.0088		0.017		0.02		0.0063		0.005	

Value is equal to or exceeds standard criteria as shown in MT WQB Circ 7 (Feb 2008).

* *T.I.N = Total Inorganic Nitrogen, is the sum of ammonina and nitrite plus nitrate.*

Alkalinity, Bicarbonate, Carbonate and Hardness are measured in mg CaCO3/L. All other units are measured in mg/L.

Thursday, March 25, 2010

Butte Highlands Project Water Quality Data

Metals Data

Sample ID	WS-7		WS-7		WS-7		WS-7		WS-7		WS-7	
Date	9/28/2009		10/26/2009		11/24/2009		12/16/2009		1/27/2010		2/24/2010	
	Dissolved	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*
Aluminum	0.0042	1.6	0.002J	0.058	0.0065	0.13	0.0024J	0.082	0.0033J	0.065	0.0033J	0.038
Antimony	0.00025	0.0003J	0.00025J	<0.00025	0.00025	<0.00025	0.00025J	<0.00025	0.00025J	0.00025U	0.00025J	0.00025U
Arsenic	0.0052	0.031	0.0047	0.0069	0.0041	0.0089	0.0043	0.0084	0.0042	0.0062	0.0043	0.0062
Barium	0.017	0.035	0.017	0.018	0.016	0.017	0.016	0.022	0.017	0.018	0.016	0.017
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001U	0.0001U	0.0001U	0.0001U
Bismuth	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U	0.00025U	0.00025U
Boron	0.0069	0.0087	0.0076	0.0072	0.0077	0.0071	0.0078	0.23	0.0058	0.0025U	0.0067	0.0094
Cadmium	<0.00004	0.00014	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	0.00004U	0.00004U	0.00004U	0.00004U
Chromium	0.00061	0.0015	0.00034J	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025J	0.00025U	0.00025U	0.00025U
Cobalt												
Copper	0.0022	0.022	0.0003J	0.0017	0.0059	0.019	0.00043J	0.002	0.00066	0.0011	0.00026J	0.00088
Iron	<0.025	2.9	<0.025	0.23	<0.025	0.4	<0.025	0.27	0.025U	0.17	0.025U	0.16
Lead	<0.00005	0.0067	<0.00005	0.00032	<0.00005	0.00042	<0.00005	0.00031	0.00005U	0.00013	0.00005U	0.000096J
Manganese	0.0017	0.17	0.0012	0.014	0.0048	0.02	0.00069	0.012	0.0011	0.0061	0.00092	0.0057
Mercury	0.000019J	0.000079J	0.000025J	0.00004J	<0.000014	<0.000014	<0.000014	0.000043J	0.000014U	0.000022J	0.000014U	0.000014U
Molybdenum												
Nickel	0.0008	0.0018	<0.00025	<0.00025	0.00026J	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U	0.00025U	0.00025U
Selenium	<0.00025	0.00041J	0.00028J	<0.00025	<0.00025	<0.00025	0.00028J	0.00029J	0.00025U	0.00025U	0.00025U	0.00027J
Silver	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.00025U	0.00025U	0.00025U	0.00025U
Strontium												
Thallium	<0.00025	J0.0003J	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	<0.00025	0.000071J	0.000084J	0.000068J	0.000079J
Uranium	0.0014	0.0016	0.0012	0.0012	0.0011	0.0011	0.0013	0.0016	0.0013	0.0013	0.0012	0.0013
Vanadium												
Zinc	0.0095	0.021	<0.0025	0.0042J	0.0033J	0.0027J	<0.0025	<0.0025	0.003J	0.0025U	0.0025U	0.0025U

Value is equal to or exceeds aquatic life standard criteria as shown in MT WQB Circ 7 (Feb 2008).
Aquatic life standards are based on a 'total recoverable' digestion procedure.

All units are measured in mg/L

Thursday, March 25, 2010

Technical Memorandum

To: Paul Dircksen
Timberline Resources
101 East Lakeside
Coeur d'Alene, ID 83814
208-664-4859

From: Doug Rogness & Tom McManus
AMEC Geomatrix, Inc.

Tel: (406) 442-0860

Fax: (406) 442-0864

Date: August 31, 2009

Subject: **Groundwater Study Update – Butte Highlands Mine Project, Montana**

INTRODUCTION

This Memorandum prepared by AMEC Geomatrix is an update of the groundwater study being conducted at the Butte Highlands mine project site near Butte, Montana. One vertical borehole (BHMW08-01) was drilled in 2008, and two vertical holes (BHMW09-01 and BHMW09-02) have been drilled to date in 2009. In addition, one angle borehole (BHMW09-03) was recently drilled at the project site. This Memorandum describes results of the on-going drilling, testing, and sampling conducted at the Butte Highlands project site for purposes of evaluating groundwater conditions (quantity and quality) and estimating groundwater yield at different depths throughout the drilling process. Borehole locations are shown on **Figures 1** and **2**.

Timberline Resources selected locations of the boreholes to extend through rock units that would be intercepted by the proposed exploration decline. O'Keefe Drilling Company of Butte, Montana drilled the boreholes using air rotary techniques. At changes in lithology or apparent water yield during drilling, the boreholes were developed by airlifting for 20 to 30 minutes, followed by measuring the groundwater yield and associated chemical parameters as the groundwater was discharging from the cyclone attached to the drill rig.

AMEC Geomatrix prepared a report in January 2009, "Hydrogeologic Characterization Report, Butte Highlands Mine Project, Montana" that describes a hydrologic conceptual model of the site based on results of first borehole and calculations of a site water balance.

SUMMARY OF 2008 GROUNDWATER STUDY

One borehole (BHMW08-01) was drilled in November and December 2008 to a total depth of 1,167 feet. After first drilling a 12-inch diameter borehole to a depth of 600 feet, an 8-inch diameter steel casing was installed and cemented in the borehole. After the cement hardened, a 6-inch diameter borehole was drilled below the 600-ft depth to a total depth of 1,167 feet. This 6-inch diameter borehole not cased (i.e., open hole in bedrock). Depth to groundwater measured in this borehole in 2009 was approximately 615 feet below ground surface.

Depths for airlift flow measurements in BHMW08-01 were 685, 805, 1065, 1085, and 1167 feet below ground surface. Measured water yield during drilling at these depths was: 685 feet = 0.3 gal/min; 805 feet = 8 gal/min; 1,065 feet = 12 gal/min; 1,085 feet = 12 gal/min; and 1,167 feet (total depth) = 12 gal/min. The water inflow rate did not increase below a depth of about 900 feet. The Highland adit that discharges near surface water station WS-1 is located at a depth of about 685 feet below ground surface in the vicinity of the borehole.

In general, geologic units encountered in the new borehole were Meagher Dolomite to a depth of about 1,040 feet, and metamorphosed Wolsey Shale (skarn and hornfels) from 1,040 feet to the total depth at 1,167 feet. No significant fault/fracture zones were noted during drilling for BHMW08-01.

Quality of groundwater measured in the field during some of the airlift tests for BHMW08-01 show the following general ranges:

- pH = 8.35 to 10.42 standard units
- Electrical conductivity = 127 to 395 micromhos/cm
- Water temperature = 9 to 11 °C

2009 GROUNDWATER STUDY

To date for 2009, three boreholes have been completed. General observations made during drilling for these boreholes are summarized in **Table 1**:

BHMW09-01

Borehole BHMW09-01 was drilled in July 2009 to a total depth of 820 feet. This vertical borehole was drilled the entire depth with a 6-inch diameter bit and was left as an open hole with 5 feet of surface steel casing.

Airlift groundwater flow measurements in BHMW09-01 at various drilling depths were: 240 feet = 2 gal/min; 400 feet = 2 gal/min; 500 feet = 3.5 gal/min; 600 feet = 3.75 gal/min; 780 feet = 6 gal/min; and 820 feet (total depth) = 12 gal/min.

Depth to water measured in BHMW09-01 is greater than 500 feet below ground surface; a 1000-ft long water level probe was lowered in the borhole, but would not go much beyond 500 feet due to moisture on the sidewalls. Another attempt will be made to measure the static water level in the near future.

Quality of groundwater measured in the field during some of the airlift tests for BHMW09-01 show the following general ranges:

- pH = 8.04 to 8.53 standard units
- Electrical conductivity = 104 to 289 micromhos/cm
- Water temperature = 12 to 18 °C

Results of a groundwater quality sample collected for laboratory analysis at a depth of 820 feet has not yet been reported.

BHMW09-02

Vertical borehole BHMW09-02 was drilled in August 2009 to a total depth of 980 feet. After first drilling a 6-inch diameter borehole to a depth of 600 feet, a 10-inch diameter bit was used to re-drill and ream the borehole to allow 6-inch steel casing to be installed and cemented in the borehole. The 6-inch steel casing was installed and cemented to a total depth of 545 feet. After the cement hardened, the 5¾-inch diameter borehole was drilled to a total depth of 980 feet. This 6-inch diameter borehole below the casing was left as an open hole in bedrock.

Airlift groundwater flow measurements in BHMW09-02 at various drilling depths were: 420 feet = 2 gal/min; 580 feet = 8 gal/min; 600 feet = 6.5 gal/min; 700 feet = 8 gal/min; 860 feet = 10 gal/min; 880 feet (total depth) = 23 gal/min; 955 feet (total depth) = 30 gal/min; and 980 feet (total depth) = 30 gal/min.

Depth to water measured in BHMW09-02 was 210 feet after drilling to 600 feet and after the steel casing was installed. Another static water level measurement will be attempted in this borehole in the near future.

Quality of groundwater measured in the field during some of the airlift tests for BHMW09-02 show the following general ranges:

- pH = 7.93 to 8.92 standard units
- Electrical conductivity = 133 to 261 micromhos/cm
- Water temperature = 12 to 19 °C

Results of a groundwater quality sample collected for laboratory analysis at a depth of 600 feet has not yet been reported.

BHMW09-03

Angle borehole BHMW09-03, which is located near the proposed portal entrance, was observed only a few times by AMEC Geomatrix staff. This hole was drilled to a total depth of 500 feet (drilled distance, not depth below ground surface). Approximately 80 feet of steel casing was placed in hole adjacent to unconsolidated material near the surface.

Geologic units encountered in borehole BHMW09-03 are summarized in **Table 1**. Airlift testing of groundwater flow resulted in the following measurements: 200 feet = 5 gal/min; 400 feet = 15 gal/min; and 500 feet = 22 gal/min. A fracture zone reportedly was encountered at about 420 feet which resulted in the increase flow rate to about 22 gal/min.

No field or laboratory water quality samples were collected from BHMW09-03.

DISCUSSION OF GROUNDWATER OBSERVATIONS

Based on a preliminary evaluation of the groundwater information obtained to date from three vertical boreholes ranging in depth from 820 to 1,167 feet, and one angle borehole drilled to a depth of 500 feet, the total groundwater flow rate encountered during drilling for all holes was similar. Maximum airlift groundwater flow rates were in the range of 12 to 30 gal/min. We are not aware of any major fault zones that were encountered during drilling; however, this must be confirmed with the project geologist.

If the fault/fracture zones located in the project area do not extend over large areas or are poorly interconnected, short-term increases in inflow may occur, but would decrease after groundwater held is storage is drained.

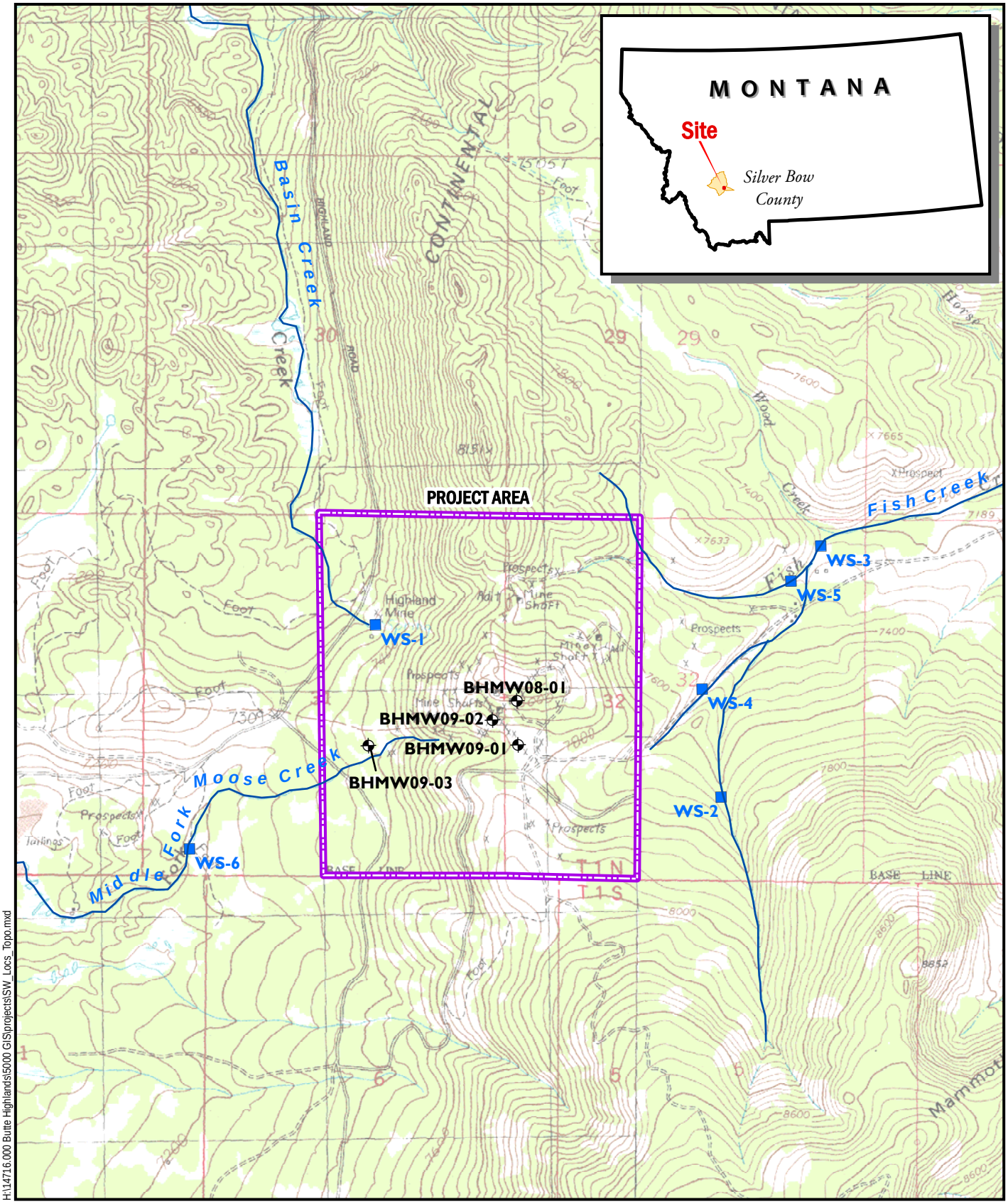
Conclusions made in our January 2009 report have not changed based on the results of drilling to date in 2009 (i.e. flow from a 10,000-ft long adit are predicted to be in the range of about 100 to 200 gal/min). One more vertical borehole, however, is planned for the site, and results of testing from this hole will be incorporated into a final report, along with laboratory water quality data and other stream flow measurements at the project site.

Flow measured from the Highland adit discharge (WS-1) in 2009 (140 to 150 gal/min) was higher than a 2008 measurement (90 gal/min), but similar to a measurement reported in 1993 (110 gal/min). This fluctuation may be reflecting changes in precipitation from season-to-season and year-to-year. This adit extends approximately 2,300 feet to the ore body, with additional underground workings in the ore zone over a 550-ft vertical extent. The main Highland adit crosses several faults which could be the primary conduits of groundwater flow that discharge from the portal.

TABLE 1
Summary of Test Holes at Butte Highlands Project Site, Montana
(as of August 31, 2009)

Drill Hole ID	Approx. Surface Elevation from map (ft)	Total Depth Drilled (ft bgs)	Total Depth Cased (ft bgs)	Water Yield from Air Lift Test	Static Water Level (ft btc)	Water Quality Sample Depth (ft bgs)	Geology	Date Drilled
BHMW08-01	7990 ft	1,167 ft (vertical)	600 ft (8-in steel)	<1 gpm at 685 ft 8 gpm at 805 ft 12 gpm at 1065 ft 12 gpm at 1085 ft 12 gpm at 1167 ft	618.8 ft	805 ft 1,085 ft	Meagher Dolomite: 0-1040 ft Skarn/hornfels: 1040-1167 ft	Dec. 2008
BHMW09-01	7840 ft	820 ft (vertical)	5 ft (6-in steel)	2 gpm at 240 ft 2 gpm at 400 ft 3.5 gpm at 500 ft 3.75 gpm at 600 ft 12 gpm at 820 ft	>500 ft (1000-ft probe got stuck on sidewalls)	820 ft	Meagher Dolomite: 0-225 ft Skarn/hornfels: 225-820 ft	July 2009
BHMW09-02	7880 ft	980 ft (vertical)	545 ft (6-in steel)	6.5 gpm at 600 ft 10 gpm at 860 ft 23 gpm at 880 ft 30 gpm at 955 ft 30 gpm at 980 ft	210 ft after drilling to 600 ft and casing installed	600 ft	Meagher Dolomite: 0-260 ft Clay Zone: 260-272 ft Skarn/hornfels: 272-980 ft	Aug. 2009
BHMW09-03	7400 ft	500 ft* (angle)	80 ft* (8-in steel)	5 gpm at 200 ft 15 gpm at 400 ft 22 gpm at 500 ft	N/A	None	Meagher Dolomite: 0- 265 ft Marble: 265-280 ft Meager Dolomite: 280-360 ft Marble: 360-370 ft Meagher Dolomite 370-440 ft Quartzite/Scarn: 440-490 ft Quartzite 490-500 ft	Aug. 2009

Note: ft = feet; bgs = below ground surface; btc = below top of casing; gpm = gallons per minute.
*Angle hole depth is drilled depth and not feet below ground surface.



H:\14716.000 Butte Highlands\5000 GIS\projects\SW_Locs_Topo.mxd

Source: USGS 24k Mount Humbug and Pipestone Pass Quads

N

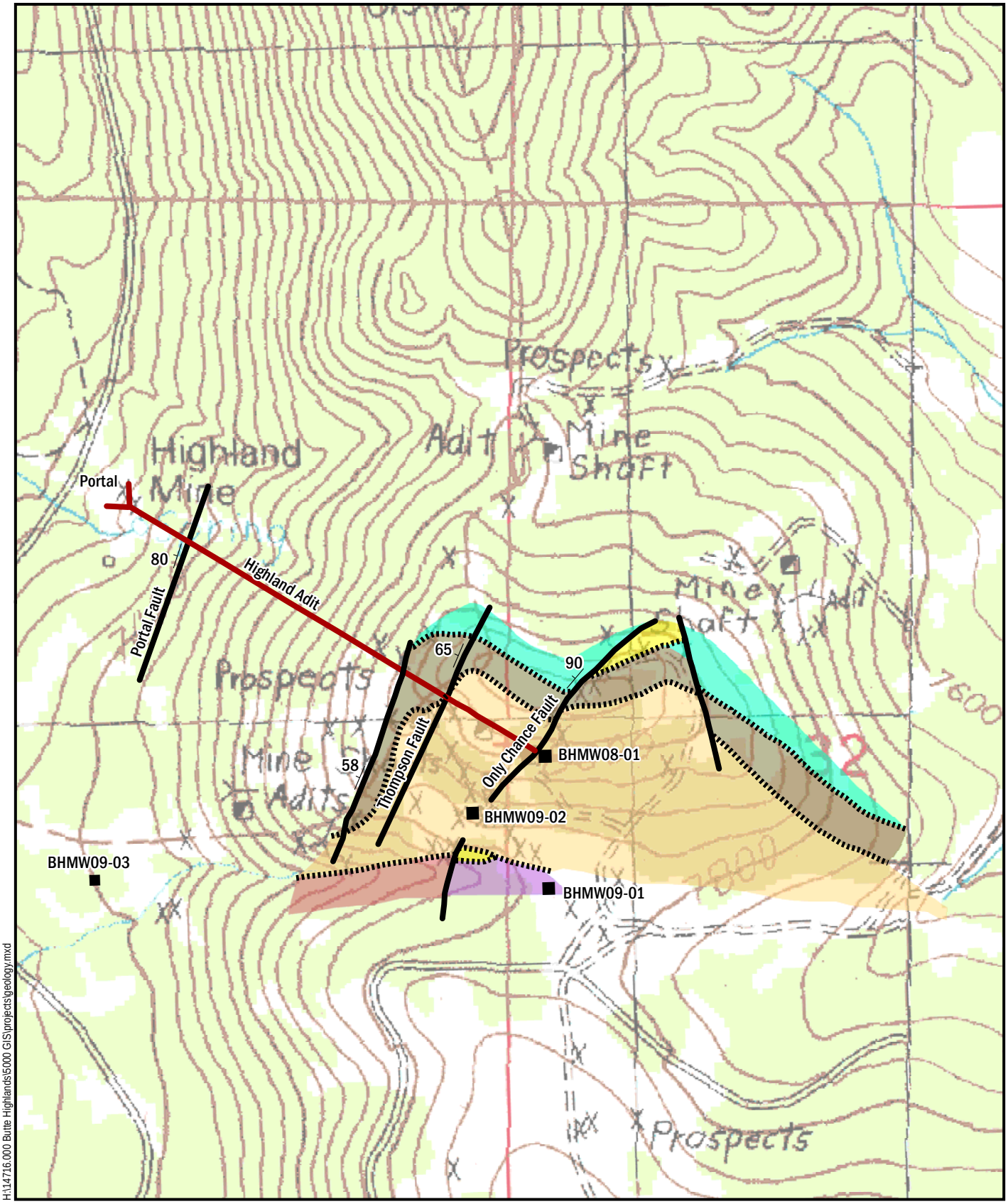
0 Feet 2,000

Surface Water Sampling Location

Groundwater Monitoring Well

AMEC Geomatrix

Project Area and Monitoring Sites
Butte Highlands Project
Silver Bow County, Montana
FIGURE 1



H:\14716.000 Butte Highlands\5000 GIS\projects\geology.mxd

N

0 Feet 800

AMEC Geomatrix

Surface Geology

- Gabbro Intrusive
- Pilgrim Dolomite, Upper Marble
- Park Shale, Metamorphosed
- Meagher Dolomite, Lower Marble
- Flathead Sandstone, Quartzite
- Wolsey Shale, Metamorphosed
- Geologic Unit Contact
- Faults

Surface Geology
Butte Highlands Project
Silver Bow County, Montana
FIGURE 3

Updated Hydrogeologic Characterization Report

Butte Highlands Mine Project

Montana

Prepared for:

Butte Highlands Joint Venture
P.O. Box 4959
Butte, Montana 59702
406-533-8104

Prepared by:

AMEC Geomatrix, Inc.
1824 North Last Chance Gulch
Helena, Montana 59601
406-442-0860

April 2010
Project No. 014716

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 PROJECT LOCATION 1

3.0 CLIMATE 2

4.0 GEOLOGIC SETTING 2

5.0 SURFACE WATER RESOURCES 3
- 5.1 Stream Flow Measurements 3
- 5.2 Surface Water Quality 4

6.0 GROUNDWATER RESOURCES 5
- 6.1 Test Well Monitoring 6
- 6.2 LAD Monitoring Wells 9
- 6.3 Water Supply Well 10
- 6.4 Highland Adit 10
- 6.5 Groundwater Flow 10
- 6.6 Groundwater Quality 12

7.0 CONCEPTUAL HYDROLOGIC MODEL 13

8.0 MINE INFLOW CALCULATIONS 15
- 8.1 USFS Method 17
- 8.2 Goodman Method 17
- 8.3 Lei Method 18
- 8.4 Summary of Mine Inflow Calculations 18

9.0 REFERENCES 20

TABLE OF CONTENTS – continued

FIGURES (Appendix A)

Figure 1 Location Map
Figure 2 Site and Precipitation Map
Figure 3 Water Monitoring Sites
Figure 4 Surface Geology
Figure 5 Groundwater Elevations
Figure 6 Mine Workings Plan View
Figure 7 Mine Workings Cross-Section

TABLES (Appendix B)

Table 1 Laboratory Parameters for Water Samples
Table 2 Summary of Test and Monitoring Wells
Table 3 Depth to Groundwater Measurements

APPENDICES

Appendix A Figures
Appendix B Tables
Appendix C Site Photographs
Appendix D Laboratory Water Quality Data
Appendix E Mine/Adit Inflow Calculations

1.0 INTRODUCTION

The purpose of this report is to present results of a hydrogeological investigation from October 2008 through January 2010 at the Butte Highlands Mine area near Butte, Montana. Field activities included drilling six test boreholes; installing steel casing to various depths in the boreholes; measuring groundwater flow rates during borehole drilling; and collecting and analyzing five groundwater samples from some of the test wells for chemical characteristics. AMEC Geomatrix, Inc. (AMEC) provided field oversight on behalf of Timberline Resources, Butte Highlands Joint Venture, and Klepfer Mining Services.

Some surface water monitoring also was completed by AMEC at the project site (i.e., measuring surface water flow, and collecting and analyzing water samples from six sites); this information is presented in a January 2009 "Hydrogeologic Characterization Report, Butte Highlands Mine Project, Montana" (AMEC 2009a) and August 2009 Technical Memorandum "Groundwater Study Update – Butte Highlands Mine Project, Montana" (AMEC 2009b).

This report also includes a conceptual hydrologic model of the Butte Highlands project site. All figures and tables are presented in **Appendices A** and **B**, respectively. Site photographs are shown in **Appendix C**, and laboratory water quality data are summarized in **Appendix D**. Calculations for estimates of groundwater inflow to underground workings are presented in **Appendix E**.

2.0 PROJECT LOCATION

The Butte Highlands project site is located approximately 13 miles south of Butte along the Continental Divide in the Highland Mountains within the Deerlodge National Forest (**Figure 1**). The project area is located in Sections 31 & 32, Township 01 North, Range 07 West (**Figure 2**). Elevations in the project area range from about approximately 7000 to 8100 feet above mean sea level. The project area covers the headwaters of three drainage basins: Fish Creek, Basin Creek, and Moose Creek.

One of the primary features of the Butte Highlands project site is the Highland Mine adit, which discharges water to upper Basin Creek in the northwest part of the project area (near surface water station WS-1; **Figure 3**). The elevation of this portal is approximately 7300 feet. Other small adits and shafts are located throughout the project area.

3.0 CLIMATE

Climate of the project area is characterized by four seasons, with warm summers and cold, snowy winters. **Figure 2** is a map showing average annual PRISM precipitation contour lines, indicating that precipitation in the Butte Highlands project area is approximately 24 to 26 inches per year (in/yr). A SNOTEL station located in the upper Basin Creek watershed at an elevation of 7180 feet shows a 30-year annual average precipitation of about 24.5 inches, with about 10 inches occurring as snow-water equivalent during the period of October through April (Natural Resources Conservation Service (NRCS) 2008).

4.0 GEOLOGIC SETTING

The Butte Highlands project area is located in the Nevin Hill area of the Highland Mountains which is part of the Boulder Batholith geologic region. Gold mineralization occurs primarily in lower Paleozoic-age Meagher Dolomite (including marble) and Wolsey Shale (including skarn and hornfels), with higher-grade mineralization occurring within sediments proximal to diorite sills and dikes.

The first lode workings in the area followed narrow veins and pipes in dolomitic limestone (Meagher Dolomite) above what was later to become the productive Highland ore body (Montana Bureau of Mines and Geology (MBMG) 1998). By 1937, all production was coming from the 600-ft level Highland adit until it was shut down in 1942. The ore body was primarily a replacement zone in the Meagher Dolomite that was localized by the intersection of a due east 60°N fault and the hinge of a fold (MBMG 1998). The workings consisted of a 2,300-ft long crosscut adit to the ore body, where the replacement zone was mined-out over a 550-ft vertical extent (MBMG 1998).

Figure 4 is a general surface geology map of the Butte Highlands project area. Although the ore body is hosted by the Meagher Dolomite and Wolsey Shale, other rocks including granite, gabbro, and pegmatite are exposed in the underground workings (MBMG 1998). The Pilgrim Dolomite, Park Shale, and Flathead Sandstone also are found at the project site. The geologic map (**Figure 4**) shows several faults that extend through the project site, including the Portal, Thompson, Gold Excel, Highland West, Only Chance, Middle, and Old Mill faults.

According to MBMG (1998), historical mining at the Butte Highlands Mine encountered quartz, pyrite, pyrrhotite, and gold, with minor galena, sphalerite, and chalcopyrite. The sulfides were oxidized and leached by groundwater in the upper zone, leaving an open sponge of quartz enriched in residual gold which then slumped to fill open spaces and formed a breccia. At lower levels where oxidation has not occurred, pyrite and pyrrhotite are abundant, and the gold is found in complex silicates (MBMG 1998).

5.0 SURFACE WATER RESOURCES

The Butte Highlands project site is located within three separate watersheds: (1) Fish Creek on the east side; (2) Basin Creek to the north; and (3) Moose Creek on the west side. Basin Creek flows north into the Basin Creek Reservoir which is a water supply for the city of Butte. The project site is located on the Continental Divide; therefore, surface water from this area flows either west-northwest to the Clark Fork River basin (Basin Creek) or east-northeast to the Missouri River basin (Fish Creek and Moose Creek). Prior to joining the Clark Fork River, Basin Creek joins Silver Bow Creek near Butte. Prior to joining the Missouri River, Moose Creek is tributary to the Big Hole River, and Fish Creek flows into the Jefferson River.

Two of the streams in the project area (Fish Creek and Moose Creek) are classified as B-1, which means that the water is to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment, as well as other purposes (ARM 17.30.607&610&623). Basin Creek is classified as A-Closed because it is a water supply source for the city of Butte; this classification means that the water is to be maintained suitable for drinking, culinary, and food processing purposes after simple disinfection, as well as other purposes (ARM 17.30.607&621). Streams classified as A-Closed also typically have access restrictions to protect the water for public health.

Two of the streams in the project area (Fish Creek and Moose Creek) are considered "impaired" by the 2008 Section 303(d) List of impaired water bodies in Montana (Montana Department of Environmental Quality (MDEQ) 2010). Fish Creek is impaired from its headwaters to mouth (26.6 miles) for the following causes: (a) alteration in stream-side or littoral vegetative covers; (b) low flow alterations; and (c) sedimentation/siltation. Probable sources include: (a) grazing in riparian or shoreline zones; (b) flow alterations from water diversions and irrigated crop production; and (c) forest roads. Moose Creek is impaired from its headwaters to mouth (12.3 miles) for low flow alterations, with the probable source being irrigated crop production.

As previously mentioned, the Highland Mine adit discharges water to upper Basin Creek near surface water station WS-1 (**Figure 3**). This 600-ft level portal is at an elevation of about 7300 feet. Other mine-related features noted by MBMG in 1998 in the vicinity of the portal were a small shaft, several pits, a waste-rock pile, two tailings piles, two small garbage dumps, and the remnants of several cabins and a mill. Seeps were observed down-gradient from the tailings piles, garbage dumps, and waste rock pile (MBMG 1998).

5.1 STREAM FLOW MEASUREMENTS

Surface water monitoring conducted by AMEC at the project site in 2008 is described in the January 2009 Hydrogeologic Characterization Report (AMEC 2009a). Surface water monitoring was conducted on the following creeks that drain from the proposed mine area (**Figure 3**):

1. WS-1: Adit discharge from Highland Mine draining to Basin Creek on northwest side of project site.
2. WS-2: Southern channel of upper Fish Creek on southeast side of project site.
3. WS-3: Combined channels of upper Fish Creek on northeast side of project site.
4. WS-4: Middle channel of upper Fish Creek on east side of project site.
5. WS-5: Northern channel of upper Fish Creek on northeast side of project site.
6. WS-6: Upper Middle Fork of Moose Creek on southwest side of project site.

Photographs of the six surface water stations are shown in **Appendix C**. The following summarizes flow measurements from November 2008 (AMEC 2009a) and August 1993 (MBMG 1998):

- Highland Mine adit discharge at WS-1 (7-22-09) = 140 gallons per minute (gal/min)
- Highland Mine adit discharge at WS-1 (11-26-08) = 90 gal/min
- Highland Mine adit discharge (8-20-93) = 110 gal/min
- Seep area flow below Highland Mine tailings piles & garbage dumps (8-20-93) = 12 gal/min
- Basin Creek below adit discharge (8-20-93) = 300 gal/min
- Fish Creek, southern channel at WS-2 (11-25-08) = 48 gal/min
- Fish Creek, middle channel at WS-4 (11-25-08) = 8 gal/min
- Fish Creek, northern channel at WS-5 (11-25-08) = 64 gal/min
- Fish Creek, combined channels at WS-3 (11-25-08) = 92 gal/min
- Moose Creek, middle fork at WS-6 (11-26-08) = 0.4 gal/min

5.2 SURFACE WATER QUALITY

Based on field measurements in November 2008, the five stream stations had temperatures of about 2 degrees Celsius (°C) or less. The Highland Mine adit discharge had the highest temperature of 5.5 °C. All six surface water samples had circum-neutral pH ranging from 6.75 to 7.67 standard units (s.u.). Electrical conductivity (EC) was in the range of 272 to 363 micromhos per centimeter (µmhos/cm) at all stations, except for 61 µmhos/cm at WS-2 (southern channel of Fish Creek) and 425 µmhos/cm at WS-6 (Middle Fork Moose Creek). Turbidity was low at all stations, ranging from approximately 1 to 4 nephelometric turbidity units (NTU). Dissolved oxygen ranged from 11 to 15 milligrams per liter (mg/L) at the five stream stations, and was 7.2 mg/L from the adit discharge (WS-1).

Table 1 is a list of parameters analyzed by the laboratory for surface water samples. Results of laboratory analyses for water samples collected at WS-1 through WS-6 in September and November 2008, and results of the three surface water samples collected by MBMG in August 1993 show the following range in values for selected constituents:

- pH = 7.3 – 8.3 s.u.
- EC = 266 – 514 µmhos/cm, except 69 µmhos/cm at WS-2 (south channel of Fish Creek)
- Total Dissolved Solids (TDS) = 148 – 278 mg/L, except 36 mg/L at WS-2
- Total Suspended Solids (TSS) = <10 mg/L
- Alkalinity = 139 – 260 mg/L, except 37 mg/L at WS-2
- Sulfate = <5 to 61 mg/L
- Ammonia = <0.1 mg/L
- Nitrate+Nitrite = <0.01 – 0.9 mg/L

Metals at low concentrations were detected for most of surface water samples. The following metals were detected in only one sample: antimony, lead, molybdenum, and uranium. The following metals were below laboratory detection limits for all surface water samples: beryllium, cadmium, chromium, cobalt, mercury, nickel, platinum, selenium, silver, thallium, and vanadium. All of the detected metal concentrations are low and do not exceed any of Montana's acute and chronic aquatic life standards (Circular DEQ-7; MDEQ 2008). A summary of laboratory results of surface water samples collected by AMEC in November 2008, along with the surface water quality standards, are included in **Appendix D**.

6.0 GROUNDWATER RESOURCES

Groundwater in the project area flows primarily in bedrock formations, with some flow in unconsolidated alluvial deposits along the stream channels. Little information is available regarding groundwater quantity and quality in the Butte Highlands project area. AMEC provided some field oversight for completing six partially cased boreholes or test wells. These test wells were used to obtain information about groundwater quantity and quality in the vicinity of the defined ore body. A summary of completion information for each of the six test wells is presented in **Table 2**, including total depth drilled, depth cased, air-lift testing results, depth to water, and general geologic units encountered in the boreholes.

O'Keefe Drilling Company of Butte, Montana drilled the boreholes using air rotary techniques. In general, drilling procedures consisted of first drilling a 10- or 12-inch diameter borehole to a target depth for installing the steel casing. Then 6- or 8-inch diameter steel casing was installed and cemented in the borehole. After the cement hardened, a 5¾-inch diameter borehole was drilled below the casing to total depth. This portion of the borehole was left open without casing.

According to Montana regulations, groundwater at the Butte Highlands project site is considered Class I because natural specific conductance is less than or equal to 1,000 µS/cm (ARM 17.30.1006(1)). In accordance with these regulations, a person may not cause a violation of the human health standards for groundwater listed in Circular DEQ-7 (MDEQ 2008). These standards are included on the groundwater quality spreadsheet in **Appendix D**.

6.1 TEST WELL MONITORING

Results of air-lift groundwater flow testing and field water quality testing are presented below for each of the six test wells located at the Butte Highlands project site (**Figure 3**).

TEST WELL BHMW08-01

Test well BHMW08-01 was drilled in November-December 2008 to a total depth of 1,167 feet. After first drilling a 12-inch diameter borehole to a depth of 600 feet, an 8-inch diameter steel casing was installed and cemented in the borehole. After the cement hardened, a 6-inch diameter borehole was drilled below the 600-ft depth to a total depth of 1,167 feet. This 6-inch diameter vertical borehole was not cased (i.e., open hole in bedrock). Depth to groundwater measured in this borehole in March 2010 was approximately 620 feet below ground surface.

Measured water yield during drilling at various depths was: 685 feet = 0.3 gal/min; 805 feet = 8 gal/min; 1,065 feet = 12 gal/min; 1,085 feet = 12 gal/min; and 1,167 feet (total depth) = 12 gal/min. The water inflow rate did not increase below a depth of about 1000 feet. The Highland adit that discharges near surface water station WS-1 is located at a depth of about 685 feet below ground surface in the vicinity of the borehole.

Core samples were previously collected by others from a nearby borehole (BHDDH08-01) completed in August 2008; this information was used to help determine lithology at this general location. In general, geologic units encountered in the new borehole were Meagher Dolomite to a depth of about 1,040 feet, and metamorphosed Wolsey Shale (skarn and hornfels) from 1,040 feet to the total depth at 1,167 feet. No significant fault/fracture zones were noted during drilling. Based on the geology map (**Figure 4**), it appears that test well BHMW08-01 is located near the vertical Only Chance Fault and the Middle Fault.

Quality of groundwater measured in the field during airlift tests for BHMW08-01 show the following general ranges:

- Field pH = 8.35 to 10.42 s.u.
- Field EC = 127 to 395 µmhos/cm
- Water temperature = 9 to 11 °C

After review of borehole water yield and lithology, water samples from depths of 805 and 1,085 feet were selected for laboratory analysis (**Appendix D**). The 805-ft depth represents the first encountered water yield greater than 1 gal/min in the Meagher Dolomite ("upper bedrock aquifer"), and the 1,085-ft depth is just below the geologic contact for the Wolsey Shale, including skarn/hornfels ("lower bedrock aquifer"). The deeper sample also represents nearly all groundwater from the entire uncased interval from 600 to 1,167 feet.

TEST WELL BHMW09-01

Test well BHMW09-01 was drilled in July 2009 to a total depth of 820 feet in dolomite and skarn/hornfels. This vertical borehole was drilled the entire depth with a 6-inch diameter bit and was left as an open hole with 5 feet of surface steel casing. Based on the geology map (**Figure 4**), test well BHMW09-01 is located east of the Old Mill Fault and Middle Fault.

Airlift groundwater flow measurements in BHMW09-01 at various drilling depths were: 240 feet = 2 gal/min; 400 feet = 2 gal/min; 500 feet = 3.5 gal/min; 600 feet = 3.75 gal/min; 780 feet = 6 gal/min; and 820 feet (total depth) = 12 gal/min. Depth to water measured in BHMW09-01 was about 274 feet below ground surface in March 2010.

Quality of groundwater measured in the field during some of the airlift tests for BHMW09-01 show the following general ranges:

- Field pH = 8.04 to 8.53 s.u.
- Field EC = 104 to 289 µmhos/cm
- Water temperature = 12 to 18 °C

Results of a groundwater quality sample collected for laboratory analysis at the total depth of 820 feet are presented in **Appendix D**.

TEST WELL BHMW09-02

Vertical test well BHMW09-02 was drilled in August 2009 to a total depth of 980 feet in dolomite and skarn/hornfels. After first drilling a 6-inch diameter borehole to a depth of 600 feet, a 10-inch diameter bit was used to re-drill and ream the borehole to allow 6-inch steel casing to be installed and cemented in the borehole. The 6-inch steel casing was installed and cemented to a total depth of 545 feet. After the cement hardened, a 5¾-inch diameter borehole was drilled to the total depth of 980 feet. This borehole below the casing was left as an open hole in bedrock. Based on the geology map (**Figure 4**), test well BHMW09-02 is located near the Only Chance Fault, and may have intercepted this fault.

Airlift groundwater flow measurements in BHMW09-02 at various drilling depths were: 420 feet = 2 gal/min; 580 feet = 8 gal/min; 600 feet = 6.5 gal/min; 700 feet = 8 gal/min; 860 feet = 10

gal/min; 880 feet = 23 gal/min; 955 feet = 30 gal/min; and 980 feet (total depth) = 30 gal/min. Depth to water measured in BHMW09-02 was about 442 feet below ground surface in March 2010.

Quality of groundwater measured in the field during some of the airlift tests for BHMW09-02 show the following general ranges:

- Field pH = 7.93 to 8.92 s.u.
- Field EC = 133 to 261 µmhos/cm
- Water temperature = 12 to 19 °C

Results of a groundwater quality sample collected for laboratory analysis at a depth of 600 feet (prior to installing steel casing) are included in **Appendix D**.

TEST WELL BHMW09-03

Angle borehole BHMW09-03 was drilled at an angle of 45 degrees in the vicinity of the proposed portal entrance. This hole was drilled in August 2009 to a total depth of 500 feet (drilled distance, not depth below ground surface). Approximately 80 feet of steel casing was placed in hole adjacent to unconsolidated material near the surface.

Geologic units encountered in borehole BHMW09-03 include dolomite, marble, skarn, and quartzite. Airlift testing of groundwater flow resulted in the following measurements: 200 feet = 5 gal/min; 400 feet = 15 gal/min; and 500 feet (total depth) = 22 gal/min. It is unknown whether this borehole encountered any faults; however, a fracture zone reportedly was intercepted at about 420 feet which resulted in the increase flow rate to about 22 gal/min.

No field or laboratory water quality samples were collected from BHMW09-03, and no depth to water measurements were taken. This hole was plugged and abandoned in 2010 due to portal construction activities.

TEST WELL BHMW09-04

Vertical test well BHMW09-04 was drilled in October-November 2009 to a total depth of 1,120 feet in shale, dolomite, and skarn/hornfels. 6-inch diameter steel casing was installed and cemented to a total depth of 620 feet. After the cement hardened, a 5¾-inch diameter borehole was drilled to the total depth of 1,120 feet. This borehole below the casing was left as an open hole in bedrock. Based on the geology map (**Figure 4**), test well BHMW09-04 is located west of the Thompson Fault, and may have intercepted this fault.

Airlift groundwater flow measurements in BHMW09-04 at various drilling depths were: 460 feet = 1.5 gal/min; 800 feet = 25 gal/min; 900 feet = 25-30 gal/min; and 1,120 feet (total depth) = 30 gal/min. Depth to water measured in BHMW09-04 was about 587 feet below ground surface in March 2010.

Quality of groundwater measured in the field during an airlift test for BHMW09-04 had the following results:

- Field pH = 7.92 s.u.
- Field EC = 336 µmhos/cm
- Water temperature = 8 °C

Results of a groundwater quality sample collected for laboratory analysis at a depth of 1,120 feet (total depth) are included in **Appendix D**.

TEST WELL BHMW09-05

Vertical test well BHMW09-05 was drilled in December 2009 and January 2010 to a total depth of 1,285 feet in shale, dolomite, marble, and skarn/hornfels. 6-inch diameter steel casing was installed and cemented to a total depth of 680 feet. After the cement hardened, a 5¾-inch diameter borehole was drilled to the total depth of 1,285 feet. This borehole below the casing was left as an open hole in bedrock. Based on the geology map (**Figure 4**), test well BHMW09-05 is located near the Only Chance Fault and Middle Fault.

Airlift groundwater flow measurements in BHMW09-05 at various drilling depths were: 200 feet = 1.0 gal/min; 320 feet = 5 gal/min; 430 feet = 1 gal/min; 600 feet = 20-23 gal/min; 800 feet = 25 gal/min; 1,000 feet = 28 gal/min; and 1,285 feet (total depth) = 30 gal/min. Depth to water measured in BHMW09-05 was about 697 feet below ground surface in February 2010.

No groundwater quality samples have yet been collected from BHMW09-05 for laboratory analysis.

6.2 LAD MONITORING WELLS

Three monitoring wells were completed in the proposed land application discharge (LAD) site (**Figure 3**). These wells were drilled to depths ranging from 60 to 67 feet in unconsolidated deposits, weathered shale (clay), and quartzite (**Table 2**). Depths to water measured in these wells in March 2010 ranged from about 8 to 65 feet.

6.3 WATER SUPPLY WELL

A water supply well was drilled and completed near the proposed portal site and near where angle test hole BHMW09-03 was drilled (**Figure 3**). The water supply well reportedly was drilled vertically to depth of 480 feet into a fault zone. Geologic units were not reported. Maximum water yield reported for this well is about 250 gal/min.

6.4 HIGHLAND ADIT

The Highland adit discharges at rates ranging from about 90 to 140 gal/min based on three known measurements: 140 gal/min in July 2009; 90 gal/min in November 2008, and 110 gal/min in August 1993. These variations in flow rate indicate some influence from seasonal local recharge, with higher flow rates in the summer compared to the fall and early winter period. The Highland adit extends approximately 2,300 feet to the ore body, with additional underground workings in the ore zone over a 550-ft vertical extent (MBMG 1998). As shown on the geology map (**Figure 4**), the main Highland adit crosses many of the mapped faults in the project area, which could be the primary conduits of groundwater flow that discharge from the portal.

6.5 GROUNDWATER FLOW

At changes in lithology or apparent water yield during drilling, each borehole was developed by airlifting for approximately 20 to 30 minutes, followed by measuring water yield (**Table 2**) as water was discharging from the cyclone attached to the drill rig. The following are general conclusions about groundwater flow in the vicinity of the test wells and water supply well:

- The following four test wells had maximum yields of 20 to 30 gal/min: BHMW09-02, BHMW09-03, BHMW09-04, and BHMW09-05.
- The following four test wells are located near mapped faults: BHMW08-01, BHMW09-02, BHMW09-04, and BHMW09-05; three of these wells had maximum air-lift yields of 30 gal/min.
- For the six test wells, greatest yields were reported at depths greater than about 600 feet below ground surface (i.e., below depth of steel casing). It is not clear whether this increase in groundwater flow is due to geologic formation or geologic structure. Most of the higher yields, however, are in skarn and hornfels, rather than dolomite and shale, indicating that that skarn/hornfels may be more fractured.
- Test holes BHMW09-01 (12 gal/min), BHMW09-02 (30 gal/min), and BHMW09-04 (30 gal/min) are located near the proposed decline, but not in the ore zone. Bottom elevations of these three test holes are from about 6800 to 7000 feet.

- Test holes BHMW08-01 (12 gal/min) and BHMW09-05 (30 gal/min) are located in the ore zone where the mine workings would be located. Bottom elevation of these two test holes is approximately 6800 feet.
- Angle test hole BHMW09-03 (22 gal/min) and the vertical water supply well (250 gal/min) are located near the adit entrance. Bottom elevation of the Water Supply well is approximately 7000 feet.
- Air lift testing of the water supply well yielded considerably more water (250 gal/min) than any of the test wells (12 to 30 gal/min), even though the water supply well is shallower (480 feet) than the five vertical test wells (820 to 1,285 feet). It is not clear why the water supply well intercepted more groundwater flow, except possibly due its location near the Middle Fork Moose Creek drainage (**Figure 3**) where the rock may be more fractured or faulted.
- Groundwater elevations measured in the test wells and water supply well in March 2010 range from approximately 7310 to 7350 feet in four wells; 7400 feet in one well; and 7550 feet in one well (**Table 3** and **Figure 5**). The Highland adit opening where discharge occurs is at an elevation of about 7300 feet, and the new Butte Highlands adit portal is located at an elevation of about 7440 feet. Horizontal direction of groundwater flow at the project site is likely to the west; however, due to its location on the Continental Divide, there may components of flow to the east and west (**Figure 5**). Groundwater also appears to flow in a downward vertical direction based on the difference between water levels measured in the upper bedrock zone (≈7550 feet) and lower bedrock zone (≈7350 feet).
- Groundwater elevations measured in the three LAD monitoring wells range from about 7725 to 7180 feet, with groundwater flow moving west in the shallow weathered rock and unconsolidated deposits along the upper Middle Fork Moose Creek drainage (**Table 3** and **Figure 5**).

For most of the test wells, the upper Meagher Dolomite (including marble) generally represents the "upper bedrock aquifer" to a depth of about 600 feet below ground surface. Below this unit typically is the Wolsey Shale (including skarn/hornfels) representing the "lower bedrock aquifer". As indicated above, the groundwater surface in the upper and lower zones is at an elevation of approximately 7550 and 7350 feet, respectively (**Figure 5**).

The Highland adit discharges at rates ranging from 90 to 140 gal/min, based on three known measurements: 140 gal/min in July 2009; 90 gal/min in November 2008, and 110 gal/min in August 1993. These variations in flow rate indicate some influence from seasonal local recharge, with higher flow rates in the summer compared to the fall and early winter period. This may reflect snowmelt recharge and infiltration of spring and early summer rain events. The Highland adit appears to intercept about six faults shown on **Figure 4**, which averages about 15 to 25 gal/min per fault zone. The adit, however, is also connected to historic mine

workings that extend through a vertical extent of about 560 feet. These workings also may be contributing to groundwater flow that discharges from the Highland adit.

The proposed Butte Highlands adit is located where it will also intercept some mapped faults in the project area (**Figure 4**). **Figures 6** and **7** show the planned configuration of the Butte Highlands adit decline, two spiral ramps, drill stations, and mine workings in the ore body area. The historic Highland Mine workings also are shown on these figures. Based on this exploration and mine plan, groundwater would be intercepted between elevations of approximately 6300 to 7300 feet. The new mine adit portal is located at an elevation of about 7440 feet.

6.6 GROUNDWATER QUALITY

Groundwater samples were collected from the end of the cyclone unit attached to the drill rig; water from the cyclone was collected in calibrated containers used for flow measurement, then transferred into sampling containers, filtered, and preserved as necessary. Five groundwater samples were collected from four of the test wells and submitted for laboratory analysis. AMEC sent the water samples under chain-of-custody procedures to Energy Laboratories in Helena, Montana. These samples were analyzed for metals (dissolved and total recoverable), common ions, nutrients, and general parameters listed in **Table 1**.

Laboratory analytical results of the five groundwater samples collected in 2008 and 2009 from the test wells are summarized in **Appendix D**. Also included in **Appendix D** are results of samples collected from the Highland Mine adit in September and November 2008 because the adit discharge water represents groundwater from a portion of the underground mine area.

Groundwater quality data for the five test well samples show the following range in values for selected constituents analyzed by the laboratory:

- pH = 8.3 – 8.5 s.u.
- EC = 325 – 355 µmhos/cm
- Total Dissolved Solids (TDS) = 172 – 185 mg/L
- Total Suspended Solids (TSS) = 115 – 938 mg/L
- Alkalinity = 170 – 200 mg/L
- Sulfate = 6 to 20 mg/L
- Ammonia = <0.1 mg/L
- Nitrate+Nitrite = 0.34 – 0.98 mg/L

Metals at low total concentrations were detected in most of the groundwater samples. The following dissolved metals were detected in only one sample from the test wells: chromium, selenium, thallium, and zinc. The following dissolved metals were below laboratory detection

limits for all groundwater samples: beryllium, boron, cadmium, cobalt, lead, mercury, nickel, silver, strontium, and vanadium. All of the detected dissolved metal concentrations are low and do not exceed any of Montana's human health standards for groundwater as presented in **Appendix D** (Circular DEQ-7; MDEQ 2008), with the exception of one sample each for antimony, iron, and manganese. The standards for iron and manganese are "secondary", which indicates that they are based on aesthetics (e.g., taste, odor, and staining) rather than human health.

For the Highland adit samples, the following dissolved metals were below laboratory detection limits for the two samples collected by AMEC in 2008: aluminum, antimony, beryllium, boron, cadmium, chromium, cobalt, lead, mercury, nickel, platinum, selenium, silver, thallium, tin, titanium, and vanadium. All of the detected dissolved metal concentrations are low and do not exceed any of Montana's human health standards for groundwater as presented in **Appendix D** (Circular DEQ-7; MDEQ 2008).

Results of all groundwater analyses show that the quality of groundwater intercepted by the test wells and Highland adit is consistent, slightly basic, and generally has good quality characteristics. Concentrations of dissolved metals are low and do not exceed water quality standards, with the exception of single test well samples for antimony, iron, and manganese.

7.0 CONCEPTUAL HYDROLOGIC MODEL

A conceptual model of the physical groundwater flow system is presented in this section for the Butte Highlands project area. The project area as shown on **Figures 1** and **2** encompasses a relatively small area around the ore body zone of approximately 1.5 square miles. Due to the site location being on the Continental Divide, this small project area is used for the conceptual model study area because groundwater recharge and discharge is expected to be localized. A description of the proposed mine plan is included in Section 8.0 (Mine Inflow Calculations).

One key element of a conceptual model is the water budget, including recharge and discharge. A generalized groundwater balance equation is:

$$\text{Inflow} = \text{Outflow} \pm \text{Change in Storage}$$

A steady-state groundwater balance is developed using a set of hydrologic inputs that represent annual average values. The steady-state groundwater balance equation can be expressed in terms of the sources of recharge and discharge:

$$R + GW_{in} = ET + GW_{out} + BF$$

Where:

R	=	recharge due to infiltrating precipitation and runoff
GW_{in}	=	groundwater flow into the study area
ET	=	evapotranspiration directly from groundwater
GW_{out}	=	groundwater flow out of the study area
BF	=	groundwater discharged to streams, springs, and adits as baseflow

Areal recharge (R) to groundwater beneath the Butte Highlands project area from precipitation can be estimated using a percentage of total annual precipitation. As previously mentioned, average annual precipitation for this area is about 24 to 26 in/yr (**Figure 2**). Studies of mountain region recharge in the western U.S. typically show recharge rates in the range of about 8 to 12 percent of precipitation. For an annual precipitation rate of 25 in/yr, this would equate to 2.0 to 3.0 in/yr of recharge (0.17 to 0.25 ft/yr). Over an area of 1.5 square mile, this amounts to 7,110,000 to 10,460,000 cubic feet per year (ft^3/yr) (20,000 to 29,000 ft^3/day) (100 to 150 gal/min).

Groundwater inflow to the study area (GW_{in}) is assumed to be minor because the project site is located on the Continental Divide. However, some of the major fault zones that extend through the area (**Figure 4**) could transmit groundwater from outside the study area. For purposes of this water balance, it is assumed that groundwater inflow equals groundwater outflow in the project area (see below).

Evapotranspiration (ET) in the groundwater balance includes only the ET that occurs directly from groundwater; thus, it is limited to ET from surface and/or near-surface expressions of groundwater. For the Butte Highlands project area, it is assumed that ET from groundwater expressions is minor. Therefore, ET is deemed insignificant and assumed to be zero for this water balance.

Some groundwater probably exits the study area as underflow (GW_{out}), most of which likely occurs in the fault and fracture zones. Using a common range of values for hydraulic conductivity of lithified rock (10^{-7} to 10^{-5} centimeters per second (cm/sec) or $3x10^{-4}$ to $3x10^{-2}$ ft/day), a cross-sectional area of 5,000 ft x 1,000 ft (5,000,000 ft^2), and a hydraulic gradient of 0.01 (assumed), horizontal groundwater flow through the project area can be estimated using Darcy's Law:

$$Q = K \times I \times A$$

where:

Q	=	groundwater flux (ft^3/day)
K	=	hydraulic conductivity (ft/day)
I	=	hydraulic gradient (ft/ft)
A	=	cross-sectional area of flow (ft^2)

Using the values mentioned above in Darcy's equation, the resulting estimate of groundwater outflow from the Butte Highlands study area is approximately 15 to 1,500 ft^3/day (0.08 to 8.0 gal/min). This is a minor component of discharge in the overall water balance. Additional groundwater flow through the project area likely is occurring through fracture zones associated with the faults. Based on measurements of discharge from the Highland adit, it is assumed that an additional 100 gal/min of groundwater flow occurs in the fault zones. Therefore, total groundwater inflow/outflow at the project site is approximately 110 gal/min (20,000 ft^3/day).

Baseflow discharging from streams and springs (BF) in the study area is estimated using flow measurements of project area streams (Basin Creek, Fish Creek, and Middle Fork Moose Creek). Baseflow for upper Basin Creek is essentially the Highland adit discharge. No springs with measureable flow were observed in the study area. For Fish Creek and Middle Fork Moose Creek, it is assumed that half of the measured flows comprise groundwater discharge to the streams. Total baseflow discharge (BF), therefore, is estimated as:

> Upper Basin Creek/Highland adit at WS-1 (100 gal/min) + Middle Fork Moose Creek at WS-6 (<1 gal/min) + upper Fish Creek at WS-4 and WS-5 (36 gal/min) = 136 gal/min (26,000 ft^3/day)

Using all of the estimated values discussed above, the following steady-state groundwater balance is developed for the Butte Highlands project area ($R + GW_{in} = ET + GW_{out} + BF$):

Water Balance Estimate (ft^3/day): 26,000 + 20,000 = 0 + 20,000 + 26,000
46,000 = 46,000 ft^3/day or 240 gal/min

For the water balance presented above, an areal recharge (R) value of 26,000 ft^3/day (135 gal/min) was used, which is within the range of 20,000 to 29,000 ft^3/day (100 to 150 gal/min) described above (2.0 to 3.0 in/yr recharge). This equates to a precipitation recharge rate of 0.23 ft/yr (2.8 in/yr) for the Butte Highlands project area (approximately 11 percent of annual precipitation).

8.0 MINE INFLOW CALCULATIONS

This section provides three independent estimates of mine inflow for the Butte Highlands mine during the exploration phase (adit decline, two spiral ramps, and numerous drill stations with boreholes that extend into the ore zone) and during the production phase for mine workings (**Figures 6** and **7**). Mine inflow calculation methods described in this section use analytical equations that require information about mine tunnel length, radius, groundwater head above the tunnel, and hydraulic conductivity of the rock. The calculations are presented in **Appendix E**. As previously described, the existing Highland adit, which extends approximately 2,300 feet into the ore zone, discharges groundwater at rates ranging from 90 to 140 gal/min.

The following are key assumptions used for the proposed Butte Highlands exploration and mine plan that are used in the mine inflow calculations (refer to **Figures 6** and **7**):

- Adit decline extends a total linear distance of about 5,000 feet from elevations of approximately 6700 to 7400 feet. Adit tunnel diameter is 30 feet.
- The first 1,000 linear feet of adit decline would not intercept groundwater.
- The spiral ramps extend 900 feet vertically from elevations of approximately 6300 to 7200 feet. Spiral ramp tunnel diameter is 30 feet.
- The spiral ramps have a total of 42 turns; each turn has an associated tunnel length of about 100 feet; total spiral ramp length is 4,200 feet.
- There are a total of 21 drill stations at outer spiral ramp turns. For purposes of calculating water inflow, it is assumed for one of the methods that a single 150-ft long tunnel approximates the boreholes that would be drilled at each station (total tunnel length = 3,150 feet). For the other two methods, it is assumed that five 3-inch diameter boreholes (150-ft long each) will be drilled at each station (total borehole length = 15,750 feet).
- The mine workings would cover an area of about 400 feet x 800 feet, and extend over a depth of about 600 feet. Within this volume of rock (192 million cubic feet), it is assumed that, for purposes of the mine inflow calculation methods, open areas are equivalent to 20 tunnels extending a total of 48,000 feet (2,400 feet x 20) with a tunnel diameter of 30 feet. Mine inflow calculations using these assumptions, however, are then reduced by 50 percent which is assumed to account for backfilling of the mine workings and groundwater lowering caused by dewatering during the exploration phase.
- Lithified rock hydraulic conductivity ranges from (10^{-7} to 10^{-6} cm/sec or $3x10^{-4}$ to $3x10^{-3}$ ft/day); this is for overall non-faulted rock that would be intercepted by the exploration and mine workings.
- Groundwater elevations in bedrock range from about 7350 to 7550 feet in the ore zone area. Ground surface elevations range from about 7600 to 7900 feet above the ore zone area. Total hydraulic head values for groundwater overlying the adit and spiral ramps range from 300 to 1,000 feet.
- Period of groundwater drawdown would be about 5 years during the exploration phase, and 10 years during the production phase.
- In addition to groundwater inflow estimates using the three analytical methods based on average hydraulic conductivity values of the overall rock mass, an additional component of inflow from the six primary mapped faults in the project area (**Figure 4**) is assumed. For purposes of this assessment, it is assumed that an additional total inflow of 100 gal/min will occur from the primary fault zones.

8.1 USFS METHOD

Adit inflow rates can be calculated using the following equation cited in the Montanore Mine Project Final EIS (USFS et al. 1992):

$$Qo = [(2\pi KH) \div (2.3\log(2H \div R))] \times 7.48$$

where:
- Qo = groundwater inflow per unit length of tunnel (gal/min/ft);
- K = hydraulic conductivity of rock (ft/min);
- R = tunnel radius (ft); and
- H = hydraulic head (ft) measured as vertical distance from adit to overlying water table.

Results using the above equation and the assumptions listed above and in **Appendix E** show that groundwater inflow would be approximately 18 to 181 gal/min, depending on rock hydraulic conductivity, for the exploration phase; and 18 to 176 gal/min for the production phase.

8.2 GOODMAN METHOD

One analytical solution for steady-state inflow during tunnel driving is (Goodman et al. 1965):

$$Q = 0.707L\ (KH^3S_y/t)^{1/2}$$

where:
- Q = inflow (m^3/day)
- L = length of drift (m)
- K = hydraulic conductivity (m/day)
- H = depth of drift below initial water table (m)
- S_y = specific yield of aquifer (dimensionless)
- t = time since water level reached top of drift (days)

Specific yield (S_y) is assumed to be 0.05 as representative of an unconfined bedrock aquifer. The amount of time (t) for the groundwater level decline to reach the top of the adit is assumed to be 5 years (1,825 days).

Results using the above equation and the assumptions listed above and in **Appendix E** show that groundwater inflow would be approximately 53 to 168 gal/min, depending on rock hydraulic conductivity, for the exploration phase; and 5 to 164 gal/min for the production phase.

8.3 LEI METHOD

Another analytical solution for estimating steady-state inflow during tunnel driving is (Lei 1998):

$$q = 2\pi K(d + P_a - \varnothing) \div \ln(D/R + \sqrt{[(D/R)^2 - 1]})$$

where:

- q = flow per unit length of tunnel (m^2/sec)
- K = hydraulic conductivity (m/sec)
- D = distance from ground surface to axis of tunnel (m)
- R = tunnel radius (m)
- Ø = hydraulic head at tunnel's perimeter (m)
- d = height of free-standing water above ground (assumed to be 0 m)
- P_a = atmospheric pressure head (assumed to be 0 m)

Results using the above equation and the assumptions listed above and in **Appendix E** show that groundwater inflow would be approximately 17 to 168 gal/min, depending on rock hydraulic conductivity, for the exploration phase; and 17 to 169 gal/min for the production phase.

8.4 Summary of Mine Inflow Calculations

The table on the next page summarizes calculation results for the three analytical equations presented above, which are predicted ranges of groundwater inflow to the exploration workings and the mine workings that would be constructed at the Butte Highlands project site. Overall hydraulic conductivity of lithified bedrock assumed in the calculations is 10^{-7} to 10^{-6} cm/sec; this rock property has not yet been verified at the project site. Other assumptions used in the calculations are based on simplified characterizations of the mine plan and subsurface geologic conditions in the mine area.

Based on the results summarized in the table below, overall groundwater inflow to the Butte Highlands underground mine would be as follows:

- Exploration phase lithified rock = 20 to 180 gal/min (calculated)
- Production phase lithified rock = 20 to 200 gal/min (calculated)
- Major fault/fracture zones = 100 gal/min (assumed from Highland adit flows)

In general, total groundwater inflow expected for the exploration and production phases of the project would be a cumulative rate of approximately 200 to 400 gal/min. This range is based on total inflow of about 100 to 300 gal/min from the lithified rock system intercepted, and about 100 gal/min from the major fault/fracture zones. These rates are considered estimates of steady-state inflows. Higher rates may occur for relatively short time periods when

groundwater is drained from intercepted fractures that are not well interconnected over large areas.

The upper range value of 400 gal/min for estimated total mine inflow is greater than the project area water balance value of 240 gal/min reported in Section 7.0 of this report. Therefore, it is possible that the long-term steady-state mine inflow rate may approach 240 gal/min assuming this rate accurately reflects the site water balance.

Location	USFS Method	Goodman Method	Lei Method
Exploration - Adit Decline Groundwater Inflow (gal/min)			
K = 10^{-7} cm/sec	5	16	4
K = 10^{-6} cm/sec	46	52	40
Exploration - Spiral Ramps Groundwater Inflow (gal/min)			
K = 10^{-7} cm/sec	4	21	4
K = 10^{-6} cm/sec	45	66	41
Exploration - Drill Stations Groundwater Inflow (gal/min)			
K = 10^{-7} cm/sec	19	16	9
K = 10^{-6} cm/sec	90	50	87
Calculated Subtotal for Exploration Period	18 – 181	53 – 168	17 – 168
Production – Mine Workings (gal/min)			
K = 10^{-7} cm/sec	18	5	17
K = 10^{-6} cm/sec	176	164	169
Combined Fault/Fracture Zones (gal/min)			
Fault Zones (assumed)	100	100	100
TOTAL ESTIMATED GROUNDWATER INFLOW (gal/min)			
TOTAL	**140 – 450**	**160 – 430**	**130 – 440**

9.0 REFERENCES

AMEC Geomatrix, Inc. (AMEC), 2009a. Hydrogeologic Characterization Report, Butte Highlands Mine Project, Montana. Prepared for Timberline Resources, Coeur d'Alene, Idaho. January 2009.

AMEC, 2009b. Groundwater Study Update – Butte Highlands Mine Project, Montana. Prepared for Timberline Resources, Coeur d'Alene, Idaho. August 31, 2009.

Goodman et al., 1965. in http://www.eco.gov.yk.ca/dap/pdf/Section_06_Underground_Mine_FINAL.pdf.

Lei, 1998. in http://www.ainc-inac.gc.ca/nu/nuwork/pi/dng/eis/DPPGIS_e.pdf.

Montana Bureau of Mines and Geology (MBMG), 1998. Abandoned – Inactive Mines Program, Deerlodge National Forest, Volume IV, Upper Clark Fork River Drainage. Open-file Report 346. J.P. Madison (MBMG); J.D. Lonn (MBMG); R.K. Marvin (MBMG); J.J. Metesh (MBMG); and R. Wintergerst (USFS). March 1998.

Montana Department of Environmental Quality (MDEQ), 2008. Circular DEQ-7, Montana Numeric Water Quality Standards. February 2008.

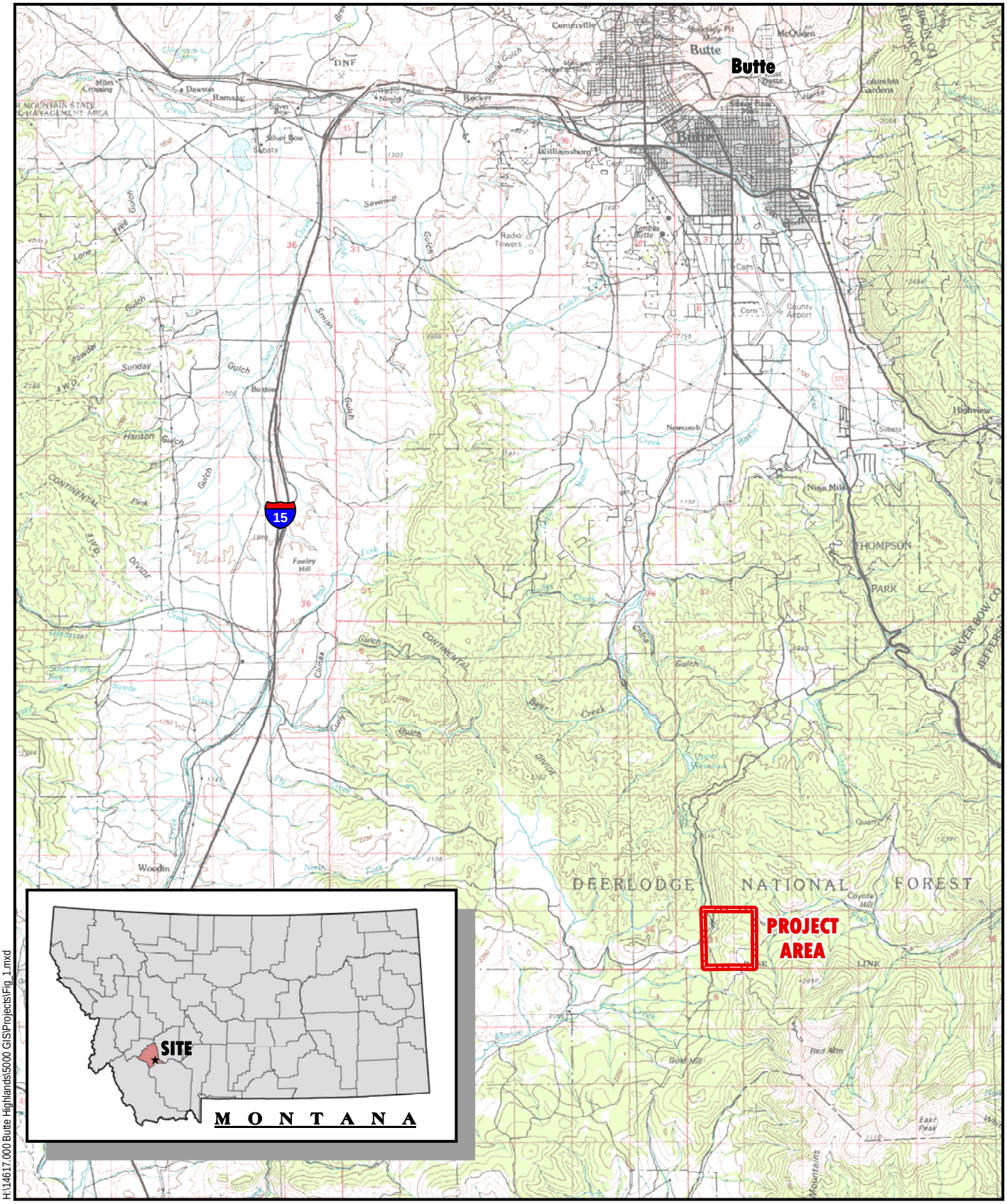
MDEQ, 2010. Clean Water Act Information Center (CWAIC), 2008 Water Quality Information. http://www.cwaic.mt.gov.

Natural Resources Conservation Service (NRCS), 2008. SNOTEL Site Information and Reports for Basin Creek, Site Number 315, Station ID 12d09s, Montana. http://www.wcc.nrcs.usda.gov/snotel.

U.S. Forest Service, Montana Department of State Lands, Montana Department of Health and Environmental Sciences, and Montana Department of Natural Resources and Conservation (USFS et al.), 1992. Final Environmental Impact Statement, Noranda Minerals Corp., Montana Reserves Company, Joint Venture, Montanore Project. October 1992.

APPENDIX A

FIGURES



H:\14617.000 Butte Highlands\5000 GIS\Projects\Fig_1.mxd

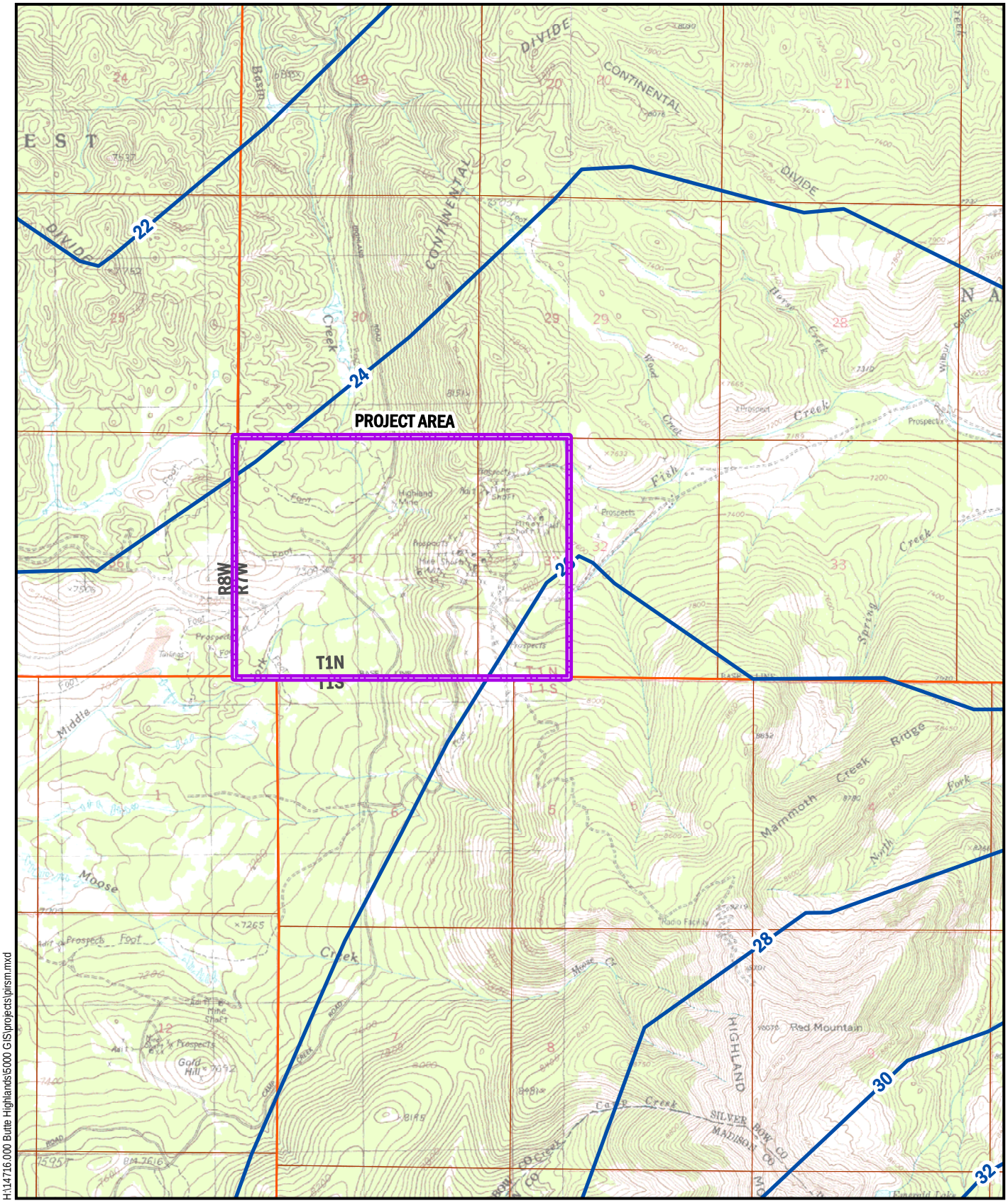
N

0 3

Miles

AMEC Geomatrix

Location Map
Butte Highlands Project
Silver Bow County, Montana
FIGURE 1



H:\14716.000 Butte Highlands\5000 GIS\projects\prism.mxd

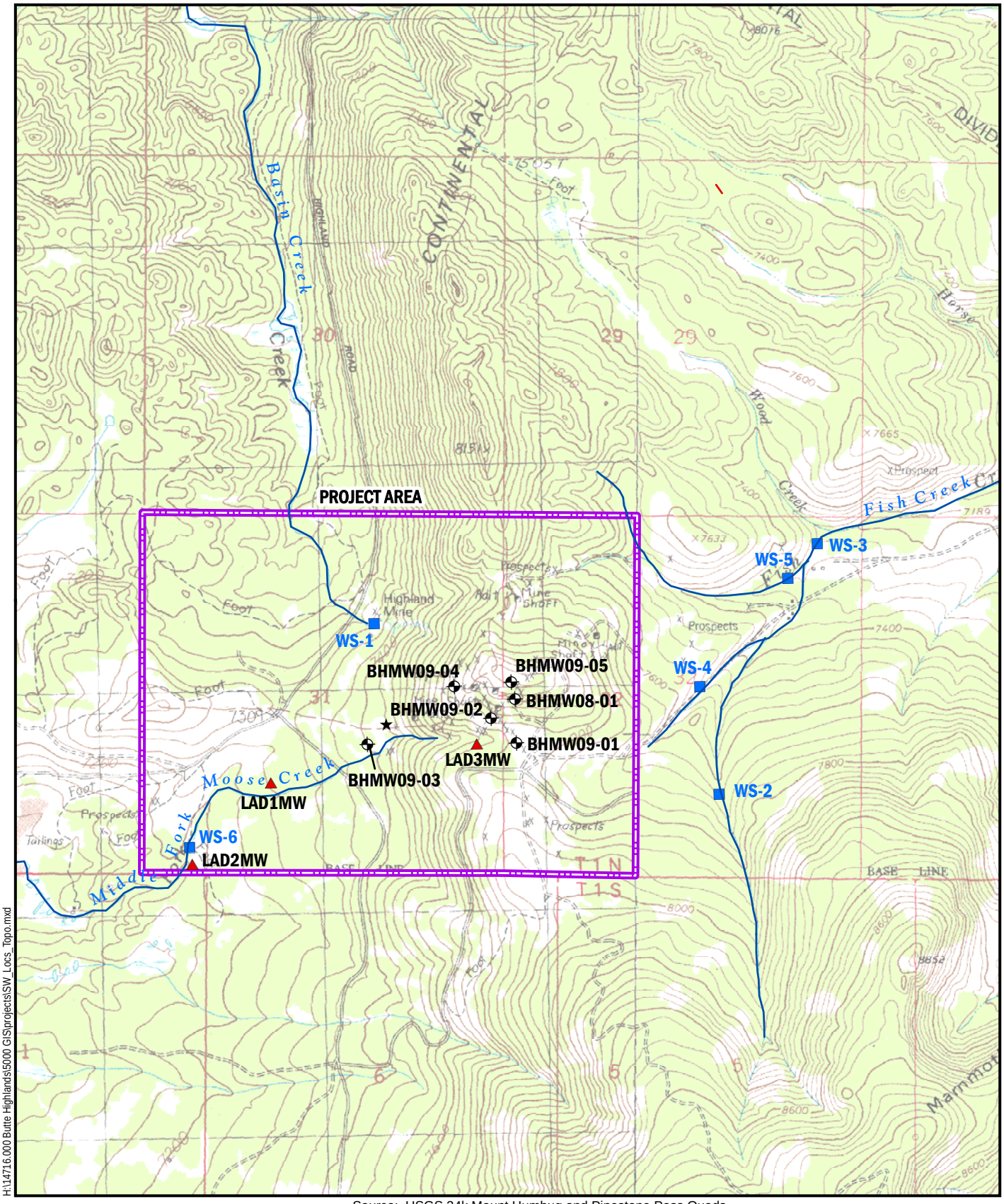
N

0 Feet 3,000

AMEC Geomatrix

24 Average Annual Precipitation (inches)
Data estimated by the Oregon Climate Service for the period 1961-1990 using the PRISM model.

Site and Precipitation Map
Butte Highlands Project
Silver Bow County, Montana
FIGURE 2



Source: USGS 24k Mount Humbug and Pipestone Pass Quads

H:\14716.000 Butte Highlands\5000 GIS\projects\SW_Locs_Topo.mxd

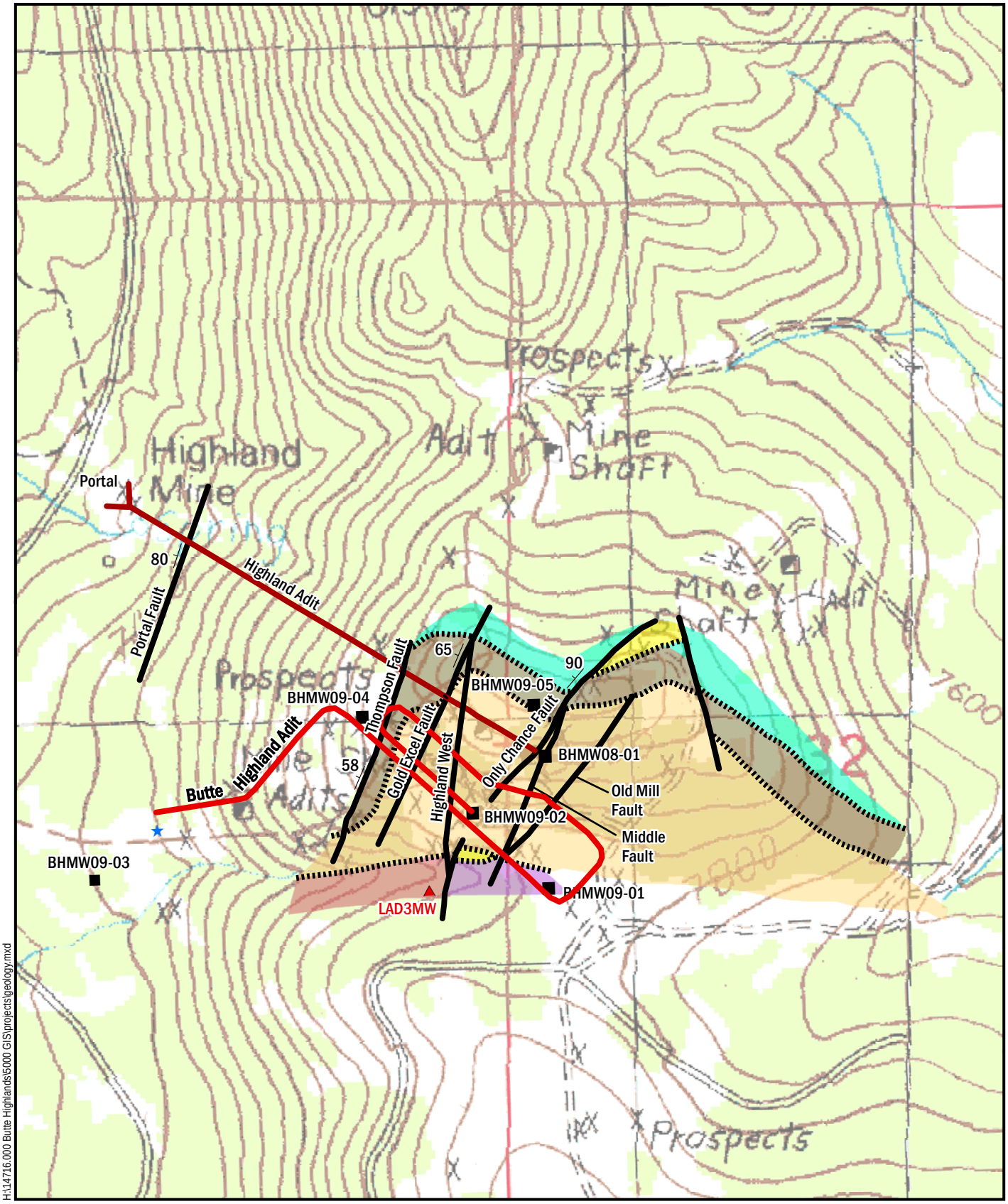
N

0 Feet 2,000

AMEC Geomatrix

- Groundwater Monitoring Well
- LAD Monitor Well
- Water Supply Well
- Surface Water Sampling Location

Water Monitoring Sites
Butte Highlands Project
Silver Bow County, Montana
FIGURE 3



N

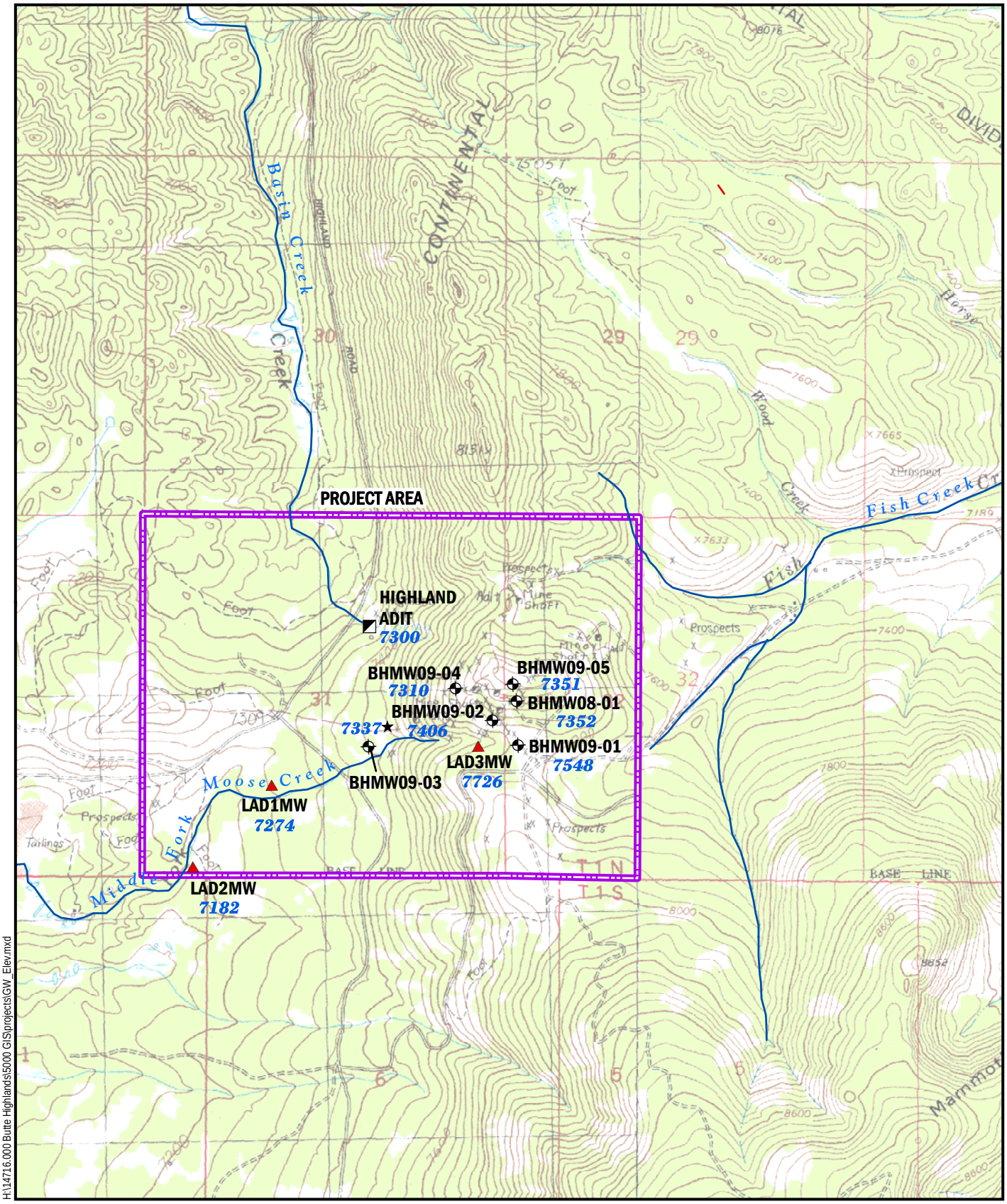
0 Feet 800

AMEC Geomatrix

Surface Geology

- Gabbro Intrusive
- Pilgrim Dolomite, Upper Marble
- Park Shale, Metamorphosed
- Meagher Dolomite, Lower Marble
- Flathead Sandstone, Quartzite
- Wolsey Shale, Metamorphosed
- Geologic Unit Contact
- Faults

Surface Geology
Butte Highlands Project
Silver Bow County, Montana
FIGURE 4



H:\14716.000 Butte Highlands\5000 GIS\projects\GW_Elev.mxd

Source: USGS 24k Mount Humbug and Pipestone Pass Quads

N

0 Feet 2,000

AMEC Geomatrix

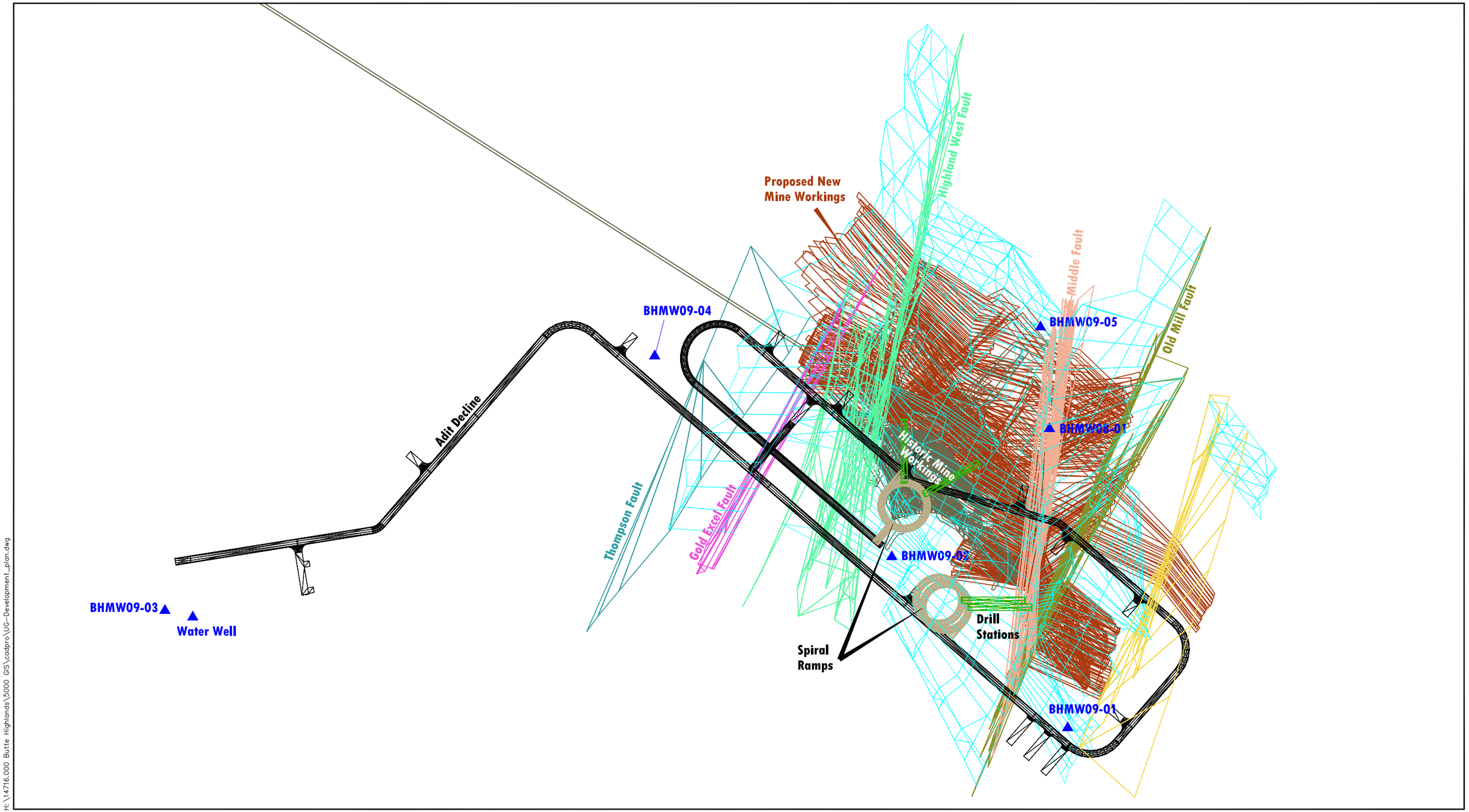
Groundwater Monitoring Well

LAD Monitor Well

★ Water Supply Well

Note: Groundwater elevations at wells are feet above mean sea level.

Groundwater Elevations
Butte Highlands Project
Silver Bow County, Montana
FIGURE 5



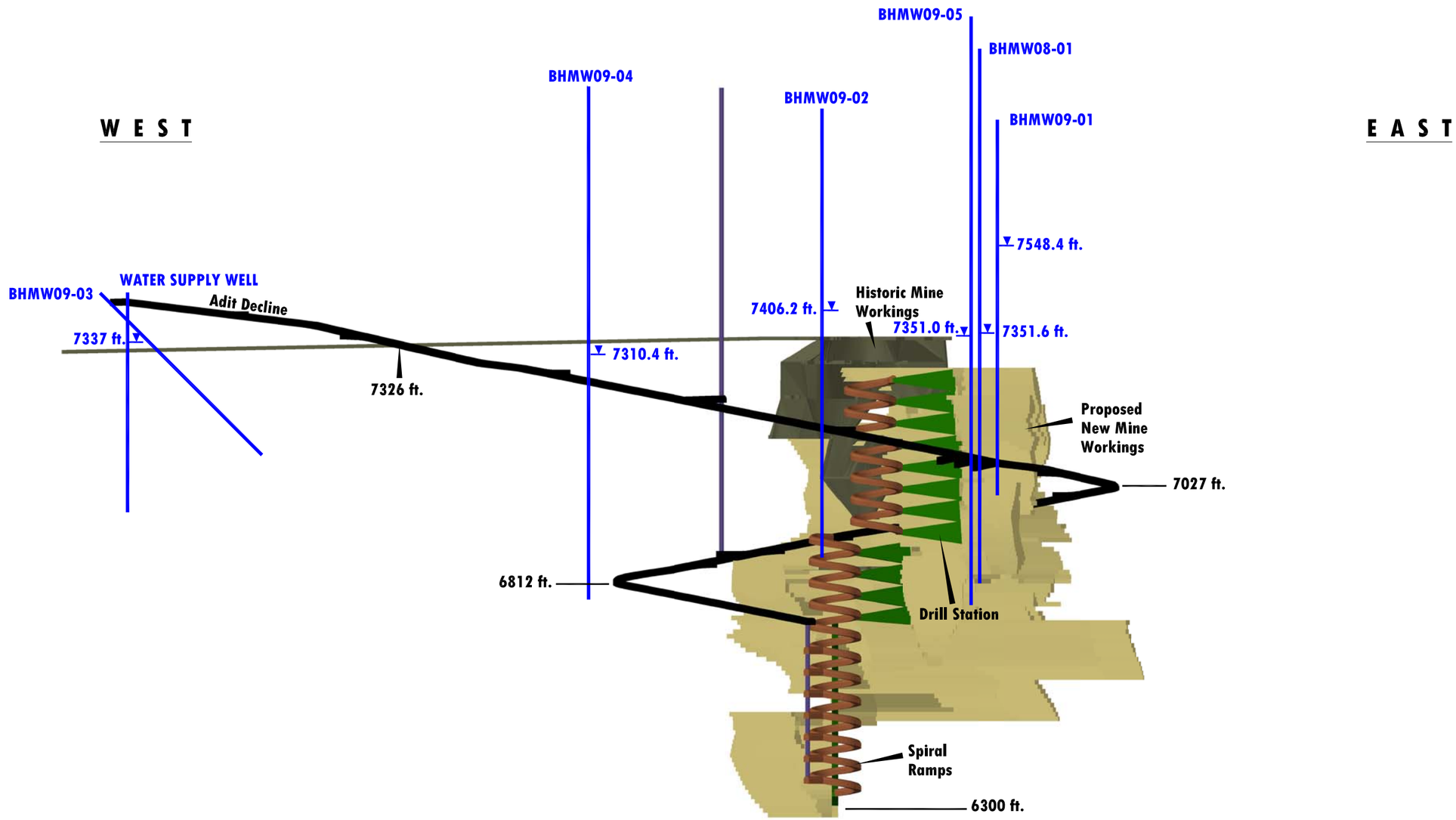
N

0 Feet 200

AMEC Geomatrix

14716

Mine Workings Plan View
Butte Highlands Project
Silver Bow County, Montana
FIGURE 6



H:\14716.000 Butte Highlands\5000 GIS\cadpro\3D_UG-Development.dwg

N

0 Feet 200

AMEC Geomatrix

14716

Mine Workings Cross Section
Butte Highlands Project
Silver Bow County, Montana
FIGURE 7

APPENDIX B

TABLES

TABLE 1
Laboratory Parameters for Water Samples
Butte Highlands Project

Parameter	Units	Reporting Limit	Method
Physical Properties			
pH	s.u.	0.1	A4500-H B
Electrical Conductivity	µmhos/cm	1	A2510 B
Turbidity	NTU	0.2	E180.1
Total Suspended Solids	mg/L	10	A2540 D
Total Dissolved Solids	mg/L	10	A2540 C
Inorganics			
Alkalinity, total as $CaCO_3$	mg/L	4	A2320 B
Bicarbonate, as $CaCO_3$	mg/L	4	A2320 B
Carbonate, as CO_3	mg/L	4	A2320 B
Chloride	mg/L	1	E300.0
Sulfate	mg/L	1	E300.0
Fluoride	mg/L	0.1	A4500-F C
Hardness, as $CaCO_3$	mg/L	1	A2320 B
Nutrients			
Ammonia	mg/L	0.1	E350.1
Total Kjeldahl Nitrogen	mg/L	0.5	E351.2
Nitrate+Nitrite	mg/L	0.05	E353.2
Orthophosphate	mg/L	0.01	E365.1
Total Phosphorous	mg/L	0.01	E365.1
Cations			
Calcium	mg/L	1	E200.7
Magnesium	mg/L	1	E200.7
Potassium	mg/L	1	E200.7
Sodium	mg/L	1	E200.7
Metals			
Aluminum	mg/L	0.03	E200.8
Antimony	mg/L	0.003	E200.8
Arsenic	mg/L	0.003	E200.8
Barium	mg/L	0.005	E200.8
Beryllium	mg/L	0.001	E200.8
Boron	mg/L	0.1	E200.8
Cadmium	mg/L	0.00008	E200.8
Chromium	mg/L	0.001	E200.8
Cobalt	mg/L	0.01	E200.8
Copper	mg/L	0.001	E200.8
Iron	mg/L	0.03	E200.7
Lead	mg/L	0.0005	E200.8
Manganese	mg/L	0.005	E200.8
Mercury	mg/L	0.00005	E245.1
Molybdenum	mg/L	0.005	E200.8
Nickel	mg/L	0.01	E200.8
Selenium	mg/L	0.001	E200.8
Silicon	mg/L	0.1	E200.7
Silica	mg/L	0.2	E200.7
Silver	mg/L	0.0005	E200.8
Strontium	mg/L	0.1	E200.8
Thallium	mg/L	0.0002	E200.8
Uranium	mg/L	0.001	E200.8
Vanadium	mg/L	0.1	E200.8
Zinc	mg/L	0.01	E200.8

Note: s.u. = standard units; µmhos/cm = micromhos per centimeter; NTU = nephelometric turbidity units; mg/L = milligrams per liter. The parameters of platinum, tin, and titanium were analyzed in some of the surface water and adit water samples.

TABLE 2
Summary of Test and Monitoring Wells
Butte Highlands Project

Drill Hole ID	Northing & Easting Coordinates and Surface Elevation (ft)	Total Depth Drilled (ft bgs)	Total Depth Cased (ft bgs)	Water Yield from Air Lift Test	Most Recent Static Water Level (ft btc), Elevation, & Measurement Date	Water Quality Sample Depth (ft bgs)	Geology	Date Drilled
BHMW08-01	N: 16640904.73 E: 1255915.168 7972.2 ft	1,167 ft (vertical)	600 ft (8-in steel)	<1 gpm at 685 ft 8 gpm at 805 ft 12 gpm at 1065 ft 12 gpm at 1085 ft 12 gpm at 1167 ft	620.55 ft 7351.6 ft (3/16/10)	805 ft 1,085 ft	Dolomite: 0-1040 ft Skarn/Hornfels: 1040-1167 ft	Dec. 2008
BHMW09-01	N: 16640254.54 E: 1255939.799 7822.6 ft	820 ft (vertical)	5 ft (6-in steel)	2 gpm at 240 ft 2 gpm at 400 ft 3.5 gpm at 500 ft 3.75 gpm at 600 ft 12 gpm at 820 ft	274.20 ft 7548.4 ft (3/16/10)	820 ft	Dolomite: 0-225 ft Skarn/Hornfels: 225-820 ft	July 2009
BHMW09-02	N: 16640632.92 E: 1255565.075 7848.5 ft	980 ft (vertical)	545 ft (6-in steel)	6.5 gpm at 600 ft 10 gpm at 860 ft 23 gpm at 880 ft 30 gpm at 955 ft 30 gpm at 980 ft	442.33 ft 7406.2 ft (3/16/10)	600 ft	Dolomite: 0-260 ft Clay Zone: 260-272 ft Skarn/Hornfels: 272-980 ft	Aug. 2009
BHMW09-03	N: 16640546.35 E: 1253985.090 7444 ft	500 ft* (45° angle)	Abandoned & Reclaimed	5 gpm at 200 ft 15 gpm at 400 ft 22 gpm at 500 ft	Not Measured (angle hole)	No Sample	Dolomite: 0-265 ft Marble: 265-280 ft Dolomite: 280-360 ft Marble: 360-370 ft Dolomite 370-440 ft Quartzite/Skarn: 440-500 ft	Aug. 2009
BHMW09-04	N: 16641078.43 E: 1255058.720 7897.2 ft	1,120 ft (vertical)	620 ft (6-in steel)	1.5 gpm at 460 ft 25 gpm at 800 ft 25-30 gpm at 900 ft 25-30 gpm at 1020 ft 30 gpm at 1120 ft	586.80 ft 7310.4 ft (3/16/10)	1,120 ft	Shale: 0-490 ft Dolomite: 490-1070 ft Skarn: 1070-1120 ft	Oct.-Nov. 2009
BHMW09-05	N: 16641125.43 E: 1255897.463 8048.4 ft	1,285 ft (vertical)	680 ft (6-in steel)	1 gpm at 200 ft 5 gpm at 320 ft 1 gpm at 430 ft 20-23 gpm at 600 ft 20-23 gpm at 720 ft 25 gpm at 800 ft 28 gpm at 1000 ft 30 gpm at 1285 ft	697.4 ft 7351.0 ft (2/23/10)	No Sample	Shale/Limestone: 0-230 ft Shale: 230-340 ft Shale/Dolomite: 340-385 ft Shale: 385-615 ft Shale/Dolomite: 615-775 ft Marble: 775-1170 ft Skarn/Hornfels: 1170-1285 ft	Dec. 2009 – Jan. 2010
Water Supply Well	N: 1254049 E: 16640538 7445 ft	480 ft (vertical)	480 ft	30 gpm at 280 ft 130 gpm at 360 ft 250 gpm at 420 ft	108 ft 7337 ft (2/2010)	Not Reported	Geology not reported. Hole drilled in a fault zone.	Oct. 2009

TABLE 2
Summary of Test and Monitoring Wells
Butte Highlands Project

Drill Hole ID	Northing & Easting Coordinates and Surface Elevation (ft)	Total Depth Drilled (ft bgs)	Total Depth Cased (ft bgs)	Water Yield from Air Lift Test	Most Recent Static Water Level (ft btc), Elevation, & Measurement Date	Water Quality Sample Depth (ft bgs)	Geology	Date Drilled
LAD1MW	N: 1252333 E: 16639704 7298 ft	65 ft (vertical)	60 ft (4-in PVC)	Not tested	23.56 ft 7274 ft (3/16/10)	30 ft	Overburden: 0-2 ft Clay/Weathered Shale: 2-35 ft Quartzite/Shale Float: 35-65 ft	Sept. 2009
LAD2MW	N: 16638530 E: 1251159 7190 ft	60 ft (vertical)	60 ft (2-in PVC)	Not tested	8.21 ft 7182 ft (3/16/10)	20 ft	Overburden: 0-10 ft Unconsolidated: 20-35 ft Dolomite/Shale/Qtzite: 35-60 ft	Jan. 2010
LAD3MW	N: 16640229 E: 1255375 7791 ft	67 ft (vertical)	60 ft (2-in PVC)	Not tested	64.85 ft 7726 ft (3/16/10)	65 ft	Unconsolidated: 0-25 ft Quartzite: 25-35 ft Quartzite/Calc-silicates: 35-45 ft Calc-silicates/Quartzite: 45-55 ft Calc-silicates: 55-67 ft	Sept. 2009

Note: ft = feet; bgs = below ground surface; btc = below top of casing; gpm = gallons per minute. Northing and Easting coordinates are from Timberline Resources.
* BHMW09-03 was completed as an angle hole; depth reported is drilled depth and not feet below ground surface; this hole was abandoned and reclaimed.

TABLE 3
Depth to Groundwater Measurements
Butte Highlands Project

Date	BHMW08-01	BHMW09-01	BHMW09-02	BHMW09-04	BHMW09-05	LAD-1MW	LAD-2MW	LAD-3MW
8/17/09	618.8	NM	NM	NM	NM	NM	NM	NM
9/1/09	618.5	NM	428.0	NM	NM	NM	NM	NM
9/11/09	618.7	NM	428.2	NM	NM	NM	NM	NM
12/10/09	NM	NM	433.40	560.85	*	21.90	NM	NM
12/11/09	620.10	NM	NM	NM	NM	NM	NM	NM
2/23/10	N M	265.70	NM	NM	697.40	NM	8.27	NM
3/16/10	620.55	274.20	442.33	566.80	*	23.56	8.21	64.85
4/12/10	621.20	279.80	439.05	568.40	697.60	23.49	7.85	65.30

Note: Depth to water measured in feet from top of casing. NM = not measured. See **Figure 3** for well locations.
* water level greater than 720 feet due to obstruction in well.

APPENDIX C

SITE PHOTOGRAPHS

SURFACE WATER LOCATION WS-1

Near Historical Adit

SURFACE WATER LOCATION WS-2

Southern fork of Fish Creek at Culvert East of Project Site

SURFACE WATER LOCATION WS-3

Combined forks of Fish Creek

SURFACE WATER LOCATION WS-4

Middle fork of Fish Creek

SURFACE WATER LOCATION WS-5

Northern fork of Fish Creek

SURFACE WATER LOCATION WS-6

Single Channel of Moose Creek

DRILL PAD IN WINTER CONDITIONS

Location BHMW08-01

ERODING LOGGING ROAD

Middle fork of Fish Creek running onto road

between Station WS-4 and WS-3

APPENDIX D

LABORATORY WATER QUALITY DATA

SURFACE WATER QUALITY AT BUTTE HIGHLANDS MINE SITE
1993 and 2008 Monitoring Results

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/25/08	WS-1 / BH-1 11/25/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 11/25/08	WS-2 / BH-2 11/25/08
Location			**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Highland Mine Adit Discharge**	**Fish Creek - south channel**	**Fish Creek - south channel**	**Fish Creek - south channel**	**Fish Creek - south channel**
Lab pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	7.6	---	---	---	7.8	---	---	---
Lab EC (µhmos/cm)	---	---	378	---	---	---	69	---	---	---
Turbidity (NTU)	---	---	---	---	---	---	0.18	---	---	---
TSS (mg/l)	---	---	<3.	---	<1.	---	7	---	<5.	---
TDS (mg/l)	---	500 s*	212	---	---	---	36	---	---	---
Alkalinity, total (mg CaCO3/l)	---	---	186	---	---	---	37	---	---	---
Bicarbonate (mg CaCO3/l)	---	---	227	---	---	---	45	---	---	---
Carbonate (mg CaCO3/l)	---	---	0	---	---	---	0	---	---	---
Chloride (mg/l)	230*	250 s*	1	---	---	---	<1.	---	---	---
Sulfate (mg/l)	---	250 s*	21	---	---	---	<5.	---	---	---
Fluoride (mg/l)	---	4		---	---	---	---	---	---	---
Hardness (mg CaCO3/l)	---	---	210	---	---	---	29	---		---
Ammonia, as N (mg/l)	---	---	<0.05	---	---	---	<0.05	---	---	---
Total Kjeldahl Nitrogen (mg/l)	---	---	0.2	---	---	---	<0.2	---	---	---
Nitrate+Nitrite, as N (mg/l)	---	10	0.18	---	0.133	---	<0.01	---	<0.01	---
Nitrate, as N (mg/l)	---	10	0.18	---	<0.1	---	<0.01	---	<0.01	---
Nitrite, as N (mg/l)	---	1	<0.1	---	0.133	---	<0.01	---	<0.01	---
Orthophosphate (mg/l)	---	---	<0.001	---	---	---	0.017	---	---	---
Phosphorus, total (mg/l)	---	---	0.009	---	<0.1	---	0.025	---	<0.05	---
			Dissolved Cations	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**
Calcium (mg/l)	---	---	43	44	37.1	---	10	10	8.65	8.6
Magnesium (mg/l)	---	---	25	27	24.8	22	1	1	1.49	1.46
Potassium (mg/l)	---	---	3	4	2.95	3.05	1	1	0.654	0.954
Sodium (mg/l)	---	---	3	4	---	3.01	2	2	1.66	1.13
			Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**
Aluminum (mg/l)	0.087	---	<0.03	0.04	<0.01	<0.01	<0.03	<0.03	0.0162	<0.01
Antimony (mg/l)	---	0.006	<0.003	<0.003	<0.001	0.00152	<0.003	<0.003	<0.001	<0.001
Arsenic (mg/l)	0.15	0.01	0.005	0.007	0.00525	0.00428	0.01	0.011	0.0109	0.0105
Barium (mg/l)	---	2	0.015	0.017	0.0147	0.0137	<0.005	<0.005	0.00163	0.00185
Beryllium (mg/l)	---	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (mg/l)	---	---	---	---	<0.01	0.0425	---	---	0.0324	<0.01
Cadmium (mg/l)	0.000097 h	0.005	<0.00008	<0.00008	<0.001	<0.001	<0.00008	<0.00008	<0.001	<0.001
Chromium (mg/l)	0.0277 h	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001
Copper (mg/l)	0.00285 h	1.3	0.001	0.003	0.00131	0.00108	<0.001	<0.001	<0.001	<0.001
Iron (mg/l)	1.0	0.3 s	<0.05	0.22	0.115	0.0972	<0.05	<0.05	<0.01	<0.01
Lead (mg/l)	0.000545 h	0.015	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001
Manganese (mg/l)	---	0.05 s	0.016	0.017	0.0112	0.00927	<0.005	<0.005	<0.001	<0.001
Mercury (mg/l)	0.00091	0.002	<0.00001	<0.00001	<0.001	<0.0001	<0.00001	<0.00001	<0.001	<0.0001
Molybdenum (mg/l)	---	---	---	---	0.00137	0.00109	---	---	<0.001	<0.001
Nickel (mg/l)	0.0161 h	0.1	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.001	<0.001
Platinum (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001
Selenium (mg/l)	0.005	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver (mg/l)	0.000374 h	0.1	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.001	<0.001
Strontium (mg/l)	---	4.0	---	---	0.082	0.0945	---	---	0.0123	0.0113
Thallium (mg/l)	---	0.002	<0.0002	<0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.001	<0.001
Tin (mg/l)	---	---	---	---	<0.001	0.00122	---	---	0.00113	0.00209
Titanium (mg/l)	---	---	---	---	<0.001	<0.001	---	---	0.00113	<0.001
Uranium (mg/l)	---	0.03	---	---	0.00131	0.00116	---	---	<0.001	<0.001
Vanadium (mg/l)	---	---	---	---	<0.001	<0.001	---	---	<0.001	<0.001
Zinc (mg/l)	0.037 h	2.0	<0.01	<0.01	0.00108	<0.001	<0.01	<0.01	<0.001	<0.001

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/26/08	WS-1 / BH-1 11/26/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 09/03/08	WS-2 / BH-2 11/25/08	WS-2 / BH-2 11/25/08
Field pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	---	---	7.67	---	---	---	6.75	---
Field Temperature (C)	---	---	---	---	5.45	---	---	---	-0.25	---
Field DO (mg/l)	---	---	---	---	7.18	---	---	---	14.89	---
Field ORP (mV)	---	---	---	---	175	---	---	---	203	---
Field Turbidity (NTU)	---	---	---	---	3.11	---	---	---	0.97	---
Field EC (µmhos/cm)	---	---	---	---	335	---	---	---	61	---

NOTE:
s.u. = standard units; EC = electrical conductance; µmhos/cm = micromhos per centimeter; mg/l = milligrams per liter; TDS = total dissolved solids; TSS = total suspended solids; NTU = nephelometric turbidity units; CaCO3 = calcium carbonate; C = Celsius; mV = millivolts.
s = secondary standard; h = hardness dependent (for this table, values presented are based on a hardness of 150 mg/L).
* = federal U.S. EPA standard. --- = no standard or not analyzed.
Aquatic life standards are the lowest reported for acute and chronic standards; and groundwater standards are the human health values, both from Montana Circular DEQ-7 (February 2008).

SURFACE WATER QUALITY AT BUTTE HIGHLANDS MINE SITE
1993 and 2008 Monitoring Results

Parameter	Surface Water Station									
	WS-3 / BH-3 09/03/08	**WS-3 / BH-3 09/03/08**	**WS-3 / BH-3 11/25/08**	**WS-3 / BH-3 11/25/08**	**WS-4 11/25/08**	**WS-5 11/25/08**	**WS-6 11/26/08**	**BHIS10H 08/20/93**	**BHIS20L 08/20/93**	**BHIS30M 08/20/93**
Location	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - combined channels**	**Fish Creek - middle channel**	**Fish Creek - north channel**	**Moose Creek - Middle Fork**	**Highland Mine Adit Discharge**	**Seep in Small Channel Upper Basin Creek**	**Basin Creek - Upper**
Lab pH (s.u.)	8.3	---	---	---	8.0	8.1	7.8	7.35	7.70	8.05
Lab EC (µhmos/cm)	266	---	---	---	390	304	513	392	514	345
Turbidity (NTU)	<0.2	---	---	---	---	---	---	---	---	---
TSS (mg/l)	2	---	<5.	---	<10.	<10.	<10.	---	---	---
TDS (mg/l)	148	---	---	---	203	167	278	---	---	---
Alkalinity, total (mg CaCO3/l)	139	---	---	---	200	150	260	---	---	---
Bicarbonate (mg CaCO3/l)	169	---	---	---	240	180	320	---	---	---
Carbonate (mg CaCO3/l)	0	---	---	---	<4.	<4.	<4.	---	---	---
Chloride (mg/l)	<1.	---	---	---	<1.	<1.	1	1.6	1.75	1.2
Sulfate (mg/l)	8	---	---	---	5	9	8	13.8	60.8	13.4
Fluoride (mg/l)	---	---	---	---	<0.1	<0.1	<0.1	0.17	0.11	0.19
Hardness (mg CaCO3/l)	145	---	---	---	197	147	264	---	---	---
Ammonia, as N (mg/l)	<0.05	---	---	---	<0.1	<0.1	<0.1	---	---	---
Total Kjeldahl Nitrogen (mg/l)	0.2	---	---	---	<0.5	<0.5	<0.5	---	---	---
Nitrate+Nitrite, as N (mg/l)	0.09	---	0.123	---	0.37	0.9	<0.05	0.24	0.13	0.14
Nitrate, as N (mg/l)	0.09	---	0.123	---	---	---	---	---	---	---
Nitrite, as N (mg/l)	<0.01	---	0.123	---	---	---	---	---	---	---
Orthophosphate (mg/l)	0.006	---	---	---	<0.1	<0.1	<0.1	---	---	---
Phosphorus, total (mg/l)	0.016	---	<0.1	---	<0.1	<0.1	0.01	---	---	---
	Dissolved Cations	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**	**Dissolved Cations**	**Dissolved Cations**	**Dissolved Cations**	**Cations**	**Cations**	**Cations**
Calcium (mg/l)	35	35	33.6	33.6	47	33	66	---	---	---
Magnesium (mg/l)	14	15	15.6	14.0	20	16	24	---	---	---
Potassium (mg/l)	2	2	1.58	1.73	2	2	1	---	---	---
Sodium (mg/l)	2	2	1.95	2.37	<1.	2	2	---	---	---
	Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Total Recov. Metals**	**Metals**	**Metals**	**Metals**
Aluminum (mg/l)	<0.03	<0.03	<0.01	0.0176	0.04	0.04	0.04	<0.03	<0.03	<0.03
Antimony (mg/l)	<0.003	<0.003	<0.001	<0.001	<0.003	<0.003	<0.003	---	---	---
Arsenic (mg/l)	<0.003	0.003	0.00242	0.00246	<0.003	<0.003	<0.003	---	---	---
Barium (mg/l)	0.007	0.008	0.0071	0.00842	0.014	0.009	0.022	0.017	0.016	0.016
Beryllium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Boron (mg/l)	---	---	<0.01	<0.01	<0.1	<0.1	<0.1	---	---	---
Cadmium (mg/l)	<0.00008	<0.00008	<0.001	<0.001	<0.00008	<0.00008	<0.00008	<0.002	<0.002	<0.002
Chromium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002
Cobalt (mg/l)	---	---	<0.001	<0.001	<0.01	<0.01	<0.01	---	---	---
Copper (mg/l)	<0.001	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.002	<0.002	0.0025
Iron (mg/l)	<0.05	0.05	0.0177	0.0274	0.04	0.05	0.07	0.007	0.024	0.015
Lead (mg/l)	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.002	<0.002	0.0025
Manganese (mg/l)	<0.005	<0.005	<0.001	0.00218	<0.005	<0.005	0.018	0.005	0.008	0.002
Mercury (mg/l)	<0.00001	<0.00001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001
Molybdenum (mg/l)	---	---	<0.001	<0.001	<0.005	<0.005	<0.005	---	---	---
Nickel (mg/l)	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	<0.002	<0.002	<0.002
Platinum (mg/l)	---	---	<0.001	<0.001	<0.1	<0.1	<0.1	---	---	---
Selenium (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Silver (mg/l)	<0.0005	<0.0005	<0.001	<0.001	<0.0005	<0.0005	<0.0005	<0.001	<0.001	<0.001
Strontium (mg/l)	---	---	0.0347	0.0394	<0.1	<0.1	<0.0002	---	---	---
Thallium (mg/l)	<0.0002	<0.0002	<0.001	<0.001	<0.0002	<0.0002	<0.0002	---	---	---
Tin (mg/l)	---	---	0.0011	0.00351	<0.1	<0.1	<0.1	---	---	---
Titanium (mg/l)	---	---	0.0011	0.00132	<0.1	<0.1	<0.1	---	---	---
Uranium (mg/l)	---	---	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Vanadium (mg/l)	---	---	<0.001	<0.001	<0.1	<0.1	<0.1	---	---	---
Zinc (mg/l)	<0.01	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	0.0045	0.0027	0.0022

Parameter	Surface Water Station									
	WS-3 / BH-3 09/03/08	**WS-3 / BH-3 09/03/08**	**WS-3 / BH-3 11/25/08**	**WS-3 / BH-3 11/25/08**	**WS-4 11/25/08**	**WS-5 11/25/08**	**WS-6 11/26/08**	**BHIS10H 08/20/93**	**BHIS20L 08/20/93**	**BHIS30M 08/20/93**
Field pH (s.u.)	---	---	7.65	---	7.09	7.44	7.49	8.37	8.10	8.50
Field Temperature (C)	---	---	1.34	---	2.1	1.7	0.1	6.3	9.5	8.9
Field DO (mg/l)	---	---	12.24	---	11.1	14.2	11.5	---	---	---
Field ORP (mV)	---	---	202	---	200	200	206	---	---	---
Field Turbidity (NTU)	---	---	3.86	---	2.6	2.9	4.1	---	---	---
Field EC (µmhos/cm)	---	---	272	---	363	282	425	391	515	338

GROUNDWATER QUALITY AT BUTTE HIGHLANDS MINE SITE
2008-2009 Monitoring Results

Parameter	Montana Aquatic Life Standard	Montana Groundwater Standard	Groundwater Sample Site								
			BHMW08-01 805 ft 12/04/08	BHMW08-01 805 ft 12/04/08	BHMW08-01 1085 ft 12/09/08	BHMW08-01 1085 ft 12/09/08	BHMW09-01 820 ft 07/28/09	BHMW09-01 820 ft 07/28/09	BHMW09-02 600 ft 08/04/09	BHMW09-04 1120 ft 11/03/09	BHMW09-04 1120 ft 11/03/09
Location			Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole	Monitoring Borehole
Lab pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.4	---	8.5	---	8.5	---	8.3	8.3	---
Lab EC (µhmos/cm)	---	---	339	---	344	---	334	---	325	355	---
Turbidity (NTU)	---	---	97.3	---	276	---	215	---	75.5	62.5	---
TSS (mg/l)	---	---	115	---	408	---	663	---	938	119	---
TDS (mg/l)	---	500 s*	185	---	180	---	172	---	184	184	---
Alkalinity, total (mg CaCO3/l)	---	---	200	---	200	---	190	---	190	170	---
Bicarbonate (mg CaCO3/l)	---	---	240	---	230	---	230	---	230	210	---
Carbonate (mg CaCO3/l)	---	---	<4.	---	<4.	---	<4.	---	<4.	<4.	---
Chloride (mg/l)	230*	250 s*	<1.	---	<1.	---	<1.	---	<1.	<1.	---
Sulfate (mg/l)	---	250 s*	6	---	7	---	20	---	15	16	---
Fluoride (mg/l)	---	4	<0.1	---	0.1	---	0.2	---	0.1	<0.1	---
Hardness (mg CaCO3/l)	---	---	194	---	194	---	154	---	151	178	---
Ammonia, as N (mg/l)	---	---	<0.1	---	<0.1	---	<0.1	---	<0.1	<0.1	---
Total Kjeldahl Nitrogen (mg/l)	---	---	<0.5	---	<0.5	---	<0.5	---	<0.5	<0.5	---
Nitrate+Nitrite, as N (mg/l)	---	10	0.98	---	0.54	---	0.47	---	0.49	0.34	---
Orthophosphate (mg/l)	---	---	0.02	---	1.03	---	0.02	---	0.02	0.02	---
Phosphorus, total (mg/l)	---	---	0.01	---	0.96	---	0.40	---	0.12	0.15	---
			Dissolved Cations		**Dissolved Cations**		**Dissolved Cations**		**Dissolved Cations**	**Dissolved Cations**	
Calcium (mg/l; dissolved)	---	---	40	---	37	---	25	---	27	32	---
Magnesium (mg/l; dissolved)	---	---	23	---	25	---	22	---	21	24	---
Potassium (mg/l; dissolved)	---	---	2	---	4	---	3	---	5	3	---
Sodium (mg/l; dissolved)	---	---	1	---	1	---	4	---	2	2	---
			Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**	**Dissolved Metals**	**Dissolved Metals**	**Total Recov. Metals**
Aluminum (mg/l)	0.087	---	<0.03	0.22	0.28	12.11	0.05	96.64	<0.03	<0.03	3.58
Antimony (mg/l)	---	0.006	<0.003	<0.003	<0.003	<0.003	0.006	0.044	<0.003	0.014	0.014
Arsenic (mg/l)	0.15	0.01	<0.003	<0.003	<0.003	<0.003	0.005	0.499	0.004	<0.003	0.018
Barium (mg/l)	---	2	0.017	0.022	0.011	0.062	0.076	0.258	0.011	0.007	0.018
Beryllium (mg/l)	---	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Boron (mg/l)	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Cadmium (mg/l)	0.000097 h	0.005	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00162	<0.00008	<0.00008	0.00014
Chromium (mg/l)	0.0277 h	0.1	<0.001	0.003	0.001	0.024	<0.001	0.163	<0.001	<0.001	0.005
Cobalt (mg/l)	---	---	<0.01	<0.01	<0.01	0.01	<0.01	<0.02	<0.01	<0.01	<0.01
Copper (mg/l)	0.00285 h	1.3	<0.001	0.005	<0.001	0.037	0.004	0.411	0.005	<0.001	0.041
Iron (mg/l)	1.0	0.3 s	<0.03	3.28	0.67	20.52	0.07	123.2	<0.03	<0.03	10.9
Lead (mg/l)	0.000545 h	0.015	<0.0005	0.0016	<0.0005	0.0032	<0.0005	0.0314	<0.0005	<0.0005	0.0027
Manganese (mg/l)	---	0.05 s	0.011	0.089	0.056	0.208	0.041	2.743	0.034	0.021	0.430
Mercury (mg/l)	0.00091	0.002	<0.00005	<0.001	<0.00005	<0.001	<0.00005	<0.001	<0.00005	<0.00005	<0.001
Molybdenum (mg/l)	---	---	<0.005	<0.005	<0.005	<0.005	0.007	0.065	0.007	<0.005	<0.005
Nickel (mg/l)	0.0161 h	0.1	<0.01	<0.01	<0.01	0.02	<0.01	0.07	<0.01	<0.01	<0.01
Platinum (mg/l)	---	---	---	---	---	---	---	---	---	---	---
Selenium (mg/l)	0.005	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.002	0.002
Silver (mg/l)	0.000374 h	0.1	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	<0.0005
Strontium (mg/l)	---	4.0	<0.1	<0.1	<0.1	0.1	<0.1	0.6	<0.1	<0.1	<0.1
Thallium (mg/l)	---	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0043	<0.0002	0.0008	0.0011
Tin (mg/l)	---	---	---	---	---	---	---	---	---	---	---
Titanium (mg/l)	---	---	---	---	---	---	---	---	---	---	---
Uranium (mg/l)	---	0.03	<0.001	<0.001	0.003	0.004	<0.001	0.027	0.005	0.005	0.009
Vanadium (mg/l)	---	---	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Zinc (mg/l)	0.037 h	2.0	<0.01	0.01	<0.01	0.02	0.02	0.29	<0.01	<0.01	0.06
Field pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.35	---	8.44	---	8.24	---	7.94	7.92	---
Field Temperature (C)	---	---	9.7	---	9.1	---	11.7	---	12.0	7.9	---
Field DO (mg/l)	---	---	6.7	---	8.1	---	---	---	---	---	---
Field ORP (mV)	---	---	129	---	---	---	---	---	---	---	---
Field Turbidity (NTU)	---	---	198	---	647	---	---	---	---	---	---
Field EC (µmhos/cm)	---	---	395	---	370	---	288	---	261	336	---

NOTE:

s.u. = standard units; EC = electrical conductance; µmhos/cm = micromhos per centimeter; mg/l = milligrams per liter; TDS = total dissolved solids; TSS = total suspended solids; NTU = nephelometric turbidity units; CaCO3 = calcium carbonate; C = Celsius; mV = millivolts.

s = secondary standard; h = hardness dependent (for this table, MT values presented are based on a hardness of 25 mg/L).

* = federal U.S. EPA standard. --- = no standard or not analyzed.

Aquatic life standards are the lowest reported for acute and chronic standards; and groundwater standards are the human health values, both from Montana Circular DEQ-7 (February 2008).

GROUNDWATER QUALITY AT BUTTE HIGHLANDS MINE SITE
2008-2009 Monitoring Results

Parameter	WS-1 / BH-1 09/03/08	WS-1 / BH-1 09/03/08	WS-1 / BH-1 11/25/08	WS-1 / BH-1 11/25/08
Location	Highland Mine Adit Discharge	Highland Mine Adit Discharge	Highland Mine Adit Discharge	Highland Mine Adit Discharge
Lab pH (s.u.)	7.6	---	---	---
Lab EC (µhmos/cm)	378	---	---	---
Turbidity (NTU)	---	---	---	---
TSS (mg/l)	<3.	---	<1.	---
TDS (mg/l)	212	---	---	---
Alkalinity, total (mg CaCO3/l)	186	---	---	---
Bicarbonate (mg CaCO3/l)	227	---	---	---
Carbonate (mg CaCO3/l)	0	---	---	---
Chloride (mg/l)	1	---	---	---
Sulfate (mg/l)	21	---	---	---
Fluoride (mg/l)	---	---	---	---
Hardness (mg CaCO3/l)	210	---	---	---
Ammonia, as N (mg/l)	<0.05	---	---	---
Total Kjeldahl Nitrogen (mg/l)	0.2	---	---	---
Nitrate+Nitrite, as N (mg/l)	0.18	---	0.133	---
Orthophosphate (mg/l)	<0.001	---	---	---
Phosphorus, total (mg/l)	0.009	---	<0.1	---
	Dissolved Cations	**Total Recov. Cations**	**Dissolved Cations**	**Total Recov. Cations**
Calcium (mg/l; dissolved)	43	44	37.1	---
Magnesium (mg/l; dissolved)	25	27	24.8	22
Potassium (mg/l; dissolved)	3	4	2.95	3.05
Sodium (mg/l; dissolved)	3	4	---	3.01
	Dissolved Metals	**Total Recov. Metals**	**Dissolved Metals**	**Total Recov. Metals**
Aluminum (mg/l)	<0.03	0.04	<0.01	<0.01
Antimony (mg/l)	<0.003	<0.003	<0.001	0.00152
Arsenic (mg/l)	0.005	0.007	0.00525	0.00428
Barium (mg/l)	0.015	0.017	0.0147	0.0137
Beryllium (mg/l)	<0.001	<0.001	<0.001	<0.001
Boron (mg/l)	---	---	<0.01	0.0425
Cadmium (mg/l)	<0.00008	<0.00008	<0.001	<0.001
Chromium (mg/l)	<0.001	<0.001	<0.001	<0.001
Cobalt (mg/l)	---	---	<0.001	<0.001
Copper (mg/l)	0.001	0.003	0.00131	0.00108
Iron (mg/l)	<0.05	0.22	0.115	0.0972
Lead (mg/l)	<0.0005	<0.0005	<0.001	<0.001
Manganese (mg/l)	0.016	0.017	0.0112	0.00927
Mercury (mg/l)	<0.00001	<0.00001	<0.0001	<0.0001
Molybdenum (mg/l)	---	---	0.00137	0.00109
Nickel (mg/l)	<0.01	<0.01	<0.001	<0.001
Platinum (mg/l)	---	---	<0.001	<0.001
Selenium (mg/l)	<0.001	<0.001	<0.001	<0.001
Silver (mg/l)	<0.0005	<0.0005	<0.001	<0.001
Strontium (mg/l)	---	---	0.082	0.0945
Thallium (mg/l)	---	---	<0.001	<0.001
Tin (mg/l)	---	---	<0.001	0.00122
Titanium (mg/l)	---	---	<0.001	<0.001
Uranium (mg/l)	---	---	0.00131	0.00116
Vanadium (mg/l)	---	---	<0.001	<0.001
Zinc (mg/l)	<0.01	<0.01	0.00108	<0.001
Field pH (s.u.)	---	---	7.67	---
Field Temperature (C)	---	---	5.45	---
Field DO (mg/l)	---	---	7.18	---
Field ORP (mV)	---	---	175	---
Field Turbidity (NTU)	---	---	3.1	---
Field EC (µmhos/cm)	---	---	335	---

APPENDIX E

MINE/ADIT INFLOW CALCULATIONS

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2010)
EXPLORATION PHASE

1992 Montanore Mine Project Final EIS Equation

$Q = [(2\pi KH) \div (2.3\log(2H \div R))] \times 7.48$

where: Q = mine tunnel inflow per unit length; K = rock hydraulic conductivity;
H = hydraulic head from adit to water table; R = tunnel radius (15 ft).

Butte Highlands Adit Decline (0-5000 ft long)

Constant (none)	K (ft/min)	H (feet)	R (feet)	q (gal/min/ft)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:						
6.28	0.000002	0	15		0	0-1000 ft
6.28	0.000002	300	15	0.0076	8	1000-2000 ft
6.28	0.000002	400	15	0.0095	9	2000-3000 ft
6.28	0.000002	600	15	0.0129	13	3000-4000 ft
6.28	0.000002	800	15	0.0161	16	4000-5000 ft
				Total =	**46**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:						
6.28	0.0000002	0	15		0	0-1000 ft
6.28	0.0000002	300	15	0.0008	1	1000-2000 ft
6.28	0.0000002	400	15	0.0009	1	2000-3000 ft
6.28	0.0000002	600	15	0.0013	1	3000-4000 ft
6.28	0.0000002	800	15	0.0016	2	4000-5000 ft
				Total =	**5**	**gal/min**

Note: Assume total adit decline length is 5000 feet, and the first 1000 feet is above water table.

1992 Montanore Mine Project Final EIS Equation

Butte Highlands Spiral Ramp (4200 ft tunnel length over 900 ft vertical height)

Constant (none)	K (ft/min)	H (feet)	R (feet)	q (gal/min/ft)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:						
6.28	0.000002	0	15		0	0-300 ft
6.28	0.000002	600	15	0.0129	18	300-600 ft
6.28	0.000002	1000	15	0.0192	27	600-900 ft
6.28	0.000002	0	15		0	
6.28	0.000002	0	15		0	
				Total =	**45**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:						
6.28	0.0000002	0	15		0	0-300 ft
6.28	0.0000002	600	15	0.0013	2	300-600 ft
6.28	0.0000002	1000	15	0.0019	3	600-900 ft
6.28	0.0000002	0	15		0	
6.28	0.0000002	0	15		0	
				Total =	**4**	**gal/min**

Note: Assume spirals over a 900-ft depth comprise 42 turns with a 100-ft long tunnel segment (total = 4200 ft or 1280 m length).
Assume first 300 ft of spirals vertically would be above water table.

1992 Montanore Mine Project Final EIS Equation

Butte Highlands Drill Stations (total borehole length = 15,750 ft)

Constant (none)	K (ft/min)	H (feet)	R (feet)	q (gal/min/ft)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:						
6.28	0.000002	0	0.25		0	0-300 ft
6.28	0.000002	600	0.25	0.0067	35	300-600 ft
6.28	0.000002	1000	0.25	0.0105	55	600-900 ft
6.28	0.000002	0	0.25		0	
6.28	0.000002	0	0.25		0	
				Total =	**90**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:						
6.28	0.0000002	0	0.25		0	0-300 ft
6.28	0.0000002	600	0.25	0.0007	3	300-600 ft
6.28	0.0000002	1000	0.25	0.0010	5	600-900 ft
6.28	0.0000002	0	0.25		0	
6.28	0.0000002	0	0.25		0	
				Total =	**9**	**gal/min**

Note: Assume there are 21 drill stations for the 900-ft vertical distance; each drill stn has 5 boreholes that are 150 ft long and 0.25 ft diameter (0.1 m).
Total borehole length = 21 x 5 x 150 = 15,750 ft or 4,800 m. Assume first 300 ft of drill stations vertically would be above water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**181**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**18**	**gal/min**

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2010)
EXPLORATION PHASE

Goodman (1965) Equation

$Q = 0.707L(KH^3S_y/t)^{1/2}$

where: Q = mine tunnel inflow; L = length of drift or tunnel; K = rock hydraulic conductivity;
H = depth of drift below initial water table; Sy = specific yield of aquifer;
t = time since water level reached top of drift.

For this Butte Highlands Adit analysis, Sy is assumed constant at 0.05; and t is assumed constant at 1,825 days (5 yrs).

Butte Highlands Adit Decline (0-5000 ft long)

Constant (none)	L (meters)	K (m/day)	H (meters)	Sy (none)	t (days)	Q (m3/day)	Q (gal/min)	Adit Segment (length)
Using bedrock K of 10^{-6} cm/sec:								
0.707	305	0.00086	0	0.05	1825	0	0	0-1000 ft
0.707	305	0.00086	91	0.05	1825	29	5	1000-2000 ft
0.707	305	0.00086	122	0.05	1825	45	8	2000-3000 ft
0.707	305	0.00086	183	0.05	1825	82	15	3000-4000 ft
0.707	305	0.00086	244	0.05	1825	126	23	4000-5000 ft
					Total =	**281**	**52**	
						m3/day	**gal/min**	
Using bedrock K of 10^{-7} cm/sec:								
0.707	305	0.000086	0	0.05	1825	0	0	0-1000 ft
0.707	305	0.000086	91	0.05	1825	9	2	1000-2000 ft
0.707	305	0.000086	122	0.05	1825	14	3	2000-3000 ft
0.707	305	0.000086	183	0.05	1825	26	5	3000-4000 ft
0.707	305	0.000086	244	0.05	1825	40	7	4000-5000 ft
					Total =	**89**	**16**	
						m3/day	**gal/min**	

Note: Assume total adit decline length is 5000 feet, and the first 1000 feet is above water table.

Goodman (1965) Equation

Butte Highlands Spiral Ramp (4200 ft tunnel length over 900 ft vertical height)

Constant (none)	L (meters)	K (m/day)	H (meters)	Sy (none)	t (days)	Q (m3/day)	Q (gal/min)	Ramp Segment (bgs)
Using bedrock K of 10^{-6} cm/sec:								
0.707	427	0.00086	0	0.05	1825	0	0	0-300 ft
0.707	427	0.00086	183	0.05	1825	115	21	300-600 ft
0.707	427	0.00086	305	0.05	1825	247	45	600-900 ft
0.707		0.00086		0.05	1825	0	0	
0.707		0.00086		0.05	1825	0	0	
					Total =	**362 m3/day**	**66 gal/min**	
Using bedrock K of 10^{-7} cm/sec:								
0.707	427	0.000086	0	0.05	1825	0	0	0-300 ft
0.707	427	0.000086	183	0.05	1825	36	7	300-600 ft
0.707	427	0.000086	305	0.05	1825	78	14	600-900 ft
0.707		0.000086		0.05	1825	0	0	
0.707		0.000086		0.05	1825	0	0	
					Total =	**114 m3/day**	**21 gal/min**	

Note: Assume spirals over a 900-ft depth comprise 42 turns with a 100-ft long tunnel segment (total = 4200 ft or 1280 m length).
Assume first 300 ft of sprials vertically would be above water table.

Goodman (1965) Equation

Butte Highlands Drill Stations (total length = 21 stns x 150 ft long = 3150 ft)

Constant (none)	L (meters)	K (m/day)	H (meters)	Sy (none)	t (days)	Q (m3/day)	Q (gal/min)	Drill Segment (bgs)
Using bedrock K of 10^{-6} cm/sec:								
0.707	320	0.00086	0	0.05	1825	0	0	0-300 ft
0.707	320	0.00086	183	0.05	1825	86	16	300-600 ft
0.707	320	0.00086	305	0.05	1825	185	34	600-900 ft
0.707		0.00086		0.05	1825	0	0	
0.707		0.00086		0.05	1825	0	0	
					Total =	**271 m3/day**	**50 gal/min**	
Using bedrock K of 10^{-7} cm/sec:								
0.707	320	0.000086	0	0.05	1825	0	0	0-300 ft
0.707	320	0.000086	183	0.05	1825	27	5	300-600 ft
0.707	320	0.000086	305	0.05	1825	58	11	600-900 ft
0.707		0.000086		0.05	1825	0	0	
0.707		0.000086		0.05	1825	0	0	
					Total =	**86 m3/day**	**16 gal/min**	

Note: Assume there are 21 drill stations for the 900-ft vertical distance; the boreholes at each drill station are approximated by a single 150-ft long tunnel; total length = 21 x 150 = 3,150 ft or 960 m. Assume first 300 ft of drill stations vertically would be above water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**168**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**53**	**gal/min**

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2009)
EXPLORATION PHASE

Lei (1998) Equation

$q = [2\pi K(d+P_a-Ø)] / \ln(D/R + \sqrt{[(D/R)^2 - 1]})$

where: q = flow per unit length of mine tunnel; K = rock hydraulic conductivity;
D = distance from ground surface to axis of tunnel; R = tunnel radius (15 ft or 4.5 m);
Ø = hydraulic head at tunnel's perimeter; d = height of free-standing water above ground (none);
Pa = atmospheric pressure head (usually assumed to be 0).

Butte Highlands Adit Decline (0-5000 ft long)

Constant (none)	K (m/sec)	d (meters)	Pa (meters)	Ø (meters)	D (meters)	R (meters)	q (m2/sec)	Q (m3/sec)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:										
6.28	0.00000001	0	0	0	60	4.5	0	0.0000	0	0-1000 ft
6.28	0.00000001	0	0	91	213	4.5	-1.2559E-06	0.0004	6	1000-2000 ft
6.28	0.00000001	0	0	122	244	4.5	-1.6349E-06	0.0005	8	2000-3000 ft
6.28	0.00000001	0	0	183	305	4.5	-2.3409E-06	0.0007	11	3000-4000 ft
6.28	0.00000001	0	0	244	366	4.5	-3.0095E-06	0.0009	15	4000-5000 ft
							Total =	**0.0025**	**40**	
								m3/day	**gal/min**	
Using bedrock K of 10^{-7} cm/sec:										
6.28	1E-09	0	0	0	60	4.5	0	0.00000	0	0-1000 ft
6.28	1E-09	0	0	91	213	4.5	-1.2559E-07	0.00004	1	1000-2000 ft
6.28	1E-09	0	0	122	244	4.5	-1.6349E-07	0.00005	1	2000-3000 ft
6.28	1E-09	0	0	183	305	4.5	-2.3409E-07	0.00007	1	3000-4000 ft
6.28	1E-09	0	0	244	366	4.5	-3.0095E-07	0.00009	1	4000-5000 ft
							Total =	**0.0003**	**4**	
								m3/day	**gal/min**	

Note: Assume total adit decline length is 5000 feet, and the first 1000 feet is above water table.

Lei (1998) Equation

Butte Highlands Spiral Ramp (4200 ft tunnel length over 900 ft vertical height)

Constant (none)	K (m/sec)	d (meters)	Pa (meters)	Ø (meters)	D (meters)	R (meters)	q (m2/sec)	Q (m3/sec)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:										
6.28	0.00000001	0	0	0	213	4.5	0	0.0000	0	0-300 ft
6.28	0.00000001	0	0	183	335	4.5	-2.297E-06	0.0010	16	300-600 ft
6.28	0.00000001	0	0	305	400	4.5	-3.6973E-06	0.0016	25	600-900 ft
6.28	0.00000001	0	0	0	0	4.5		0.0000	0	
6.28	0.00000001	0	0	0	0	4.5		0.0000	0	
							Total =	**0.0026**	**41**	
								m3/day	**gal/min**	
Using bedrock K of 10^{-7} cm/sec:										
6.28	1E-09	0	0	0	213	4.5	0	0.00000	0	0-300 ft
6.28	1E-09	0	0	183	335	4.5	-2.297E-07	0.00010	2	300-600 ft
6.28	1E-09	0	0	305	400	4.5	-3.6973E-07	0.00016	3	600-900 ft
6.28	1E-09	0	0	0	0	4.5		0.00000	0	
6.28	1E-09	0	0	0	0	4.5		0.00000	0	
							Total =	**0.0003**	**4**	
								m3/day	**gal/min**	

Note: Assume spirals over a 900-ft depth comprise 42 turns with a 100-ft long tunnel segment (total = 4200 ft or 1280 m length).
Assume first 300 ft of spirals vertically would be above water table.

Lei (1998) Equation

Butte Highlands Drill Stations (total borehole length = 15,750 ft)

Constant (none)	K (m/sec)	d (meters)	Pa (meters)	Ø (meters)	D (meters)	R (meters)	q (m2/sec)	Q (m3/sec)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:										
6.28	0.00000001	0	0	0	213	0.1	0	0.0000	0	0-300 ft
6.28	0.00000001	0	0	183	335	0.1	-1.3045E-06	0.0021	33	300-600 ft
6.28	0.00000001	0	0	305	400	0.1	-2.1313E-06	0.0034	54	600-900 ft
6.28	0.00000001	0	0	0	0	0.1		0.0000	0	
6.28	0.00000001	0	0	0	0	0.1		0.0000	0	
							Total =	**0.0055**	**87**	
								m3/day	**gal/min**	
Using bedrock K of 10^{-7} cm/sec:										
6.28	1E-09	0	0	0	213	0.1	0	0.0000	0	0-300 ft
6.28	1E-09	0	0	183	335	0.1	-1.3045E-07	0.0002	3	300-600 ft
6.28	1E-09	0	0	305	400	0.1	-2.1313E-07	0.0003	5	600-900 ft
6.28	1E-09	0	0	0	0	0.1		0.0000	0	
6.28	1E-09	0	0	0	0	0.1		0.0000	0	
							Total =	**0.0005**	**9**	
								m3/day	**gal/min**	

Note: Assume there are 21 drill stations for the 900-ft vertical distance; each drill stn has 5 boreholes that are 150 ft long and 0.25 ft diameter (0.1 m).
Total borehole length = 21 x 5 x 150 = 15,750 ft or 4,800 m. Assume first 300 ft of drill stations vertically would be above water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**168**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**17**	**gal/min**

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2010)
PRODUCTION PHASE

1992 Montanore Mine Project Final EIS Equation

$Q = [(2\pi KH) \div (2.3\log(2H \div R))] \times 7.48$

where: Q = mine tunnel inflow per unit length; K = rock hydraulic conductivity;
H = hydraulic head from adit to water table; R = tunnel radius (15 ft).

Butte Highlands Mine Workings (0-48,000 ft equivalent length)

Constant (none)	K (ft/min)	H (feet)	R (feet)	q (gal/min/ft)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:						
6.28	0.000002	0	15		0	0-10000 ft
6.28	0.000002	0	15		0	10000-20000 ft
6.28	0.000002	400	15	0.0095	95	20000-30000 ft
6.28	0.000002	600	15	0.0129	129	30000-40000 ft
6.28	0.000002	800	15	0.0161	129	40000-48000 ft
				Total =	**352**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:						
6.28	0.0000002	0	15		0	0-10000 ft
6.28	0.0000002	0	15		0	10000-20000 ft
6.28	0.0000002	400	15	0.0009	9	20000-30000 ft
6.28	0.0000002	600	15	0.0013	13	30000-40000 ft
6.28	0.0000002	800	15	0.0016	13	40000-48000 ft
				Total =	**35**	**gal/min**

Note: Assume total mine workings equivalent length is 48,000 feet, and the first 20,000 feet would be above water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**352**	**gal/min**	x 0.50 =	**176**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**35**	**gal/min**	x 0.50 =	**18**	**gal/min**

Note: Assume 50% reduction in calculated rate due to backfilling of mine workings.

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2010)
PRODUCTION PHASE

Goodman (1965) Equation

$Q = 0.707L(KH^3S_y/t)^{1/2}$

where: Q = mine tunnel inflow; L = length of drift or tunnel; K = rock hydraulic conductivity;
H = depth of drift below initial water table; Sy = specific yield of aquifer;
t = time since water level reached top of drift.

For this Butte Highlands Adit analysis, Sy is assumed constant at 0.05; and t is assumed constant at 3,650 days (10 yrs).

Butte Highlands Mine Workings (0-48,000 ft equivalent length)

Constant (none)	L (meters)	K (m/day)	H (meters)	Sy (none)	t (days)	Q (m3/day)	Q (gal/min)	Adit Segment (length)
Using bedrock K of 10^{-6} cm/sec:								
0.707	3050	0.00086	0	0.05	3650	0	0	0-10000 ft
0.707	3050	0.00086	0	0.05	3650	0	0	10000-20000 ft
0.707	3050	0.00086	122	0.05	3650	315	58	20000-30000 ft
0.707	3050	0.00086	183	0.05	3650	579	106	30000-40000 ft
0.707	3050	0.00086	244	0.05	3650	892	164	40000-48000 ft
					Total =	**1787 m3/day**	**328 gal/min**	
Using bedrock K of 10^{-7} cm/sec:								
0.707	305	0.000086	0	0.05	3650	0	0	0-10000 ft
0.707	305	0.000086	0	0.05	3650	0	0	10000-20000 ft
0.707	305	0.000086	122	0.05	3650	10	2	20000-30000 ft
0.707	305	0.000086	183	0.05	3650	18	3	30000-40000 ft
0.707	305	0.000086	244	0.05	3650	28	5	40000-48000 ft
					Total =	**57 m3/day**	**10 gal/min**	

Note: Assume total mine workings equivalent length is 48,000 feet, and the first 20,000 feet would be above water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**328**	**gal/min**	x 0.50 =	**164**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**10**	**gal/min**	x 0.50 =	**5**	**gal/min**

Note: Assume 50% reduction in calculated rate due to backfilling of mine workings.

BUTTE HIGHLANDS MINE/ADIT INFLOW CALCULATIONS (April 19, 2009)
PRODUCTION PHASE

Lei (1998) Equation

$q = [2\pi K(d+P_a-Ø)] / \ln(D/R + \sqrt{[(D/R)^2 - 1]})$

where: q = flow per unit length of mine tunnel; K = rock hydraulic conductivity;
D = distance from ground surface to axis of tunnel; R = tunnel radius (15 ft or 4.5 m);
Ø = hydraulic head at tunnel's perimeter; d = height of free-standing water above ground (none);
Pa = atmospheric pressure head (usually assumed to be 0).

Butte Highlands Mine Workings (0-48,000 ft equivalent length)

Constant (none)	K (m/sec)	d (meters)	Pa (meters)	Ø (meters)	D (meters)	R (meters)	q (m2/sec)	Q (m3/sec)	Q (gal/min)	Adit Segment
Using bedrock K of 10^{-6} cm/sec:										
6.28	0.00000001	0	0	0	60	4.5	0	0.0000	0	0-10000 ft
6.28	0.00000001	0	0	0	213	4.5	0	0.0000	0	10000-20000 ft
6.28	0.00000001	0	0	122	244	4.5	-1.6349E-06	0.0050	79	20000-30000 ft
6.28	0.00000001	0	0	183	305	4.5	-2.3409E-06	0.0071	113	30000-40000 ft
6.28	0.00000001	0	0	244	366	4.5	-3.0095E-06	0.0092	146	40000-48000 ft
							Total =	**0.0213**	**338**	
								m3/day	**gal/min**	
Using bedrock K of 10^{-7} cm/sec:										
6.28	1E-09	0	0	0	60	4.5	0	0.00000	0	0-10000 ft
6.28	1E-09	0	0	0	213	4.5	0	0.00000	0	10000-20000 ft
6.28	1E-09	0	0	122	244	4.5	-1.6349E-07	0.00050	8	20000-30000 ft
6.28	1E-09	0	0	183	305	4.5	-2.3409E-07	0.00071	11	30000-40000 ft
6.28	1E-09	0	0	244	366	4.5	-3.0095E-07	0.00092	15	40000-48000 ft
							Total =	**0.0021**	**34**	
								m3/day	**gal/min**	

Note: Assume total mine workings equivalent length is 48,000 feet, and the first 20,000 feet would be above the water table.

TOTAL GROUNDWATER YIELD

Using bedrock K of 10^{-6} cm/sec:	**338**	**gal/min**	x 0.50 =	**169**	**gal/min**
Using bedrock K of 10^{-7} cm/sec:	**34**	**gal/min**	x 0.50 =	**17**	**gal/min**

Note: Assume 50% reduction in calculated rate due to backfilling of mine workings.

Wetland Delineation Report
Butte Highlands Project
Silver Bow County, Montana

Prepared For:

Butte Highlands Joint Venture
P.O. Box 4959
Butte, Montana 59702

Prepared By:

Kirk Eakin, PWS
AMEC Earth and Environmental, Inc.
639 Helena Avenue, Suite 1A
Helena, Montana 59601

December 2010

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	**1**
1.1	Project Overview	1
2.0	**METHODS**	**1**
2.1	Data Review	2
2.2	Field Investigation	2
2.3	Classification of Delineated Wetlands	2
2.4	Jurisdictional Status	3
3.0	**DELINEATION RESULTS**	**3**
3.1	Data Review	3
3.2	Field Investigation	5
3.3	Classification of Delineated Wetlands	10
3.4	Jurisdictional Status	10
3.5	Wetland Impacts	11
4.0	**REFERENCES**	**11**

FIGURES

FIGURE 1 Project Location Map
FIGURE 2 Wetland Site Map
FIGURE 3 Soils Map
FIGURE 4 U.S. Geological Survey 7.5 minute topographic map (Mt. Humbug, MT (1996))

APPENDICES

APPENDIX A Wetland Determination Data Forms
APPENDIX B Wetland Photographs

1.0 INTRODUCTION

1.1 Project Overview

AMEC Geomatrix, Inc. (AMEC) was retained by Butte Highlands Joint Venture to conduct wetland delineations on two separate mining claims in the vicinity of the Butte Highlands Mine. The project area is located south of Butte in Silver Bow County, Montana (**Figure 1**). The Pony Placer Claim is 150.9 acres in total size and is located southwest of the mine office. The wetland delineation was conducted on approximately 130 acres of the Pony Placer Claim and encompassed only the claim area southwest of Forest Service Road 8250 since much of the area northeast of the road has already been disturbed by existing mine construction. The Upper Claims mine claim comprises 74.1 acres and includes the area between Highland Road east into Section 32 (**Figure 2**). Only the extreme western portion of this mine claim from the headwaters of Basin Creek downstream to the culvert under Highland Road was inventoried for wetlands, which equates to roughly 8.0 acres. Butte Highlands Joint Venture proposes to develop to some extent all or portions of the two mining claims; however, at the time of this report no detailed mine activities that would result in ground disturbance at these two mine claims has been proposed. The legal descriptions for the proposed project mine claims are as follows:

Pony Placer Claim

- Township 1 North, Range 8 West, Section 36
- Township 1 South, Range 7 West, Section 6
- Township 1 South, Range 8 West, Section 1

Upper Claims

- Township 1 North, Range 7 West, Sections 31 and 32

The purpose of AMEC's assessment was to 1) Identify areas on the claims meeting the U.S. Army Corps of Engineers' (USACE) criteria for wetland or other Waters of the U.S. 2) delineate the boundaries of all identified wetlands according to USACE methods, and 3) prepare a wetland delineation report that identifies and describes the existing wetland resources that were located in the proposed project area.

2.0 METHODS

The project area was evaluated for the presence and extent of wetlands using standard methods described in the *1987 Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland*

Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2010). Wetlands were classified in accordance with the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et. al. 1979). The indicator status of the vegetation was derived from the *National List of Plant Species that occur in Wetlands: Northwest (Region 9)*, and *1993 Supplement to List of Plant Species that occur in Wetlands: Northwest (Region 9)* (Porter et. al. 1988 and 1993, respectively). The project area was evaluated for wetlands using the routine, level-2 determination method described in the *1987 Corps of Engineers Wetlands Delineation Manual (*Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (USACE 2010). The routine, level-2 determination method includes a review of existing data in addition to conducting an on-site field investigation. Specific data review and field investigation methods are provided below.

Wetland determination data forms were completed for all delineated wetlands and are contained in **Appendix A**. Representative wetland site photographs are contained in **Appendix B**. The boundaries of all delineated wetlands were located using a Trimble GeoXT GPS unit with sub-meter accuracy. The wetland shape file data was downloaded and differentially corrected using Trimble® Pathfinder Software.

2.1 Data Review

AMEC conducted a review of existing data to identify potential wetlands and tributary waters occurring on the subject mine claims. Data reviewed included United States Geological Survey (USGS) 7.5 minute topographic maps, National Wetland Inventory (NWI) mapping, Digital Orthophotograph (DOQ) aerial photographs, and Natural Resources Conservation Service (NRCS) soil survey information.

2.2 Field Investigation

Potential wetlands were further reviewed during field investigations conducted on October 8 and 11, 2010. Areas exhibiting wetland characteristics were evaluated by collecting soil, vegetation, and hydrology data at sample locations along the suspected wetland boundaries (**Figure 2**).

2.3 Classification of Delineated Wetlands

Delineated wetlands were classified using the *Classification of Wetlands and Deepwater Habitats of the United States (Cowardin classification system)*. Classifying wetlands and waters under this system requires identification of the delineated areas major class association

(Riverine, Palustrine, Lacustrine, Estuarine, or Marine), general vegetative cover type, primary source of hydrology, and factors related to the origin of the wetland or water (Cowardin et. al. 1979).

2.4 Jurisdictional Status

The jurisdictional status of all delineated wetlands and tributary waters was evaluated by reviewing USGS topographic maps, and through field observations to determine the connectivity or adjacency of these areas with known waters of the U.S. Delineated areas with an observable surface connection with, or located adjacent to known waters of the U.S. were determined to likely be under the jurisdiction of the USACE.

3.0 DELINEATION RESULTS

This section summarizes the results of the wetland delineation of the project area, as well as the classification and supporting documentation for all areas identified and delineated.

3.1 Data Review

National Wetland Inventory (NWI) data

A search of the NWI database revealed that no wetland mapping exists for the project area (NWI 2010).

Natural Resources Conservation Service (NRCS) Soil Survey Data

A review of NRCS soil survey information (NRCS 2010) for the project area indicates soils associated with the delineated wetland areas are classified as Cryofluvents-Finn family-Water Complex (64GJ1), Finn-Lowder-Dunkleber families (64UJ1), and Kurrie-Goldflint-Warwood families (75GD2) in the Pony Placer Claim. The wetland recorded along Basin Creek in the Upper Claims mine claim is associated with the NRCS soil type, Windyridge-Como-Hiore families, complex (75GB2) (**Figure 3**).

The majority of Middle Fork Moose Creek (Wetland 1), all of Wetlands 5, 6, and portions of Wetlands 8 and 9 are located within the soil map unit classified as Cryofluvents-Finn family-Water Complex (64GJ1) (**Figure 3**). This soil map unit is associated with rolling stream terraces and floodplains. The parent material is alluvium derived from granite. The drainage class varies from poorly to very poorly drained soils with a high water table at or near the surface (0-24 in), with occasional to frequent flooding. The Finn soil component of this complex that is

associated with floodplains is listed by the NRCS as a hydric soil with a hydric criteria code of 2B3. The hydric criteria code of 2B3 is defined as soils that are poorly drained or very poorly drained and have a water table at a depth of 1.0 feet or less during the growing season, if saturated hydraulic conductivity is less than 6.0 inches/hour in any layer within a depth of 20 inches.

The majority of Wetland 3 is located within the soil map unit classified as Finn-Lowder-Dunkleber families (64UJ1) (**Figure 3**). This soil map unit is associated with stream terraces and floodplains. The parent material is alluvium derived from sandstone, shale, and siltstone. The drainage class is very poorly drained soils with a high water table within 12 inches of the surface, with frequent flooding and ponding events. The Finn soil component of this complex is associated with floodplains and drainageways and is listed by the NRCS as a hydric soil with a hydric criteria code of 2B3.

The entire delineated area of Wetlands 2, 4, 7 and 10, and portions of Wetlands 1, 3, 8 and 9 are located within the soil map unit Kurrie-Goldflint-Warwood families, complex (75GD2) (**Figure 3**). This soil map unit is associated with low relief mountain slopes and ridges. The parent material of this complex is colluvium derived from granite, residuum weathered from granite, and fine-loamy colluvium derived from granite, respectively. The drainage class varies from well drained to somewhat excessively drained soils with a depth to water table of more than 80 inches. Flooding and ponding are not noted at any frequency with this soil type. The Lowder component which comprises about five percent of the map unit and is typically confined to the draws and drainageways is listed by the NRCS as a hydric soil with a hydric criteria code of 2B3.

The entire delineated area of Wetland 12 is located within the soil map unit Windyridge-Como-Hiore families, complex (75GB2) (**Figure 3**). This soil map unit is associated with low relief mountain slopes and ridges. The parent material of this complex is colluvium derived from granite and residuum weathered from granite. The drainage class varies from well drained to somewhat excessively drained soils with a depth to water table of more than 80 inches. Flooding and ponding are not noted at any frequency with this soil type. The Lowder component which comprises about five percent of the map unit and is typically confined to the draws and drainageways is listed by the NRCS as a hydric soil with a hydric criteria code of 2B3.

3.2 Field Investigation

Project Area Description

The topography of the project area is characterized by rolling forested foothills and wet meadows along the Continental Divide on the west flank of the Highland Mountains. A review of topographic maps indicates the elevation of the Pony Placer Claim ranges from 7,120 to 7,440 feet above mean sea level (amsl). The portion of the Upper Claims parcel that was surveyed near Highland Road ranged from approximately 7,200 to 7,400 feet amsl (USGS Mt. Humbug 7.5 minute topographic map (1996)).

Surface water within the Pony Placer claim consists of three perennial streams, Middle Fork Moose Creek and two unnamed tributaries to the Middle Fork Moose Creek. The headwater area of Middle Fork Moose Creek originates in the Pony Placer Claim south of the junction of Highland Road and Forest Service Road 8250. The stream flows in a southwesterly direction along the western boundary of the mine claim. Note that the channel of Middle Fork Moose Creek does not originate north of Forest Service Road 8250 as is depicted on the USGS 7.5 minute Mt. Humbug, MT topographic map (1996) (**Figures 2 & 4**).

Two unnamed perennial streams originate on the west side of the Highland Mountains and flow westerly into the Pony Placer Claim where they join together at the southern end of the claim. A large wetland complex has formed in the area near the junction of these two drainages and is mapped as wetland on the USGS 7.5 minute Mt. Humbug, MT topographic map (1996) (**Figure 4**). The unnamed stream, resulting from the joining of the two streams, in the Pony Placer claim is a tributary to the Middle Fork Moose Creek.

Recent cattle grazing was evident throughout the entire Pony Placer Claim with much of the wetland herbaceous vegetation eaten or crushed making for difficult wetland plant identification. Also, past selective logging in some wetland areas associated with the Pony Placer Claim was evident by the number of stumps still remaining.

Surface water within the western portion of the Upper Claims mine claim consists of the reclaimed headwaters area of Basin Creek. Basin Creek originates as a spring on a steep west facing hillside that appears to have been mined in the past and is shown as the Highland Mine on the USGS 7.5 minute Mt. Humbug, MT topographic map (**Figure 4**). Recent reclamation of the upper stream channel diverts the flow from the spring discharge point across slope through a rock hardened channel back to the original channel to the south of the reclaimed area and then flows straight down slope to the west to a culvert under Highland Road.

Wetland Descriptions

Eleven wetlands were delineated in the Pony Placer Mine Claim and one wetland area was delineated in the Upper Claims Mine Claim (**Figure 2**). The following section provides descriptions of the delineated wetlands. Wetland determination data forms for each wetland are included in **Appendix A**.

Wetland 1 is a mixture of palustrine scrub-shrub (PSS) and palustrine emergent (PEM) wetland associated with the Middle Fork Moose Creek between the headwaters area in Section 31, Township 1 North, Range 7 West to the downstream limit of the study area in Section 1, Township 1 South, Range 8 West (**Figure 2**). The wetland begins at the headwaters of Middle Fork Moose Creek south of the junction of Highland Road and Forest Service Road 8250 and flows in a southwesterly direction through the Pony Placer Claim before exiting onto U.S. Forest Service land. The hydrophytic vegetation dominating the wetlands along this perennial stream included a mix of scrub-shrub and herbaceous communities that included Drummond willow (*Salix drummondiana*) (FACW), Booth willow (*Salix boothii*) (OBL), mountain alder (*Alnus incana*) (FACW), beaked sedge (*Carex utriculata*) (OBL), Nebraska sedge (*Carex nebrascensis*) (OBL), Baltic rush (*Juncus balticus*) (FACW), American mannagrass (*Glyceria grandis*) (OBL), short-beak sedge (*Carex simulata*) (OBL), bluejoint reedgrass (*Calamagrostis canadensis*) (FACW), and fowl mannagrass (*Glyceria striata*) (OBL). The soils are listed as hydric by the NRCS and consist of low chroma silt loam near the surface to silty clay loam near the bottom of the soil pit (0-4”, 10YR3/1 with no mottles; 4-10”, 10YR4/1 with 10% mottling of 10YR4/6; 10-20”, 10YR2/1 with no mottles). Primary hydrologic indicators include water in the soil pit to the surface and perennial surface water in the stream with the majority of wetlands either inundated or saturated to the surface. Primary sources of water appear to be surface water from direct precipitation and groundwater at or near the surface. Recent cattle grazing was evident as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated along the Middle Fork Moose Creek within the Pony Placer Claim study area for wetland 1 was 5.334 acres.

Wetland 2 is a mixture of palustrine scrub-shrub (PSS) and palustrine emergent (PEM) wetland in Section 1, T1S, R8W (**Figure 2**). Vegetation is dominated by hydrophytic species including Drummond willow (FACW), Booth willow (OBL), Nebraska sedge (OBL), Baltic rush (FACW), Nevada rush (*Juncus nevadensis*) (FACW), and long-style rush (*Juncus longistylis*) (FACW). The soils are hydric and consist of low chroma silty clay loam soils near the surface to sandy loam near the bottom of the soil pit (0-8”, 10YR3/1 with no mottling; 8-19”, 10YR3/2 with greater than 10% mottling of 10YR4/6). Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. Primary

hydrologic indicators include areas of inundation and saturation to the soil surface. Recent cattle grazing was evident as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 2 was 0.20 acres.

Wetland 3 is a large wetland complex comprised of a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forest (PFO) wetlands. The wetland complex is associated with two perennial streams that join together in Section 1, T1S, R8W (**Figure 2**). Vegetation is dominated by hydrophytic species including beaked sedge (OBL), Baltic rush (FACW), bluejoint reedgrass (FACW), Drummond willow (FACW), and Engelmann spruce (*Picea engelmannii*) (FAC). The soils are listed as hydric by the NRCS and consist of low chroma silty clay loam soils near the surface to silty clay near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-21", 10YR2/1 with 10% mottling of 10YR5/6). Primary hydrologic indicators include saturation to the soil surface and areas of inundation. Primary sources of water appear to be high groundwater levels and surface water from two perennial streams that flow through the wetland from the east and join up near the south end of the mine claim. Water in the wetland complex appears to drain to the southwest to an unnamed perennial drainage that is a tributary to Middle Fork Moose Creek. Old beaver dams were noted at several locations within the mapped wetland area. The area was also mapped as wetland on the U.S. Geological Survey 7.5 minute topographic map (USGS 1996). Recent cattle grazing was evident as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 3 was 7.3 acres.

Wetland 4 is a mixture of palustrine emergent (PEM) and palustrine scrub-shrub (PSS) wetland located in Section 6, T1S, R7W (**Figure 2**). Vegetation is dominated by hydrophytic species including Drummond willow (FACW), Booth willow (OBL), Baltic rush (FACW), Nebraska sedge (OBL), woolly-fruit sedge (*Carex lasiocarpa*) (OBL), large-leaf avens (*Geum macrophyllum*) (FACW), and bluejoint reedgrass (FACW). The soils are hydric and consist of low chroma silty clay loam soils near the surface to silty clay near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-21", 10YR2/1 with 10% mottling of 10YR5/6). The primary hydrologic indicator observed was saturation to the surface. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. Recent evidence of cattle grazing was noted as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 4 was 0.03 acres.

Wetland 5 is a mixture of palustrine emergent (PEM) and palustrine forested (PFO) wetland located in Section 6, T1S, R7W (**Figure 2**). The wetland was dominated by the following

hydrophytic vegetation: an overstory of Engelmann spruce (FAC), with an understory emergent community of beaked sedge (OBL), woolly-fruit sedge (OBL), Baltic rush (FACW), fowl mannagrass (OBL), hairy willow-herb (*Epilobium ciliatum*) (FACW), and bluejoint reedgrass (FACW). The soils are listed as hydric by the NRCS and consist of low chroma silt loam near the surface to silty clay loam near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-22", 10YR2/1 with no mottling). Primary hydrologic indicators include surface water inundation and saturation to the surface. Primary sources of water appear to be surface water with areas of high groundwater levels at or near the surface. The total wetland area delineated within the Pony Placer Claim study area for wetland 5 was 0.33 acres.

Wetlands 6 & 7 are a mixture of palustrine emergent (PEM) and palustrine forested (PFO) wetlands located in Section 31, T1N, R7W (**Figure 2**). The hydrophytic vegetation was dominated by an overstory of both live and dead Engelmann spruce (FAC) and quaking aspen (*Populus tremuloides*) (FAC). The emergent understory vegetation was comprised of beaked sedge (OBL), woolly-fruit sedge (OBL), water sedge (*Carex aquatilis*) (OBL), fowl mannagrass (OBL), large-leaf avens (FACW), and bluejoint reedgrass (FACW). The soils at both wetlands are hydric and consist of low chroma silt loam near the surface to silty clay loam near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-22", 10YR2/1 with no mottling). The soils associated with Wetland 6 are listed as hydric by the NRCS. The primary hydrologic indicators observed were saturation to the surface and some areas of inundation. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. The total wetland area delineated within the Pony Placer Claim study area for Wetland 6 was 0.14 acres and 0.04 acres for Wetland 7.

Wetland 8 is a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetland located in Section 31, T1N, R7W (**Figure 2**). The wetland was dominated by the following hydrophytic vegetation: Engelmann spruce (FAC), Drummond willow (FACW), Booth willow (OBL), shrubby cinquefoil (*Potentilla fruticosa*) (FAC), beaked sedge (OBL), Baltic rush (FACW), and fowl bluegrass (FAC). The soils are hydric and consist of low chroma silty clay loam soils near the surface to silty clay near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-21", 10YR2/1 with 10% mottling of 10YR5/6). The primary hydrologic indicator observed was saturation to the surface. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. Recent evidence of cattle grazing was noted as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 8 was 1.05 acres.

Wetland 9 is a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetland located in Section 31, T1N, R7W (**Figure 2**). The wetland was dominated by the following hydrophytic vegetation: Engelmann spruce (FAC), quaking aspen (FAC), Booth willow (OBL), Drummond willow (FACW), beaked sedge (OBL), woolly-fruit sedge (OBL), Baltic rush (FACW), hairy willow-herb (FACW), and bluejoint reedgrass (FACW). The soils are listed as hydric by the NRCS and consist of low chroma silty clay loam soils near the surface to silty clay near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-21", 10YR2/1 with 10% mottling of 10YR5/6). The primary hydrologic indicator observed was saturation to the surface. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. Recent evidence of cattle grazing was noted as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 9 was 0.19 acres.

Wetland 10 is a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetland located in Section 31, T1N, R7W (**Figure 2**). The wetland was dominated by the following hydrophytic vegetation: Engelmann spruce (FAC), Drummond willow (FACW), Booth willow (OBL), beaked sedge (OBL), Nebraska sedge (OBL), short-beak sedge (OBL), Baltic rush (FACW), hairy willow-herb (FACW), and bluejoint reedgrass (FACW). The soils are hydric and consist of low chroma silt loam near the surface to silty clay loam near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-22", 10YR2/1 with no mottling). The primary hydrologic indicators observed were saturation to the surface and recent evidence of ponding. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface with evidence of some areas of inundation. Recent evidence of cattle grazing was noted as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 10 was 0.05 acres.

Wetland 11 is a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetland located in Section 31, T1N, R7W (**Figure 2**). The wetland was dominated by the following hydrophytic vegetation: Engelmann spruce (FAC), Drummond willow (FACW), Booth willow (OBL), beaked sedge (OBL), Nebraska sedge (OBL), short-beak sedge (OBL), Baltic rush (FACW), large-leaf avens (FACW), hairy willow-herb (FACW), and bluejoint reedgrass (FACW). The soils are hydric and consist of low chroma silt loam near the surface to silty clay loam near the bottom of the soil pit (0-10", 10YR2/1 with no mottling; 10-22", 10YR2/1 with no mottling). The primary hydrologic indicator observed was saturation to the surface. Primary sources of wetland hydrology appear to be surface water from direct precipitation and high groundwater levels at or near the surface. Recent evidence of cattle

grazing was noted as was visible sign of past selective logging in the wetland area and vicinity. The total wetland area delineated within the Pony Placer Claim study area for wetland 11 was 0.08 acres.

Wetland 12 is a mixture of palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetland on a steep slope in the headwaters of Basin Creek in the Upper Claims mine claim. The wetland originates from spring seeps and surface water from Basin Creek in Section 31, T1N, R7W (**Figure 2**). The wetland was dominated by the following hydrophytic vegetation: Engelmann spruce (FAC), Drummond willow (FACW), Booth willow (OBL), beaked sedge (OBL), Baltic rush (FACW), bluejoint reedgrass (FACW), and hairy willow-herb (FACW). A soil pit was attempted at this location but was unsuccessful due to the amount of rock near the surface. Primary hydrologic indicators include areas of saturation to the surface and surface water from Basin Creek. Primary sources of wetland hydrology appear to be surface water and groundwater discharge from the headwaters of Basin Creek. The total wetland area delineated within the Upper Claims study area for wetland 12 was 0.09 acres.

3.3 Classification of Delineated Wetlands

All wetlands identified in the project area are most appropriately classified under the Cowardin system as palustrine emergent (PEM), palustrine scrub-shrub (PSS), and palustrine forested (PFO) wetlands. The wetlands associated with Middle Fork Moose Creek and tributaries (Wetlands 1 and 3) are considered seasonally flooded wetlands. The water regime for Wetlands 2, 4, 5, 6, 7, 8, 9, 10, 11 and 12 would be considered saturated based on the topography and limited or lack of surface water associated with the wetlands (Cowardin et al. 1979).

3.4 Jurisdictional Status

Wetlands 1 and 3 delineated along Middle Fork Moose Creek and the unnamed perennial tributary to Middle Fork Moose Creek, and Wetland 12 at the headwaters of Basin Creek are likely jurisdictional and subject to regulation by the USACE in accordance with Section 404 of the Clean Water Act. Middle Fork Moose Creek and tributaries have a significant nexus with the Big Hole River, whereas Basin Creek has a significant nexus with the Clark Fork River.

Wetlands 2, 4, 5, 6, 7, 8, 9, 10 and 11 are likely not jurisdictional and subject to regulation by the USACE in accordance with Section 404 of the Clean Water Act since they are isolated and do not have a significant nexus with a downstream receiving water.

However, the final authority over whether a wetland is jurisdictional lies with the USACE.

3.5 Wetland Impacts

This report serves as a baseline inventory of the existing wetlands at the Pony Placer Claim and for a portion of the Upper Claims mine claim. Wetland impacts were not calculated for this report since no particular ground disturbance activities have been proposed. Additionally, wetland functional assessments were not conducted, as no mining activities have been proposed at the two mine claims.

4.0 REFERENCES

Cowardin, L. M., Carter, V., Golet, F. C., and LaRoe, E. T. 1979. Classification of Wetlands and Deepwater Habitats of the United States, FWS/OBS79/31, US Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

GretagMacbeth. 2000. Munsell® Color. New Windsor, NY.

Natural Resources Conservation Service. 2010. Soils mapping of Butte Highlands Project Area. Available at http://websoilsurvey.nrcs.usda.gov/app/. Accessed October 2010.

National Wetland Inventory. 2009. National Wetland Inventory maps of Montana. Available at http://wetlandsfws.er.usgs.gov/wtlnds/launch.html. Accessed October 2010.

Reed, P.B., Jr. 1993. Supplement to National list of plant species that occur in wetlands: Northwest (Region 9). U.S. Fish Wildl. Serv. Biol. Rep. 88(26.9). 89 pp.

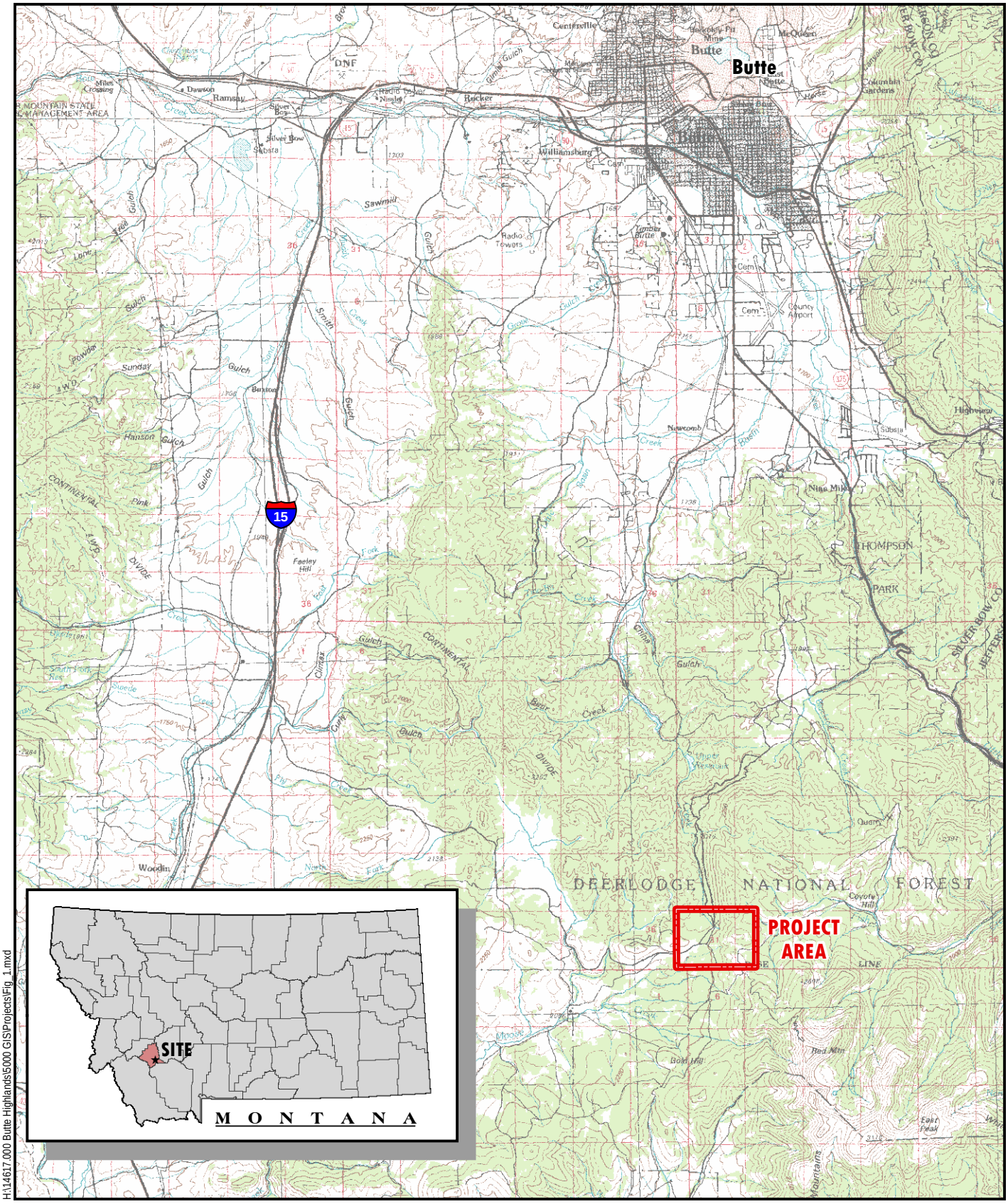
Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: Northwest (Region 9). U.S. Fish Wildl. Serv. Biol. Rep. 88(26.9). 89 pp.

U.S. Army Corps of Engineers. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)*, ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-10-3. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

U.S. Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Waterways Experiment Station Technical Report Y-87-1.

U.S. Geological Survey. 1996. Mt. Humbug, Montana 7.5 minute series topographical map.

FIGURES



H:\14617.000 Butte Highlands\5000 GIS\Projects\Fig_1.mxd

N

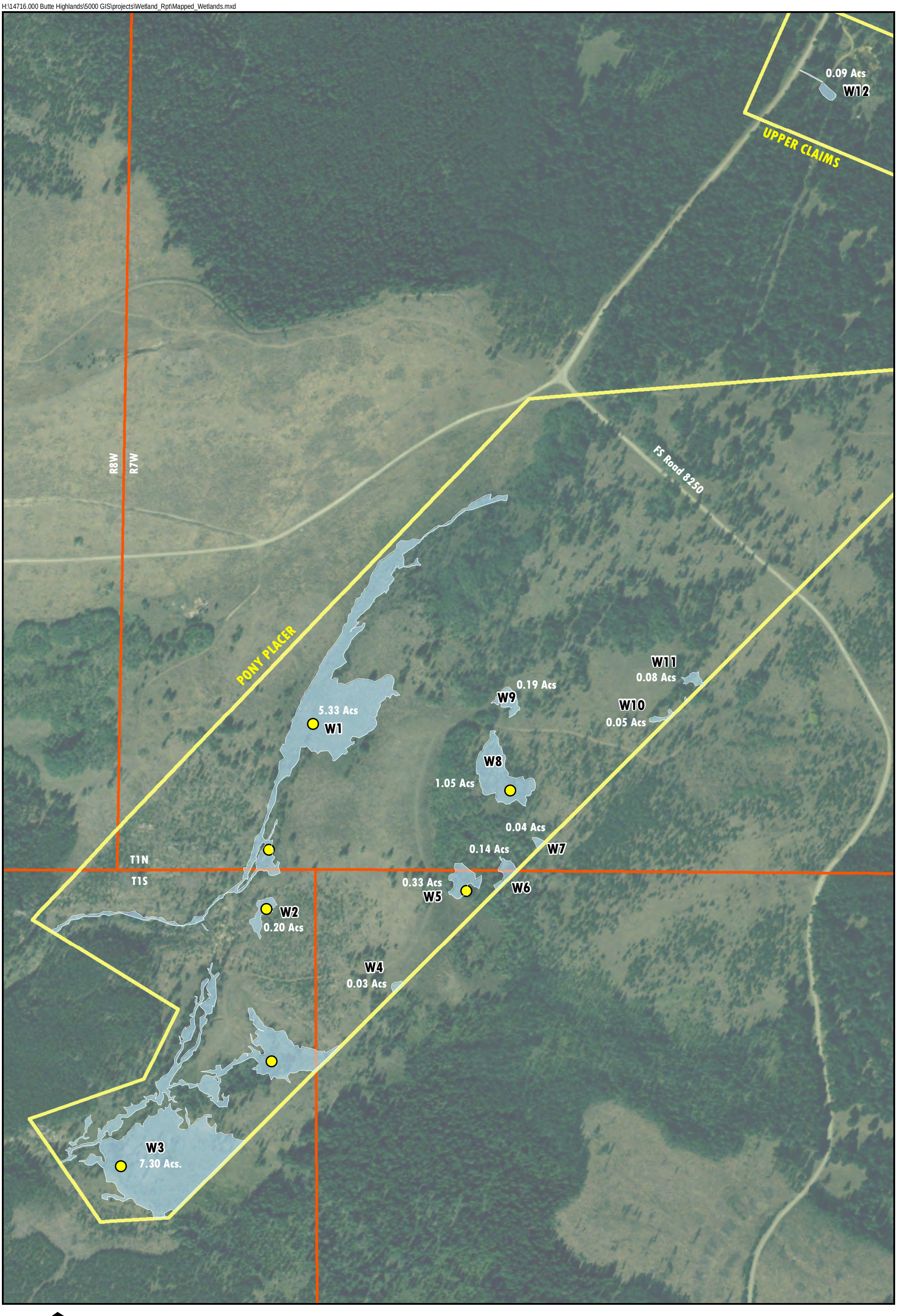
0 3

Miles

AMEC Geomatrix

Location Map
Butte Highlands Project
Silver Bow County, Montana
FIGURE 1

H:\14716.000 Butte Highlands\5000 GIS\projects\Wetland_Rpt\Mapped_Wetlands.mxd



N

0 Feet 500

AMEC Geomatrix

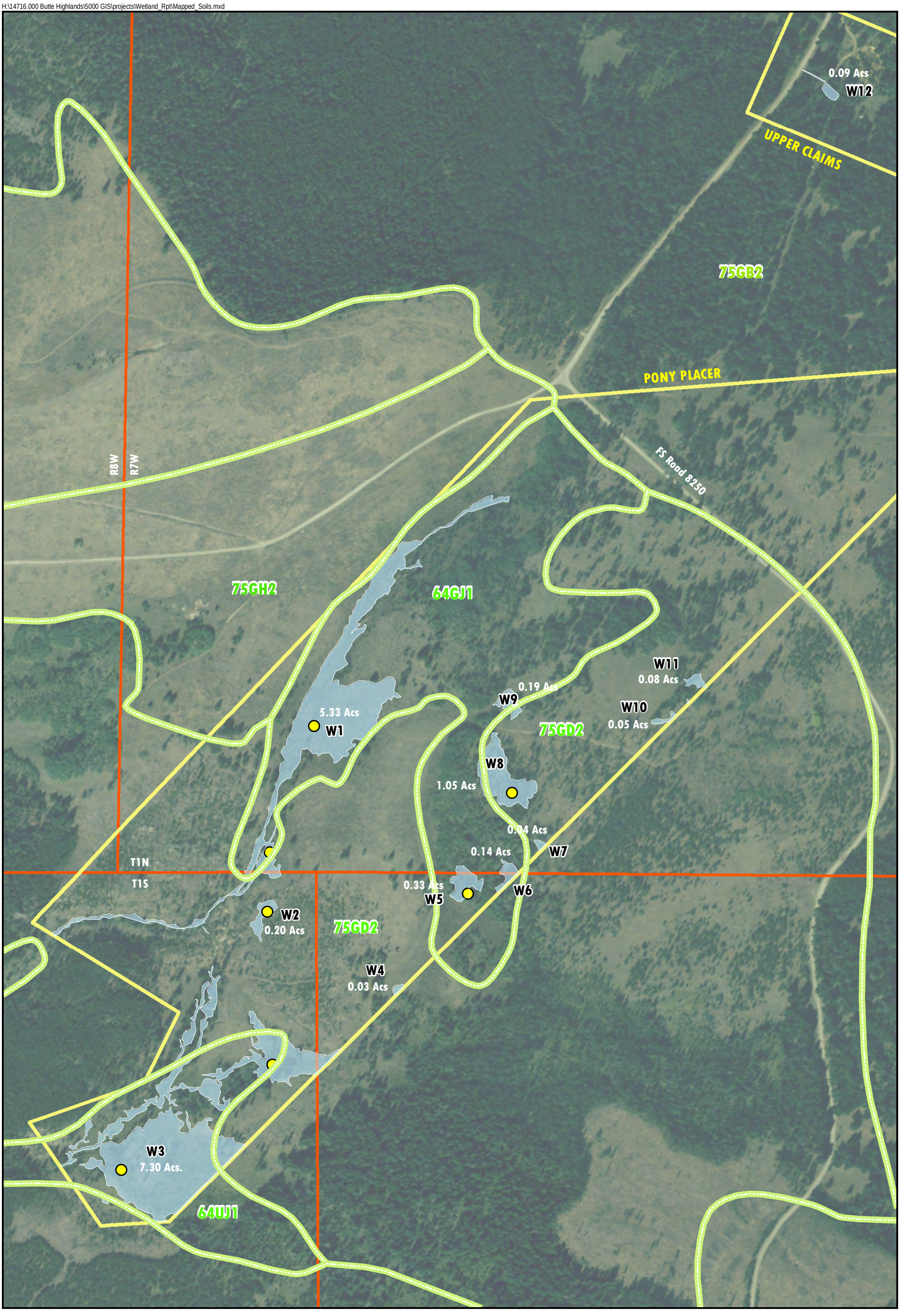
Soil Sample Location

Mapped Wetlands

Claim Boundary

Mapped Wetlands - October 2010
Butte Highlands Project
Silver Bow County, Montana
FIGURE 2

H:\14716.000 Butte Highlands\5000 GIS\projects\Wetland_Rpt\Mapped_Soils.mxd



N

0 Feet 500

AMEC Geomatrix

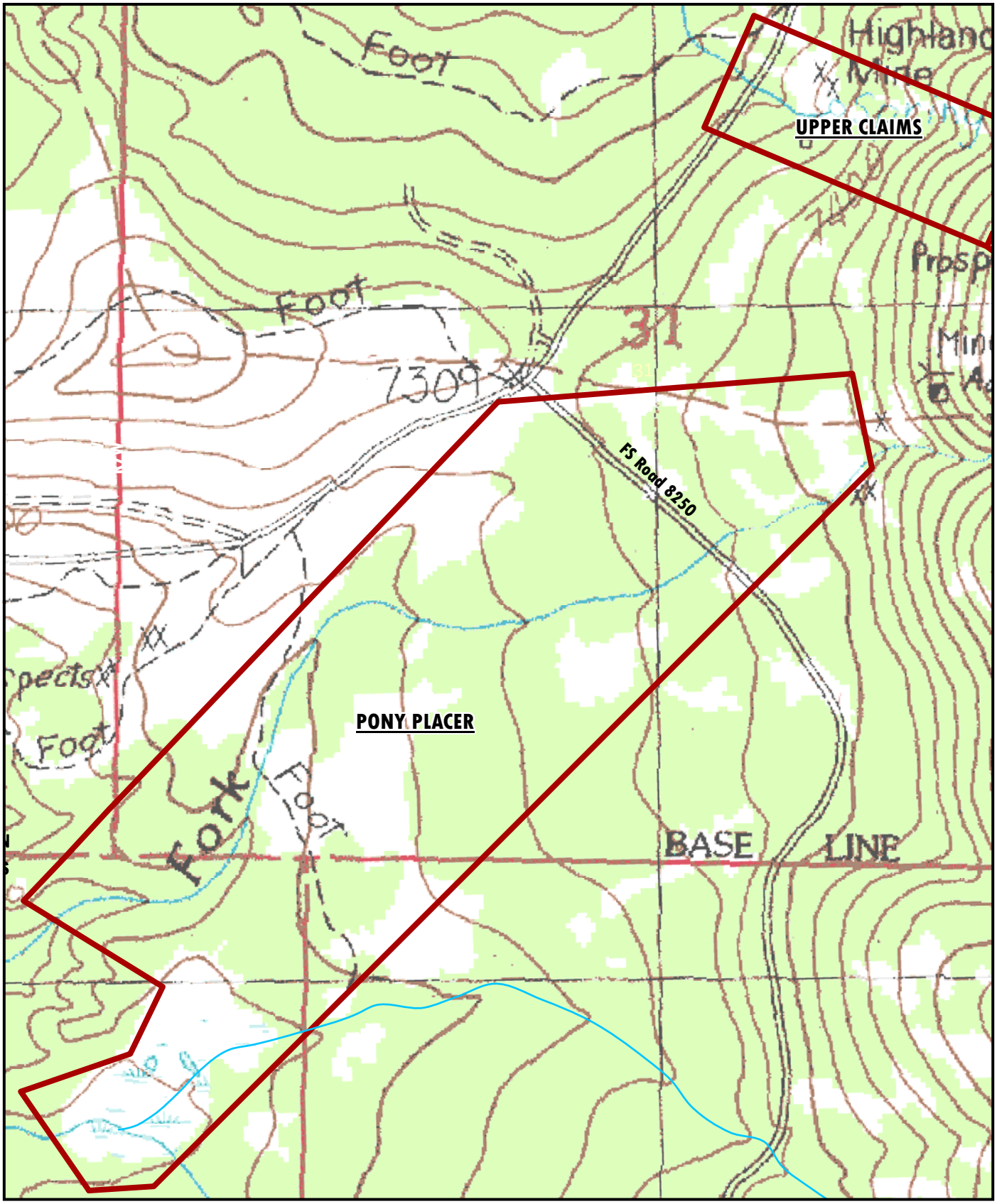
Soil Sample Location

SSURGO Soil Type (NRCS)

Mapped Wetlands

Claim Boundary

NRCS Mapped Soils
Butte Highlands Project
Silver Bow County, Montana
FIGURE 3



N

0 Feet 1,000

Claim Boundary

AMEC Geomatrix

Topographic Basemap
Butte Highlands Project
Silver Bow County, Montana
FIGURE 4

APPENDICES

APPENDIX A

Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silver Bow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W1
Investigator(s): K. Eakin - AMEC E&E Section, Township, Range: 31, T1N, R7W
Landform (hillslope, terrace, etc.): drainage Local relief (concave, convex, none): Concave Slope (%): ~2%
Subregion (LRR): Rocky Mtn. Forests & Rangeland Lat: 45.78796 Long: -112.52591 Datum: NAD 83
Soil Map Unit Name: Cryofluvents - Finn Family - Water Complex (64GJ) NWI classification: PEMC/PSSC
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)
Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____
Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	Is the Sampled Area within a Wetland? Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	12	Y	FACW
2. Salix boothii	12	Y	OBL
3. Alnus incana	6	Y	FACW
4.			
5.			
	30 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	20	Y	OBL
2. Carex nebrascensis	20	Y	OBL
3. Carex simulata	15	Y	OBL
4. Juncus balticus	10	N	FACW
5. Glyceria grandis	8	N	OBL
6. Calamagrostis canadensis	8	N	FACW
7. Glyceria striata	6	N	OBL
8.			
9.			
10.			
11.			
	87 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)
Total Number of Dominant Species Across All Strata: 6 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:
✓ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)
[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
Pit 2	0-4	10YR3/1						silt loam	organic material layer,
	4-10	10YR4/1		10YR4/6	10	D	M	sandy loam	organics mixed w/ mineral soil
	10-20	10YR2/1						silty clay loam	dark mineral soil
Pit 1	0-7	10YR2/1						silt loam	organic material layer
	7-12	10YR5/2				D	M	sandy loam	lots of rock/cobble/sand. Refusal @ 12" due to rock/cobble substrate

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: Rock/cobble
Depth (inches): ~12"
Pit #1 only

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ✓ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 3
Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface
Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Middle Fork Moose Creek with perennial surface water flow

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W2
Investigator(s): K. Eakin – AMEC Section, Township, Range: 31; T1N; R7W
Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope (%): ~2%
Subregion (LRR): Rocky Mtn Forests & Rangeland Lat: 45.78544 Long: -112.52688 Datum: NAD83
Soil Map Unit Name: Kiwale-Goloflint-Warwood families, complex NWI classification: PEMB/PSSB
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	10	Y	FACW
2. Salix boothii	10	Y	OBL
3.			
4.			
5.			
	20 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex nebrascensis	35	Y	OBL
2. Juncus balticus	30	Y	FACW
3. Juncus nevadensis	20	N	FACW
4. Juncus longistylis	15	N	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)
Total Number of Dominant Species Across All Strata: 4 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	____	x 1 = ____
FACW species	____	x 2 = ____
FAC species	____	x 3 = ____
FACU species	____	x 4 = ____
UPL species	____	x 5 = ____
Column Totals:	____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
✓ 1 - Rapid Test for Hydrophytic Vegetation
__ 2 - Dominance Test is >50%
__ 3 - Prevalence Index is ≤3.0[1]
__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ 5 - Wetland Non-Vascular Plants[1]
__ Problematic Hydrophytic Vegetation[1] (Explain)
[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/1						silty clay loam	minor amount of mineral soil mixed in
0-8	10YR 3/1							organic material layer (majority)
8-19	10YR 3/2		10YR 4/6	10	D	M	sandy loam	Rock/cobble/sand

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 1

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Soils saturated to surface with some standing water (~1") water in soil pit to the surface

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W3
Investigator(s): K. Eakin - AMEC Section, Township, Range: 1, T 1S, R8W
Landform (hillslope, terrace, etc.): drainage Local relief (concave, convex, none): Concave Slope (%): ~2
Subregion (LRR): Rocky Mtn. Forests & Rangeland Lat: 45.78235 Long: -112.52822 Datum: NAD83
Soil Map Unit Name: Finn-Lowden-Dunkleberg families, Complex NWI classification: PEMB/PSSB/PFOB
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	30	Y	FAC
2.			
3.			
4.			
	30 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	15	Y	FACW
2.			
3.			
4.			
5.			
	15 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	50	Y	OBL
2. Juncus balticus	25	Y	FACW
3. Calamagrostis canadensis	20	Y	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	95 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)
Total Number of Dominant Species Across All Strata: 5 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

	Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
Pit	0-8	10YR 2/1	90					silty clay loam	organic material layer
	0-8	10YR 2/1	10				M	silty clay loam	
	8-21	10YR 2/1	100	10YR 5/6	10	C	M	silty clay	sandstone like concretions in matrix
Pit –	0-22	10YR 2/1						silty clay loam	organic material dominant throughout horizon. (Histosol)

Histic epipe

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ✓ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks: Water in soil pit to surface

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ✓ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ✓ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 3

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Wetland saturated to the surface
Areas of inundation throughout wetland

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010

Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W4

Investigator(s): K. Gakin - AMEC Section, Township, Range: 6, T15, R7W

Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): Concave Slope (%): <1

Subregion (LRR): Rocky Mtn. Forests & Range Lat: 45.78444 Long: -112.52444 Datum: NAD 83

Soil Map Unit Name: Kuhrie-Golotlint-Wallwood families, complex NWI classification: PEM1B / PSS1B

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	10	Y	FACW
2. Salix boothii	10	Y	OBL
3.			
4.			
5.			
	20 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex nebrascensis	40	Y	OBL
2. Juncus balticus	22	Y	FACW
3. Carex lasiocarpa	15	Y	OBL
4. Geum macrophyllum	12	N	FACW
5. Calamagrostis canadensis	10	N	FACW
6.			
7.			
8.			
9.			
10.			
11.			
	99 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

✓ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ 5 - Wetland Non-Vascular Plants[1]

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR2/1						silty clay/pm	bluish colored soil
10-21	10YR2/1		10YR5/6	10	D	M	silty clay	" "

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 6" bgs

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W5
Investigator(s): K. Eakin – AMEC Section, Township, Range: 6, T1S, R7W
Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): concave Slope (%): <1
Subregion (LRR): Rocky Mtn. Forests & Rangeland Lat: 45.78579 Long: -112.52319 Datum: NAD83
Soil Map Unit Name: Cryofluvents-Finn Family-Water Complex (64GJ) NWI classification: PEMB/PFOB
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)
Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____
Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	70	Y	FAC
2.			
3.			
4.			
	70 = Total Cover		

Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		

Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	25	Y	OBL
2. Carex lasiocarpa	20	Y	OBL
3. Juncus balticus	15	Y	FACW
4. Glyceria striata	8	N	OBL
5. Epilobium ciliatum	5	N	FACW
6. Calamagrostis canadensis	5	N	FACW
7.			
8.			
9.			
10.			
11.			
	78 = Total Cover		

Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)
Total Number of Dominant Species Across All Strata: 4 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:
___ 1 - Rapid Test for Hydrophytic Vegetation
✓ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)
[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/1						silt loam	organic material layer
10-22	10YR 2/1						silty clay loam	gleys AND gray sand lenses thru out horizon. (not able to characterize the colors of these features) (blackish mineral soil)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ✓ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 3

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W6
Investigator(s): K. Eakin – AMEC Section, Township, Range: 31, T1N, R7W
Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): Concave Slope (%): <1
Subregion (LRR): Rocky Mtn. Forests & Rangeland Lat: 45.78599 Long: -112.52242 Datum: NAD83
Soil Map Unit Name: Cryofluvents – Fink Family – Water Complex (64GJ) NWI classification: PEMB / PFOB
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)
Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____
Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	25	Y	FAC
2. Populus tremuloides	10	Y	FAC
3.			
4.			
	35 = Total Cover		

Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		

Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	40	Y	OBL
2. Carex lasiocarpa	25	Y	OBL
3. Carex aquatilis	20	Y	OBL
4. Glyceria striata	12	N	OBL
5. Geum macrophyllum	8	N	FACW
6. Calamagrostis canadensis	8	N	FACW
7.			
8.			
9.			
10.			
11.			
	113 = Total Cover		

Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)
Total Number of Dominant Species Across All Strata: 5 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:
___ 1 - Rapid Test for Hydrophytic Vegetation
✓ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)
[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/1						silt loam	organic material layer
10-22	10YR 2/1						silty clay loam	gray gleyed sand lenses throughout horizon (Not able to characterize the colors of these features) (Blackish colored soil)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) (LRR A)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (LRR A)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 2

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Sampling Date: 10/11/2010

Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W7

Investigator(s): K. Eakin - AMEC Section, Township, Range: 31, T1N, R7W

Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): Concave Slope (%): <1

Subregion (LRR): Rocky Mtn. Forests & Rangeland Lat: 45.78648 Long: -112.52177 Datum: NAD83

Soil Map Unit Name: Kanie-Goloflint-Wanwood families, complex (75GD2) NWI classification: PEMB / PFOB

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	25	Y	FAC
2. Populus tremuloides	10	Y	FAC
3.			
4.			
	35 = Total Cover		

Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	____ = Total Cover		

Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	30	Y	OBL
2. Carex lasiocarpa	25	Y	OBL
3. Carex aquatilis	20	Y	OBL
4. Glyceria striata	10	N	OBL
5. Geum macrophyllum	8	N	FACW
6. Calamagrostis canadensis	8	N	FACW
7.			
8.			
9.			
10.			
11.			
	101 = Total Cover		

Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR2/1						silt loam	organic material layer
10-22	10YR2/1						silty clay loam	gray gleying! SAND lenses thru out horizon.
								(not able to characterize the colors of the se features)
								(Black soils)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ✓ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 2

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010

Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W8

Investigator(s): K. Eakin – AMEC Section, Township, Range: 31, T1N, R7W.

Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): CONCAVE Slope (%): <1

Subregion (LRR): Rocky Mtn. Foothills & Rangeland Lat: 45.78731 Long: -112.52267 Datum: NAD83

Soil Map Unit Name: Kuvale – Golo flint – Warwood families, complex (75GD2) NWI classification: PEMB/PSSB/PFOB

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' RADIUS)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	20	Y	FAC
2.			
3.			
4.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' RADIUS)			
1. Salix drummondiana	20	Y	FACW
2. Salix bebbii	15	Y	OBL
3. Potentilla fruticosa	15	Y	FAC
4.			
5.			
	50 = Total Cover		
Herb Stratum (Plot size: 5' RADIUS)			
1. Carex utriculata	45	Y	OBL
2. Juncus balticus	25	Y	FACW
3. Poa palustris	15	N	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	85 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/1						silty clay loam	Black mineral soil
10-21	10YR 2/1		10YR 5/6	10	D	M	silty clay	Black mineral soil

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 4 below surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W9
Investigator(s): K. Eakin – AMEC Section, Township, Range: 31, T1N, R7W
Landform (hillslope, terrace, etc.): berm Local relief (concave, convex, none): concave Slope (%): <1
Subregion (LRR): Rocky Mtn. Forest & Rangelands Lat: 45.78811 Long: -112.52261 Datum: NAD83
Soil Map Unit Name: Cryofluvents – Finn Family – Water Complex (64GJ) NWI classification:
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	40	Y	FAC
2. Populus tremuloides	10	Y	FAC
3.			
4.			
	50	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix boothii	15	Y	OBL
2. Salix drummondiana	10	Y	FACW
3.			
4.			
5.			
	25	= Total Cover	

Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	36	Y	OBL
2. Carex lasiocarpa	26	Y	OBL
3. Juncus balticus	20	Y	FACW
4. Epilobium ciliatum	12	N	FACW
5. Calamagrostis canadensis	12	N	FACW
6.			
7.			
8.			
9.			
10.			
11.			
	106	= Total Cover	

Woody Vine Stratum (Plot size: ____)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 7 (A)
Total Number of Dominant Species Across All Strata: 7 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR2/1						silty clay loam	Black mineral soil
10-21	10YR2/1		10YR5/6	10	D	M	silty clay	" "

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010
Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W10
Investigator(s): K. Eakin - AMEC Section, Township, Range: 31, T1N, R7W
Landform (hillslope, terrace, etc.): drainage Local relief (concave, convex, none): Concave Slope (%): ~5
Subregion (LRR): Rocky Mtn. Forest & Range lands Lat: 45.78799 Long: -112.51962 Datum: NAD 83
Soil Map Unit Name: Kurnie-Coloflint-Warwood families, complex (75GD2) NWI classification: PEMB/PSSB/PFOB
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	10	Y	FAC
2.			
3.			
4.			
	10 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	10	Y	FACW
2. Salix boothii	10	Y	OBL
3.			
4.			
5.			
	20 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	27	Y	OBL
2. Carex nebrascensis	22	Y	OBL
3. Carex lasiocarpa	17	Y	OBL
4. Juncus balticus	13	N	FACW
5. Epilobium ciliatum	7	N	FACW
6. Calamagrostis canadensis	7	N	FACW
7.			
8.			
9.			
10.			
11.			
	93 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)
Total Number of Dominant Species Across All Strata: 6 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR2/1						silt loam	Black mineral soil
10-22	10YR2/1						silty clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ✓ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 1

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Ponding occurs in depressional areas

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010

Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W11

Investigator(s): K. Eakin – AMEC Section, Township, Range: 31, T1N, R7W

Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): Concave Slope (%): ~5

Subregion (LRR): Rocky Mtn. Forest & Rangelands Lat: 45.78845 Long: -112.51895 Datum: NAD83

Soil Map Unit Name: Kunnie – Goloflint – Warwood families, complex (75GD2) NWI classification: PEMB/PSSB/PFOB

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	8	Y	FAC
2.			
3.			
4.			
	8 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	8	Y	FACW
2. Salix boothii	6	Y	OBL
3.			
4.			
5.			
	14 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	20	Y	OBL
2. Carex nebrascensis	18	Y	OBL
3. Carex lasiocarpa	15	Y	OBL
4. Juncus balticus	10	N	FACW
5. Geum macrophyllum	6	N	FACW
6. Epilobium ciliatum	6	N	FACW
7. Calamagrostis canadensis	6	N	FACW
8.			
9.			
10.			
11.			
	81 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ✓ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: W11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/1	100					silt loam	Black mineral soil
10-22	10YR 2/1	100					silty clay loam	" "

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 2

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Butte Highlands Mine City/County: Silverbow Co. Sampling Date: 10/11/2010

Applicant/Owner: Butte Highlands Joint Venture State: MT Sampling Point: W12

Investigator(s): K. Eakin - AMEC Section, Township, Range: 31, T1N, R7W

Landform (hillslope, terrace, etc.): Drainage on slope Local relief (concave, convex, none): Con Cave Slope (%): >10%

Subregion (LRR): Rocky Mtn. Forest & Rangeland Lat: 45.79598 Long: -112.51656 Datum: NAD83

Soil Map Unit Name: Windy Ridge-Cosmo-Hiore families, complex (75GB2) NWI classification: PEMB/PSSB/PFOB

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? NA Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? NA (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____	**Is the Sampled Area within a Wetland?** Yes ✓ No ____
Hydric Soil Present?	Yes ✓	No ____	
Wetland Hydrology Present?	Yes ✓	No ____	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Picea engelmannii	40	Y	FAC
2.			
3.			
4.			
	40 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15' radius)			
1. Salix drummondiana	20	Y	FACW
2. Salix boothii	18	Y	OBL
3.			
4.			
5.			
	38 = Total Cover		
Herb Stratum (Plot size: 5' radius)			
1. Carex utriculata	26	Y	OBL
2. Juncus balticus	16	Y	FACW
3. Calamagrostis canadensis	14	Y	FACW
4. Epilobium ciliatum	8	N	FACW
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	64 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: W12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Rock/cobble (see Remarks)

Depth (inches): 4

Hydric Soil Present? Yes ✓ No ___

Remarks:

Thin layer of soil AND ROOT MATS (mostly organic material) over Rock/cobble substrate, no success in finding suitable location for soil pit. Used best professional judgement to determine presence of hydric soil.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ✓ High Water Table (A2)
- ✓ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) **(except MLRA 1, 2, 4A, and 4B)**
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Stunted or Stressed Plants (D1) **(LRR A)**
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) **(MLRA 1, 2, 4A, and 4B)**
- ✓ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) **(LRR A)**
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ✓ No ___ Depth (inches): 3

Water Table Present? Yes ✓ No ___ Depth (inches): 0 at surface

Saturation Present? (includes capillary fringe) Yes ✓ No ___ Depth (inches): 0 at surface

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Headwaters of Basin Creek with spring seeps throughout wetland area on steep slope.

APPENDIX B

Wetland Photographs

Wetland 1 – Looking south from headwaters of Middle Fork Moose Creek.

Wetland 1 – Looking north along Middle Fork Moose Creek.

Wetland 1 – Soil plug from soil pit along Middle Fork Moose Creek.

Wetland 1 – Soil pit along Middle Fork Moose Creek.

Wetland 2 – Looking east from west edge of wetland.

Wetland 2 – Soil plug from pit at Wetland 2.

Wetland 3 – Looking south at large sedge/spruce meadow at south end of wetland.

Wetland 3 – Looking northeast at sedge community along banks of unnamed perennial tributary to Middle Fork Moose Creek.

Wetland 3 – Soil plug from soil pit at Wetland 3. The soil is considered a histosol (organic soil).

Wetland 4 – Looking east from west edge of wetland.

Wetland 5 – Looking south from soil pit location.

Wetland 5 – Soil plug from soil pit at Wetland 5.

Wetland 6 – Looking west at sedge community among aspen dead fall.

Wetland 7 – Looking east at Engelmann spruce and dead aspen trees.

Wetland 8 – Looking south at Engelmann spruce overstory and willow shrub community.

Wetland 9 – Looking north from south edge of wetland.

Wetland 10 – Looking south at depressional area from north edge of wetland.

Wetland 11 – Looking west from east edge of wetland.

Wetland 12 – Looking east (upslope) at wetland along channel of Basin Creek on left side of photo.

Review of Existing Wildlife Data and July 2009 Wildlife and Habitat Observations for the Butte Highlands Project

Kline Environmental Research, LLC
2041 120th St.
Milltown, WI 54858
715-857-5537
edkline@lakeland.ws

and

Klepfer Mining Services, LLC
13058 Sherwood Court
Hayden Lake, ID 83835
208-772-6993
eric@klepfermining.com

January 14, 2010

Table of Contents

Section	Page
1.0 Introduction	1
2.0 Existing Information	1
3.0 Methods	1
4.0 Results and Discussion	2
4.1 General Habitat Descriptions	2
4.2 Potential Species Occurrence	4
4.3 July 2009 Observations	6
5.0 References	6

Table

1. Wildlife species whose range includes the Butte Highlands Project area that have special state or federal designations.

Figures

1. Project location map.
2. Habitat type map.
3. Wildlife sightings, July 2007.

Photographs

Photographs taken during July 2009 in the Butte Highlands Project area.

Appendices

A. Vertebrate species whose range includes the Butte Highlands Project area based on distribution maps in the Montana Field Guide.
B. State and federal wildlife designation descriptions.
C. Wildlife distribution maps.
D. Canada lynx critical habitat.

1.0 Introduction

The Butte Highlands Project is a proposed underground gold mine located in Silver Bow County, Montana, approximately 15 miles south of Butte (Figure 1). The Project straddles the Continental Divide within the upper portion of the drainages of Basin Creek, Fish Creek, and Middle Fork Moose Creek (Figure 2). The objectives of this report were to:

- Summarize existing information pertaining to wildlife in the Project area;
- Document wildlife observations that were made while conducting stream and wetland surveys during July 2009.

2.0 Existing Information

The following information sources were investigated:

1. Montana Natural Heritage Program
   (http://mtnhp.org/default.asp)
2. Montana Department of Fish, Wildlife, and Parks
   (http://fwp.mt.gov/doingBusiness/reference/gisData/download.aspx)
3. Montana Field Guide
   (http://fieldguide.mt.gov/)
4. U.S. Fish and Wildlife Service
   (http://www.fws.gov/mountain-prairie/mt.html).
5. A search of the Montana Department of Environmental Quality web site and a keyword internet search using the names of previous operators and local geographic descriptors did not provide additional information.

3.0 Methods

The Montana Field Guide included maps of distribution for vertebrate species that occur in the state. Using these maps, a list of all vertebrate species that could potentially occur at the Project site and species conservation status was compiled (Appendix A). The potential status of species

included exotic species, MT Species of Concern, MT Comprehensive Fish and Wildlife Conservation Strategy status, Partners in Flight status, and designations of the U.S. Fish and Wildlife Service (FWS), Forest Service (FS), and Bureau of Land Management (BLM) (Appendix B). The Montana Department of Fish, Wildlife, and parks web site also included distribution maps for some species (Appendix C).

Many of the species whose reported range included the Project area may be determined to be unlikely to occur on the site if their required habitat types are not found in the Project area. Although no specific efforts were made to document wildlife sign or habitat during field work that was conducted during July 2009, general habitat observations allowed many species to be omitted from the list of potential species in the Project area. Several wildlife sightings were also noted.

4.0 Results and Discussion

4.1 General Habitat Descriptions

The Project area includes a mosaic of forested and non-forested habitats (Figure 2). Forested portions are dominated by fir, pine, and spruce. Unforested areas are densely to moderately vegetated with a variety of shrubs, forbs, and grasses. The Pony Placer claim is mainly unforested and gently sloping with scattered, wet meadows and stands of aspen and spruce. Riparian wetlands exist along reaches of Middle Fork Moose Creek and tributaries that flow through the claim. Cattle were grazing in much of the Pony Placer claim during July 2009. The Main Ripple claim is steep, forested mainly with conifers, and includes the origin of Basin Creek, but does not include significant riparian habitat. The other claims are mainly steep, have no wetland or stream habitat, and conifer coverage ranging from sparse to dense.

Lesica (1993) offered the following description of the Project area.

> "Vegetation of the Highland Mountains is predominantly coniferous forest dominated by Douglas fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta*). Spruce (*Picea engelmannii*) is common along streams and higher cool slopes. Whitebark pine (*Pinus albicaulis*) dominates subalpine and timberline forests. Limber pine (*P. flexilis*) is locally

common on outcrops of calcareous parent material in the Moose Town and Fish Creek areas. Where granite is the parent material, coniferous forest generally dominates all aspects (narrow mesas above Hells Canyon Creek are an exception). On soils derived from metasediments, steppe dominated by sagebrush (*Artemisia tridentate*), rabbit brush (*Chrysothamnus* spp.), shrubby cinquefoil (*Potentilla fruticosa*) and Idaho fescue (*Festuca idahoensis*), occurs on warm slopes. Meadows dominated by tufted hairgrass (*Deschampsia cespitosa*) and sedges (*Carex* spp.) are common in Moose Town and Burton Park. Swamp and carr vegetation dominated by bog birch (*Betula glandulosa*) and willows (*Salix* spp.) are found along many drainages and in large areas of Moose Town. Groves of aspen (*Populus tremuloides*) occur sporadically in the Moose Town area."

Lesica (1993) continued:

"The Highland Mountains have been greatly impacted by human use. The area was the scene of a great deal of mining exploration. There are numerous old mines and associated roads in the Moose Town and Fish Creek areas. Concentrations of precious metals are presumably associated with the contact zone between the Belt sediments and the granite batholith. There is an active mining operation near the head of Fish Creek. Wherever steppe or meadows are the predominant vegetation, cattle grazing is a common use of the land. Douglas fir composing much of the forests are short and deformed, but some areas of lodgepole pine forest have been clearcut. In addition, some trees have been harvested for firewood and lumber during the times when the area was a more active mining district. The Highland Mountains-Moffet Mountain-Moose Town area is a very productive wildlife area. I observed large numbers of elk, moose, deer, bighorn sheep and mountain goats. As a result, the area is heavily used by hunters during the fall. There is a good deal of recreational driving both on and off roads during the summer. The area is undoubtedly used by snowmobilers during the winter."

The Project area is within the Elkhorn Mountains-Boulder Batholith Ecoregion (Ecoregion number 17ai). Ecoregions are areas of general similarity in factors that affect ecosystems, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.

The following description is specific to Ecoregion 17ai from a University of Montana - Missoula web site.

> "The mostly forested Elkhorn Mountains-Boulder Batholith ecoregion straddles the Continental Divide and is underlain by Cretaceous and Tertiary intrusive and extrusive rocks; areas of unique boulder-strewn topography occur and are composed of erosion-prone andesitic rocks. Ecoregion 17ai is lithologically distinct from the neighboring Precambrian Belt rocks of the Eastern Divide Mountains (17aj) and the Southern Garnet Sedimentary-Volcanic Mountains (17al). Both mining and related environmental impacts are common and most of the major known deposits of copper, zinc, lead, silver, and gold in Montana are associated with the Boulder Batholith. Annual precipitation is much less than in the mountains to the northwest and averages 12 to 30 inches. The mapped climax vegetation is subalpine fir and Douglas-fir forests and is distinct from the Douglas-fir and ponderosa pine forests of the neighboring Eastern Divide Mountains (17aj) and the treeless Townsend Basin (17w) and Deer Lodge-Phillipsburg-Avon Grassy Intermontane Hills and Valleys (17ak). Logging, mining, and recreation are the common land uses."

The following description is specific to Ecoregion 17 from a U.S. Environmental Protection Agency web site.

> "The climate of Ecoregion 17 lacks the strong maritime influence of Ecoregion 15. Mountains have Douglas-fir, subalpine fir, and Engelmann spruce forests and alpine areas. Pacific tree species such as grand fir, western hemlock, and western redcedar are never dominant and forests can have open canopies. Foothills are partly wooded or shrub- and grass-covered. Intermontane valleys are grass and/or shrub-covered and contain a mosaic of terrestrial and aquatic fauna that is distinct from nearby mountains. Many mountain-fed streams occur. Granitics and associated management problems are less extensive than in Ecoregion 16. Recreation, logging, mining, and summer livestock grazing are common land uses; summer livestock grazing also occurs and is more common than in Ecoregion 15. In Montana, Ecoregion 17 has been divided into 32 level IV ecoregions (17d–17j, 17l, 17m, 17p–17ac, 17ae–17am) that separate areas of significantly different rock type, climate, water quality, and/or terrain. The Absaroka, Madison, and Gallatin ranges are

much wetter than other portions of the Middle Rockies (17). High elevations are treeless, typically snow- and ice-covered, and can be lake-studded. Ecoregion 17's carbonate, igneous, and metamorphic rocks strongly influence hydrological characteristics, fish assemblages, and stream quality."

4.2 Potential Species Occurrence

Based on the Montana Field Notebook distribution maps, the Project area is within the range of 3 amphibian species, 285 bird species, 78 mammal species, and 7 reptile species (Appendix A). This list was reduced to 18 species that have special conservation status and habitat requirements that may occur in the immediate Project area (Table 1). Examples of habitat requirements, based on the Montana Field Notebook, that do not occur in the Project area and were used to exclude some species from Table 1 are large bodies of water, agricultural fields, cliffs above timberline, and beaches.

As of September 2009 (see http://fwp.mt.gov/content/getItem.aspx?id=25796), the only animal species listed under the Endangered Species Act as endangered, threatened, proposed, or candidate in Silver Bow county, where the Project is located, was bull trout (*Salvelinus confluentus*, listed threatened). The nearest neighboring county to the Project is Madison county, where Canada lynx (*Lynx canadensis*) and grizzly bear (*Ursus arctos horribilis*) are listed as threatened. The distribution map in the Montana Field Guide indicated that the Project area is within the year-round range of Canada lynx and the historic range of grizzly bear (Appendix C). The September 2009 USFWS update states that the list "…identifies the counties where one would reasonably expect the species to occur…". Apparently, different criteria were used for the Montana Field Guide distribution maps for Canada lynx. Silver Bow County does not include critical habitat for Canada lynx (Appendix D).

4.3 July 2009 Observations

The following observations were made during July 2009 by Ed Kline (Figure 1). Nest or brood protection behavior was displayed by a ruffed grouse (*Bonasa umbellus*), redwing blackbird (*Agelaius phoeniceus*), and green wing teal (*Anas crecca*) near or within the Pony Placer claim. A western toad (*Bufo boreas*) and Columbia spotted frog (*Rana luteiventris*) were seen in upper Middle Fork Moose Creek near or within the Pony Placer claim (Photographs 1 and 2). A mule deer (*Odocoileus hemionus*) buck and antlerless mule deer were seen in the Red Mountain claim (Photographs 3 and 4). A herd of elk (*Cervus canadensis*) was seen near the Pony Placer claim (Photograph 5). A gray wolf (*Canis lupus*) or domestic canine paw track was seen near the Murphy claim (Photograph 6).

5.0 References

Lesica, P. 1993. Vascular plant and sensitive plant species inventory for the Highland Mountains, Deerlodge National Forest, Montana. Montana Natural Heritage Program. Helena, MT. 20 pp. plus appendix.

Montana Field Guide
http://fieldguide.mt.gov/

U.S. Environmental Protection Agency
ftp://ftp.epa.gov/wed/ecoregions/mt/mt_front_1.pdf)

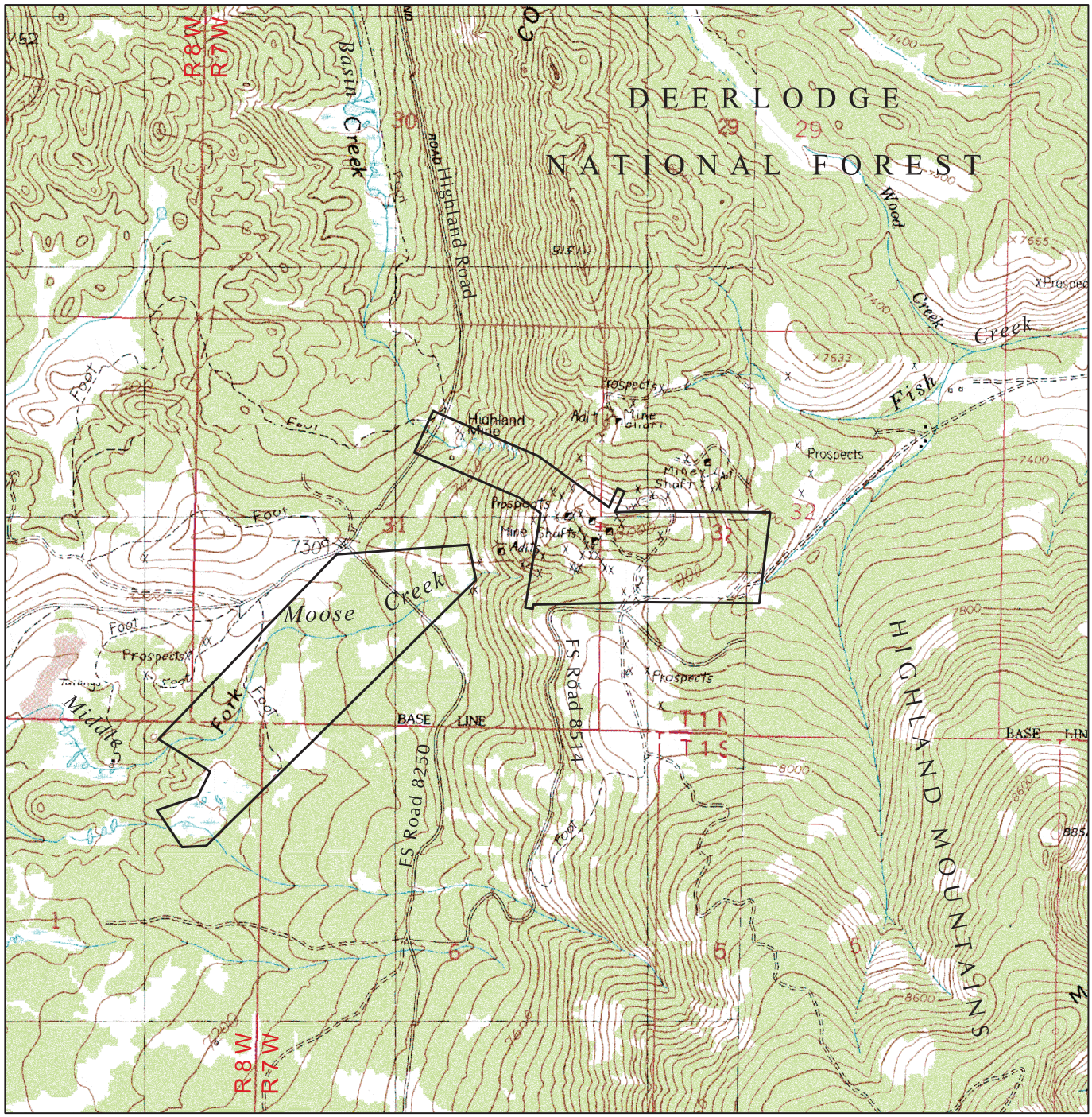
U.S. Fish and Wildlife Service
http://fwp.mt.gov/content/getItem.aspx?id=25796

University of Montana - Missoula.
http://nhguide.dbs.umt.edu/index.php?c=habitats&m=wmt_ecoregions_desc

Table 1. Wildlife species that may occur in the Butte Highlands Project area and have special state or federal designations.

Class	Common name	Genus species	Range	MT rank*	USFWS	USFS	BLM
amphibian	western toad	Bufo boreas	year-round	S2		sensitive	sensitive
bird	Cassin's finch	Carpodacus cassinii	year-round	S3			
	northern goshawk	Accipiter gentilis	year-round	S3			sensitive
	golden eagle	Aquila chrysaetos	year-round	S3			sensitive
	great blue heron	Ardea herodias	year-round	S3			
	pinyon jay	Gymnorhinus cyanocephalus	year-round	S3			
	Clark's nutcracker	Nucifraga columbiana	year-round	S3			
	flammulated owl	Otus flammeolus	summer	S3B		sensitive	sensitive
	mountain plover	Charadrius montanus	summer	S2B			sensitive
	grasshopper sparrow	Ammodramus savannarum	summer	S3B			
	pileated woodpecker	Dryocopus pileatus	year-round	S3			
	black-backed woodpecker	Picoides arcticus	year-round	S3		sensitive	sensitive
	American three-toed woodpecker	Picoides dorsalis	year-round	S4			sensitive
mammal	hoary bat	Lasiurus cinereus	summer	S3			
	long-eared myotis	Myotis evotis	year-round	S4			sensitive
	long-legged myotis	Myotis volans	year-round	S4			sensitive
	Canada lynx	Lynx canadensis	year-round	S3	threatened	threatened	special status
	pygmy rabbit	Brachylagus idahoensis	year-round	S3		sensitive	sensitive

*MT rank defintions:
S2 - At risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state.
S3 - Potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas.
S4 - Apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining.
B - Breeding. Rank refers to the breeding population of the species in Montana. Appended to the state rank, e.g. S2B,S5N = At risk during breeding season, but common in the winter.



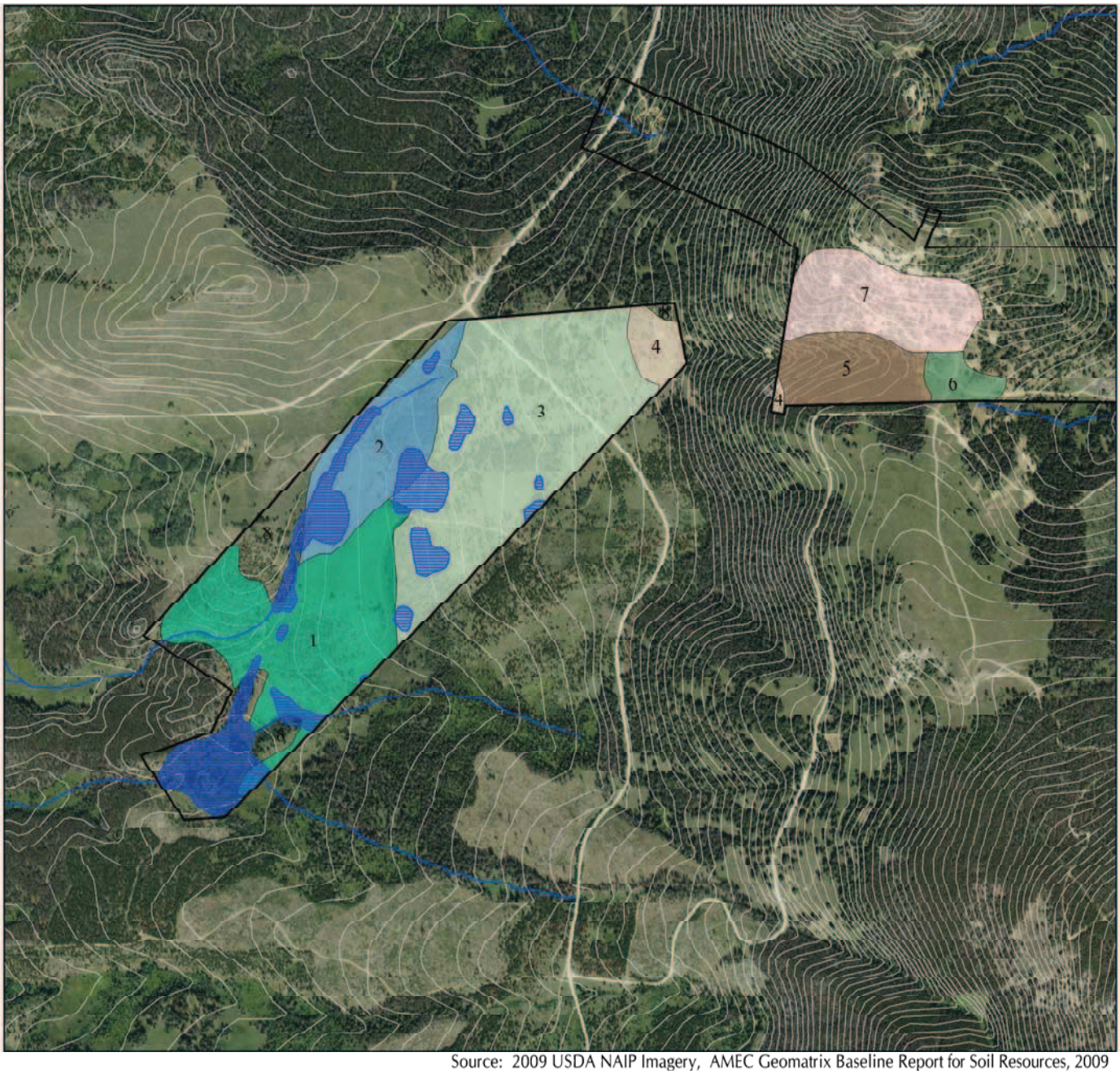
Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

Patented Claims

0 2000 ft

Wildlife Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Project Location Map
Figure 1



Source: 2009 USDA NAIP Imagery, AMEC Geomatrix Baseline Report for Soil Resources, 2009

Explanation

Areas of Similar Topography and Vegetation - based on AMEC mapping

1	Toeslope Meadow	5	Saddle Forest
2	Seasonal Channels	6	Saddle Meadow
3	Footslope, Aspen Fir Groves & Logged Areas	7	South Facing Slope
4	Steep, West-facing Fir-Spruce Backslope	8	Unmapped (AMEC)

Potential Wetlands (see 1/2010 Wetland Report)

Perennial and Intermittent Streams (see 1/2010 Stream Report)

N

0 1200 ft

Wildlife Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Habitat Type Map
Figure 2

Source: 2009 USDA NAIP Imagery

N

0 1500 ft

▲ Wildlife Sightings

1. Nesting Green-winged Teal and Redwing Blackbird
2. Columbia Spotted Frog
3. Elk Herd
4. Western Toad
5. Nesting Ruffed Grouse
6. Mule Deer
7. Canine Track

Wildlife Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Wildlife Sightings, July 2007
Figure 3

Photographs taken during July 2009 in the Butte Highlands Project area.

Photograph 1.
Western toad (*Bufo boreas*)

Photograph 2.
Columbia spotted from (*Rana luteiventris*)

Photograph 3.
Mule deer (*Odocoileus hemionus*)

Photograph 4.
Mule deer (*Odocoileus hemionus*)

Photograph 5.
Elk (*Cervus Canadensis*)

Photograph 6.
Canine track

Appendix A. Vertebrate species whose range includes the Butte Highlands Project area based on Distribution maps in the Montana Field Guide (http://fieldguide.mt.gov/). See Appendix B for designation descriptions.

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
amphibians	Mole Salamanders	Ambystoma macrodactylum	Long-toed Salamander	year-round	no	G5	S4	none	none	none	2		no
amphibians	True Frogs	Rana luteiventris	Columbia Spotted Frog	year-round	no	G4	S4	none	none	none	2		no
amphibians	True Toads	Bufo boreas	Western Toad	year-round	yes	G4	S2	none	sensitive	sensitive	1		no
birds	Avocets	Recurvirostra americana	American Avocet	summer	no	G5	S4B	none	none	none	3	none	no
birds	Barn Owl	Tyto alba	Barn Owl	year-round	no	G5	S4	none	none	none	4	none	no
birds	Blackbirds	Agelaius phoeniceus	Red-winged Blackbird	year-round	no	G5	S5B	none	none	none	3	3	no
birds	Blackbirds	Dolichonyx oryzivorus	Bobolink	summer	yes	G5	S3B	none	none	sensitive	3	3	no
birds	Blackbirds	Euphagus carolinus	Rusty Blackbird	migration range	no	G4	SNA	none	none	none	3	none	no
birds	Blackbirds	Euphagus cyanocephalus	Brewer's Blackbird	year-round	no	G5	S5B	none	none	none	3	3	no
birds	Blackbirds	Icterus bullockii	Bullock's Oriole	summer	no	G5	S5B	none	none	none	2	none	no
birds	Blackbirds	Icterus galbula	Northern Oriole	breeding	no	G5	SNR	none	none	none	2	none	no
birds	Blackbirds	Molothrus ater	Brown-headed Cowbird	summer	no	G5	S5B	none	none	none	3	none	no
birds	Blackbirds	Quiscalus quiscula	Common Grackle	summer	no	G5	S5B	none	none	none	3	none	no
birds	Blackbirds	Sturnella neglecta	Western Meadowlark	summer	no	G5	S5B	none	none	none	3	none	no
birds	Blackbirds	Xanthocephalus xanthocephalus	Yellow-headed Blackbird	summer	no	G5	S5B	none	none	none	3	3	no
birds	Cardinals / Buntings	Passerina amoena	Lazuli Bunting	summer	no	G5	S4B	none	none	none	3	2	no
birds	Cardinals / Buntings	Passerina cyanea	Indigo Bunting	migration range	no	G5	S4B	none	none	none	2	none	no
birds	Cardinals / Buntings	Pheucticus ludovicianus	Rose-breasted Grosbeak	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Cardinals / Buntings	Pheucticus melanocephalus	Black-headed Grosbeak	summer	no	G5	S5B	none	none	none	3	none	no
birds	Cardinals / Buntings	Plectrophenax nivalis	Snow Bunting	winter	no	G5	S5N	none	none	none	3	none	no
birds	Chickadees	Poecile atricapillus	Black-capped Chickadee	year-round	no	G5	S5	none	none	none	3	none	no
birds	Chickadees	Poecile gambeli	Mountain Chickadee	year-round	no	G5	S5	none	none	none	3	none	no
birds	Cormorants	Phalacrocorax auritus	Double-crested Cormorant	summer	no	G5	S5B	none	none	none	3	none	no
birds	Crane	Grus canadensis	Sandhill Crane	summer	no	G5	S5B,S2N	none	none	none	3	none	no
birds	Creepers	Certhia americana	Brown Creeper	year-round	yes	G5	S3	none	none	none	2	1	no
birds	Cuckoos	Coccyzus erythropthalmus	Black-billed Cuckoo	summer	yes	G5	S3B	none	none	none	2	2	no
birds	Dippers	Cinclus mexicanus	American Dipper	year-round	no	G5	S5	none	none	none	3	3	no
birds	Falcons	Falco columbarius	Merlin	year-round	no	G5	S4	none	none	none	2	none	no
birds	Falcons	Falco mexicanus	Prairie Falcon	year-round	no	G5	S4	none	none	none	2	none	no
birds	Falcons	Falco peregrinus	Peregrine Falcon	year-round	yes	G4	S3B	DM	sensitive	sensitive	2	2	no
birds	Falcons	Falco rusticolus	Gyrfalcon	winter	no	G5	SNA	none	none	none	3	none	no
birds	Falcons	Falco sparverius	American Kestrel	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Finches	Acanthis flammea	Common Redpoll	winter	no	G5	S5N	none	none	none	3	none	no
birds	Finches	Acanthis hornemanni	Hoary Redpoll	winter	no	G5	SNA	none	none	none	4	none	no
birds	Finches	Carpodacus cassinii	Cassin's Finch	year-round	yes	G5	S5	none	none	none	3	3	no
birds	Finches	Carpodacus mexicanus	House Finch	year-round	no	G5	S5	none	none	none	3	none	no
birds	Finches	Carpodacus purpureus	Purple Finch	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Finches	Coccothraustes vespertinus	Evening Grosbeak	year-round	no	G5	S5	none	none	none	4	none	no
birds	Finches	Leucosticte atrata	Black Rosy-Finch	summer	yes	G4	S2	none	none	none	2	2	no
birds	Finches	Leucosticte tephrocotis	Gray-crowned Rosy-Finch	year-round	yes	G5	S2B,S5N	none	none	none	2	none	no
birds	Finches	Leucosticte tephrocotis littoralis	Gray-crowned Rosy-Finch (Hepburn's)	winter	no	G5TNR	SNR	none	none	none	none	none	no
birds	Finches	Leucosticte tephrocotis tephrocotis	Gray-crowned Rosy-Finch (Cassin's)	year-round	no	G5TNR	SNR	none	none	none	none	none	no
birds	Finches	Loxia curvirostra	Red Crossbill	year-round	no	G5	S5	none	none	none	3	3	no
birds	Finches	Loxia leucoptera	White-winged Crossbill	year-round	no	G5	S4	none	none	none	2	none	no
birds	Finches	Passer domesticus	House Sparrow	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Finches	Pinicola enucleator	Pine Grosbeak	year-round	no	G5	S5	none	none	none	3	none	no
birds	Finches	Spinus pinus	Pine Siskin	year-round	no	G5	S5	none	none	none	3	none	no
birds	Finches	Spinus tristis	American Goldfinch	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Flycatchers	Contopus cooperi	Olive-sided Flycatcher	summer	no	G4	S4B	none	none	none	1	1	no
birds	Flycatchers	Contopus sordidulus	Western Wood-Pewee	summer	no	G5	S5B	none	none	none	3	none	no
birds	Flycatchers	Empidonax hammondii	Hammond's Flycatcher	summer	no	G5	S4B	none	none	none	2	2	no
birds	Flycatchers	Empidonax minimus	Least Flycatcher	summer	no	G5	S5B	none	none	none	3	3	no
birds	Flycatchers	Empidonax oberholseri	Dusky Flycatcher	summer	no	G5	S5B	none	none	none	3	none	no
birds	Flycatchers	Empidonax occidentalis	Cordilleran Flycatcher	summer	no	G5	S4B	none	none	none	3	2	no
birds	Flycatchers	Empidonax traillii	Willow Flycatcher	summer	no	G5	S4B	none	none	none	3	2	no
birds	Flycatchers	Sayornis saya	Say's Phoebe	summer	no	G5	S5B	none	none	none	3	none	no
birds	Flycatchers	Tyrannus tyrannus	Eastern Kingbird	summer	no	G5	S5B	none	none	none	3	none	no
birds	Grebes	Aechmophorus clarkii	Clark's Grebe	migration range	yes	G5	S3B	none	none	none	3	3	no
birds	Grebes	Aechmophorus occidentalis	Western Grebe	summer	no	G5	S4B	none	none	none	2	none	no
birds	Grebes	Podiceps auritus	Horned Grebe	migration range	yes	G5	S3B	none	none	none	2	2	no
birds	Grebes	Podiceps grisegena	Red-necked Grebe	summer	no	G5	S4B	none	none	none	2	none	no
birds	Grebes	Podiceps nigricollis	Eared Grebe	summer	no	G5	S5B	none	none	none	3	none	no
birds	Grebes	Podilymbus podiceps	Pied-billed Grebe	year-round	no	G5	S5B	none	none	none	3	none	no

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
birds	Gulls/Terns	Chlidonias niger	Black Tern	summer	yes	G4	S3B	none	none	sensitive	1	2	no
birds	Gulls/Terns	Chroicocephalus philadelphia	Bonaparte's Gull	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Gulls/Terns	Hydroprogne caspia	Caspian Tern	migration range	yes	G5	S2B	none	none	none	2	2	no
birds	Gulls/Terns	Larus argentatus	Herring Gull	winter	no	G5	SNA	none	none	none	3	none	no
birds	Gulls/Terns	Larus canus	Mew Gull	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Gulls/Terns	Larus delawarensis	Ring-billed Gull	summer	no	G5	S5B	none	none	none	3	none	no
birds	Gulls/Terns	Larus hyperboreus	Glaucous Gull	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Gulls/Terns	Larus thayeri	Thayer's Gull	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Gulls/Terns	Leucophaeus pipixcan	Franklin's Gull	migration range	yes	G4G5	S3B	none	none	sensitive	2	2	no
birds	Gulls/Terns	Sterna forsteri	Forster's Tern	summer	yes	G5	S3B	none	none	none	2	2	no
birds	Gulls/Terns	Sterna hirundo	Common Tern	migration range	yes	G5	S3B	none	none	none	2	2	no
birds	Gulls/Terns	Sterna paradisaea	Arctic Tern	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Hawks/Eagles	Accipiter cooperii	Cooper's Hawk	year-round	no	G5	S4B	none	none	none	2	none	no
birds	Hawks/Eagles	Accipiter gentilis	Northern Goshawk	year-round	yes	G5	S3	none	none	sensitive	2	2	no
birds	Hawks/Eagles	Accipiter striatus	Sharp-shinned Hawk	year-round	no	G5	S4B	none	none	none	2	3	no
birds	Hawks/Eagles	Aquila chrysaetos	Golden Eagle	year-round	yes	G5	S3	none	none	sensitive	2	none	no
birds	Hawks/Eagles	Buteo jamaicensis	Red-tailed Hawk	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Hawks/Eagles	Buteo lagopus	Rough-legged Hawk	winter	no	G5	S5N	none	none	none	3	none	no
birds	Hawks/Eagles	Buteo platypterus	Broad-winged Hawk	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Hawks/Eagles	Buteo regalis	Ferruginous Hawk	summer	yes	G4	S3B	none	none	sensitive	2	2	no
birds	Hawks/Eagles	Buteo swainsoni	Swainson's Hawk	year-round	potential	G5	S4B	none	none	sensitive	2	3	no
birds	Hawks/Eagles	Circus cyaneus	Northern Harrier	year-round	no	G5	S4B	none	none	none	2	3	no
birds	Hawks/Eagles	Haliaeetus leucocephalus	Bald Eagle	year-round	yes	G5	S3	DM	Threatened	Special Status	1	2	no
birds	Hawks/Eagles	Pandion haliaetus	Osprey	summer	no	G5	S5B	none	none	none	3	none	no
birds	Herons	Ardea herodias	Great Blue Heron	year-round	yes	G5	S3	none	none	none	3	none	no
birds	Herons	Botaurus lentiginosus	American Bittern	summer	yes	G4	S3B	none	none	none	2	3	no
birds	Herons	Egretta thula	Snowy Egret	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Herons	Nycticorax nycticorax	Black-crowned Night-Heron	migration range	yes	G5	S3B	none	none	none	2	3	no
birds	Hummingbirds	Archilochus alexandri	Black-chinned Hummingbird	summer	no	G5	S4B	none	none	none	2	none	no
birds	Hummingbirds	Selasphorus rufus	Rufous Hummingbird	summer	potential	G5	S4B	none	none	none	3	3	no
birds	Hummingbirds	Stellula calliope	Calliope Hummingbird	summer	no	G5	S5B	none	none	none	3	2	no
birds	Ibis	Plegadis chihi	White-faced Ibis	summer	yes	G5	S3B	none	none	sensitive	2	2	no
birds	Jays/Crows/Magpies	Corvus brachyrhynchos	American Crow	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Jays/Crows/Magpies	Corvus corax	Common Raven	year-round	no	G5	S5	none	none	none	3	none	no
birds	Jays/Crows/Magpies	Cyanocitta cristata	Blue Jay	year-round	no	G5	S5N	none	none	none	3	none	no
birds	Jays/Crows/Magpies	Cyanocitta stelleri	Steller's Jay	year-round	no	G5	S5	none	none	none	3	none	no
birds	Jays/Crows/Magpies	Gymnorhinus cyanocephalus	Pinyon Jay	year-round	yes	G5	S3	none	none	none	2	none	no
birds	Jays/Crows/Magpies	Nucifraga columbiana	Clark's Nutcracker	year-round	yes	G5	S3	none	none	none	3	3	no
birds	Jays/Crows/Magpies	Perisoreus canadensis	Gray Jay	year-round	no	G5	S5	none	none	none	3	none	no
birds	Jays/Crows/Magpies	Pica hudsonia	Black-billed Magpie	year-round	no	G5	S5	none	none	none	3	none	no
birds	Kingfishers	Megaceryle alcyon	Belted Kingfisher	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Kinglets	Regulus calendula	Ruby-crowned Kinglet	summer	no	G5	S5B	none	none	none	3	none	no
birds	Kinglets	Regulus satrapa	Golden-crowned Kinglet	year-round	no	G5	S5	none	none	none	3	3	no
birds	Larks	Eremophila alpestris	Horned Lark	year-round	no	G5	S5	none	none	none	3	none	no
birds	Loons	Gavia immer	Common Loon	migration range	yes	G5	S3B	none	sensitive	sensitive	1	1	no
birds	Loons	Gavia pacifica	Pacific Loon	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Nighthawks	Chordeiles minor	Common Nighthawk	summer	no	G5	S5B	none	none	none	3	none	no
birds	Nighthawks	Phalaenoptilus nuttallii	Common Poorwill	summer	potential	G5	S4B	none	none	none	3	3	no
birds	Nuthatches	Sitta canadensis	Red-breasted Nuthatch	year-round	no	G5	S5	none	none	none	3	none	no
birds	Nuthatches	Sitta carolinensis	White-breasted Nuthatch	year-round	no	G5	S4	none	none	none	2	none	no
birds	Nuthatches	Sitta pygmaea	Pygmy Nuthatch	year-round	no	G5	S4	none	none	none	2	none	no
birds	Owls	Aegolius acadicus	Northern Saw-whet Owl	year-round	no	G5	S4	none	none	none	2	none	no
birds	Owls	Aegolius funereus	Boreal Owl	year-round	no	G5	S4	none	none	none	2	3	no
birds	Owls	Asio flammeus	Short-eared Owl	year-round	potential	G5	S4	none	none	none	3	3	no
birds	Owls	Asio otus	Long-eared Owl	year-round	no	G5	S5	none	none	none	3	none	no
birds	Owls	Athene cunicularia	Burrowing Owl	summer	yes	G4	S3B	none	sensitive	sensitive	1	1	no
birds	Owls	Bubo scandiacus	Snowy Owl	winter	no	G5	SNA	none	none	none	3	none	no
birds	Owls	Bubo virginianus	Great Horned Owl	year-round	no	G5	S5	none	none	none	3	none	no
birds	Owls	Glaucidium gnoma	Northern Pygmy-Owl	year-round	no	G5	S4	none	none	none	2	none	no
birds	Owls	Megascops kennicottii	Western Screech-Owl	year-round	potential	G5	S3s4	none	none	none	3	3	no
birds	Owls	Otus flammeolus	Flammulated Owl	summer	yes	G4	S3B	none	sensitive	sensitive	1	1	no
birds	Owls	Strix nebulosa	Great Gray Owl	year-round	yes	G5	S3	none	none	sensitive	2	3	no
birds	Owls	Strix varia	Barred Owl	year-round	no	G5	S4	none	none	none	2	none	no
birds	Owls	Surnia ulula	Northern Hawk Owl	year-round	potential	G5	S4	none	none	none	3	none	no

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
birds	Pelicans	Pelecanus erythrorhynchos	American White Pelican	migration range	yes	G4	S3B	none	none	none	3	3	no
birds	Pigeon/Doves	Columba livia	Rock Pigeon	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Pigeon/Doves	Streptopelia decaocto	Eurasian Collared-Dove	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Pigeon/Doves	Zenaida macroura	Mourning Dove	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Pipits	Anthus rubescens	American Pipit	summer	no	G5	S4B	none	none	none	3	none	no
birds	Plovers	Charadrius montanus	Mountain Plover	summer	yes	G3	S2B	none	none	sensitive	1	1	no
birds	Plovers	Charadrius semipalmatus	Semipalmated Plover	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Plovers	Charadrius vociferus	Killdeer	summer	no	G5	S5B	none	none	none	3	3	no
birds	Plovers	Pluvialis dominica	American Golden-Plover	migration range	no	G5	SNA	none	none	none	5	none	no
birds	Plovers	Pluvialis squatarola	Black-bellied Plover	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Rail	Fulica americana	American Coot	summer	no	G5	S5B	none	none	none	3	none	no
birds	Rail	Porzana carolina	Sora	summer	no	G5	S5B	none	none	none	3	none	no
birds	Rail	Rallus limicola	Virginia Rail	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sandpipers	Actitis macularius	Spotted Sandpiper	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sandpipers	Bartramia longicauda	Upland Sandpiper	summer	no	G5	S4B	none	none	none	2	none	no
birds	Sandpipers	Calidris alba	Sanderling	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Sandpipers	Calidris alpina	Dunlin	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Calidris bairdii	Baird's Sandpiper	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Calidris himantopus	Stilt Sandpiper	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Sandpipers	Calidris mauri	Western Sandpiper	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Calidris melanotos	Pectoral Sandpiper	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Calidris minutilla	Least Sandpiper	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Gallinago delicata	Wilson's Snipe	summer	no	G5	S5	none	none	none	3	none	no
birds	Sandpipers	Limnodromus scolopaceus	Long-billed Dowitcher	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Limosa fedoa	Marbled Godwit	migration range	no	G5	S4B	none	none	sensitive	2	2	no
birds	Sandpipers	Numenius americanus	Long-billed Curlew	summer	yes	G5	S3B	none	none	sensitive	1	2	no
birds	Sandpipers	Numenius phaeopus	Whimbrel	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Sandpipers	Phalaropus lobatus	Red-necked Phalarope	migration range	no	G4G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Phalaropus tricolor	Wilson's Phalarope	summer	no	G5	S4B	none	none	sensitive	3	3	no
birds	Sandpipers	Tringa flavipes	Lesser Yellowlegs	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Tringa melanoleuca	Greater Yellowlegs	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sandpipers	Tringa semipalmata	Willet	summer	no	G5	S4B	none	none	sensitive	3	3	no
birds	Sandpipers	Tringa solitaria	Solitary Sandpiper	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Shrikes	Lanius excubitor	Northern Shrike	winter	no	G5	S5N	none	none	none	3	none	no
birds	Shrikes	Lanius ludovicianus	Loggerhead Shrike	summer	yes	G4	S3B	none	none	sensitive	2	2	no
birds	Sparrows	Ammodramus savannarum	Grasshopper Sparrow	summer	yes	G5	S3B	none	none	none	2	2	no
birds	Sparrows	Amphispiza belli	Sage Sparrow	summer	yes	G5	S3B	none	none	sensitive	3	none	no
birds	Sparrows	Calcarius lapponicus	Lapland Longspur	winter	no	G5	SNA	none	none	none	3	none	no
birds	Sparrows	Chondestes grammacus	Lark Sparrow	summer	no	G5	S5B	none	none	none	3	3	no
birds	Sparrows	Green-tailed Towhee	Green-tailed Towhee	summer	no	G5	S4B	none	none	none	2	3	no
birds	Sparrows	Junco hyemalis	Dark-eyed Junco	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Junco hyemalis hyemalis	Dark-eyed Junco (Slate-colored)	winter	no	G5T5	SNR	none	none	none	3	none	no
birds	Sparrows	Junco hyemalis mearnsi	Dark-eyed Junco (Pink-sided)	summer	no	G5TNR	SNR	none	none	none	3	none	no
birds	Sparrows	Junco hyemalis oreganus	Dark-eyed Junco (Oregon)	year-round	no	G5T5	SNR	none	none	none	3	none	no
birds	Sparrows	Melospiza lincolnii	Lincoln's Sparrow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Melospiza melodia	Song Sparrow	year-round	no	G5	S5B	none	none	none	3	3	no
birds	Sparrows	Passerculus sandwichensis	Savannah Sparrow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Passerella iliaca	Fox Sparrow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Pipilo maculatus	Spotted Towhee	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Pooecetes gramineus	Vesper Sparrow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Spizella arborea	American Tree Sparrow	winter	no	G5	SNA	none	none	none	3	none	no
birds	Sparrows	Spizella breweri	Brewer's Sparrow	summer	yes	G5	S3B	none	none	sensitive	2	2	no
birds	Sparrows	Spizella pallida	Clay-colored Sparrow	summer	no	G5	S4B	none	none	none	2	3	no
birds	Sparrows	Spizella passerina	Chipping Sparrow	summer	no	G5	S5B	none	none	none	3	3	no
birds	Sparrows	Zonotrichia albicollis	White-throated Sparrow	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Sparrows	Zonotrichia leucophrys	White-crowned Sparrow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Sparrows	Zonotrichia querula	Harris's Sparrow	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Starlings	Sturnus vulgaris	European Starling	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Swallows	Hirundo rustica	Barn Swallow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swallows	Petrochelidon pyrrhonota	Cliff Swallow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swallows	Progne subis	Purple Martin	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swallows	Riparia riparia	Bank Swallow	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swallows	Stelgidopteryx serripennis	Northern Rough-winged Swallow	summer	no	G5	S5B	none	none	none	4	none	no
birds	Swallows	Tachycineta bicolor	Tree Swallow	summer	no	G5	S5B	none	none	none	4	none	no

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
birds	Swallows	Tachycineta thalassina	Violet-green Swallow	summer	no	G5	S5B	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Aix sponsa	Wood Duck	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas acuta	Northern Pintail	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas americana	American Wigeon	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas clypeata	Northern Shoveler	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas crecca	Green-winged Teal	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas cyanoptera	Cinnamon Teal	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas discors	Blue-winged Teal	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas penelope	Eurasian Wigeon	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Anas platyrhynchos	Mallard	year-round	no	G5	S5	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anas strepera	Gadwall	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Anser albifrons	Greater White-fronted Goose	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Aythya affinis	Lesser Scaup	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Aythya americana	Redhead	summer	no	G5	S5B	none	none	none	2	none	no
birds	Swans/Geese/Ducks	Aythya collaris	Ring-necked Duck	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Aythya marila	Greater Scaup	winter	no	G5	SNA	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Aythya valisineria	Canvasback	summer	no	G5	S5B	none	none	none	2	none	no
birds	Swans/Geese/Ducks	Branta canadensis	Canada Goose	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Branta hutchinsii	Cackling Goose	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Bucephala albeola	Bufflehead	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Bucephala clangula	Common Goldeneye	year-round	no	G5	S5	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Bucephala islandica	Black Scoter look at pg 2	year-round	potential	G5	S4	none	none	none	3	2	no
birds	Swans/Geese/Ducks	Chen caerulescens	Snow Goose	migration range	no	G5	S4N	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Chen rossii	Ross's Goose	migration range	no	G4	S4N	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Clangula hyemalis	Long-tailed Duck	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Cygnus buccinator	Trumpeter Swan	migration range	yes	G4	S3	none	sensitive	sensitive	1	1	no
birds	Swans/Geese/Ducks	Cygnus columbianus	Tundra Swan	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Histrionicus histrionicus	Harlequin Duck	summer	yes	G4	S5B	none	sensitive	sensitive	1	1	no
birds	Swans/Geese/Ducks	Lophodytes cucullatus	Hooded Merganser	year-round	potential	G5	S4B	none	none	none	2	2	no
birds	Swans/Geese/Ducks	Melanitta fusca	White-winged Scoter	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Melanitta perspicillata	Surf Scoter	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Swans/Geese/Ducks	Mergus merganser	Common Merganser	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Mergus serrator	Red-breasted Merganser	migration range	no	G5	SNA	none	none	none	3	none	no
birds	Swans/Geese/Ducks	Oxyura jamaicensis	Ruddy Duck	summer	no	G5	S5B	none	none	none	3	none	no
birds	Swifts	Aeronautes saxatalis	White-throated Swift	summer	no	G5	S5B	none	none	none	3	none	no
birds	Tanagers	Piranga ludoviciana	Western Tanager	summer	no	G5	S5B	none	none	none	3	none	no
birds	Thrashers / Mockingbirds / Catbirds	Dumetella carolinensis	Gray Catbird	summer	no	G5	S5B	none	none	none	3	3	no
birds	Thrashers / Mockingbirds / Catbirds	Mimus polyglottos	Northern Mockingbird	summer	no	G5	SNA	none	none	none	4	none	no
birds	Thrashers / Mockingbirds / Catbirds	Oreoscoptes montanus	Sage Thrasher	summer	yes	G5	S3B	none	none	sensitive	3	3	no
birds	Thrushes	Catharus fuscescens	Veery	summer	yes	G5	S3B	none	none	sensitive	2	2	no
birds	Thrushes	Catharus guttatus	Hermit Thrush	summer	no	G5	S5B	none	none	none	3	none	no
birds	Thrushes	Catharus ustulatus	Swainson's Thrush	summer	no	G5	S5B	none	none	none	3	none	no
birds	Thrushes	Ixoreus naevius	Varied Thrush	summer	no	G5	S5B	none	none	none	3	3	no
birds	Thrushes	Myadestes townsendi	Townsend's Solitaire	year-round	no	G5	S5	none	none	none	3	3	no
birds	Thrushes	Sialia currucoides	Mountain Bluebird	summer	no	G5	S5B	none	none	none	3	none	no
birds	Thrushes	Sialia mexicana	Western Bluebird	summer	no	G5	S4B	none	none	none	2	none	no
birds	Thrushes	Turdus migratorius	American Robin	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Upland Game Birds	Bonasa umbellus	Ruffed Grouse	year-round	no	G5	S4	none	none	none	3	2	no
birds	Upland Game Birds	Centrocercus urophasianus	Greater Sage-Grouse	year-round	yes	G4	S2	none	sensitive	sensitive	1	1	no
birds	Upland Game Birds	Dendragapus obscurus	Dusky Grouse	year-round	no	G5	S4	none	none	none	2	3	no
birds	Upland Game Birds	Falcipennis canadensis	Spruce Grouse	year-round	no	G5	S4	none	none	none	3	none	no
birds	Upland Game Birds	Meleagris gallopavo	Wild Turkey	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Upland Game Birds	Perdix perdix	Gray Partridge	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Upland Game Birds	Phasianus colchicus	Ring-necked Pheasant	year-round	no	G5	SNA	none	none	none	4	none	yes
birds	Vireos	Vireo cassinii	Cassin's Vireo	summer	no	G5	S4B	none	none	none	3	3	no
birds	Vireos	Vireo gilvus	Warbling Vireo	summer	no	G5	S5B	none	none	none	3	3	no
birds	Vireos	Vireo olivaceus	Red-eyed Vireo	summer	no	G5	S4B	none	none	none	3	2	no
birds	Vireos	Vireo solitarius	Solitary Vireo	summer	no	G5	SNR	none	none	none	3	none	no
birds	Vultures	Cathartes aura	Turkey Vulture	summer	no	G5	S4B	none	none	none	2	none	no
birds	Warblers	Dendroica coronata	Yellow-rumped Warbler	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Dendroica coronata auduboni	Audubon's Warbler	summer	no	G5T5	S5B	none	none	none	3	none	no
birds	Warblers	Dendroica magnolia	Magnolia Warbler	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Warblers	Dendroica palmarum	Palm Warbler	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Warblers	Dendroica pensylvanica	Chestnut-sided Warbler	migration range	no	G5	SNA	none	none	none	4	none	no

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
birds	Warblers	Dendroica petechia	Yellow Warbler	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Dendroica striata	Blackpoll Warbler	migration range	no	G5	SNA	none	none	none	4	none	no
birds	Warblers	Dendroica tigrina	Cape May Warbler	migration range	no	G5	SNA	none	none	none		none	no
birds	Warblers	Geothlypis trichas	Common Yellowthroat	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Icteria virens	Yellow-breasted Chat	summer	no	G5	S5B	none	none	none	2	none	no
birds	Warblers	Oporornis tolmiei	MacGillivray's Warbler	summer	no	G5	S5B	none	none	none	3	3	no
birds	Warblers	Seiurus noveboracensis	Northern Waterthrush	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Setophaga ruticilla	American Redstart	summer	no	G5	S5B	none	none	none	2	3	no
birds	Warblers	Vermivora celata	Orange-crowned Warbler	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Vermivora peregrina	Tennessee Warbler	migration range	potential	G5	S3S4B	none	none	none	3	none	no
birds	Warblers	Vermivora ruficapilla	Nashville Warbler	summer	no	G5	S5B	none	none	none	3	3	no
birds	Warblers	Wilsonia pusilla	Wilson's Warbler	summer	no	G5	S5B	none	none	none	3	none	no
birds	Warblers	Dendroica townsendi	Townsend's Warbler	summer	no	G5	S5B	none	none	none	3	3	no
birds	Waxwings	Bombycilla cedrorum	Cedar Waxwing	year-round	no	G5	S5B	none	none	none	3	none	no
birds	Waxwings	Bombycilla garrulus	Bohemian Waxwing	winter	no	G5	S5N	none	none	none	3	none	no
birds	Woodpeckers	Colaptes auratus	Northern Flicker	year-round	no	G5	S5	none	none	none	3	none	no
birds	Woodpeckers	Colaptes auratus auratus	Northern Flicker (Yellow-shafted)	year-round	no	G5T5	SNRB	none	none	none	3	none	no
birds	Woodpeckers	Colaptes auratus cafer	Northern Flicker (Red-shafted)	year-round	no	G5T5	SNRB	none	none	none	3	none	no
birds	Woodpeckers	Dryocopus pileatus	Pileated Woodpecker	year-round	yes	G5	S3	none	none	none	2	2	no
birds	Woodpeckers	Melanerpes lewis	Lewis's Woodpecker	summer	yes	G4	S2B	none	none	none	2	2	no
birds	Woodpeckers	Picoides arcticus	Black-backed Woodpecker	year-round	yes	G5	S3	none	sensitive	sensitive	1	1	no
birds	Woodpeckers	Picoides dorsalis	American Three-toed Woodpecker	year-round	no	G5	S4	none	none	sensitive	2	2	no
birds	Woodpeckers	Picoides pubescens	Downy Woodpecker	year-round	no	G5	S5	none	none	none	3	3	no
birds	Woodpeckers	Picoides villosus	Hairy Woodpecker	year-round	no	G5	S5	none	none	none	3	none	no
birds	Woodpeckers	Sphyrapicus nuchalis	Red-naped Sapsucker	summer	no	G5	S4B	none	none	none	3	2	no
birds	Woodpeckers	Sphyrapicus thyroideus	Williamson's Sapsucker	summer	no	G5	S4B	none	none	none	2	2	no
birds	Wrens	Catherpes mexicanus	Canyon Wren	year-round	no	G5	S4	none	none	none	2	none	no
birds	Wrens	Cistothorus palustris	Marsh Wren	summer	no	G5	S3	none	none	none	3	none	no
birds	Wrens	Salpinctes obsoletus	Rock Wren	summer	no	G5	S5B	none	none	none	3	none	no
birds	Wrens	Troglodytes aedon	House Wren	summer	no	G5	S5B	none	none	none	3	none	no
birds	Wrens	Troglodytes troglodytes	Winter Wren	year-round	yes	G5	S3	none	none	none	2	2	no
birds		Tyrannus verticalis	Western Kingbird	summer	no	G5	S5B	none	none	none	3	none	no
mammal	bats	Corynorhinus townsendii	Townsend's big-eared bat	year-round	yes	G4	S2	none	sensitive	sensitive	1		no
mammal	bats	Eptesicus fuscus	big brown bat	year-round	no	G5	S4	none	none	none	2		no
mammal	bats	Euderma maculatum	spotted bat	year-round	yes	G4	S2	none	sensitive	sensitive	1		no
mammal	bats	Lasionycteris noctivagans	silver-haired bat	year-round	potential	G5	S4	none	none	none	2		no
mammal	bats	Lasiurus cinereus	hoary bat	summer	yes	G5	S3	none	none	none	2		no
mammal	bats	Myotis californicus	California myotis	year-round	no	G5	S4	none	none	none	2		no
mammal	bats	Myotis ciliolabrum	western small-footed myotis	year-round	no	G5	S4	none	none	none	2		no
mammal	bats	Myotis evotis	long-eared myotis	year-round	no	G5	S4	none	none	sensitive	2		no
mammal	bats	Myotis lucifugus	little brown myotis	year-round	no	G5	S4	none	none	none	3		no
mammal	bats	Myotis thysandodes	fringed myotis	year-round	yes	G4G5	S3	none	none	sensitive	2		no
mammal	bats	Myotis volans	long-legged myotis	year-round	no	G5	S4	none	none	sensitive	2		no
mammal	Bears	Ursus americanus	Black Bear	year-round	no	G5	S5	none	none	none	3		no
mammal	Bears	Ursus arctos	Grizzly Bear	historic range	yes	G4	S2S3	LT,XN,DM	Threatened	Special Status	1		no
mammal	beavers	Castor canadensis	beaver	year-round	no	G5	S5	none	none	none	3		no
mammal	Cats	Lynx canadensis	Canada Lynx	year-round	yes	G5	S3	LT	Threatened	Special Status	1		no
mammal	Cats	Lynx rufus	Bobcat	year-round	no	G5	S5	none	none	none	3		no
mammal	Cats	Puma concolor	Mountain Lion	year-round	no	G5	S4	none	none	none	3		no
mammal	Deer/Moose/Elk	Alces alces	Moose	year-round	no	G5	S5	none	none	none	3		no
mammal	Deer/Moose/Elk	Cervus canadensis	Elk or Wapiti	year-round	no	G5	S5	none	none	none	3		no
mammal	Deer/Moose/Elk	Odocoileus hemionus	Mule Deer	year-round	no	G5	S5	none	none	none	3		no
mammal	Deer/Moose/Elk	Odocoileus virginianus	White-tailed Deer	year-round	no	G5	S5	none	none	none	3		no
mammal	Jumping Mice	Zapus princeps	Western Jumping Mouse	year-round	no	G5	S4	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Clethrionomys gapperi	Southern Red-backed Vole	year-round	no	G5	S4	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Lemmiscus curtatus	Sagebrush Vole	year-round	no	G5	S4	none	none	none	2		no
mammal	Mice/Voles/Lemmings/Rats	Microtus longicaudus	Long-tailed Vole	year-round	no	G5	S4	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Microtus montanus	Montane Vole	year-round	no	G5	S5	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Microtus pennsylvanicus	Meadow Vole	year-round	no	G5	S5	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Microtus richardsoni	Water Vole	year-round	no	G5	S4	none	none	none	2		no
mammal	Mice/Voles/Lemmings/Rats	Mus musculus	House Mouse	year-round	no	G5	SNA	none	none	none	4		yes
mammal	Mice/Voles/Lemmings/Rats	Neotoma cinerea	Bushy-tailed Woodrat	year-round	no	G5	S5	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Ondatra zibethicus	Muskrat	year-round	no	G5	S5	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Peromyscus maniculatus	Deer Mouse	year-round	no	G5	S5	none	none	none	3		no

Class	Family	Genus species	Common	Range	MT SoC	Global	State	USFWS	USFS	BLM	CFWCS	PIF	Exotic Species
mammal	Mice/Voles/Lemmings/Rats	Phenacomys intermedius	Heather Vole	year-round	no	G5	S4	none	none	none	3		no
mammal	Mice/Voles/Lemmings/Rats	Rattus norvegicus	Norway Rat	year-round	no	G5	SNA	none	none	none	4		yes
mammal	pikas	Ochotona princeps	pika	year-round	no	G5	S4	none	none	none	3		no
mammal	Pocket Gophers	Thomomys talpoides	Northern Pocket Gopher	year-round	no	G5	S5	none	none	none	3		no
mammal	Pocket Mice/Kangaroo Rats	Perognathus parvus	Great Basin Pocket Mouse	year-round	yes	G5	S2S3	none	sensitive	sensitive	1		no
mammal	porcupines	Erethizon dorsatum	porcupine	year-round	no	G5	S4	none	none	none	3		no
mammal	Pronghorn	Antilocapra americana	Pronghorn	year-round	no	G5	S5	none	none	none	3		no
mammal	rabbits/hares	Brachylagus idahoensis	pygmy rabbit	year-round	yes	G4	S3	none	sensitive	sensitive	1		no
mammal	rabbits/hares	Lepus americanus	snowshoe hare	year-round	no	G5	S4	none	none	none	3		no
mammal	rabbits/hares	Lepus townsendii	white-tailed jack rabbit	year-round	no	G5	S4	none	none	none	2		no
mammal	rabbits/hares	Sylvilagus nuttallii	mountain cottontail	year-round	no	G5	S4	none	none	none	2		no
mammal	Raccoon	Procyon lotor	Raccoon	year-round	no	G5	S4	none	none	none	4		no
mammal	Sheep/Bison	Bos bison	Bison	historic range	yes	G4	S2	none	none	none	1		no
mammal	Sheep/Bison	Oreamnos americanus	Mountain Goat	year-round	no	G5	S4	none	none	none	3		no
mammal	Sheep/Bison	Ovis canadensis	Bighorn Sheep	year-round	no	G4	S4	none	none	none	3		no
mammal	shrews	Sorex cinereus	Masked Shrew	year-round	no	G5	S5	none	none	none	3		no
mammal	shrews	Sorex monticolus	dusky or montane shrew	year-round	no	G5	S5	none	none	none	3		no
mammal	shrews	Sorex nanus	dwarf shrew	year-round	yes	G4	S2S3	none	none	none	2		no
mammal	shrews	Sorex palustris	water shrew	year-round	no	G5	S4	none	none	none	3		no
mammal	shrews	Sorex preblei	Preble's shrew	year-round	yes	G4	S3	none	none	none	2		no
mammal	shrews	Sorex vagrans	vagrant shrew	year-round	no	G5	S4	none	none	none	2		no
mammal	Skunk	Mephitis mephitis	Striped Skunk	year-round	no	G5	S4	none	none	none	3		no
mammal	Skunk	Spilogale gracilis	Western Spotted Skunk	year-round	yes	G5	S1S3	none	none	sensitive	2		no
mammal	Squirrels	Cynomys ludovicianus	Black-tailed Prairie Dog	year-round	yes	G4	S3	none	sensitive	sensitive	1		no
mammal	Squirrels	Glaucomys sabrinus	Northern Flying Squirrel	year-round	no	G5	S4	none	none	none	2		no
mammal	Squirrels	Marmota flaviventris	Yellow-bellied Marmot	year-round	no	G5	S4	none	none	none	3		no
mammal	Squirrels	Spermophilus armatus	Uinta Ground Squirrel	year-round	potential	G5	S3S4	none	none	none	2		no
mammal	Squirrels	Spermophilus columbianus	Columbian Ground Squirrel	year-round	no	G5	S5	none	none	none	3		no
mammal	Squirrels	Spermophilus elegans	Wyoming Ground Squirrel	year-round	potential	G5	S3S4	none	none	none	2		no
mammal	Squirrels	Spermophilus lateralis	Golden-mantled Ground Squirrel	year-round	no	G5	S4	none	none	none	3		no
mammal	Squirrels	Spermophilus richardsonii	Richardson's Ground Squirrel	year-round	no	G5	S5	none	none	none	3		no
mammal	Squirrels	Tamias amoenus	Yellow-pine Chipmunk	year-round	no	G5	S5	none	none	none	3		no
mammal	Squirrels	Tamias minimus	Least Chipmunk	year-round	no	G5	S4	none	none	none	3		no
mammal	Squirrels	Tamias ruficaudus	Red-tailed Chipmunk	year-round	no	G5	S4	none	none	none	3		no
mammal	Squirrels	Tamiasciurus hudsonicus	Red Squirrel	year-round	no	G5	S5	none	none	none	3		no
mammal	Weasel	Gulo gulo	Wolverine	year-round	yes	G4	S3	none	sensitive	sensitive	2		no
mammal	Weasel	Lontra canadensis	Northern River Otter	year-round	no	G5	S4	none	none	none	2		no
mammal	Weasel	Martes americana	Marten	year-round	no	G5	S4	none	none	none	2		no
mammal	Weasel	Mustela erminea	Short-tailed Weasel	year-round	no	G5	S5	none	none	none	3		no
mammal	Weasel	Mustela frenata	Long-tailed Weasel	year-round	no	G5	S5	none	none	none	3		no
mammal	Weasel	Mustela nigripes	Black-footed Ferret	historic range	yes	G1	S1	LE,XN	Endangerd	Special Status	1		no
mammal	Weasel	Mustela vison	Mink	year-round	no	G5	S5	none	none	none	3		no
mammal	Weasel	Taxidea taxus	Badger	year-round	no	G5	S4	none	none	none	2		no
mammal	Wolves/Coyotes/Foxes	Canis latrans	Coyote	year-round	no	G5	S5	none	none	none	3		no
mammal	Wolves/Coyotes/Foxes	Canis lupus	Gray Wolf	year-round	yes	G4	S3	DM	sensitive	Special Status	1		no
mammal	Wolves/Coyotes/Foxes	Vulpes vulpes	Red Fox	year-round	no	G5	S5	none	none	none	3		no
reptiles	Boa	Charina bottae	Rubber Boa	year-round	no	G5	S4	none	none	none	2		no
reptiles	Colubrid Snakes	Coluber constrictor	Eastern Racer	year-round	no	G5	S5	none	none	none	3		no
reptiles	Colubrid Snakes	Pituophis catenifer	Gophersnake	year-round	no	G5	S5	none	none	none	3		no
reptiles	Colubrid Snakes	Thamnophis elegans	Terrestrial Gartersnake	year-round	no	G5	S5	none	none	none	3		no
reptiles	Colubrid Snakes	Thamnophis sirtalis	Common Gartersnake	year-round	no	G5	S4	none	none	none	2		no
reptiles	Pond Turtles	Chrysemys picta	Painted Turtle	year-round	no	G5	S4	none	none	none	3		no
reptiles	Vipers	Crotalus viridis	Prairie Rattlesnake	year-round	no	G5	S4	none	none	none	2		no

Appendix B. State and federal wildlife designation descriptions.

Species of Concern

Species of Concern are native taxa that are at-risk due to declining population trends, threats to their habitats, restricted distribution, and/or other factors. Designation as a Montana Species of Concern or Potential Species of Concern is based on the Montana Status Rank, and is not a statutory or regulatory classification. Rather, these designations provide information that helps resource managers make proactive decisions regarding species conservation and data collection priorities. See the latest Species of Concern Reports for more detailed explanations and assessment criteria.

Potential Species of Concern

Potential Species of Concern are native taxa for which current, often limited, information suggests potential vulnerability. Also included are animal species which additional data are needed before an accurate status assessment can be made.

Status Under Review

Species designated "Status Under Review" are plant species that require additional information and currently do not have a status rank but may warrant future consideration as Species of Concern. This category also includes plant species whose status rank is questionable due to the availability of new information or the availability of conflicting or ambiguous information or data. Species listed in this category will be reviewed periodically or as new information becomes available.

Exotic Species

Exotic species are not native to North America, but have either been deliberately or accidentally introduced to the continent. These species, able to reproduce and survive outside of the habitats where they evolved, are also referred to as alien, introduced, invasive, non-native, or non-indigenous.

Accidental Species

Species that arrived in Montana via unknown or uncommon circumstances, which could include weather related events or other migratory disturbances. The term Accidental Species is often assigned to species that have less than 20 verified observations in Montana.

Montana Species Ranking Codes

Montana employs a standardized ranking system to denote global (range-wide) and state status (NatureServe 2006). Species are assigned numeric ranks ranging from 1 (highest risk, greatest

concern) to 5 (demonstrably secure), reflecting the relative degree of risk to the species' viability, based upon available information.

A number of factors are considered in assigning ranks — the number, size and quality of known occurrences or populations, distribution, trends (if known), intrinsic vulnerability, habitat specificity, and definable threats. The process of assigning state ranks for each taxon relies heavily on the number of occurrences and Species Occurrence (OE) ranks, which is a ranking system of the quality (usually A through D) of each known occurrence based on factors such as size (# of individuals) and habitat quality. The remaining factors noted above are also incorporated into the ranking process when they are known. The "State Rank Reason" field in the Montana Field Guide provides additional information on the reasons for a particular species' rank.

For example, Clustered lady's slipper (Cypripedium fasciculatum) is ranked G4 S2. Globally the species is uncommon but not vulnerable, while in Montana it is at risk because of limited and potentially declining numbers, extent and/or habitat.

Rank		Definition
G1	S1	At high risk because of extremely limited and/or rapidly declining population numbers, range and/or habitat, making it highly vulnerable to global extinction or extirpation in the state.
G2	S2	At risk because of very limited and/or potentially declining population numbers, range and/or habitat, making it vulnerable to global extinction or extirpation in the state.
G3	S3	Potentially at risk because of limited and/or declining numbers, range and/or habitat, even though it may be abundant in some areas.
G4	S4	Apparently secure, though it may be quite rare in parts of its range, and/or suspected to be declining.
G5	S5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range.
GX	SX	Presumed Extinct or Extirpated - Species is believed to be extinct throughout its range or extirpated in Montana. Not located despite intensive searches of historical sites and other appropriate habitat, and small likelihood that it will ever be rediscovered.
GH	SH	Historical, known only from records usually 40 or more years old; may be rediscovered.
GNR	SNR	Not Ranked as of yet.
GU	SU	Unrankable - Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
GNA	SNA	A conservation status rank is not applicable for one of the following reasons: 1) The taxa is of Hybrid Origin; is Exotic or Introduced; is Accidental or 2) is Not Confidently Present in the state. (see other codes below)

Combination or Range Ranks

G#G# Indicates a range of uncertainty about the status of the species.

or S#S# e.g. G1G3 = Global Rank ranges between G1 and G3 inclusive

Sub-rank

T# Rank of a subspecies or variety. Appended to the global rank of the full species, e.g. G4T3

Qualifiers

Q	Questionable taxonomy that may reduce conservation priority-Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank. Appended to the global rank, e.g. G3Q
?	Inexact Numeric Rank - Denotes uncertainty; inexactness.
HYB	Hybrid - Entity not ranked because it represents an interspecific hybrid and not a species.
C	Captive or Cultivated Only - Species at present exists only in captivity or cultivation, or as a reintroduced population not yet established.
A	Accidental - Species is accidental or casual in Montana, in other words, infrequent and outside usual range. Includes species (usually birds or butterflies) recorded once or only a few times at a location. A few of these species may have bred on the few occasions they were recorded.
SYN	Synonym - Species reported as occurring in Montana, but the Montana Natural Heritage Program does not recognize the taxon; therefore the species is not assigned a rank.
B	Breeding - Rank refers to the breeding population of the species in Montana. Appended to the state rank, e.g. S2B,S5N = At risk during breeding season, but common in the winter
N	Nonbreeding - Rank refers to the non-breeding population of the species in Montana. Appended to the state rank, e.g. S5B,S2N = Common during breeding season, but at risk in the winter
M	Migratory - Species occurs in Montana only during migration.

U.S. Fish and Wildlife Service (Endangered Species Act)

Status of a taxon under the federal Endangered Species Act of 1973
(16 U.S.C.A. § 1531-1543 (Supp. 1996))

Designation Descriptions

LE	Listed endangered: Any species in danger of extinction throughout all or a significant portion of its range (16 U.S.C. 1532(6)).
LT	Listed threatened: Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (16 U.S.C. 1532(20)).
PE	Proposed endangered: Any species for which a proposed rule to list the species as endangered has been published in the Federal Register.
PT	Proposed threatened: Any species for which a proposed rule to list the species as threatened has been published in the Federal Register.

E(S/A) or T(S/A)	Any species listed endangered or threatened because of similarity of appearance.
C	Candidate: Those taxa for which sufficient information on biological status and threats exists to propose to list them as threatened or endangered. We encourage their consideration in environmental planning and partnerships; however, none of the substantive or procedural provisions of the Act apply to candidate species.
PDL	Proposed for delisting - Typically combined with another designation code, where a species has one status currently, but a more recent proposal has been made to change that status with no final action yet published. For example, "LE, PDL" indicates that the species is currently listed as endangered, but has been proposed for delisting.
DM	Recovered, delisted, and being monitored - Any previously listed species that is now recovered, has been delisted, and is being monitored.
NL	Not listed - No designation.
XE	Experimental - Essential population - An experimental population whose loss would be likely to appreciably reduce the likelihood of the survival of the species in the wild.
XN	Experimental - Nonessential population - An experimental population of a listed species reintroduced into a specific area that receives more flexible management under the Act.
CH	Critical Habitat - The specific areas (i) within the geographic area occupied by a species, at the time it is listed, on which are found those physical or biological features (I) essential to conserve the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by the species at the time it is listed upon determination that such areas are essential to conserve the species.
PS	Partial status - status in only a portion of the species' range. Typically indicated in a "full" species record where an infraspecific taxon or population, that has a record in the database has USESA status, but the entire species does not.
PS:value	Partial status - status in only a portion of the species' range. The value of that status appears in parentheses because the entity with status is not recognized as a valid taxon by Central Sciences (usually a population defined by geopolitical boundaries or defined administratively, such as experimental populations.) For example, Yellow-billed Cuckoo (Coccyzus americanus) is ranked PS:C. Partial Status - Candidate. Designated as a Candidate in the Western U.S. Distinct Population Segment (DPS) (subspecies occidentalis)

Bureau of Land Management

BLM Sensitive Species are defined by the BLM 6840 Manual as those that normally occur on Bureau administered lands for which BLM has the capability to significantly affect the conservation status of the species through management. The State Director may designate

additional categories of special status species as appropriate and applicable to his or her state's needs. The sensitive species designation, for species other than federally listed, proposed, or candidate species, may include such native species as those that:

1. could become endangered in or extirpated from a state, or within a significant portion of its distribution in the foreseeable future,
2. are under status review by FWS and/or NMFS,
3. are undergoing significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution,
4. are undergoing significant current or predicted downward trends in population or density such that federally listed, proposed, candidate, or State listed status may become necessary,
5. have typically small and widely dispersed populations,
6. are inhabiting ecological refugia, specialized or unique habitats, or
7. are State listed but which may be better conserved through application of BLM sensitive species status. Such species should be managed to the level of protection required by State laws or under the BLM policy for candidate species, whichever would provide better opportunity for its conservation.

Designation Descriptions

Sensitive	Denotes species listed as sensitive on BLM lands
Special Status	Denotes species that are listed as Endangered or Threatened under the Endangered Species Act

U.S. Forest Service

U.S. Forest Service Manual (2670.22) defines Sensitive Species on Forest Service lands as those for which population viability is a concern as evidenced by a significant downward trend in population or a significant downward trend in habitat capacity. The Regional Forester (Northern Region) designates Sensitive species on National Forests in Montana. These designations were last updated in 2007 and they apply only on USFS-administered lands.

Since 2005, the U.S. Forest Service has also been moving toward implementing new planning regulations which would lead to changes in the identification of "special status" species on National Forest lands. These planning regulations were invalidated by the 9th Circuit Court on June 30, 2009. For the time being, Sensitive species will continue to be recognized for Region 1 under existing agency policy, but in addition some of the newly revised Forest Plans may also identify USFS Species of Concern and USFS Species of Interest.

Designation Descriptions

Endangered	Listed as Endangered (LE) under the U.S. Endangered Species Act.
Threatened	Listed as Threatened (LT) under the U.S. Endangered Species Act.
Sensitive	Listed as a Sensitive Species by USFS Northern Region (R1).

MFWP Conservation Need

In recent years states have received federal funding to develop Comprehensive Fish and Wildlife Conservation Strategies. Montana Fish, Wildlife, and Parks completed Montana's Comprehensive Fish and Wildlife Conservation Strategy in 2005. Under this conservation strategy individual animal species were assigned levels of conservation need as follows:

Tier I	Greatest conservation need. Montana Fish, Wildlife & Parks has a clear obligation to use its resources to implement conservation actions that provide direct benefit to these species, communities, and focus areas.
Tier II	Moderate conservation need. Montana Fish, Wildlife & Parks could use its resources to implement conservation actions that provide direct benefit to these species, communities, and focus areas.
Tier III	Lower conservation need. Although important to Montana's wildlife diversity, these species, communities, and focus areas are either abundant and widespread or are believed to have adequate conservation already in place.
Tier IV	Species that are non-native, incidental, or on the periphery of their range and are either expanding or very common in adjacent states.

Percent of Global Breeding Range in MT

The percentage of the species' Global Breeding Range represented by its Breeding Range in Montana.

Percent of MT that is Breeding Range

The percentage of Montana's Total Area identified as the Breeding Range of this species.

Habitat

A short description of the general habitat in which you are most likely to find this species.

Partners In Flight (PIF)

Partners In Flight (PIF) is a partnership of federal and state agencies, industry, non-governmental organizations, and many others, with the goal of conserving North American birds. In 1991, PIF began developing a formal species assessment process that could provide consistent, scientific evaluations of conservation status across all bird species in North America, and identify areas

most important to the conservation of each species. This process applies quantitative rule sets to complex biological data on the population size, distribution, population trend, threats, and regional abundance of individual bird species to generate simple numerical scores that rank each species in terms of its biological vulnerability and regional status. The process results in global and regional conservation assessments of each bird species that, among other uses, can be used to objectively assign regional and continental conservation priorities among birds.

The species assessment scores and process has recently been updated! Check out the new scores and make sure to download and read the updated Handbook on Species Assessment, which contains important information on the how scores are derived and used in the assessment process. Note that currently only breeding-season regional scores are available for BCRs. We hope to have non-breeding scores available soon. For those needing access to the previous versions of the PIF Species Assessment Database, including past regional scores for physiographic areas, click here.

Appendix C. Wildlife distribution maps.

Grouse: Ruffed - Greater Sage - Dusky - Spruce

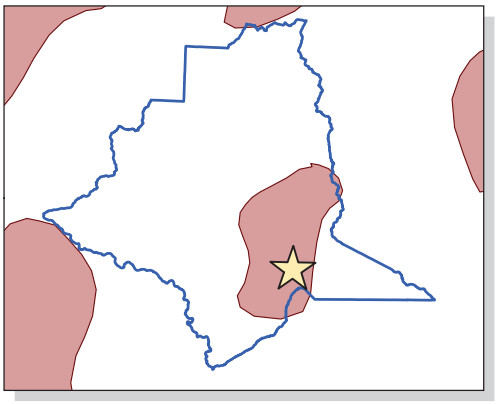
Montana Fish, Wildlife & Parks GIS Data

Montana Field Guide Data

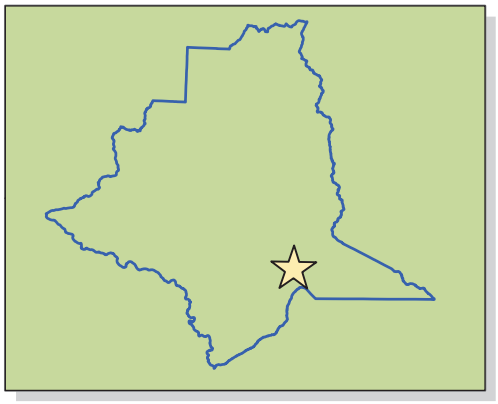
Distribution (Habitat for Greater Sage Grouse)

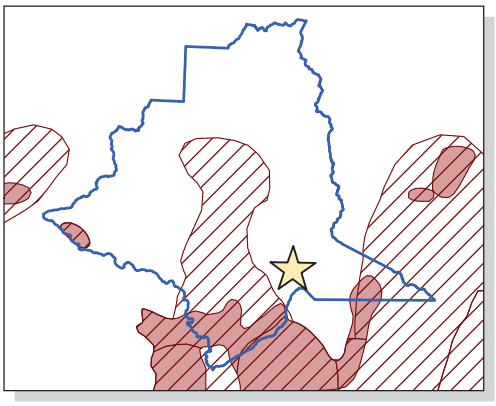
Historical Habitat

Year Round Range

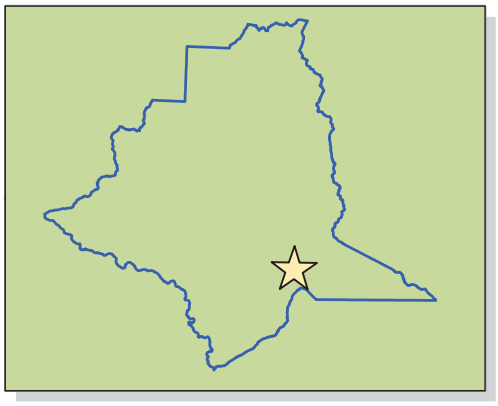


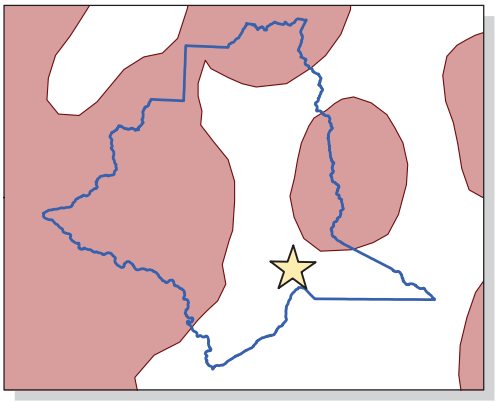
Ruffed Grouse



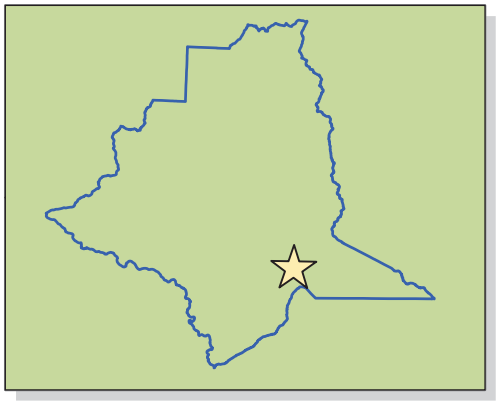


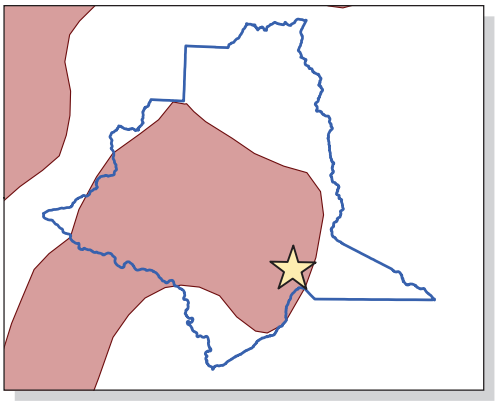
Greater Sage Grouse



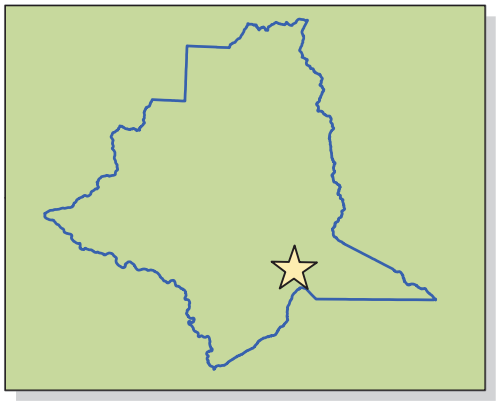


Dusky Grouse





Spruce Grouse



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

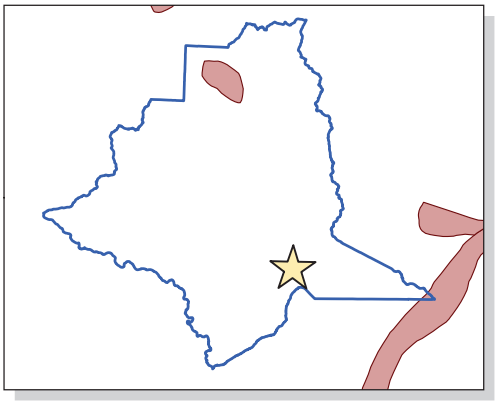
Wild Turkey - Gray Partridge - Ring-necked Pheasant

Montana Fish, Wildlife & Parks GIS Data

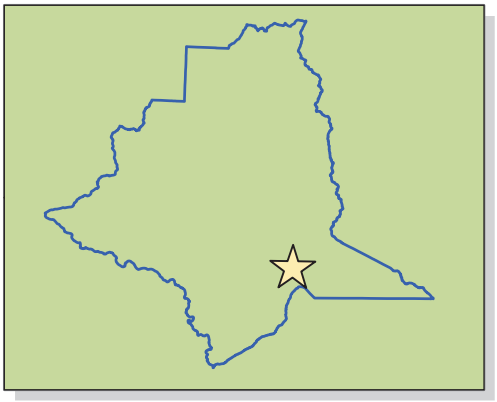
Habitat (Distribution for Gray Partridge)

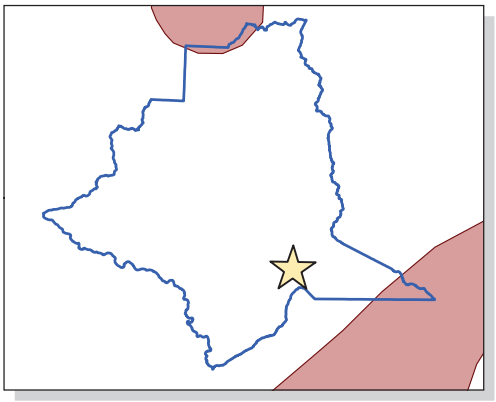
Montana Field Guide Data

Year Round Range

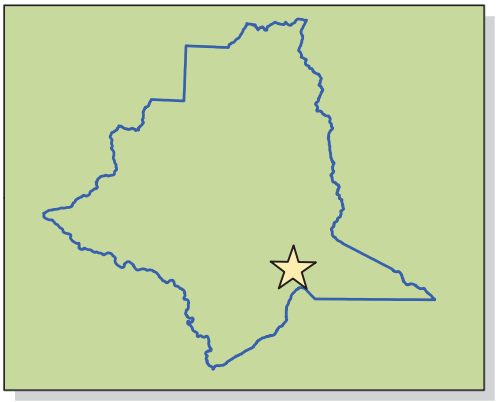


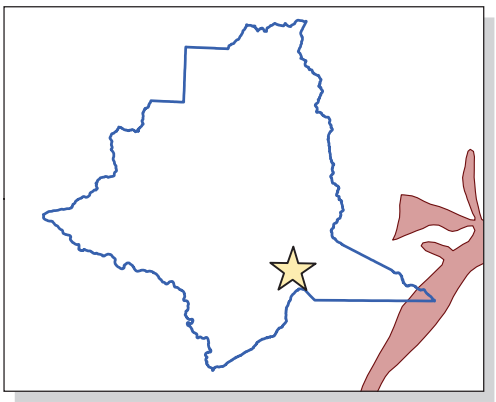
Wild Turkey



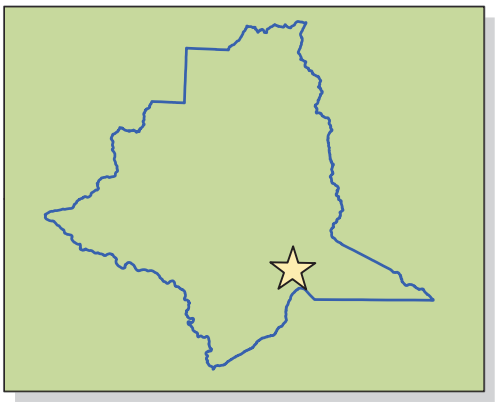


Gray Partridge





Ring-necked Pheasant



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Black Bear - Grizzly Bear

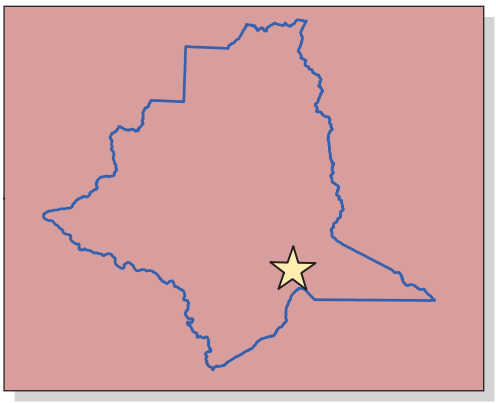
Montana Fish, Wildlife & Parks GIS Data

General Range

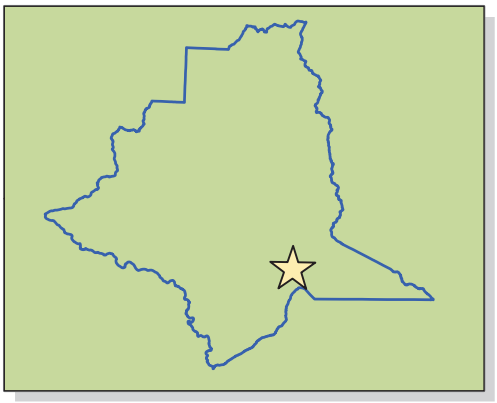
Montana Field Guide Data

Year Round Range

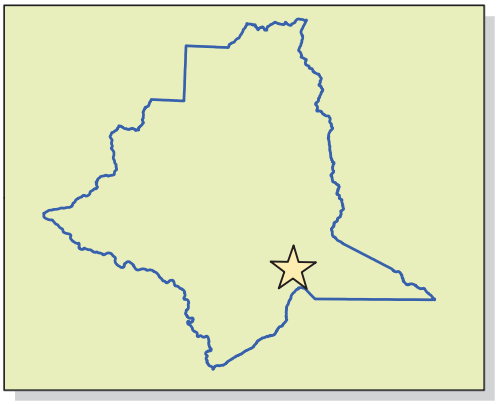
Historic Range



Black Bear



Grizzly Bear



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Canada Lynx - Bobcat - Mountain Lion

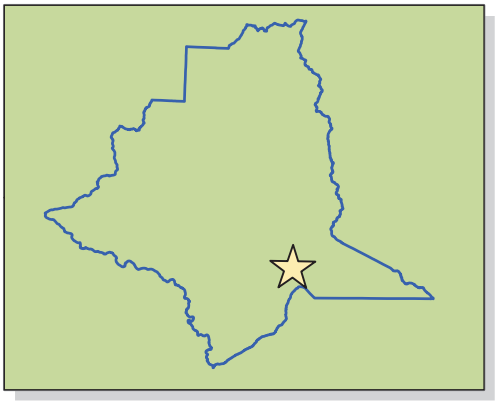
Montana Fish, Wildlife & Parks GIS Data

General Range

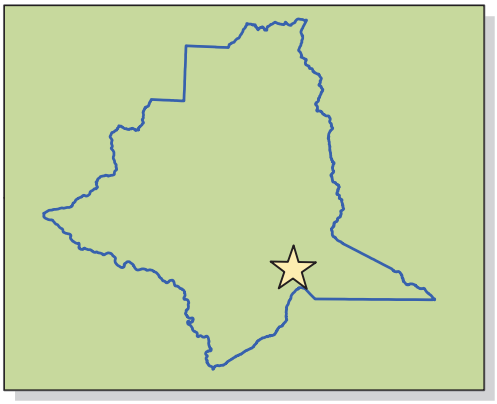
Montana Field Guide Data

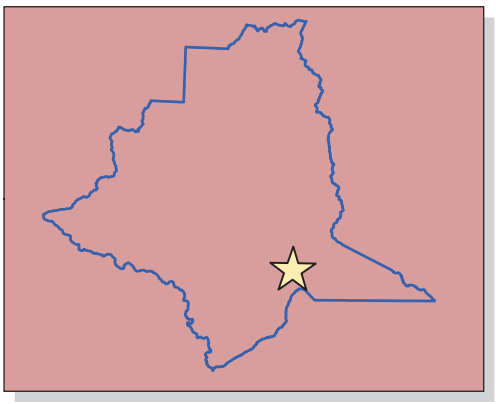
Year Round Range

Canada Lynx

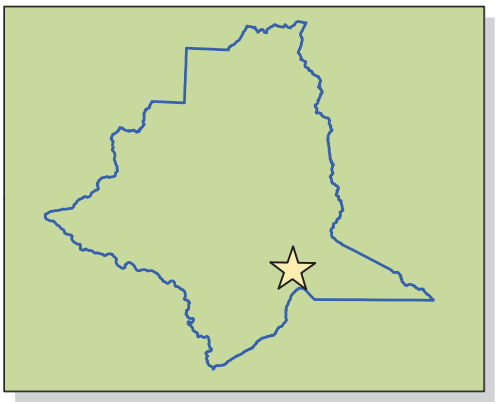


Bobcat





Mountain Lion



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Elk - Moose - Mule Deer - Whitetailed Deer

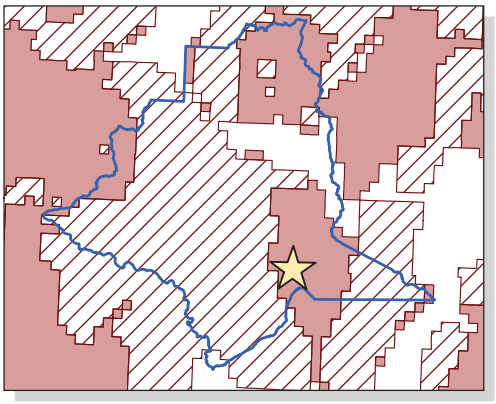
Montana Fish, Wildlife & Parks GIS Data

Montana Field Guide Data

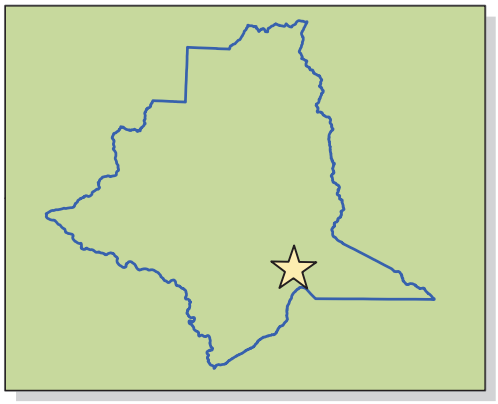
General Range

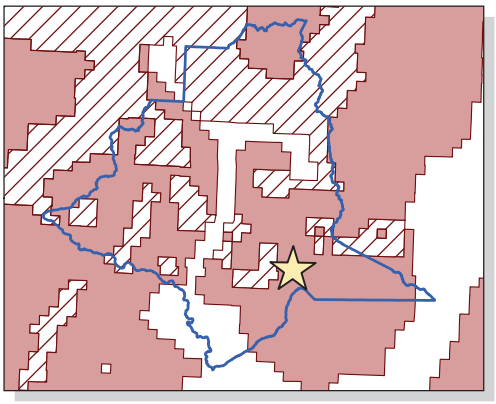
Winter/General Range

Year Round Range

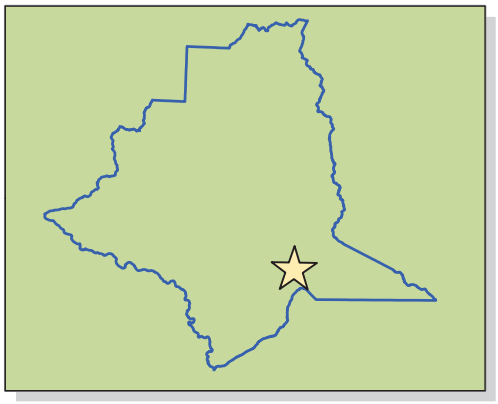


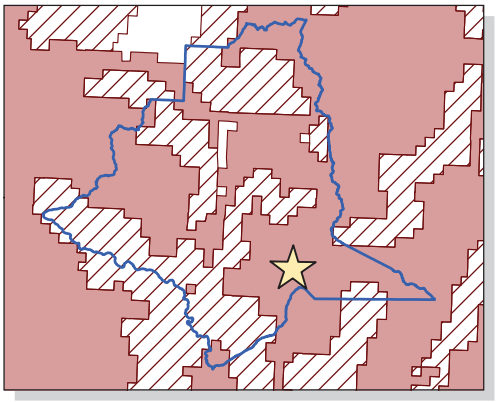
Elk



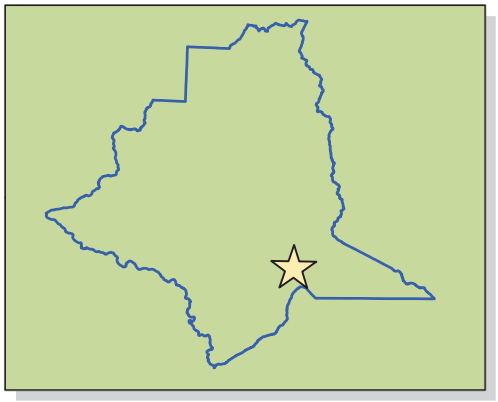


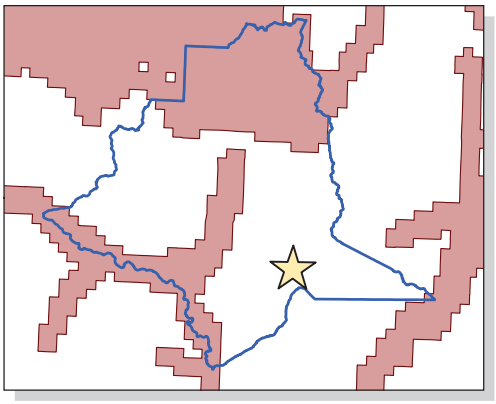
Moose



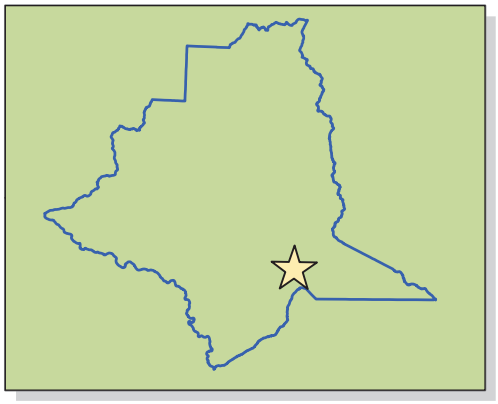


Mule Deer





White-tailed Deer



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Pronghorn Antelope - Mountain Goat - Bighorn Sheep

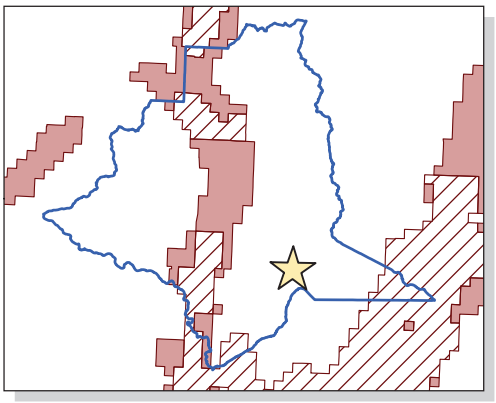
Montana Fish, Wildlife & Parks GIS Data

General Range

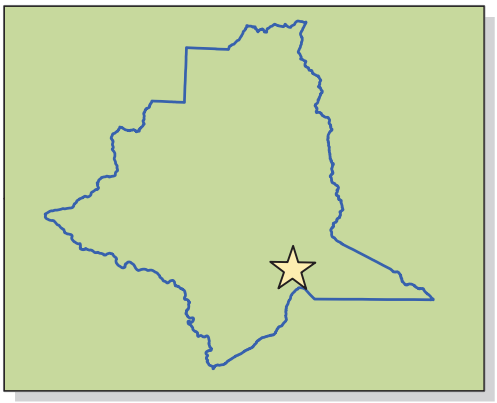
Winter/General Range

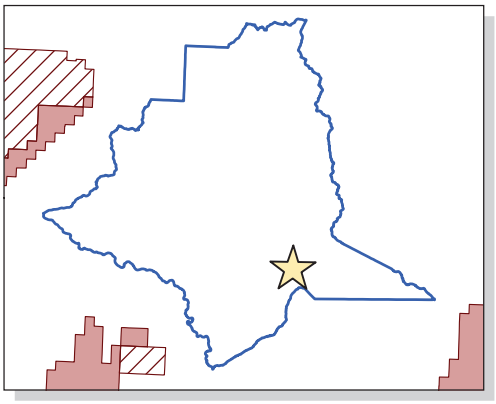
Montana Field Guide Data

Year Round Range

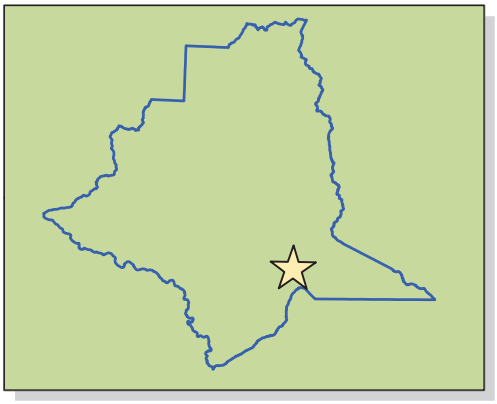


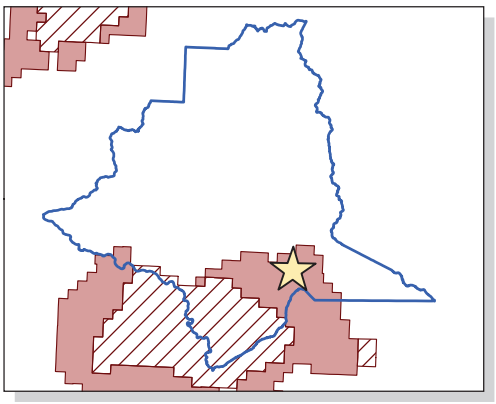
Pronghorn Antelope



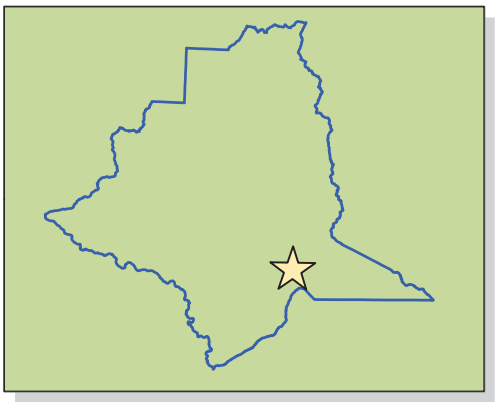


Mountain Goat





Bighorn Sheep



Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Coyote - Gray Wolf - Red Fox

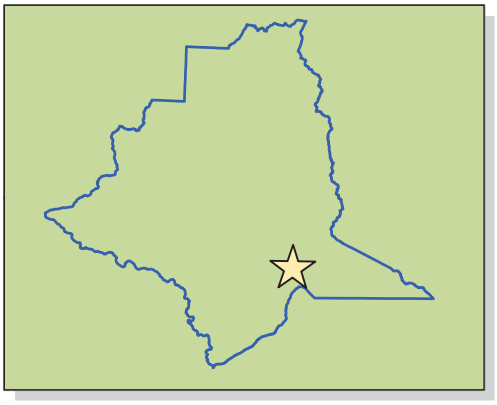
Montana Fish, Wildlife & Parks GIS Data

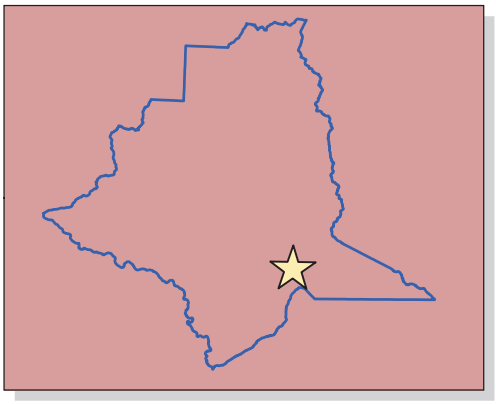
General Range

Montana Field Guide Data

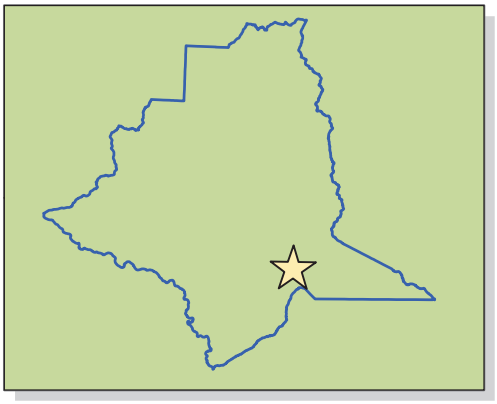
Year Round Range

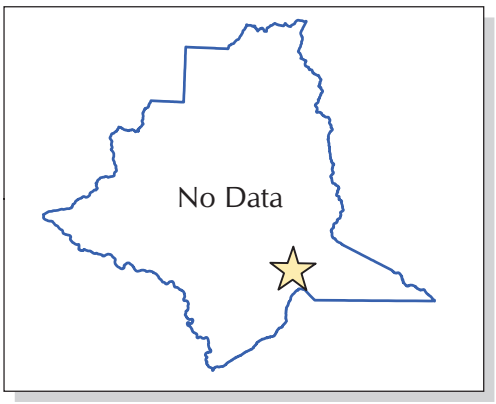
Coyote



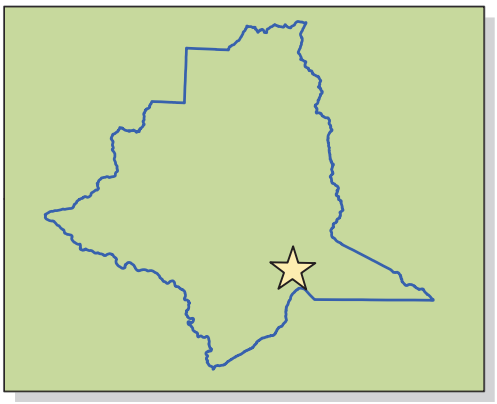


Gray Wolf





Red Fox

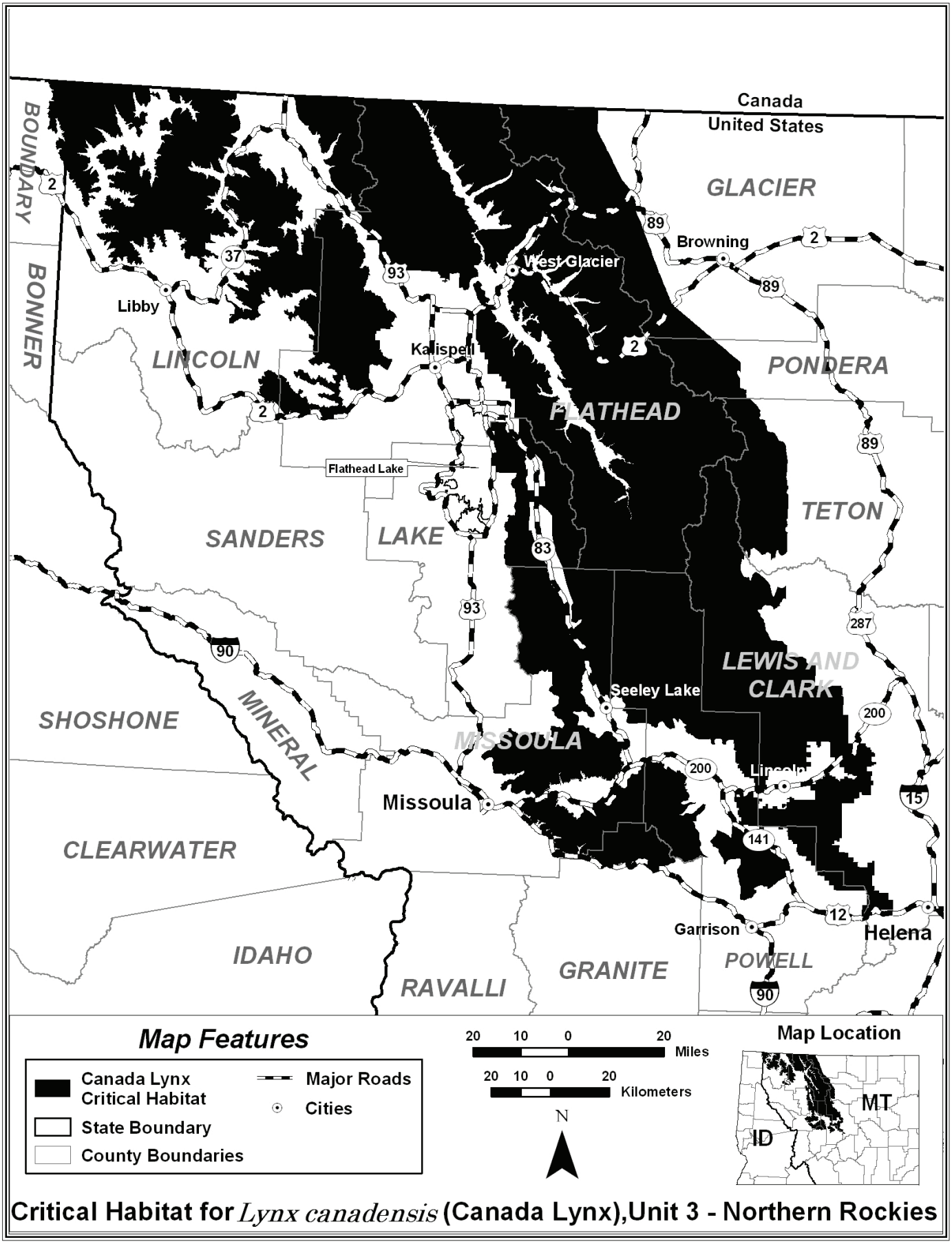


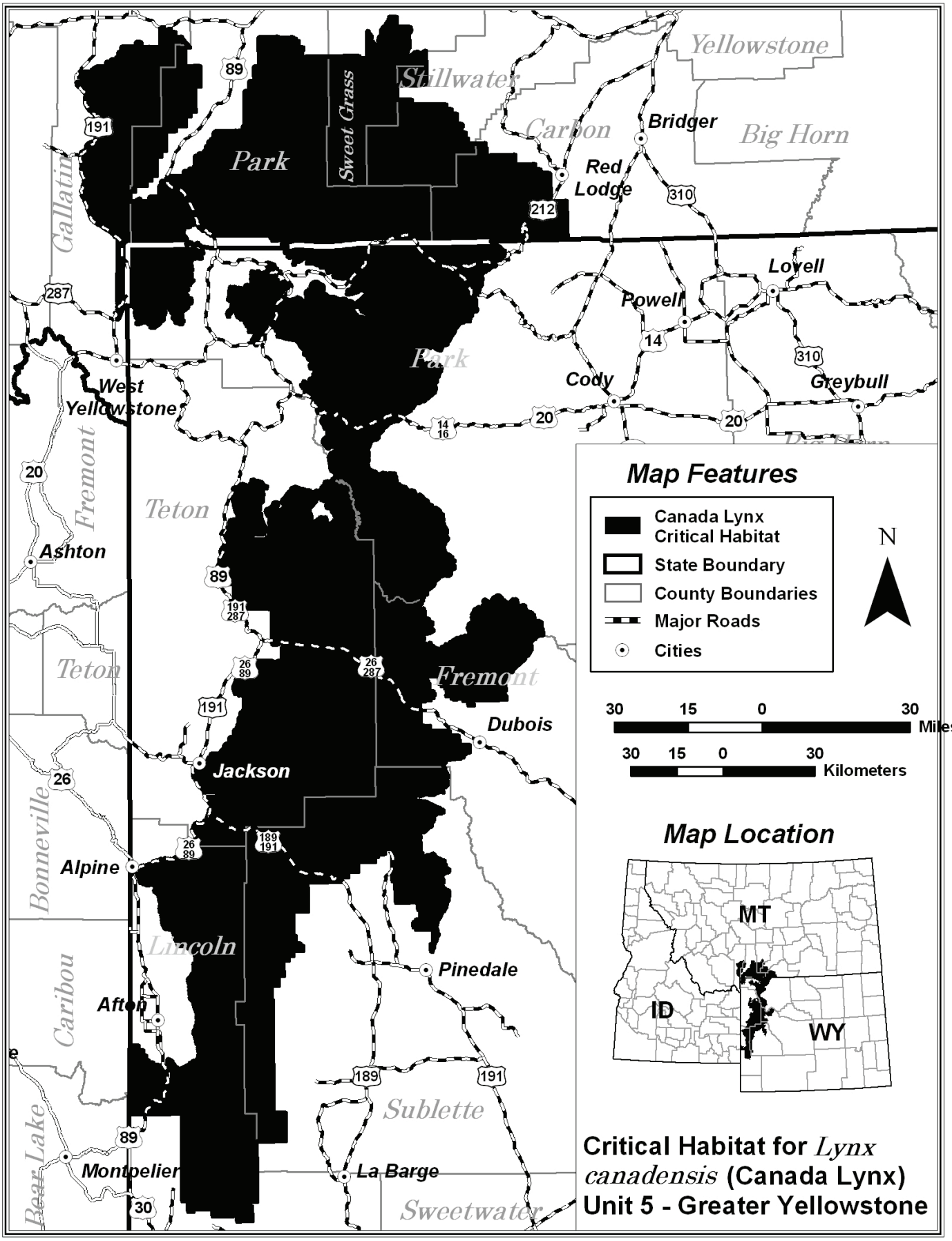
Silver Bow County

Butte Highlands Project Area

Jasper Geographics 12/2009

Appendix D. Canada lynx critical habitat.





Critical Habitat for *Lynx canadensis* (Canada Lynx)
Unit 5 - Greater Yellowstone

July 2009 Stream Habitat Survey for the Butte Highlands Project

Kline Environmental Research, LLC
2041 120th St.
Milltown, WI 54858
715-857-5537
edkline@lakeland.ws

and

Klepfer Mining Services, LLC
13058 Sherwood Court
Hayden Lake, ID 83835
208-772-6993
eric@klepfermining.com

January 15, 2010

Table of Contents

Section	Page
1.0 Introduction	1
2.0 Existing Information	1
3.0 Methods	4
4.0 Results and Discussion	5
4.1 Basin Creek	5
4.2 Middle Fork Moose Creek	6
4.3 Fish Creek	9
5.0 References	11

Tables

1. Reported fish occurrence in drainages that include Butte Highlands claims
2. Field notes, stream mile locations, photograph identifiers, and corresponding GPS coordinates

Figures

1. Project location map
2. Perennial and intermittent stream reaches surveyed during July 2009
3. Basin Creek habitat features
4. Middle Fork Moose Creek habitat features
5. Fish Creek habitat features

Photographs

Appendices

A. MFISH maps and data for streams in the Butte Highlands Project area
B. Historic placer mining activity in the Butte Highlands Project area

1.0 Introduction

The Butte Highlands Project is a proposed underground gold mine located in Silver Bow County, Montana, approximately 15 miles south of Butte (Figure 1). The Project straddles the Continental Divide within the upper portion of the drainages of Basin Creek, Fish Creek, and Middle Fork Moose Creek (Figure 2). The objectives of this report were to:

- Summarize existing information pertaining to streams in the Project area;
- Document baseline conditions of stream habitat in the Project area based on a field survey that was conducted during July 2009.

2.0 Existing Information

The Montana Fisheries Information System database (MFISH) was queried to gather existing data on streams in the Project area (Appendix A). The MFISH database is updated annually with information from Montana Department of Fish, Wildlife, and Parks, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, tribal fisheries biologists, and technical documents. A search of the Montana Department of Environmental Quality web site and a keyword search using the names of previous operators did not reveal any relevant documents.

The MFISH database included information on fish distribution in Basin Creek, Middle Fork Moose Creek, Moose Creek, and Fish Creek (Table 1). There was no information on stream conditions near the Project area in the MFISH database. No information was found for tributaries to Fish Creek and Middle Fork Moose Creek that were located during the July 2009 field survey. A figure that is provided on the Timberline Resources Corporation website (www.timberline-resources.com) indicated that historic placer mining activity occurred in the drainages of Basin Creek, Middle Fork Moose Creek, and Fish Creek (Appendix B).

The following fish species are reported to occur within or near the Project area:

- native, genetically pure westslope cutthroat trout (*Oncorhynchus clarki lewisi*)
- introduced, hybridized Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*)
- introduced rainbow trout (*Oncorhynchus mykiss*, no genetic analysis)

- various cutthroat and rainbow trout hybrids (*Oncorhynchus* sp.)
- introduced brook trout (*Salvelinus fontinalis*)
- mottled sculpin (*Cottus bairdii*)

Westslope cutthroat trout are a Montana Species of Concern, defined as native animals breeding in the state that are considered to be at risk due to declining population trends, threats to their habitats, and/or restricted distribution. They are also considered to have special or sensitive status by the U.S. Forest Service, Montana Department of Natural Resources and Conservation, the Bureau of Land Management, and the Crow Tribe. Westslope cutthroat trout were reviewed by the U.S. Fish and Wildlife Service but are not listed under the Endangered Species Act. Management goals for the species are described in a Memorandum of Understanding and Conservation Agreement that has been developed between resource agencies, conservation and industry organizations, tribes, resource users, and private landowners (Montana Cutthroat Steering Committee 2007).

Basin Creek is 16.1 stream miles in length. It is reported to support introduced brook trout from stream mile 12.5 (3.4 stream miles downstream of the Project) to its confluence with Silver Bow Creek. Native, genetically pure westslope cutthroat trout are reported to occur in the upper 6.9 stream miles of Basin Creek, including the upper 0.2 stream miles that are within the Main Ripple Claim (Figure 2). Both species are reported to be common, year-round residents. This information is based on extrapolation of results from a population survey that was conducted 3.6 stream miles downstream of the Project during 2007, and presumably other surveys that were conducted further downstream or in Silver Bow Creek. Identification of westslope cutthroat trout was based on genetic analysis of fish that were collected 7 stream miles downstream of the Project during 2001. Drainage from the historic Highlands Mine contributes to the stream flow in the upper reach of Basin Creek.

Middle Fork Moose Creek is indicated as originating in the Red Mountain Claim and flowing 2.7 stream miles to its confluence with Moose Creek. It is reported to support a year-round resident population of introduced, hybridized Yellowstone cutthroat trout (unreported cross species) and to be used for spawning and rearing by introduced Yellowstone/westslope cutthroat trout

hybrids. The abundance of these fish is unknown and their presence in the stream is presumably extrapolated from surveys that were conducted in Moose Creek. No population or genetic survey data for Middle Fork Moose Creek was found. An unnamed tributary from the south crosses the Pony Placer Claim and enters Middle Fork Moose 0.5 stream miles downstream of the claim boundary (Figure 2). No information was found regarding the potential for this drainage to provide perennial stream habitat.

Moose Creek is approximately 2 stream miles downstream of the Pony Placer Claim boundary. Moose Creek is 16.2 stream miles in length and is a tributary to the Big Hole River. Middle Fork Moose Creek enters Moose Creek at stream mile 12.3. Near this confluence, introduced brook trout and native mottled sculpin are reported to be abundant, introduced rainbow trout are reported to be rare, and introduced Yellowstone/westslope cutthroat trout hybrids are reported to be present.

Fish Creek flows 25.6 stream miles from its origin to the Jefferson River. Two unnamed tributaries to Fish Creek originate within the Project area (Figure 2). Tributary 1 is down-gradient from the Murphy Claim and enters Fish Creek at stream mile 25.2. Tributary 2 is fed by Tributary 2A, which crosses the southeast corner of the Main Chance Claim, joins with Tributary 2B, which is not potentially impacted by the Project, and enters Fish Creek at stream mile 24.8. The upper limits of fish distribution in Fish Creek are reported to be 0.1 stream miles downstream of the confluence of Tributary 2, based on surveys that were conducted, most recently, during 2007 downstream of stream mile 22.1. Introduced brook trout and native westslope cutthroat trout are reported to be year-round residents, but rare, in this portion of Fish Creek. Westslope cutthroat trout are considered potentially unaltered, genetically, with no record of stocking between stream mile 22.7 and 24.6 (1994 sampling), and are considered 90 to 99.9% pure based on genetic analysis of fish collected between stream mile 14.0 and 22.7 (2007 sampling).

3.0 Methods

All drainages in the Project area were surveyed during July 6-12, 2009. Moose Creek was not surveyed because fish habitat was identified in Middle Fork Moose Creek. The route of each stream was documented using a handheld GPS receiver, from the upper limit of evidence of water flow to perennial stream habitat at varying distances downstream from the Project boundaries. Relevant features were photographed, described, and located using GPS. These features included general descriptions of stream and riparian habitat, observed fish, fish passage barriers, erosion, culverts, and other features.

All field notes and photographs were tabulated along with GPS coordinates. Location determination was based on frequent noting of location combined with interpolation of intermediate points. Stream mile location was calculated based on calculated distances using the Universal Transverse Mercator (UTM) projection and the Pythagorean theorem:

$$\text{distance} = \text{sqrt}\ (\ (x1-x2)^2 + (y1-y2)^2)$$

Data from multiple surveys of certain reaches were superimposed. Data were adjusted when necessary to bring outliers in line with the stream course. UTM coordinates and stream mile calculations in this report should be considered approximations.

4.0 Results and Discussion

Data are presented and discussed from downstream to upstream. All field notes were tabulated along with UTM coordinates, calculated stream mile locations, and photograph identifiers (Table 2). Corresponding photographs follow the tables and figures.

Stream discharge in the Project area has been measured and is reported in a separate report. Based on data from the Natural Resources Conservation Service SNOTEL station at Basin Creek (www.wcc.nrcs.usda.gov/snotel/), stream flow during the survey period was probably greater than baseflow and somewhat greater than average for July. Baseflow conditions usually occur during August or September in streams and rivers in the Butte area. Snow melt was complete on May 27 at the Basin Creek SNOTEL station. Total precipitation through June of the 2009 water year (October - September) was 11% greater than the average total through June of the previous ten water years. There was 0.1 inches of rain on July 5 and 0.2 inches on July 9.

4.1 Basin Creek

The upper 0.58 stream miles of Basin Creek were surveyed, from stream mile 15.50 where a barbed wire fence crossed the stream, to its underground origin at stream mile 16.08 (Figure 3).

The lower 0.31 stream miles of this reach (stream mile 15.50 to 15.81) provided suitable habitat for a resident fish population. Riparian vegetation ranged from conifer stands of varying ages to sedge and horsetail meadows. Canopy coverage was generally moderate to light. With the exception of one short braided segment, the reach was a single channel. Depths of 4 to 8 inches and wetted widths of 4 feet were common, narrowing to 1 foot where the stream was incised in meadows. There was ample holding cover in the form of undercut banks, overhanging vegetation, and some large woody debris. A variety of habitat types were present, including high gradient riffles, runs, glides, plunge pools, and low gradient riffles, which were the most prevalent habitat type. Sand and gravel substrate dominated this reach. Sand would limit the use of this reach for spawning, although some spawning gravels were present. There were no deep pools, which would limit the use of this reach for overwintering. Three tributaries entered this reach, with one contributing approximately the same discharge as Basin Creek (stream mile 15.59). A significant barrier occurred at stream mile 15.66. The vertical drop was 3.5 feet, the

plunge pool was 8 inches deep, and the landing was 4 inches wide, making the launch and landing challenging and thus probably presenting a barrier to most fish at the discharge that occurred during the survey.

From this barrier to the origin of Basin Creek (stream mile 15.81 to 16.08), fish are unlikely to occur under the conditions that were observed during this survey. Riparian vegetation was similar to downstream, with conifer stands of varying ages, wet meadows, and willows. Canopy coverage was generally moderate to light but was heavy in some of the steep, upper reaches. The channel was often braided or split into two or three shallow channels. Depths of 1 to 3 inches were common. Wetted widths varied widely depending on braiding. Holding cover was limited due to shallow depths. Low and high gradient riffles predominated, with some shallow cascades and two culverts that would restrict fish passage. A variety of substrate sizes were present, although sand and silt were common. When coarser substrates occurred (large gravel, small cobble), they were often heavily embedded with sand. These conditions would limit the potential use of this reach for spawning and suppress the macroinvertebrate population. The upper portion of this reach included a silted glide and low gradient riffle that was downstream of a final steep segment before the underground origin. No evidence of surface flow was found above the underground origin. While there were short segments that offered potential fish holding and spawning habitat in this reach, overall, it offered poor fish habitat due to shallow water, heavily embedded substrate, isolated reaches due to cascades and braiding, and an absence of deep pools.

4.2 Middle Fork Moose Creek

Middle Fork Moose Creek was surveyed from its confluence with Moose Creek to the upper limit of a definable drainage (Figure 4). This limit occurred at stream mile 2.18, which was down-gradient from FS Road 8250. The MFISH stream mile map shows the stream originating at stream mile 2.7, up-gradient from FS Road 8250. The area above FS Road 8250 was surveyed and found not to include perennial or intermittent stream habitat. Only short, isolated segments of storm water runoff channels were located. Two culverts within the stream basin under FS Road 8250 were dry and did not have eroded channels or wetlands associated with them. Tributary 1 (1.27 stream miles) was surveyed from the confluence with Middle Fork Moose

Creek to a culvert under FS Road 8250, where it still had considerable flow but was unlikely to support fish (see below). Tributary 1A (0.61 stream miles) was surveyed from its origin, down-gradient of FS Road 8250, to the confluence with Tributary 1.

Between the confluence with Moose Creek and Tributary 1, Middle Fork Moose Creek (stream mile 0 to 0.71) was deeply incised (1 to 3 feet to the water surface) in a wetland. Riparian vegetation was mainly sedge and other non-woody wetland species. Canopy coverage was generally absent, except for some segments that flowed near bushes and scattered conifers. The reach was sometimes a single, dominant channel, but was often split into multiple channels or dispersed in a wetland. Depths of 1 to 3 feet and wetted widths of 1 to 2 feet were common. Holding cover in the form of undercut banks and overhanging vegetation was prevalent. Habitat types were mainly glides and runs, with some pools. The substrate was mainly organic detritus, sand, and silt, with little or no spawning habitat. Deep, overwintering habitat was plentiful.

Upstream of the confluence with Tributary 1A (stream mile 0.79 to 1.42), Middle Fork Moose Creek flowed through a wetland, however, no definable channel was present through most of this reach. Within this reach, a large berm formed a pond (stream mile 1.03). Up-gradient from this pond, except for short segments with visible flow, the stream was totally dispersed within wetland habitat and no fish habitat was located. A small berm was present that appeared to direct the majority of the flow toward the pond. Without the small berm, it appeared possible that the majority of the discharge would flow to the south, where a minor portion of the flow was present during the survey. This minor drainage is referred to as MF Moose minor split in Table 2.

From stream mile 1.42 to 1.89, there was a wide variety of stream conditions, most of which could potentially provide habitat for fish. However, several locations had conditions that fragmented the fish habitat into isolated segments, including an 18 m long segment that was dry (stream mile 1.42), a 3 foot vertical barrier (stream mile 1.55), debris jams (stream mile 1.55 and 1.63), and dispersion in wetlands (stream mile 1.71, 1.74, 1.75, 1.79, 1.80, 1.86).

From stream mile 1.89 to the up-gradient extent of a defined drainage (stream mile 2.18), there was too much dispersion and insufficient discharge to provide fish habitat under the conditions that occurred during the survey.

Tributary 1 to Middle Fork Moose Creek was the only reach in the Project area where a fish was observed (stream mile 0.29). Based on a fleeting glimpse, the fish appeared to be a salmonid that was approximately 5 inches in length. The lower 0.15 stream miles of Tributary 1 was a meandering single channel through a wetland. Much of this segment had a gravel substrate and undercut banks, offering more consistent and higher quality fish habitat than the lower reach of Middle Fork Moose Creek. Wetted widths were generally between 2 and 4 feet. Typical water depth ranged from 4 to 24 inches. Upstream of stream mile 0.15, the gradient increased, resulting in a mix of low gradient riffles, high gradient riffles, and plunge pools. Habitat diversity was high, with holding cover in the form of large substrate, root wads, large woody debris, overhanging vegetation, undercut banks, and turbulence. Gravel and cobble substrate predominated. Riparian vegetation varied between wetland plants and conifers, resulting in canopy coverage ranging from open to dense. In wooded segments, wetted widths were generally 2 to 4 feet and depths were 3 to 6 inches. In wetland segments, wetted widths were reduced and depths were greater. Tributary 1A entered Tributary 1 at stream mile 0.64. Tributary 1 flowed as a single channel through a wetland upstream of this confluence until a berm was reached at stream mile 0.72.

Tributary 1 was dispersed for 0.1 stream miles upstream of this location, offering no fish habitat and blocking passage. Fish habitat resumed at stream mile 0.82, but was intermittent. There were segments of clean gravel, cobble, riffles, 12-inch deep pools, varying canopy coverage, and undercut banks. Between segments of good fish habitat were segments with high embeddedness, siltation, subsurface flow, dispersion, split channels, and a 4 foot barrier at stream mile 1.18. Significant flow continued upstream of a FS Road 8250culvert and through a culvert that is approximately 0.3 stream miles upstream, under Fish Creek Road. The stream was not surveyed upstream of FS Road 8250.

Tributary 1A provided continuous habitat that may support a resident fish population. However, a barrier that would restrict upstream movement of small fish was 0.1 stream miles upstream of the confluence with Tributary 1. The barrier was 4 vertical feet and had a 16 inch deep plunge pool. In addition, while riparian and stream habitat diversity was high in Tributary 1A, overall fish habitat quality was reduced by high levels of substrate embeddedness. Tributary 1A originated in a wetland, down-gradient of FS Road 8250.

4.3 Fish Creek

Fish Creek was surveyed from an arbitrary location at stream mile 24.40 to the upper limits of a definable drainage (Figure 5). This limit occurred at stream mile 25.32. Two tributaries that originated down-gradient of the mine site were also surveyed. Tributary 1 (0.40 stream miles) was surveyed from the confluence with Fish Creek to the upper limits of a definable drainage. Tributary 2 (0.35 stream miles) was surveyed from the confluence with Fish Creek to the confluence of Tributaries 2A and 2B. Tributary 2A was surveyed to the upper limits of a definable drainage. Tributary 2B was surveyed to a culvert under Fish Creek Road, where it still had considerable flow.

The lower survey reach of Fish Creek (stream mile 24.40 to 24.66) was comprised of low gradient and high gradient riffles, runs, and pools that were typically 12 to 15 inches deep. Wetted widths of the riffles were 4 to 8 feet and depths were generally 5 to 8 inches. Conifers provided moderate canopy coverage, with some short open segments. High velocity flows through most of the reach maintained a gravel and cobble substrate that was low in fine sediments on substrate surfaces, but often highly embedded with sand. Plumes generated from walking indicated the presence of buried fine sediments in some locations. Holding cover was plentiful in the form of undercut banks, large substrate, and turbulent plunge pools. Much of the flow in this reach was derived from Tributary 2 at stream mile 24.66.

Existence of a fish population in Fish Creek is less likely upstream of the Tributary 2 confluence at stream mile 24.68, due initially to a 67 foot long cascade and low flow, which probably blocks all upstream fish passage under the survey conditions. Upstream of this cascade, Fish Creek offered intermittent fish habitat, but was often heavily silted, impounded, or segmented by

wetlands or cascades. Populations of fish may exist that are isolated from the lower reach, downstream of Tributary 2, although highly embedded substrate and siltation would severely limit the availability of spawning habitat. The stream flowed intermittently subsurface in its headwaters and appeared to originate from a wetland at stream mile 25.32.

Tributary 1 entered Fish Creek at stream mile 25.12. Flows were generally too low to provide fish habitat, except for possibly the lower 22 feet of Tributary 1. Short segments of developed channel along its 0.40 mile length indicated that minimal fish habitat during high flows may be available.

Tributary 2 had similar or greater discharge than Fish Creek at their confluence. It probably supports fish through stream mile 0.06. At this point, a 100 foot long cascade probably blocks upstream passage for most fish. Upstream of this cascade, suitable habitat for spawning, rearing, and holding existed, despite numerous locations where the channel split and rejoined the main channel. The stream passed through a culvert at steam mile 0.12. The entire stream followed the path of a gravel road for a short segment where Tributaries 2A and 2B joined at stream mile 0.35.

Tributary 2A (0.74 stream miles) offered short, isolated segments of fish habitat and probably did not support any fish during the survey. Water was often only 1 to 2 inches deep, and disappeared in sand in places. There were impounded areas of sediment in the upper reaches and evidence of a sediment impoundment that had washed out.

Tributary 2B was similar to the main branch of Tributary 2. Low gradient riffles, high gradient riffles, cascades, and pools were common. Large cobble substrate and gravel predominated, although embeddeness was often high. Large woody debris was abundant, particularly in the upper portion of the reach. A conifer canopy varied from light to heavy. There was significant flow through the culvert under Fish Creek Road where the survey ended.

5.0 References

Overton, C.K., S.P. Wollrab, B.C. Roberts and M.A. Radko, 1997. R1/R4 (Northern/Intermountain Regions) Fish and Fish Habitat Standard Inventory Procedures Handbook, General Technical Report INT-6TR-346, United States Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah, 73 p

The Montana Fisheries Information System database (MFISH, http://fwp.mt.gov/fishing/mfish/)

Montana Cutthroat Steering Committee. 2007. Memorandum of understanding and conservation agreement for westslope cutthroat trout and Yellowstone cutthroat trout in Montana.

Table 1. Reported fish occurrence in drainages that include Butte Highlands claims. Data are from the Montana Fish Wildlife and Parks MFISH database. Fish occurrence was extrapolated in the MFISH database based on surveys conducted downstream.

Stream name	Tributary to	MT river basin HUC	Continental divide side	Reported fish occurrence
Basin Creek	Silver Bow Creek	Upper Clark Fork (17010201)	west	Westslope cutthroat trout (100% pure) within claim boundaries. Brook trout 3.4 miles downstream of claim boundary.
Middle Fork Moose Creek	Moose Creek	Big Hole (10020004)	east	Hybridized Yellowstone cutthroat trout (unreported cross species) and Yellowstone/westslope cutthroat trout hybrids within claim boundaries. Brook trout, rainbow trout, mottled sculpin 2 miles downstream of claim boundary.
Tributary 1	Middle Fork Moose Creek			No data.
Fish Creek	Jefferson River	Jefferson (10020005)		Westslope cutthroat trout (90 to 99.9% pure) and brook trout 0.8 mile downstream of claim boundaries via Tributary 2.
Tributary 1 and 2	Fish Creek			No data.

Table 2. Field notes, stream mile locations, photograph identifiers, and corresponding GPS coordinates.

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
1	Basin	7/10/09	1, 2	2	381835	5073078		15.50												
2	Basin	7/10/09	3	2	381836	5073050	29	15.52												
3	Basin	7/10/09	4	2	381836	5073021	29	15.54												
4	Basin	7/10/09	5	2	381837	5072993	29	15.55												
5	Basin	7/10/09	6	2	381837	5072983	10	15.56												minor tributary
6	Basin	7/10/09	7	2	381838	5072964	19	15.57												
7	Basin	7/7/09	8	2	381838	5072958	6	15.57									sedge, horsetail			significant tributary from left, looking upstream
8	Basin	7/7/09			381837	5072950	8	15.58	6			sand, gravel		1	6-8		sedge, horsetail meadow	incised 6"		
9	Basin	7/10/09	9	3	381838	5072938	12	15.59												tributary, similar flow to basin
10	Basin	7/10/09	10	3	381838	5072936	3	15.59												
11	Basin	7/7/09	11	3	381835	5072932	5	15.59	18	lgr		sand, gravel		1-2		light	mixed conifer	incised 1'		
12	Basin	7/7/09	12	3	381833	5072907	25	15.61	14	lgr	braided	sand		4-15	2-8					
13	Basin	7/10/09	13	3	381826	5072907	7	15.61												
14	Basin	7/10/09	14	3	381820	5072879	29	15.63												
15	Basin	7/10/09	15	3	381813	5072850	29	15.65												
16	Basin	7/10/09			381807	5072847	7	15.65												tributary
17	Basin	7/7/09	16	3	381800	5072844	7	15.66												barrier, 3.5' vertical, 8" plunge pool, 4" wide curving landing
18	Basin	7/10/09	17	4	381802	5072822	23	15.67												
19	Basin	7/7/09	18	4	381803	5072816	6	15.67	27	lgr, hgr		sand, gravel		0.5-4		light	sedge meadow, youg/medium conifer			
20	Basin	7/7/09	19	4	381818	5072796	25	15.69	21	lgr		sand, gravel		1-4	1-3	moderate to light	mid-age conifer	incised 1'		
21	Basin	7/10/09	20	4	381826	5072793	8	15.69												
22	Basin	7/7/09	21	4	381834	5072775	20	15.71	25	lgr		sand, gravel		1-4	3-6	moderate to heavy	mature conifer			
23	Basin	7/10/09	22	4	381841	5072765	13	15.72												
24	Basin	7/7/09	23	4	381849	5072754	13	15.72	39					<1				incised 2'		
25	Basin	7/10/09	24	4	381856	5072736	20	15.74												
26	Basin	7/7/09	25	5	381864	5072733	8	15.74	26	glides, lgrs, plunge pools		sand		1-4	6-10	open	young conifer, wet meadow, sedge	stable		
27	Basin	7/7/09			381879	5072712	26	15.76	41	lgr, hgr		sand		1-3	4-6			stable, incised 1'		
28	Basin	7/10/09	26	5	381883	5072708	6	15.76												
29	Basin	7/7/09	27	5	381887	5072692	16	15.77	16	hgr, lgr		gravel		1-2	4-8	mixed				
30	Basin	7/7/09	28	5	381895	5072691	8	15.78	12	lgr		sand		2-4	6-8			stable, incised 1-2'		
31	Basin	7/10/09	29	5	381902	5072679	14	15.78												
32	Basin	7/7/09	30	5	381910	5072670	12	15.79	48	lgr, hgr		sand		2	4-10	light to moderate	mature conifer	incised 1'		
33	Basin	7/7/09	31	5	381933	5072651	30	15.81	41	lgr, hgr				2-5	2-6			stable, incised 2'		rusty debris
34	Basin	7/10/09	32	5	381940	5072650	7	15.81												nearly dry tributary

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
35	Basin	7/10/09	33	6	381949	5072642	12	15.82												
36	Basin	7/10/09	34	6	381957	5072633	12	15.83												split rejoin from left
37	Basin	7/7/09	35	6	381956	5072631	1	15.83	7	lgr		silt, sand		5	2	moderate	conifer			minor drainage from left look down
38	Basin	7/10/09			381988	5072623	33	15.85												split origin
39	Basin	7/7/09	36	6	381968	5072619	20	15.86	16	hgr	single	gravel, sand		1-2	4-8			stable, incised 1-2' in soil	yes	
40	Basin	7/10/09	37	6	382009	5072608	43	15.89												
41	Basin	7/7/09	38	6	382003	5072603	8	15.90	53	hgr, lgr	braid		100			mixed moderate				
42	Basin	7/10/09	39	6	382030	5072593	29	15.91												
43	Basin	7/7/09	40	6	382032	5072589	4	15.92	16	lgr									no cover	debris jam
44	Basin	7/10/09	41	7	382051	5072577	22	15.93												
45	Basin	7/7/09	42	7	382053	5072575	3	15.93	2	lgr										rejoined split from left looking down
46	Basin	7/7/09	43	7	382056	5072573	3	15.93	52	hgr, lgr		gravel		1	1-3	mixed		incised 2'		
47	Basin	7/7/09			382058	5072570	4	15.94	91	hgr		cobble, sand		2-3	2-4	mixed		stable, mossy	no cover	
48	Basin	7/10/09	44	7	382072	5072562	16	15.95												
49	Basin	7/7/09	45	7	382083	5072550	16	15.96	21										no cover	24" culvert, upstream end
50	Basin	7/10/09	46	7	382093	5072547	10	15.96												culvert
51	Basin	7/6/09			382101	5072534	15	15.97	10	hgr		cobble, roots, gravel, sand			1-3		mixed age conifer	stable, some undecut		
52	Basin	7/10/09	47	7	382104	5072539	6	15.98												
53	Basin	7/6/09			382106	5072525	14	15.98	9	cas		cobble	20-80		1-3		mixed age conifer	stable, some undecut		
54	Basin	7/10/09	48	7	382116	5072530	11	15.99												
55	Basin	7/6/09			382117	5072535	5	15.99	7											15" culvert downstream end
56	Basin	7/10/09	49	8	382127	5072522	16	16.00												culvert
57	Basin	7/6/09	50	8	382129	5072520	3	16.01												15" culvert upstream end
58	Basin	7/10/09	51	8	382132	5072519	3	16.01												
59	Basin	7/6/09			382136	5072516	4	16.01	2	cas		cobble, sand					conifer, willow			
60	Basin	7/10/09	52	8	382137	5072515	2	16.01												
61	Basin	7/10/09	53	8	382142	5072512	6	16.02												
62	Basin	7/6/09			382142	5072512	0	16.02	4	lgr		gravel, sand								
63	Basin	7/10/09	54	8	382147	5072508	6	16.02												
64	Basin	7/6/09			382149	5072507	2	16.02	26	cas	split	cobble, roots, gravel, sand		15		light	sedge, spruce, willow	stable, mossy		
65	Basin	7/10/09	55	8	382152	5072505	4	16.02												
66	Basin	7/6/09	56	8	382155	5072503	3	16.03	9	cas	split	roots								
67	Basin	7/10/09	57	9	382157	5072501	3	16.03												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
68	Basin	7/6/09			382160	5072499	3	16.03	10	cas		cobble, gravel, sand				heavy				
69	Basin	7/10/09	58	9	382162	5072498	3	16.03												
70	Basin	7/6/09			382165	5072496	4	16.03	6	cas		cobble, gravel				none	moss, horsetail			
71	Basin	7/10/09			382167	5072494	3	16.03												tank
72	Basin	7/6/09	59	9	382170	5072492	4	16.04	4	glide		sand, gravel				none				
73	Basin	7/10/09	60	9	382171	5072496	4	16.04												
74	Basin	7/6/09			382174	5072495	3	16.04	6	lgr		silt, sand, gravel								
75	Basin	7/10/09	61	9	382174	5072498	3	16.04												
76	Basin	7/6/09			382177	5072498	3	16.05	11	lgr		silt, sand, gravel			2-4				potential	
77	Basin	7/10/09	62	9	382178	5072499	2	16.05												
78	Basin	7/6/09			382181	5072500	3	16.05	5	pool					5					lumber jam
79	Basin	7/10/09	63	9	382181	5072501	1	16.05												approaching origin
80	Basin	7/6/09			382184	5072503	4	16.05	9	lgr		silt								
81	Basin	7/6/09	64	9	382188	5072506	5	16.05	17	hgr						heavy		incised		
82	Basin	7/10/09	65, 66	10	382195	5072506	7	16.06												origin
83	Basin	7/6/09	67	10	382214	5072503	19	16.07												above origin
84	Basin	7/10/09	68	10	382228	5072501	14	16.08												above origin
85	MF Moose	7/8/09	1	11	379133	5070568	0	0.00			one dominant	sand, silt			12-36		sedge wetland	incised		
86	MF Moose	7/8/09	2	11	379241	5070701	171	0.11												
87	MF Moose	7/8/09	3, 4	11	379310	5070749	84	0.16			one dominant but most is dispersed									
88	MF Moose	7/8/09	5	11	379593	5070768	284	0.33			one dominant	soil		1-2	36	open	sedge wetland	incised		
89	MF Moose	7/8/09	6	11	379614	5070829	65	0.38			totally dispersed					open	wetland			
90	MF Moose	7/8/09	7	11	379757	5070854	145	0.47			multiple and dispersed					open	wetland			
91	MF Moose	7/8/09	8	11	379864	5070897	115	0.54								moderate to light	wetland			
92	MF Moose	7/8/09	9, 10	12	379972	5071015	160	0.64			single	gravel, soil				open	sedge wetland	incised 1-3'		wetland flows converge
93	MF Moose	7/8/09	11	12	380067	5071077	113	0.71			multiple and dispersed	soil			18	open	sedge wetland			
94	MF Moose upper	7/7/09			380167	5071158	128	0.79												tributary
95	MF Moose upper	7/7/09			380193	5071177	33	0.81		wetland	dispersed						wetland			tire track pool
96	MF Moose upper	7/7/09	1	13	380309	5071285	158	0.91		wetland							wetland			
97	MF Moose upper	7/7/09	2	13	380454	5071425	202	1.03												fenced pond outlet
98	MF Moose upper	7/7/09	3	13	380481	5071435	44	1.06												into fenced pond
99	MF Moose upper	7/9/09	4	13	380764	5071209	378	1.29			defined	sand, soil, gravel		1-3				incised 3'		
100	MF Moose upper	7/7/09	5	13	380781	5071217	19	1.30		wetland	dispersed						wetland			

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
101	MF Moose upper	7/7/09			380784	5071210	8	1.31												claim boundary
102	MF Moose upper	7/9/09	6	13	380790	5071204	8	1.31												
103	MF Moose upper	7/9/09	7	13	380816	5071199	26	1.33												
104	MF Moose upper	7/9/09	8	13	380842	5071194	26	1.35			undefined									
105	MF Moose upper	7/9/09	9	14	380862	5071208	24	1.36												
106	MF Moose upper	7/9/09	10	14	380882	5071222	24	1.38												dry
107	MF Moose upper	7/9/09	11	14	380926	5071229	45	1.41			small									
108	MF Moose upper	7/7/09	12	14	380949	5071242	26	1.42		wetland										head of wetland
109	MF Moose upper	7/7/09	13	14	380949	5071243	1	1.42	18	dry	dry									
110	MF Moose upper	7/7/09	14	14	380963	5071240	14	1.43	30	lgr		gravel		1	2-4	open				
111	MF Moose upper	7/7/09	15	14	380994	5071259	36	1.45	46	lgr, step pools		gravel, silt								
112	MF Moose upper	7/7/09	16	14	381022	5071313	61	1.49	11	lgr		gravel, small cobble, vegetation		3	4-9		small conifer	30 degrees, stable	fish hab and Surber do-able	downstream project boundary
113	MF Moose upper	7/7/09	17	15	381025	5071314	3	1.49	4	lgr		gravel		1-4	1-4					
114	MF Moose upper	7/9/09	18	15	381027	5071315	2	1.50												claim boundary
115	MF Moose upper	7/7/09	19	15	381037	5071316	10	1.50	12	lgr, pool		gravel, small cobble		1-2	1-2					
116	MF Moose upper	7/7/09			381043	5071317	6	1.51	6			gravel, vegetation		1	3		sedge			
117	MF Moose upper	7/7/09	20	15	381046	5071318	4	1.51	4	pool		gravel, small cobble, algae		5	5					
118	MF Moose upper	7/7/09	21	15	381075	5071324	29	1.53	31	stepped lgr, glide, small pools		gravel, silt, vegetation		1-4	1-3, 6-8	open to light	sedge, conifer			
119	MF Moose upper	7/7/09			381076	5071324	1	1.53	1	plunge pool				1	12					
120	MF Moose upper	7/7/09			381077	5071324	1	1.53	1	plunge pool				2	8					
121	MF Moose upper	7/7/09	22	15	381091	5071327	14	1.54	15	step pools		gravel, silt, algae		4	8	heavy	young mixed			
122	MF Moose upper	7/7/09	23	15	381094	5071327	3	1.54	4	glide						none				
123	MF Moose upper	7/7/09			381102	5071329	8	1.54	9			soil, cobble		3	2					
124	MF Moose upper	7/7/09	24	15	381110	5071331	8	1.55	9					2	3-6	moderate	mixed	incised		
125	MF Moose upper	7/7/09			381114	5071332	4	1.55	5			gravel		4	2-4	heavy	conifer			

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
126	MF Moose upper	7/7/09			381116	5071332	2	1.55	2	plunge pool		cobble		4	10					3' debris barrier
127	MF Moose upper	7/7/09	25	16	381121	5071333	5	1.56	5	pool		silt		5	9					
128	MF Moose upper	7/7/09			381124	5071333	3	1.56	3	lgr		gravel		5	2					
129	MF Moose upper	7/7/09			381126	5071334	2	1.56	2	plunge pool		gravel, silt, cobble		5	9	moderate				
130	MF Moose upper	7/7/09			381127	5071334	0	1.56	0											debris jam
131	MF Moose upper	7/9/09	26	16	381128	5071334	1	1.56												
132	MF Moose upper	7/7/09			381131	5071335	3	1.56	4	pool		silt		6	10	moderate	conifer			
133	MF Moose upper	7/7/09	27	16	381135	5071336	5	1.56	5	lgr		gravel, silt		3	3			30 degrees		
134	MF Moose upper	7/7/09			381141	5071337	6	1.57	6	lgr		gravel				open				
135	MF Moose upper	7/7/09	28	16	381165	5071342	25	1.58	27		split	vegetation		2	5	mixed, some open	some sedge			
136	MF Moose upper	7/7/09			381172	5071343	7	1.59	7	pools				2	9					
137	MF Moose upper	7/7/09			381175	5071344	3	1.59	3	glide		cobble, gravel		3	7	mixed				
138	MF Moose upper	7/7/09	29	16	381182	5071345	7	1.59	8	lgr		cobble, gravel		2	3-4	heavy		incised		
139	MF Moose upper	7/7/09	30	16	381188	5071346	7	1.60	7	lgr		gravel		2-3	2		horsetail			
140	MF Moose upper	7/7/09	31	16	381223	5071353	35	1.62	38	lgr		gravel		1-2	2-4	open	sedge, horsetail	incised		
141	MF Moose upper	7/9/09	32	16	381229	5071352	6	1.62												
142	MF Moose upper	7/7/09			381234	5071355	6	1.63	12	hgr, small plunge pools		gravel, small cobble		2-3	2-4	moderate to light	aspen, conifer	incised		
143	MF Moose upper	7/7/09			381234	5071355	0	1.63	0											debris jam
144	MF Moose upper	7/7/09			381254	5071359	20	1.64	22	lgr				3	2-4	mixed		incised		
145	MF Moose upper	7/7/09	33	17	381267	5071362	13	1.65	14	lgr		gravel, silt, grass		3-4	2-3	open		30 degrees		
146	MF Moose upper	7/9/09	34	17	381275	5071368	10	1.65												
147	MF Moose upper	7/9/09			381275	5071368	0	1.65												
148	MF Moose upper	7/7/09			381286	5071366	11	1.66	4	pool		silt		10	6					
149	MF Moose upper	7/7/09			381290	5071367	4	1.66	4	lgr		gravel, small cobble		5	2-3	open				other channel joins
150	MF Moose upper	7/9/09	35	17	381296	5071369	7	1.67												
151	MF Moose upper	7/7/09	36	17	381303	5071371	7	1.67	14	lgr		gravel, cobble		2-5	2-4					
152	MF Moose upper	7/7/09	37	17	381304	5071372	1	1.67									willow			choked with willows
153	MF Moose upper	7/7/09	38	17	381313	5071438	67	1.71			dispersed	silt					sedge wetland	none	isolated by wetland	

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
154	MF Moose upper	7/9/09	39	17	381318	5071451	14	1.72												
155	MF Moose upper	7/9/09	40	17	381331	5071460	16	1.73												
156	MF Moose upper	7/7/09	41	18	381332	5071473	13	1.74	32	lgr	single	silt, gravel, sand		1	1-2	light	aspen, conifer		isolated by wetland	
157	MF Moose upper	7/7/09			381337	5071483	11	1.75											varies from insignificant to isolated by wetlands	upstream end of minor flow in channel 40' to left (south)
158	MF Moose upper	7/7/09	42	18	381338	5071490	7	1.75	29		braided						wetland		isolated by wetland	
159	MF Moose upper	7/9/09	43	18	381339	5071493	3	1.75												3 side valley head
160	MF Moose upper	7/9/09	44	18	381340	5071525	32	1.77												
161	MF Moose upper	7/9/09	45	18	381344	5071533	9	1.78												
162	MF Moose upper	7/7/09	46, 47	18	381344	5071509	24	1.79			single								isolated by wetland	start of single channel
163	MF Moose upper	7/7/09	48	18	381344	5071510	1	1.80	22	lgr		gravel, silt, sand		1-2	1-3	light to moderate	young mixed		isolated by wetland	cattle
164	MF Moose upper	7/9/09	49	19	381348	5071541	31	1.81												
165	MF Moose upper	7/9/09	50	19	381351	5071548	9	1.82												
166	MF Moose upper	7/9/09	51	19	381355	5071556	9	1.83												
167	MF Moose upper	7/9/09	52	19	381359	5071564	9	1.83												
168	MF Moose upper	7/9/09	53	19	381363	5071572	9	1.84												
169	MF Moose upper	7/9/09	54	19	381367	5071580	9	1.84												
170	MF Moose upper	7/9/09	55	19	381371	5071588	9	1.85												
171	MF Moose upper	7/9/09	56	19	381374	5071595	9	1.85												
172	MF Moose upper	7/9/09	57	20	381378	5071603	9	1.86												
173	MF Moose upper	7/9/09	58	20	381382	5071611	9	1.86			dispersed						wetland			right channel
174	MF Moose upper	7/9/09	59	20	381384	5071619	8	1.87												
175	MF Moose upper	7/9/09	60	20	381386	5071627	8	1.87												
176	MF Moose upper	7/9/09	61	20	381388	5071635	8	1.88												
177	MF Moose upper	7/9/09	62	20	381390	5071644	8	1.88												
178	MF Moose upper	7/9/09	63	20	381391	5071652	8	1.89												
179	MF Moose upper	7/9/09	64	20	381393	5071660	8	1.89												
180	MF Moose upper	7/9/09	65	21	381395	5071668	8	1.90												
181	MF Moose upper	7/9/09	66	21	381397	5071676	8	1.90			dispersed						wetland			left channel

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
182	MF Moose upper	7/7/09	67 - 71	21	381398	5071665	11	1.91			multiple						wetland	heavy cattle use	isolated by wetland	headwaters, first guess
183	MF Moose upper	7/9/09	72	21	381429	5071712	56	1.95												
184	MF Moose upper	7/9/09	73	22	381461	5071748	48	1.98												
185	MF Moose upper	7/9/09	74	22	381494	5071784	48	2.01												
186	MF Moose upper	7/9/09	75	22	381526	5071820	48	2.04												
187	MF Moose upper	7/9/09	76	22	381558	5071856	48	2.07												
188	MF Moose upper	7/9/09	77	22	381590	5071892	48	2.10												
189	MF Moose upper	7/9/09	78	22	381647	5071923	65	2.14												
190	MF Moose upper	7/9/09	79	22	381704	5071954	65	2.18												lost drainage in conifers
191	MF Moose minor split	7/8/09	1	23	380184	5071174	0	0.00												valley of minor flow
192	MF Moose minor split	7/9/09	2	23	380455	5071188	271	0.17			none									almost dry
193	MF Moose minor split	7/8/09	3	23	380502	5071201	49	0.20												
194	MF Moose minor split	7/9/09			380558	5071222	60	0.24			dispersed						wetland			
195	MF Moose minor split	7/8/09			380625	5071221	67	0.28												possible flow to fenced pond
196	MF Moose minor split	7/9/09	4	23	380625	5071221	0	0.28												south berm end
197	MF Moose minor split	7/9/09			380629	5071235	15	0.29												on berm
198	MF Moose minor split	7/9/09			380661	5071286	60	0.32												berm notch
199	MF Moose trib 1	7/9/09	1	24	380167	5071158	0	0.00												confluence with mf moose
200	MF Moose trib 1	7/9/09	2	24	380175	5071142	18	0.01												bermed pond
201	MF Moose trib 1	7/9/09	3	24	380188	5071128	19	0.02												
202	MF Moose trib 1	7/9/09	4	24	380201	5071114	19	0.03												
203	MF Moose trib 1	7/9/09	5	24	380213	5071100	19	0.05												
204	MF Moose trib 1	7/9/09	6	24	380226	5071086	19	0.06												
205	MF Moose trib 1	7/9/09	7	24	380239	5071072	19	0.07				sand, gravel		2-4	10-24			incised		tire track cattle crossing
206	MF Moose trib 1	7/9/09	8	24	380263	5071073	24	0.08												
207	MF Moose trib 1	7/9/09	9	25	380286	5071074	24	0.10												
208	MF Moose trib 1	7/9/09	10	25	380310	5071075	24	0.11			single	gravel		2-5	4-8	open	wetland			
209	MF Moose trib 1	7/9/09	11	25	380328	5071063	22	0.13												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
210	MF Moose trib 1	7/9/09	12	25	380345	5071050	22	0.14			single	soil, gravel, sand					scattered trees thru wetland	incised		
211	MF Moose trib 1	7/9/09	13	25	380352	5071042	11	0.15												
212	MF Moose trib 1	7/9/09	14	25	380359	5071033	11	0.15		lgr, glide						heavy				
213	MF Moose trib 1	7/9/09	15	25	380370	5071022	16	0.16												
214	MF Moose trib 1	7/9/09	16	25	380381	5071011	16	0.17												
215	MF Moose trib 1	7/9/09	17	26	380392	5071000	16	0.18												
216	MF Moose trib 1	7/9/09	18	26	380403	5070989	16	0.19		lgr, hgr, plunge pools				2-5	6-8		mixed			
217	MF Moose trib 1	7/9/09	19	26	380414	5070978	16	0.20		lgr, hgr, plunge pool 18" deep						light	mixed			
218	MF Moose trib 1	7/9/09	20	26	380425	5070968	15	0.21												
219	MF Moose trib 1	7/9/09	21	26	380436	5070958	15	0.22												
220	MF Moose trib 1	7/9/09	22	26	380447	5070948	15	0.23		glides and deep pools		sand								
221	MF Moose trib 1	7/9/09	23	26	380460	5070947	13	0.24												
222	MF Moose trib 1	7/9/09	24	26	380472	5070946	12	0.25												
223	MF Moose trib 1	7/9/09	25	27	380484	5070943	13	0.25												
224	MF Moose trib 1	7/9/09	26	27	380497	5070943	12	0.26												
225	MF Moose trib 1	7/9/09	27	27	380509	5070942	12	0.27												
226	MF Moose trib 1	7/9/09	28	27	380522	5070940	12	0.28		lgrs, glides						light to moderate				
227	MF Moose trib 1	7/9/09	29	27	380534	5070939	12	0.29		glide		gravel, small cobble, cobble		3-5	4-10	small opening			5" fish	
228	MF Moose trib 1	7/9/09	30	27	380622	5070934	88	0.34		lgr, hgr						moderate to heavy			good	
229	MF Moose trib 1	7/9/09	31	27	380638	5070934	16	0.35												
230	MF Moose trib 1	7/9/09	32	27	380653	5070934	15	0.36												
231	MF Moose trib 1	7/9/09	33	28	380668	5070934	15	0.37												
232	MF Moose trib 1	7/9/09	34	28	380683	5070934	15	0.38			single	gravel, soil		1	12	light	mixed conifer			
233	MF Moose trib 1	7/9/09			380696	5070932	13	0.39												
234	MF Moose trib 1	7/9/09	35	28	380708	5070930	13	0.39												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
235	MF Moose trib 1	7/9/09	36	28	380721	5070928	13	0.40			single	gravel, soil		1	12	open	wetland	incised		
236	MF Moose trib 1	7/9/09	37	28	380730	5070924	10	0.41												
237	MF Moose trib 1	7/9/09	38	28	380739	5070919	10	0.41									young conifer			
238	MF Moose trib 1	7/9/09	39	28	380829	5070968	102	0.48			minor dispersion, but one dominant	gravel		1-2	4-12	light	young conif, wetland	incised		
239	MF Moose trib 1	7/9/09	40	28	380840	5070969	11	0.48												
240	MF Moose trib 1	7/9/09	41	29	380850	5070970	10	0.49		lgr, hgr, plunge pool 10" deep		gravel, small cobble, cobble		3-4	3-6	moderate	conifer		long stretch good	
241	MF Moose trib 1	7/9/09	42	29	380872	5070973	22	0.50												
242	MF Moose trib 1	7/9/09	43	29	380894	5070975	22	0.52												
243	MF Moose trib 1	7/9/09	44	29	380916	5070977	22	0.53												
244	MF Moose trib 1	7/9/09	45	29	380937	5070979	22	0.55												
245	MF Moose trib 1	7/9/09	46	29	380959	5070981	22	0.56												
246	MF Moose trib 1	7/9/09	47	29	380981	5070984	22	0.57												
247	MF Moose trib 1	7/9/09	48	29	381002	5070986	22	0.59												
248	MF Moose trib 1	7/9/09	49	30	381024	5070988	22	0.60												claim boundary
249	MF Moose trib 1	7/9/09	50	30	381037	5070995	15	0.61												
250	MF Moose trib 1	7/9/09	51	30	381051	5071003	15	0.62												
251	MF Moose trib 1	7/9/09	52	30	381064	5071010	15	0.63		lgr		gravel, small cobble		2-3	2-6	light	mixed conifer	incised		
252	MF Moose trib 1	7/9/09	53	30	381081	5071021	20	0.64		lgr		gravel, small cobble		2-4	3-6	none				minor flow enters from right
253	MF Moose trib 1	7/9/09	54	30	381088	5071023	8	0.65												
254	MF Moose trib 1	7/9/09	55	30	381096	5071026	8	0.65												
255	MF Moose trib 1	7/9/09	56	30	381103	5071028	8	0.65												
256	MF Moose trib 1	7/9/09	57	31	381110	5071030	8	0.66												
257	MF Moose trib 1	7/9/09	58	31	381117	5071032	8	0.66												
258	MF Moose trib 1	7/9/09	59	31	381125	5071034	8	0.67												
259	MF Moose trib 1	7/9/09	60	31	381132	5071036	8	0.67				gravel, then mud		1-2	3-12		sparse young conifer			
260	MF Moose trib 1	7/9/09	61	31	381153	5071045	23	0.69												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
261	MF Moose trib 1	7/9/09	62	31	381174	5071054	23	0.70				mud, some gravel		1-3	12		wetland	incised		
262	MF Moose trib 1	7/9/09			381184	5071025	31	0.72			defined						wetland			berm
263	MF Moose trib 1	7/9/09	63	31	381276	5071000	95	0.78			dispersed									claim boundary
264	MF Moose trib 1	7/9/09	64	31	381286	5070989	15	0.79												
265	MF Moose trib 1	7/9/09	65	32	381295	5070977	15	0.80												
266	MF Moose trib 1	7/9/09	66	32	381305	5070966	15	0.81			dispersed						wetland			
267	MF Moose trib 1	7/9/09	67	32	381314	5070954	15	0.82		lgr		silt, sand		2-4		moderate	mature conifer			
268	MF Moose trib 1	7/9/09	68	32	381325	5070944	15	0.83												
269	MF Moose trib 1	7/9/09			381336	5070934	15	0.84												
270	MF Moose trib 1	7/9/09	69	32	381347	5070924	15	0.85	7											subsurface at rootwad
271	MF Moose trib 1	7/9/09	70	32	381356	5070922	9	0.85												
272	MF Moose trib 1	7/9/09	71	32	381366	5070920	9	0.86												
273	MF Moose trib 1	7/9/09	72	32	381375	5070918	9	0.86												
274	MF Moose trib 1	7/9/09	73	33	381384	5070916	9	0.87		stepped lgr		gravel, sand		2-4	2-6	heavy	mixed			
275	MF Moose trib 1	7/9/09	74	33	381398	5070910	16	0.88												
276	MF Moose trib 1	7/9/09	75	33	381413	5070903	16	0.89												
277	MF Moose trib 1	7/9/09	76	33	381427	5070897	16	0.90			mostly dispersed					light to none	mixed age conifer			
278	MF Moose trib 1	7/9/09	77	33	381440	5070890	15	0.91												
279	MF Moose trib 1	7/9/09	78	33	381453	5070882	15	0.92												
280	MF Moose trib 1	7/9/09	79	33	381466	5070875	15	0.93			dispersed and incised						sedge and grass			
281	MF Moose trib 1	7/9/09	80	33	381482	5070870	17	0.94		varying		silted					mature conifer		mostly bad	steep mat con poorly defined split varying habs
282	MF Moose trib 1	7/9/09	81	34	381497	5070864	16	0.95												
283	MF Moose trib 1	7/9/09	82	34	381512	5070858	16	0.96												
284	MF Moose trib 1	7/9/09	83	34	381527	5070852	16	0.97												
285	MF Moose trib 1	7/9/09	84	34	381542	5070846	16	0.98			split					heavy	conifer			
286	MF Moose trib 1	7/9/09	85	34	381584	5070823	48	1.01			split					heavy	sedge to conifer	some incised		
287	MF Moose trib 1	7/9/09	86, 87	34	381611	5070816	28	1.02			dispersed						sedge			
288	MF Moose trib 1	7/9/09	88	34	381638	5070808	28	1.04							12-18			incised		

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
289	MF Moose trib 1	7/9/09	89, 90	35	381712	5070777	80	1.09		lgr, 1' plunge pools		gravel but mainly silted		3-7	2-5	moderate to heavy	mature conifer			
290	MF Moose trib 1	7/9/09	91, 92	35	381767	5070765	56	1.13		hgr, lgr, step pools 1' deep		gravel, some silted		1-4	2-6	heavy	young conifer			
291	MF Moose trib 1	7/9/09	93	35	381809	5070757	43	1.15		some 10" deep pools		some clean gravel		1-3	2-6			some 1' incised		
292	MF Moose trib 1	7/9/09	94	35	381851	5070749	43	1.18												4' barrier, root wad
293	MF Moose trib 1	7/9/09	95, 96	35	381893	5070741	43	1.21		cas, step pools, lgr		cobble	heavy	2-3	2-8	heavy	conifer			
294	MF Moose trib 1	7/9/09	97, 98	36	381948	5070734	55	1.24		cas, step pools, lgr		cobble	heavy	2	2-5	heavy	conifer			minor flow enters from south
295	MF Moose trib 1	7/9/09	99, 100	36	382002	5070726	55	1.27		step pools, steep cas, lgr	defined	cobble, sand	heavy	2	2-6	none				culvert
296	MF Moose trib 1a	7/9/09			381080	5071013	0	0.00				gravel, soil		1	6			incised		
297	MF Moose trib 1a	7/9/09	1	37	381108	5071028	31	0.02												
298	MF Moose trib 1a	7/9/09	2	37	381135	5071043	31	0.04												
299	MF Moose trib 1a	7/9/09	3	37	381163	5071058	31	0.06												
300	MF Moose trib 1a	7/9/09	4	37	381190	5071073	31	0.08												
301	MF Moose trib 1a	7/9/09	5	37	381218	5071088	31	0.10		plunge pool					16					barrier 4'
302	MF Moose trib 1a	7/9/09	6	37	381251	5071098	34	0.12												
303	MF Moose trib 1a	7/9/09	7	37	381283	5071107	34	0.14												
304	MF Moose trib 1a	7/9/09	8	37	381316	5071117	34	0.16												
305	MF Moose trib 1a	7/9/09	9	38	381348	5071126	34	0.18												
306	MF Moose trib 1a	7/9/09	10	38	381381	5071136	34	0.20												
307	MF Moose trib 1a	7/9/09			381414	5071145	34	0.22												
308	MF Moose trib 1a	7/9/09	11	38	381446	5071155	34	0.25												ford
309	MF Moose trib 1a	7/9/09	12	38	381468	5071158	22	0.26												
310	MF Moose trib 1a	7/9/09	13	38	381490	5071161	22	0.27												
311	MF Moose trib 1a	7/9/09	14	38	381512	5071164	22	0.29												
312	MF Moose trib 1a	7/9/09	15	38	381534	5071167	22	0.30			multiple						wetland			debris jam
313	MF Moose trib 1a	7/9/09	16	38	381554	5071168	20	0.31												
314	MF Moose trib 1a	7/9/09	17	39	381575	5071169	20	0.33												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
315	MF Moose trib 1a	7/9/09	18	39	381595	5071170	20	0.34												
316	MF Moose trib 1a	7/9/09	19	39	381615	5071171	20	0.35												
317	MF Moose trib 1a	7/9/09	20	39	381635	5071172	20	0.36												
318	MF Moose trib 1a	7/9/09	21	39	381656	5071173	20	0.38												
319	MF Moose trib 1a	7/9/09	22	39	381676	5071173	20	0.39												
320	MF Moose trib 1a	7/9/09	23	39	381696	5071174	20	0.40												
321	MF Moose trib 1a	7/9/09	24	39	381716	5071175	20	0.41												
322	MF Moose trib 1a	7/9/09	25	40	381737	5071176	20	0.43												
323	MF Moose trib 1a	7/9/09	26	40	381757	5071177	20	0.44		variety			high						good but embedded	
324	MF Moose trib 1a	7/9/09	27	40	381777	5071178	20	0.45												split to left, followed right
325	MF Moose trib 1a	7/9/09	28	40	381802	5071170	26	0.47												
326	MF Moose trib 1a	7/9/09	29	40	381826	5071162	26	0.48												
327	MF Moose trib 1a	7/9/09	30	40	381851	5071154	26	0.50												
328	MF Moose trib 1a	7/9/09	31	40	381876	5071146	26	0.52												
329	MF Moose trib 1a	7/9/09	32	40	381901	5071138	26	0.53												
330	MF Moose trib 1a	7/9/09	33	41	381925	5071129	26	0.55												
331	MF Moose trib 1a	7/9/09	34	41	381950	5071121	26	0.56												
332	MF Moose trib 1a	7/9/09	35	41	381975	5071113	26	0.58												
333	MF Moose trib 1a	7/9/09	36	41	381999	5071105	26	0.60												several splits
334	MF Moose trib 1a	7/9/09	37	41	382024	5071097	26	0.61			dispersed						wetland			
335	Fish	7/10/09			384422	5072925	0	24.40		lgr, hgr, some 12-15" plunge pools			high	4-8	5-8	moderate				
336	Fish	7/10/09	1	42	384403	5072922	19	24.41												
337	Fish	7/10/09	2	42	384384	5072920	19	24.42												
338	Fish	7/10/09	3	42	384365	5072917	19	24.44												
339	Fish	7/10/09	4	42	384346	5072914	19	24.45		lgr, hgr, some 12-15" plunge pools			high	4-8	5-8	moderate				tributary from right looking downstream
340	Fish	7/10/09	5	42	384333	5072929	20	24.46		lgr, hgr, some 12-15" plunge pools			high	4-8	5-8	moderate				tributary from left looking downstream
341	Fish	7/10/09	6	42	384325	5072925	9	24.47												
342	Fish	7/10/09	7	42	384316	5072922	9	24.47												

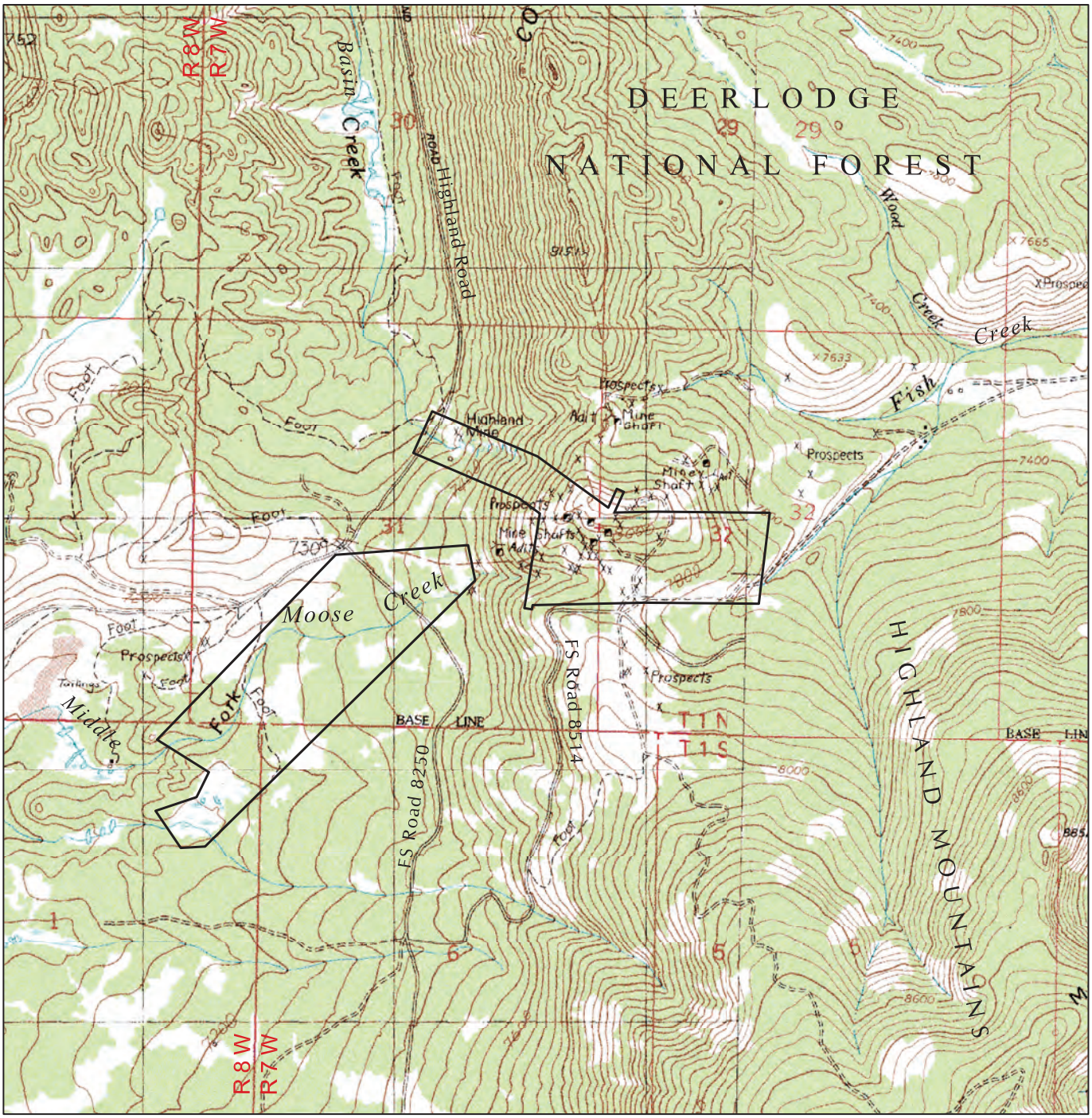
Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
343	Fish	7/10/09	8	42	384308	5072918	9	24.48		lgr, hgr, some 12-15" plunge pools			high	4-8	5-8	moderate				significant tributary from right looking downstream
344	Fish	7/10/09	9	43	384293	5072903	21	24.49												
345	Fish	7/10/09	10	43	384278	5072888	21	24.50												
346	Fish	7/10/09	11	43	384263	5072873	21	24.52												
347	Fish	7/10/09	12	43	384249	5072857	21	24.53												
348	Fish	7/10/09	13	43	384234	5072842	21	24.54												
349	Fish	7/10/09	14	43	384219	5072827	21	24.56												
350	Fish	7/10/09	15	43	384204	5072812	21	24.57												
351	Fish	7/10/09	16	43	384189	5072797	21	24.58												
352	Fish	7/10/09	17	44	384174	5072782	21	24.60												
353	Fish	7/10/09	18	44	384159	5072767	21	24.61												
354	Fish	7/10/09	19	44	384145	5072751	21	24.62												
355	Fish	7/10/09	20	44	384130	5072736	21	24.64												
356	Fish	7/10/09	21	44	384115	5072721	21	24.65												
357	Fish	7/10/09	22	44	384100	5072706	21	24.66		lgr, hgr, some 12-15" plunge pools			high	4-8	5-8	decent			good except embedded with sand	major tributary from right looking downstream
358	Fish	7/10/09	23	44	384087	5072701	14	24.67												
359	Fish	7/10/09	24	44	384073	5072695	14	24.68												bottom of cas
360	Fish	7/10/09	25	45	384060	5072690	14	24.69		cas, wetland	dispersed and split									split to wetland to left and cas with low flow to right
361	Fish	7/10/09	26	45	384027	5072680	35	24.71												
362	Fish	7/10/09	27	45	383994	5072669	35	24.73												
363	Fish	7/10/09	28	45	383961	5072659	35	24.75												significant tributary from left facing downstream
364	Fish	7/10/09	29	45	383940	5072654	22	24.77												
365	Fish	7/10/09	30	45	383918	5072649	22	24.78												
366	Fish	7/10/09	31	45	383897	5072644	22	24.79												
367	Fish	7/10/09	32	45	383875	5072639	22	24.81												
368	Fish	7/10/09	33	46	383854	5072634	22	24.82												
369	Fish	7/10/09	34	46	383832	5072629	22	24.83												
370	Fish	7/10/09	35	46	383811	5072624	22	24.85												
371	Fish	7/10/09	36	46	383789	5072619	22	24.86												
372	Fish	7/10/09	37	46	383768	5072614	22	24.88	7	cas										
373	Fish	7/10/09	38	46	383738	5072615	30	24.89												
374	Fish	7/10/09	39	46	383723	5072615	15	24.90												
375	Fish	7/10/09	40	46	383708	5072616	15	24.91												
376	Fish	7/10/09	41	47	383692	5072616	15	24.92												
377	Fish	7/10/09	42	47	383677	5072617	15	24.93												
378	Fish	7/10/09	43	47	383662	5072617	15	24.94												
379	Fish	7/10/09	44	47	383647	5072618	15	24.95												
380	Fish	7/10/09	45	47	383632	5072618	15	24.96												total barrier, seeps out of series of mud pools
381	Fish	7/10/09	46	47	383608	5072626	25	24.98		mud pool										
382	Fish	7/10/09	47	47	383585	5072634	25	24.99												
383	Fish	7/10/09	48	47	383561	5072642	25	25.01												
384	Fish	7/10/09	49	48	383537	5072649	25	25.02												
385	Fish	7/10/09	50	48	383513	5072657	25	25.04												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
386	Fish	7/10/09	51	48	383489	5072665	25	25.05												
387	Fish	7/10/09	52	48	383465	5072673	25	25.07	18	cas										
388	Fish	7/10/09	53	48	383458	5072689	17	25.08												
389	Fish	7/10/09	54	48	383452	5072705	17	25.09												
390	Fish	7/10/09	55	48	383445	5072721	17	25.10												end of subsurface
391	Fish	7/10/09	56	48	383428	5072738	24	25.12	17											subsurface starts near upstream end at Tributary 1 confluence
392	Fish	7/10/09	57	49	383419	5072749	14	25.13												
393	Fish	7/10/09	58	49	383411	5072759	13	25.13												
394	Fish	7/10/09	59	49	383403	5072770	13	25.14												
395	Fish	7/10/09	60	49	383395	5072780	13	25.15												
396	Fish	7/10/09	61	49	383387	5072790	13	25.16												
397	Fish	7/10/09	62	49	383379	5072800	13	25.17												
398	Fish	7/10/09	63	49	383371	5072810	13	25.17												
399	Fish	7/10/09	64	49	383363	5072821	13	25.18												
400	Fish	7/10/09	65	50	383355	5072831	13	25.19												
401	Fish	7/10/09	66	50	383347	5072841	13	25.20											good but filled with sand	trickle from well defined drainage to right
402	Fish	7/10/09	67	50	383341	5072850	11	25.21											some but heavily embedded with sand	no flow
403	Fish	7/10/09	68	50	383335	5072927	77	25.25											some but heavily embedded with sand	intermittent flow, mainly subsurface
404	Fish	7/10/09	69	50	383329	5072943	17	25.26	16											
405	Fish	7/10/09	70	50	383323	5072959	17	25.27												
406	Fish	7/10/09	71	50	383318	5072976	17	25.29												
407	Fish	7/10/09	72	50	383312	5072992	17	25.30												
408	Fish	7/10/09	73	51	383306	5073008	17	25.31												
409	Fish	7/10/09	74, 75	51	383300	5073024	17	25.32											some but heavily embedded with sand	dispersed in wetland upstream of here
410	Fish trib 1	7/10/09	1	52	383427	5072739	0	0.00		some 3" pools	single								none except 3" pools in lower 22'	confluence with fish cr
411	Fish trib 1	7/10/09	2	52	383417	5072746	13	0.01												
412	Fish trib 1	7/10/09	3	52	383406	5072754	13	0.02												
413	Fish trib 1	7/10/09	4	52	383396	5072761	13	0.02												
414	Fish trib 1	7/10/09	5	52	383385	5072768	13	0.03												
415	Fish trib 1	7/10/09	6	52	383375	5072776	13	0.04												
416	Fish trib 1	7/10/09			383364	5072783	13	0.05			single								none	
417	Fish trib 1	7/10/09	7	52	383349	5072765	23	0.06			two								none	
418	Fish trib 1	7/10/09	8	52	383338	5072768	11	0.07												
419	Fish trib 1	7/10/09	9	53	383327	5072770	11	0.08			none									first wet and first flowing
420	Fish trib 1	7/10/09	10	53	383259	5072739	75	0.12												
421	Fish trib 1	7/10/09	11	53	383191	5072709	75	0.17												
422	Fish trib 1	7/10/09	12	53	383122	5072679	75	0.22												
423	Fish trib 1	7/10/09	13	53	383054	5072648	75	0.26												
424	Fish trib 1	7/10/09			382986	5072618	75	0.31												

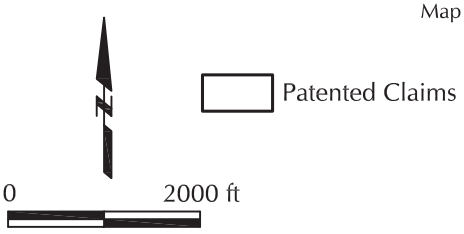
Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
425	Fish trib 1	7/10/09	14	53	382918	5072587	75	0.35												
426	Fish trib 1	7/10/09	15	53	382850	5072557	75	0.40												head
427	Fish trib 2	7/10/09			384134	5072770	0	0.00												confluence with fish cr
428	Fish trib 2	7/10/09	1	54	384128	5072751	20	0.01												
429	Fish trib 2	7/10/09	2	54	384122	5072732	20	0.02												
430	Fish trib 2	7/10/09	3	54	384116	5072713	20	0.04												tributary from right looking upstream, probabaly rejoined split
431	Fish trib 2	7/10/09	4	54	384110	5072694	20	0.05												
432	Fish trib 2	7/10/09	5	54	384104	5072675	20	0.06	30	cas with one pool										
433	Fish trib 2	7/10/09	6	54	384107	5072668	8	0.07												
434	Fish trib 2	7/10/09	7	54	384123	5072634	38	0.09												25% splits to left looking upstream
435	Fish trib 2	7/10/09	8	54	384126	5072625	10	0.10												
436	Fish trib 2	7/10/09	9	55	384129	5072615	10	0.10												split to left that joins previous split
437	Fish trib 2	7/10/09	10	55	384110	5072594	28	0.12												culvert
438	Fish trib 2	7/10/09	11	55	384103	5072585	12	0.13												
439	Fish trib 2	7/10/09	12	55	384095	5072576	12	0.13												small tributary from left
440	Fish trib 2	7/10/09	13	55	384088	5072566	12	0.14												
441	Fish trib 2	7/10/09	14	55	384080	5072557	12	0.15												
442	Fish trib 2	7/10/09			384073	5072548	12	0.16												barbed wired
443	Fish trib 2	7/10/09	15	55	384060	5072525	27	0.17												
444	Fish trib 2	7/10/09	16	55	384046	5072502	27	0.19												tributary from right
445	Fish trib 2	7/10/09	17	56	384050	5072497	6	0.19												tributary from left
446	Fish trib 2	7/10/09	18	56	384034	5072490	17	0.20												
447	Fish trib 2	7/10/09	19	56	384019	5072484	17	0.21												
448	Fish trib 2	7/10/09	20	56	384003	5072477	17	0.23												split return from right
449	Fish trib 2	7/10/09	21	56	383941	5072459	65	0.27												stream on road
450	Fish trib 2	7/10/09	22	56	383952	5072459	11	0.27												
451	Fish trib 2	7/10/09			383963	5072458	11	0.28												
452	Fish trib 2	7/10/09	23	56	383974	5072458	11	0.29												complex of splits and tributaries or return splits, half flow from right, went up right
453	Fish trib 2	7/10/09	24	56	383913	5072434	66	0.33												
454	Fish trib 2	7/10/09	25	57	383885	5072406	40	0.35												upstream end of stream on road
455	Fish trib 2a	7/11/09	1	58	383889	5072403	0	0.00												joins 2b on road
456	Fish trib 2a	7/11/09	2	58	383858	5072378	40	0.02												
457	Fish trib 2a	7/11/09	3	58	383827	5072352	40	0.05												
458	Fish trib 2a	7/11/09	4	58	383796	5072327	40	0.07			dry, would go down road									
459	Fish trib 2a	7/11/09	5	58	383785	5072313	18	0.09												

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
460	Fish trib 2a	7/11/09	6	58	383774	5072299	18	0.10			disappears in sand						meadow			
461	Fish trib 2a	7/11/09	7	58	383763	5072285	18	0.11			single with flow									
462	Fish trib 2a	7/11/09	8	58	383741	5072268	28	0.13												
463	Fish trib 2a	7/11/09	9	59	383718	5072250	28	0.14												
464	Fish trib 2a	7/11/09	10	59	383696	5072233	28	0.16												
465	Fish trib 2a	7/11/09	11	59	383673	5072215	28	0.18												
466	Fish trib 2a	7/11/09	12	59	383651	5072198	28	0.20												
467	Fish trib 2a	7/11/09	13	59	383628	5072180	28	0.21												
468	Fish trib 2a	7/11/09	14	59	383606	5072163	28	0.23												
469	Fish trib 2a	7/11/09	15	59	383583	5072145	28	0.25												
470	Fish trib 2a	7/11/09	16	59	383561	5072128	28	0.27												
471	Fish trib 2a	7/11/09	17	60	383538	5072110	28	0.28												
472	Fish trib 2a	7/11/09	18	60	383516	5072093	28	0.30												
473	Fish trib 2a	7/11/09	19	60	383493	5072075	28	0.32												
474	Fish trib 2a	7/11/09	20	60	383471	5072058	28	0.34												
475	Fish trib 2a	7/11/09	21	60	383448	5072040	28	0.36												
476	Fish trib 2a	7/11/09	22	60	383426	5072023	28	0.37												
477	Fish trib 2a	7/11/09	23	60	383403	5072005	28	0.39												
478	Fish trib 2a	7/11/09	24	60	383381	5071988	28	0.41												
479	Fish trib 2a	7/11/09	25	61	383358	5071970	28	0.43												
480	Fish trib 2a	7/11/09	26	61	383336	5071953	28	0.44												
481	Fish trib 2a	7/11/09	27	61	383313	5071935	28	0.46												
482	Fish trib 2a	7/11/09			383291	5071918	28	0.48												
483	Fish trib 2a	7/11/09	28	61	383268	5071900	28	0.50												
484	Fish trib 2a	7/11/09	29	61	383246	5071883	28	0.51												
485	Fish trib 2a	7/11/09	30	61	383223	5071865	28	0.53												
486	Fish trib 2a	7/11/09	31	61	383201	5071848	28	0.55			single									
487	Fish trib 2a	7/11/09	32	61	383175	5071835	29	0.57												
488	Fish trib 2a	7/11/09	33	62	383150	5071823	29	0.59												
489	Fish trib 2a	7/11/09	34	62	383124	5071810	29	0.60			dry									
490	Fish trib 2a	7/11/09	35, 36	62	383010	5071863	126	0.68			dispersed									
491	Fish trib 2a	7/11/09	37	62	382924	5071867	86	0.74			dry									
492	Fish trib 2b	7/11/09	1	63	383889	5072404	0	0.00											good up from road problem	
493	Fish trib 2b	7/11/09	2	63	383884	5072386	19	0.01												
494	Fish trib 2b	7/11/09	3	63	383880	5072367	19	0.02												
495	Fish trib 2b	7/11/09	4	63	383875	5072349	19	0.04												
496	Fish trib 2b	7/11/09	5	63	383870	5072331	19	0.05												
497	Fish trib 2b	7/11/09	6	63	383866	5072312	19	0.06												
498	Fish trib 2b	7/11/09	7	63	383861	5072294	19	0.07												
499	Fish trib 2b	7/11/09	8	63	383857	5072275	19	0.08												
500	Fish trib 2b	7/11/09	9	64	383852	5072257	19	0.09												
501	Fish trib 2b	7/11/09	10	64	383847	5072239	19	0.11												
502	Fish trib 2b	7/11/09	11	64	383843	5072220	19	0.12												
503	Fish trib 2b	7/11/09	12	64	383838	5072202	19	0.13												
504	Fish trib 2b	7/11/09	13	64	383833	5072184	19	0.14												
505	Fish trib 2b	7/11/09	14	64	383829	5072165	19	0.15												
506	Fish trib 2b	7/11/09	15	64	383824	5072147	19	0.16												
507	Fish trib 2b	7/11/09	16	64	383819	5072129	19	0.18												
508	Fish trib 2b	7/11/09	17	65	383815	5072110	19	0.19												
509	Fish trib 2b	7/11/09	18	65	383810	5072092	19	0.20												
510	Fish trib 2b	7/11/09	19	65	383806	5072074	19	0.21												
511	Fish trib 2b	7/11/09	20	65	383801	5072055	19	0.22												split return or tributary from right

Item	Stream	Date	Photo number	Photo page	Easting	Northing	Calculated distance from previous (m)	Calculated stream mile	Measured distance (m)	Habitat type	Channel type	Substrate	Embeddedness (%)	Width (ft)	Depth (in)	Canopy coverage	Riparian vegetation	Bank description	Fish habitat comments	Other comments
512	Fish trib 2b	7/11/09	21	65	383796	5072037	19	0.24												
513	Fish trib 2b	7/11/09	22	65	383792	5072018	19	0.25												
514	Fish trib 2b	7/11/09	23	65	383787	5072000	19	0.26												
515	Fish trib 2b	7/11/09	24	65	383782	5071982	19	0.27												
516	Fish trib 2b	7/11/09	25	66	383778	5071963	19	0.28												
517	Fish trib 2b	7/11/09			383773	5071945	19	0.29												
518	Fish trib 2b	7/11/09	26	66	383768	5071927	19	0.31												
519	Fish trib 2b	7/11/09	27	66	383764	5071908	19	0.32												
520	Fish trib 2b	7/11/09	28	66	383759	5071890	19	0.33												
521	Fish trib 2b	7/11/09	29	66	383754	5071872	19	0.34												
522	Fish trib 2b	7/11/09	30	66	383750	5071853	19	0.35												
523	Fish trib 2b	7/11/09	31	66	383745	5071835	19	0.36												
524	Fish trib 2b	7/11/09	32	66	383741	5071816	19	0.38												
525	Fish trib 2b	7/11/09	33	67	383736	5071798	19	0.39												
526	Fish trib 2b	7/11/09	34	67	383731	5071780	19	0.40												
527	Fish trib 2b	7/11/09	35	67	383727	5071761	19	0.41												
528	Fish trib 2b	7/11/09	36	67	383722	5071743	19	0.42												culvert 4' diameter



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)



Stream Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Project Location Map
Figure 1

Source: 2009 USDA NAIP Imagery

Explanation

Patented Claims

Perennial and Intermittent Stream Reaches

N

0 2000 ft

Stream Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana

Perennial & Intermittent Stream Reaches
Surveyed July 2009
Figure 2

Source: 2009 USDA NAIP Imagery

Explanation

- Patented Claims
- Stream Reach Probably Inhabitated by Fish
- Stream Reach Possibly Inhabited by Fish
- Culvert

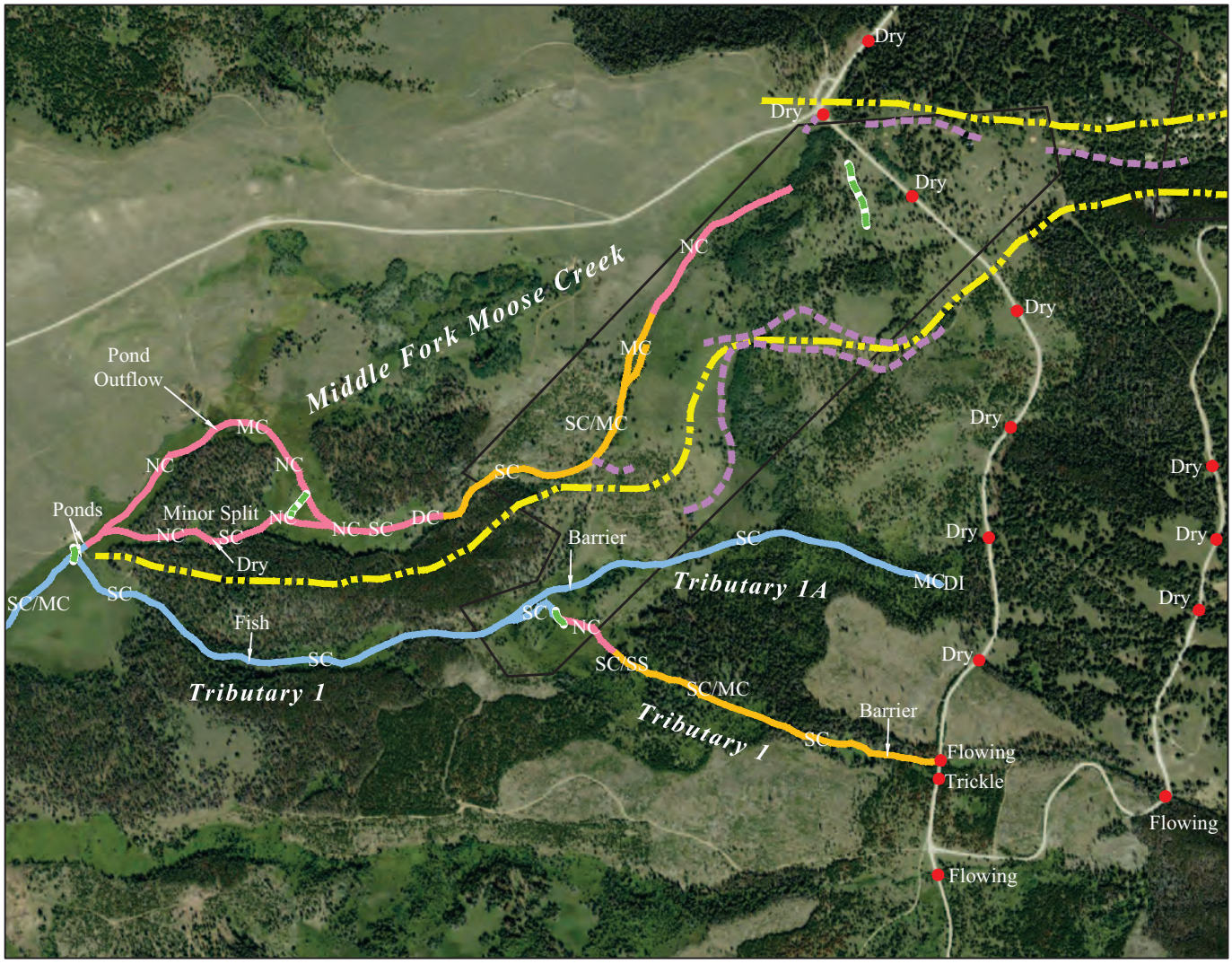
CA = cascade; MC = multiple channels; SC = single channel

N

0 500 ft

Stream Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Basin Creek Habitat Features
Figure 3



Source: 2009 USDA NAIP Imagery

Explanation

- Patented Claims
- Approximate Drainage Divide
- Storm Runoff
- Berm (that may alter water flow route)
- Stream Reach Probably Inhabitated by Fish
- Stream Reach Possibly Inhabited by Fish
- No Significant Fish Habitat
- Culvert

CA = cascade; DC = dry channel; DI = dispersed; MC = multiple channels; NC = no channel; SC = single channel; SS = subsurface

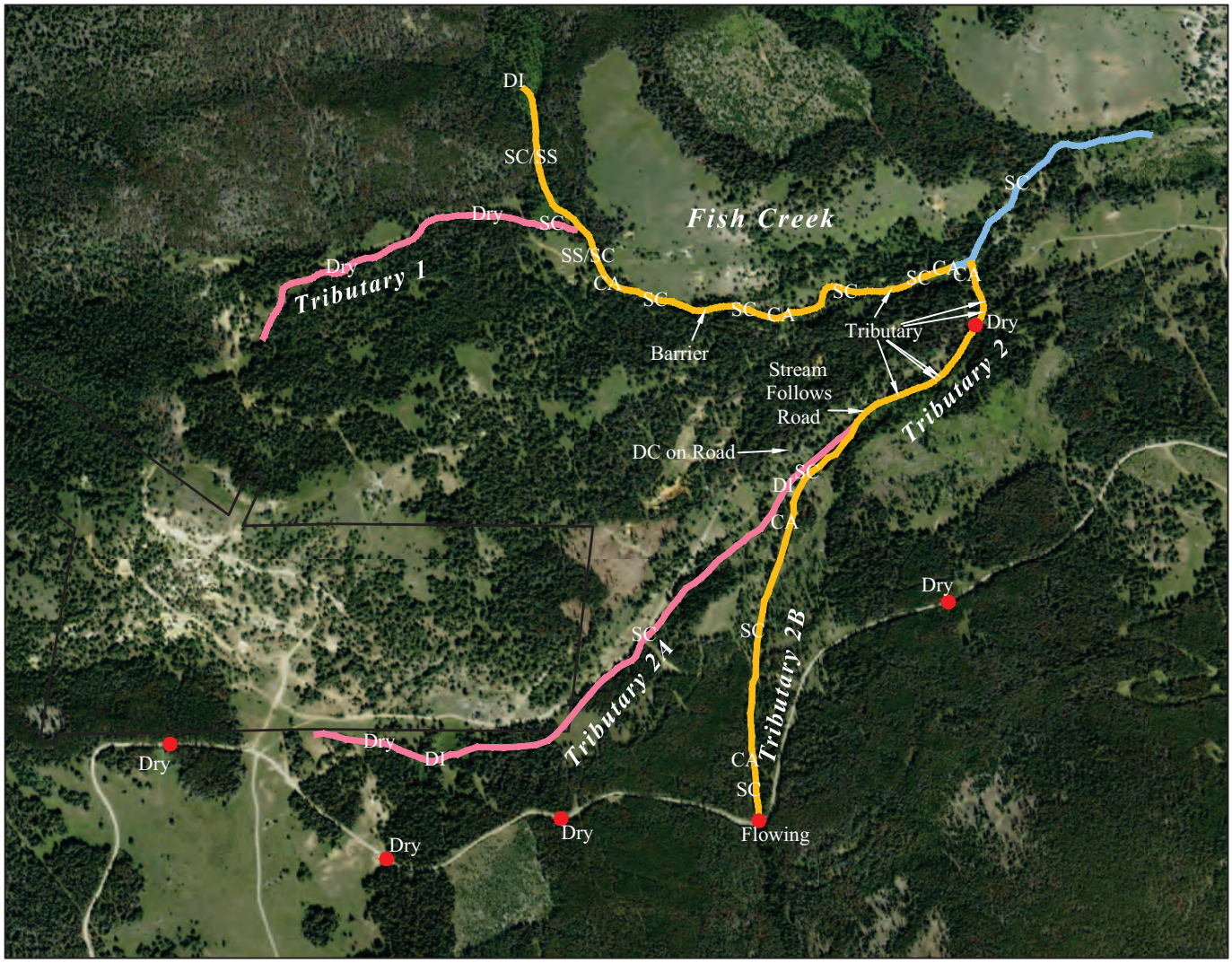
N

0 1200 ft

Stream Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana

Middle Fork Moose Creek Habitat Features
Figure 4



Source: 2009 USDA NAIP Imagery

Explanation

- Patented Claims
- Stream Reach Probably Inhabitated by Fish
- Stream Reach Possibly Inhabited by Fish
- No Significant Fish Habitat
- Culvert

CA = cascade; DC = dry channel; DI = dispersed; MC = multiple channels;
NC = no channel; SC = single channel; SS = subsurface

N

0 1000 ft

Stream Report
January 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Fish Creek Habitat Features
Figure 5

Photographs arranged as listed in Table 2.

Basin Creek 1

Basin Creek 2

Basin Creek 3

Basin Creek 4

Basin Creek 5

Basin Creek 6

Basin Creek 7

Basin Creek 8

Basin Creek 9

Basin Creek 10

Basin Creek 11

Basin Creek 12

Basin Creek 13

Basin Creek 14

Basin Creek 15

Basin Creek 16

Basin Creek 17

Basin Creek 18

Basin Creek 19

Basin Creek 20

Basin Creek 21

Basin Creek 22

Basin Creek 23

Basin Creek 24

Basin Creek 25

Basin Creek 26

Basin Creek 27

Basin Creek 28

Basin Creek 29

Basin Creek 30

Basin Creek 31

Basin Creek 32

Basin Creek 33

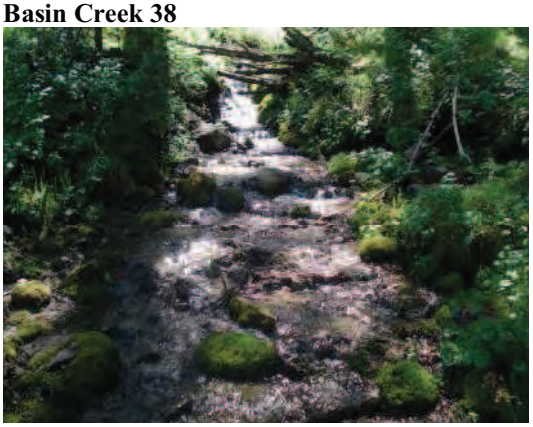
Basin Creek 34

Basin Creek 35

Basin Creek 36

Basin Creek 37

Basin Creek 38



Basin Creek 39

Basin Creek 40

Basin Creek 41

Basin Creek 42

Basin Creek 43

Basin Creek 44

Basin Creek 45

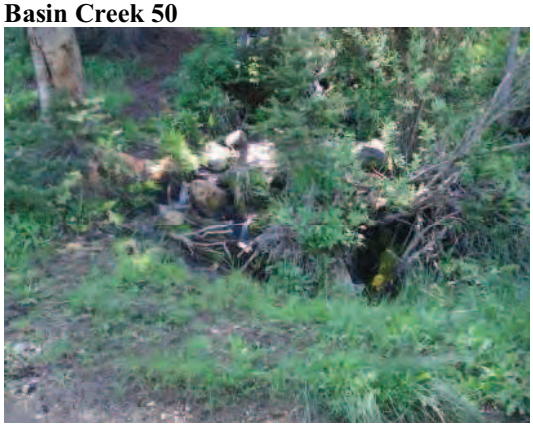
Basin Creek 46

Basin Creek 47

Basin Creek 48

Basin Creek 49

Basin Creek 50



Basin Creek 51

Basin Creek 52

Basin Creek 53

Basin Creek 54

Basin Creek 55

Basin Creek 56

Basin Creek 57

Basin Creek 58

Basin Creek 59

Basin Creek 60

Basin Creek 61

Basin Creek 62

Basin Creek 63

Basin Creek 64

Basin Creek 65

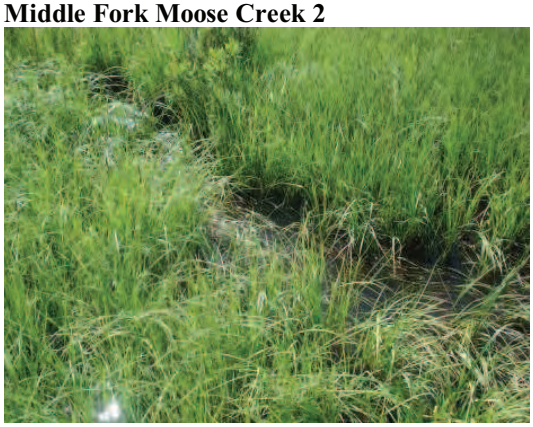
Basin Creek 66

Basin Creek 67

Basin Creek 68

Middle Fork Moose Creek 1

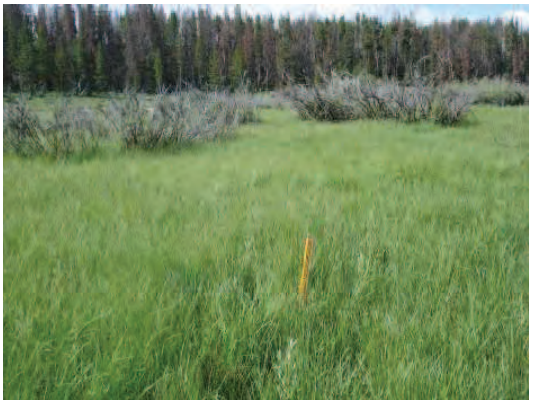
Middle Fork Moose Creek 2



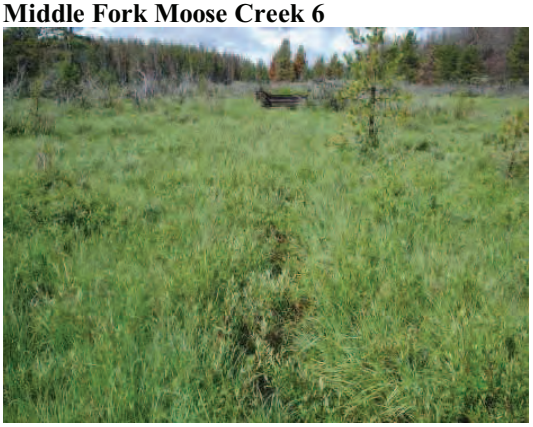
Middle Fork Moose Creek 3

Middle Fork Moose Creek 4

Middle Fork Moose Creek 5



Middle Fork Moose Creek 6

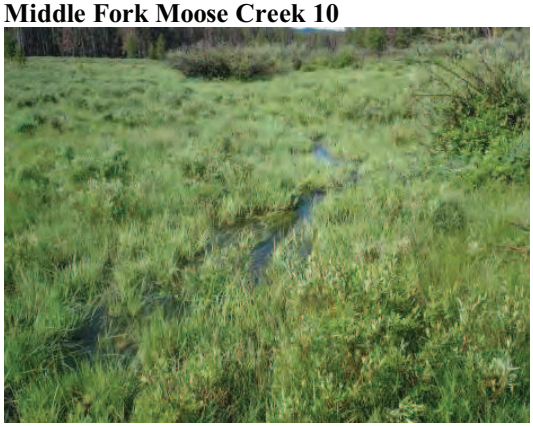


Middle Fork Moose Creek 7

Middle Fork Moose Creek 8

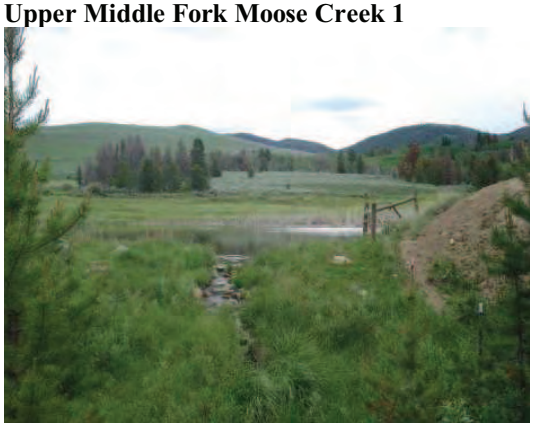
Middle Fork Moose Creek 9

Middle Fork Moose Creek 10

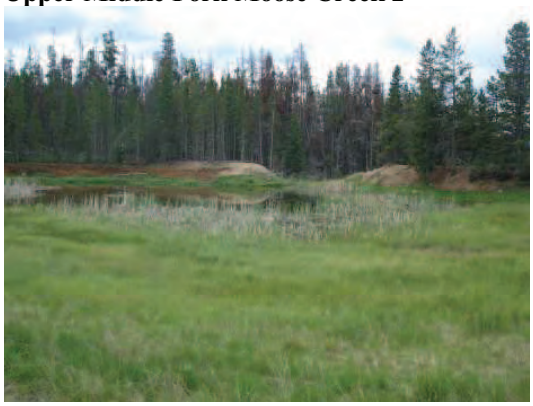


Middle Fork Moose Creek 11

Upper Middle Fork Moose Creek 1



Upper Middle Fork Moose Creek 2

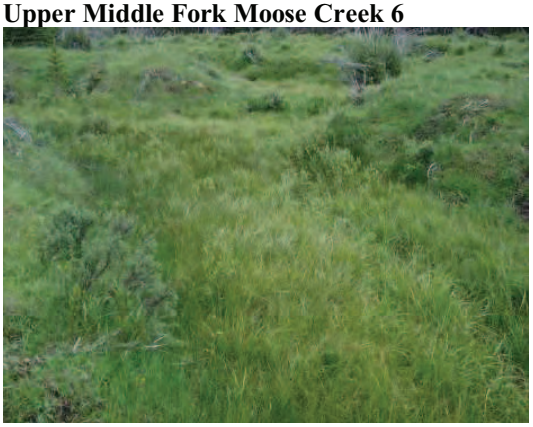


Upper Middle Fork Moose Creek 3

Upper Middle Fork Moose Creek 4

Upper Middle Fork Moose Creek 5

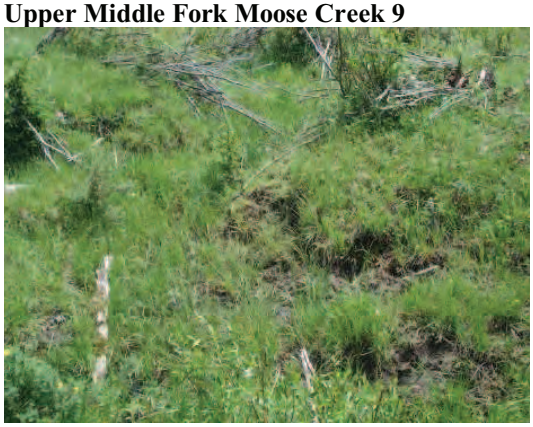
Upper Middle Fork Moose Creek 6



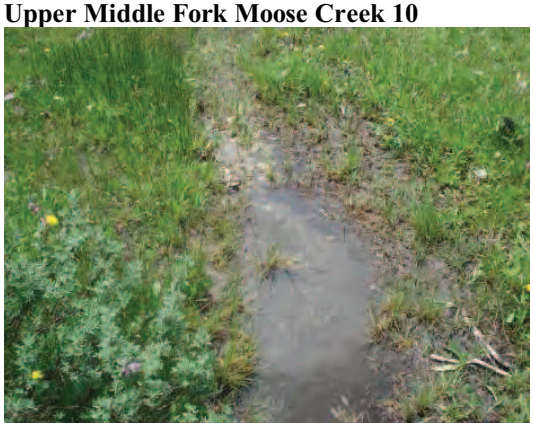
Upper Middle Fork Moose Creek 7

Upper Middle Fork Moose Creek 8

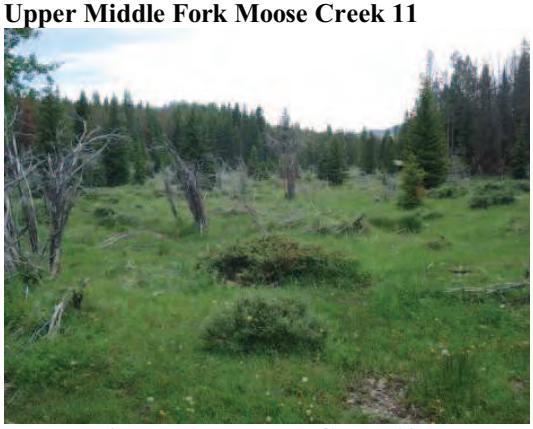
Upper Middle Fork Moose Creek 9



Upper Middle Fork Moose Creek 10



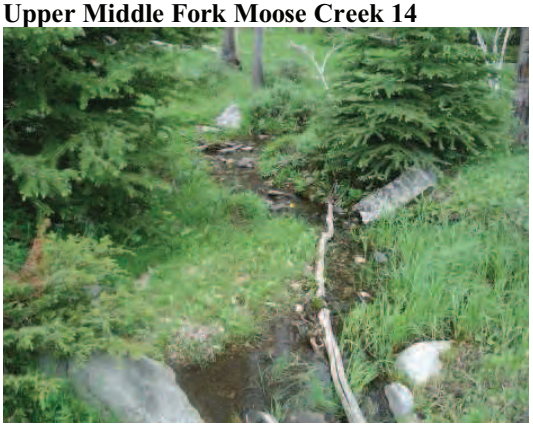
Upper Middle Fork Moose Creek 11



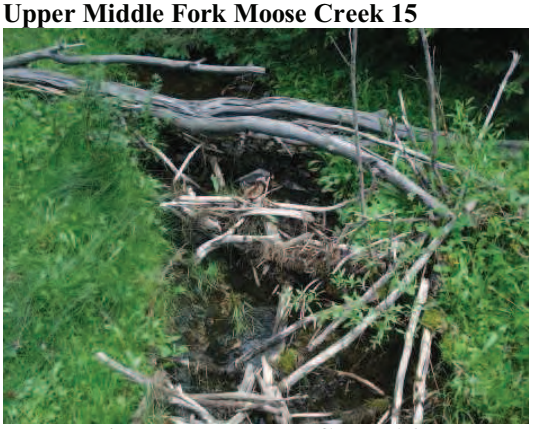
Upper Middle Fork Moose Creek 12

Upper Middle Fork Moose Creek 13

Upper Middle Fork Moose Creek 14



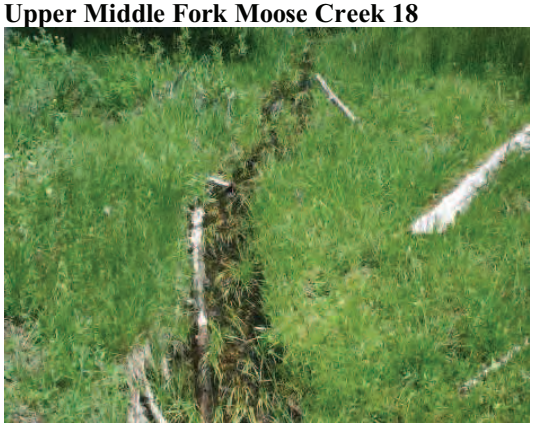
Upper Middle Fork Moose Creek 15



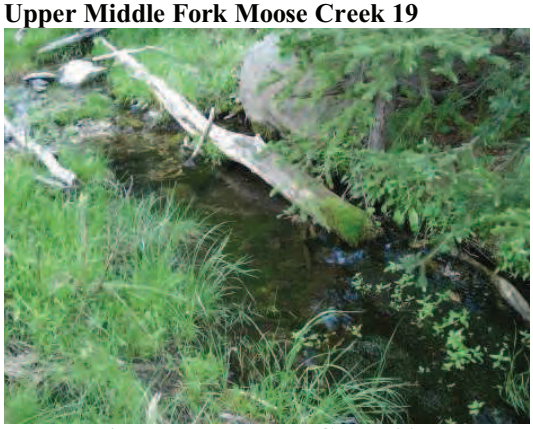
Upper Middle Fork Moose Creek 16

Upper Middle Fork Moose Creek 17

Upper Middle Fork Moose Creek 18

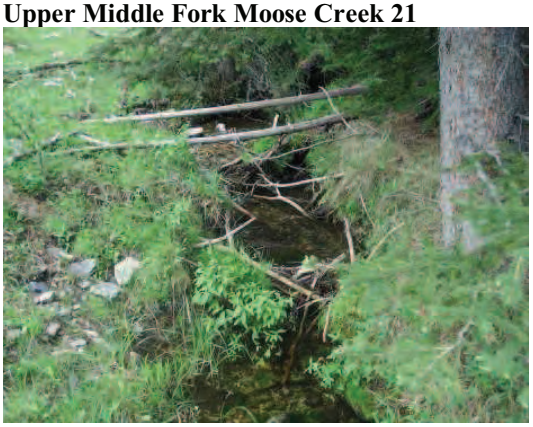


Upper Middle Fork Moose Creek 19



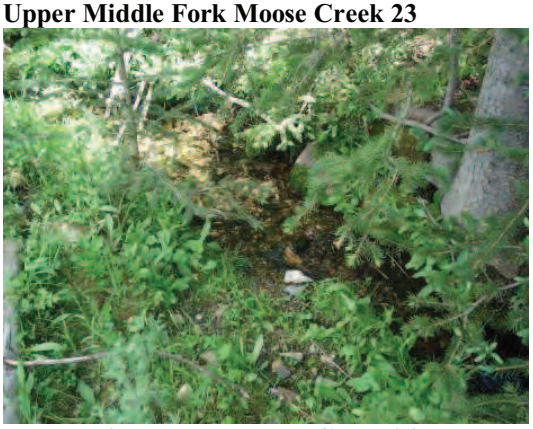
Upper Middle Fork Moose Creek 20

Upper Middle Fork Moose Creek 21



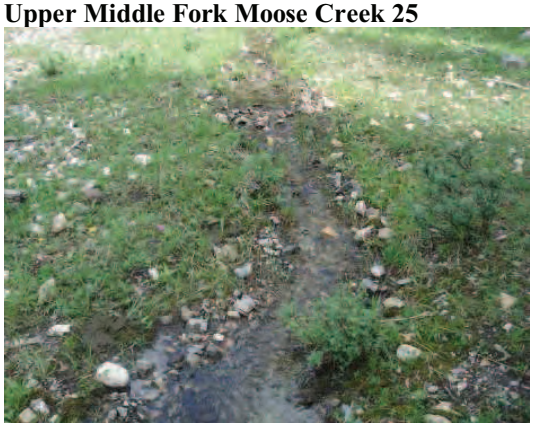
Upper Middle Fork Moose Creek 22

Upper Middle Fork Moose Creek 23

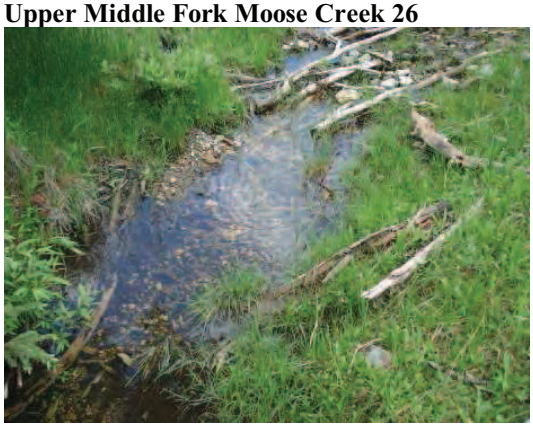


Upper Middle Fork Moose Creek 24

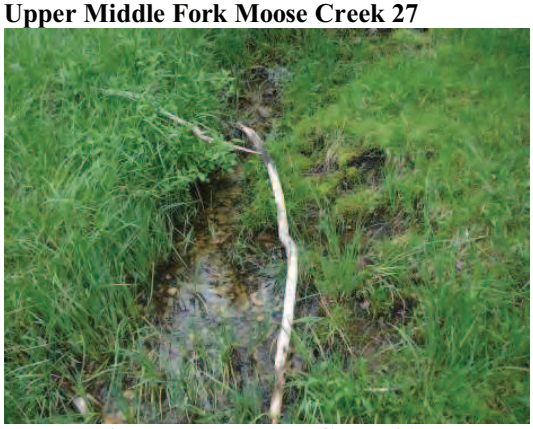
Upper Middle Fork Moose Creek 25



Upper Middle Fork Moose Creek 26

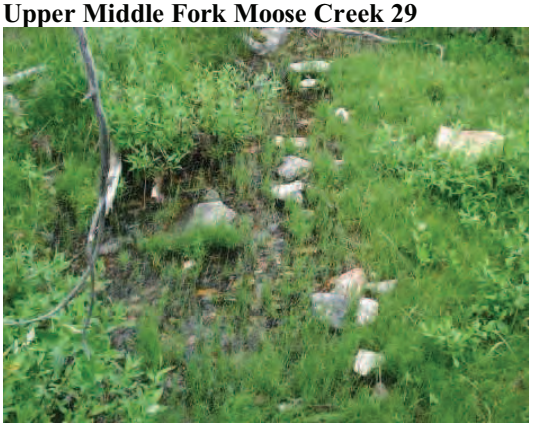


Upper Middle Fork Moose Creek 27

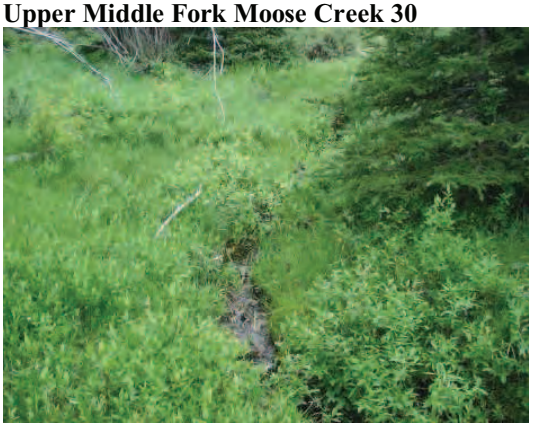


Upper Middle Fork Moose Creek 28

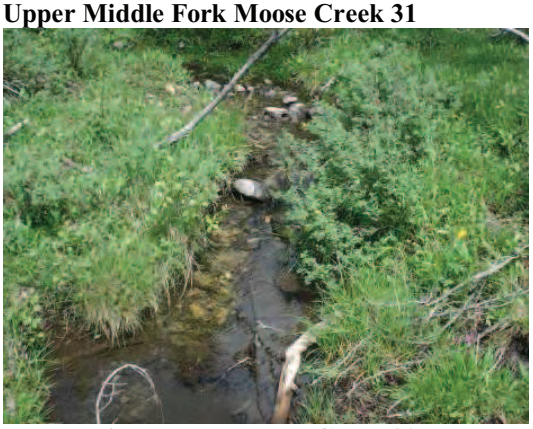
Upper Middle Fork Moose Creek 29



Upper Middle Fork Moose Creek 30



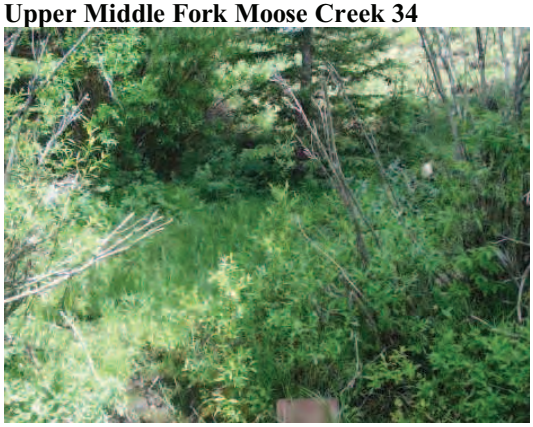
Upper Middle Fork Moose Creek 31



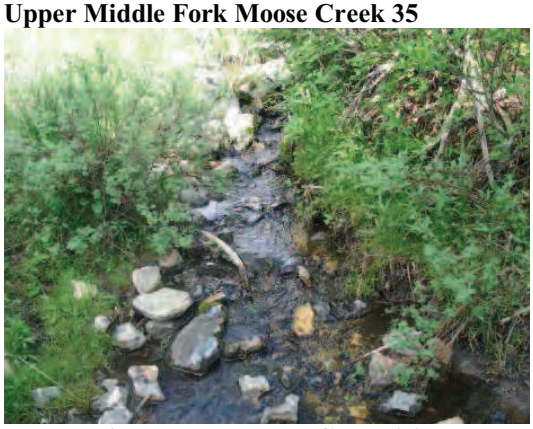
Upper Middle Fork Moose Creek 32

Upper Middle Fork Moose Creek 33

Upper Middle Fork Moose Creek 34



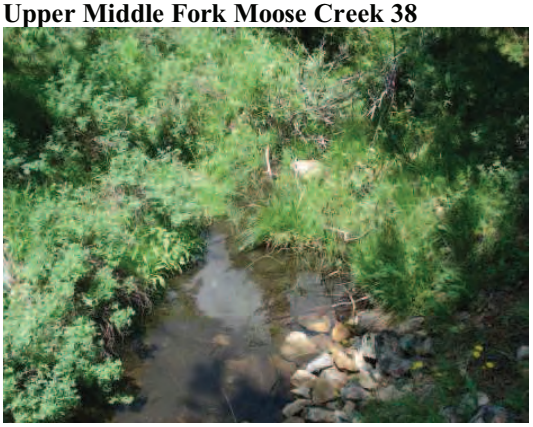
Upper Middle Fork Moose Creek 35



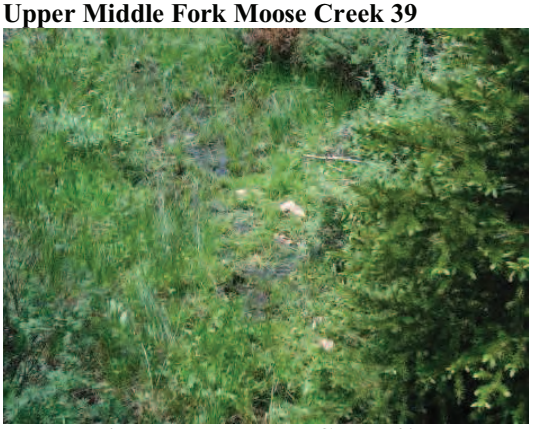
Upper Middle Fork Moose Creek 36

Upper Middle Fork Moose Creek 37

Upper Middle Fork Moose Creek 38

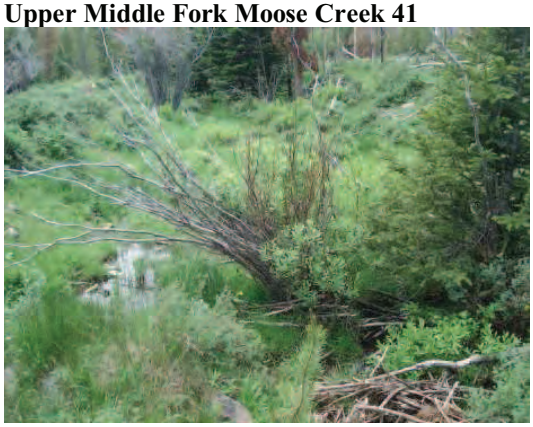


Upper Middle Fork Moose Creek 39

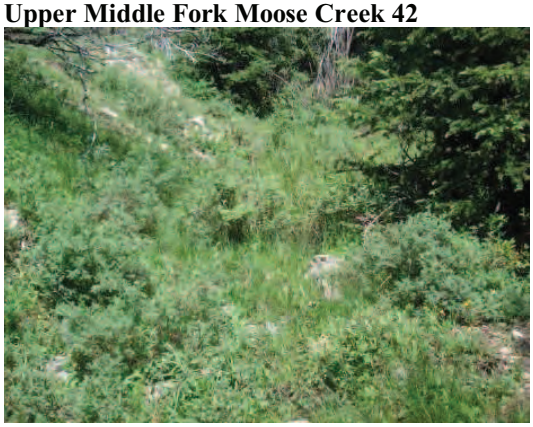


Upper Middle Fork Moose Creek 40

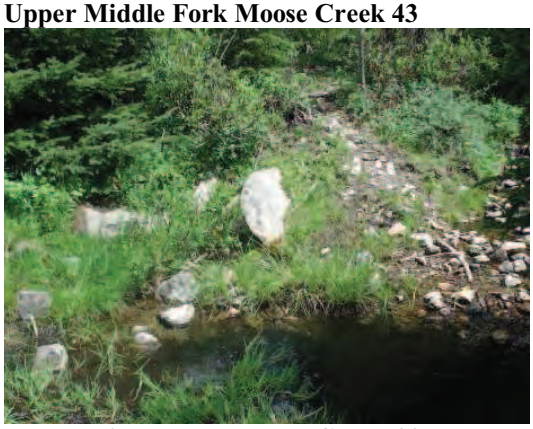
Upper Middle Fork Moose Creek 41



Upper Middle Fork Moose Creek 42

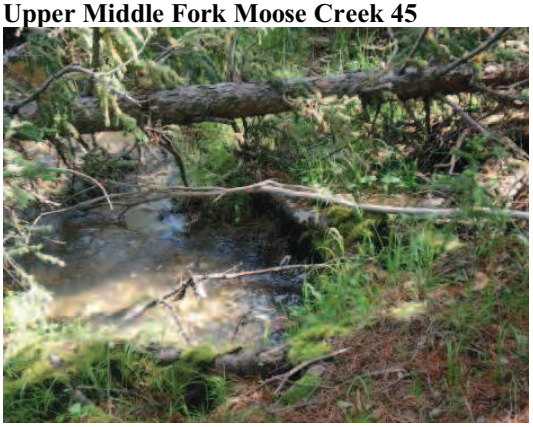


Upper Middle Fork Moose Creek 43

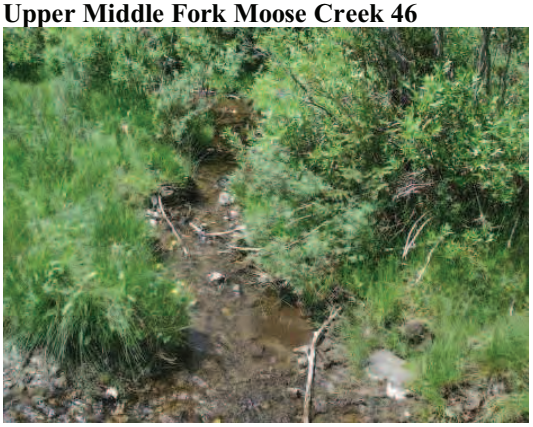


Upper Middle Fork Moose Creek 44

Upper Middle Fork Moose Creek 45



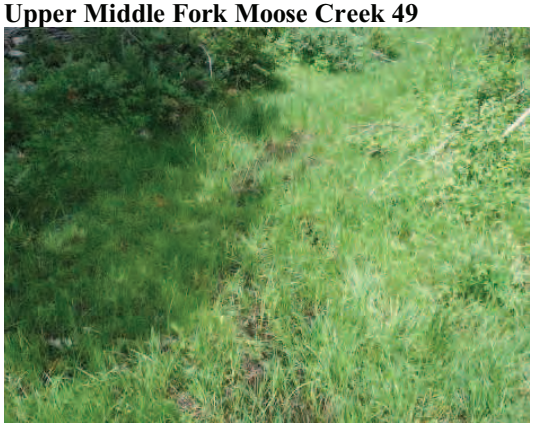
Upper Middle Fork Moose Creek 46



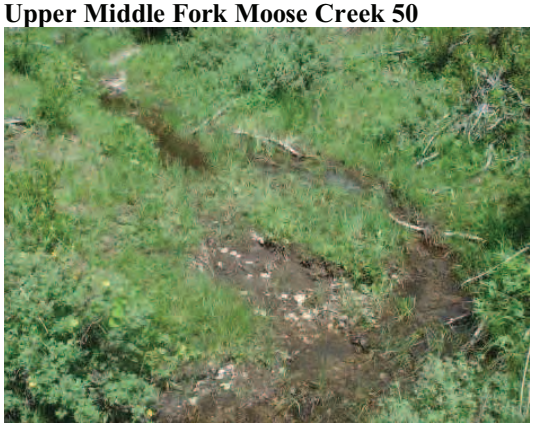
Upper Middle Fork Moose Creek 47

Upper Middle Fork Moose Creek 48

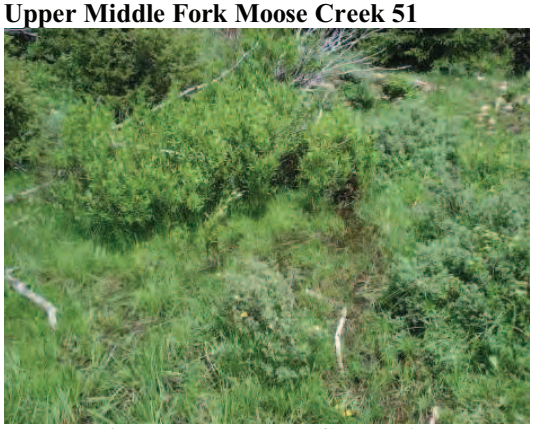
Upper Middle Fork Moose Creek 49



Upper Middle Fork Moose Creek 50

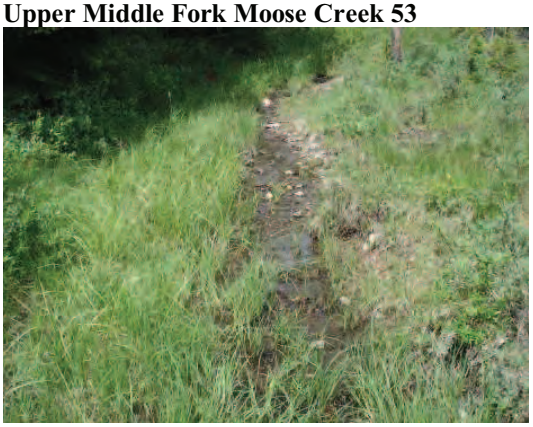


Upper Middle Fork Moose Creek 51



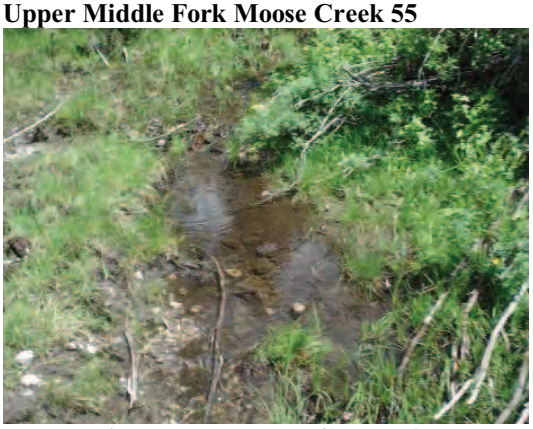
Upper Middle Fork Moose Creek 52

Upper Middle Fork Moose Creek 53



Upper Middle Fork Moose Creek 54

Upper Middle Fork Moose Creek 55

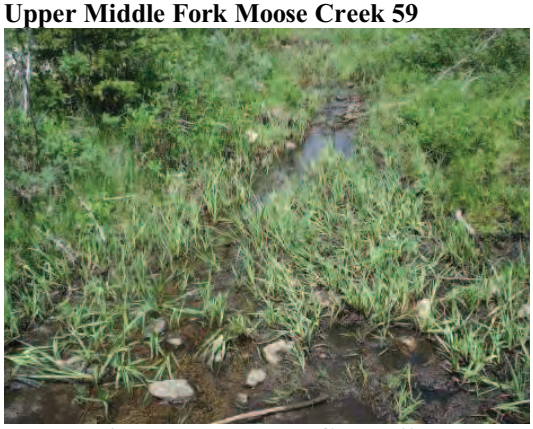


Upper Middle Fork Moose Creek 56

Upper Middle Fork Moose Creek 57

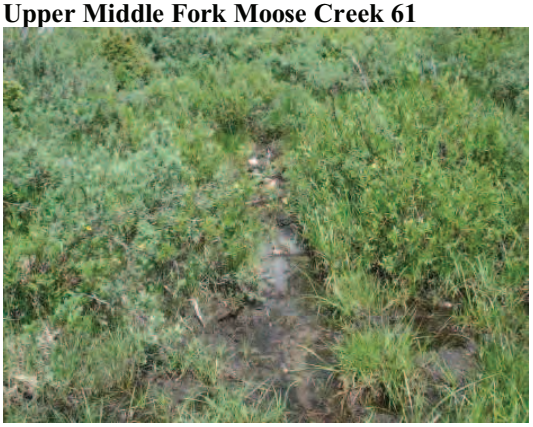
Upper Middle Fork Moose Creek 58

Upper Middle Fork Moose Creek 59



Upper Middle Fork Moose Creek 60

Upper Middle Fork Moose Creek 61



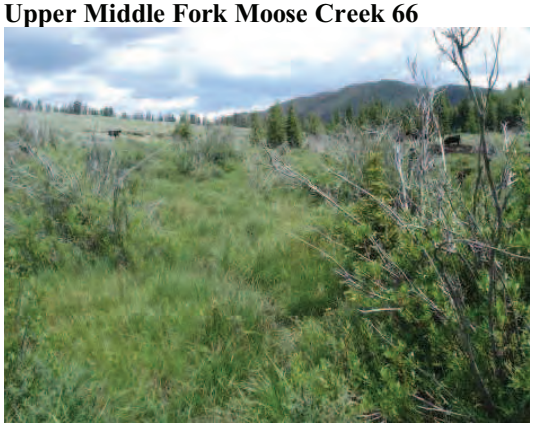
Upper Middle Fork Moose Creek 62

Upper Middle Fork Moose Creek 63

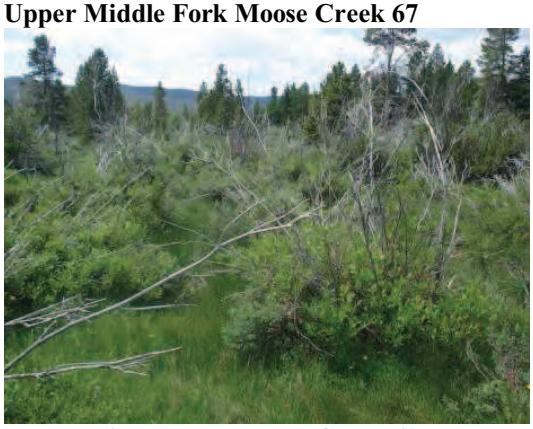
Upper Middle Fork Moose Creek 64

Upper Middle Fork Moose Creek 65

Upper Middle Fork Moose Creek 66



Upper Middle Fork Moose Creek 67

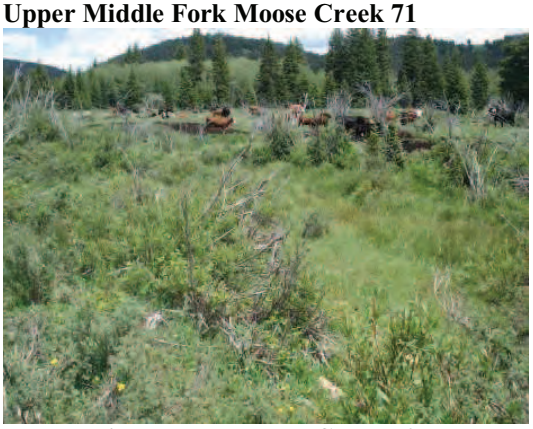


Upper Middle Fork Moose Creek 68

Upper Middle Fork Moose Creek 69

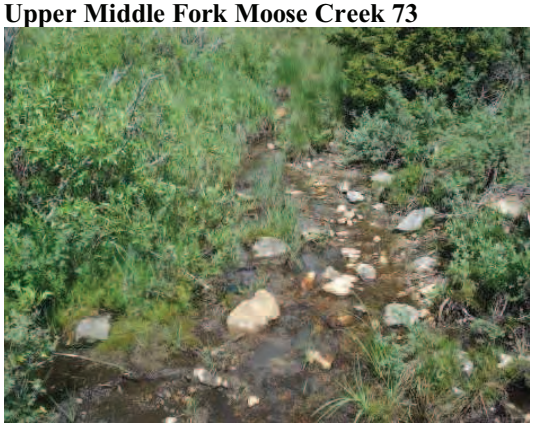
Upper Middle Fork Moose Creek 70

Upper Middle Fork Moose Creek 71

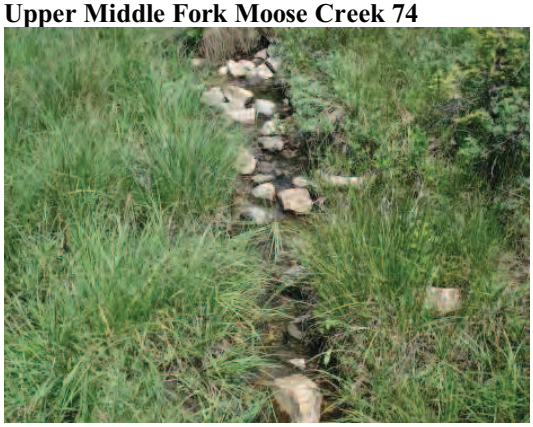


Upper Middle Fork Moose Creek 72

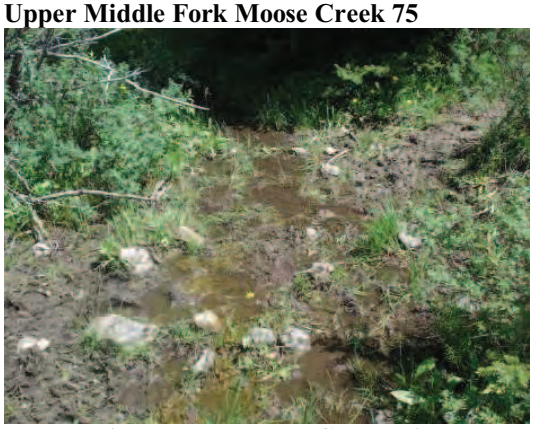
Upper Middle Fork Moose Creek 73



Upper Middle Fork Moose Creek 74

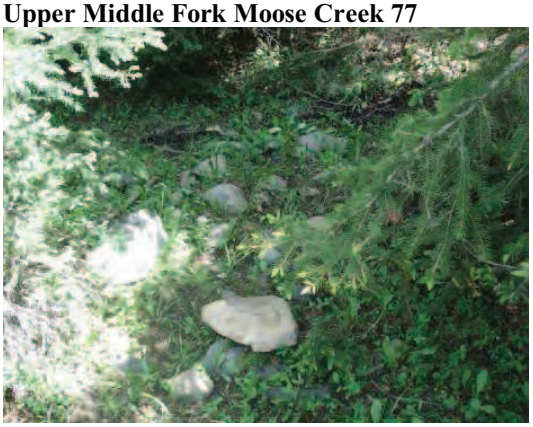


Upper Middle Fork Moose Creek 75



Upper Middle Fork Moose Creek 76

Upper Middle Fork Moose Creek 77



Upper Middle Fork Moose Creek 78

Upper Middle Fork Moose Creek 79

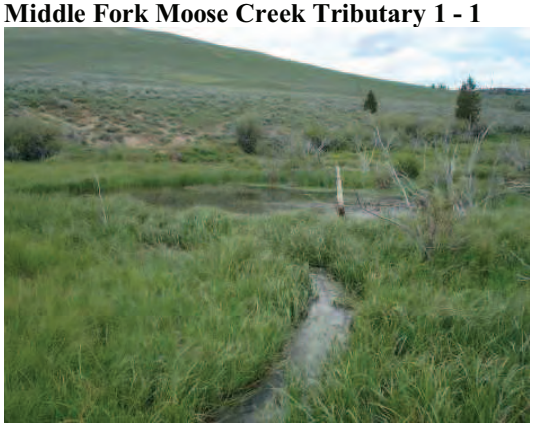
Minor split channel of MF Moose Creek 1

Minor split channel of MF Moose Creek 2

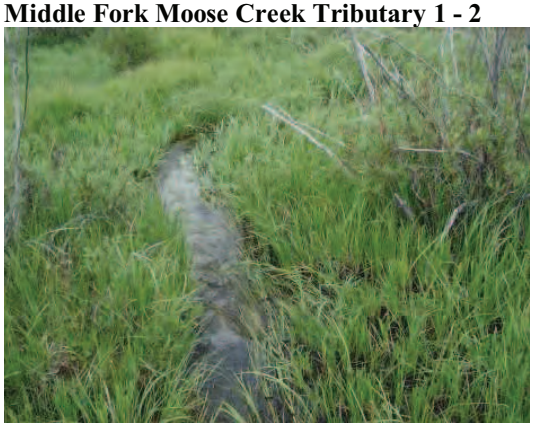
Minor split channel of MF Moose Creek 3

Minor split channel of MF Moose Creek 4

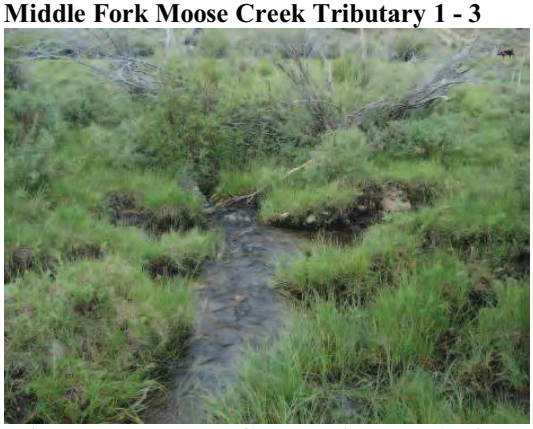
Middle Fork Moose Creek Tributary 1 - 1



Middle Fork Moose Creek Tributary 1 - 2

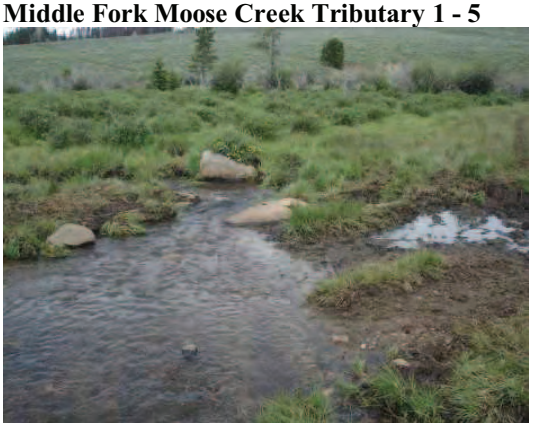


Middle Fork Moose Creek Tributary 1 - 3



Middle Fork Moose Creek Tributary 1 - 4

Middle Fork Moose Creek Tributary 1 - 5

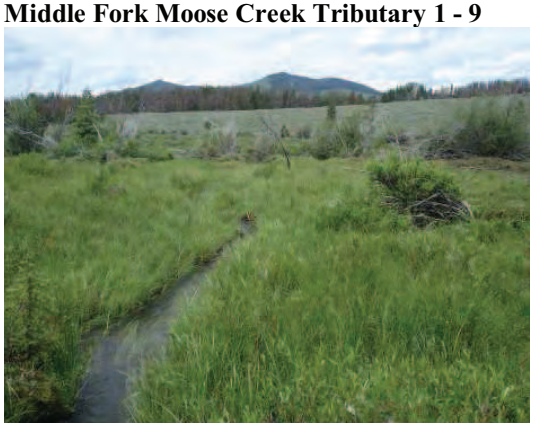


Middle Fork Moose Creek Tributary 1 - 6

Middle Fork Moose Creek Tributary 1 - 7

Middle Fork Moose Creek Tributary 1 - 8

Middle Fork Moose Creek Tributary 1 - 9

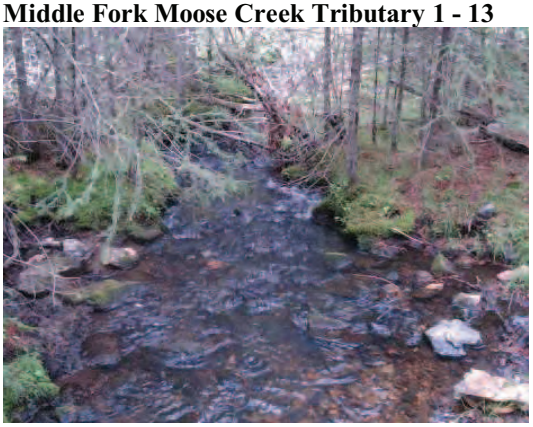


Middle Fork Moose Creek Tributary 1 - 10

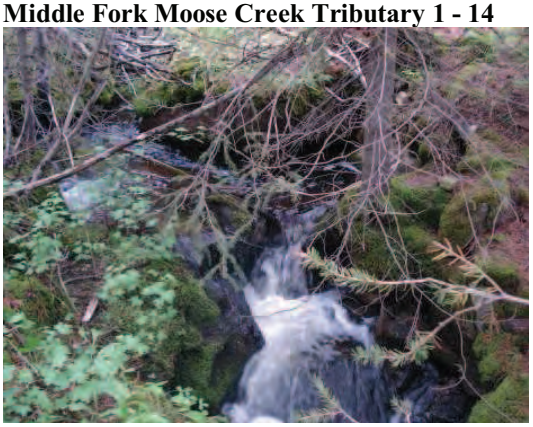
Middle Fork Moose Creek Tributary 1 - 11

Middle Fork Moose Creek Tributary 1 - 12

Middle Fork Moose Creek Tributary 1 - 13



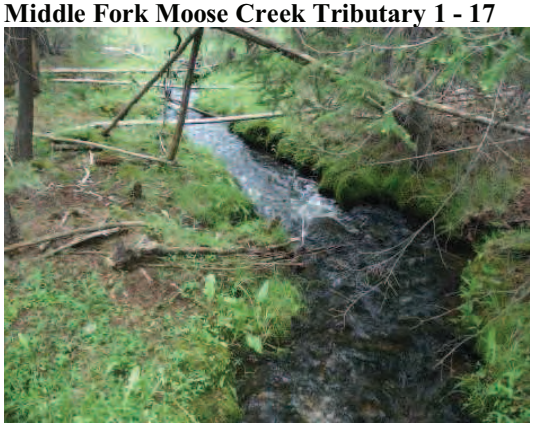
Middle Fork Moose Creek Tributary 1 - 14



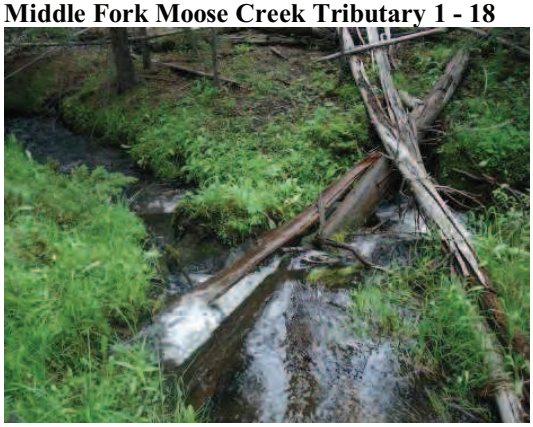
Middle Fork Moose Creek Tributary 1 - 15

Middle Fork Moose Creek Tributary 1 - 16

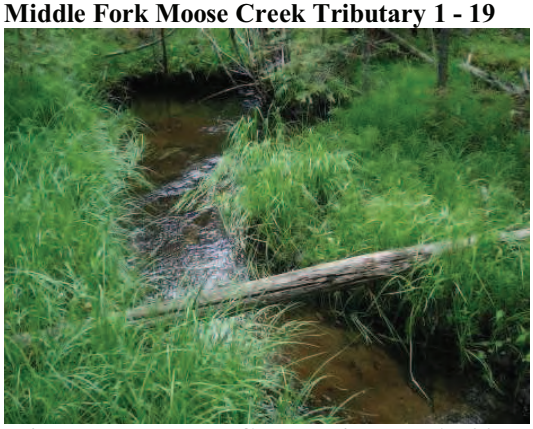
Middle Fork Moose Creek Tributary 1 - 17



Middle Fork Moose Creek Tributary 1 - 18

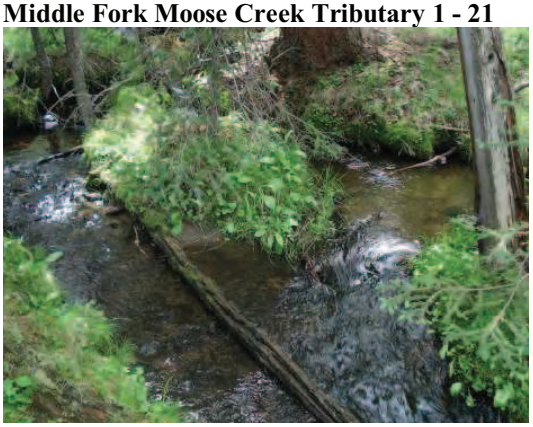


Middle Fork Moose Creek Tributary 1 - 19

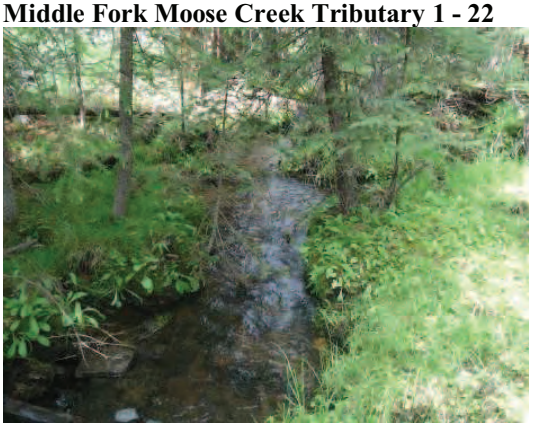


Middle Fork Moose Creek Tributary 1 - 20

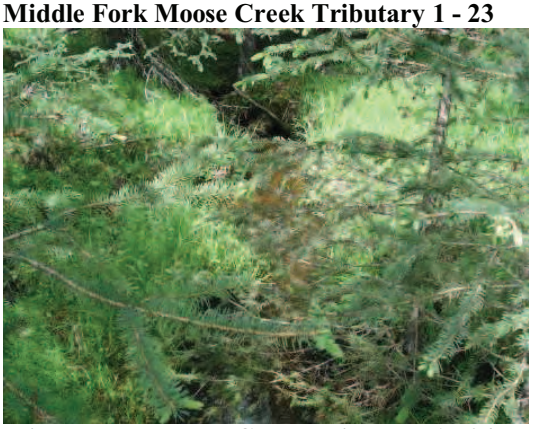
Middle Fork Moose Creek Tributary 1 - 21



Middle Fork Moose Creek Tributary 1 - 22

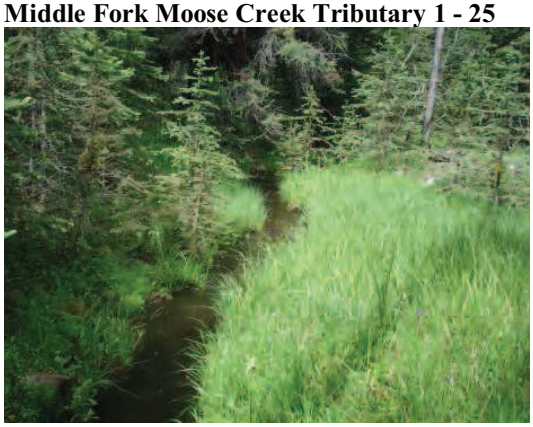


Middle Fork Moose Creek Tributary 1 - 23

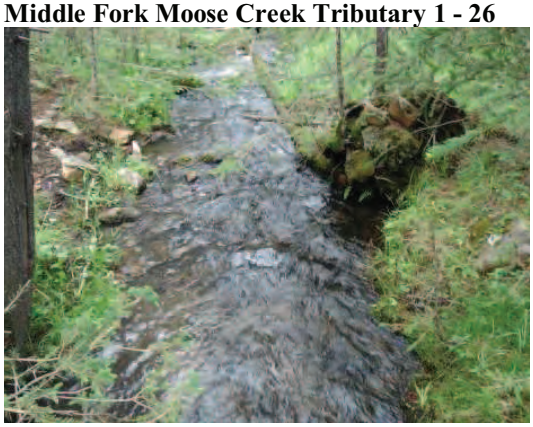


Middle Fork Moose Creek Tributary 1 - 24

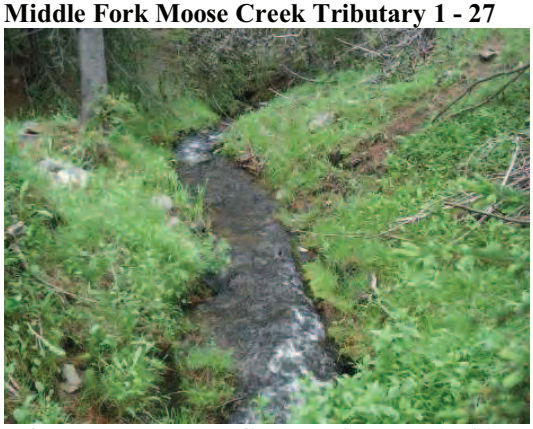
Middle Fork Moose Creek Tributary 1 - 25



Middle Fork Moose Creek Tributary 1 - 26

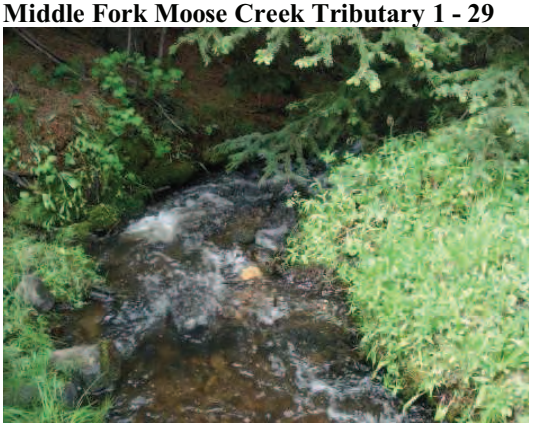


Middle Fork Moose Creek Tributary 1 - 27



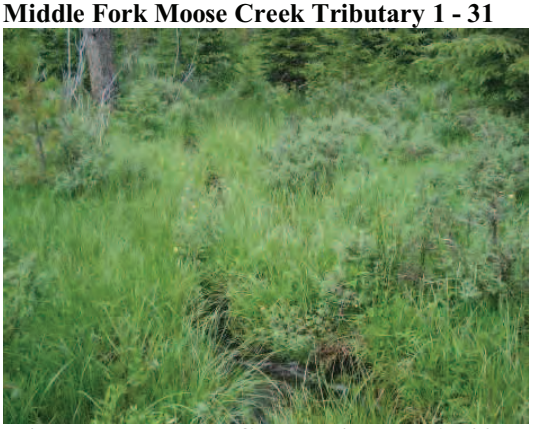
Middle Fork Moose Creek Tributary 1 - 28

Middle Fork Moose Creek Tributary 1 - 29



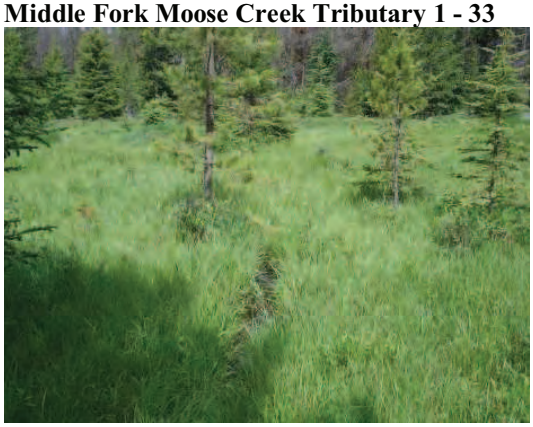
Middle Fork Moose Creek Tributary 1 - 30

Middle Fork Moose Creek Tributary 1 - 31

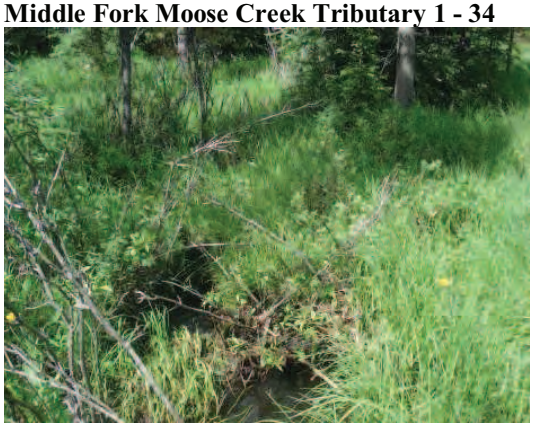


Middle Fork Moose Creek Tributary 1 - 32

Middle Fork Moose Creek Tributary 1 - 33



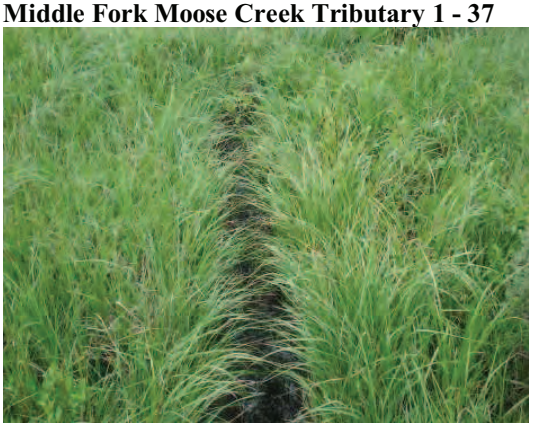
Middle Fork Moose Creek Tributary 1 - 34



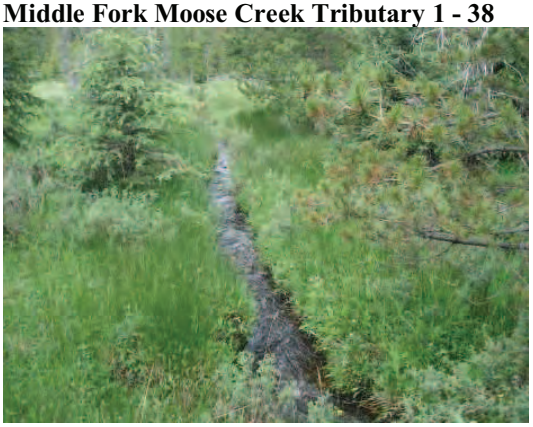
Middle Fork Moose Creek Tributary 1 - 35

Middle Fork Moose Creek Tributary 1 - 36

Middle Fork Moose Creek Tributary 1 - 37



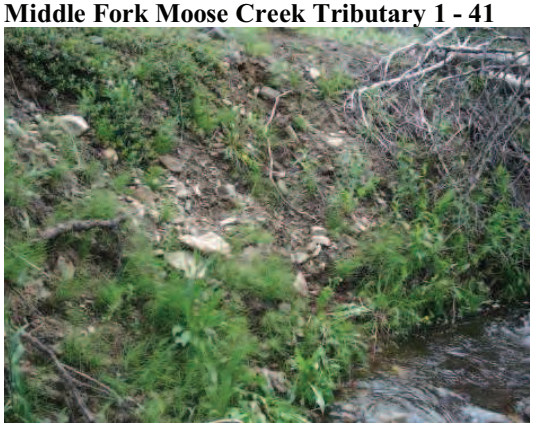
Middle Fork Moose Creek Tributary 1 - 38



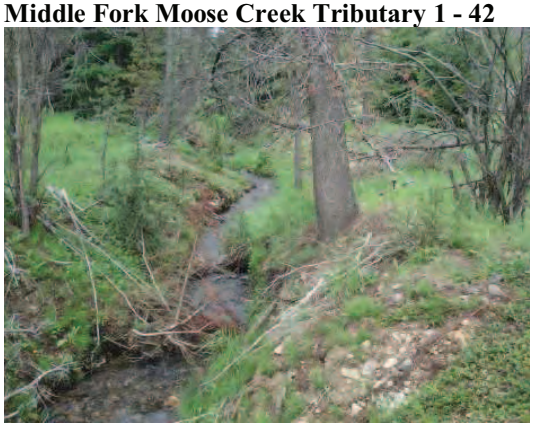
Middle Fork Moose Creek Tributary 1 - 39

Middle Fork Moose Creek Tributary 1 - 40

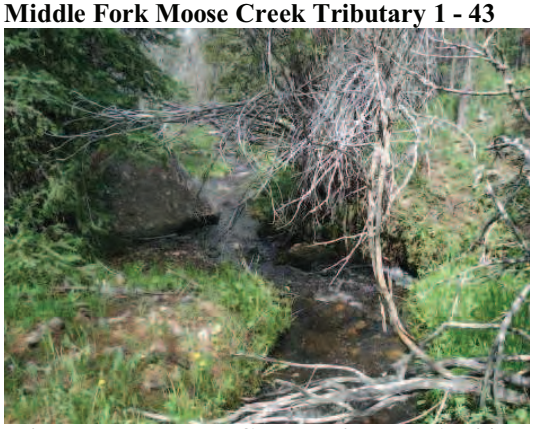
Middle Fork Moose Creek Tributary 1 - 41



Middle Fork Moose Creek Tributary 1 - 42

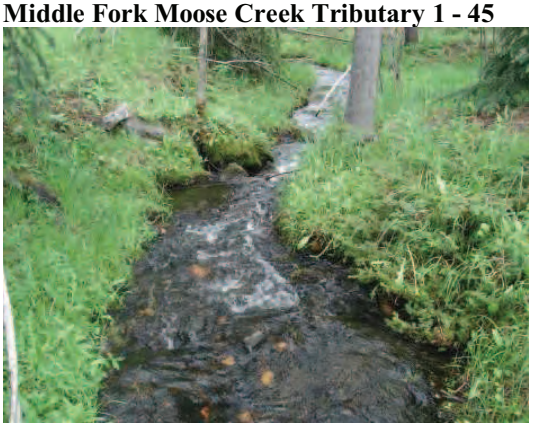


Middle Fork Moose Creek Tributary 1 - 43

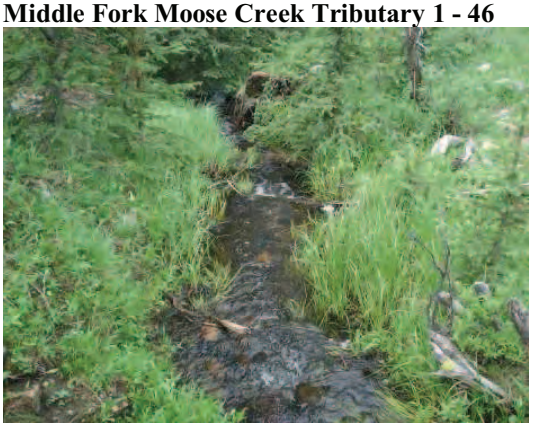


Middle Fork Moose Creek Tributary 1 - 44

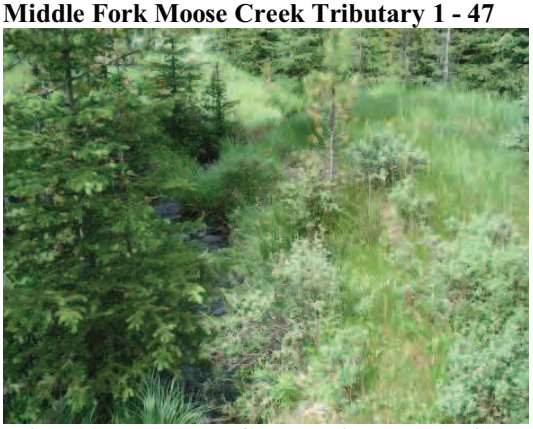
Middle Fork Moose Creek Tributary 1 - 45



Middle Fork Moose Creek Tributary 1 - 46

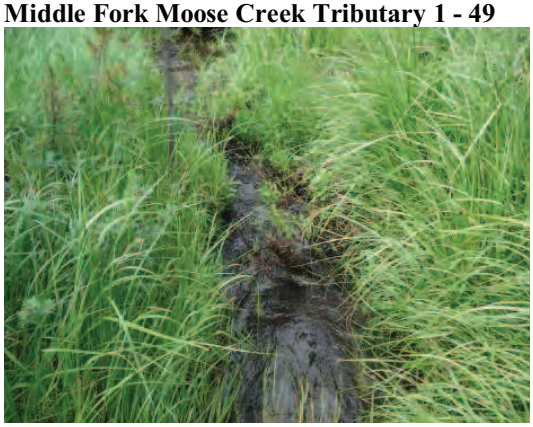


Middle Fork Moose Creek Tributary 1 - 47

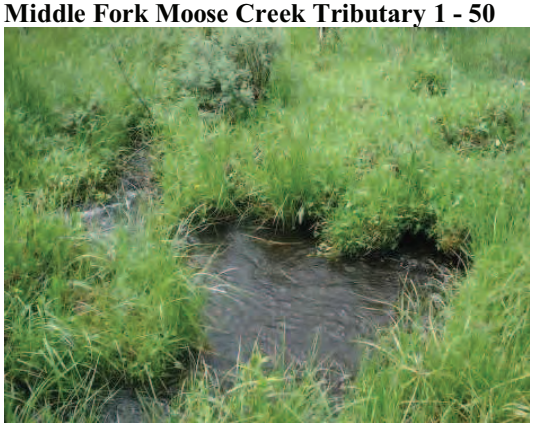


Middle Fork Moose Creek Tributary 1 - 48

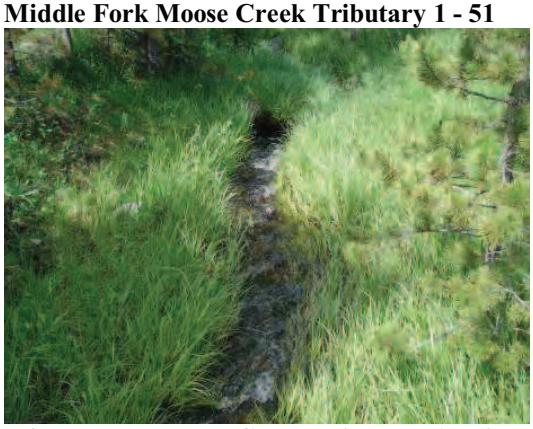
Middle Fork Moose Creek Tributary 1 - 49



Middle Fork Moose Creek Tributary 1 - 50

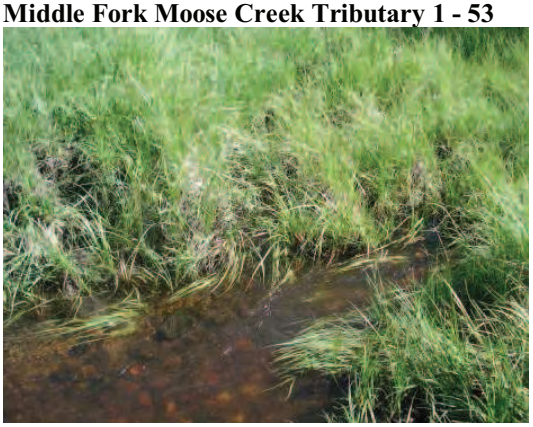


Middle Fork Moose Creek Tributary 1 - 51

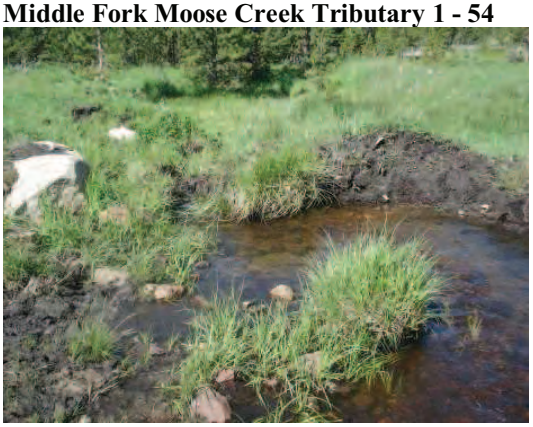


Middle Fork Moose Creek Tributary 1 - 52

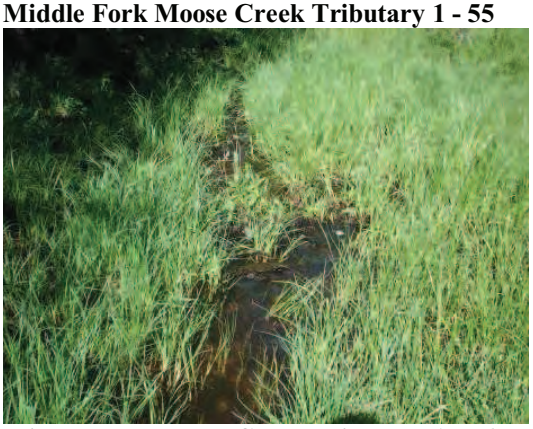
Middle Fork Moose Creek Tributary 1 - 53



Middle Fork Moose Creek Tributary 1 - 54

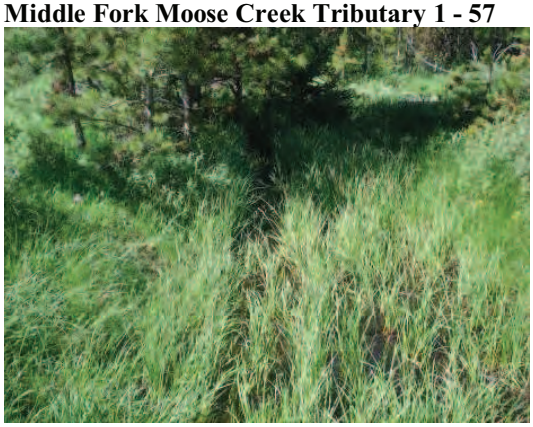


Middle Fork Moose Creek Tributary 1 - 55

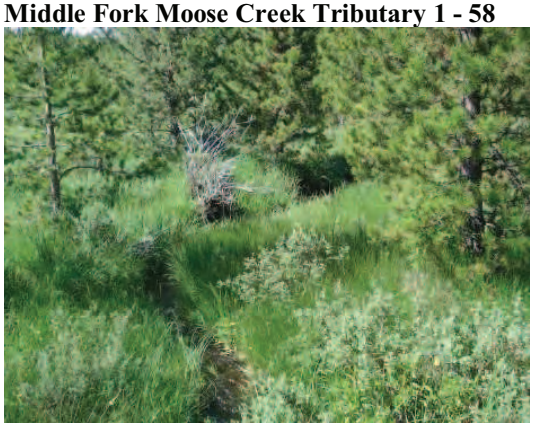


Middle Fork Moose Creek Tributary 1 - 56

Middle Fork Moose Creek Tributary 1 - 57



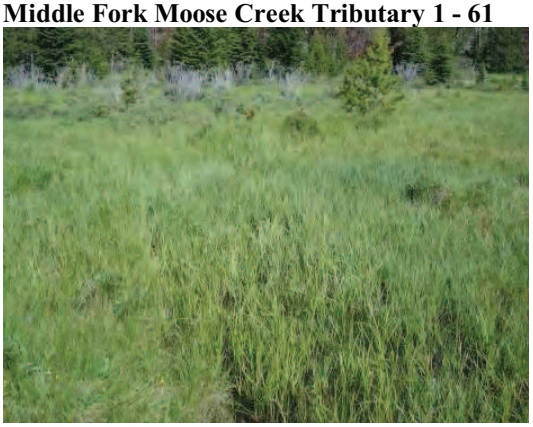
Middle Fork Moose Creek Tributary 1 - 58



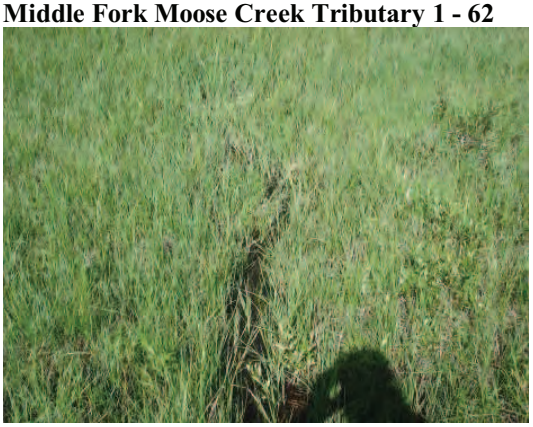
Middle Fork Moose Creek Tributary 1 - 59

Middle Fork Moose Creek Tributary 1 - 60

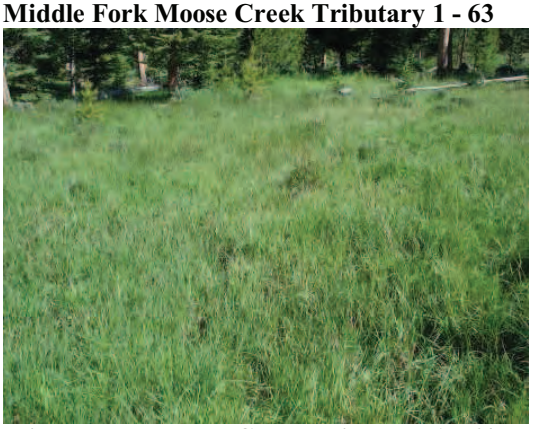
Middle Fork Moose Creek Tributary 1 - 61



Middle Fork Moose Creek Tributary 1 - 62

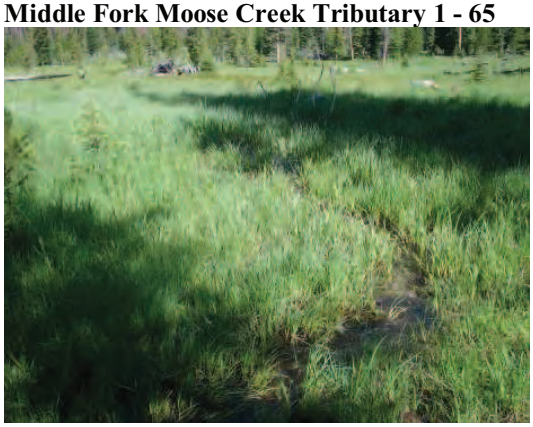


Middle Fork Moose Creek Tributary 1 - 63



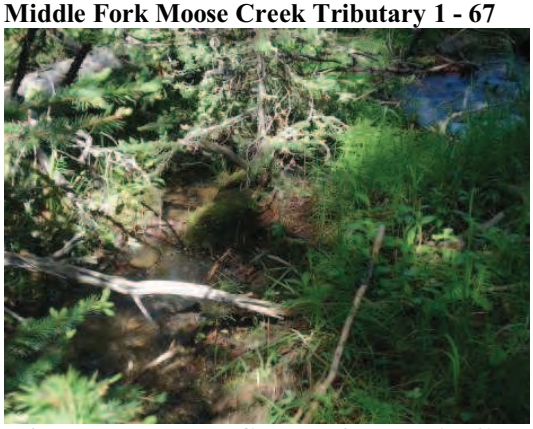
Middle Fork Moose Creek Tributary 1 - 64

Middle Fork Moose Creek Tributary 1 - 65



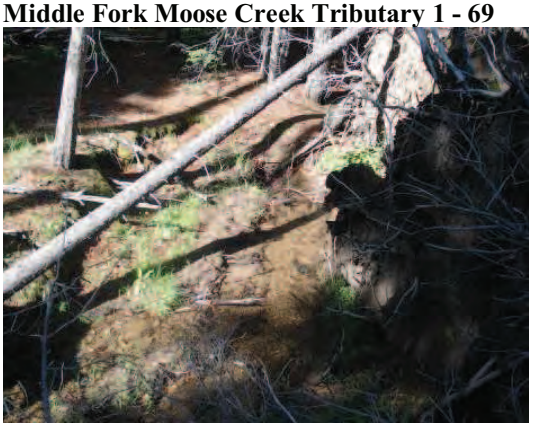
Middle Fork Moose Creek Tributary 1 - 66

Middle Fork Moose Creek Tributary 1 - 67

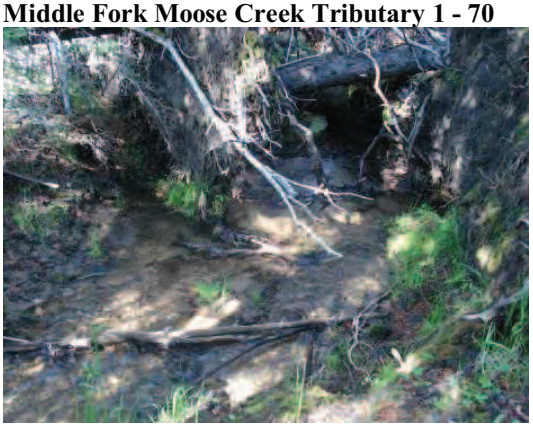


Middle Fork Moose Creek Tributary 1 - 68

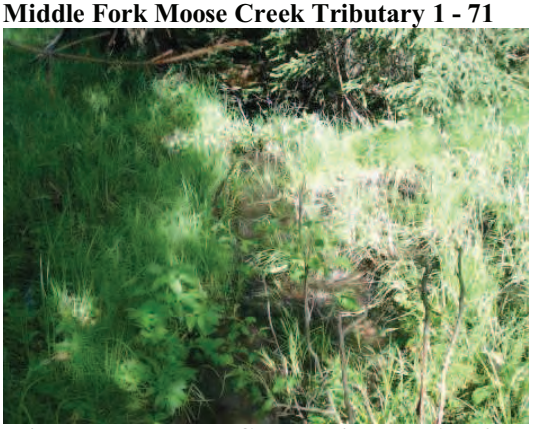
Middle Fork Moose Creek Tributary 1 - 69



Middle Fork Moose Creek Tributary 1 - 70

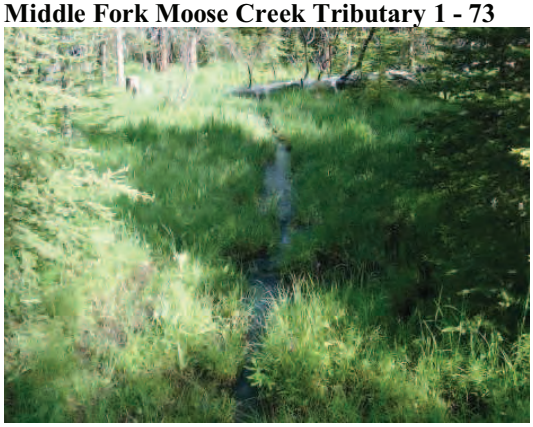


Middle Fork Moose Creek Tributary 1 - 71

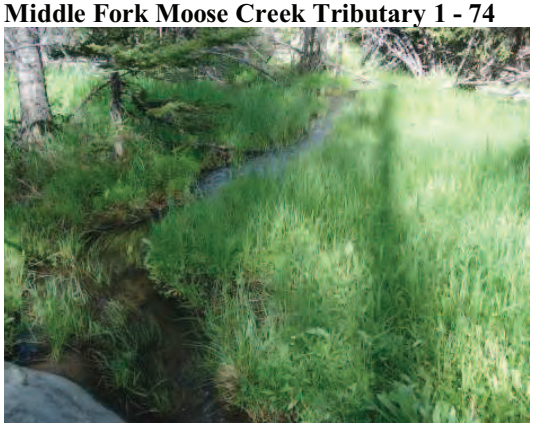


Middle Fork Moose Creek Tributary 1 - 72

Middle Fork Moose Creek Tributary 1 - 73



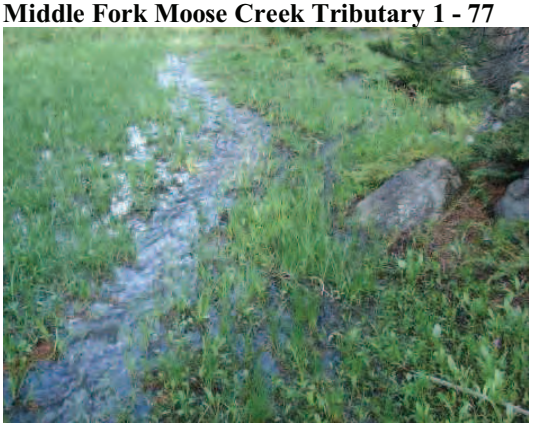
Middle Fork Moose Creek Tributary 1 - 74



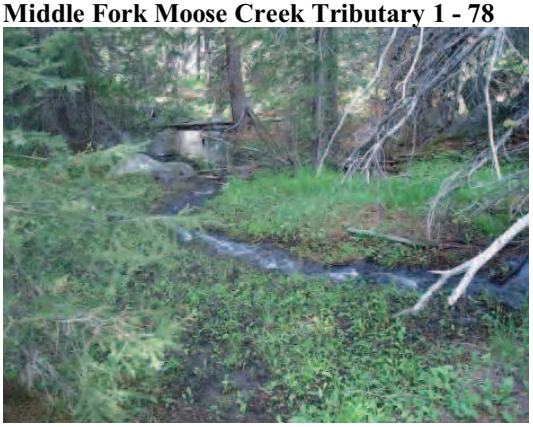
Middle Fork Moose Creek Tributary 1 - 75

Middle Fork Moose Creek Tributary 1 - 76

Middle Fork Moose Creek Tributary 1 - 77



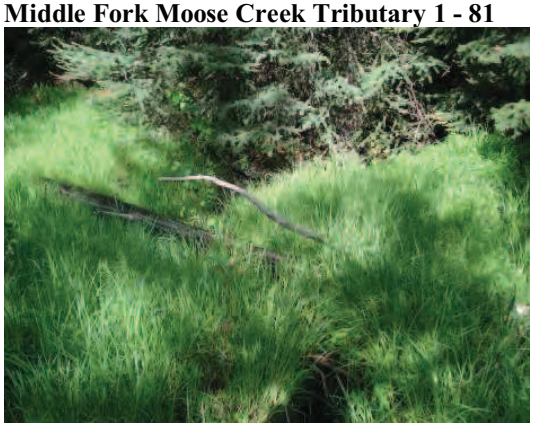
Middle Fork Moose Creek Tributary 1 - 78



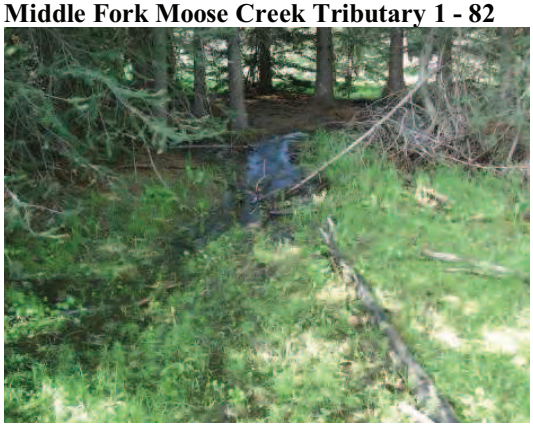
Middle Fork Moose Creek Tributary 1 - 79

Middle Fork Moose Creek Tributary 1 - 80

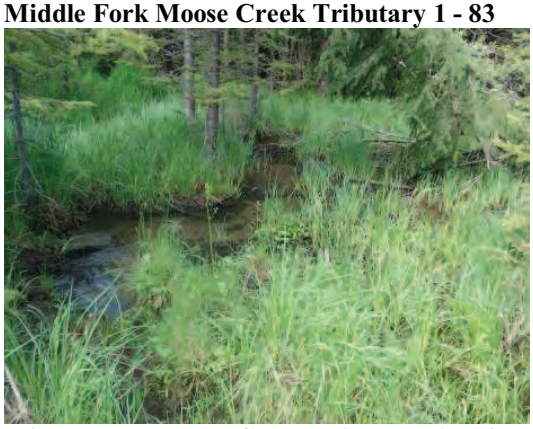
Middle Fork Moose Creek Tributary 1 - 81



Middle Fork Moose Creek Tributary 1 - 82

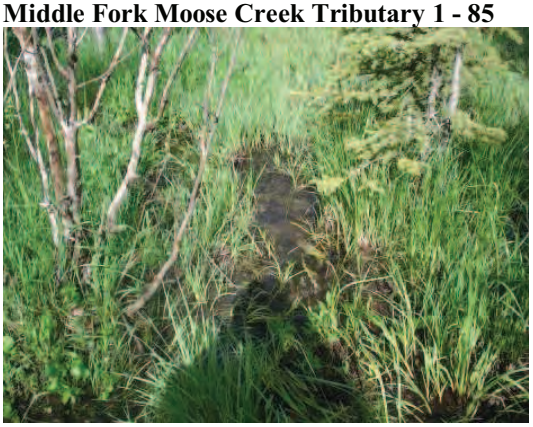


Middle Fork Moose Creek Tributary 1 - 83

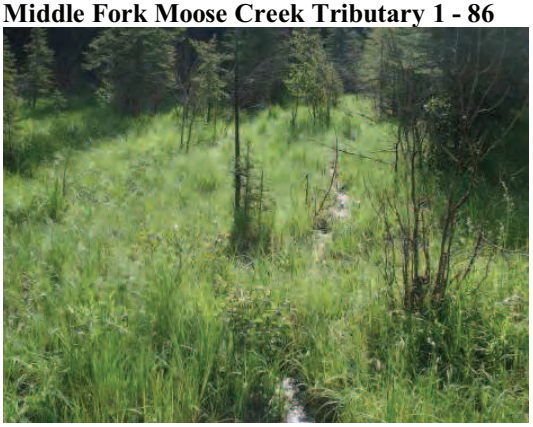


Middle Fork Moose Creek Tributary 1 - 84

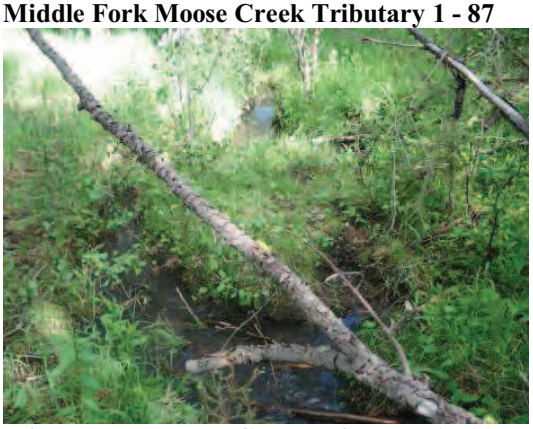
Middle Fork Moose Creek Tributary 1 - 85



Middle Fork Moose Creek Tributary 1 - 86



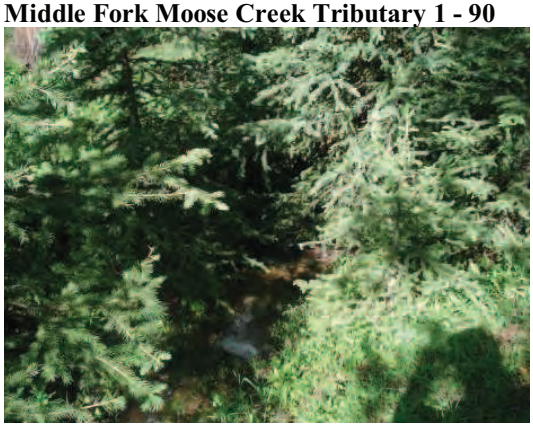
Middle Fork Moose Creek Tributary 1 - 87



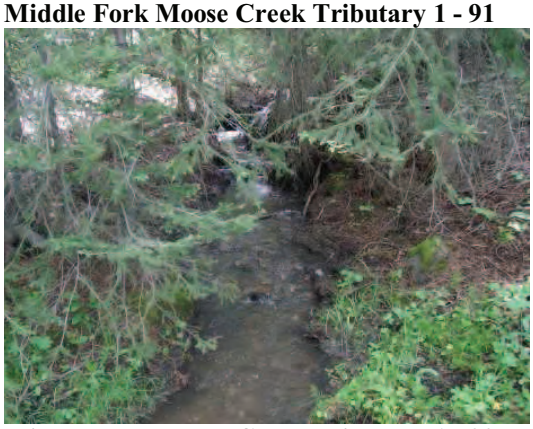
Middle Fork Moose Creek Tributary 1 - 88

Middle Fork Moose Creek Tributary 1 - 89

Middle Fork Moose Creek Tributary 1 - 90

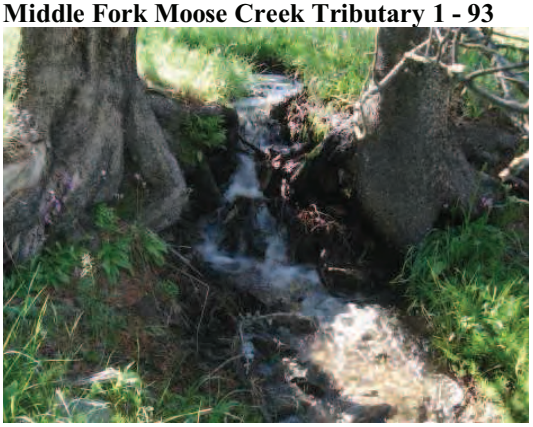


Middle Fork Moose Creek Tributary 1 - 91

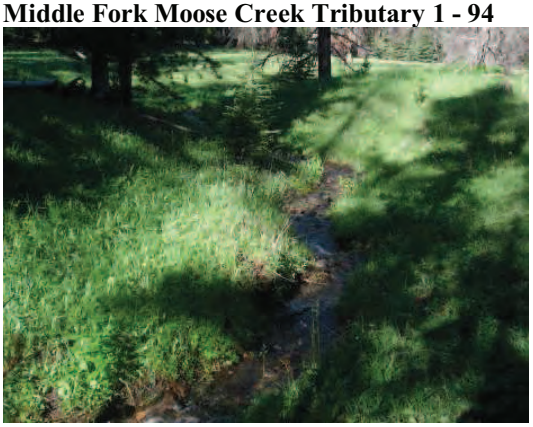


Middle Fork Moose Creek Tributary 1 - 92

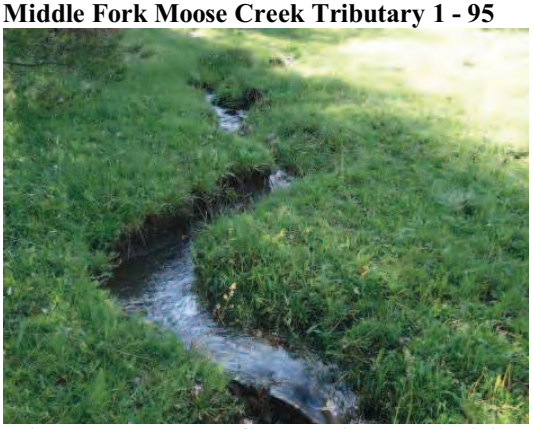
Middle Fork Moose Creek Tributary 1 - 93



Middle Fork Moose Creek Tributary 1 - 94

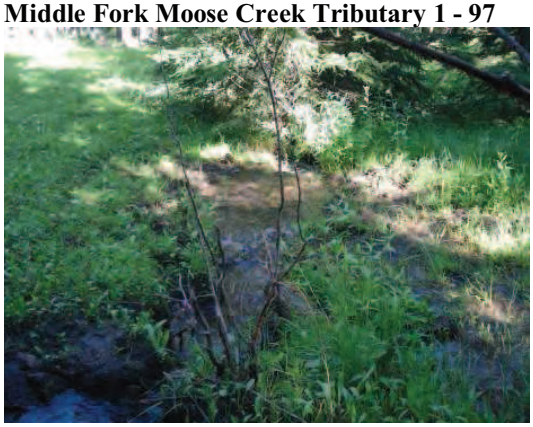


Middle Fork Moose Creek Tributary 1 - 95

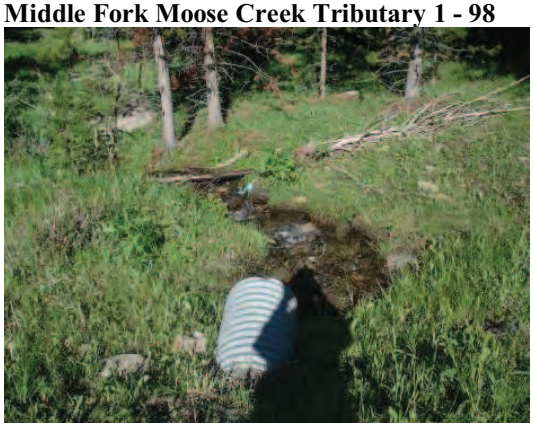


Middle Fork Moose Creek Tributary 1 - 96

Middle Fork Moose Creek Tributary 1 - 97



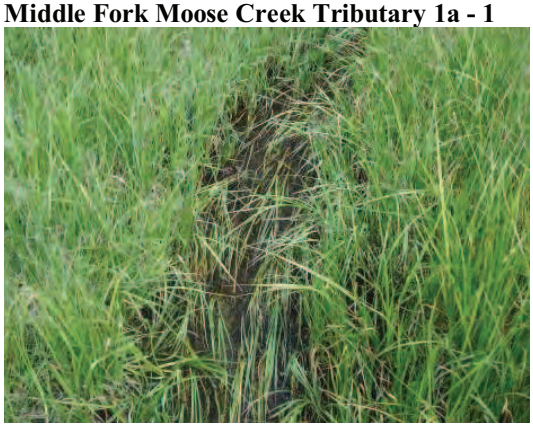
Middle Fork Moose Creek Tributary 1 - 98



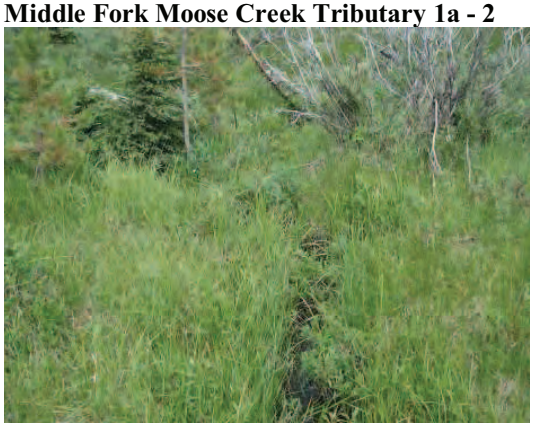
Middle Fork Moose Creek Tributary 1 - 99

Middle Fork Moose Creek Tributary 1 - 100

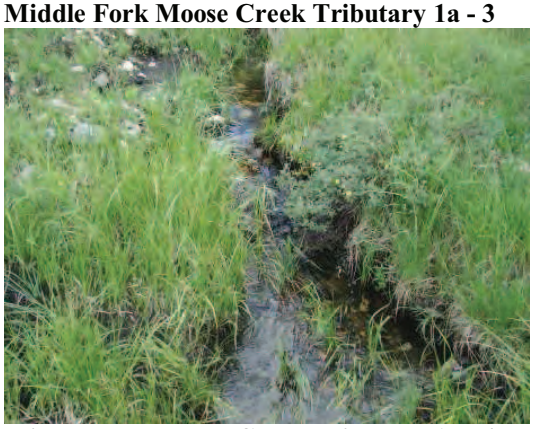
Middle Fork Moose Creek Tributary 1a - 1



Middle Fork Moose Creek Tributary 1a - 2

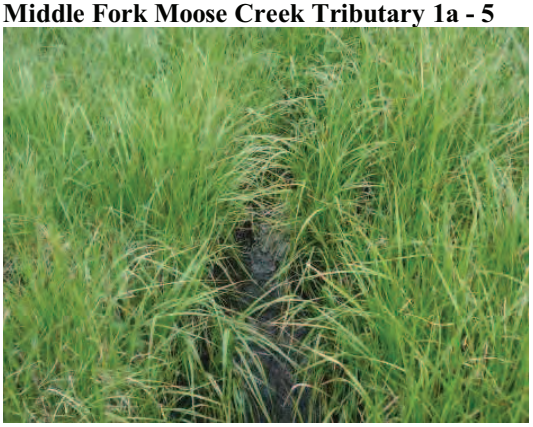


Middle Fork Moose Creek Tributary 1a - 3

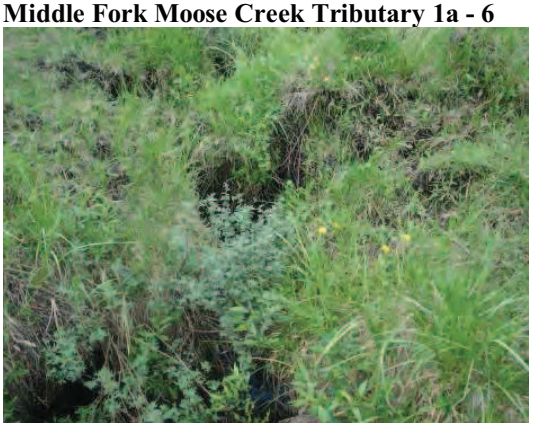


Middle Fork Moose Creek Tributary 1a - 4

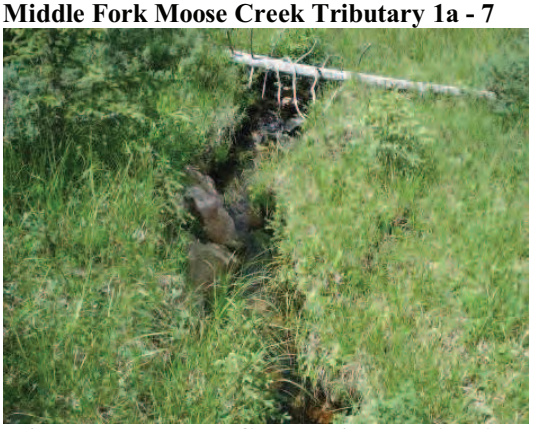
Middle Fork Moose Creek Tributary 1a - 5



Middle Fork Moose Creek Tributary 1a - 6

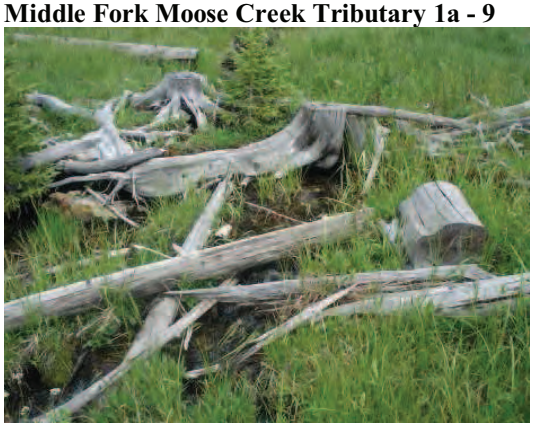


Middle Fork Moose Creek Tributary 1a - 7

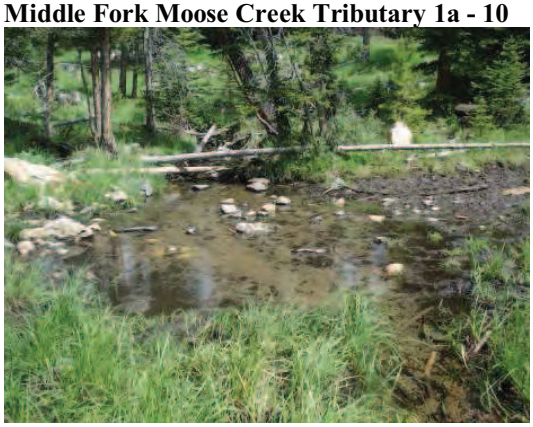


Middle Fork Moose Creek Tributary 1a - 8

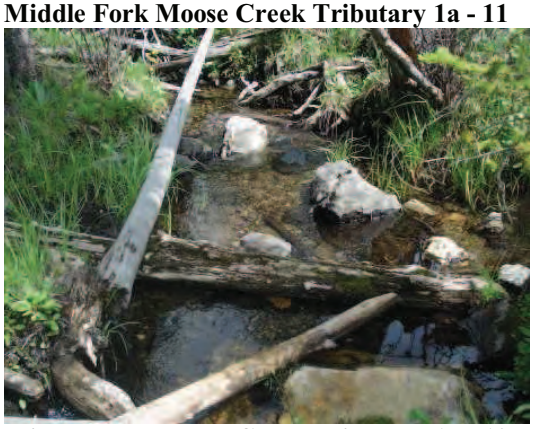
Middle Fork Moose Creek Tributary 1a - 9



Middle Fork Moose Creek Tributary 1a - 10

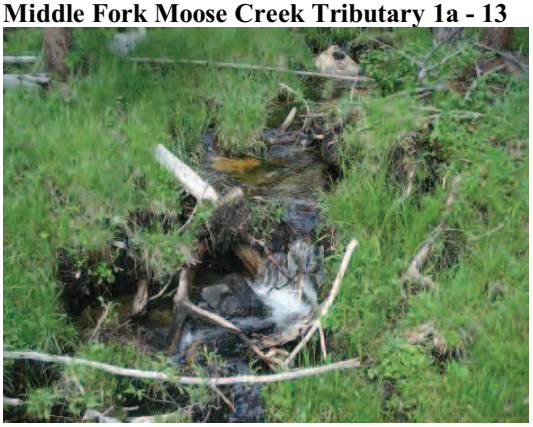


Middle Fork Moose Creek Tributary 1a - 11

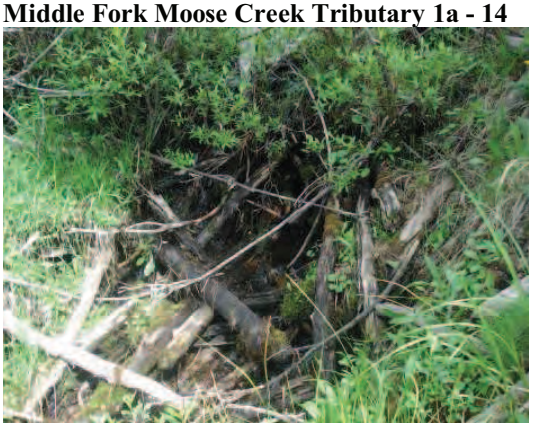


Middle Fork Moose Creek Tributary 1a - 12

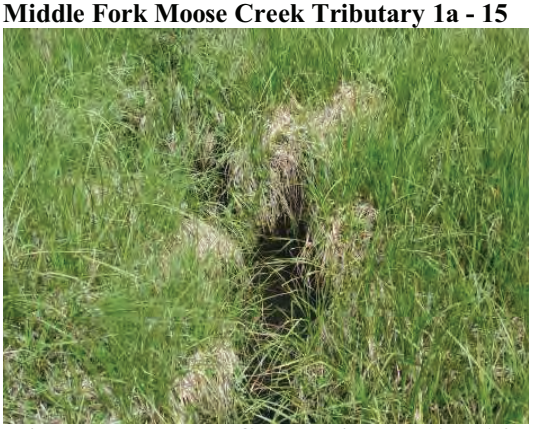
Middle Fork Moose Creek Tributary 1a - 13



Middle Fork Moose Creek Tributary 1a - 14



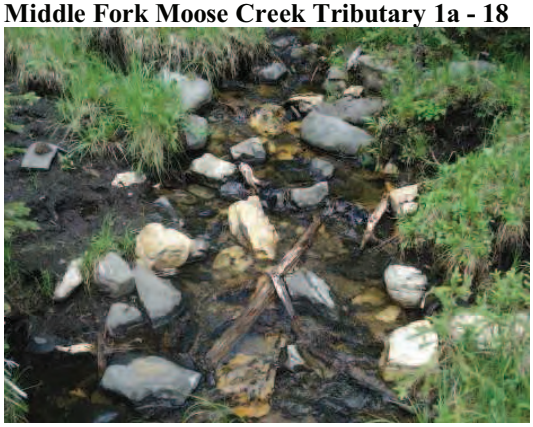
Middle Fork Moose Creek Tributary 1a - 15



Middle Fork Moose Creek Tributary 1a - 16

Middle Fork Moose Creek Tributary 1a - 17

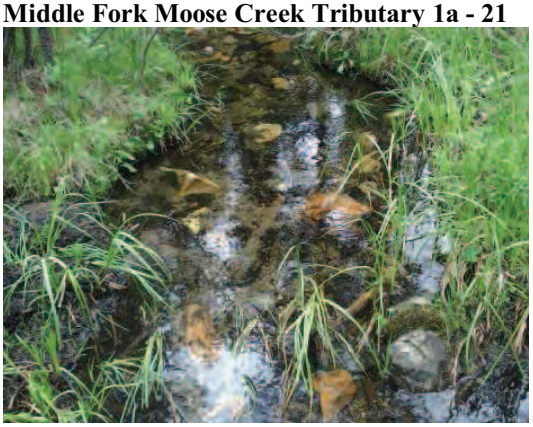
Middle Fork Moose Creek Tributary 1a - 18



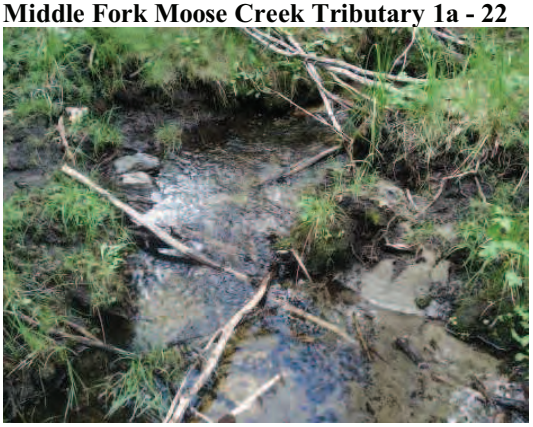
Middle Fork Moose Creek Tributary 1a - 19

Middle Fork Moose Creek Tributary 1a - 20

Middle Fork Moose Creek Tributary 1a - 21



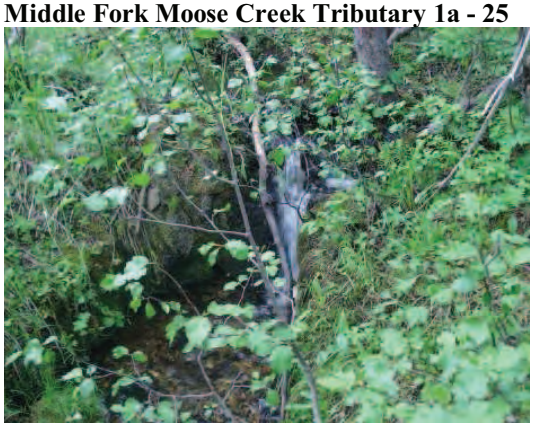
Middle Fork Moose Creek Tributary 1a - 22



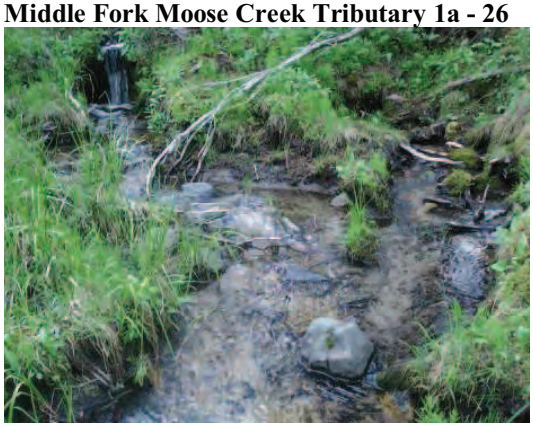
Middle Fork Moose Creek Tributary 1a - 23

Middle Fork Moose Creek Tributary 1a - 24

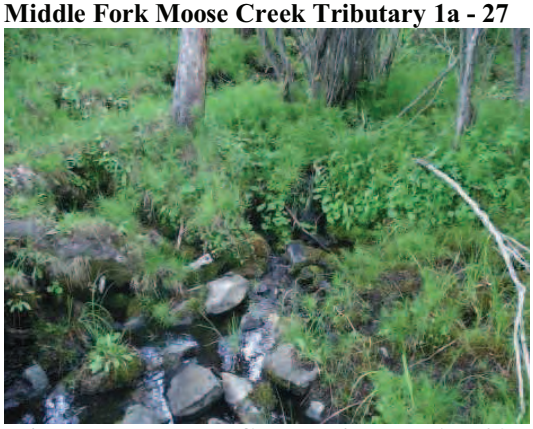
Middle Fork Moose Creek Tributary 1a - 25



Middle Fork Moose Creek Tributary 1a - 26

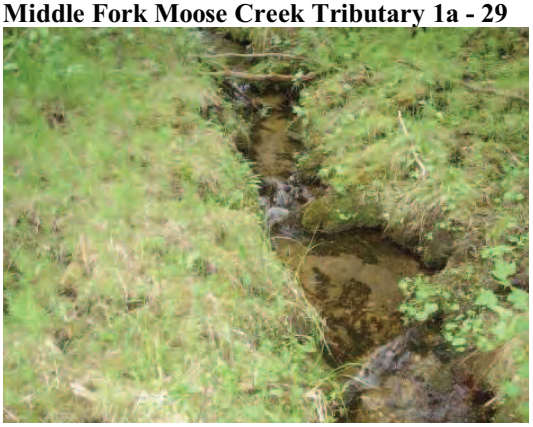


Middle Fork Moose Creek Tributary 1a - 27

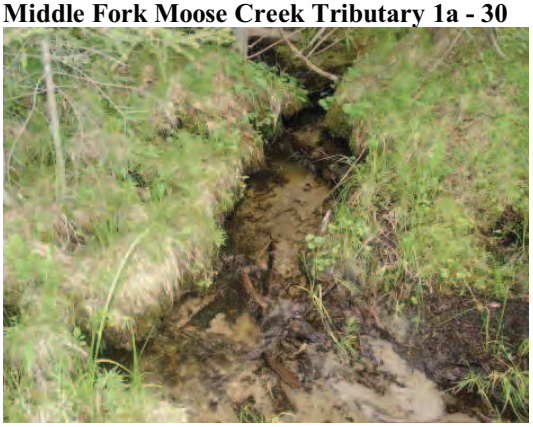


Middle Fork Moose Creek Tributary 1a - 28

Middle Fork Moose Creek Tributary 1a - 29



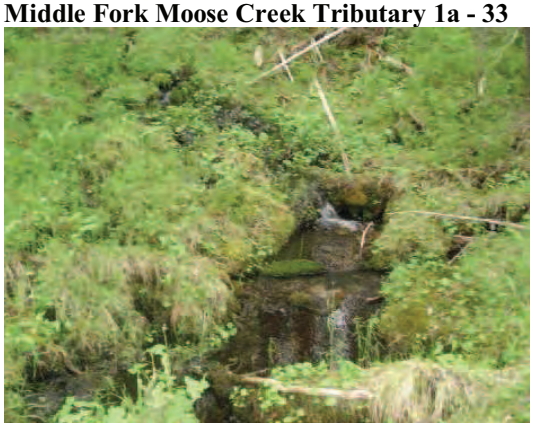
Middle Fork Moose Creek Tributary 1a - 30



Middle Fork Moose Creek Tributary 1a - 31

Middle Fork Moose Creek Tributary 1a - 32

Middle Fork Moose Creek Tributary 1a - 33



Middle Fork Moose Creek Tributary 1a - 34

Middle Fork Moose Creek Tributary 1a - 35

Middle Fork Moose Creek Tributary 1a - 36

Middle Fork Moose Creek Tributary 1a - 37

Fish Creek 1

Fish Creek 2

Fish Creek 3

Fish Creek 4

Fish Creek 5

Fish Creek 6

Fish Creek 7

Fish Creek 8

Fish Creek 9

Fish Creek 10

Fish Creek 11

Fish Creek 12

Fish Creek 13

Fish Creek 14

Fish Creek 15

Fish Creek 16

Fish Creek 17

Fish Creek 18

Fish Creek 19

Fish Creek 20

Fish Creek 21

Fish Creek 22

Fish Creek 23

Fish Creek 24

Fish Creek 25

Fish Creek 26

Fish Creek 27

Fish Creek 28

Fish Creek 29

Fish Creek 30

Fish Creek 31

Fish Creek 32

Fish Creek 33

Fish Creek 34

Fish Creek 35

Fish Creek 36

Fish Creek 37

Fish Creek 38

Fish Creek 39

Fish Creek 40

Fish Creek 41

Fish Creek 42

Fish Creek 43

Fish Creek 44

Fish Creek 45

Fish Creek 46

Fish Creek 47

Fish Creek 48

Fish Creek 49

Fish Creek 50

Fish Creek 51

Fish Creek 52

Fish Creek 53

Fish Creek 54

Fish Creek 55

Fish Creek 56

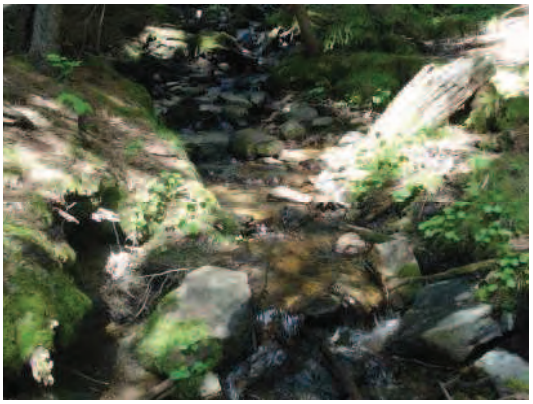
Fish Creek 57

Fish Creek 58

Fish Creek 59

Fish Creek 60

Fish Creek 61



Fish Creek 62

Fish Creek 63

Fish Creek 64

Fish Creek 65

Fish Creek 66

Fish Creek 67

Fish Creek 68

Fish Creek 69

Fish Creek 70

Fish Creek 71

Fish Creek 72

Fish Creek 73

Fish Creek 74

Fish Creek 75

Fish Creek Tributary 1 - 1

Fish Creek Tributary 1 - 2

Fish Creek Tributary 1 - 3

Fish Creek Tributary 1 - 4

Fish Creek Tributary 1 - 5

Fish Creek Tributary 1 - 6

Fish Creek Tributary 1 - 7

Fish Creek Tributary 1 - 8

Fish Creek Tributary 1 - 9

Fish Creek Tributary 1 - 10

Fish Creek Tributary 1 - 11

Fish Creek Tributary 1 - 12

Fish Creek Tributary 1 - 13

Fish Creek Tributary 1 - 14

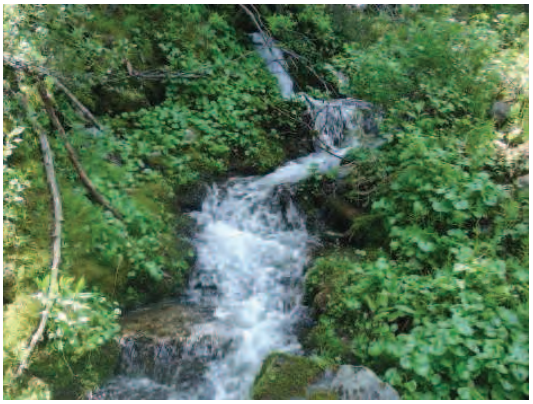
Fish Creek Tributary 1 - 15

Fish Creek Tributary 2 - 1

Fish Creek Tributary 2 - 2

Fish Creek Tributary 2 - 3

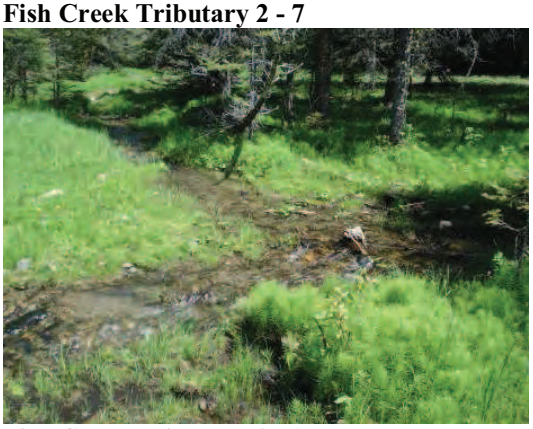
Fish Creek Tributary 2 - 4



Fish Creek Tributary 2 - 5

Fish Creek Tributary 2 - 6

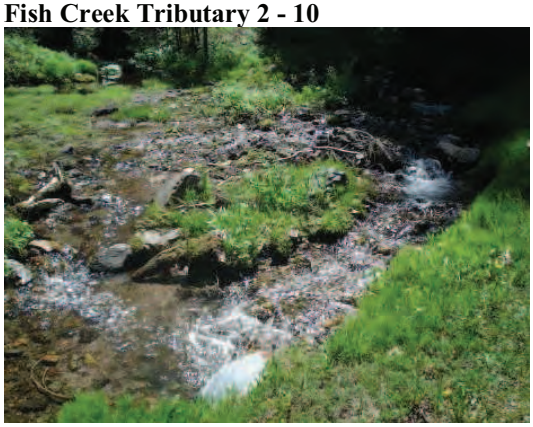
Fish Creek Tributary 2 - 7



Fish Creek Tributary 2 - 8

Fish Creek Tributary 2 - 9

Fish Creek Tributary 2 - 10



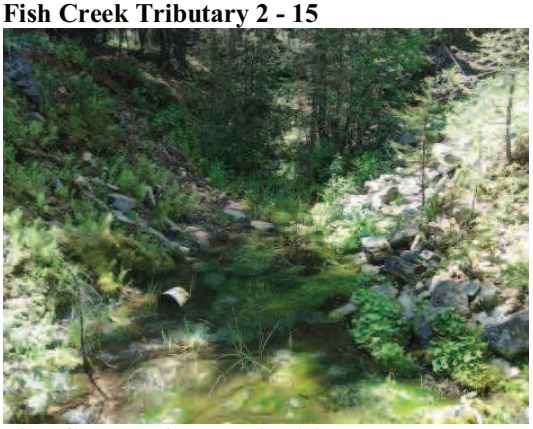
Fish Creek Tributary 2 - 11

Fish Creek Tributary 2 - 12

Fish Creek Tributary 2 - 13

Fish Creek Tributary 2 - 14

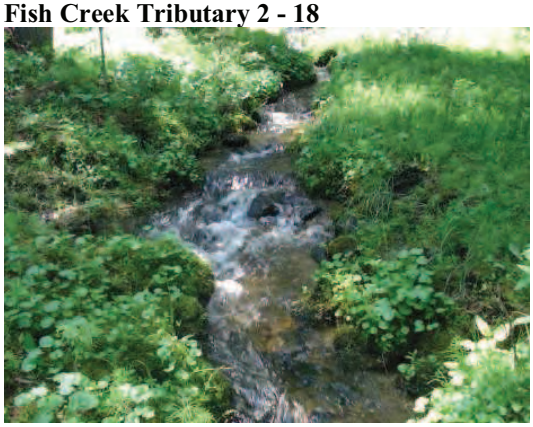
Fish Creek Tributary 2 - 15



Fish Creek Tributary 2 - 16

Fish Creek Tributary 2 - 17

Fish Creek Tributary 2 - 18



Fish Creek Tributary 2 - 19

Fish Creek Tributary 2 - 20

Fish Creek Tributary 2 - 21

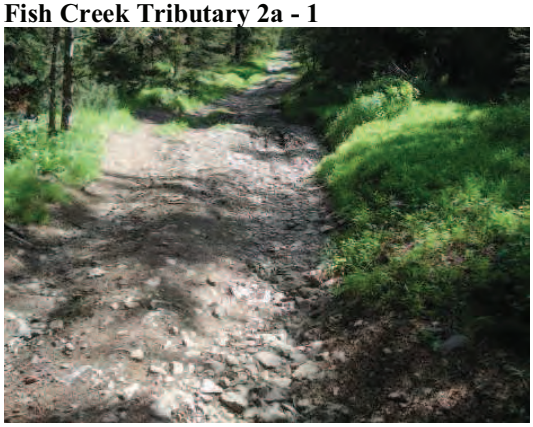
Fish Creek Tributary 2 - 22

Fish Creek Tributary 2 - 23

Fish Creek Tributary 2 - 24

Fish Creek Tributary 2 - 25

Fish Creek Tributary 2a - 1



Fish Creek Tributary 2a - 2

Fish Creek Tributary 2a - 3

Fish Creek Tributary 2a - 4

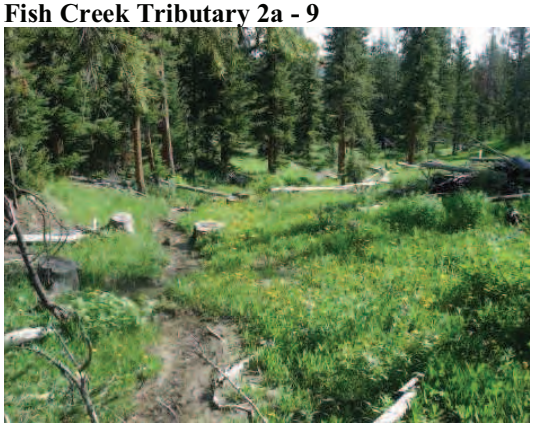
Fish Creek Tributary 2a - 5

Fish Creek Tributary 2a - 6

Fish Creek Tributary 2a - 7

Fish Creek Tributary 2a - 8

Fish Creek Tributary 2a - 9



Fish Creek Tributary 2a - 10

Fish Creek Tributary 2a - 11

Fish Creek Tributary 2a - 12

Fish Creek Tributary 2a - 13

Fish Creek Tributary 2a - 14

Fish Creek Tributary 2a - 15

Fish Creek Tributary 2a - 16

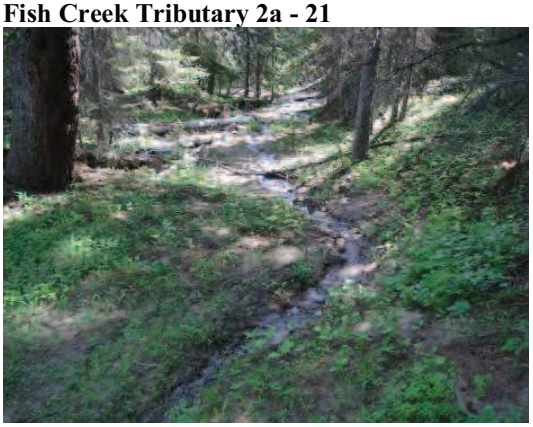
Fish Creek Tributary 2a - 17

Fish Creek Tributary 2a - 18

Fish Creek Tributary 2a - 19

Fish Creek Tributary 2a - 20

Fish Creek Tributary 2a - 21

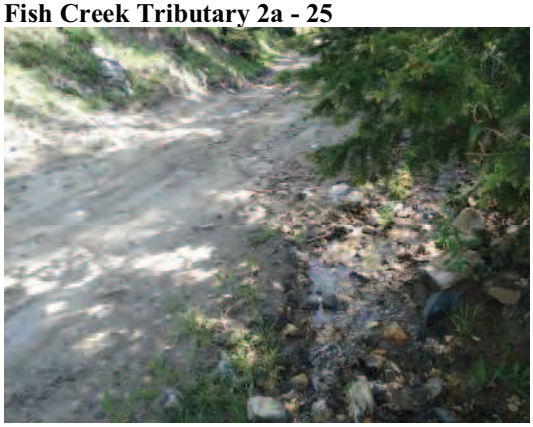


Fish Creek Tributary 2a - 22

Fish Creek Tributary 2a - 23

Fish Creek Tributary 2a - 24

Fish Creek Tributary 2a - 25



Fish Creek Tributary 2a - 26

Fish Creek Tributary 2a - 27

Fish Creek Tributary 2a - 28

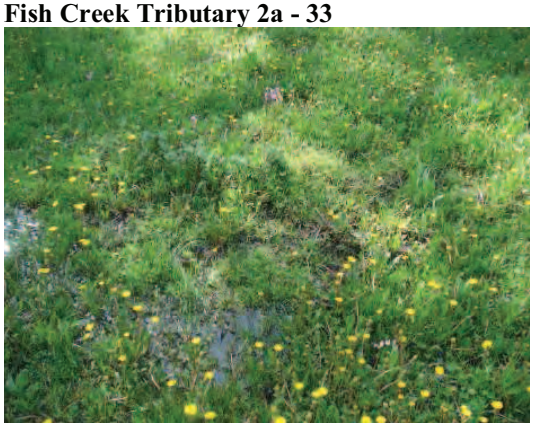
Fish Creek Tributary 2a - 29

Fish Creek Tributary 2a - 30

Fish Creek Tributary 2a - 31

Fish Creek Tributary 2a - 32

Fish Creek Tributary 2a - 33



Fish Creek Tributary 2a - 34

Fish Creek Tributary 2a - 35

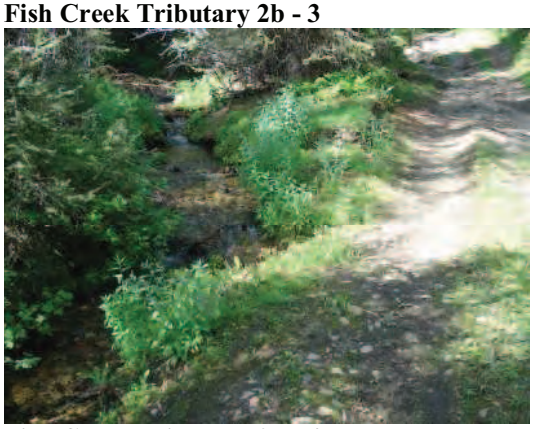
Fish Creek Tributary 2a - 36

Fish Creek Tributary 2a - 37

Fish Creek Tributary 2b - 1

Fish Creek Tributary 2b - 2

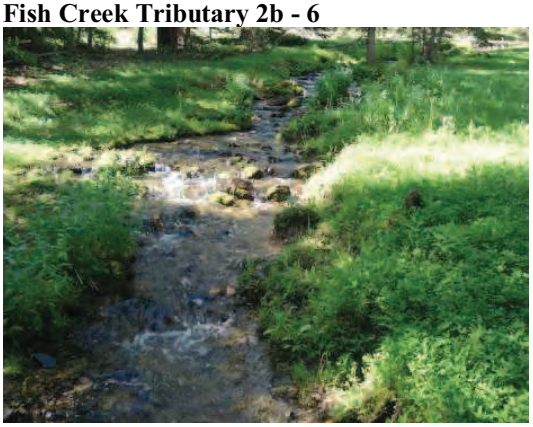
Fish Creek Tributary 2b - 3



Fish Creek Tributary 2b - 4

Fish Creek Tributary 2b - 5

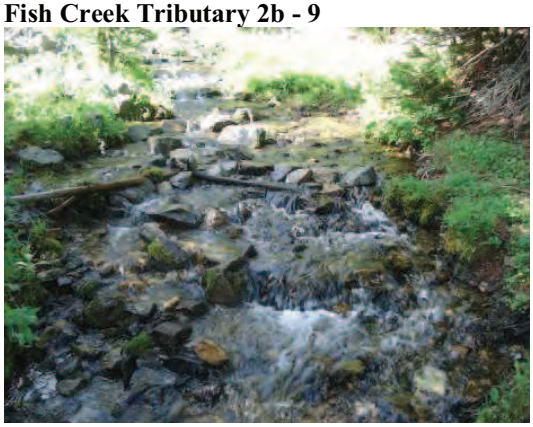
Fish Creek Tributary 2b - 6



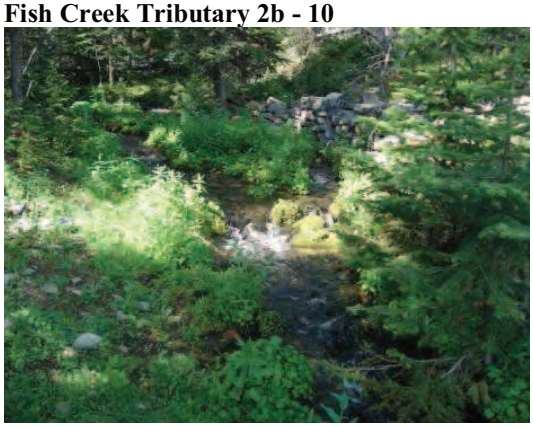
Fish Creek Tributary 2b - 7

Fish Creek Tributary 2b - 8

Fish Creek Tributary 2b - 9



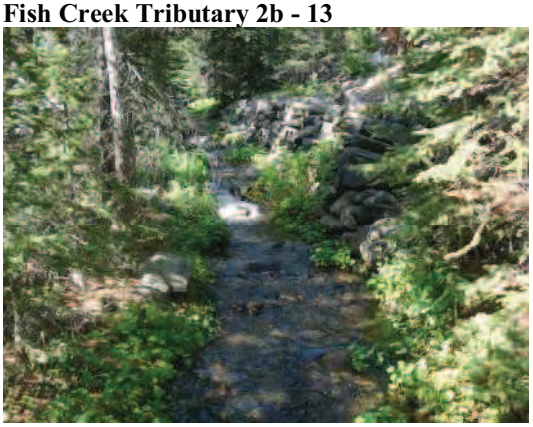
Fish Creek Tributary 2b - 10



Fish Creek Tributary 2b - 11

Fish Creek Tributary 2b - 12

Fish Creek Tributary 2b - 13



Fish Creek Tributary 2b - 14

Fish Creek Tributary 2b - 15

Fish Creek Tributary 2b - 16

Fish Creek Tributary 2b - 17

Fish Creek Tributary 2b - 18

Fish Creek Tributary 2b - 19

Fish Creek Tributary 2b - 20

Fish Creek Tributary 2b - 21

Fish Creek Tributary 2b - 22

Fish Creek Tributary 2b - 23

Fish Creek Tributary 2b - 24

Fish Creek Tributary 2b - 25

Fish Creek Tributary 2b - 26

Fish Creek Tributary 2b - 27

Fish Creek Tributary 2b - 28

Fish Creek Tributary 2b - 29

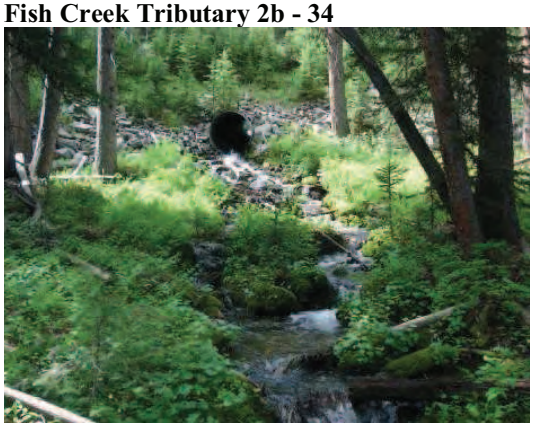
Fish Creek Tributary 2b - 30

Fish Creek Tributary 2b - 31

Fish Creek Tributary 2b - 32

Fish Creek Tributary 2b - 33

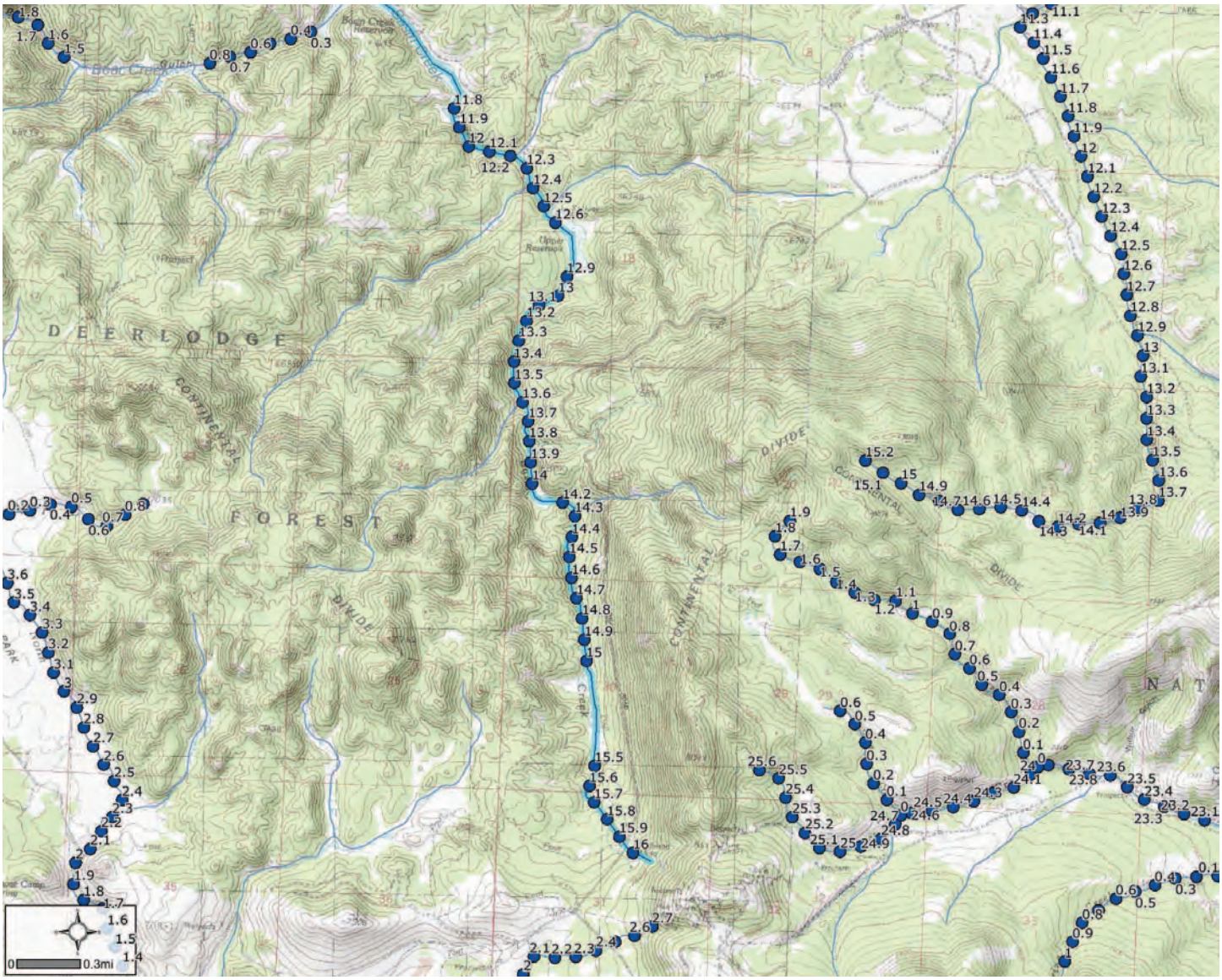
Fish Creek Tributary 2b - 34



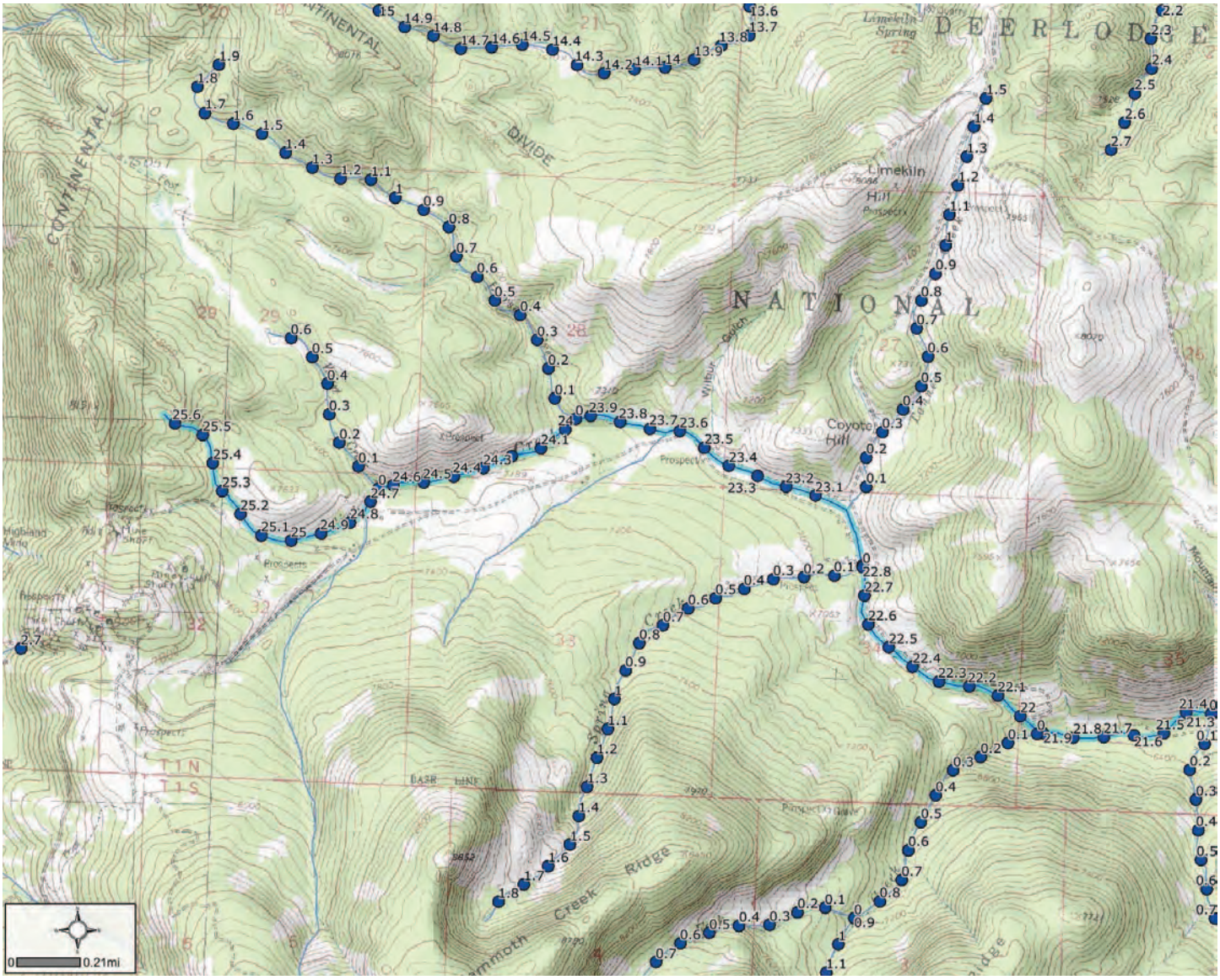
Fish Creek Tributary 2b - 35

Fish Creek Tributary 2b - 36

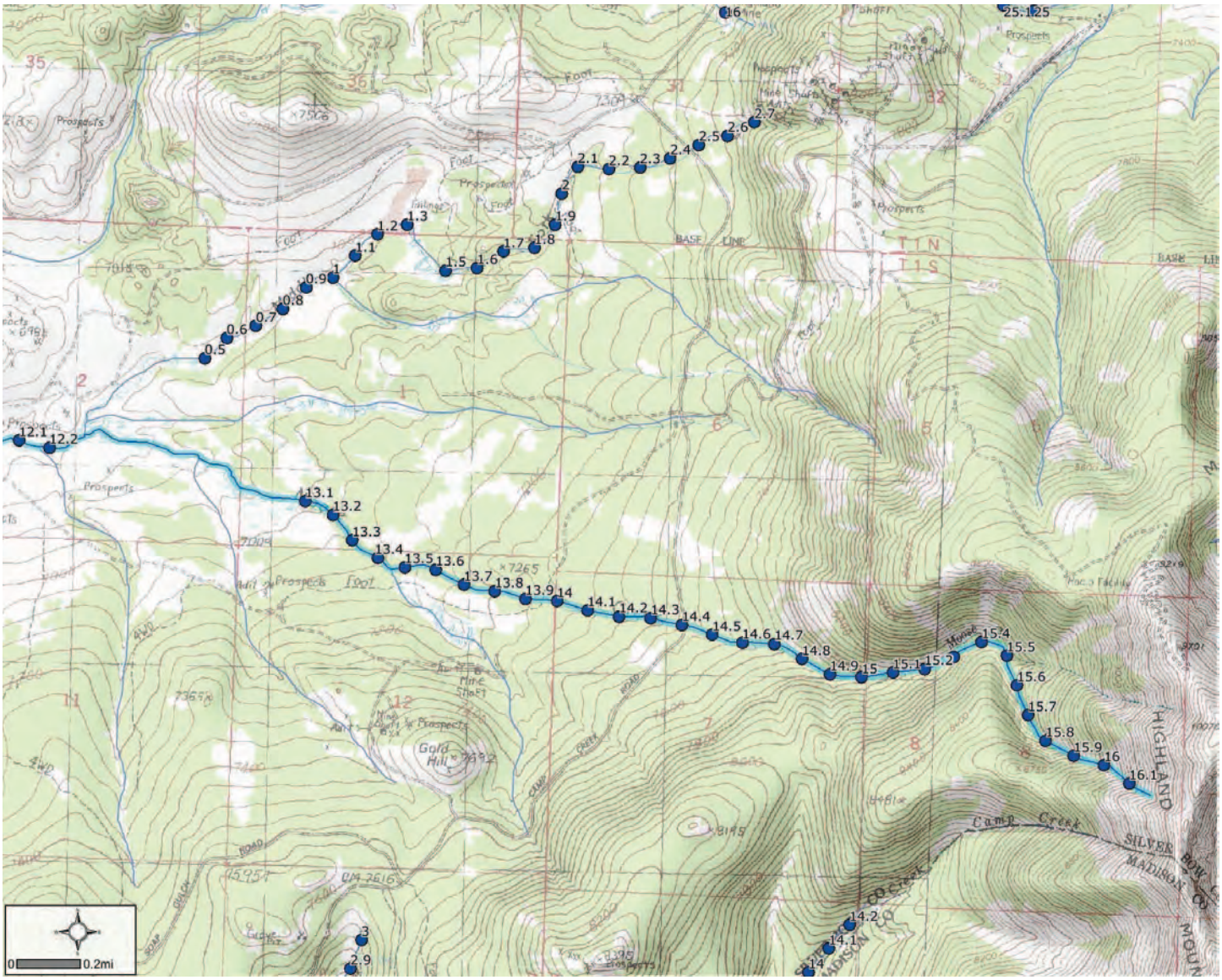
Appendix A. MFISH maps and data for streams in the Butte Highlands Project area.



MFISH stream miles, Basin Creek



MFISH stream miles, Fish Creek



MFISH stream miles, Moose Creek

Basin Creek
River Mile: 0 to 16.1
Miles: 16.1
Total Stream Miles: 16.1
HUC: Upper Clark Fork (17010201)
Tributary To: Silver Bow Creek
Regions: Region 3
Counties: Silver Bow

Fish Distribution Download Data

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Origin	Genetic Status	Data Rating	Data Source
0	12.5	Brook Trout	Common	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP
9.2	16.1	Westslope Cutthroat Trout	Common	Year-round resident	Resident	Native	Genetically pure, determined by genetic analysis	Extrapolated based on surveys	FS

Population Surveys Download Data

Section: Above Reservoir and Sediment Trap
River Miles: 12.2 to 12.3

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
10/25/2007	Lindstrom, Jason	Westslope Cutthroat Trout	140	no estimate, counts only	Total number captured or presence only	60	241	124.6	mm	Electrofishing	Good quality	FWP

Genetic Samples Download Data

Date: 11/1/2001
Sample #: 2264

Collector: Brammer, Jim
River Miles: 12.1 to 12.2
Analysis Type: PINES
Analyzer: Cook, Margaret

Target Species: Westslope Cutthroat Trout
# of Fish: 27
Comments:

Species Name	Percent	Count	Hybrid
Westslope Cutthroat Trout	100	-	-

Fish Stocking
No Data Found

Habitat Measurements
No Data Found

Bull Trout Core Areas
Selection is not within a Bull Trout Core Area

Fish Creek
River Mile: 0 to 25.6
Miles: 25.6
Total Stream Miles: 25.6
HUC: Jefferson (10020005)
Tributary To: Jefferson River
Regions: Region 3
Counties: Jefferson; Silver Bow

Fish Distribution Download Data

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Origin	Genetic Status	Data Rating	Data Source
0	21.3	Brook Trout	Rare	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP
21.9	24.7	Brook Trout	Rare	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP
0	0.8	Brown Trout	Unknown	Unknown	Unknown	Unknown	Unknown	Extrapolated based on surveys	UN
0	11.2	Rainbow Trout	Rare	Fluvial/Adfluvial population, Spawning elsewhere	Not applicable	Introduced	Not Applicable	No Survey, Professional judgment	FWP
14	22.7	Westslope Cutthroat Trout	Rare	Year-round resident	Resident	Native	90.0%-99.9% pure based on genetic analysis	Extrapolated based on surveys	UM
22.7	24.6	Westslope Cutthroat Trout	Rare	Year-round resident	Resident	Native	Potentially unaltered with no record of stocking	Extrapolated based on surveys	FS

Population Surveys Download Data

Section: Mouth
River Miles: 0 to 0.3

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
9/1/2005	Spoon, Ron	Brown Trout	0	fish/second	Catch per unit effort	-	-	-	mm	Backpack shocking	Medium quality	FWP
9/1/2005	Spoon, Ron	Rainbow Trout	0	fish/second	Catch per unit effort	-	-	-	mm	Backpack shocking	Medium quality	FWP

Section: N/A
River Miles: 12.6 to 12.7

						Length					Data	

Date	Collector	Species	Est.	Sec. Unit	Method	Min	Max	Avg.	Unit	Gear	Rating	Source
10/10/2007	Nelson, Lee	Brook Trout	5.2	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP
10/10/2007	Nelson, Lee	Westslope Cutthroat Trout	0.7	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP

Section: N/A
River Miles: 14.6 to 14.7

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
10/10/2007	Nelson, Lee	Brook Trout	5.2	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP
10/10/2007	Nelson, Lee	Westslope Cutthroat Trout	9.3	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP

Section: N/A
River Miles: 18.3 to 18.4

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
7/10/2002	Sada de Suplee, Rosie	Brook Trout	34	no estimate, counts only	Total number captured or presence only	3.1	8.7	-	in	Backpack shocking	Unknown	MDEQ
7/10/2002	Sada de Suplee, Rosie	Westslope Cutthroat Trout	26	no estimate, counts only	Total number captured or presence only	2.8	9.1	-	in	Backpack shocking	Unknown	MDEQ

Section: N/A
River Miles: 19.2 to 19.3

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
8/1/1994	Sanborn, Brian	Brook Trout	9	no estimate, counts only	Total number captured or presence only	1.8	9	-	in	Backpack shocking	Medium quality	FS
8/1/1994	Sanborn, Brian	Westslope Cutthroat Trout	1	no estimate, counts only	Total number captured or presence only	-	-	-	N/A	Backpack shocking	Medium quality	FS

Section: N/A
River Miles: 19.4 to 19.5

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
9/19/2007	Nelson, Lee	Brook Trout	1	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP
9/19/2007	Nelson, Lee	Westslope Cutthroat Trout	6.3	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP

Section: N/A
River Miles: 20.3 to 20.4

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
9/19/2007	Nelson, Lee	Brook Trout	0.6	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP
9/19/2007	Nelson, Lee	Westslope Cutthroat Trout	5.3	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP

Section: N/A
River Miles: 21.3 to 21.4

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
9/19/2007	Nelson, Lee	Brook Trout	0.2	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP
9/19/2007	Nelson, Lee	Westslope Cutthroat Trout	12	per 100 ft.	One pass	-	-	-	N/A	Electrofishing	Unknown	FWP

Section: Reach 1
River Miles: 21.7 to 21.8

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
6/30/2007	Brammer, Jim	Brook Trout	4	no estimate, counts only	Total number captured or presence only	55	182	-	mm	Electrofishing	Medium quality	SCP
6/30/2007	Brammer, Jim	Westslope Cutthroat Trout	4	no estimate, counts only	Total number captured or presence only	57	159	-	mm	Electrofishing	Medium quality	SCP

Section: Reach 2
River Miles: 22 to 22.1

						Length					Data	

Date	Collector	Species	Est.	Sec. Unit	Method	Min	Max	Avg.	Unit	Gear	Rating	Source
6/30/2007	Brammer, Jim	Brook Trout	4	no estimate, counts only	Total number captured or presence only	95	167	-	mm	Electrofishing	Medium quality	SCP
6/30/2007	Brammer, Jim	Westslope Cutthroat Trout	4	no estimate, counts only	Total number captured or presence only	65	218	-	mm	Electrofishing	Medium quality	SCP

Section: Reach 3
River Miles: 22.1 to 22.2

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
6/30/2007	Brammer, Jim	Trout	1	no estimate, counts only	Total number captured or presence only	-	-	130	mm	Electrofishing	Medium quality	SCP

Section: N/A
River Miles: 22.5 to 22.6

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
8/9/1994	Sanborn, Brian	Brook Trout	6	no estimate, counts only	Total number captured or presence only	4.4	9.6	-	in	Backpack shocking	Medium quality	FS
8/9/1994	Sanborn, Brian	Westslope Cutthroat Trout	23	no estimate, counts only	Total number captured or presence only	2.7	8.3	-	in	Backpack shocking	Medium quality	FS

Section: N/A
River Miles: 22.8 to 22.9

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
11/13/1997	Spoon, Ron	Westslope Cutthroat Trout	6	no estimate, counts only	Total number captured or presence only	-	-	-	N/A	Backpack shocking	Unknown	FWP

Genetic Samples Download Data

Date: 10/10/2007
Sample #: 3654

Collector: Nelson, Lee
River Miles: 14.6 to 14.7
Analysis Type: PINES
Analyzer: Leary, Robb
Target Species: Westslope Cutthroat Trout
# of Fish: 25
Comments: Lower

Species Name	Percent	Count	Hybrid
Westslope X Yellowstone X Rainbow	-	25	-

Date: 9/19/2007
Sample #: 3655

Collector: Nelson, Lee
River Miles: 19.4 to 19.5
Analysis Type: PINES
Analyzer: Leary, Robb
Target Species: Westslope Cutthroat Trout
# of Fish: 30
Comments:

Species Name	Percent	Count	Hybrid
Westslope Cutthroat Trout	99.1	-	-
Rainbow Trout	0.5	-	-
Yellowstone Cutthroat Trout	0.4	-	-

Date: 8/2/1994
Sample #: 980

Collector: Sanborn, Brian
River Miles: 19 to 19.1
Analysis Type: Allozymes
Analyzer: Leary, Robb
Target Species: Westslope Cutthroat Trout
# of Fish: 20
Comments: Analysis uncertain. Larger sample size needed to distinguish characteristics.

Species Name	Percent	Count	Hybrid
Westslope Cutthroat Trout	100	-	-

Fish Stocking
No Data Found

Habitat Measurements
No Data Found

Bull Trout Core Areas
Selection is not within a Bull Trout Core Area

Bull Trout Node Areas
Selection is not within a Bull Trout Node Area

Angling Days Per Year Download Data

River Miles: 0 to 24.7

	Total		Resident		Non Resident		Ranking	
Year	Days Fished(+-S.D.)	Trips	Days Fished(+-S.D.)	Trips	Days Fished(+-S.D.)	Trips	State	Region
2007	50 (+- 50)	1	50 (+- 50)	1	(+-)		1119	260
2005	119 (+- 85)	3	119 (+- 85)	3	(+-)		882	205
2003	47 (+- 47)	1	47 (+- 47)	1	(+-)		1267	306
1999	183 (+- 110)	4	34 (+- 34)	1	149 (+- 105)	3	780	171

Fisheries Resource Value Download Data

Begin Mile	End Mile	Sport Class	Habitat Class	Final Rating
0	11.1	4	4	Moderate (4)
11.1	21.3	4	3	Substantial (3)
21.3	21.9	5	6	Limited (5)
21.9	24.6	4	3	Substantial (3)

Dewatered Concern Areas Download Data

Begin Mile	End Mile	Level of Concern	Lower Bound	Upper Bound
0	10	Chronic Dewatering		

FWP Instream Flow Protection/Quantification
No Data Found

FWP Water Leases
No Data Found

Protected Areas
No Data Found

Special Fishing Regulations
No Data Found

Stream Restoration Projects

Project Name:	Fish Creek channel restoration and riparian fencing		
River Miles:	5.2 to 5.3		
Program Desc	Start Year	Data Compiler	Status
Future Fisheries	2008	Montana Department of Fish, Wildlife, and Parks	Completed
Treatment Type:	Channel restoration Riparian Fencing		
Target Species:	Brown Trout - Primary target species Rainbow Trout - Primary target species		
Description: Fish Creek has potential to improve recruitment of brown and rainbow trout to the Jefferson but the channel is overly widened and shallow. This project, located on Klos Ranch, would involve treating two segments of stream that together are about 3,600 ft long. Treatments would include removing fine sediment, narrowing and deepening the channel, installation of riparian fencing, and construction of two bridges			
Project Name:	Fish Creek channel and riparian restoration		
River Miles:	6 to 6		
Program Desc	Start Year	Data Compiler	Status
Future Fisheries	2006	Montana Department of Fish, Wildlife, and Parks	Completed
Treatment Type:	Channel restoration Diversion modification Riparian Fencing		
Target Species:	Brown Trout - Primary target species Rainbow Trout - Primary target species		
Description: Fish Creek (Jefferson County) has potential as a rainbow and brown trout spawning tributary for Jefferson River fish. However, irrigation and grazing practices have degraded the channel and eliminated much of the potential for spawning. This project involves restoring Fish Creek by removing accumulations of fine sediment, narrowing the channel to increase sediment transport capacity, construction of riparian fencing, and replacement of two irrigation structures with a single pin and plank structure. Approximately, 7,650 ft. of stream will be treated.			

FWP Management

Begin Mile	End Mile	Region	District	Water Type
0	25.6	3	Central	Trout Water

Fishing Logs
No Data Found

References Download Data

Author	Title	Year	Publisher	Repository ID
Brammer, Jim	Scientific Collector Permit Report SCP-27-07	2007		34090
Leary, Robb	Genetic Letter To Brian Sanborn, 3/10/1996	1996	University of Montana	
Leary, Robb	Genetic Letter to Lee Nelson May 14, 2008	2008	University of Montana	
Nelson, Lee	2007 and 2006 data for MFISH update	2007	Montana Department of Fish, Wildlife, and Parks	
Rumsey, Scott	Regional Mris Updates 2000, 4/1/2000	2000	Montana Department of Fish, Wildlife, and Parks	
Sada De Suplee, Rosie	Collectors Report For SCP-23-02	2002	Personal Consultant	7534
Usfs Et Al	Wsct Assessment, 1/1/2003	2003	U.S. Forest Service	

Moose Creek
River Mile: 0 to 16.2
Miles: 16.2
Total Stream Miles: 16.2
HUC: Big Hole (10020004)
Tributary To: Big Hole River
Regions: Region 3
Counties: Beaverhead; Silver Bow

Fish Distribution Download Data

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Origin	Genetic Status	Data Rating	Data Source
0	16.2	Brook Trout	Abundant	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP
0	16.2	Mottled Sculpin	Abundant	Year-round resident	Not applicable	Native	Not Applicable	Extrapolated based on surveys	FWP
0	16.2	Rainbow Trout	Rare	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP
0	11.5	Yellowstone Cutthroat Trout	Unknown	Year-round resident	Not applicable	Introduced	Hybridized species based on genetic analysis less than 90%	Extrapolated based on surveys	FWP
0	16.2	Yellowstone Cutthroat Trout X Westslope Cutth.	Unknown	Year-round resident	Not applicable	Introduced	Not Applicable	Extrapolated based on surveys	FWP

Population Surveys Download Data

Section: N/A
River Miles: 0 to 0.2

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
7/2/1979	N/A	Brook Trout	86	per 1000 ft.	Peterson mark-recapture	4	11.9	-	in	Unknown	Medium quality	UN
7/2/1979	N/A	Rainbow Trout	137	per 1000 ft.	Peterson mark-recapture	4	11.9	-	in	Unknown	Medium quality	UN

Section: N/A
River Miles: 11.5 to 11.6

Date	Collector	Species	Est.	Sec. Unit	Method	Length				Gear	Data	
						Min	Max	Avg.	Unit		Rating	Source
8/1/1979	N/A	Brook Trout	51	per 1000 ft.	Peterson mark-recapture	5.9	-	-	in	Unknown	Low quality	UN

Genetic Samples Download Data

Date: 8/10/1995
Sample #: 1075

Collector: Sanborn, Brian
River Miles: 10 to 10.1
Analysis Type: Allozymes
Analyzer: Leary, Robb

Target Species: Westslope Cutthroat Trout
# of Fish: 5
Comments:

Species Name	Percent	Count	Hybrid
Yellowstone Cutthroat Trout	87	-	-
Westslope Cutthroat Trout	13	-	-

Date: 8/10/1995
Sample #: 1076

Collector: Sanborn, Brian
River Miles: 12.3 to 12.4
Analysis Type: Allozymes
Analyzer: Leary, Robb

Target Species: Westslope Cutthroat Trout
# of Fish: 5
Comments:

Species Name	Percent	Count	Hybrid
Yellowstone Cutthroat Trout	82	-	-
Westslope Cutthroat Trout	18	-	-

Fish Stocking
No Data Found

Habitat Measurements
No Data Found

Bull Trout Core Areas
Selection is not within a Bull Trout Core Area

Bull Trout Node Areas
Selection is not within a Bull Trout Node Area

Angling Days Per Year Download Data

River Miles: 0 to 16.2

Year	Total		Resident		Non Resident		Ranking	
	Days Fished(+-S.D.)	Trips	Days Fished(+-S.D.)	Trips	Days Fished(+-S.D.)	Trips	State	Region

2007	376 (+- 284)	3	117 (+- 117)	1	259 (+- 259)	2	417	81
2005	54 (+- 54)	1	54 (+- 54)	1	(+-)		1177	278
2003	227 (+- 103)	6	164 (+- 82)	4	63 (+- 63)	2	608	134
2001	99 (+- 58)	3	99 (+- 58)	3	(+-)		930	195
1999	212 (+- 126)	6	212 (+- 126)	6	(+-)		732	161

Fisheries Resource Value Download Data

Begin Mile	End Mile	Sport Class	Habitat Class	Final Rating
0	16.2	3	4	Substantial (3)

Dewatered Concern Areas Download Data

Begin Mile	End Mile	Level of Concern	Lower Bound	Upper Bound
0	3	Periodic Dewatering		

FWP Instream Flow Protection/Quantification Download Data

Section: MOUTH to HEADWATERS
Type: Water Reservation Granted
River Miles: 0 to 16.2

Begin Date	End Date	Flow (CFS)	Priority Date
01 / 01	12 / 31	9	07/01/1985

FWP Water Leases
No Data Found

Protected Areas
No Data Found

Special Fishing Regulations
No Data Found

Stream Restoration Projects

Project Name:	Moose and Swamp creeks riparian enancement		
River Miles:	Unknown		
Program Desc	Start Year	Data Compiler	Status
Future Fisheries	2008	Montana Department of Fish, Wildlife, and Parks	Completed
Treatment Type:	Other		
Target Species:	Arctic Grayling - Primary target species Brook Trout - Secondarily affected species: positive effect Brown Trout - Secondarily affected species: positive effect		

Description: Moose and Swamp creeks (Beaverhead County), located in the upper Big Hole River drainage, are important spawning streams for fluvial arctic grayling. Improved riparian grazing management is an important component of the CCAA for the Big Hole. This project involves installation of off-stream watering facilities that will improve grazing management.

FWP Management

Begin Mile	End Mile	Region	District	Water Type
0	16.2	3	Central	Trout Water

Fishing Logs
No Data Found

References Download Data

Author	Title	Year	Publisher	Repository ID
Decker-hess, Janet, Et Al.	Instream Flow Evaluation For Selected Waterways Of The Beaverhead, Big Hole And Red Rock River Drainages Of Southwest Montana; June 1981,upper Missouri Instream Flow Studies - Contract No. Mt950-ct0-36	1981	Bureau of Land Management	36964
Leary, Robb	Genetic Letter To Brian Sanborn, 3/18/1996	1996	University of Montana	
Rumsey, Scott	Regional Mris Updates 2000, 4/1/2000	2000	Montana Department of Fish, Wildlife, and Parks	
Wells, Jerry D., And Janet Decker-hess	Ib, Inventory And Survey Of The Waters Of The Big Hole, Ruby And Beaverhead River Drainages, July 1, 1980 Through June 30, 1981; August 15, 1981,southwest Montana Fisheries Study	1981	Montana Department of Fish, Wildlife, and Parks	
Wells, Jerry D., And Janet Decker-hess	Ib, Inventory And Survey Of The Waters Of The Big Hole And Beaverhead Drainages, July 1, 1979 Through July 1, 1980; January 12, 1981,southwest Montana Fisheries Study	1981	Montana Department of Fish, Wildlife, and Parks	

Middle Fork Moose Creek
River Mile: 0 to 2.7
Miles: 2.7
Total Stream Miles: 2.7
HUC: Big Hole (10020004)
Tributary To: Moose Creek
Regions: Region 3
Counties: Silver Bow

Fish Distribution Download Data

Begin Mile	End Mile	Species	Abundance	Use Type	Life History	Origin	Genetic Status	Data Rating	Data Source
0	2.7	Yellowstone Cutthroat Trout	Unknown	Year-round resident	Not applicable	Introduced	Hybridized species based on genetic analysis less than 90%	Extrapolated based on surveys	FWP
0	2.7	Yellowstone Cutthroat Trout X Westslope Cutth.	Unknown	Primarily spawning and rearing	Adfluvial	Introduced	Not Applicable	Extrapolated based on surveys	FWP

Population Surveys
No Data Found

Genetic Samples
No Data Found

Fish Stocking
No Data Found

Habitat Measurements
No Data Found

Bull Trout Core Areas
Selection is not within a Bull Trout Core Area

Bull Trout Node Areas
Selection is not within a Bull Trout Node Area

Angling Days Per Year
No Data Found

Fisheries Resource Value Download Data

Begin Mile	End Mile	Sport Class	Habitat Class	Final Rating
0	2.7	4	5	Moderate (4)

Dewatered Concern Areas
No Data Found

FWP Instream Flow Protection/Quantification
No Data Found

FWP Water Leases
No Data Found

Protected Areas
No Data Found

Special Fishing Regulations
No Data Found

Stream Restoration Projects
No Data Found

FWP Management

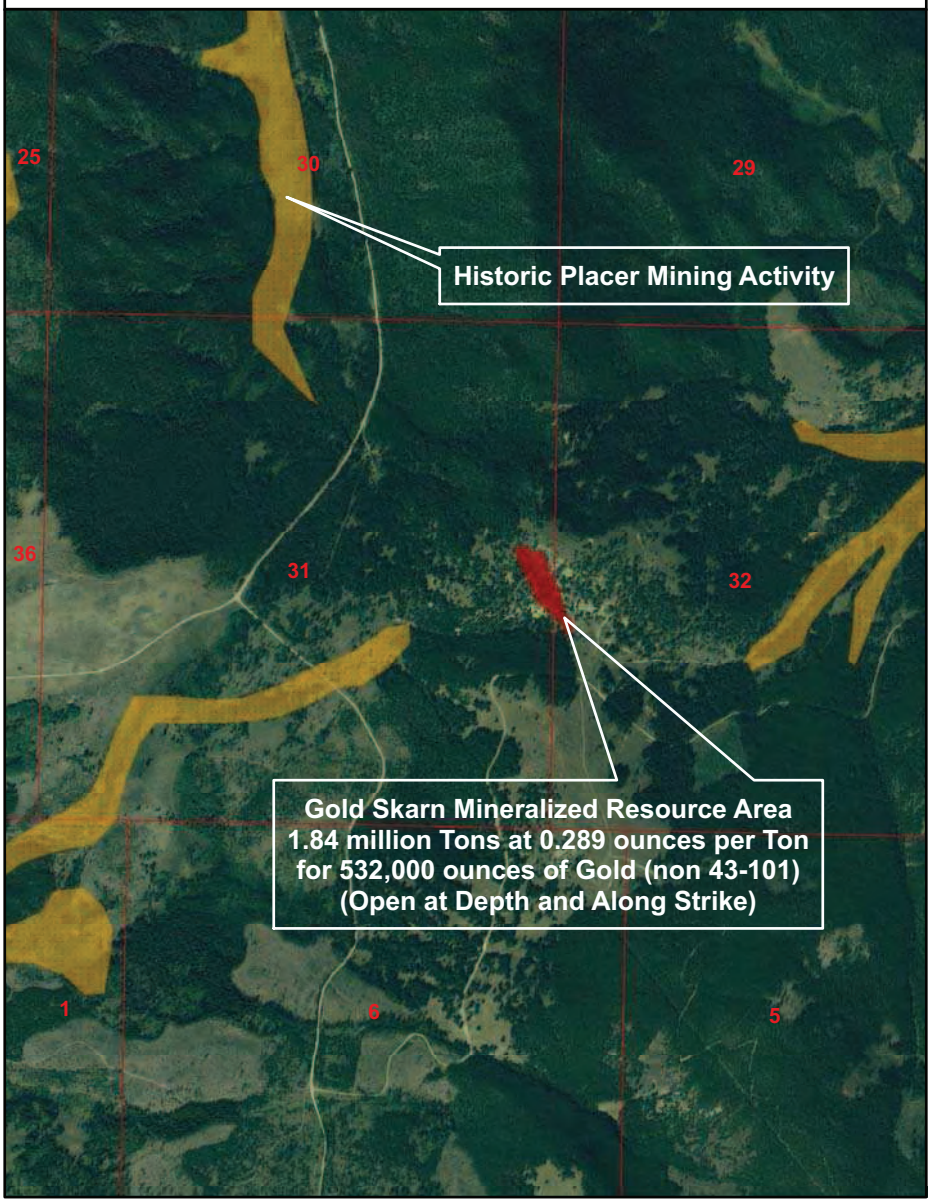
Begin Mile	End Mile	Region	District	Water Type
0	2.7	3	Central	Undesignated

Fishing Logs
No Data Found

References Download Data

Author	Title	Year	Publisher	Repository ID
Decker-hess, Janet, Et Al.	Instream Flow Evaluation For Selected Waterways Of The Beaverhead, Big Hole And Red Rock River Drainages Of Southwest Montana; June 1981,upper Missouri Instream Flow Studies - Contract No. Mt950-ct0-36	1981	Bureau of Land Management	36964
Rumsey, Scott	Regional Mris Updates 2000, 4/1/2000	2000	Montana Department of Fish, Wildlife, and Parks	

Appendix B. Historic placer mining activity in the Butte Highlands Project area.

Butte Highlands Project
Timberline Resources Corporation

Silverbow County, Montana
High Grade Gold Skarn Mineralization