Review of Existing Vegetation Data and July 2009 Field Observations for the Butte Highlands Project

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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 vegetation in the Project area, including noxious weeds;
- Document vegetation observations that were made while conducting stream and wetland surveys during July 2009.

2.0 Existing Information

A considerable amount of information on vegetation in the Project area is available through the online Montana Field Guide (http://fieldguide.mt.gov/). This is a collaborative effort between the Montana Natural Heritage Program and the Montana Department of Fish, Wildlife and Parks. The Montana Natural Heritage Program web site has a spreadsheet of the current state and federal designations for plant species that are Montana Species of Concern or Potential Species of Concern (http://mtnhp.org/plants/). 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 reveal any relevant documents except for a report on a vegetation survey that was conducted in the Project area (Lesica 1993, Appendix A) and an update for portions of the 1993 report (Mincemoyer 2005). Information pertaining to noxious weeds was located on the web site of the Montana Department of Agriculture.

The Lesica (1993) report was based on surveys conducted during the summer of 1992 in the vicinity of Moose Town/Burton Park, Fish Creek/Limekiln Mountain, Red Mountain/Table Mountain, Moffet Mountain, and Hells Canyon Creek. A map of the survey areas is included in Appendix A. Portions of the survey area overlapped the Project area, but it is not known if any transects were within the Project claims. Lesica hiked transects and recorded all vascular plant species that were observed. The list of species reported by Lesica (1993) did not include location

information for some species. As such, this list may include species that do not occur in the Project area, since most of the transects were not in the immediate Project area.

The following datasets were also investigated. Relevant information is presented in Appendix B:

- PNV (Potential Natural Vegetation Classification for Western and Central Montana and Northern Idaho);
- National Land cover Dataset for Montana;
- Montana Gap Analysis Project 90 meter Land Cover Data;
- Montana Climax Vegetation (NRCS source);
- 1Km AVHRR Land Cover Grid for Montana (EROS source);
- USFS vegetation layer;
- USFS timber layer.

3.0 Methods

The list of species reported by Lesica (1993) was compared to the current Montana Species of Concern/Potential Species of Concern list. Using this information, a list of all plant species that could potentially occur at the Project site and species conservation status was compiled. The potential status of species included, MT Species of Concern, and designations of the U.S. Fish and Wildlife Service (FWS), Forest Service (FS), and Bureau of Land Management (BLM).

Some information that was collected during 2009 is included below. A map of areas of similar topography and vegetation was prepared by AMEC Geomatrix based on observations that were made during 2009 soil surveys (Figure 2). Relevant data from 2009 stream and wetland surveys (Kline Environmental Research/Klepfer Mining Services) was also incorporated into this report.

4.0 Results and Discussion

4.1 General Habitat Descriptions

The Project area includes a mosaic of forested and non-forested habitats. Forested portions include stands dominated by fir and larch, groves of aspen and fir, north facing slopes dominated

by lodgepole pine, and west-facing slopes dominated by fir and spruce (Figure 1). 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. Land cover maps that were available for the Project area are presented in Appendix B for comparison, although they are largely at odds with field observations.

Lesica (1993) offered the following description of the Project area and surrounding areas.

> "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

This report addresses vascular plants, including noxious weeds. No information was found for bryophytes or lichens in the Project area, however, relevant state-wide information .

Lesica (1993) identified 526 species of vascular plants in the Highland Mountains (Appendix A). Seven of these are Montana Species of Concern or Potential Species of Concern, currently considered present in Silver Bow County (MNHP), and located in the Highland Mountains (Lesica 1993, Table 1, Appendix C). Five of the Species of Concern are classified as sensitive by the FS or BLM. None are listed under the Endangered Species Act. More recent surveys on BLM lands managed by the Butte Field Office (Mincemoyer 2005), which includes areas in the vicinity of the Project, did not reveal any changes to the findings of Lesica (1993). The

following are descriptions of the seven Species of Concern located in the Highland Mountains, and descriptions of their habitat associations. See Appendix B for more information.

Sapphire Rockcress - *Arabis fecunda*

Lesica (1993) located sapphire rockcress in the Moose Town and Fish Creek areas. Additional details on the locations are provided in Appendix A. It was found in mineral soil on south- or west-facing slopes, associated with sparse grasses or very open limber pine woodlands. The Montana Field Guide (January 13, 2010) describes habitat for this species as areas of relatively sparse vegetation on steep slopes with periodic natural erosion.

Idaho sedge - *Carex idahoa*

Lesica (1993) located Idaho sedge in the Moose Town and Fish Creek areas. Additional details on the locations are provided in Appendix A. It was found in drier ecotonal areas of wet meadows along streams in areas influenced by calcareous parent material. This is consistent with a description in the Montana Field Guide (November 30, 2009): "Idaho sedge inhabits moist alkaline meadows, often along streams (Vanderhorst and Lesica 1994). It most often occupies ecotonal areas between wet meadow and sagebrush steppe (Lesica 1998), and appears to be restricted to nearly level sites in the high valleys of southwest Montana." This is similar to some areas in the Pony Placer claim.

Dense-leaf draba - *Draba densifolia*

Lesica (1993) located this species near Interstate Highway 90 in coarse, sandy, granite-derived soil on a steep, south-facing bank. The Montana Field Guide (November 30, 2009) describes habitat for this species as, gravelly, open soil of rocky slopes and exposed ridges in the montane to alpine zones. This habitat type is not common within the Project claims.

Slender fleabane - *Erigeron gracilis*

Lesica (1993) located this species in the Moffet Mountain, Moose Town, and Fish Creek/Limekiln Hill areas. The plant appeared to be widespread throughout much of the Highland Mountains in silty to loamy soils of mesic to moist steppe and grasslands. The

Montana Field Guide (January 13, 2010) describes habitat for this species as meadows, rocky slopes and talus in the subalpine and alpine zones.

Hall's rush - *Juncus hallii*

Lesica (1993) located this species in the Moose Town area. The habitat was described as moist soil on the drier margins of a wet meadow. According to the Montana Field Guide (November 30, 2009), this species occurs in subalpine parklands and moist meadows and slopes in the montane zone. This habitat type is common in the Pony Placer claim.

Lemhi beardtongue - *Penstemon lemhiensis*

Lesica (1993) located this species in the Moose Town and Fish Creek areas (Table 1). The habitat was described as open exposure on a concave slope, dry on a residual mountain slope, sandy soil, and calcareous parent material. Additional details of the locations and habitat are provided in Appendix A. He considered this species to be probably enhanced by moderate levels of disturbance, but also threatened by mining and grazing. According to the Montana Field Guide (November 30, 2009), "In Montana, Lemhi beardtongue occurs on moderate to steep, east- to southwest-facing slopes, often on open soils. In Beaverhead County, it generally grows below or near the lower extent of Douglas-fir and/or lodgepole pine forest, in habitat dominated by big sagebrush and bunchgrasses, including western wheatgrass and Idaho fescue. Within these habitats, Lemhi beardtongue prefers areas that are more sparsely vegetated (Shelly 1990). In the northeastern Pioneer Mountains, it inhabits forb-dominated openings in lodgepole pine and to a lesser extent Douglas-fir forest; big sage is typically not present, and prominent forbs include *Astragalus miser, Pedicularis contorta* and *Townsendia parryi*. The species is not restricted to any particular geological substrate, and has been found on granitic soils as well as limestone and other sedimentary substrates. Soils are often very gravelly, however soil texture is highly variable and ranges from sand to fine clay. Field surveys from 1986-1989 indicate that it is most commonly found on gravelly loams. Some populations grow partially or entirely on roadbanks."

Small-flowered pennycress - *Thlaspi parviflorum*

Lesica (1993) located this species on an open exposure slope and a moist area of a flood plain. According to the Montana Field Guide (November 30, 2009), "In Montana it is known from Beaverhead, Carbon, Madison, Park and Silver Bow counties, where it is found from mid-elevation grasslands to alpine turf (6,500 to 10,000 feet). It most often inhabits sagebrush steppe dominated by *Artemisia tridentata* ssp. *vaseyana* and *Festuca idahoensis*." This habitat is not common within the Project claims.

4.3 July 2009 Observations

The following taxa were used to varying degrees during July 2009 as indicators of wetlands in the Project area: sedge (*Carex* sp.); rush (*Juncus* sp.); willow (*Salix* sp.); wild iris (*Iris missouriensis*); shrubby cinquefoil (*Dasiphora floribunda*). Stands of Engelmann spruce (*Picea engelmanni*) and aspen (*Populus tremuloides*) occurred within or near some wetlands. In addition, larkspur (*Delphinium bicolor*) was located in a moist area (UTM 12 T 381898 E 5071621 N) in the Pony Placer claim. Photographs of this finding were included in Appendix D to allow reviewers to determine if these were the more common little larkspur or limestone larkspur (*Delphinium bicolor* var. *calcicola*), a Potential Species of Concern.

4.4 Noxious Weeds

The Montana Department of Agriculture lists 18 species of noxious weeds that occur in Silver Bow County (Table 2). Three of these were added during 2009. Four were located in the Highland Mountains during 1992 (Lesica 1993), including tall buttercup, which was considered to be recently introduced or rapidly spreading during 2008 (Category 2).

5.0 References

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Mincemoyer, S. 2005. Surveys of significant plant resources and related vegetation types for the Butte office of the Bureau of Land Management. Report to the USDI Bureau of Land Management, Butte Field Office. Montana Natural Heritage Program, Helena, MT. 11 pp. + appendices.

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Montana Field Guide. http://fieldguide.mt.gov/

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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

Vanderhorst, J. P. and P. Lesica. 1994. Sensitive plant survey in the Tendoy Mountains, Beaverhead County, Montana. Unpublished report to the Bureau of Land Management, Butte District. Montana Natural Heritage Program, Helena, MT. 59 pp. plus appendices.

Table 1. Vegetation Species of Concern for Silver Bow county located by Lesica (1993) in the Highland Mountains.

Genus species	Common name	Status*
Arabis fecunda	sapphire rockcress	SOC, FS, BLM
Carex idahoa	Idaho sedge	SOC, FS, BLM
Draba densifolia	dense-leaf draba	SOC
Erigeron gracilis	slender fleabane	PSOC
Juncus hallii	Hall's rush	SOC, FS
Penstemon lemhiensis	lemhi beardtongue	SOC, FS, BLM
Thlaspi parviflorum	small-flowered pennycress	SOC, BLM

* SOC - MT Species of Concern, PSOC - MT Potential Species of Concern, FS - Forest Service, Sensitive, BLM - Bureau of Land Management, Sensitive.

Table 2. Noxious weeds that occur in Silver Bow county.

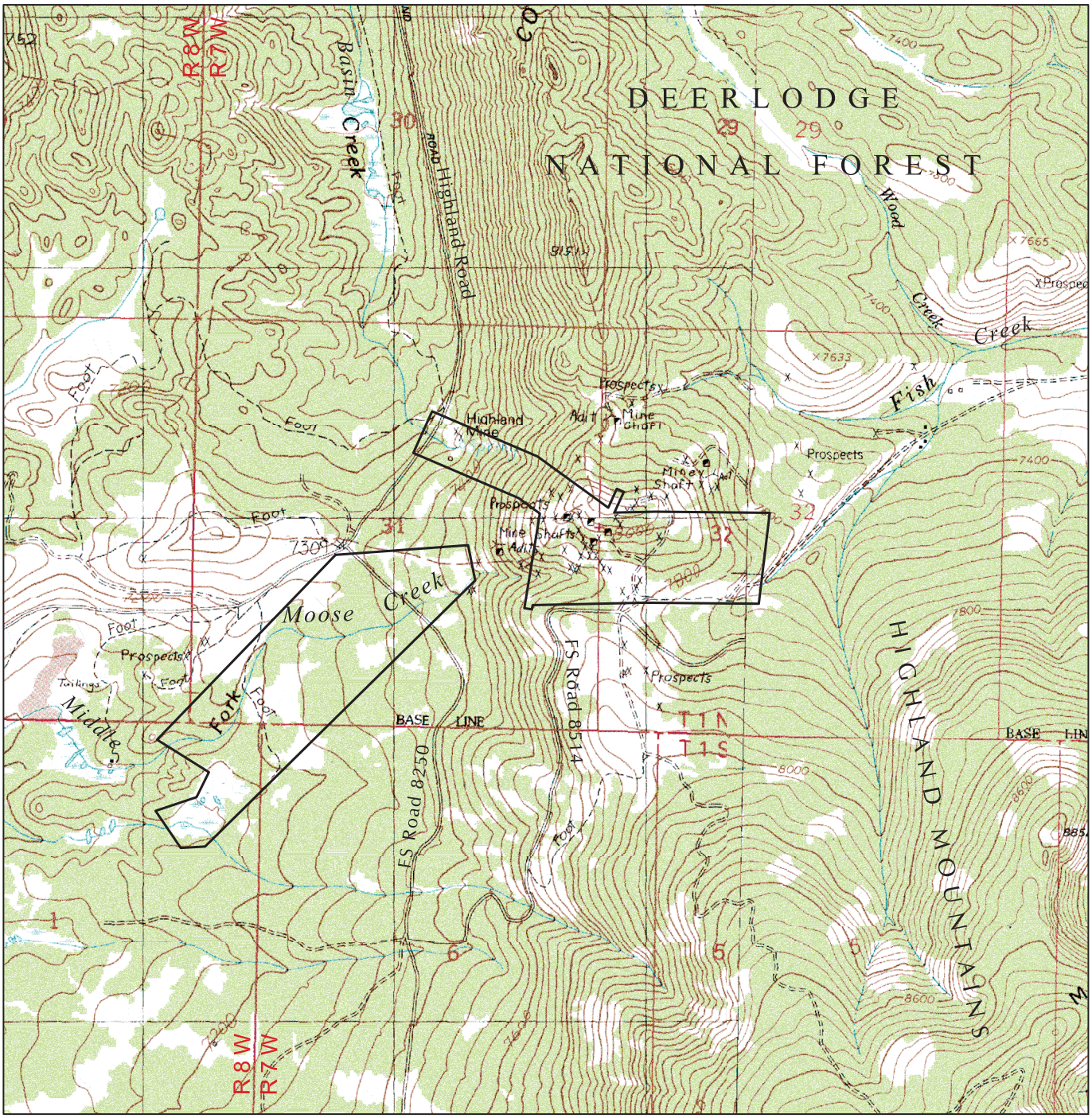
Genus species	Common name	State weed category	Reported in the Highland Mountains by Lesica (1993)
Cardaria draba	hoary cress	1	
Carum carvi	caraway	NC	
Centaurea diffusa	diffuse knapweed	1	
Centaurea maculosa	spotted knapweed	1	
Centaurea repens	Russian knapweed	1	
Chrysanthemum leucanthemum	oxeye-daisy	1	
Cirsium arvense	Canada thistle	1	X
Convolvulus arvensis	field bindweed	1	
Cynoglossum officinale	houndstongue	1	X
Euphorbia esula	leafy spurge	1	
Gypsophila paniculata	baby's breath	NC	
Isatis tinctoria	dyers woad	2	
Lepidium latifolium	perennial pepperweed	2	
Linaria dalmatica	dalmation toadflax	1	
Linaria vulgaris	yellow toadflax	1	X
Lycium halimifolium	matrimony vine	NC	
Ranunculus acris	tall buttercup	2	X
Tanacetum vulgare	common tansy	1	

Source: Montana Department of Agriculture. http://agr.mt.gov/weedpest/noxiousweeds.asp.

Category 1. Currently established and generally widespread

Category 2. Recently introduced or rapidly spreading

NC - Not categorized. Added to county list during 2009.



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

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Patented Claims

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Vegetation Report
January 2010
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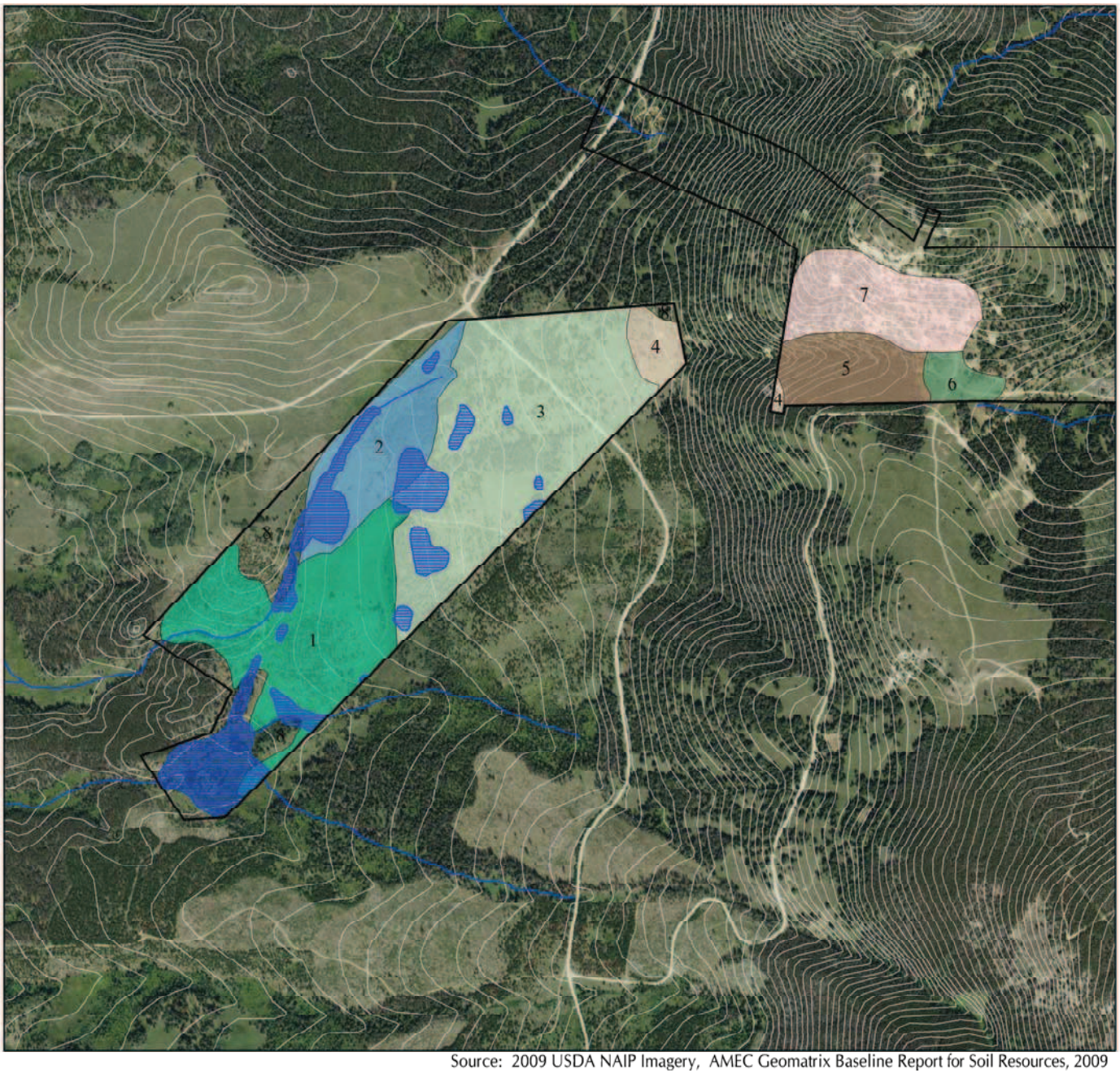
Jasper Geographics

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

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January 2010
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Butte Highlands Project
Silver Bow County, Montana
Habitat Type Map
Figure 2

Appendix A. Lesica (2003) abridged report.

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VASCULAR PLANT AND SENSITIVE PLANT SPECIES INVENTORY FOR THE HIGHLAND MOUNTAINS DEERLODGE NATIONAL FOREST

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This document should be cited as follows: Lesica, Peter. 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.

INTRODUCTION

The National Forest Management Act of 1976 mandates the protection of biological diversity on National Forest lands. One response to this mandate has been the development of sensitive species programs throughout the national forest system (Reel et al. 1989). Each national forest is required to protect the viability of sensitive species found within its bounds. Numerous plants that are listed as sensitive in the U.S. Forest Service Region One occur in the mountain ranges of southwest Montana (Lesica and Shelly 1991).

The Highland Mountains are a small alpine mountain range in southwest Montana. Much of this range is land administered by Deer Lodge National Forest. In spite of The Highland's proximity to Butte, there has been little botanical exploration of the area. Recently, Klaus Lackschewitz made collections in the area and discovered populations of Carex idahoa and Erigeron gracilis, but the size and extent of these populations was not reported. The Highland Mountains receive a great deal of use by recreationists as well as having mining, timber harvest and livestock grazing activity. In order to manage the Highland Mountains for the protection of biological diversity, the Forest Service must know which sensitive species are present, what habitats they occur in, and how common they are. The purpose of this study was to survey the Highland Mountains for sensitive plant species and report the size, location and habitat for these species. In addition, a complete list of all vascular plant species encountered during this study was prepared. This list will be useful to managers doing other studies in the area.

STUDY AREA

The Highland Mountains are a small alpine range in southwest Montana, just south of Butte. They lie between the Big Hole River and the Jefferson River on the south and east respectively, and they contain the headwaters of Silver Bow Creek and the Clark Fork River. The main divide ridge of the Highland Range is the Continental Divide. It runs between Red Mountain at 10,070 ft on the north, and Table Mountain at the south end, which is the highest peak at 10,200 ft. Slopes on the north, east and south sides are relatively steep, and streams and glaciers have formed canyons dropping to the main river valleys. On the west side of the divide there is a large plateau that is the headwaters of Moose Creek. Part of this plateau is referred to as Moose Town, while the northwest portion is called Burton Park. Low mountains (7,000-8,000 ft) surround Moose Town and Burton Park on the north, west and south sides. Low mountains on the west are called the Humbug Spires (Fig. 1)

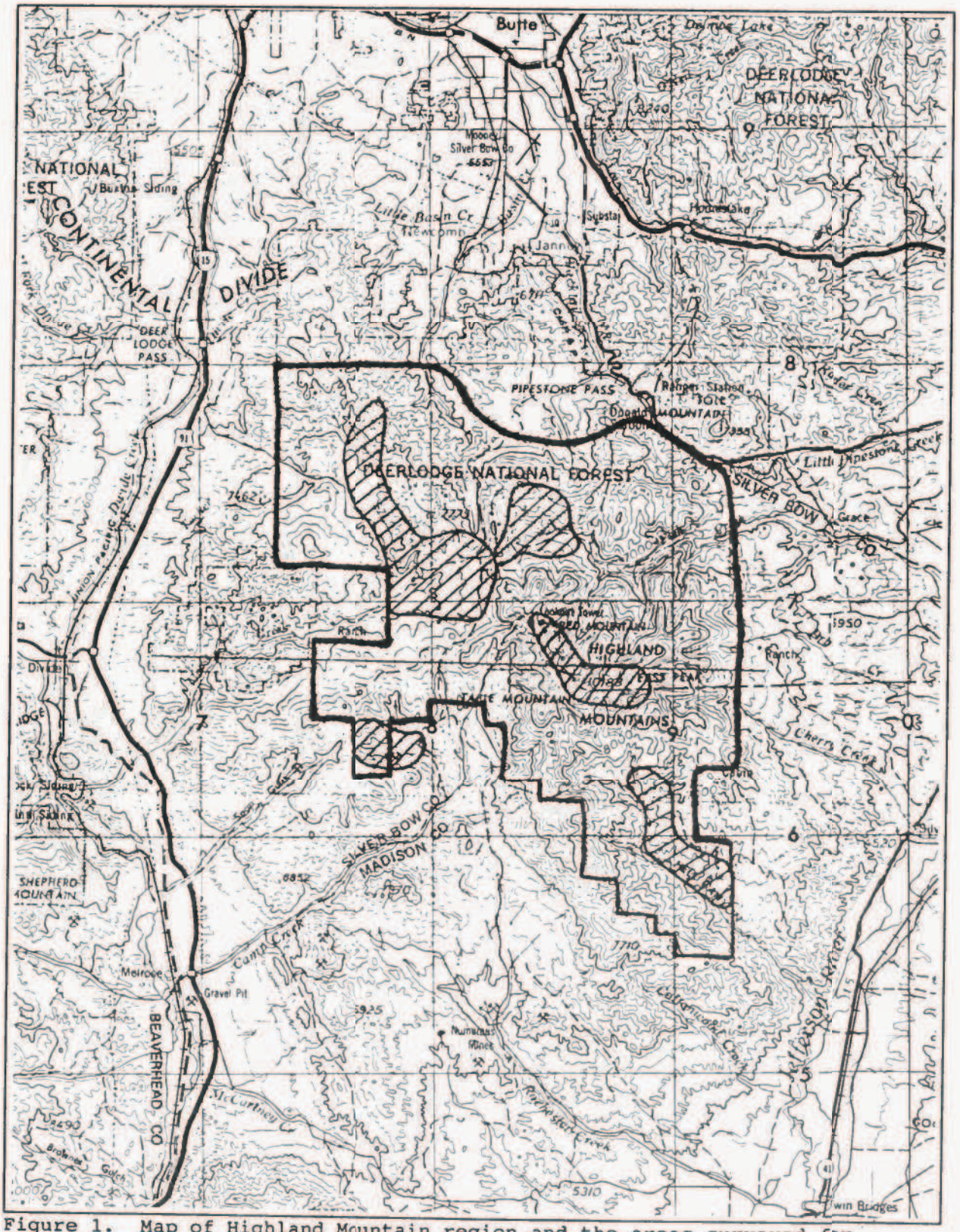

Figure 1. Map of Highland Mountain region and the areas surveyed for sensitive species.

The core of the Highland Mountains is formed of Precanbrian basement rock in the south and granite of the Boulder Batholith in the north (Alt and Hyndman 1986). The Humbug Spires are low mountains formed of this granite. A band of calcareous Belt Series sedimentary rock, 5-10 miles wide runs from near the town of Divide west to just east of the Continental Divide (Alt and Hyndman 1986). The crest of the Highland Mountains are argillite on the north near Red Mountain and quartzite and granite in the south around Table Mountain. Soils at 6,000-7,500 ft throughout most of the north portion of the area are derived from granite and are coarse-textured and well-drained. Soils in the south are derived from metamorphosed sedimentary rocks and are more silty or loamy in texture. Calcareous soils occur sporadically in the Moose Town area and just east of the Continental Divide in the Lime Kiln Hill and head of Fish Creek area (Fig. 1). Soils near or above timberline are generally shallow and poorly developed. Small cirques along the main divide suggest that the core of the range was glaciated during Pleistocene times.

Climate of the Highland Mountains is continental-montane with short, cool summers and long, cold winters. Butte, at 5,540 ft on the north side of the Highland Mountains, had mean July maximum and mean January minimum of 80.1 and 3.7°F respectively from 1950 to 1980 (NOAA 1982). During this same period mean annual precipitation was 11.7 inches. Divide, at 5,406 ft on the west side of the study area, had mean July maximum and mean January minimum of 79.4 and 8.5°F respectively from 1950 to 1980 (NOAA 1982). During this same period mean annual precipitation was 12.4 inches. Precipitation in the Highland Mountains is estimated to vary from 16-30 inches per year based on snow course records (USDA-SCS 1981). June is the wettest month. Approximately half of the precipitation falls as snow during the winter.

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 on all aspects (narrow mesas above Hells Canyon Creek are an exception). On soils derived from metasediments, steppe dominated by sagebrush (Artemisia tridentata), 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.

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 often 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.

METHODS

For the purpose of my study, the Highland Mountains are defined as land administered by the U.S. Forest Service and private inholdings above 6,000 ft south of Pipestone Pass and Hwy 10, west of the Jefferson River Valley, and east and north of the Big Hole River Valley. I surveyed the Highland Mountains on June 25-July 6, 1992 and July 31-August 3, 1992. I concentrated my surveys in five areas (Fig. 1): (1) Moose Town/Burton Park - an abundance of wetlands and outcrops of calcareous parent material, (2) Fish Creek/Limekiln Mountain - numerous outcrops of calcareous parent material, (3) Red Mountain/Table Mountain - expansive alpine habitat, (4) Moffet Mountain - expanses of sagebrush steppe and high elevation grasslands, and (5) Hells Canyon Creek - coarse granitic soils and sagebrush steppe. I conducted my surveys by hiking transects through each area, inspecting typical habitat as well as unusual edaphic or topographic features. I recorded all vascular plant species observed and made representative collections of many species. I completed Montana Natural Heritage Program (MNHP) "Plant Species of Special Concern" forms for all species on the most recent MNHP list, and I completed MNHP-modified ECODATA forms for representative plant communities harboring species listed as sensitive in Region One of the U.S. Forest Service (Lesica and Shelly 1991).

Vascular plant nomenclature generally follows Hitchcock and Cronquist (1973). Nomenclature for willows follows Dorn (1984).

Information on nomenclature for sensitive species and "species of special concern" can be found in Lesica and Shelly (1991). Specimens are deposited in the herbarium of the University of Montana (MONTU).

In 1992 I received a separate contract from Deerlodge National Forest to conduct floristic surveys of the Table Mountain area. The results of that study (Lesica 1992) have been included in this report.

RESULTS

I recorded 526 species of vascular plants in 52 families from the Highland Mountains (Appendix A). Of these, seven are listed as sensitive in Region One of the U.S. Forest Service: Arabis fecunda, Carex idahoa, Juncus hallii, Orobanche corymbosa, Penstemon lemhiensis, Saxifraga tempestiva and Thlaspi parviflorum. Five additional species are listed as species of special concern by MNHP: Carex vallicola, Erigeron gracilis, Gentiana aquatica, Haplopappus macronema ssp. linearis and Ranunculus verecundus. Information on the occurrence of these species in the study area is given below. Additional information can be found in the MNHP element occurrence records in Appendix B. Copies of ECODATA forms for all sensitive species sites can be found in Appendix C.

Element Name: Arabis fecunda Rollins

Common Name: Sapphire rockcress

Range: Endemic to the Sapphire, Pioneer and Highland mountain ranges of Beaverhead, Ravalli and Silver Bow counties, Mortana.

Element Rank: G2/S2

Federal Status: USFWS C2, USFS Region 1 Sensitive

Local Occurrence: Two populations of A. fecunda occur in the Moose Town area and two were found in the Fish Creek area (Fig. 2,3). Moose Town populations were estimated at 1,000-2,000 plants, while those in the Fish Creek area are larger, with 5,000-10,000 plants. All populations occur in mineral soil derived from metamorphosed calcareous sediments on south- or west-facing slopes. Associated plant communities are sparse Agropyron spicatum grasslands or very open limber pine woodland.

Although apparently appropriate habitat occurs on Limekiln Hill, I was unable to locate the species in the area.

Comments: All four populations occur in areas where there has been extensive mining exploration, and the southern Fish Creek

population is within 1 mile of an active mine. Mining is probably the principal threat to A. fecunda in the study area. In addition, the northern Moose Town population is in close proximity to a major road and may be threatened by future road construction. Finally, the areas are subject to livestock grazing, but disturbance appears to be moderate at this time and is probably not detrimental to the species. These populations are on the eastern edge of the known range of the species.

Element Name: Carex idahoa (Bailey)

Common Name: Idaho sedge

Range: Beaverhead, Madison, Powell and Silver Bow counties, Montana and southeast Idaho

Element Rank: G2QS2

Federal Status: USFWS 3C, USFS Region 1 Sensitive

Local Occurrence: I relocated the population in the Moose Town area and discovered another in the Fish Creek area (Fig. 2,3). Both populations occur in drier ecotonal areas of wet meadows along streams in areas influenced by calcareous parent material. Both populations contain fewer than 100 plants. The associated plant community is Potentilla fruticosa/Deschampsia cespitosa.

Comments: This plant is also referred to as Carex parryana Dewey ssp. idahoa (Bailey.) Murray.

I searched for this plant throughout the study area, but located only these two populations. However, populations are usually small, and I may not have located all of them. Nonetheless, C. idahoa does seem to be rare in the study area. Populations may be threatened by livestock grazing. In addition, the Moose Town population is immediately adjacent to a main road and could be threatened by road construction.

Element Name: Juncus hallii Engelm.

Common Name: Hall's rush

Range: Southwest Montana and southern Idaho south to Colorado. In Montana this species is known from Madison, Meagher, Powell and Silver Bow counties.

Element Rank: G4G5/S2

Federal Status: USFS Region 1 Sensitive

Local Occurrence: I located one population of J. hallii in the Moose Town area (Fig. 2). Unfortunately I was unsure of the

identity of the plant when I collected it and did not take extensive information on the site. It occurs in moist soil on the drier margins of a wet meadow adjacent to an old logging road. Before the area was logged this meadow was in a matrix of moist spruce forest. My impression is that the population was small, probably less than 200 plants.

Comments: At this site J. hallii occurs near a population of J. tenuis, and the two species can be confused. The logging road through the area may have impacted this population when it was built, and timber harvest undoubtedly altered the hydrologic regime of the site.

Element Name: Orobanche corymbosa (Rydb.) Ferris

Common Name: Flat-topped broomrape

Range: Southern British Columbia to southwest Montana, south to California, Nevada and Utah. In Montana the species is known from Beaverhead, Madison and Ravalli counties.

Element Rank: G4/S2

Federal Status: USFS Region 1 Sensitive

Local Occurrence: I located one population of O. corymbosa in the Hells Canyon Creek area (Fig. 4). Plants occurred in course-textured, granitic soil on gentle slopes of mesas on the northeast side of the canyon. The population consists of three subpopulations, all within 1 mile of each other. I estimated that at least 2,000 plants occur between these three subpopulations. Associated plant community is Artemisia tridentata/Festuca idahoensis.

Comments: Although similar habitat exists both north and south of the three subpopulations, I was unable to locate any plants in these areas. Additional populations may occur on BLM or private land to the west and south of the study area.

I am not aware of any threats to this population of O. corymbosa.

Element Name: Penstemon lemhiensis (Keck) Keck & Cronq.

Common Name: Lemhi beardtongue

Range: Endemic to Beaverhead, Ravalli and Silver Bow counties, Montana and Lemhi County Idaho

Element Rank: G2/S2

Federal Status: USFWS C2, USFS Region 1 Sensitive

Local Occurrence: I discovered two populations of P. lemhiensis in the Moose Town area (Fig. 2). The eastern population consists of two subpopulations on opposite sides of a hill. Both populations occur in relatively sparse vegetation on soil derived from calcareous metasediments. Both populations were estimated to be 100-200 plants. Nearly all plants in the western population had been grazed down to near the base of the plant, probably by deer or elk but possibly by livestock. The associated plant community was Festuca idahoensis/Agropyron spicatum grassland. In addition to these two populations, I observed 3-5 plants on a roadcut ca. 1/2 mile south of Fish Creek (T1N R7W S33, NW1/4 of SW1/4). Plant were present only in disturbed soil immediately adjacent to the road so I did not map or document this occurrence.

Comments: Penstemon lemhiensis occurs in areas that are subject to both mining activity and livestock grazing. Although P. lemhiensis is probably enhanced by low or even moderate levels of disturbance, both mining development and grazing could be a threat to this species. These populations are on the eastern edge of the known range of the species.

Element Name: Saxifraga tempestiva Elvander & Denton

Common Name: Storm saxifrage

Range: Endemic to Beaverhead, Deer Lodge, Granite, Ravalli and Silver Bow (?) counties, Montana

Element Rank: G2/S2

Federal Status: USFS Region 1 Sensitive

Local Occurrence: I located two subpopulations of S. tempestiva on the west flank of Table Mountain (Fig. 5). Both sites were snow cachement areas on relatively gentle terrain. The population was estimated to be fewer than 300 plants. Associated plant community was Geum rossii turf.

Comments: Plants at the Table Mountain site appear intermediate between S. tempestiva and S. rhomboidea and may be a hybrid population (see Lesica 1992 for further discussion).

The area is subject to few direct human-caused disturbances. However, grazing by bighorn sheep in the area is intense, and this level of grazing may be having an impact on the vegetation. Bighorn sheep may be overusing this remote part of their range because of intense ORV use of lower, more accessible areas (Lesica 1992).

Element Name: Thlaspi parviflorum A. Nels.

Common Name: Small-flowered pennycress

Range: Endemic to southwest Montana, northwest Wyoming and central Idaho. In Montana this species is known from Beaverhead, Madison, Park and Silver Bow counties.

Element Rank: G3/S2

Federal Status: USFS Region 1 Sensitive

Local Occurrence: I located two populations of T. parviflorum in moist grasslands and meadows on gentle slopes or alluvial terraces in the Moose Town area (Fig. 2). The eastern population occurred in a somewhat drier site and was estimated at 100-1,000 plants. The western site was estimated at 1,000-10,000 plants. Associated plant communities are Potentilla fruticosa/Festuca idahoensis and Potentilla fruticosa/Juncus balticus.

Comments: I searched extensively for this species in the Moose Town area, but in spite of large areas of apparently potential habitat, I located only two populations. However, T. parviflorum is inconspicuous unless it is blooming, and it blooms very early and has completely disappeared by mid-summer. Thus, I may not have located all populations in the study area.

Both T. parviflorum sites are subject to livestock grazing. The effects of grazing on the species are not known.

Element Name: Carex vallicola Dewey

Common Name: Valley sedge

Range: Eastern Oregon to southwest Montana and western South Dakota, south to California, Utah and Mexico. In Montana the species is known from Beaverhead, Gallatin, Lewis & Clark, Madison, Park and Silver Bow counties.

Element Rank: G5/S2

Federal Status: None

Local Occurrence: I located one population of C. vallicola in mesic high-elevation grassland in the Limekiln Hill area (Fig. 3). The population was estimated to be 100-1,000 plants. The associated plant community is Festuca idahoensis/Agropyron caninum.

Comments: This small population of C. vallicola is in an area that has extensive mining exploration. The area is also subject

to livestock grazing. The plant is highly palatable to livestock and decreases with overgrazing (Hermann 1970).

Element Name: Erigeron gracilis Rydb.

Common Name: Slender fleabane

Range: Endemic to Southwest Montana, western Wyoming and east-central Idaho. In Montana the species is known from Beaverhead, Park, Silver Bow and Sweetgrass counties.

Element Rank: G4/S2

Federal Status: None

Local Occurrence: I located populations of E. gracilis in the Moffet Mountain, Moose Town and Fish Creek/Limekiln Hill areas (Figs. 2,3,6). The plant appeared to be widespread throughout much of the Highland Mountains in silty to loamy soils of mesic to moist steppe and grasslands. Populations were all estimated to be larger than 1,000 plants. Associated plant communities are Artemisia tridentata/Festuca idahoensis (Geranium phase) and Potentilla fruticosa/Festuca idahoensis.

Comments: Erigeron gracilis was common enough in the study area that I did not purposely look for it but mapped only occurrences that I observed while surveying for other species. It is probably not threatened in the study area.

Element Name: Gentiana aquatica L.

Common Name: Wet meadow gentian

Range: Southern Alberta and Saskatchewan south to Colorado; also in Asia. In Montana the species is known from Beaverhead, Madison and Silver Bow counties.

Element Rank: G4/S2

Federal Status: USFWS 3C (under synonym of G. fremontii)

Local Occurrence: I located one population of G. aquatica in the Fish Creek area, in the same meadow as Carex idahoa (Fig. 3). The species occurs on shrub-dominated hummocks in an alkaline meadow along a small stream. Associated plant community was Potentilla fruticosa/Deschampsia cespitosa. I estimated the population to be greater than 1,000 plants.

Comments: This meadow is subject to livestock grazing. Trampling of this wet site resulting from overuse by livestock

could degrade the site and negatively impact the G. aquatica population.

Element Name: Haplopappus macronema Gray ssp. linearis (Rydb.) Hall

Common Name: Discoid goldenweed

Range: The subspecies is endemic to northwest Wyoming and southwest Montana. In Montana it is known from Beaverhead, Madison, Meagher and Silver Bow counties.

Element Rank: G4T?/S2

Federal Status: None

Local Occurrence: I located two populations of H. macronema linearis in moist steppe in the Moose Town/Burton Park area (Fig. 7). The Burton Park population was estimated to be fewer than 300 plants, while the Moose Town population was estimated to be 500-1,000 plants. Associated plant communities were Artemisia tridentata/Festuca idahoensis and Potentilla fruticosa/Festuca idahoensis.

Comments: Although there is an abundance of apparently appropriate habitat in the study area, I located only two populations of H. macronema linearis. Many of the plants at the Burton Park site had been broken due to livestock trampling. However, the plant seems to respond positively to disturbance at the Moose Town site, being most common near fences and along roads.

Element Name: Ranunculus verecundus Robins.

Common Name: Modest buttercup

Range: Alaska south to Oregon, Idaho and Wyoming. In Montana this species is known from Glacier National Park and the Highland and Anaconda ranges in Beaverhead, Deer Lodge and Madison counties.

Element Rank: G5/S1

Federal Status: None

Local Occurrence: I located one population of R. verecundus in wet tundra on the west shoulder of Table Mountain (Lesica 1992, Fig. 5). Associated plant community was Deschampsia cespitosa/Caltha leptosepala. Population size was estimated to be 200-500 plants.

Comments: Typical R. verecundus has deciduous sepals and persistent petals. Plants from the Table Mountain site have persistent sepals and lack petals (Lesica 1992). The area is subject to few direct human-caused disturbances. However, grazing by bighorn sheep in the area is intense, and this level of grazing may be having an impact on the vegetation. Bighorn sheep may be overusing this remote part of their range because of intense ORV use of lower, more accessible areas (Lesica 1992).

DISCUSSION

The Moose Town area has a great diversity of parent materials and soils. Coarse-textured sandy soils derived from granite of the Boulder Batholith occur on the northern periphery. The majority of the upland areas have silty or loamy soils derived from metasediments, including outcroppings of calcareous parent material. These soils support Douglas-fir and lodgepole pine forests, limber pine woodland, sagebrush and cinquefoil steppe, and grasslands. The area also has a complex hydrologic geology and supports a vast array of wetland communities including aspen groves, wet spruce forests, willow swamps, fens, marshes and wet meadows. The diversity of plant communities and the extent of the wetlands is exceptional. The area is also important habitat for many species of wildlife including elk, moose and bighorn sheep.

Fives species of vascular plants listed as sensitive in U.S. Forest Service Region One occur in the Moose Town area (Fig. 2): Arabis fecunda, Carex idahoa, Juncus hallii, Penstemon lemhiensis and Thlaspi parviflorum. Both A. fecunda and P. lemhiensis are candidates for listing as threatened or endangered species by the U.S. Fish and Wildlife Service, and all but J. hallii are endemic to small areas of southwest Montana and adjacent Idaho and Wyoming (Lesica and Shelly 1991). In addition, Erigeron gracilis and Haplopappus macronema ssp. linearis, two regional endemics that are MNHP species of special concern, are also found in this area (Fig. 2,7).

The habitat diversity and number of rare plant species make the Moose Town area the most outstanding biological area in the Highland Mountains. Unfortunately, the area has suffered a great deal of human-caused disturbance. It was the site of numerous mines and prospects, and apparently a small community existed there in the past. There are unreclaimed tailings heaps and mine shafts as well as water diversion ditches and old cabins. Probably more damaging are the numerous roads and 4-wheel drive trails throughout much of the area. These roads and trails continue to be used for recreation by residents of Butte and the surrounding area. The area is grazed by livestock during July and August, and some of the wetland and upland communities have been degraded as a result. Finally, forests on the north and

west sides of the Moose Town area have been clearcut. All of these disturbances have had and, in some cases, continue to have a negative impact on wildlife, populations of sensitive plants and the integrity of native communities.

Biological values in the Moose Town area could be protected by diminishing and mitigating human-caused disturbances: (1) limiting motorized vehicle traffic to main roads, (2) managing livestock to protect fragile wetland and riparian areas and prevent overgrazing of adjacent uplands, (3) reclamation of mine sites, and (4) limiting timber harvest to protect watershed values and wildlife. Approximately 1,800 acres of the Moose Town area is in private ownership; the rest is public land managed by the U.S. Forest Service and the Bureau of Land Management. A cooperative management plan for the area that addresses these issues is essential for maintaining the ecological integrity and biological diversity of the area.

The Fish Creek/Limekiln Hill area harbors populations of Arabis fecunda and Carex idahoa, both of which are on the U.S. Forest Service Region One sensitive species list. In addition, there are populations of three MNHP species of special concern in the area (Fig. 3). This area is similar to the Moose Town area in its history of mining and livestock grazing, and there is an active mine along Fish Creek at this time. The topography is steeper, so there are fewer opportunities for off-road vehicle abuse. Although I do not believe that this area has the biological significance of the Moose Town area, developments and livestock management should be regulated to protect populations of rare and sensitive species.

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Appendix A. Vascular plants observed in the Highland Mountains June 25-July 6, 1992 and July 31-August 3, 1992. Nomenclature generally follows Hitchcock and Cronquist (1973). Nomenclature for willows follows Dorn (1984). Nomenclature for sensitive species follows Lesica and Shelly (1991). Species in bold were collected and specimens are deposited at MONTU. An asterisk (*) indicates an introduced species.

Apiaceae
Angelica arguta
Cymopterus bipinnatus
Heracleum lanatum
Lomatium cous
Lomatium cusickii
Lomatium dissectum
Lomatium triternatum
Osmorhiza depauperata
Perideridia gairdneri

Asclepiadaceae
Asclepias speciosa

Asteraceae
Achillea millefolium
Agoseris aurantiaca
Agoseris glauca
Antennaria alpina
Antennaria anaphaloides
Antennaria aromatica
Antennaria corymbosa
Antennaria microphylla
Antennaria parviflora
Antennaria pulcherrima
Antennaria racemosa
Antennaria umbrinella
Arnica chamissonis
Arnica cordifolia
Arnica fulgens
Arnica mollis
Arnica sorroria
Artemisia absinthium*
Artemisia campestris
Artemisia dracunculus
Artemisia frigida
Artemisia michauxiana
Artemisia tridentata
Aster brachyactis
Aster campestris
Aster conspicuous
Aster foliaceus
Aster hesperius
Aster integrifolius
Aster laevis
Aster occidentalis
Aster scopulorum
Aster stenomeres
Chaenactis alpina
Chaenactis douglasii
Chrysopsis villosa
Chrysothamnus nauseosus
Chrysothamnus viscidiflorus
Cirsium arvense*
Cirsium canovirens
Cirsium hookerianum
Cirsium scariosum
Crepis acuminata
Crepis atrabarba
Crepis modocensis
Crepis runcinata
Erigeron acris
Erigeron caespitosus
Erigeron compositus
Erigeron corymbosus
Erigeron divergens
Erigeron gracilis
Erigeron lonchophyllus
Erigeron ochroleucus
Erigeron rydbergii
Erigeron simplex
Erigeron subtrinervis
Erigeron tweedyi
Erigeron ursinus
Filago arvensis
Gailardia aristata
Haplopappus acaulis
Haplopappus integrifolius
Haplopappus lanuginosus
Haplopappus lyallii
Haplopappus macronema ssp. linearis
Haplopappus uniflorus
Helianthella uniflora
Hieracium cynoglossoides
Hieracium gracile
Hulsea algida
Hymenopappus filifolius
Hymenoxys grandiflorus
Machaeranthera canescens
Matricaria matricarioides*
Microseris cuspidata
Senecio canus
Senecio crassulus
Senecio cymbalarioides
Senecio foetidus
Senecio fremontii
Senecio indecorus
Senecio integerrimus
Senecio pauperculus
Senecio pseudaureus
Senecio serra
Solidago missouriensis
Solidago multiradiata
Sonchus uliginosus*
Taraxacum ceratophorum
Taraxacum laevigatum*
Taraxacum lyratum
Taraxacum officinale*

Tetradymia canescens
Townsendia hookeri
Townsendia parryi

Betulaceae
Alnus sinuata
Betula glandulosa

Boraginaceae
Cryptantha ambigua
Cryptantha spiculifera
Cynoglossum officinale*
Eritrichium nanum
Hackelia micrantha
Lappula redowskii
Lithospermum ruderale
Mertensia ciliata
Mertensia oblongifolia
Onosmodium molle
Plagiobothrys scouleri

Brassicaceae
Arabis drummondii
Arabis fecunda
Arabis glabra
Arabis hirsuta
Arabis holboellii
Arabis lemmonii
Arabis lyallii
Arabis nuttallii
Arabis sparsiflora
Barbarea orthoceras
Berteroa incana
Capsella bursa-pastoris*
Cardamine pensylvanica
Descurainia pinnata
Descurainia richardsonii
Descurainia sophia*
Draba crassifolia
Draba densifolia
Draba incerta
Draba lanceolata
Draba lonchocarpa
Draba nemorosa
Draba oligosperma
Draba paysonii
Draba stenoloba
Draba sp.
Erysimum asperum
Erysimum cheiranthoides*
Erysimum repandrum
Physaria geyeri
Smelowskia calycina
Thlaspi arvense*
Thlaspi parviflorum

Callitrichaceae
Callitriche sp.

Campanulaceae
Campanula rotundifolia

Caprifoliaceae
Lonicera involucrata
Linnaea borealis
Sambucus racemosa

Caryophyllaceae
Arenaria capillaris
Arenaria congesta
Arenaria lateriflora
Arenaria nuttallii
Arenaria obtusiloba
Arenaria rossii
Cerastium arvense
Cerastium beeringianum
Cerastium vulgatum*
Silene acaulis
Silene menziesii
Silene parryi
Silene repens
Spergularia rubra*
Stellaria americana
Stellaria calycantha
Stellaria longipes

Chenopodiaceae
Chenopodium album*
Chenopodium chenopodioides
Chenopodium fremontii
Monolepsis nuttallianus

Cornaceae
Cornus stolonifera

Crassulaceae
Sedum lanceolatum
Sedum rosea

Cupressaceae
Juniperus communis

Cyperaceae
Carex albonigra
Carex aquatilis
Carex athrostachya
Carex atrata
Carex aurea
Carex bebbii
Carex canescens
Carex concinoides
Carex dioica
Carex disperma
Carex douglasii
Carex elynoides
Carex filifolia
Carex geyeri
Carex hoodii
Carex idahoa
Carex lanuginosa
Carex leporinella
Carex microptera
Carex nebrascensis
Carex norvegica

Carex obtusata
Carex paysonis
Carex pensylvanica
Carex petasata
Carex phaeocephala
Carex praegracilis
Carex raynoldsii
Carex rossii
Carex rostrata
Carex rupestris
Carex scirpoidea
Carex scopulorum
Carex simulata
Carex vallicola
Eleocharis pauciflora

Elaeagnaceae
Shepherdia canadensis

Equisetaceae
Equisetum arvense
Equisetum laevigatum
Equisetum pratense
Equisetum scirpoidea
Equisetum variegatum

Ericaceae
Arctostaphylos uva-ursi
Cassiope mertensiana
Chimaphila umbellata
Kalmia microphylla
Ledum glandulosum
Phyllodoce empetriformis
Phyllodoce glanduliflora
Pyrola asarifolia
Pyrola chlorantha
Pyrola minor
Pyrola uniflora
Vaccinium caespitosum
Vaccinium scoparium

Fabaceae
Astragalus aboriginum
Astragalus adsurgens
Astragalus agrestis
Astragalus alpinus
Astragalus atropubescens
Astragalus canadensis
Astragalus microcystis
Astragalus miser
Coronilla varia*
Hedysarum sulphurescens
Lupinus argenteus
Lupinus sericeus
Medicago lupulina*
Onobrychis viciifolia*
Oxytropis besseyi
Oxytropis campestris
Oxytropis deflexa
Oxytropis lagopus
Trifolium hybridum*
Trifolium longipes
Trifolium pratense*
Trifolium repens*

Fumariaceae
Corydalis aurea

Gentianaceae
Frasera speciosa
Gentiana amarella
Gentiana aquatica
Gentiana affinis
Gentiana aquatica
Gentiana calycosa
Gentiana propinqua

Geraniaceae
Geranium richarsonii
Geranium viscosissimum

Grossulariaceae
Ribes cereum
Ribes hudsonianum
Ribes lacustre
Ribes setosum

Hydrophyllaceae
Phacelia franklinii
Phacelia hastata
Phacelia sericea

Iridaceae
Iris missouriensis
Sisyrinchium angustifolium

Juncaceae
Juncus balticus
Juncus drummondii
Juncus ensifolius
Juncus hallii
Juncus longistylis
Juncus mertensianus
Juncus tenuis
Luzula campestris
Luzula parviflora
Luzula piperi
Luzula spicata

Liliaceae
Allium brevistylum
Allium cernuum
Allium geyeri
Allium schoenoprasum
Calochortus nuttallii
Erythronium grandiflorum
Fritillaria atropurpurea
Fritillaria pudica
Smilacina stellata
Zigadenus elegans
Zigadenus veneosus

Linaceae
Linum perenne

Onagraceae
Epilobium alpinum
Epilobium angustifolium
Epilobium glaberrimum
Epilobium palustre
Epilobium watsonii
Gayophytum decipiens

Ophioglossaceae
Botrychium lanceolatum
Botrychium lunaria

Orchidaceae
Corallorhiza trifida
Habenaria dilatata
Habenaria hyperborea
Habenaria obtusata
Spiranthes cernua

Orobanchaceae
Orobanche fasciculata

Pinaceae
Abies lasiocarpa
Picea engelmannii
Pinus albicaulis
Pinus contorta
Pinus flexilis
Pseudotsuga menziesii

Poaceae
Agropyron caninum
Agropyron cistatum*
Agropyron intermedium*
Agropyron spicatum
Agropyron scribneri
Agropyron smithii
Agrostis alba
Agrostis exarata
Agrostis humilis
Agrostis scabra
Alopecurus aequalis
Alopecurus alpinus
Alopecurus pratensis*
Bromus carinatus
Bromus ciliatus
Bromus inermis*
Bromus pumpellianus
Bromus tectorum*
Calamagrostis canadensis
Calamagrostis montanensis
Calamagrostis neglecta
Calamagrostis purpurascens
Calamagrostis rubescens
Catabrosa aquatica
Dactylis glomerata*
Danthonia intermedia
Danthonia uniflora
Deschampsia cespitosa
Elymus cinereus
Festuca idahoensis
Festuca occidentalis
Festuca ovina
Festuca rubra
Glyceria striata
Hordeum brachyantherum
Hordeum jubatum
Koeleria cristata
Muhlenbergia richardsonis
Oryzopsis exigua
Phleum alpinum
Phleum pratense*
Poa alpina
Poa annua*
Poa compressa*
Poa cusickii
Poa grayana
Poa interior
Poa juncifolia
Poa lettermanii
Poa leptocoma
Poa nervosa
Poa nevadensis
Poa pratensis*
Poa reflexa
Poa rupicola
Poa scabrella
Poa secunda
Puccinellia distans*
Puccinellia pauciflora
Sitanion hystrix
Stipa comata
Stipa occidentalis
Stipa richardsonii
Stipa viridula
Trisetum canescens
Trisetum cernuum
Trisetum spicatum

Plantaginaceae
Plantago major*

Polemoniaceae
Collomia debilis
Collomia linearis
Gilia inconspicua var. tweedyi
Gilia tenerrima
Ipomopsis spicata
Linanthus septentrionalis
Phlox longifolia
Phlox muscoides
Phlox pulvinata
Polemonium occidentale
Polemonium viscosum

Polygonaceae
Eriogonum flavum
Eriogonum ovalifolium
Eriogonum strictum
Eriogonum umbellatum
Polygonum aviculare*
Polygonum bistortoides
Polygonum douglasii
Rumex acetosella*

Rumex crispus*
Rumex paucifolius
Rumex salicifolius
Rumex venosus

Polypodiaceae
Athyrium dissentifolium
Cystopteris fragilis
Woodsia oregana

Portulacaceae
Claytonia lanceolata
Lewisia pygmaea
Lewisia redivida
Spraguea umbellata

Potamogetonaceae
Potamogeton alpinus
Potamogeton gramineus
Potamogeton pusillus

Primulaceae
Androsace filiformis
Androace septenrionalis
Dodecatheon conjugens
Dodecatheon pulchellum
Douglasia montana

Ranunculaceae
Actaea rubra
Anemone drummondii
Anemone multifida
Anemone nuttallianum
Delphinium bicolor
Delphinium occidentale
Ranunculus acriformis
Ranunculus acris*
Ranunculus cymbalaria
Ranunculus eschscholtzii
Ranunculus inamoenus
Ranunculus natans
Ranunculus sceleratus
Ranunculus uncinatus
Ranunculus verecundus
Thalictrum occidentale

Rhamnaceae
Ceanothus velutinus

Rosaceae
Amelanchier alnifolia
Dryas octopetala
Fragaria virginiana
Geum macrophyllum
Geum rossii
Geum triflorum
Potentilla anserina
Potentilla biennis
Potentilla concina
Potentilla diversifolia
Potentilla fruticosa
Potentilla glandulosa
Potentilla gracilis
Potentilla hippiana
Potentilla ovina
Potentilla pensylvanica
Purshia tridentata
Rosa nutkana
Rosa woodsii
Rubus idaeus
Sibbaldia procumbens
Spiraea betulifolia

Rubiaceae
Galium bifolium
Galium boreale
Galium trifidum

Salicaceae
Populus tremuloides
Salix bebbiana
Salix boothii
Salix brachycarpa
Salix drummondiana
Salix exigua
Salix lemmonii
Salix lutea
Salix nivalis
Salix planifolia
Salix scouleriana
Salix wolfii

Saxifragaceae
Conimitella williamsii
Heuchera cylindrica
Heuchera grossularifolia
Heuchera parvifolia
Lithophragma bulbifera
Lithophragma parviflora
Parnassia fimbriata
Parnassia palustris
Saxifraga arguta
Saxifraga bronchialis
Saxifraga cespitosa
Saxifraga oregana
Saxifraga tempestiva

Scrophulariaceae
Besseya wyomingensis
Castilleja cusickii
Castilleja lineariifolia
Castilleja miniata
Castilleja pallescens
Chionophila tweedyi
Collinsia parviflora
Linaria vulgaris*
Melampyrum lineare
Mimulus guttatus
Pedicularis contorta
Pedicularis groenlandica
Pedicularis parryi
Penstemon aridus
Penstemon attenuatus
Penstemon eriantherus

Penstemon fruticosus
Penstemon lemhiensis
Penstemon montanus
Penstemon procerus
Veronica americana
Veronica peregrina
Veronica serpyllifolia
Veronica wormskjoldii

Selaginellaceae
Selaginella densa

Urticaceae
Urtica dioica

Valerianaceae
Valeriana dioica
Valeriana occidentalis

Violaceae
Viola adunca
Viola macloskeyi
Viola nephrophylla
Viola nuttallii

Appendix B. Element occurrence records for species of special concern occurring in the Highland Mountains.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.014
Element occurrence type:

Survey site name: FISH CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	28	S2SW4

Survey date:	1992-06-29	Elevation:	7080 - 7560
First observation:	1992-06-29	Slope/aspect:	60% / SOUTHEAST
Last observation:	1992-06-29	Size (acres):	15

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE; FROM CAMP CREEK ROAD (FS RD 8520) TAKE ROAD TO FISH CREEK. ONCE ON THE FISH CREEK ROAD, PROCEED WEST UNTIL ROAD CROSSES TO SOUTH SIDE OF CREEK. PROCEED ANOTHER 0.3 MILES. SITE IS ON NORTH SIDE OF CREEK.

Element occurrence data:
2,000 TO 5,000 INDIVIDUALS, FRUITING, EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON STRAIGHT MIDSLOPE. DRY AREA, SANDY SOIL, CALCAREOUS METASEDIMENT. ASSOCIATED DOMINANT SPECIES: ARTEMISIA FRIGIDA, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED PLANT SPECIES: SENECIO CANUS, ERIGERON COMPOSITUS, CAMPANULA ROTUNDIFOLIA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
EVIDENCE OF LIVESTOCK/WILDLIFE TRAILS, OLD MINING CLAIMS. ECODATA PLOT #92PL108.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5740). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.014
Element occurrence type:

Survey site name: FISH CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	28	S2SW4

Survey date:	1992-06-29	Elevation:	7080 - 7560
First observation:	1992-06-29	Slope/aspect:	60% / SOUTHEAST
Last observation:	1992-06-29	Size (acres):	15

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE; FROM CAMP CREEK ROAD (FS RD 8520) TAKE ROAD TO FISH CREEK. ONCE ON THE FISH CREEK ROAD, PROCEED WEST UNTIL ROAD CROSSES TO SOUTH SIDE OF CREEK. PROCEED ANOTHER 0.3 MILES. SITE IS ON NORTH SIDE OF CREEK.

Element occurrence data:
2,000 TO 5,000 INDIVIDUALS, FRUITING, EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON STRAIGHT MIDSLOPE. DRY AREA, SANDY SOIL, CALCAREOUS METASEDIMENT. ASSOCIATED DOMINANT SPECIES: ARTEMISIA FRIGIDA, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED PLANT SPECIES: SENECIO CANUS, ERIGERON COMPOSITUS, CAMPANULA ROTUNDIFOLIA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
EVIDENCE OF LIVESTOCK/WILDLIFE TRAILS, OLD MINING CLAIMS. ECODATA PLOT #92PL108.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5740). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.015
Element occurrence type:

Survey site name: LIMEKILN HILL
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	27	NW4, NW4SW4; 28 E2SE4NE4

Survey date:		Elevation:	7320 - 7760
First observation:	1992-06-29	Slope/aspect:	75% / SOUTHEAST
Last observation:	1992-06-29	Size (acres):	25

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM FISH CREEK ROAD (FS RD 668), TAKE ROAD TO LIMEKILN HILL (FS RD 8492). PROCEED 0.6 MILE; SITE IS ON RIDGE TO THE WEST.

Element occurrence data:
5,000-10,000 INDIVIDUALS, FRUITING. EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON UNDULATING UPPER RESIDUAL MOUNTAIN SLOPE; DRY AREA, SILTY SOIL, CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: PINUS FLEXILIS, AGROPYRON SPICATUM, HAPLOPAPPUS ACAULIS. ADDITIONAL ASSOCIATED SPECIES: POTENTILLA FRUTICOSA, PENSTEMON ARIDUS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
DATA GIVEN ARE FOR EAST PORTION OF THE SITE. ECODATA PLOT #92PL110.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.016
Element occurrence type:

Survey site name: TUCKER CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: TUCKER CREEK

Township/Range	Section:	TRS Note:
001S009W	01	NW4
001N009W	36	S2

Survey date: 1992-06-27 Elevation: 6640 - 6880
First observation: 1992-06-27 Slope/aspect: 35% / SOUTH
Last observation: 1992-06-27 Size (acres): 40

Location:
FROM DIVIDE (TOWN), TAKE FRONTAGE ROAD NORTH CA. 5 MILES. GO EAST UNDER I-15 TO RANCH, THEN TAKE ROAD TO RESERVOIR. SITE IS ON HILL NORTH OF RESERVOIR.

Element occurrence data:
10,000+ INDIVIDUALS, FRUITING, SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON UNDULATING SLOPE, DRY AREA ON RESIDUAL MOUNTAIN MIDSLOPE. SANDY SOIL OF CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: CERCOCARPUS LEDIFOLIUS, AGROPYRON SPICATUM, HAPLOPAPPUS ACAULIS. ADDITIONAL ASSOCIATED SPECIES: ORYZOPSIS HYMENOIDES, CYMOPTERUS BIPINNATUS.

Land owner/manager:
BLM: BUTTE DISTRICT, HEADWATERS RESOURCE AREA
STATE LAND - UNDESIGNATED
HUMBUG SPIRES PRIMITIVE AREA

Comments:
ECODATA PLOT NUMBER 92PL105. LITTLE OR NO LIVESTOCK DISTURBANCE; DEER SCAT.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.017
Element occurrence type:

Survey site name: SOUTH FORK TUCKER CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: TUCKER CREEK

Township/Range	Section:	TRS	Note:
001N008W	31	N2	

Survey date: 1992-06-27
First observation: 1992-06-27
Last observation: 1992-06-27

Elevation: 6720 - 6980
Slope/aspect: 50% / SOUTHWEST
Size (acres): 25

Location:
FROM DIVIDE (TOWN) TAKE FRONTAGE ROAD NORTH CA. 5 MILES. GO EAST UNDER I-15 TO RANCH. FOLLOW DIRT ROAD TO NORTHEAST CA. 4 MILES, KEEPING TO RIGHT AT FORKS, TO SITE ON EITHER SIDE OF SOUTH FORK TUCKER CREEK, CA. 1 MILE NORTHEAST OF RESERVOIR.

Element occurrence data:
10,000+ INDIVIDUALS; FRUITING, SEED DISPERSAL.

General site description:
PARTIALLY SHADED EXPOSURE ON CONVEX SLOPE; DRY AREA ON RESIDUAL LOWER MOUNTAIN SLOPE. SANDY SOIL OF CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: CERCOCARPUS LEDIFOLIUS, JUNIPERUS SCOPULORUM, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED SPECIES: HAPLOPAPPUS ACAULIS, CYMOPTERUS BIPINNATUS. DEER SCAT PRESENT.

Land owner/manager:
BLM: BUTTE DISTRICT, HEADWATERS RESOURCE AREA
HUMBUG SPIRES PRIMITIVE AREA

Comments:
ECODATA PLOT NUMBER 92PL106.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5729). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ARABIS FECUNDA
Common Name: SAPPHIRE ROCKCRESS

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDBRA06290.018
Element occurrence type:

Survey site name: MOOSE TOWN
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001S008W	03	S2, NW4; 10 N2
001N008W	35	SW4

Survey date: 1992-06-26 Elevation: 6700 - 7000
First observation: 1992-06-26 Slope/aspect: 045% / SOUTH
Last observation: 1992-06-26 Size (acres): 35

Location:
FROM HIGHLAND ROAD, TAKE MOOSE TOWN ROAD SOUTHWEST CA. 2 MILES TO MALONEY PARK. SITE IS ON BLUFFS NORTH OF MOOSE CREEK.

Element occurrence data:
1000-5000 INDIVIDUALS, FRUITING, EVIDENCE OF SEED DISPERSAL IN LARGEST SUBPOPULATION. ADDITIONAL SUBPOPULATION CA. 1.5 MILES NORTHWEST: 2000 PLANTS, FRUITING, MANY SMALL PLANTS AS EVIDENCE OF REPRODUCTIVE SUCCESS. THIRD SUBPOPULATION CA. 1 MILE NNW: 100-2000 STEMS, FRUITING, MATURE FRUIT AND SMALL PLANTS PRESENT.

General site description:
OPEN TO PARTIALLY SHADED EXPOSURE ON UNDULATING AND CONVEX SLOPES. DRY AREAS LOWER TO MIDSLOPE; SANDY SOIL OF CALCAREOUS METASEDIMENT PARENT MATERIAL AND POSSIBLY DOLOMITE. ASSOCIATED DOMINANT SPECIES: AGROPYRON SPICATUM, PHLOX MUSCOIDES, HAPLOPAPPUS ACAULIS, POTENTILLA FRUTICOSA, PINUS FLEXILIS, JUNIPERUS COMMUNIS. ADDITIONAL ASSOCIATED SPECIES: ERIGERON COMPOSITUS, DOUGLASIA MONTANA, SENECIO CANUS, ARCTOSTAPHYLOS UVA-URSI, AND SEDUM LANCEOLATUM.

Land owner/manager:
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
LARGEST SUBPOPULATION: ECODATA PLOT NUMBER 92PL103; MINING CLAIMS. NNE SUBPOPULATION: ECODATA PLOT NUMBER 92PL101; NO EVIDENCE OF DISTURBANCE. NNW SUBPOPULATION: ECODATA PLOT NUMBER 92PL102; LIVESTOCK.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

ARABIS FECUNDA
OCCURRENCE #018
PAGE 2

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5719). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CAREX IDAHOA
Common Name: IDAHO SEDGE

Global rank: G2Q Forest Service status: SENSITIVE
State rank: S1 Federal Status: 3C

Element occurrence code: PMCYP036E0.001

Survey site name: HIGHLAND CITY
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	35	SW4

Survey date:		Elevation:	6860 -
First observation:	1981-07-22	Slope/aspect:	5% / WEST
Last observation:	1992-07-11	Size (acres):	1

Location:
FROM BUTTE, TAKE STATE HWY 2 TOWARD PIPESTONE PASS; CA. 1.5 MILES BEFORE PASS, GO SOUTHWEST ON FS RD 84 (HIGHLAND ROAD) 10.25 MILES TO 0.1 MILE EAST OF TURNOFF TO MOOSE TOWN. SITE IS BETWEEN ROAD AND CREEK.

Element occurrence data:
1992: CA. 50 INDIVIDUALS, WITH IMMATURE FRUIT PRESENT. 1981: 20-30 PLANTS, GROWING RIGHT ALONG THE ROAD.

General site description:
1992: OPEN EXPOSURE ON STRAIGHT SLOPE; MOIST BOTTOM IN NARROW VALLEY FLOODPLAIN. SILTY SOIL OF ALLUVIAL OR CALCAREOUS PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, DESCHAMPSIA CESPITOSA, JUNCUS BALTICUS. ADDITIONAL ASSOCIATED PLANT SPECIES: POA PRATENSIS, CAREX PETASATA, FRAGARIA VIRGINIANA, POTENTILLA GRACILIS. 1981: CALCAREOUS WET-MOIST MEADOW SURROUNDED BY WILLOWS AND BOG BIRCH; WITH CAREX SCOPULORUM, PEDICULARIS GROENLANDICA, THALICTRUM SPARSIFLORUM, POTENTILLA FRUTICOSA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
ECODATA PLOT #92PL114. EVIDENCE OF LIVESTOCK DISTURBANCE.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LACKSCHEWITZ, K. (9728). 1981. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CAREX IDAHOA
Common Name: IDAHO SEDGE

Global rank: G2Q Forest Service status: SENSITIVE
State rank: S1 Federal Status: 3C

Element occurrence code: PMCYP036E0.007
Element occurrence type:

Survey site name: COYOTE HILL
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	27	SE4SW4

Survey date:		Elevation:	6960 -
First observation:	1992-06-29	Slope/aspect:	2% / SOUTHWEST
Last observation:	1992-06-29	Size (acres):	1

Location:
HIGHLAND MOUNTAINS, SOUTH OF BUTTE. FROM FISH CREEK ROAD (FS RD 668), GO NORTH ON LIME KILN MOUNTAIN ROAD (FS RD 8492) CA. 100 YARDS. SITE IS ALONG SMALL SPRING CREEK.

Element occurrence data:
50-100 RAMETS, IMMATURE FRUIT PRESENT.

General site description:
OPEN EXPOSURE ON STRAIGHT SLOPE; MOIST AREA IN BOTTOM ON ALLUVIAL FLOODPLAIN. SILTY SOIL OF ALLUVIAL OR CALCAREOUS PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, JUNCUS BALTICUS, DESCHAMPSIA CESPITOSA. ADDITIONAL ASSOCIATED SPECIES: POA PRATENSIS, TARAXACUM OFFICINALE, TRIFOLIUM LONGIPES.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
ECODATA PLOT #92PL109. EVIDENCE OF LIVESTOCK GRAZING.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5746). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CAREX IDAHOA
Common Name: IDAHO SEDGE

Global rank: G2Q Forest Service status: SENSITIVE
State rank: S1 Federal Status: 3C

Element occurrence code: PMCYP036E0.008
Element occurrence type:

Survey site name: SOUTH FORK TUCKER CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: TUCKER CREEK

Township/Range	Section:	TRS Note:
001N009W	36	NE4

Survey date:
First observation: 1992-06-27
Last observation: 1992-06-27

Elevation: 6180 -
Slope/aspect:
Size (acres): 1

Location:
FROM DIVIDE (TOWN), GO NORTH ON FRONTAGE ROAD CA. 5 MILES. GO EAST UNDER I-15 CA. 1.5 MILES TO RANCH. TAKE ROAD TO RESERVOIR CA. 1 MILE. INSTEAD OF CONTINUING UPHILL, GO DOWN TO CREEK. SITE IS CA. 0.4 MILE UPSTREAM.

Element occurrence data:
50-100 INDIVIDUALS; IMMATURE FRUIT PRESENT.

General site description:
OPEN EXPOSURE ON STRAIGHT SLOPE; MOIST AREA IN BOTTOM ON FLOODPLAIN TERRACE. SILTY SOIL OF ALLUVIAL PARENT MATERIAL. ECOTONE BETWEEN CAREX NEBRASCENSIS WET MEADOW AND ARTEMISIA TRIDENTATA-FESTUCA IDAHOENSIS STEPPE, WITH POA PRATENSIS AND JUNCUS BALTICUS.

Land owner/manager:
STATE LAND - UNDESIGNATED

Comments:
LIVESTOCK DISTURBANCE EVIDENT.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5730). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CAREX VALLICOLA
Common Name: A SEDGE

Global rank: G5 Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PMCYP03EA0.007
Element occurrence type:

Survey site name: LIMEKILN HILL
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	22	E2E2

Survey date:	1992-06-29	Elevation:	7600 - 7650
First observation:	1992-06-29	Slope/aspect:	10% / EAST
Last observation:	1992-06-29	Size (acres):	2

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE; CA. 0.25 MILE DUE EAST OF LIMEKILN SPRING. FROM FISH CREEK TAKE FS RD 8492 TO LIMEKILN HILL. GO NORTH TO THE SADDLE. SITE IS CA. 0.1 MILE NORTH.

Element occurrence data:
100-1000 INDIVIDUALS, IN FRUIT.

General site description:
OPEN EXPOSURE ON CONVEX UPPER SLOPE. MOIST AREA ON RESIDUAL MOUNTAIN SLOPE, SILTY SOIL, CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: FESTUCA IDAHOENSIS, LUPINUS SERICEUS. ADDITIONAL ASSOCIATED PLANT SPECIES: CAREX HOODII, CAREX PETASATA, STIPA OCCIDENTALIS, ERIOGONUM UMBELLATUM.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
ROAD RUNS THROUGH POPULATION.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5743). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: CLAYTONIA LANCEOLATA VAR FLAVA
Common Name: YELLOW SPRINGBEAUTY

Global rank: G5T5 Forest Service status: SENSITIVE
State rank: S3 Federal Status: C2

Element occurrence code: PDPCR03092.005
Element occurrence type:

Survey site name: BURTON PARK
EO rank: A
EO rank comments: LARGE, REPRESENTATIVE POPULATION; ALL WHITE-FLOWERED.

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	27	SW4NE4,NE4NW4,E2SE4;22W2,NW4SE4,26SW4SW4,35NW

Survey date: 1989-06-05 Elevation: 6880 -
First observation: 1988 Slope/aspect: LEVEL
Last observation: 1989-06-05 Size (acres): 200

Location:
HIGHLAND MOUNTAINS, BURTON PARK AND UPPER NORTH FORK TUCKER CREEK, CA. 12 AIR MILES SSW OF BUTTE; ALONG HIGHLAND ROAD (N.F. ROAD #84).

Element occurrence data:
CA. 60,000 PLANTS IN 11 SUBPOPULATIONS: ONLY WHITE-FLOWERED PLANTS OBSERVED.

General site description:
LARGE, LEVEL MEADOW, WITH POTENTILLA FRUTICOSA, DODECATHEON CONJUGENS, POLYGONUM BISTORTOIDES, GEUM TRIFLORUM.

Land owner/manager:
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
VOUCHER-SCHASSBERGER, L.A. (204). 1988. MONTU; SYSTEMATIC STUDIES IN PROGRESS. UNIQUE POPULATION--ENTIRELY WHITE-FLOWERED.

Information source:
SCHASSBERGER, L.A. 1989. FIELD SURVEYS OF THE PIONEER MOUNTAINS, 6-9 JUNE.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: DRABA DENSIFOLIA
Common Name: DENSE-LEAF WHITLOW-GRASS

Global rank: G5 Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDBRA110W0.001
Element occurrence type:

Survey site name: HOMESTAKE REST AREA
EO rank:
EO rank comments:

County: JEFFERSON

USGS quadrangle: HOMESTAKE
DELMOE LAKE

Township/Range Section: TRS Note:
002N006W 20

Survey date: Elevation: 6300 -
First observation: 1986 Slope/aspect: - / SOUTH
Last observation: 1986-04-26 Size (acres): 0

Location:
JUST EAST OF REST AREA, OFF INTERSTATE-90, 2 MILES EAST OF HOMESTAKE PASS.

Element occurrence data:
COMMON.

General site description:
IN COARSE, SANDY, GRANITE-DERIVED SOIL OF STEEP SOUTH-FACING BANK, WITH ERYSIMUM ASPERUM AND CHAENACTIS DOUGLASII.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
LABEL READS RANGE 7 WEST; REST AREA IS IN RANGE 6 WEST.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812. (3693). 1986. SPECIMEN # 104255. MONTU.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ERIGERON GRACILIS
Common Name: SLENDER FLEABANE

Global rank: G4 Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDAST3M1R0.008
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	34	

Survey date: - -
First observation: 1981
Last observation: 1981-07-22

Elevation: 7300 -
Slope/aspect:
Size (acres): 0

Location:
BUTTE HIGHLANDS.

Element occurrence data:
WIDELY SCATTERED.

General site description:
SAGEBRUSH PRAIRIE.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
E. URSINUS, ANNOTATED AS E. GRACILIS BY K.H.L., 1987.

Information source:
LACKSCHEWITZ, K.H. (9739). 1981. SPECIMEN #86510. MONTU.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ERIGERON GRACILIS
Common Name: SLENDER FLEABANE

Global rank: G4 Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDAST3M1R0.010
Element occurrence type:

Survey site name: PANDORA MOUNTAIN
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: WICKIUP CREEK

Township/Range	Section:	TRS Note:
001S008W	34	NE4

Survey date:		Elevation:	7350 - 7550
First observation:	1992-06-30	Slope/aspect:	5% / EAST
Last observation:	1992-06-30	Size (acres):	40

Location:
FOLLOW CAMP CREEK ROAD SOUTH TO CROSSING OF WICKIUP CREEK. PROCEED 0.2 MILE TO MOFFET MOUNTAIN ROAD. PROCEED WEST AND SOUTH CA. 1 MILE TO NATIONAL FOREST BOUNDARY. SITE IS JUST WEST OF FENCE.

Element occurrence data:
1000+ INDIVIDUALS, FLOWERING.

General site description:
OPEN EXPOSURE ON CONCAVE UPPER SLOPE. DRY/MOIST AREA ON RESIDUAL MOUNTAIN SLOPE; SILTY SOIL. ASSOCIATED DOMINANT SPECIES: ARTEMISIA TRIDENTATA, FESTUCA IDAHOENSIS, GERANIUM VISCOSISSIMUM. ADDITIONAL ASSOCIATED SPECIES: ASTER STENOMERES.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
EVIDENCE OF LIVESTOCK, 4 x 4 ROADS, PROSPECTING. SPECIES MAY BE COMMON IN THE AREA; LARGE AMOUNT OF UNSURVEYED HABITAT AVAILABLE.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5751). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: ERIGERON GRACILIS
Common Name: SLENDER FLEABANE

Global rank: G4 Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDAST3M1R0.012
Element occurrence type:

Survey site name: PIPESTONE PASS
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	33	N2NE4NW4; 28 S2S2S2; 27 N2NE4; 22 S2S2SE4

Survey date:
First observation: 1992-06-29
Last observation: 1992-06-29

Elevation: 7120 - 7650
Slope/aspect: 2-15% / SOUTH, EAST
Size (acres): 35

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. TWO SITES: 1) FROM FISH CREEK TAKE ROAD TO LIMEKILN HILL (FS RD 8492), SITE IS CA. 0.2 MILES SOUTH OF SADDLE; 2) TAKE FISH CREEK ROAD (FS RD 668) WEST TO CREEK CROSSING. PROCEED 0.3 MILE TO MEADOWS.

Element occurrence data:
1,000 TO 10,000 INDIVIDUALS, FLOWERING; 2 SUBPOPULATIONS.

General site description:
OPEN EXPOSURE ON STRAIGHT SLOPE; DRY-MOIST AREA ON RESIDUAL MOUNTAIN SLOPES, SILTY SOIL, CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, FESTUCA IDAHOENSIS, POA PRATENSIS. ADDITIONAL ASSOCIATED SPECIES: LUPINUS SERICEUS, ARTEMISIA TRIDENTATA, CERASTIUM ARVENSE, POTENTILLA GRACILIS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
LIVESTOCK, EXOTICS, AND ROADS IN AREA. ERIGERON GRACILIS PROBABLY OCCURS IN OTHER AREAS IN HIGHLAND CITY AREA; HABITATS NOT SURVEYED.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5741). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: GENTIANA AQUATICA
Common Name: WET MEADOW GENTIAN

Global rank: G4 Forest Service status:
State rank: S2S3 Federal Status:

Element occurrence code: PDGEN06050.012
Element occurrence type:

Survey site name: LIMEKILN HILL
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: PIPESTONE PASS

Township/Range	Section:	TRS Note:
001N007W	27	SE4SW4

Survey date:		Elevation:	6920 - 7000
First observation:	1992-06-29	Slope/aspect:	2% / SOUTH
Last observation:	1992-06-29	Size (acres):	5

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM FISH CREEK ROAD (FS RD 668), TAKE ROAD TO LIME KILN HILL (FS RD 8492) FOR CA. 100 YARDS. SITE IS ALONG SMALL SIDE CREEK JUST 100 YARDS UP ROAD.

Element occurrence data:
1000+ INDIVIDUALS, FLOWERING AND FRUITING. EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON STRAIGHT BOTTOM SLOPE. MOIST AREA, SILTY SOIL, CALCAREOUS ALLUVIUM PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, JUNCUS BALTICUS, POA PRATENSIS, DESCHAMPSIA CESPITOSA. ADDITIONAL ASSOCIATED PLANT SPECIES: ANTENNARIA CORYMBOSA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
LIVESTOCK GRAZING. ANNUAL SPECIES; POPULATION SIZE FLUCTUATES.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5747). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: HAPLOPAPPUS MACRONEMA VAR LINEARIS
Common Name: LINEAR-LEAVED DISCOID GOLDENWEED

Global rank: G4T? Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDAST4F0U3.001
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	35	SW4SW4; 34 SE4SE4
001S008W	03	NE4NE4

Survey date:
First observation: 1992-08-01
Last observation: 1992-08-01

Elevation: 6880 - 6980
Slope/aspect: 10% / SOUTHEAST
Size (acres): 15

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE; TAKE HIGHLAND ROAD (FS RD 84) WEST TO TURNOFF TO MOOSE TOWN. GO LEFT AND PROCEED TO FIRST CATTLE GUARD. SITE IS CA. 0.6 MILE SOUTHEAST OF MOOSE CAMP SPRING.

Element occurrence data:
500-1000 INDIVIDUALS; FLOWERING, IN FRUIT AND BUD. EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON CONCAVE MIDSLOPE. DRY AREA ON RESIDUAL MOUNTAIN SLOPE; LOAM SOIL, METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, ARTEMISIA TRIDENTATA, FESTUCA IDAHOENSIS, AGROPYRON DASYSTACHYUM, STIPA RICHARDSONII. ADDITIONAL ASSOCIATED SPECIES: POA PRATENSIS, ANTENNARIA MICROPHYLLA, GEUM TRIFLORUM, ERIOGONUM UMBELLATUM.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
ROAD RUNS THROUGH POPULATION; HEAVY LIVESTOCK USE NEAR CATTLEGUARD. PLANT APPEARS TO BE MOST COMMON IN MOST DISTURBED AREAS.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5831). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: HAPLOPAPPUS MACRONEMA VAR LINEARIS
Common Name: LINEAR-LEAVED DISCOID GOLDENWEED

Global rank: G4T? Forest Service status:
State rank: S2 Federal Status:

Element occurrence code: PDAST4F0U3.002
Element occurrence type:

Survey site name: BURTON PARK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	22	S2N2

Survey date:		Elevation:	6940 - 6980
First observation:	1992-08-01	Slope/aspect:	5% / SOUTH
Last observation:	1992-08-01	Size (acres):	20

Location:
HIGHLAND MOUNTAINS, SOUTH OF BUTTE. SITE IS AT NORTH END OF BURTON PARK ALONG TRAIL #108, CA. 2.25 MILES DUE NORTH OF MOOSE CAMP SPRING.

Element occurrence data:
100-300 INDIVIDUALS, FLOWERING, IN BUD.

General site description:
OPEN EXPOSURE ON STRAIGHT LOWER SLOPE; DRY AREA ON ALLUVIAL FAN, LOAM SOIL, GRANITE PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: ARTEMESIA TRIDENTATA, FESTUCA IDAHOENSIS, CAREX FILIFOLIA. ADDITIONAL ASSOCIATED SPECIES: GEUM TRIFLORUM, SELAGINELLA DENSA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
CATTLE DISTURBANCE; MANY PLANTS TRAMPLED. ECODATA PLOT #92PL118.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5830). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: HAPLOPAPPUS MACRONEMA VAR MACRONEMA
Common Name: DISCOID GOLDENWEED

Global rank: G4T4 Forest Service status: SENSITIVE
State rank: S1 Federal Status:

Element occurrence code: PDAST4F0U2.001
Element occurrence type:

Survey site name: STORM PEAK
EO rank:
EO rank comments:

County: BEAVERHEAD

USGS quadrangle: STORM PEAK

Township/Range	Section:	TRS Note:
003S010W	21	SE4

Survey date:		Elevation:	8900 -
First observation:	1920	Slope/aspect:	
Last observation:	1990-07-29	Size (acres):	0

Location:
EAST PIONEER MOUNTAINS, CA. 0.5 MILE SOUTHEAST OF STORM PEAK.

Element occurrence data:
CA. 20 PLANTS OBSERVED IN AREA CA. 20M N-S BY 50M E-W; SOME NOT YET IN FLOWER.

General site description:
TALUS SLOPE, SOUTH FACING, WITH SCATTERED WHITEBARK PINE, AND RIBES, ARTEMISIA, DELPHINIUM.

Land owner/manager:
BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT
BEAVERHEAD NATIONAL FOREST, DILLON RANGER DISTRICT

Comments:
ADDITIONAL HABITAT TO EAST NOT SURVEYED (1990). VOUCHER - ELOFSON, H. W. (133), 1920, MONT.

Information source:
JONES, CEDRON. c/o MT NATURAL HERITAGE PROGRAM.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: JUNCUS HALLII
Common Name: HALL'S RUSH

Global rank: G4G5 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PMJUN011E0.010
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N008W	36	SE4NW4

Survey date:		Elevation:	7210 - 7280
First observation:	1992-06-30	Slope/aspect:	5% / NORTH
Last observation:	1992-06-30	Size (acres):	1

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM JUNCTION OF HIGHLAND ROAD (FS RD 84) AND CAMP CREEK ROAD (FS RD 8520), TAKE HIGHLAND ROAD WEST CA. 0.5 MILE. TAKE ROAD TO RIGHT AND PROCEED CA. 0.5 MILE TO JUNCTION. STAY LEFT AND PROCEED 0.25-0.50 MILE TO SITE.

Element occurrence data:
50+ INDIVIDUALS IN EARLY FRUIT.

General site description:
OPEN EXPOSURE ON CONCAVE MIDSLOPE; MOIST AREA. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA AND JUNCUS BALTICUS. ADDITIONAL ASSOCIATED SPECIES: ASTRAGALUS ALPINUS, POTENTILLA FRUTICOSA, JUNCUS TENUIS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
SITE IS ADJACENT TO ROAD. AREA HAS BEEN LOGGED.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5750). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: OROBANCHE CORYMBOSA
Common Name: FLAT-TOPPED BROOMRAPE

Global rank: G4 Forest Service status: WATCH
State rank: S2 Federal Status:

Element occurrence code: PDORO04040.006
Element occurrence type:

Survey site name: HELLS CANYON
EO rank:
EO rank comments:

County: MADISON

USGS quadrangle: TABLE MOUNTAIN

Township/Range	Section:	TRS Note:
002S006W	7	SW4; SW4SE4
002S007W	12	NE4NE4

Survey date: 1992-07-29 Elevation: 6150 - 6650
First observation: 1992-07-29 Slope/aspect: 5-10% / SOUTH
Last observation: 1992-07-29 Size (acres): 50

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. SITES ARE OFF MAIN HELLS CANYON ROAD. MAIN (CENTROID) POPULATION IS CA. 1.7 MILES SOUTHEAST OF HELLS CANYON FOREST SERVICE STATION.

Element occurrence data:
OVER 2000 INDIVIDUALS, WITH 3 SUBPOPULATIONS. OLD STEMS, SOME FLOWERING PLANTS. ROOTS ARE FULL OF WORMS.

General site description:
OPEN EXPOSURE ON RIDGE. CONVEX SLOPE SHAPE. DRY AREA ON RESIDUAL MOUNTAIN SLOPES. SANDY SOIL, GRANITE PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: ARTEMISIA TRIDENTATA, FESTUCA IDAHOENSIS, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED PLANT SPECIES: POA SECUNDA, ERIGERON COMPOSITUS, ANTENNARIA MICROPHYLLA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
BLM: BUTTE DISTRICT, DILLON RESOURCE AREA

Comments:
DISTURBANCE FROM LIVESTOCK EVIDENT. ECODATA PLOT #92PL116, 92PL117.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5811). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: PENSTEMON LEMHIENSIS
Common Name: LEMHI BEARDTONGUE

Global rank: G3 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDSCR1L3N0.046
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001S007W	06	NE4
001N007W	32	SW4SW4

Survey date:
First observation: 1992-06-28
Last observation: 1992-06-28

Elevation: 7640 - 7880
Slope/aspect: 30% / NORTHEAST
Size (acres): 12

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM CAMP CREEK ROAD (FS RD 8520) TAKE ROAD TO FISH CREEK AND HIGHLAND LOOKOUT (FS RD 8514). SITE IS 0.2 MILE BEYOND TURNOFF TO LOOKOUT.

Element occurrence data:
TWO SUBPOPULATIONS, EACH WITH 50-100 INDIVIDUALS, FLOWERING.

General site description:
OPEN EXPOSURE ON CONCAVE MIDSLOPE. DRY AREA ON RESIDUAL MOUNTAIN SLOPE; SANDY SOIL, CALCAREOUS METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: AGROPYRON SPICATUM, FESTUCA IDAHOENSIS, ASTRAGALUS MISER. ADDITIONAL ASSOCIATED SPECIES: PHACELIA HASTATA, DELPHINIUM BICOLOR, PHLOX LONGIFOLIA, COLLOMIA LINEARIS, BROMUS CARINATUS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
OLD MINE PROSPECTS, ROAD, POCKET GOPHERS. ECODATA PLOT #92PL107.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5738). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: PENSTEMON LEMHIENSIS
Common Name: LEMHI BEARDTONGUE

Global rank: G3 Forest Service status: SENSITIVE
State rank: S2 Federal Status: C2

Element occurrence code: PDSCR1L3N0.047
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001S008W	04	SE4NE4SE4

Survey date:		Elevation:	6920 -
First observation:	1992-07-11	Slope/aspect:	35% / EAST
Last observation:	1992-07-11	Size (acres):	1

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM HIGHLAND ROAD (FS RD 84) TAKE ROAD TO MOOSE TOWN (FS RD 8594). FOLLOW ROAD TO MALONEY PARK, CONTINUE WEST 0.2 MILE TO TRACK GOING NORTH ACROSS CREEK AND PROCEED ON TRACK FOR CA. 0.7 MILES. SITE IS JUST EAST OF TRACK, CA. 1.6 MILES SOUTHEAST OF THE PEAK OF MOUNT HUMBUG.

Element occurrence data:
100-200 INDIVIDUALS, FLOWERS AND IMMATURE FRUIT. NEARLY ALL INFLORESCENCES EATEN OFF.

General site description:
OPEN EXPOSURE ON CONCAVE RESIDUAL LOWER SLOPE, DRY AREA, SANDY SOIL, CALC METASEDIMENT PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: CHRYSOTHAMNUS NAUSEOSUS, FESTUCA IDAHOENSIS, AGROPYRON SPICATUM. ADDITIONAL ASSOCIATED SPECIES: HAPLOPAPPUS ACAULIS, MACHAERANTHERA CANESCENS.

Land owner/manager:
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
PREDATION PROBABLY CAUSED BY ELK, BUT POSSIBLY DEER OR COWS. ECODATA PLOT #92PL115

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: RANUNCULUS VERECUNDUS
Common Name: TIMBERLINE BUTTERCUP

Global rank: G5 Forest Service status:
State rank: S1 Federal Status:

Element occurrence code: PDRANOL2Q0.005
Element occurrence type:

Survey site name: HELLS CANYON
EO rank:
EO rank comments:

County: MADISON

USGS quadrangle: TABLE MOUNTAIN

Township/Range	Section:	TRS Note:
001S007W	16	S2S2; 21

Survey date:	1992-07-30	Elevation:	9200 - 9300
First observation:	1992 07-30	Slope/aspect:	10% / SOUTH
Last observation:	1992-07-30	Size (acres):	1

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE; CA. 0.6 MILE DUE WEST OF THE PEAK OF TABLE MOUNTAIN. SITE IS ALONG DRAINAGE AT HEAD OF CIRQUE.

Element occurrence data:
200-500 INDIVIDUALS, MAINLY FLOWERING.

General site description:
OPEN EXPOSURE ON BOTTOM OF MOIST, NARROW ALPINE CIRQUE. WET-ORGANIC SOIL, QUARTZITE PATENT MATERIAL. ASSOCIATED DOMINANT SPECIES: DESCHAMPSIA CESPITOSA, CAREX PAYSONIS. ADDITIONAL ASSOCIATED PLANT SPECIES; VERONICA WORMSKJOLDII, EPILOBIUM ALPINUM, CAREX ALBONIGRA, AGROSTIS HUMILIS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT

Comments:
SOME BIGHORN OR GOAT GRAZING EVIDENT.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIVERSITY OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5820). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: SAXIFRAGA TEMPESTIVA
Common Name: STORM SAXIFRAGE

Global rank: G2 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDSAX0U1R0.014
Element occurrence type:

Survey site name: HELLS CANYON
EO rank:
EO rank comments:

County: MADISON

USGS quadrangle: TABLE MOUNTAIN

Township/Range	Section:	TRS Note:
001S007W	16	SW4SE4,W2

Survey date:	1992-07-06	Elevation:	9400 - 9900
First observation:	1992-07-06	Slope/aspect:	10% / SOUTHWEST
Last observation:	1992-07-06	Size (acres):	1

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE, CA. 0.5 MILE NORTHWEST OF THE PEAK OF TABLE MOUNTAIN, AND CA. 0.25 MILE SOUTHWEST OF THE MADISON-SILVER BOW COUNTY LINE.

Element occurrence data:
100-500 INDIVIDUALS, 2 SUBPOPULATIONS, IN FRUIT.

General site description:
OPEN EXPOSURE ON UPPER CONCAVE SLOPE. MOIST AREA ON GLACIATED MOUNTAIN SLOPE, GRAVELLY/SILTY SOIL, QUARTZITE PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: GEUM ROSSII, CAREX ELYNOIDES. ADDITIONAL ASSOCIATED PLANT SPECIES: DODECATHEON PULCHELLUM, POLYGONUM BISTORTOIDES.

Land owner/manager:
DEERLODGE NATIONAL FOREST, JEFFERSON RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
ECODATA PLOT #92PL114.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5814). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: THLASPI PARVIFLORUM
Common Name: SMALL-FLOWERED PENNYCRESS

Global rank: G3 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDBRA2P050.007
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001S008W	01	W2NW4

Survey date:		Elevation:	6950 -
First observation:	1992-06-30	Slope/aspect:	5% / NORTHWEST
Last observation:	1992-06-30	Size (acres):	5

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. FROM JUNCTION OF HIGHLAND ROAD (FS RD 84) AND CAMP CREEK ROAD (FS RD 8520), TAKE HIGHLAND ROAD WEST CA. 1.2 MILES. SITE IS 0.25 MILES SOUTH ON SOUTH SIDE OF CREEK.

Element occurrence data:
1,000-10,000 INDIVIDUALS, IN FRUIT; EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON STRAIGHT BOTTOM SLOPE, MOIST AREA ON FLOODPLAIN IN WIDE VALLEY, SILTY SOIL, ALLUVIUM PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, JUNCUS BALTICUS, POA JUNCIFOLIA. ADDITIONAL ASSOCIATED SPECIES: POA PRATENSIS, TARAXACUM OFFICINALE, POTENTILLA DIVERSIFOLIA.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT

Comments:
EXOTICS, EVIDENCE OF LIVESTOCK GRAZING. ECODATA PLOT #92PL112.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: THLASPI PARVIFLORUM
Common Name: SMALL-FLOWERED PENNYCRESS

Global rank: G3 Forest Service status: SENSITIVE
State rank: S2 Federal Status:

Element occurrence code: PDBRA2P050.008
Element occurrence type:

Survey site name: MOUNT HUMBUG
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: MOUNT HUMBUG

Township/Range	Section:	TRS Note:
001N007W	31	NE4SW4, SE4NW4

Survey date:		Elevation:	7300 - 7350
First observation:	1992-06-26	Slope/aspect:	5% / SOUTHEAST
Last observation:	1992-06-26	Size (acres):	3

Location:
HIGHLAND MOUNTAINS SOUTH OF BUTTE. SITE IS AT JUNCTION OF HIGHLAND ROAD (FS RD 84) AND CAMP CREEK ROAD (FS RD 8520) ON WEST EDGE OF LODGEPOLE.

Element occurrence data:
100-1,000 INDIVIDUALS, FRUITING, EVIDENCE OF SEED DISPERSAL.

General site description:
OPEN EXPOSURE ON STRAIGHT TERRACE; MOIST AREA ON RESIDUAL MOUNTAIN SLOPES, SILTY SOIL OF ALLUVIUM PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: POTENTILLA FRUTICOSA, POA PRATENSIS, TARAXACUM OFFICINALE. ADDITIONAL ASSOCIATED SPECIES: BROMUS CARINATUS, POTENTILLA GRACILIS, ERIGERON GRACILIS.

Land owner/manager:
DEERLODGE NATIONAL FOREST, BUTTE RANGER DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Comments:
ROADS, LIVESTOCK AND ABUNDANT GOPHER ACTIVITY. ECODATA PLOT #92PL104.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5723). 1992. MONTU.

MONTANA NATURAL HERITAGE PROGRAM
Element Occurrence Record

Scientific Name: VIOLA RENIFOLIA
Common Name: KIDNEY-LEAF WHITE VIOLET

Global rank: G5 Forest Service status: SENSITIVE
State rank: S1 Federal Status:

Element occurrence code: PDVIO041V0.010
Element occurrence type:

Survey site name: SOUTH FORK TUCKER CREEK
EO rank:
EO rank comments:

County: SILVER BOW

USGS quadrangle: TUCKER CREEK

Township/Range	Section:	TRS Note:
001N008W	31	SW4
001N009W	36	NW4

Survey date:
First observation: 1992-06-27
Last observation: 1992-06-27

Elevation: 6120 - 6520
Slope/aspect: 5% / -
Size (acres):

Location:
FROM DIVIDE (TOWN) TAKE FRONTAGE ROAD NORTH CA. 5 MILES. GO EAST UNDER I-15 TO RANCH. TAKE ROAD TO RESERVOIR CA. 1 MILE, THEN SIDEHILL EAST TO CREEK. SITE IS CA. 1 MILE UPSTREAM ALONG CREEK.

Element occurrence data:
100+ INDIVIDUALS IN TWO SUBPOPULATIONS; CLEISTOGAMOUS FLOWERS AND MATURE FRUIT.

General site description:
SHADED BOTTOM; MOIST AREA IN RESIDUAL MOUNTAIN STREAM VALLEY. SILTY SOIL OF ALLUVIAL PARENT MATERIAL. ASSOCIATED DOMINANT SPECIES: PICEA ENGELMANNII, PSEUDOTSUGA MENZIESII. ADDITIONAL ASSOCIATED PLANT SPECIES: ACTAEA RUBRA, RIBES HUDSONIANUM, PYROLA OSARIFOLIA.

Land owner/manager:
HUMBUG SPIRES PRIMITIVE AREA
BLM: BUTTE DISTRICT, HEADWATERS RESOURCE AREA
STATE LAND - UNDESIGNATED

Comments:
ENTIRE CREEK NOT SURVEYED. STREAM IN FLOOD; SOME LIVESTOCK USE.

Information source:
LESICA, P. DIVISION OF BIOLOGICAL SCIENCES, UNIV. OF MONTANA, MISSOULA, MT 59812.

Specimens:
LESICA, P. (5731). 1992. MONTU.

Appendix C. ECODATA plot forms for plant communities associated with populations of sensitive plant species in the Highland Mountains.

Appendix D. Photographs of sensitive species and species of special concern located in the Highland Mountains.

Arabis fecunda site
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992 92PL101

Moose Town

Deerlodge NF

Silver Bow Co.
June 1992 92PL103

Tucker Creek

Deerlodge NF

Silver Bow Co.
June 1992 92PL105

Arabis fecunda site
Tucker Creek

Deerlodge NF

Silver Bow Co.
June 1992 92PL106

Arabis fecunda site
Tucker Creek

Deerlodge NF

Silver Bow Co.
June 1992 92PL106

Arabis fecunda site
Highland City

Deerlodge NF

Silver Bow Co.
June 1992 92PL108

Arabis fecunda site
Highland City

Deerlodge NF

Silver Bow Co.
June 1992 92PL110

Arabis fecunda site
Hornbag Spires

Silver Bow Co.
June 1992 PL

Tucker Creek
Silver Bow Co.
June 1992

Carex parryana idahoa

Deerlodge NF

Carex parryana idahoa site
Highland City

Deerlodge NF

Silver Bow Co.
June 1992 92PL109

Carex parryana idahoa site
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992 92PL114

Carex parryana idahoa site
Tucker Creek

Deerlodge NF

Silver Bow Co.
June 1992

Carex vallicola
Highland City

Deerlodge NF

Silver Bow Co.
June 1992 PL

Erigeron gracilis
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992

Moose Town site

Deerlodge NF

Silver Bow Co.
June 1992
92PL115

Moose Town site

Deerlodge NF

Silver Bow Co.
June 1992
92PL111

Penstemon lemhiensis
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992

Saxifraga tempestiva site
Table Mt.

Deerlodge NF

Silver Bow Co.
June 1992
PL

Saxifraga tempestiva
Table Mt.

Deerlodge NF

Silver Bow Co.
June 1992
PL

Penstemon lemhiensis site
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992
92PL107

Thlaspi parviflorum
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992

Thlaspi parviflorum
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992

Thlaspi parviflorum
Moose Town

Deerlodge NF

Silver Bow Co.
June 1992
92PL112

Thlaspi parviflorum
Moose Town site

Deerlodge NF

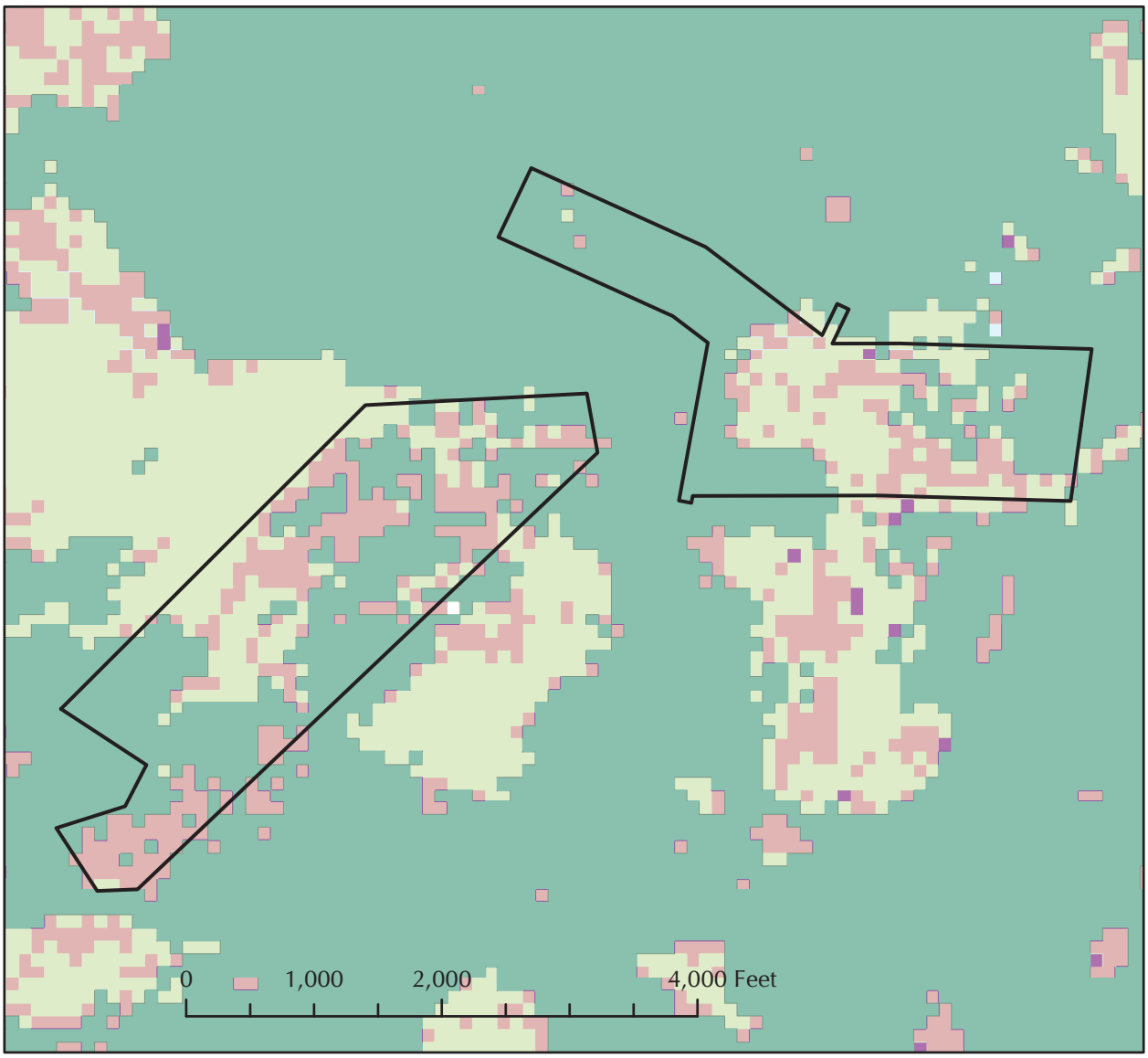
Silver Bow Co.
June 1992
92PL104

MONTANA
STATE
LIBRARY

This "cover" page added by the Internet Archive for formatting purposes

Appendix B. NRIS and US Forest Service land cover maps.

National Land Cover Dataset for Montana
Montana NLCD



NRIS - USGS, EPA 1992, 2000

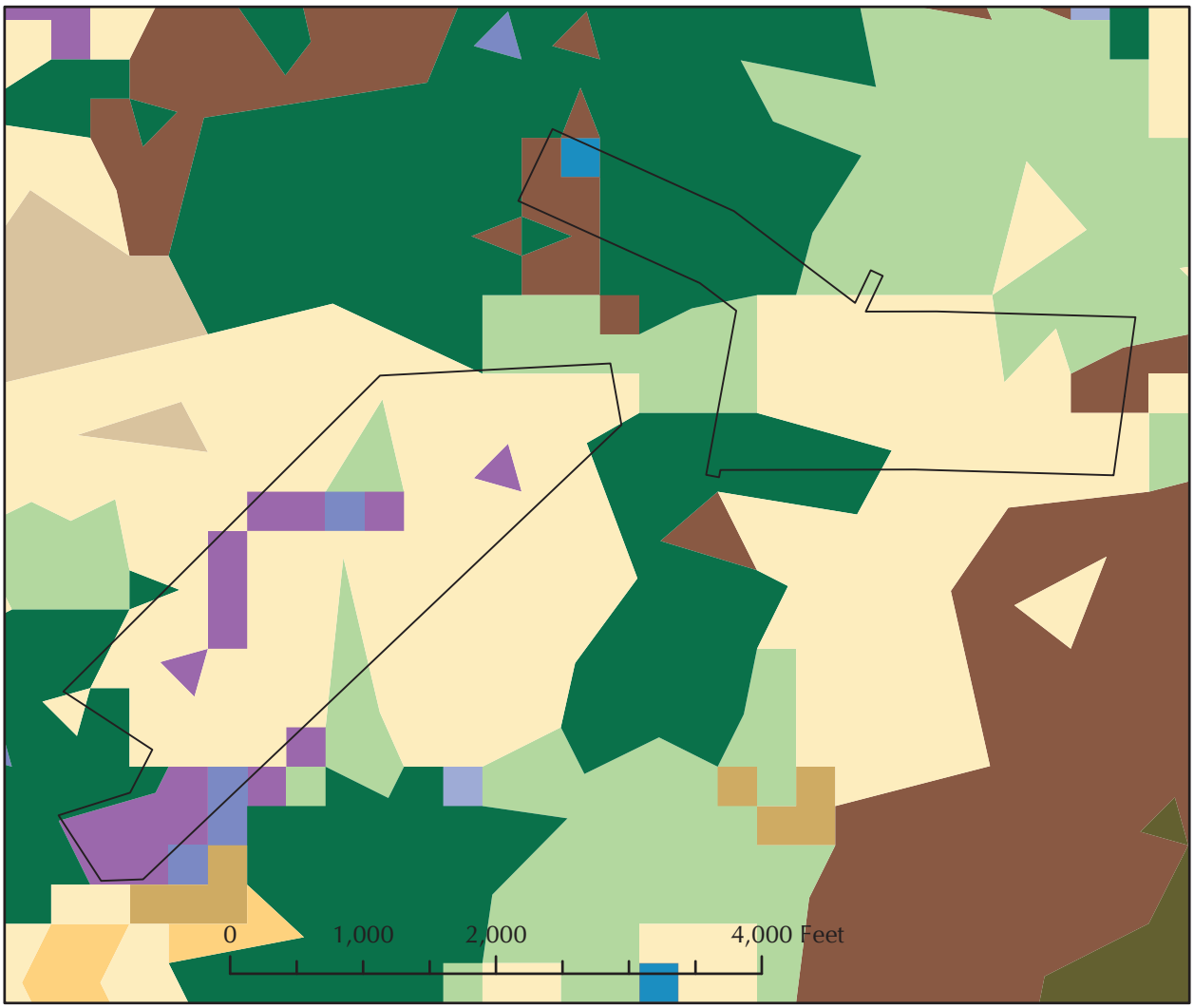
Legend

- Butte Highlands Patent Claims
- Perennial Ice & Snow
- Bare Rock/Sand/Clay
- Evergreen Forest
- Shrubland
- Grasslands/Herbaceous

N

Jasper Geographics 1/2010

Montana 90-meter Land Cover Data from the GAP Analysis Project



NRIS - University of Montana 1998

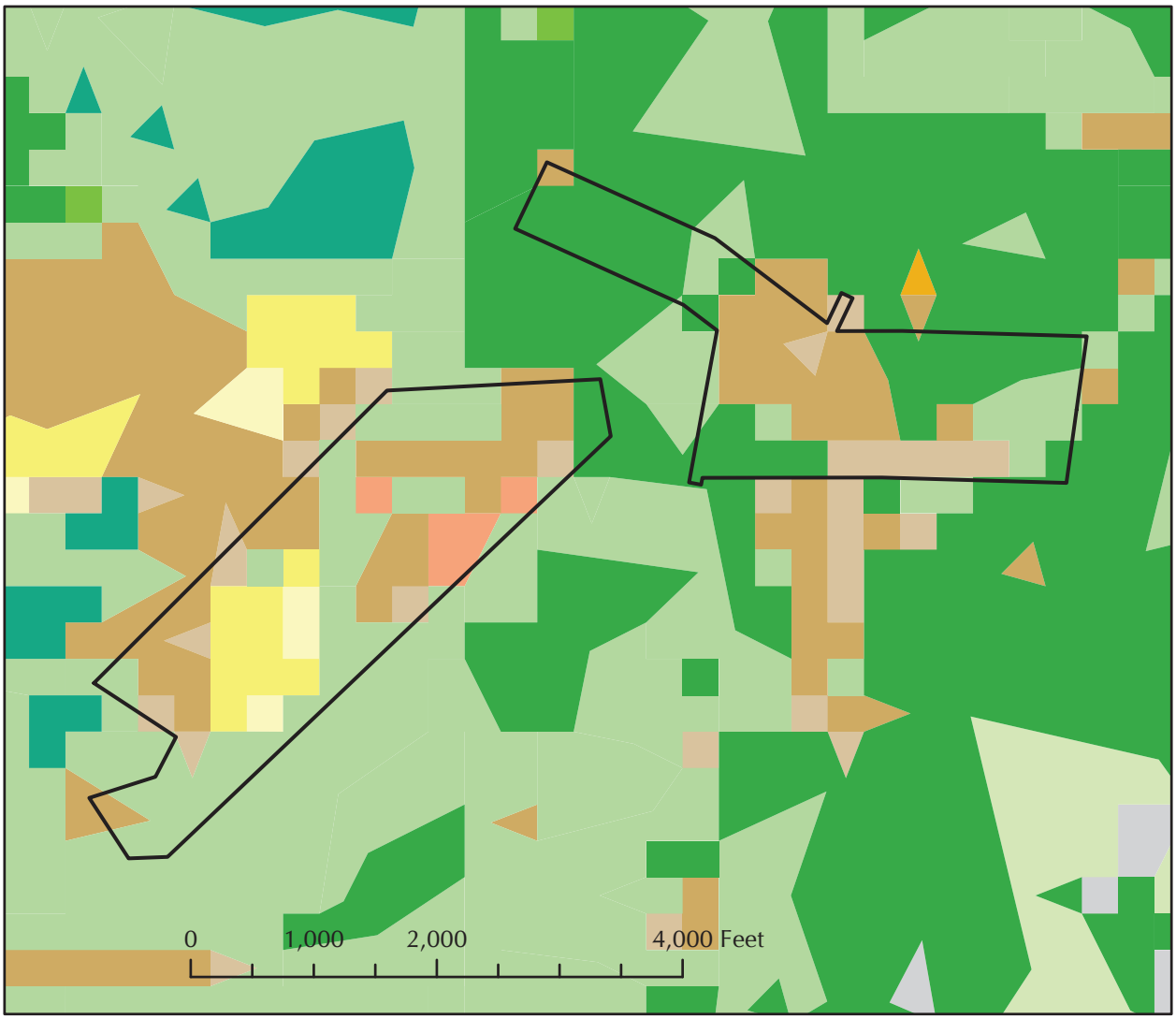
Legend

- Butte Highlands Patent Claims
- ParklandsSubalpineMeadow
- MixedMesicShrubs
- Sagebrush
- LodgepolePine
- DouglasFir
- MixedWhitebarkPineForest
- MixedSubalpineForest
- MixedXericForest
- ConiferRiparian
- MixedBroadleafConiferRiparian
- ShrubRiparian
- MixedRiparian

N

Jasper Geographics 1/2010

Potential Natural Vegetation (PNV) Classification for Western and Central Montana and Northern Idaho



http://www.fs.fed.us/r1/gis/thematic_data/vegetation_pnv_n_id_wc_mt_90m.htm

USFS 2002

Legend

- Butte Highlands Patent Claims
- SubalpineFir
- WhitebarkPine
- Spruce
- Lodgepole Pine
- Douglas Fir
- RoughFesceuGrassland
- DrySpeciesGrassland
- BigSagebrushSpeciesShrubland
- ShrubbyCinquefoilShrubland
- DrySpeciesShrubland
- MesicSpeciesShrubland
- Rock, Talus/Scree, Barren Areas and Mines

N

Jasper Geographics 1/2010

Appendix C. Montana Field Guide information for Silver Bow county, MT Species of Concern located by Lesica (1993) in the Highland Mountains.

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Dicots - *Dicotyledoneae*

Order - Mustards / Capers - *Capparales*

Family - Mustards - *Brassicaceae*

Species - Sapphire Rockcress - Arabis fecunda

Species of Concern

Global Rank: G2
State Rank: S2 * (see reason below)

Agency Status
USFWS: none
USFS: SENSITIVE
BLM: SENSITIVE
MNPS Threat Rank: 1

State Rank Reason
Sapphire rockcress is a state endemic known from several locations in southwest Montana where it is restricted to specific and localized habitats. Encroachment of spotted knapweed threatens several populations, particularly in Ravalli County. It is unclear whether grazing has significant negative impacts

General Description
Sapphire rockcress is a small perennial with one to many unbranched flowering stems reaching up to 30 cm in height, arising from a simple or branched rootcrown. The spoon-shaped or lance-shaped basal leaves are 10-30 mm long and 2-4 mm wide, and have margins that are untoothed or with a few shallow lobes toward the tip; those produced in the fall are usually larger and broader than those produced in the spring. The stem leaves are smaller and clasping at the base. Both stem and leaves are grayish-white with a dense cover of small, branched hairs.

Several to many white or blueish-tinged flowers are borne in an unbranched spike-like inflorescence. Each flower has 4 petals (9-13 mm long and 3-5 mm wide) and densely hairy sepals (6-7 mm long and about 2 mm wide). The flowers are tightly clustered at first, but become farther apart as the fruits develop. The pods are grayish, hairy and 3-5 cm long by 1-2 mm wide; they are held nearly erect when mature and have two narrow chambers with a single row of small seeds in each one.

Phenology
Sapphire rockcress flowers from late April to early June.

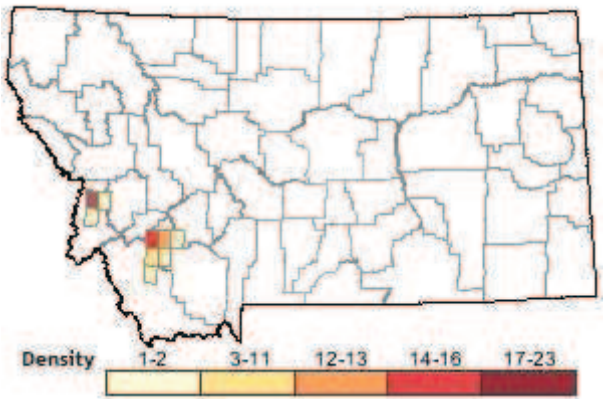
Diagnostic Characteristics
The relatively small size and densely hairy erect fruits of *Arabis fecunda* are distinctive. Several other species of rockcress have erect fruits, but *Arabis hirsuta* and *A. glabra* are taller and have larger leaves, and *Arabis drummondii*, *A. divaricarpa* and *A. lyallii* are glabrous rather than densely hairy.

General Distribution
Mapped Occurrences

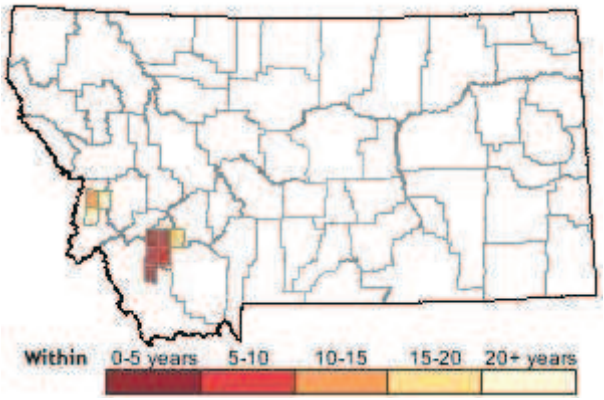
Summary of Observations Submitted for Montana

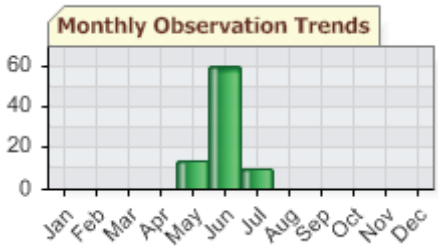
Number of Occurrences: 61

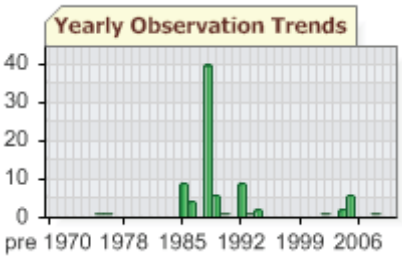
Relative Density

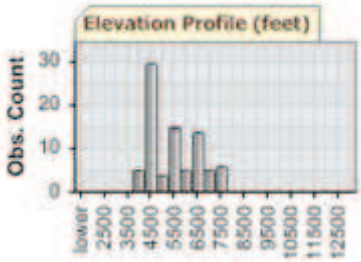


Recency









(Records associated with a range of dates are excluded from time charts)

Distribution Comments
Montana endemic, restricted to Ravalli, Beaverhead, and Silver Bow counties, Montana.

Habitat

Sapphire rockcress is endemic to the Northern Rocky Mountains, where it is known only from the mountains of southwest Montana. It grows on moderate to steep slopes with warm aspects (SE, S, SW, W) and sparse vegetation. In Ravalli County, it is typically found in steppe communities of *Artemisia tridentata, Festuca idahoensis* and *Agropyron spicatum*, sometimes with a sparse overstory of ponderosa pine. In Beaverhead and Silver Bow counties, it grows in *Cercocarpus ledifolius - Juniperus scopulorum* or limber pine woodland, very open Douglas-fir forest, or sparse *Agropyron spicatum* grassland.

Most populations are in lower slope positions, although some occur on middle and upper slopes. Sites in the Sapphire Mountains are at or below 5000 feet, while populations farther south are at 5500-8000 feet. Sapphire rockcress occurs on soils derived exclusively from calcareous sediments that have been metamorphosed to some extent by contact with granitic intrusions

(Lesica 1993). Soils are generally sandy in texture with low organic matter content and a light albedo. Soil analyses from the Charley's Gulch site in Ravalli County indicate a silty-sand texture and high calcium content. Parent materials from Ravalli County belong to the Wallace Formation in the Precambrian Belt Series, while those from Beaverhead and Silver Bow counties are Paleozoic Madison limestone.

Ecology

Sapphire rockcress grows in areas of relatively sparse vegetation on steep slopes with periodic natural erosion. Periodic erosion and slumping of steep slope habitat may be partially responsible for maintaining sparse vegetation and reducing competition for light, water and nutrients (Lesica 1993). Many sites would be considered early successional or edaphic disclimaxes, and these conditions may be important for species persistence. At three sites in Ravalli and Beaverhead counties, coverage of bare soil varied from 408-%, and basal vegetation from 20-50% (Lesica and Shelly 1994). Some slopes support cryptogamic soil crusts that are beneficial to the survival of older, larger plants of sapphire rockcress (Lesica and Shelly 1992). Fire was relatively frequent in many of these areas, but the sparse vegetation on the slopes occupied by this species probably did not carry fire well.

Genetic research suggests that Bitterroot Valley populations of sapphire rockcress may be distinct in their adaptation to survive drought conditions (McKay et al. 2001).

Management

Several factors may affect the long-term persistence of this species, including exotic weed encroachment, grazing, herbicide application, mining and pathogens. Livestock grazing occurs at most sites, although fewer than half are reported to have heavy grazing. Direct herbivory has never been observed and is probably rare, however, soil crusts are beneficial to the species' survivorship at some sites; such crusts are often destroyed by livestock. Livestock can also adversely affect survivorship by trampling plants. Exclosure studies were conducted at two sites near the Big Hole River. At one site sapphire rockcress increased in the grazing exclosure while decreased in another. Sapphire rockcress establishes best when not competing with other species, and grazing may limit competition. It is interesting to note that some of the largest populations (Birch Creek and Jerry Creek) are in areas with the most intensive grazing. Spotted knapweed (Centaurea maculosa) poses a major threat to populations in Ravalli County, where it has severely invaded this species' habitat. Studies indicate that knapweed reduces the successful establishment of sapphire rockcress seedlings. Spotted knapweed is an aggressive Eurasian weed present at all sites in Ravalli County. This taprooted perennial is widely introduced in North America where it has become a serious invader of semi-arid grasslands in the Pacific Northwest and intermountain valleys of the Northern Rocky Mountains. Its ability to invade and replace native plants is well documented. Most of our Arabis fecunda sites have severe infestations of spotted knapweed. Research on water use efficiency in this species has shown significant differences between low-elevation populations in the Bitterroot Valley and those at higher sites in Beaverhead County, suggesting that Bitterroot Valley populations, which are most threatened by weed encroachment, may be genetically distinct. Roads are a major source of weed infestation, and road construction or other major disturbances can introduce or provide avenues for the introduction of weeds. Livestock can also be a significant vector for exotic weed encroachment. Currently, spotted knapweed does not occur at the Beaverhead or Silver Bow County sites, but it does occur in these counties and may become a problem. Little is known about the effects of herbicides on sapphire rockcress, so it is advisable to avoid herbicide application in direct proximity to populations. Only one sapphire rockcress site is near an active mine, and has not been impacted to date. Other populations are near mining claims or inactive mines that could become active with improved extraction methods or increases in the value of minerals.

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Citations & Sources

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Sapphire Rockcress — Arabis fecunda. Montana Field Guide. Retrieved on January 14, 2010, from http://FieldGuide.mt.gov/detail_PDBRA06290.aspx

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Monocots - *Monocotyledoneae*

Order - Grasses / Sedges - *Cyperales*

Family - Sedges - *Cyperaceae*

Species - Idaho Sedge - *Carex idahoa*

Other Names: *Carex parryana ssp. idahoa*

Species of Concern

Global Rank: G2G3
State Rank: S3 * (see reason below)

Agency Status
USFWS: none
USFS: SENSITIVE
BLM: SENSITIVE
MNPS Threat Rank: 2

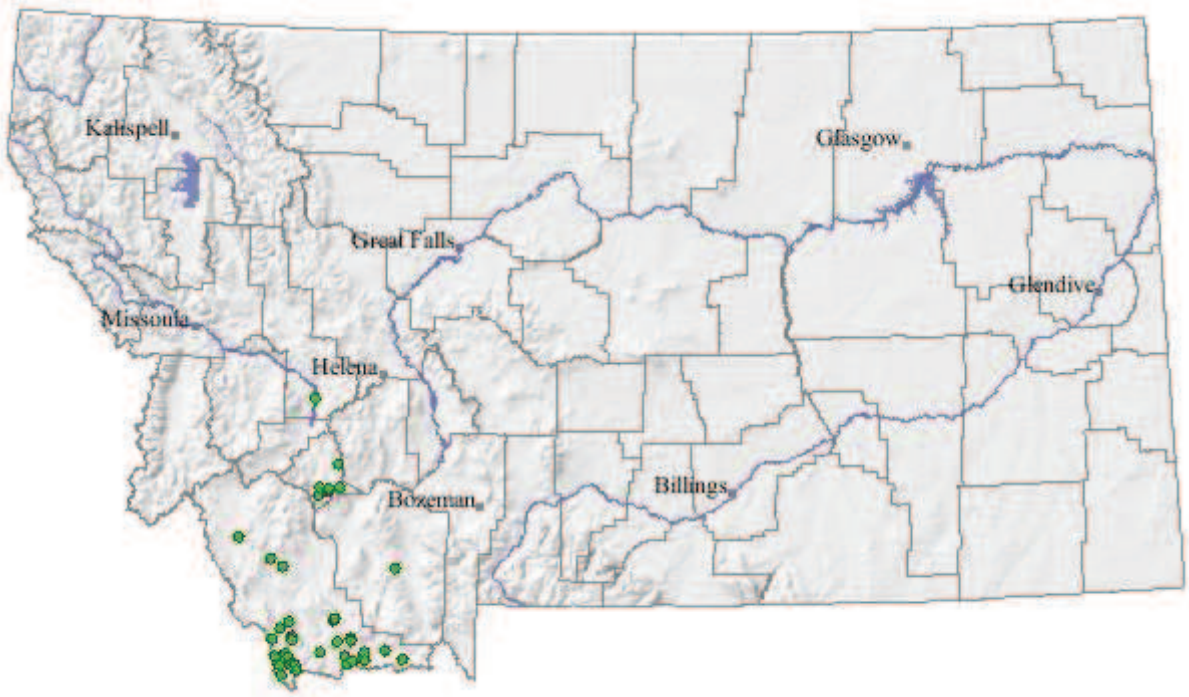
State Rank Reason
Idaho sedge is a regional endemic known from several dozen sites in Montana which cluster into approx 15-20 populations, most on public lands. The estimated number of stems is in the tens of thousands, but total occupied habitat has been estimated at less than 200 acres. The species is palatable, and populations may be affected by heavy grazing. Other risks are competition from exotic species, hydrologic alterations, agricultural development and road construction/maintenance.

General Description
Idaho sedge is a rhizomatous perennial producing small clumps of stems that reach 20-35 cm in height. The flat leaves are 2-4 mm in width and most are crowded near the base of the plant. Flowers are borne in 1 to 4 oblong-cylindrical spikes, each 1-3 cm long, with the uppermost being larger than the others. The spikes form a narrow, interrupted head, subtended by small leaf-like bracts at the top of the stems. Male flowers are absent or scattered among the female perigynia on the largest spike. Each perigynium is subtended by a narrowly oval, brown scale 2 to 3 times its length, with a tapered tip, membranous margins and a distinct pale center. The glabrous, egg-shaped perigynia are yellow-green and about 3 mm long, with a short beak. There are 3 stigmas and the seed is 3-sided.

Phenology
Fruits mature in July-August.

Diagnostic Characteristics
Carex idahoa is difficult to distinguish from Carex parryana and Carex hallii. The uppermost spikes of *Carex parryana* are cylindrical and all more-or-less equal in size, while in *Carex idahoa* and *Carex hallii*, the terminal spike is enlarged and club-shaped. Female scales of *C. hallii* are as long as the perigynia, while they are much shorter than the perigynia in *C. idahoa*. This species has been previously treated as *C. parryana* ssp. *idahoa*.

General Distribution
Mapped Occurrences



Summary of Observations Submitted for Montana

Total Number of Occurrences in Montana: 46

Distribution Comments

Southwest Montana and adjacent Idaho; specimens also verified by Murray for FNA that extend the range to Oregon and Utah. Regional endemic.

Habitat

Idaho sedge inhabits moist alkaline meadows, often along streams (Vanderhorst and Lesica 1994). It most often occupies ecotonal areas between wet meadow and sagebrush steppe (Lesica 1998), and appears to be restricted to nearly level sites in the high valleys of southwest Montana. It is commonly found on terraces of headwaters streams above 6000 feet elevation. Small populations may occur at lower elevations or along larger streams. Soils tend to be silty, with high organic content and little or no coarse material (Lesica 1998). Most documented Montana populations are in areas with calcareous parent material, however a few occupy non-calcareous sites.

The moist, alkaline, streamside meadow habitat of Idaho sedge is typically dominated by graminoids (especially *Deschampsia caespitosa*, *Juncus balticus*, *Carex praegracilis, C. nebrascensis*, *C. aquatilis*), with or without *Potentilla fruticosa* (Vanderhorst and Lesica 1994; Lesica 1998). Adjacent steppe vegetation is dominated by *Artemisia tridentata* and/or *A. tripartita*, *Festuca idahoensis* and *Agropyron smithii*. Species most commonly associated with Idaho sedge are (in order of importance) *Juncus balticus*, *C. praegracilis*, *Muhlenbergia richardsonis*, *Aster occidentalis*, *Poa pratensis*, *Taraxacum officinale*, *Potentilla gracilis* and *Antennaria microphylla*. Graminoid cover is high (60-100%), and forb cover low to moderate (5-50%) except in overgrazed areas. Bare ground averages 8% and cover of lichens and bryophytes averages 14% (Lesica 1998).

Idaho sedge consistently occurs in subirrigated soils associated with low-gradient streams or springs and seeps. These soils are wet early in the growing season but are only moist later in the summer. In wetlands where part of the habitat was saline (as indicated by the

presence of *Distichlis* and *Puccinellia*), it is usually limited to non-saline areas, although it has been found in salt-encrusted soils (Lesica 1998).

Ecology

Flooding is probably uncommon in most of these habitats, as they tend to occur in headwaters areas where snow accumulation and stream gradients are low (Lesica 1998). Although fire was common in high-elevation steppe vegetation in southwest Montana prior to European settlement, it probably did not play an important role in the dynamics of herbaceous riparian wetlands (Lesica 1998).

Management

Idaho sedge can probably tolerate light to moderate livestock grazing but will decline under heavy grazing (Lesica 1998). Its wetland habitat is favored by cattle and frequently subject to overgrazing on both public and private lands. Graminoids such as sedges are adapted to grazing and are usually able to persist with light to moderate grazing pressure (Lesica 1998). Evidence suggests that this species responds to grazing like a typical palatable graminoid, and is capable of tolerating light to moderate grazing, but would likely decline under continuous heavy grazing. This is based on correlation data and studies of other, anatomically similar species. Experiments and monitoring studies to determine the actual response of Idaho sedge have not been conducted (Lesica 1998), however grazing regimes that permit 50% or less annual utilization and allow seed production and dispersal at regular intervals would likely be compatible with its survival. Almost all known populations of the species on public lands are subject to livestock grazing, as is much of its habitat on private land (Lesica 1998). Its mesic habitat provides high quality, green forage for livestock throughout the summer and is a magnet for cattle, often leading to overgrazing. Many of the small populations occur in localized springs, seeps or along small streams in extensive semi-arid steppe, and are particularly at risk from overgrazing, which can cause streambank destabilization followed by lowering of the water table and a loss of riparian vegetation (Lesica 1998). Populations in larger wetland areas may not face such intensive grazing pressure. Large areas of potential habitat for this species in southern Beaverhead County are mowed for hay. While the effects of mowing on native vegetation are unknown, plowing and seeding of non-native species almost certainly have adverse effects on native communities and may result in local extirpation of native species. Poa pratensis (Kentucky bluegrass) is the only exotic plant documented with significant frequency in this species' habitat (Lesica 1998). It is a rhizomatous grass similar in stature to Idaho sedge, and may compete with it, especially where there is grazing and trampling by livestock. Taraxacum officinale (dandelion) and Trifolium repens (clover) occur at some sites, but these are short plants that increase only where heavy grazing removes the larger graminoids, and by themselves do not pose a threat to Idaho sedge. Roads are often constructed along or adjacent to riparian areas, and have impacted wetland habitat for three Idaho sedge populations (Lesica 1998). A fourth is vulnerable to road improvement and construction. Road development can reduce or degrade habitat through increased runoff, pollution and physical disturbance. Ranch and recreational use of such roads probably has little impact on the species, however maintenance or widening can lead to habitat loss. A portion of Moose Creek, where one population occurs, has been dredged, presumably for mineral extraction (Lesica 1998). Dredging most likely reduces the extent and character of riparian vegetation, and may reduce habitat for Idaho sedge. Fortunately, most populations do not occur in areas prone to mining activity.

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- Mincemoyer, S. 2005. Surveys of significant plant resources and related vegetation types for the Butte Office of the Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 11 pp + appendices.
- Murray, D. F. 1969. Taxonomy of CAREX sect. Atratae (Cyperaceae) in the southern Rocky Mountains. Brittonia 21: 55-76.
- Vanderhorst, J. P. and P. Lesica. 1994. Sensitive plant survey in the Tendoy Mountains, Beaverhead County, Montana. Unpublished report to the Bureau of Land Management, Butte District. Montana Natural Heritage Program, Helena, MT. 59 pp. plus appendices.

Idaho Sedge — Carex idahoa. Montana Field Guide. Retrieved on November 30, 2009, from http://FieldGuide.mt.gov/detail_PMCYP036E0.aspx

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Dicots - *Dicotyledoneae*

Order - Mustards / Capers - *Capparales*

Family - Mustards - *Brassicaceae*

Species - Dense-leaf Draba - *Draba densifolia*

Species of Concern

Global Rank: G5
State Rank: S2 * (see reason below)

Agency Status
USFWS: none
USFS: none
BLM: none
MNPS Threat Rank: 2

State Rank Reason
Draba densifolia is distributed in the western half of the state in four moderate to large populations, six small occurrences and nine historical or poorly documented occurrences. Occupied habitats are at moderate to high elevation which help to minimize disturbance to some of the populations. However, livestock grazing, invasive weeds and off-road ATV use impact some populations.

Threats: Low-Moderate
Short- and Long-Term Trends: Unknown
Intrinsic Vulnerability: Moderate

General Description
Dense-leaf Draba is a mat-forming perennial with leaf rosettes at the ends of numerous rootcrown branches, which are clothed with old leaf bases. The leafless stems are 3-15 mm high and arise from some of the rosettes. The fleshy, narrowly lance-shaped leaves are 2-12 mm long and have a prominent midvein and straight, unbranched hairs on the entire margins but are otherwise mostly glabrous. 3-15 stalked flowers are borne at the tops of the stems. Each flower has 4 separate sepals, 4 separate, yellow petals that are 2-6 mm long, and 4 long and 2 short stamens. The style is 0.5-1.0 mm long. The hairy, egg-shaped capsules are 2-7 mm long and are borne on erect or ascending stalks.

Phenology
Flowering from May-July, depending on elevation.

Diagnostic Characteristics
There are many similar-appearing, yellow-flowered, mat-forming species of DRABA in our area. A technical manual and hand lens or microscope is required for positive identification. This species can be dintinquished from D. OLIGOSPERMA by the simple hairs. D. DAVIESIAE also has glabrous leaves, except for simple hairs on the margins, but it has glabrous fruits.

General Distribution
Mapped Occurrences

Summary of Observations Submitted for Montana

Total Number of Occurrences in Montana: 19

Distribution Comments

Southern British Columbia south to Sierran California, Oregon, Washington, Idaho, Montana, Wyoming, Utah. Widely spaced sites in central and eastern Alaska (Hitchcock 1973). Range in Hulten (1968) appears to be the four collections of Gjaerevoll (1963), three of which have been reidentified to other species.

Habitat

Gravelly, open soil of rocky slopes and exposed ridges in the montane to alpine zones.

Citations & Sources

- Mulligan, G. A. 1976. The genus DRABA in Canada and Alaska: key and summary. Canadian Journal of Botany 54:1386-1393.

Dense-leaf Draba — Draba densifolia. Montana Field Guide. Retrieved on November 30, 2009, from http://FieldGuide.mt.gov/detail_PDBRA110W0.aspx

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Dicots - *Dicotyledoneae*

Order - Aster / Sunflowers - *Asterales*

Family - Aster / Sunflowers - *Asteraceae*

Species - Slender Fleabane - *Erigeron gracilis*

Potential Species of Concern

Global Rank: G4
State Rank: S3

Agency Status
USFWS: none
USFS: none
BLM: none
MNPS Threat Rank: none

General Description

We do not yet have descriptive information on this species. Please try the buttons above to search for information from other sources.

General Distribution

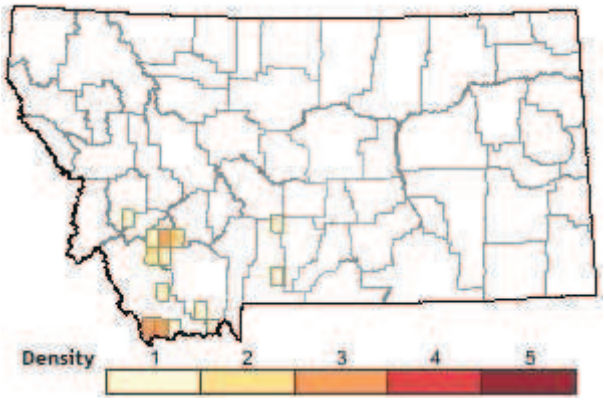
Mapped Occurrences

Summary of Observations Submitted for Montana

Number of Occurrences: 22

(Click on the following maps and charts to see full sized version) Map Help and Descriptions

Relative Density



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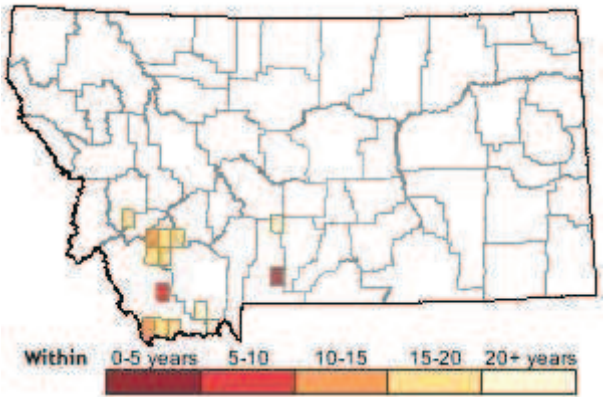
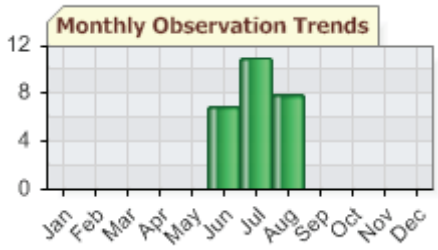
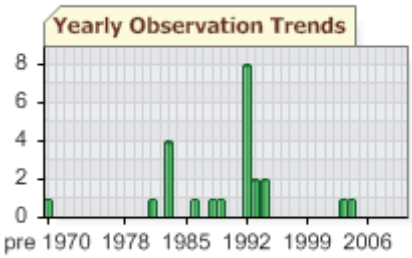
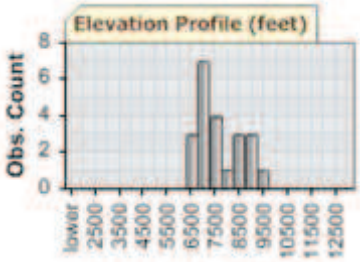








(Records associated with a range of dates are excluded from time charts)

Habitat

Meadows, rocky slopes and talus in the subalpine and alpine zones.

Citations & Sources

- Lesica, P. 1992. Vascular plant and sensitive plant species inventory for the Highland Mountains, Deerlodge National Forest. Unpublished report prepared for the Deerlodge National Forest. Montana Natural Heritage Program, Helena, MT. 21 pp. plus appendices, photographs.
- Vanderhorst, J. P. and P. Lesica. 1994. Sensitive plant survey in the Tendoy Mountains, Beaverhead County, Montana. Unpublished report to the Bureau of Land Management, Butte District. Montana Natural Heritage Program, Helena, MT. 59 pp. plus appendices.

Slender Fleabane — Erigeron gracilis. Montana Field Guide. Retrieved on January 14, 2010, from http://FieldGuide.mt.gov/detail_PDAST3M1R0.aspx

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Monocots - *Monocotyledoneae*

Order - Rushes - *Juncales*

Family - Rushes - *Juncaceae*

Species - Hall's Rush - *Juncus hallii*

Species of Concern

Global Rank: G4G5
State Rank: S2

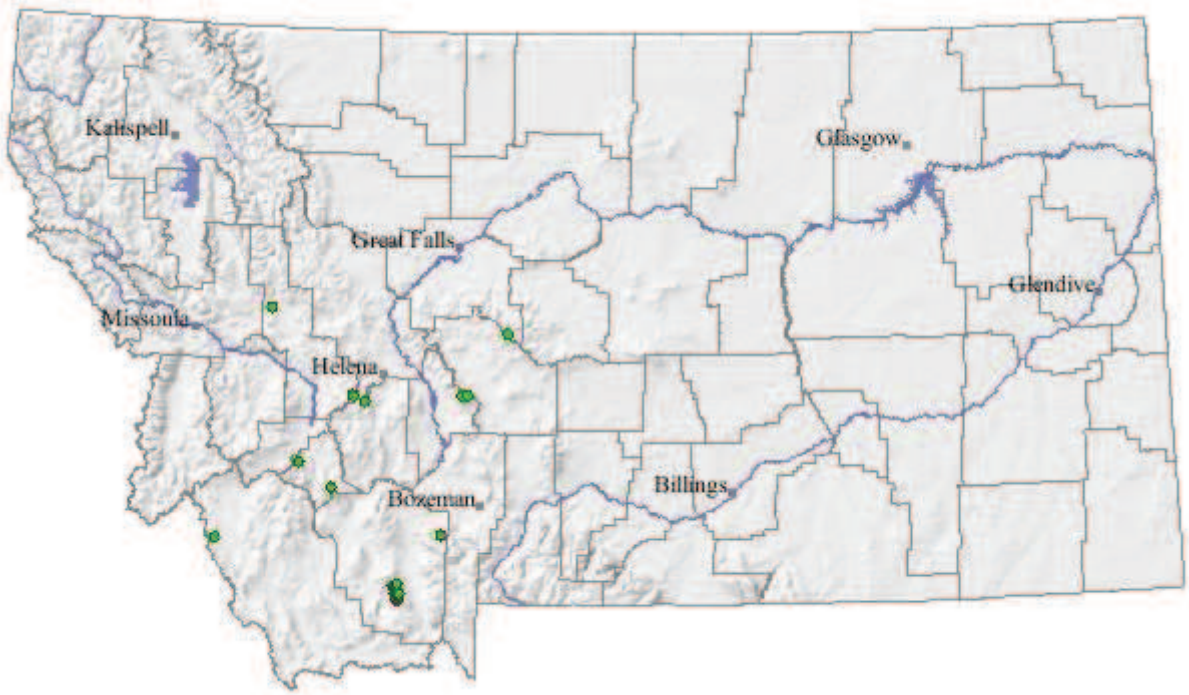
Agency Status
USFWS: none
USFS: SENSITIVE
BLM: none
MNPS Threat Rank: 3

General Description
Hall's Rush is a perennial with erect stems that are 20-30 cm tall. The leaves, which are confined to near the base of the plant, are round and up to 15 cm long with a groove on the side facing the stem. The uppermost leaf has a sheath surrounding the stem but lacks a blade. The 2-6 flowers are borne in a loosely congested inflorescence subtended by an erect leaf, or bract. Because this involucral leaf is erect and round, it seems to be lateral rather than terminal. The flowers have 6 undifferentiated, sharply pointed perianth segments that are light brown with membranous margins and 4-5 mm long. The seed capsules are dark brown with a lobed top. Each seed is ca. 1 mm long with a distinct tail at each end.

Phenology
Flowering from July-August.

Diagnostic Characteristics
JUNCUS is a large and difficult genus to distinguish, so a technical key should be consulted. Mature fruit is necessary for positive determination. The apparently lateral inflorescence, lack of an upper leaf blade, lobed seed capsule, and tailed seeds should help distinguish this species.

General Distribution
Mapped Occurrences



Summary of Observations Submitted for Montana

Total Number of Occurrences in Montana: 28

Distribution Comments

Montana south to Utah (seven counties) and Colorado (Welsh, 1993).

Habitat

Subalpine parklands and moist meadows and slopes in the montane zone.

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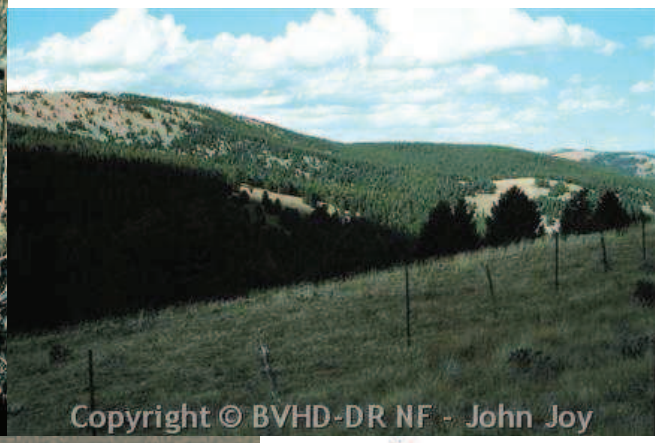

Citations & Sources

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Hall's Rush — Juncus hallii. Montana Field Guide. Retrieved on November 30, 2009, from http://FieldGuide.mt.gov/detail_PMJUN011E0.aspx

Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Dicots - *Dicotyledoneae*

Order - Scrophulariales - *Scrophulariales*

Family - Figwort Family - *Scrophulariaceae*

Species - Lemhi Beardtongue - *Penstemon lemhiensis*

Species of Concern

Global Rank: G3
State Rank: S3 * (see reason below)

Agency Status
USFWS: none
USFS: SENSITIVE
BLM: SENSITIVE
MNPS Threat Rank: 2

State Rank Reason
Penstemon lemhiensis is a regional endemic that occurs only in southwest Montana and adjacent Idaho. There are numerous occurrences in Beaverhead and Ravalli Counties with a few additional occurrences located in Deer Lodge and Silver Bow Counties in Montana, but most are small to moderate in size. The number of plants in Montana is estimated at approximately 10,000 individual plants based on recent survey efforts. Plants occur on a mix of federal, state and private ownerships with National Forest lands supporting the majority of the occurrences. The species is primarily sensitive to negative impacts associated with drought conditions and fire suppression, both of which are believed to have played a significant role in the species' decline. Additional impacts to populations are occurring from noxious weed invasion, primarily spotted knapweed in the Bitterroot region. Heavy livestock grazing also negatively impacts the species. Several occurrences are found adjacent to roadsides and thus may be impacted by activities associated with road construction, maintenance and use.

General Description
Lemhi beardtongue is a large perennial, with 1 to several stems reaching 70 cm in height and arising from a branched rootstock and short taproot. The leaves are narrowly lance-shaped and untoothed. Stalks of the basal leaves are up to 16 cm long, while the opposite stem leaves lack stalks and become smaller up the stem. Herbage is lightly covered with small hairs and occasionally a thin, bluish wax. Clusters of several short-stalked flowers are borne in the axils of upper leaves. The bright blue, tubular corolla is flared and two-lipped at the mouth and 25-35 mm long. The lance-shaped calyx segments taper to a long tip, are 7-11 mm long, and have a narrow white margin. Anthers are hairy with short pubescence, and the staminode is glabrous.

Phenology
Flowering takes place from early June to late July, depending on climatic conditions and elevation. Fruits mature and dehisce during August and early September.

Diagnostic Characteristics
Lemhi penstemon is a tall, conspicuous plant, and easy to spot when in full bloom. Distinguishing features include the large, bright blue corollas, the sharp, narrow, elongated tips on the calyx lobes, and the lack of hairs on the staminode. *Penstemon*

cyaneus is very similar but has sepals that are rounded at the tip and nearly as broad as long. *Penstemon cyananthus* also has smaller flowers that are only 15-25 mm long.

General Distribution

Mapped Occurrences

Summary of Observations Submitted for Montana

Total Number of Occurrences in Montana: 245

Distribution Comments

Regional endemic of Lemhi county, Idaho; and Beaverhead, Deer Lodge, Ravalli and Silverbow counties, Montana.

Habitat

In Montana, Lemhi beardtongue occurs on moderate to steep, east- to southwest-facing slopes, often on open soils. In Beaverhead County, it generally grows below or near the lower extent of Douglas-fir and/or lodgepole pine forest, in habitat dominated by big sagebrush and bunchgrasses, including western wheatgrass and Idaho fescue. Within these habitats, Lemhi beardtongue prefers areas that are more sparsely vegetated (Shelly 1990). In the northeastern Pioneer Mountains, it inhabits forb-dominated openings in lodgepole pine and to a lesser extent Douglas-fir forest; big sage is typically not present, and prominent forbs include *Astragalus miser, Pedicularis contorta* and *Townsendia parryi*.

The species is not restricted to any particular geological substrate, and has been found on granitic soils as well as limestone and other sedimentary substrates. Soils are often very gravelly, however soil texture is highly variable and ranges from sand to fine clay. Field surveys from 1986-1989 indicate that it is most commonly found on gravelly loams. Some populations grow partially or entirely on roadbanks.

Ecology

Lemhi beardtongue has some degree of adaptation to natural disturbance, as evidenced by its preference for more open habitats such as rock outcrops and steep, rocky slopes with natural soil slippage (Shelly 1990). This adaptation is underscored where plants have colonized roadbanks.

Studies have shown that seed germination and recruitment are the most critical life history stages (Heidel and Shelly 2001). In general, both flowering and germination are higher in years when spring and early summer are cool and wet. Mortality of established plants is highest in hot, dry years (Heidel and Shelly 2001). Waxing and waning of populations is expected for native species of successional habitats, like *P. lemhiensis*.

Management

Monitoring studies on National Forest and BLM lands in southwest Montana have documented sharp declines in some of the largest populations east of the Continental Divide (Shelly 1990; Achuff 1992). One relatively small monitored population was restricted to roadcut habitat and was similarly in decline. Continued declines were projected in the absence of seed germination and recruitment at part or all of the other three sites. Waxing and waning of populations is expected for native ruderal species such as Penstemon lemhiensis. Fire suppression has been suggested as a factor in the range-wide decline of Lemhi beardtongue (Moseley et al. 1990). It is thought to increase under certain fire regimes, based on qualitative observations after a wildfire in the Salmon National Forest and monitoring of a prescribed burn in Big Hole National Monument, where it increased for a decade after the burn but disappeared from an adjoining untreated area (Heidel and Shelly 1997). Another monitoring study at Badger Pass found that recruitment increased dramatically after fire treatment, consistent with the tendency of fire-adapted species to emerge from seedbanks when fire removes accumulated litter and reduces competition. Based on these studies, prescribed burning has been recommended where Lemhi beardtongue occupies deep-soil rangeland habitats east of the Continental Divide, which are prone to increasing density of Artemisia tridentata in the absence of fire (Heidel and Shelly 2001). Spotted knapweed is a widespread invader in this species' habitat, particularly west of the Continental Divide. Where Lemhi beardtongue occurs in the Bitterroot National Forest, management is problematic because of the high potential for noxious weeds to expand after fire (Heidel and Shelly 2001). Although herbicides can be used to control invasives, their effect on pollinators of Lemhi beardtongue is unknown. It is an obligate out-crosser, primarily dependent on insect pollination, and relatively small, isolated populations may already be at a disadvantage in their ability to attract effective pollinators (Shelly 1990). Spotted knapweed has not yet invaded populations in Beaverhead and Silver Bow counties, though it has been observed in nearby areas where it can still be controlled without direct impact to this species. Livestock grazing occurs throughout much of the species' range in southwestern Montana, and monitoring transects have been established to assess its effect on populations. The habitat of Lemhi beardtongue was historically impacted by mining at some locations, and renewed gold mining activity could pose a future threat (Shelly 1990).

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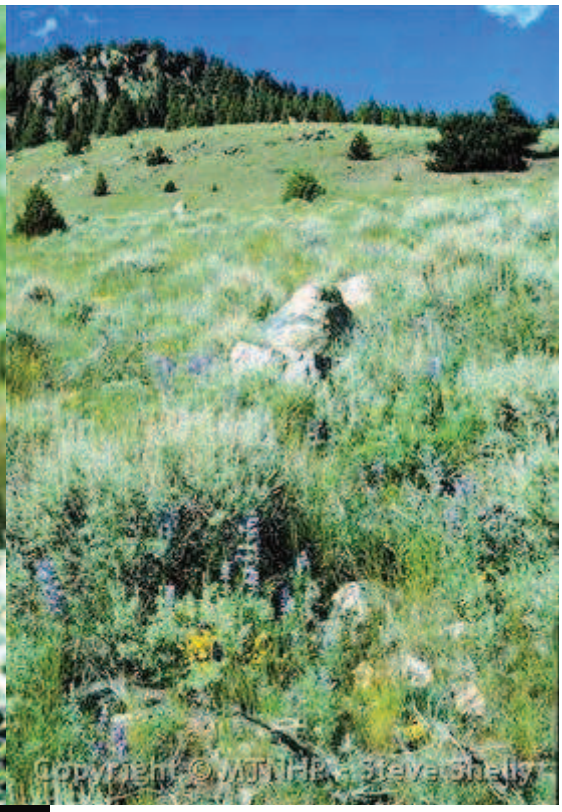
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Penstemon davidsonii
Illustration by Jeanne R. Janish
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Kingdom - Plants - *Plantae*

Division - Angiosperms (Flowering Plants) - *Anthophyta*

Class - Dicots - *Dicotyledoneae*

Order - Mustards / Capers - *Capparales*

Family - Mustards - *Brassicaceae*

Species - Small-flowered Pennycress - *Thlaspi parviflorum*

Other Names: *Noccaea parviflora*

Species of Concern

Global Rank: G3
State Rank: S2S3 * (see reason below)

Agency Status
USFWS: none
USFS: none
BLM: SENSITIVE
MNPS Threat Rank: 3

State Rank Reason
Thlaspi parviflorum is a regional endemic, known in Montana from several southwestern counties. It is a small, short-lived plant that likely requires some disturbance to maintain its habitat.

Threats: Low
Short- and Long-Term Trends: Unknown
Intrinsic Vulnerability: Low

General Description
Thlaspi parviflorum is a taprooted biennial or short-lived perennial that reaches 1-3 dm in height and is often branched above the middle of the stem. The foliage is glabrous and glaucous, and basal leaves are 5-15 mm long with a slender stalk and narrowly elliptic blades that are sometimes toothed. Stems leaves are sessile and clasp the stem. Flowers are borne on short, nearly horizontal stalks in a narrow inflorescence that elongates as the fruits mature. The four white petals are 2-3 mm long, and the four green sepals 1-1.5 mm long. The oblanceolate, flattened fruits are 5-7 mm long, with a style up of to 0.5 mm.

Phenology
Plants flower in late June and early July, and fruit matures in August.

Diagnostic Characteristics
Thlaspi parviflorum is similar to the more common *T. montanum* var. *fendleri*. However, the latter has longer sepals and petals, and the style in fruit is at least 1 mm long.

General Distribution
Mapped Occurrences

Summary of Observations Submitted for Montana

Total Number of Occurrences in Montana: 26

Distribution Comments

Central Idaho, northwestern Wyoming (Absarokas, Wind Rivers, and southwestern Bighorns, greater Yellowstone area), and Montana. Regional endemic (Montana Natural Heritage Program 1999; Walt Fertig, personal communication 1999).

Habitat

Thlaspi parviflorum is found in north-central Wyoming, east-central Idaho and southwest Montana. In Montana it is known from Beaverhead, Carbon, Madison, Park and Silver Bow counties, where it is found from mid-elevation grasslands to alpine turf (6,500 to 10,000 feet). It most often inhabits sagebrush steppe dominated by *Artemisia tridentata* ssp. *vaseyana* and *Festuca idahoensis*. Several moisture-loving species, such as *Juncus balticus* and *Potentilla fruticosa,* are often also present in these habitats. *Thlaspi parviflorum* has also been found occasionally in alpine turf communities, ranging from moist habitats dominated by *Deschampsia cespitosa* and *Carex scirpoidea* to drier sites supporting *Carex elynoides*.

Ecology

Thlaspi parviflorum is a short-lived plant, smaller than the dominant species in most habitats where it occurs. It flowers early and is often found in open microsites between shrubs or bunchgrasses. Given its growth form and habitat, it may be expected to respond positively to disturbances such as moderate grazing or fire that opens the canopy.

Management

Fire and grazing are two important forces affecting small-flowered pennycress habitat. Disturbance from fire reduces competition from sagebrush and large bunchgrasses and likely enhances population viability for Thlaspi parviflorum. Livestock grazing generally favors broad-leaved forbs at the expense of graminoids. Thlaspi parviflorum is a very

small plant likely to benefit from removal of the dominant grass canopy. Nearly all known Montana populations of Thlaspi parviflorum are on public land, primarily managed by the U.S. Forest Service. Most of these sites are subject to livestock grazing.

Citations & Sources

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Appendix D. *Delphinium bicolor* photographs. These were included to allow reviewers to determine if these were the more common little larkspur or limestone larkspur (*Delphinium bicolor* var. *calcicola*), a Potential Species of Concern.

Baseline Report for Soil Resources

Butte Highlands Project, Silver Bow County, Montana

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1.0 INTRODUCTION

Butte Highlands JV, LLC (BHJV) is proposing to develop gold reserves within the Butte Highlands Property near the continental divide in southern Silver Bow County, Montana. The Butte Highlands Property is located on land controlled by BHJV. Baseline soil resources data collected at the Butte Highlands Property will be used to support decisions regarding management of mine water and closure/reclamation of disturbed areas.

1.1 STUDY AREA

The Butte Highlands study area for soil resources encompasses the area to be disturbed by proposed mine development and the immediate vicinity (**Figure 1**). The Butte Highlands project area consists of the lower, or Pony Placer, claim and the upper claims to the northeast, as shown in **Figure 1**. The site is located primarily in Section 31, Township 1 North, Range 7 West in Silver Bow County, Montana.

1.2 DOCUMENT ORGANIZATION

Section 2.0 of this document describes the objectives of this soil resources study. Section 3.0 describes the investigation methods, including subsections regarding field activities and laboratory analysis. Results of the field study and laboratory testing are presented in Section 4.0 entitled Data and Analysis. Section 4.0 has subsections detailing the soil map units designated for the study area, and calculation of erodibility parameters. References are presented in Section 5.0.

2.0 STUDY OBJECTIVES

Specific objectives of this baseline soil resources study were to evaluate the suitability of soil in the Butte Highlands project area for use as plant growth medium in reclamation, or as low-permeability capping material.

3.0 INVESTIGATION METHODS

3.1 FIELD ACTIVITIES

Ten test pits were excavated at locations of proposed disturbance throughout the site, as shown on **Figure 1**. Soil observations were recorded for these ten test pits from August 27-28, 2009. Test pits were distributed as follows:

- Two test pits were excavated in each of the three LAD areas (TP2, TP3; TP7, TP8; TP9, and TP10),

- Two test pits (TP4 and TP5) were excavated in the Main Surface Facilities area, and
- Two test pits (TP1 and TP6) were excavated at locations of proposed mine roads.

In addition to the ten test pits excavated in areas of proposed disturbance, a small area of intensive test pitting that was investigated on the southwest portion of the Pony Placer claim near the western-most LAD area (**Figure 1**). Twenty four test pits were excavated 200 feet apart in this area. Soil observations were recorded for the 24 pits in the area of intensive test pitting from September 14-15, 2009. The locations of the test pits in the area of intensive test pitting are shown on **Figure 2**.

Depth of excavation was 60 inches in each of the ten test pits in areas of proposed disturbance. The depth excavated for the 24 locations in the area of intensive test pitting was to the total depth achievable with the backhoe in most test pits, which ranged from 24 to 120 inches deep. Field observations were noted on field forms presented in **Appendix A**. Photographs of observed soil in the ten test pits in areas of proposed disturbance are presented in **Appendix B**. Wet soil colors were noted for all horizons. Dry soil colors were noted for horizons that were dry in the field. USDA horizon designations were recorded on the field forms. Soil survey information for the entire project area and surroundings from the Natural Resources Conservation Service (NRCS) is attached as **Appendix C**.

The greater density of test pits in the vicinity of the western-most LAD area revealed a wider variability in parent material and soil characteristics and provided a higher level of detail than the project-wide study in areas of proposed disturbance, which had a much lower density of test pits. **Figure 2** shows five types of subsurface conditions that were encountered in the area of intensive test pitting near the western-most LAD area.

3.2 LABORATORY ANALYSIS

Samples from the ten test pits in the areas of proposed disturbance were analyzed for agronomic properties and metals. In each test pit, a one-gallon sample was collected from each master horizon through the first C horizon, except for the following: sampling ended at the bottom of the last B horizon in test pits TP5, TP9, and TP10; and sampling was conducted through both the first and second C horizons to the total depth of test pit TP6. One-gallon samples were provided to the laboratory for analysis of agronomic properties and selected metals using methods shown in **Table 1**.

Geotechnical testing for properties relevant to water permeability was also performed on samples from the test pits in proposed areas of disturbance. One 5-gallon bulk sample was collected from each test pit for geotechnical testing, except test pits TP4 and TP5 in the Main Surface Facilities area. The bulk samples from test pits outside the Main Surface Facilities area were analyzed for Particle Size Distribution and Atterberg Limits by methods listed in **Table 2**. The vertical interval composited for geotechnical testing of bulk samples was from ground surface to a depth of 60 inches in the eight test pits sampled for geotechnical properties, except test pits TP1 and TP2 near the top of the ridge in the

project area. The bulk sampling intervals for TP1 and TP2 ended at 36 and 26 inches, respectively, at depths where bedrock was encountered.

In addition to the 5-gallon bulk samples, undisturbed samples were collected in metal tubes driven directly into the sidewall of the test pits in the LAD areas. One undisturbed sample was collected from each fine-grained horizon of the test pits in the LAD areas (TP3, TP7, TP8, TP9, and TP10). All of these samples were analyzed for Particle Size Distribution. The samples from one test pit per LAD area (TP3, TP7, and TP10) were also analyzed for *in situ* density. No undisturbed samples were collected from TP2.

The naming convention for the Sample ID used in the text and tables of this report is the test pit number followed by a comma, then the sampling interval in inches below ground surface. For example, agronomic sample TP8, 26-42 was collected from test pit 8 at a depth from 26 to 42 inches below ground surface. Similarly, geotechnical sample TP10, 0-60 was collected from test pit 10 at a depth from 0 to 60 inches below ground surface.

4.0 DATA AND ANALYSIS

4.1 LABORATORY RESULTS

Results for agronomic parameters are presented in **Table 3**, and the complete laboratory report from Energy Laboratories, Inc. is included in **Appendix D**. As shown in **Table 3**, Electrical Conductivity (EC) of all sampled soil was low, ranging from 0.14 to 0.70 milliSiemens per centimeter (mS/cm). For most samples (26 of 33), measured pH values were near neutral and in the range from 6.0 to 8.0. Seven results were in the pH range from 5.0 to 6.0. No pH values were below 5.0 or above 8.0.

In accordance with criteria shown in **Table 4**, agronomic parameters were assigned ratings to indicate the suitability of the associated soil for use as growth medium. The suitability rating for coarse fragments is different for soils to be reused in flat protected areas versus soil to be reused on steep slopes and exposed areas, because steep or exposed areas require additional coarse fragments to armor the soil against erosion. The criteria listed in **Table 4** show ratings for coarse fragment content on both flat protected areas and steep or exposed areas. Overall ratings that integrate all measured agronomic parameters for each soil sample are presented on the right-hand side of **Table 3**, with one column for suitability in flat protected areas and another for suitability in steep or exposed areas. Except for coarse fragment content, all individual agronomic results indicated either ideal or moderate reuse potential for the associated soil; therefore coarse fragment content was the parameter that showed the greatest differences between soils, and was used to identify soils with fair or poor reuse potential. Description of the locations and thicknesses of growth medium is provided in Section 4.4.

Metals results for soil samples are summarized in **Table 5**. None of the metals results were above the range of natural background concentrations found for soils in the Western United States (Shacklette and

Boerngen 1984). Arsenic in the surface horizon of seven of the test pits was above the Montana Department of Environmental Quality (DEQ) Generic Action Level of 40 milligrams per kilogram (mg/kg), but all arsenic concentrations were both within the range of natural background concentrations for the Western United States (Shacklette and Boerngen 1984), and were well below the upper limit (187 mg/kg) of natural background concentrations detected in the DEQ study that created the Generic Action Level (DEQ 2005).

Geotechnical results are summarized in **Table 6**. The results presented in **Table 6** are the texture class by the Unified Soil Classification System (USCS), the percent of material passing a No. 200 sieve, and Plasticity Index (PI). The complete laboratory reports showing the gradation curves and *in situ* bulk density are included in **Appendix D**. The criteria shown in **Table 7** were used to assign a rating indicating the suitability of the associated soil for use in a low-permeability capping system. As explained in Section 3.2, geotechnical results for the Main Surface Facilities area which includes test pits TP4 and TP5 were not obtained for this report. Results for all other test pits are shown in **Table 6** and **Appendix D**, and a summary of the locations of fine-grained material is in Section 4.5 of this report.

4.2 ERODIBILITY PARAMETERS

Procedures outlined in the National Soil Survey Handbook (USDA 1993) were used to estimate water erodibility factors, surface runoff class, wind erodibility index, root restriction depth, and soil loss tolerance. The erodibility parameters are presented in **Table 8**. As shown in **Table 8**, all test pits contained soil with a low or medium degree of water erodibility (Kw less than 0.40). Relatively low erodibility (Kw) for test pits TP2, TP5, TP9, and TP10 was due to the relatively high coarse fragment content (30% or greater) of the surface soil at these locations, which can help armor the soil against erosion. The low Kw for test pit TP1 was due to the low silt content. The higher erodibility (Kw) for test pits TP3, TP4, TP6, TP7, and TP8 was due to the relatively high silt content compared to test pit TP1, or lack of substantial coarse fragment content in the surface soil.

Surface runoff class indicates the degree to which water can be expected to flow overland, rather than infiltrate into the soil. Surface runoff class can be used in combination with Kw to determine the actual risk of water erosion under different soil management scenarios. As shown in **Table 8**, the surface runoff class is high for test pits TP2, TP3, and TP4. This rating is due to the steep slope in the case of TP2, and is due to moderate slopes combined with slow permeability at TP3 and TP4. The surface runoff class is medium for test pits TP1, TP5, and TP6, which have moderate slopes over 5%, and permeability that is moderate to moderately slow. The remainder of the test pits (TP7 through TP10) were in relatively flat, low elevation areas and have a low surface runoff class.

Wind erodibility index (I) represents the relative susceptibility of soil to wind erosion, and can be used to calculate amounts of wind erosion under specific climates and management practices. Coarse fragments can serve to armor the soil against erosion, and clays can serve to bind soil together, so the soils with the highest wind erodibility index are generally those that do not have coarse fragments, and

also lack substantial clay content. As shown in **Table 8**, wind erodibility index was highest for test pits TP1 and TP6, which had a sandy loam texture to the surface mineral soil, but did not have greater than 15% coarse fragment content. In contrast, wind erodibility index was lowest for test pits TP5 and TP9, which have loam surface textures with greater than 35% coarse fragments. The wind erodibility index for the surface soil at all other test pits in areas of proposed disturbance fell in between the values for the test pits listed above.

The final erosion-related parameters presented in **Table 8** are root restriction depth and the resulting soil loss tolerance (T). Depending on the severity and degree of permanence to the observed root restriction, soils will have different capacities to support plant growth following erosion. The T-value is the quantity of soil that can be lost, in tons per acre per year, without reducing the ability of the soil to support plant growth. Soil from all test pits in areas of proposed disturbance had T-values of 1 or 2 tons per acre per year, indicating that the soil in the project area is only slightly tolerant of erosion. Due to the shallow depths of root restriction in the project area, and the relatively permanent nature of these restrictions, soil in the project area requires a high degree of protection from erosion in order to maintain productivity as a plant-growth medium.

4.3 SOIL MAP UNIT DESIGNATIONS

As described in Section 3.1, the test pitting performed for this project was designed to evaluate only specific areas of proposed soil disturbance, with an additional area of intensive test pitting on the Pony Placer claim. Soil information for the wider project area is available from the Natural Resources Conservation Service (NRCS), which has designated soil map units for the project area and surroundings. **Appendix C** is an NRCS Custom Soil Resource Report for portions of the Deer Lodge National Forest survey area that are in and near the Butte Highlands project. NRCS map unit symbols and names for the project area and surroundings are shown on **Figure 1**. There are four NRCS soil map units that cover the vast majority of the project area. Map units 64UJ1, 71GD4, and 75CC2 are in small portions of the project area, outside proposed soil disturbances. The map units outside of proposed soil disturbances are described only in **Appendix C**. **Table 9** lists the symbol and name of the four map units in locations of proposed soil disturbances. Brief descriptions of the four NRCS map units that are within areas of proposed disturbance are below, along with a discussion of which test pits were excavated in each of these map units. The map units are presented in numerical and alphabetical order by their NRCS map unit symbol.

Map unit 51CH2 is located on the highest elevation portions of the project area. The full name of this map unit is *Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes*. Test pits TP1 and TP2 were excavated in map unit 51CH2. Weathered rock was encountered at a depth of 26 inches in both of these test pits. The properties of the Hanson and Tiban soils, such as slope, drainage class, and saturated hydraulic conductivity, generally correspond with the observed shallow soil with prevalent coarse material encountered in test pits TP1 and TP2. Both the Hanson and Tiban soils are residuum from limestone, whereas the surficial geology in this location consists primarily of marble. The saddle

area to the south and east of test pit TP2 is likely to be different than the soil described in the NRCS report for map unit 51CH2, due to the relatively flat topography in the saddle area.

Map unit 64GJ1 is located in low-lying areas adjacent to the northern fork of Moose Creek. The name of this map unit is *Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains*. Test pits TP7 and TP9 were excavated in map unit 64GJ1, as were some of the test pits from the area of intensive test pitting. Standing water was observed in both of these test pits at depths of 60 inches or less. The soil observed in test pit TP9 and the adjacent test pits in the area of intensive test pitting generally corresponded with the cryofluvents component of this map unit. The soil in the vicinity of TP9 is poorly developed, with a gradual transition from B to C horizons. Small willow trees and surface channels indicate the seasonally saturated conditions that occur at the ground surface at TP9, and frozen ponded water was observed at in the vicinity of TP9 during surface water monitoring in November 2008. The soil observed in test pit TP7 generally corresponded with the Finn component of this map unit. Both test pit TP7 and Finn soils have water-saturated gravelly material at depths of 60 inches or less. In addition, a transition to generally less permeable material was observed at a depth of 16 inches in TP7, and a similar transition is listed at a depth of 17 inches in the description of Finn soils. The saturated hydraulic conductivity of the limiting layer listed for Finn soils in the NRCS report (**Appendix C**) is 0.20 to 1.98 inches per hour (in/hr), which is higher than the estimated permeability for the material from TP7 shown in **Table 6**. The estimated permeability for soil at location TP7, based upon the geotechnical results, ranges from 10^{-6} to 10^{-4} centimeters per second (0.0015 to 0.15 in/hr). The narrow finger of map unit 64GJ1 that is slightly east of test pit TP10 is has different vegetation than the more low-lying areas of this map unit. Aspen tress and water saturated surface soils were observed in this area, whereas willow and evergreen trees were observed at the locations of test pits TP7 and TP9.

Map unit 75GB2 is located on the backslope areas facing west above Forest Road (FR) 8250, covering the Main Surface Facilities area of the lower claim (Pony Placer), and the lower elevation areas of the upper claims, as well as the U.S. Forest Service land that separates the upper and lower claims. The name of this map unit is *Windyridge-Como-Hiore families, complex low relief mountain slopes and ridges*. Test pits TP3, TP4, and TP5 were excavated in map unit 75GB2. Horizons with violent reaction to hydrochloric acid (HCl) were present in these three test pits, which were excavated in areas of colluvium from marble. The parent material listed for each major component of this map unit is granite, which does not yield HCl reaction. The soil observed in test pit TP3 resembles the NRCS description of Hiore soils, however the shape of the slope for the Hiore soils is linear in both directions in contrast to the concave across-slope shape for TP3. Test pits TP4 and TP5 do not resemble any of the major components of map unit 75GB2, but the map unit consists of almost one-third minor components of various types, as listed in **Appendix C**. The landscapes present in map unit 75GB2 in the Butte Highlands project area and vicinity include the saddle near TP3, steep forested backslope areas facing west above the lower claim and Main Surface Facilities area, and the logged footslope in the Main Surface Facilities area.

Map unit 75GD2 is located in footslope and toeslope areas below FR8250, but generally above the areas of seasonal stream channels in map unit 64GJ1. The name of this map unit is *Kurrie-Goldflint-Warwood families, complex low relief mountain slopes and ridges*. Test pits TP6, TP8, and TP10 were excavated in map unit 75GD2, as were some of the test pits from the area of intensive test pitting. Within the project area, this map unit generally consists of similar topography on linear slopes facing southwest roughly in line with the long axis of the Pony Placer claim. To the southeast of the Pony Placer claim, outside of the project area, this map unit has more complex topography. The area listed as shallow fractured rock in **Figure 2** is similar to the Goldflint component of this map unit. The materials encountered in test pits TP6 and TP8 were very similar to eachother, with an organic horizon 2 or 3 inches thick, underlain by an A horizon 17 to 24 inches thick, then moist, gravelly, massive C horizons below. Prevalent stumps and sparse trees were observed in the vicinity of test pits TP6 and TP8. The soil in test pit TP10 was different from TP6 and TP8. A relatively thin A horizon in test pit TP10 was observed over B horizons and a non-gravelly C horizon encountered at a depth of only 18 inches. No trees or stumps were observed at TP10, in contrast to the surroundings of TP6 and TP8. Observed conditions in test pits TP6 and TP8 were somewhat similar to the Finn component this map unit, whereas TP10 was similar to the Kurrie component. Finn soils are also present in the adjacent map unit 64GJ1. It is possible that NRCS did not notice that the sparsely treed and open areas near TP6 and TP8 were not in their natural condition, and were forested at one time, then logged. The sun-bleached stumps in the vicinity of TP6 and TP8 indicate that logging may have occurred before the most current rounds of NRCS soil survey for the region.

4.4 EVALUATION OF SOIL SUITABILITY FOR USE AS GROWTH MEDIUM IN RECLAMATION

With respect to this report, growth medium means soil with observed rooting, less than 60% gravel, and a color value of 4 or less. Material meeting this definition could be described in a soil salvage operation simply as dark soil containing plant roots, without high gravel content. As shown in **Table 3** and described in Section 4.1, the only agronomic parameter that indicated growth medium potential less than Ideal or Moderate was coarse fragment content. The criteria for coarse fragment content shown in **Table 4** are different for soil that will be reused in flat protected areas versus soil used on steep slopes and exposed areas, because steep or exposed areas require additional coarse fragments to armor the soil against erosion.

As shown in **Table 3**, coarse fragment values reported in the field for the surface horizon of all test pits from areas of proposed disturbance except TP2 indicate that the surface soil is ideal or moderate for reuse in flat protected areas. In TP2, the surface soil had a coarse fragment content estimated at 30% in the field, which is rated as fair for flat protected areas, and moderately well-suited for use in steep or exposed areas such as the current vicinity of TP2. When reuse in steep or exposed areas is considered, surface horizon coarse fragment content was rated as ideal or moderate in half (5) of the test pits in areas of proposed disturbance, and fair in the other half, due to insufficient coarse fragments to protect the soil from erosion.

The first subsurface mineral soil horizon in the majority of the test pits (TP1 through TP5, TP7, and TP10) was rated as poor for reuse potential in flat protected areas. These horizons begin at depths as shallow as 4 inches. Subsurface mineral horizons with a poor rating for reuse potential on steep or exposed areas are only the bottom sampled horizon in TP1, TP2, and TP6.

Table 10 shows the depth of growth medium in each of the test pits in areas of proposed disturbance. Part of the growth medium interval in test pits TP4, TP5, and TP7 is rated as poor for reuse in flat protected areas. The entire growth medium interval for all other test pits shown on **Table 10** is rated as fair or better for reuse in flat protected areas. The depth of growth medium is less than 12 inches at locations TP2 and TP3 on the upper claims, and at locations TP7, TP9, and TP10 on the Pony Placer claim.

The depth of the A horizon is also shown on **Table 10**. The depth of the A horizon corresponded with the depth of growth medium for all test pits, except TP4, TP5, and TP7, in which growth medium extended below a thin A horizon. The thickest layers of growth medium were present in test pits TP4, TP5, TP6, and TP8, which all have 20 or more inches of growth medium. These four test pits are all located outside of areas of seasonally shallow water table, and in a similar setting of topography and vegetation termed footslope, aspen-fir groves and logged areas on **Figures 3** and **4**.

4.5 EVALUATION OF SOIL SUITABILITY FOR USE AS LOW-PERMEABILITY CAPPING MATERIAL

As explained in Section 3.2, geotechnical results for the Main Surface Facilities area which includes test pits TP4 and TP5 were not obtained for this report. For the remainder of the test pits in areas of proposed disturbance, the geotechnical results are shown in **Table 6**. The USCS classification, the estimated coefficient of permeability (k), and the percent passing a No. 200 sieve are shown on **Table 6** for each sampled soil horizon. The Plasticity Index (PI) is shown for the bulk samples collected from the ground surface to a depth of 60 inches.

A rating is also shown for use of the sampled soil as low-permeability capping material. This type of capping material is generally used when there are potential leaching issues with waste rock, such as acid-generating materials or rock with a high content of leachable metals. Material not rated as suitable for low-permeability capping material is still potentially usable to cover waste material that does not have leaching issues. This potential use includes as sub-soil in a revegetation cover system. Ratings for use as low-permeability capping material are summarized below.

The results in **Table 6** indicate that the soil in the vicinity of test pits TP1 and TP2 is unsuitable for use as low-permeability capping material, because the soil is non-plastic, has high gravel content and low fines content (material passing a No. 200 sieve). The soil in test pit TP3 in the saddle area of the upper claims is fine-grained for in the first 10 inches from ground surface, and is suitable for use as low-permeability capping material. The material below 10 inches is marginal for such use, due to relatively low fines content. On the Pony Placer claim most of the sampled soil is suitable for use as low-

permeability capping material. Potentially less-suitable material is present in the following sampled locations on the Pony Placer claim. In test pit TP8, there is substantial gravel content below a depth of 26 inches, indicating a marginal potential for such use. In test pit TP9, there is also substantial gravel content from depths of 11 to 24 inches, without a substantial clay fraction to reduce permeability. Below 18 inches in test pit TP10, there is low fines content and a substantial gravel fraction. As shown in **Table 6**, all of the sampled material from test pit TP6 is rated as suitable low-permeability capping material. The material from the individual horizons of test pit TP7 is rated as suitable for such use, due to substantial fines content, but the plasticity of the bulk sample was low.

The thickness and depth interval of material with a significant fine fraction is shown in **Table 10** for each test pit, along with the thickness of fine-grained material below the A horizon. The thickness below the A horizon indicates the fine-grained material that could be salvaged if the A horizon was salvaged first. As shown in **Table 10**, fine-grained material is present below the A horizon in test pits TP4, TP6, TP8, and TP10 which are all located on the Pony Placer claim in the lower elevation areas of the project, but away from the northern fork of Moose Creek.

5.0 REFERENCES

Montana Department of Environmental Quality (DEQ), 2005. Position Paper - Action Level for Arsenic in Surface Soil. April 2005. Available at http://deq.mt.gov/StateSuperfund/PDFs/ArsenicPositionPaper.pdf

Shacklette, H.T., Boerngen, J.G., 1984. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. USGS Professional Paper 1270.

US Department of Agriculture (USDA), 1993. National Soil Survey Handbook, title 430-VI. Soil Conservation Service.

TABLES

Table 1: Agronomic and Metals Laboratory Methods Butte Highlands Project Soil Resources	
Analyte	**Method Number**
Electrical Conductivity (EC)	ASA10-3
pH, Saturated Paste	ASAM10-3.2
Saturation Percent	USDA27a
Organic Matter Content (%)	ASA29-3
Particle Size Analysis / Texture	ASA15-5
Total Metals: arsenic, cadmium, copper, manganese, molybdenum, nickel, selenium, zinc	E6010.20

Table 2: Geotechnical Laboratory Methods Butte Highlands Project Soil Resources	
Test Name	**ASTM Standard**
Particle Size Distribution (PSD)	D422
Atterberg Limits	D4318
Dry Unit Weight / *In Situ* Density	C127 (coarse material) or C128/D854 (fine material)

Table 3: Agronomic Laboratory Results and Growth Media Rating
Butte Highlands Project Soil Resources

Sample ID	Electrical Conductivity (EC, mS/cm)	pH, Saturated Paste (s.u.)	Organic Matter Content (%)	Texture [1]	Coarse Fragment Content [2] (%)	Overall Rating for Use as Growth Medium	
						Flat protected areas	Steep or exposed areas
TP1, 1-13	0.70	7.50	2.47	SL	10	Ideal	Moderate
TP1, 13-26	0.38	7.60	1.00	LS	70	Poor	Poor
TP2, 0.75-5	0.63	7.30	1.66	SL	30	Fair	Moderate
TP2, 5-26	0.45	7.40	0.64	SL	60	Poor	Poor
TP3, 0.5-10	0.76	6.90	3.95	SiL	20	Ideal	Ideal
TP3, 10-32	0.28	7.70	0.40	LS	50	Poor	Fair
TP3, 32-38	0.47	7.50	1.28	SL	40	Poor	Fair
TP3, 38-50	0.27	7.70	0.12	SL	30	Fair	Moderate
TP4, 0-4	0.58	5.90	7.95	SiL	2	Ideal	Moderate
TP4, 4-11	0.57	6.50	3.28	L	50	Poor	Fair
TP4, 11-20	0.42	7.40	1.41	SL	5	Ideal	Moderate
TP4, 20-37	0.46	7.40	1.07	SL	5	Ideal	Moderate
TP5, 0-2	0.27	5.50	---	---	0	Ideal	Fair
TP5, 2-9	0.60	6.90	5.62	L	50	Poor	Fair
TP5, 9-26	0.59	7.20	0.86	SL	50	Poor	Fair
TP6, 0-3	0.69	5.40	---	---	0	Ideal	Fair
TP6, 3-20	0.18	5.80	2.33	SL	5	Ideal	Moderate
TP6, 20-44	0.14	6.00	0.36	SL	15	Ideal	Ideal
TP6, 44-60	0.17	6.30	0.21	SL	70	Poor	Poor
TP7, 0-3	0.92	6.10	12.6	L	15	Ideal	Ideal
TP7, 3-9	0.42	6.50	3.95	L	40	Poor	Fair
TP7, 9-16	0.39	7.40	0.64	SL	40	Poor	Fair
TP7, 16-35	0.28	7.60	0.28	SL	5	Ideal	Moderate
TP8, 0-2	0.54	6.10	---	---	0	Ideal	Fair
TP8, 2-26	0.36	6.70	7.34	L	5	Ideal	Moderate
TP8, 26-42	0.36	7.50	0.47	SL	15	Ideal	Ideal
TP9, 0-4	0.27	6.40	---	---	0	Ideal	Fair
TP9, 4-11	0.31	6.30	4.36	L	30	Fair	Moderate
TP9, 11-24	0.17	6.70	0.36	SL	10	Ideal	Moderate
TP9, 24-35	0.19	6.80	0.28	SL	0	Ideal	Fair
TP10, 0-4	0.34	5.80	---	---	0	Ideal	Fair
TP10, 4-14	0.24	5.90	0.67	SL	40	Poor	Fair
TP10, 14-18	0.18	5.80	0.59	SL	30	Fair	Moderate

Color Codes for Usability Ratings:	(No Highlighting = Ideal)	Moderate	Fair	Fair to Poor	Poor

Notes:
1. Texture letter codes are as follows, in accordance with USDA conventions: C=Clay, S=Sand(y), Si=Silt(y), L=Loam(y)
2. Coarse Fragment Content estimated in the field. The color codes in the Coarse Fragment Content column refer to rating for reuse in flat protected areas.

--- = Not applicable, because sample is from a horizon consisting of organic material.

Table 4: Growth Media Rating System Butte Highlands Project Soil Resources				
Analyte Name	**Ideal**	**Moderate**	**Fair**	**Poor**
Electrical Conductivity (EC, µS/cm)	<4	4 to 6	6 to 10	>10
pH, Saturated Paste	6 to 8	5 to 6, 8 to 8.5	4.5 to 5, 8.5 to 9.0	<4.5, >9.0
Texture	Silt loam, Loam, Sandy clay loam, Silty clay loam, Clay loam	Sandy loam, Loamy sand	Clean sand, Sandy clay, Silty clay	Clay
Coarse Fragment Content (%) – Flat protected areas	<15	15 to 25	25 to 35	>35
Coarse Fragment Content (%) – Steep slopes or exposed areas	15 to 25	<15, 25 to 35	0, 35 to 60	>60

Table 5: Metals Laboratory Results
Butte Highlands Project Soil Resources

Sample ID	Arsenic	Cadmium	Copper	Manganese	Molybdenum	Nickel	Selenium	Zinc
Background Concentration[1]	**0.1 - 97**	**--**	**2 - 300**	**30 - 5,000**	**3 - 7**	**5 - 700**	**<0.1 - 4.3**	**10 - 2,100**
TP1, 1-13	51	<1	44	625	<5	10	<5	39
TP1, 13-26	17	<1	38	448	<5	12	<5	26
TP2, 0.75-5	18	<1	22	480	<5	16	<5	30
TP2, 5-26	5	<1	14	299	<5	16	<5	17
TP3, 0.5-10	31	1	43	1100	<5	18	<5	68
TP3, 10-32	<5	<1	9	320	<5	6	<5	14
TP3, 32-38	<5	<1	12	280	<5	9	<5	14
TP3, 38-50	6	<1	14	321	<5	9	<5	20
TP4, 0-4	53	2	54	997	<5	22	<5	94
TP4, 4-11	23	<1	29	647	<5	21	<5	42
TP4, 11-20	26	<1	28	456	<5	17	<5	27
TP4, 20-37	17	<1	26	398	<5	16	<5	25
TP5, 0-2	8	<1	26	326	<5	8	<5	39
TP5, 2-9	17	<1	28	543	<5	16	<5	37
TP5, 9-26	8	<1	32	335	<5	14	<5	21
TP6, 0-3	53	4	88	1350	<5	8	<5	112
TP6, 3-20	5	<1	13	296	<5	9	<5	24
TP6, 20-44	<5	<1	11	247	<5	8	<5	21
TP6, 44-60	8	<1	25	173	<5	17	<5	20
TP7, 0-3	56	2	50	673	<5	17	<5	88
TP7, 3-9	14	<1	31	685	<5	18	<5	47
TP7, 9-16	6	<1	20	390	<5	12	<5	20
TP7, 16-35	8	<1	19	332	<5	11	<5	18
TP8, 0-2	51	2	69	716	<5	11	<5	97
TP8, 2-26	17	<1	29	636	<5	15	<5	47
TP8, 26-42	9	<1	18	366	<5	11	<5	16
TP9, 0-4	88	<1	28	737	<5	23	<5	21
TP9, 4-11	11	<1	26	156	<5	18	<5	34
TP9, 11-24	7	<1	14	111	<5	11	<5	18
TP9, 24-35	7	<1	17	144	<5	11	<5	21
TP10, 0-4	42	1	34	607	<5	10	<5	70
TP10, 4-14	9	<1	12	236	<5	8	<5	19
TP10, 14-18	11	<1	16	298	<5	8	<5	30

Notes:

All results reported in milligrams per kilogram (mg/kg).

1. Background concentrations for all elements are reported for the Western United States (Shacklette and Boerngen 1984).

-- = No background concentration reported in the above reference.

None of the above results are higher than background concentrations for the Western United States.

Gray highlighting indicates that the concentration is above the Montana Department of Environmental Quality Generic Action Level for arsenic of 40 mg/kg.

Table 6: Geotechnical Laboratory Results and Low-Permeability Material Rating
Butte Highlands Project Soil Resources

Sample ID	USCS Classification	% of Particles Passing No. 200 Sieve	Plasticity Index (PI)	Rating for Use as Low-Permeability Capping Material
TP-1, 0-36	P.G. Sand with Silt	1	N/P	Unsuitable
TP-2, 0-26	P.G. Gravel with Silt and Sand	---	N/P	Unsuitable
TP-3, 0.5-10	Sandy Silt	68	---	Suitable
TP-3, 10-32	Silty Sand with Gravel	17	---	Marginal
TP-3, 38-50	Silty Sand with Gravel	24	---	Marginal
TP-3, 0-60	Silty Sand with Gravel	---	N/P	---
TP-6, 0-60	Clayey Sand with Gravel	37	16	Suitable
TP-7, 3-9	Silty Clay with Sand & Gravel	64	---	Suitable
TP-7, 16-35	Silty Sand	34	---	Suitable
TP-7, 35-60	Silty Clayey Sand	48	---	Suitable
TP-7, 0-60	Silty Sand with Gravel	---	2	---
TP-8, 2-26	Sandy Silt	55	---	Suitable
TP-8, 26-42	Silty Sand with Gravel	26	---	Marginal
TP-8, 0-60	Clayey Sand with Gravel and Cobbles	---	10	---
TP-9, 4-11	Silty Clayey Sand	49	---	Suitable
TP-9, 11-24	Silty Sand with Gravel	24	---	Marginal
TP-9, 24-35	Silty Sand with Gravel	27	---	Marginal
TP-9, 35-46	Silty Sand with Gravel	34	---	Suitable
TP-9, 0-60	Elastic Silt with Sand and Gravel	---	21	---
TP-10, 0-4	Silty Sand	46	---	Suitable
TP-10, 4-14	Silty Clayey Sand with Gravel	35	---	Suitable
TP-10, 14-18	Silty Clayey Sand	30	---	Suitable
TP-10, 18-60	Silty Sand with Gravel	13	---	Unsuitable
TP-10, 0-60	P.G. Sand with Clay and Gravel	---	21	---

Color Codes for Usability as Low-Permeability Capping Material:	**(No Highlighting = Suitable)**	**Marginal**	**Unsuitable**

Notes:

P.G. = Poorly Graded

--- = Not reported by the laboratory, or not estimated. Coefficient of Permeability (k) was estimated only for undisturbed samples, and no estimates are reported for disturbed bulk samples.

1. The k for each sample was estimated from the USCS texture class based on the ranges presented in US Department of the Interior (USDOI) 1977 publication entitled "Design of Small Dams – A Water Resources Technical Publication".

Table 7: Low-Permeability Capping Material Rating System Butte Highlands Project Soil Resources			
Analyte Name	**Suitable**	**Marginal**	**Unsuitable**
Particle Size Distribution (% Passing No. 200 Sieve)	>25	25 to 15	<15
Atterberg Limit (PI)	PI>15	15 to 7	PI<7

Table 8: Erodibility Parameters
Butte Highlands Project Soil Resources

Test Pit ID	Associated NRCS Map Unit	Erodibility - fine fraction (Kf)	Erodibility - whole soil (Kw)	Surface Runoff Class	Wind Erodibility Index (I)	Root Restriction Depth (inches)	Soil Loss Tolerance (T, tons/acre-year)
1	51CH2	0.19	0.15	Medium	86	13	1
2	51CH2	0.30	0.14	High	56	5	1
3	75GB2	0.46	0.28	High	48	38	2
4	75GB2	0.43	0.26	High	48	20	2
5	75GB2	0.34	0.10	Medium	38	26	2
6	75GD2	0.33	0.30	Medium	86	20	2
7	64GJ1	0.44	0.30	Low	48	16	2
8	75GD2	0.35	0.31	Low	56	26	2
9	64GJ1	0.30	0.14	Low	38	11	1
10	75GD2	0.31	0.12	Low	48	14	1

Color Codes:	Low	Medium	High	Very High

Notes:

NRCS = U.S. Natural Resources Conservation Service

Higher values for wind erodibility index (I) indicate greater susceptibility to erosion. The actual amount of wind erosion is dependent upon climate and specific management practices employed at a site.

Soil Loss Tolerance is the amount of soil that can be lost without a reduction in productivity of the soil as a plant growth medium.

All values determined based on guidance in the National Soil Survey Handbook (USDA 1993).

Table 9: NRCS Map Unit Names
Butte Highlands Project Soil Resources

NRCS Map Unit Symbol	NRCS Map Unit Name
51CH2	Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes
64GJ1	Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains
75GB2	Windyridge-Como-Hiore families, complex low relief mountain slopes and ridges
75GD2	Kurrie-Goldflint-Warwood families, complex low relief mountain slopes and ridges

Notes:

NRCS = U.S. Natural Resources Conservation Service

Further details regarding these map units are available in Appendix C and in the complete NRCS soil survey for the Deer Lodge National Forest survey area.

Table 10: Thickness of Fine-Grained Material and Growth Medium
Butte Highlands Project Soil Resources

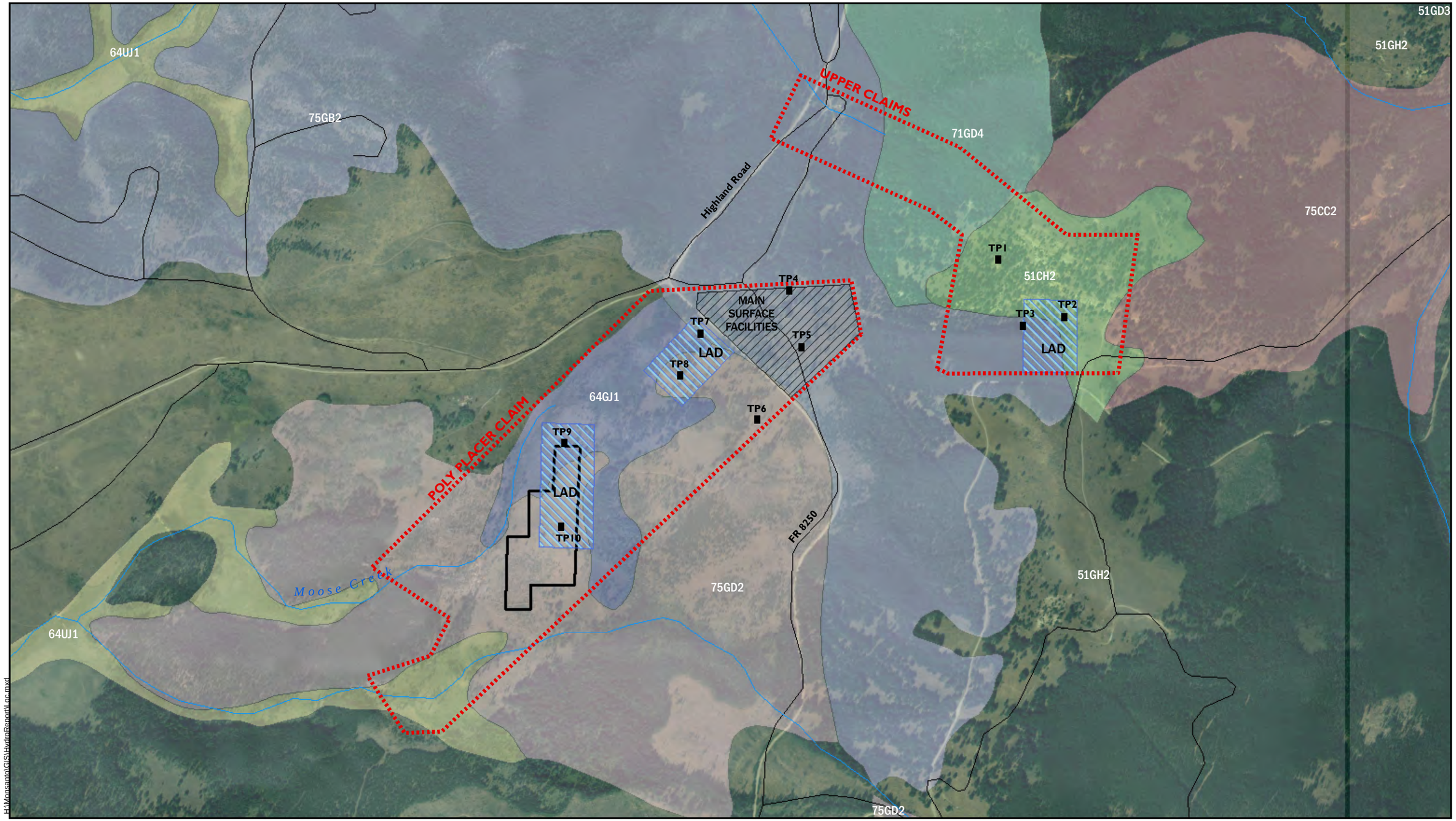
Test Pit ID	Associated NRCS Map Unit	Thickness of Growth Medium[1] (in.)	Depth to Bottom of A horizon[2] (in.)	Thickness of Material with Significant Fines[3] (in.)	Thickness of Fine-Grained Material beneath A horizon (in.)
1	51CH2	13	13	0	0
2	51CH2	5	5	0	0
3	75GB2	10	10	10 (0 to 10 in.)	0
4	75GB2	20	**4**	26 (11 to 37 in.)	26
5	75GB2	26	**9**	0	0
6	75GD2	20	20	41 (3 to 44 in.)	24
7	64GJ1	9	**3**	3 (0 to 3 in.)	0
8	75GD2	26	26	40 (2 to 42 in.)	18
9	64GJ1	11	11	7 (4 to 11 in.)	0
10	75GD2	4	4	18 (0 to 18 in.)	14

Notes:

NRCS = U.S. Natural Resources Conservation Service

1. Thickness of growth medium indicates the observed rooting depth in soil that has less than 60% gravel and a color value of 4 or less (i.e. in dark soil).
2. Bold values are for A horizon that is thinner than the full depth of potential growth medium.
3. Thickness of material with significant fines was determined based on field observations. Depth of interval is shown in parentheses.

FIGURES



Source: NAIP 2005, NRIS

Test Pit Location

Project Area

Area of Intensive Test Pitting

SOIL MAP UNITS

51CH2, Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes

64GJ1, Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains

64UJ1, Finn-Lowder-Dunkleber families, complex, stream terraces and flood plains

71GD4, Blackleed-Ovando-Kurrie families, complex, high relief mountain slopes and ridges

75CC2, Helmville-Relyea-Whitore families, complex, low relief mountain slopes and ridges

75GB2, Windyridge-Como-Hiore families, complex, low relief mountain slopes and ridges

75GD2, Kurrie-Goldflint-Warwood families, complex, low relief mountain slopes and ridges

N

Feet

0 800

AMEC Geomatrix

Soil Map Units
Butte Highlands
Silver Bow County, Montana
FIGURE 1

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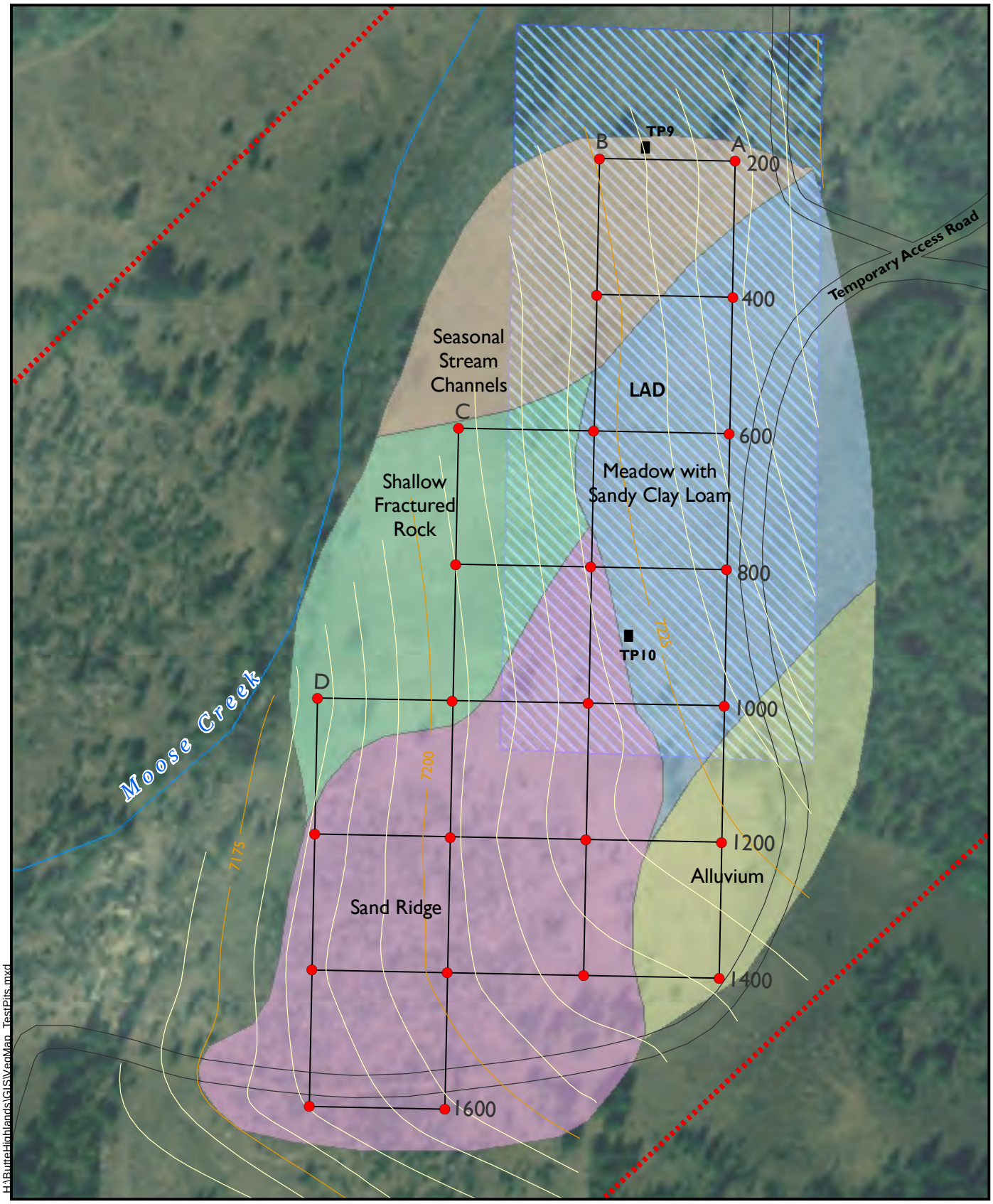


Source: NAIP 2005, NRIS

N

Feet

0 200

AMEC Geomatrix

Test Pit Location - Intensive Area

Test Pit Location - Sitewide Soil Survey

Lease Area

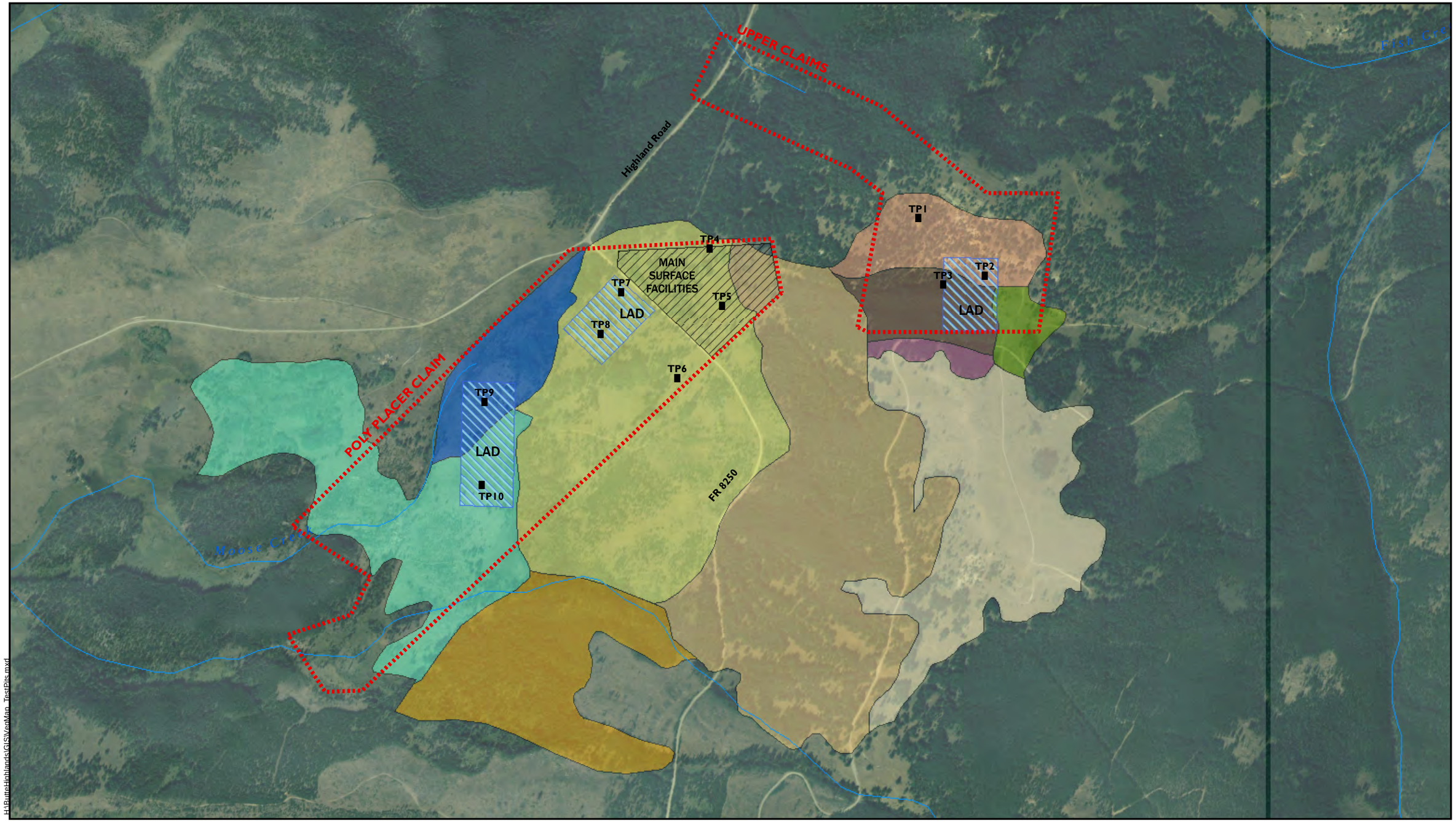
Soil Sample Grid

5 Ft Major Contour

5 Ft Minor Contour

Access Roads

Area of Intensive Test Pitting
Butte Highlands
Silver Bow County, Montana
FIGURE 2



Source: NAIP 2005, NRIS

N

Feet

0 800

AMEC Geomatrix

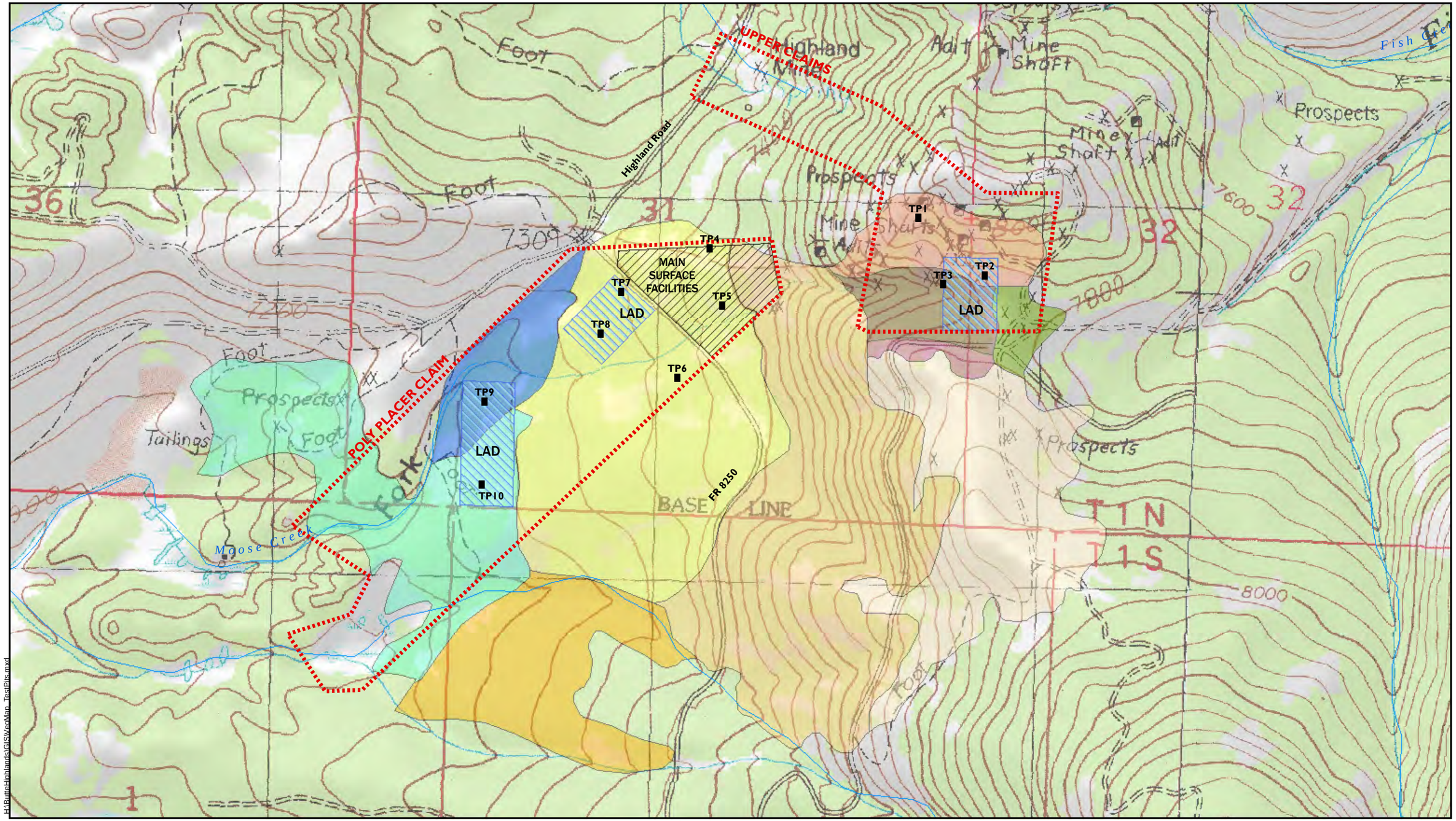
Test Pit Location

Project Area

Topography and Vegetation Units

- Fir-Larch Backslope
- Footslope, Aspen-Fir Groves and Logged Areas
- North-Facing Lodgepole Forest
- Ridge Meadow
- Saddle Forest
- Saddle Meadow
- Seasonal Channels
- South-Facing Slope
- Steep, West-Facing Fir-Spruce Backslope
- Toeslope Meadow

Areas of Similar Topography and Vegetation
(Aerial Photo Basemap)
Butte Highlands
Silver Bow County, Montana
FIGURE 3



Source: 24K USGS Mount Humbug and Pipestone Pass Quads

N

Feet

0 800

AMEC Geomatrix

Test Pit Location

Project Area

Topographic and Vegetation Units

- Fir-Larch Backslope
- Footslope, Aspen-Fir Groves and Logged Areas
- North-Facing Lodgepole Forest
- Ridge Meadow
- Saddle Forest
- Saddle Meadow
- Seasonal Channels
- South-Facing Slope
- Steep, West-Facing Fir-Spruce Backslope
- Toeslope Meadow

Areas of Similar Topography and Vegetation
(Topographic Basemap)
Butte Highlands
Silver Bow County, Montana
FIGURE 4

H:\ButteHighlands\GIS\VegMap_TestPits.mxd

APPENDIX A
Field Forms

USDA-NRCS | **PEDON DESCRIPTION** | Pedon ID #: TP1 | Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 8-11	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 10:00 8/28/09	Weather: Temp.: Air: 60°F, Sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature: Adj. to mature tree	Anthro: new road cut	Elevation:	Aspect: S-SW	Slope (%): 10-15	Slope Complexity: (flat)	Slope Shape: (Up & Dn / Across) linear / Concave

Hillslope Profile Position: Shoulder	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status: Dry	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Douglas fir (2 stages:	30%
	mature - 3 ft. diam, young -	
	up to 1 ft. diam)	
	Grass	10%
	Knick-knick	10%
	Forbs	30%

MISCELLANEOUS FIELD NOTES / SKETCH :

Road cut near top of lease.
Frequent mature downed wood in vicinity (10% ground cover)
At BH-9H-9 (borehole) drill pad

Butte Highlands, W.W.

Component Name:		Map Unit Symbol:	tp 1	Date:	8/28/09

	Obser. Method	Depth (cm) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		0	1	Of	CL	10YR 3/1	10YR 2/1	—	Ø	none					
2		1	13	A	WV	10YR 4/3	10YR 3/3	S	10 ang. <3/4in	ang. blocky					
3		13	26	C	WV	10YR 4/3	10YR 3/3	S	70 ang. >3in.	massive					
*		(26+		Saprolite)		—	—	—	—	—					
5															
6															
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Unified	Notes moist:
1		samples: none (too thin)		none			none		dry
2				prev. fine & med			↓		↓
3		agronomic only agr.		sl. fine & med	*				
4									
5			* in upper ½ of horizon						
6									
7									
8									
9									
10									

Butte Highlands, W.W.

USDA-NRCS PEDON DESCRIPTION

Pedon ID # : TP2

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 45-48	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 11:00 8/28/09	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT, Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: S	Slope (%): 30	Slope Complexity:	Slope Shape: (Up & Dn / Across) convex / convex

Hillslope Profile Position: backslope (Sl. above saddle/footslope)	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding:	Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	fir + spruce trees	10
	grass	15
	forbs	10

MISCELLANEOUS FIELD NOTES / SKETCH :

Test pit into road cut
Trees are short (<20ft) and
less than 1.5ft diam.

Butte Highlands, W.W.

Component Name:																Map Unit Symbol:	TP 2	Date: 8/28/09
	Obser. Method	Depth (cm) (TOP)	Depth (cm) (BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc			
1		0	3/4	Of		10YR 2/2	10YR 2/1	—	20 subang. 2-10in.	none								
2		3/4	5	A		10YR 5/4	10YR 4/3	SL	30 ang. <2in	subang. blocky								
3		5	26	C		10YR 6/4	10YR 5/4	S	60 ang. <4in.	massive								
X		(26	45	gap — Rock)		10YR 8/6	—	—										
X		(45+		Rock)														
6																		
7																		
8																		
9																		
10																		

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified	Notes moist
1		samples:		none					
2		none (too thin)		none			none		dry
3		agronomic	prev. fine + med.				none		↓
X		agr.	med. + fine in upper ½ of horizon.				sl. (violent)		
5									
6									
7									
8									
9									
10									

Butte Highlands

USDA-NRCS PEDON DESCRIPTION

Pedon ID # : TP3

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 49-53	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 12:00 8/28/09	Weather: Temp.: Air: Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT, Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: W-SW	Slope (%): 10	Slope Complexity:	Slope Shape: (Up & Dn / Across) Convex / concave

Hillslope Profile Position: shoulder (saddle)	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	long fir (mostly mature - 2 to 3 ft. diam)	40
	grass	20
	forbs	20

MISCELLANEOUS FIELD NOTES / SKETCH :

Lodgepole forest starts ~60 ft. South of TP3.
Reclaimed roads are inured.
North and south of TP3, however TP3 taken from under tree in apparently undisturbed area.
Pit located on edge (not center) of proposed LAD area, due to thick forest to south.

Butte Highlands W.W.

Component Name:		Map Unit Symbol:	TP3	Date:	8/28/09

	Obser. Method	Depth (cm) (TOP)	(BOT) (in.)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		~~0~~	0.5	~~0~~ f	Cl	10YR 3/1	10YR 2/1	—	~~20~~	none					
2		0.5	10	A 重	WV	10YR 4/3	10YR 3/2	SL	20 ang. <2in.	ang blocky					
3		10	32	~~Bz~~ Bw	v. wv	10YR 6/4	10YR 5/4	S	50 ang. <2in.	weak blocky					
4		32	38	Bk	Cl	10YR 7/2	10YR 5/3	SL	40 ang. <4in.	ang. blocky					
5		38	50	C1	Cl	10YR 6/3	10YR 4/3	S	30 sub ang. <3in	massive					
6		50+		C2	—	10YR 6/3	10YR 4/3	S	40 ang. <8in.	massive					
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Unified	Notes moisture
1		Samples:	none (too thin)	none			none		dry
2			agr. + undist	few fine med.			none		sl. moist
3			agr. ~~undist~~	sl. fine		none ~~violent~~			dry
4			agr. ~~undist~~	few med. (sl. fine)		violent ~~strong~~			dry
5			agr. + undist	none		strong	~~none~~		~~sl. moist~~ dry
6			none (similar to C1)	none			none		sl. moist
7									
8									
9									
10									

Butte Highlands

USDA-NRCS

PEDON DESCRIPTION

Pedon ID #: TP4

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 26-30	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 18:00 8/27/09	Weather: Temp.: Air: 70°F, Sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:		

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect:	Slope (%): 10-15	Slope Complexity:	Slope Shape: (Up & Dn / Across) ~~flat~~ sl. convex / sl. convex

Hillslope Profile Position: footslope (near uphill edge)	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	fir trees (8-14in. diam)	30
	Grass	5
	Forbs	30
	Aspen trees	3

MISCELLANEOUS FIELD NOTES / SKETCH :

Some stumps, apparently same age/diam as existing trees, are ~5% of ~~trees~~ prev. forest

Site is on North edge of Main Facilities Area (proposed).

Test pit has been open for 8 days (prev. geotech samples collected from pit)

Geotechnical test pit LRD-06.

Butte Highlands, W.W.

Component Name:		Map Unit Symbol:	TP4	Date:	8/27/09

	Obser. Method	Depth (cm) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		0	4	A	cl	10YR 4/2	10YR 2/1	CL	20% ang, <4in	subang. blocky					
2		4	11	B	cl	10YR 4/2	10YR 4/3	CL	50% ang, mostly <1in	ang. blocky					
3		11	20	Bk	wv	10YR 6/4	10YR 4/3	SCL	5% subang, <1in.	ang. blocky					
4		20	37	C1	cl	2.5Y 6/3	10YR 4/4	SCL	5% ang. <1in	massive					
5		37	60	C2	–	2.5Y 7/2	10YR 6/4	SL	60% ang, <10in	massive					
6															
7		Horizon		2	has	intermittent			(<5%)	rocks ~6in. diam.					
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified	Notes
1				few fine roots			none		dry
2				" and large tree roots			none		↓
3				sl. fine roots			none *		
4				none			slight		
5				none			violent		
6					* except violent rxn. on white concentrations				
7									
8									
9									
10									

Butte Highlands

USDA-NRCS PEDON DESCRIPTION

Pedon ID # : TPS

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 22-25	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 17,30 8/27/09	Weather: Temp.: Air: 75°F, Sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect:	Slope (%): 15	Slope Complexity:	Slope Shape: (Up & Dn / Across) sl. concave / sl. concave

Hillslope Profile Position: Footslope	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Fir trees (<6in. diam)	5
	Sagebrush	5
	Grass	50
	Forbs / thistles	20

MISCELLANEOUS FIELD NOTES / SKETCH :

Test pit has been open for 8 days (prev. geotech. pit)
Two types of stumps over ~10% of surface:
large (>3ft.) with no bark
smaller (<2 ft.) with bark
Geotechnical test pit LRD-01

Butte Highlands, W.W.

Component Name:		Map Unit Symbol: TP5	Date: 8/27/09

	Obser. Method	Depth (cm) (in) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		Ø	2	O_e	CW	10YR 3/1	10YR 2/1	—	Ø	massive					—
2		2	9	A		10YR 5/1	2/1	L	50 ang, <6in	sub ang. blocky					—
3		9	26	B		10YR 5/3	4/3	SCL	50 sub-ang, <3in	ang. blocky					—
4		26	39	C1	WW	10YR 6/3	5.5/4	CL	30 ang, <4in	massive					—
5		39	60	C2		10YR 8/6	7/6	LS	(Saprolite)	massive					white horiz. mottles
6															
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified
1		Samples: agronomic		—			none	dry
2		agr.		v. pred. fine roots			none	
3		agr.		pred. fine roots			none	
4		none (too coarse)		sil. fine roots			violent	
5		none (non-soil)		none			violent	
6								
7								
8								
9								
10								

USDA-NRCS | **PEDON DESCRIPTION** | Pedon ID # : JP6 | Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 41-44	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 8:45 8/28/09	Weather: Temp.: *Air:* *Soil:* *Depth:*	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: *Zone:* *mE:* *mN:*	Topo Quad.:	Site ID: *YR:* *State:* *County:* *Pedon #:* mT Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: *ID:* *Stop #:* *Interval:*	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: SW	Slope (%): 5-10%	Slope Complexity: (flat)	Slope Shape: (*Up & Dn / Across*) linear / linear

Hillslope Profile Position:	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: *Kind:* *Fract.:* *Hard.:* *Depth:*	Lithostrat. Units: *Group:* *Formation:* *Member:*	

Erosion: *Kind:* *Degree:*	Runoff:	Surface Frag %: *GR:* *CB:* *ST:* *BD:* *CN:* *FL:* *Kind:*	Diagnostic Horz. / Prop.: *Kind:* *Depth:*

P.S. Control Section: *Ave. Clay %:* *Ave. Rock Frag %:* *Depth Range:*	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Fir trees (~1 ft. diam.)	<5%
	Pin trees (~3in. diam.)	~2%
	Grass (grazed to ~3in.)	60%
	Forbs	~10%
	Potentilla shrubs	~2%

MISCELLANEOUS FIELD NOTES / SKETCH :

Stumps prevalent (10% cover) up to 3 ft. diam. Small diam. (2in.) woody debris. Cow dung prevalent. More trees ~100 ft. downslope to SW.

Butte Highlands, W.W.

Component Name:		Map Unit Symbol: TP6	Date: 8/28/09

	Obser. Method	Depth ~~(cm)~~ (in.) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		0	3	Of		10YR 3.5/2	10YR 2/1	—	Ø	granular					
2		3	20	A		10YR 4/1	10YR 2/1	SCL	5 ang. <1in	ang. blocky					
3		20	44	C1		—	10YR 6/4	SCL	15 ang. <3in.	massive					
4		44	60	C2		—	2.5YR 5/4	CL	70 ang. 7in.	massive					
5															
6															
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified	Notes moist!
1		samples:							
2		agr. only					none		dry
3		agr. ~~& undisturbed geotech.~~					↓		dry
4		agr. ~~& undist.~~							slr moist
5		agr. ~~none (to gravelly for undist.)~~					—		v. moist
6		none: undisturbed geotech.							
7		samples collected at nearby TP8							
8		C2 not sampled for agronomic							
9		properties at TP8.							
10									

Butte Highlands

USDA-NRCS PEDON DESCRIPTION

Pedon ID #: TP 7

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 31-35	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 19:00 8/27/09	Weather: Temp.: Air: 65°F, sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect: S	Slope (%): 3-5%	Slope Complexity: (flat)	Slope Shape: (Up & Dn / Across) linear / slightly convex

Hillslope Profile Position: Footslope	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Douglas fir (regrowth up to 1 ft. diam.)	10%
	Grass (grazed to ~3 in. tall)	60%
	Sagebrush	<5%
	Forbs	10%
	(Prevalent stumps up to 2 ft diam.)	100%

MISCELLANEOUS FIELD NOTES / SKETCH :

Water in test pit at 60 in. depth after ½ day open. Soil saturated from ~4 to 5 ft. during excavation.

Butte Highlands, W.W.

Component Name:		Map Unit Symbol:	TP7	Date:	8/27/09

	Obser. Method	Depth (cm) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		0	3	A	Cl	10YR 3/2	10YR 2/1	SCL	15% ang. <2ft.	rounded blocky					
2		3	9	B	WW	10YR 3/2	10YR 2/1	SL	40% ang. <8in	ang. blocky					
3		9	16	B	WW	—	10YR 5/3	LS	40% ang. <5in.	subang. blocky					
4		16	35	C1	Cl	—	10YR 5/4	LS	5% ang <3in	massive					white mottles
5		35	60	C2	—	—	10YR 5/3	SiC	35% ang. mostly <5in. (except one boulder spanning test pit)	massive					orange mottles
6															
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified	Notes moist/s
1		sampling notes: agr. sample	(no undist.)	few, fine/med.			None		dry
2		agr. & undist.		few, fine			None		dry
3		agr. (non undist. - too gravelly to sample)		few, fine			None		moist
4		agr. + undist		sl. fine			Strong*		wet
5		no agr., undist.		none			Strong		wet
6		Totals 4	3						
7				*in finer-grained lighter color areas					
8									
9									
10									

USDA-NRCS

PEDON DESCRIPTION

Pedon ID # : TP8

Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 36-40	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 8:00 8/28/09	Weather: Temp.: Air: 70°F, Sunny Soil: Depth:	Latitude: ° ' " N Datum: Longitude: ° ' " W	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT, Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:		

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect:	Slope (%): 5	Slope Complexity: flat	Slope Shape: (Up & Dn / Across) linear/linear

Hillslope Profile Position: foot slope	Geom. Component:	Microrelief: stumps	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Spruce/fir trees	15
	Aspen trees	~2
	Sagebrush/Potentilla shrubs	30
	Grass (grazed to ~3 in.)	20
	Forbs	10

MISCELLANEOUS FIELD NOTES / SKETCH :

Prevalent stumps (up to 3 ft. diam, 20% ground cover)

Butte Highlands W.W.

Component Name:		Map Unit Symbol:	TP 8	Date:	8/28/09

	Obser. Method	Depth (cm) (TOP)	(BOT) (inches)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc
1		Ø	2	Of	cl	10YR 2/1	10YR 3/2	—	Ø	granular					
2		2	26	A	v. wv.	10YR 2/1	10YR 3.5/1	SiCL	5 ang. <1in	granular					
3		26	42	C1	cl	—	10YR 5/4	SCL	15 ang. <2in.	massive					sl. orange mottles
4		42	60	C2	—	—	10YR 4/4	SCL	70 ang. >3in.	massive					
5															
6															
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Unified	Notes moist
1		samples:							
2		agr. only					none		dry
3		agr & undist.		v. few fine + med					sl. moist
4		agr. + undist		none					moist
5		none (too gravelly for undist. sample)		none			—		v. moist
6									
7									
8									
9									
10									

USDA-NRCS **PEDON DESCRIPTION** Pedon ID # : TP 9 Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #: 16-21	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Wetzenbach	Date: 14:30 8/27/09	Weather: Temp.: Air: 70°F, sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #:	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:	

Landscape:	Landform: seasonal channels	Microfeature:	Anthro:	Elevation:	Aspect: W-SW	Slope (%): 3-5	Slope Complexity: frost heaves	Slope Shape: (Up & Dn / Across)

Hillslope Profile Position: Channel	Geom. Component:	Microrelief: frost heaves	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range:	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	Spruce/fir trees	~2
	Grass (grazed to 3in)	35
	Sagebrush/potentilla shrub	30
	Forbs	10
	Shrubs	10

MISCELLANEOUS FIELD NOTES / SKETCH :

Wood shrubs (willow?) standing dead wood on ~15% ground cover. Frost heaves and season channels prevalent.
Water in bottom of test pit. First measured at ~84 in, and after ~2hrs at ~50 in.

Butte Highlands W.W.

Component Name:	TP9	Map Unit Symbol:		Date:	8/27/09

	Obser. Method	Depth (cm) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc — Notes
1		Ø	4	Of	cl	7.5YR3/3	10YR2/1	—	Ø	ang. blocky					
2		4	11	AB	wv	5Y6/2	2.5Y2.5/1	SL	30, ang. <1in	ang. blocky					undist. sample
3		11	24	Bt	wv	5Y6/2	2.5Y6/4	SC	10 ang <1in	ang. blocky					" "
4		24	35	Bw	wv	—	2.5Y5/3	SC	Ø	blocky (SL)					" "
5		35	46	BC	cl	—	2.5Y4/3	C	10 ang <1in	massive					undist sample, no agr. sample
6		46	60	C2	-	—	2.5Y5/4	C	20 ang <2in	massive					no agr. sample
7															
8															
9															
10															

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	HCl rxn	Notes Unified	Notes
1	—	—		v. prev. fine roots			none		Dry
2	—	—		prev. fine roots					moist
3	gray, orange mottles	—		sl fine roots	at top				moist
4	orange mottles	—		none					v. moist
5	orange + black mottles	—		none					wet
6	orangish red mottles	—		none					wet
7									
8									
9									
10									

USDA-NRCS **PEDON DESCRIPTION** Pedon ID # : TP10 Basic Soils Course May-04

Series or Component Name:	Map Unit Symbol:	Photo #:	Classification:	Soil Moist. Regime (Tax.):

Describer(s): W. Welzenbach	Date: 13:30 8/27/09	Weather: Temp.: Air: 70°f, sunny Soil: Depth:	Latitude: ° ' " N Longitude: ° ' " W Datum:	Location: Sec. T. R.

UTM: Zone: mE: mN:	Topo Quad.:	Site ID: YR: State: County: Pedon #: MT, Silver Bow	Soil Survey Area:	MLRA / LRU:	Transect: ID: Stop #: Interval:

Landscape:	Landform:	Microfeature:	Anthro:	Elevation:	Aspect:	Slope (%): 3	Slope Complexity:	Slope Shape: (Up & Dn / Across) convex / concave

Hillslope Profile Position: footslope	Geom. Component:	Microrelief:	Physio. Division:	Physio. Province:	Physio. Section:	State Physio. Area:	Local Physio. Area:

Drainage:	Flooding: Ponding:	Soil Moisture Status:	Profile Saturated Hydraulic Conductivity Ksat:	Land Cover / Use:

Parent Material:	Bedrock: Kind: Fract.: Hard.: Depth:	Lithostrat. Units: Group: Formation: Member:	

Erosion: Kind: Degree:	Runoff:	Surface Frag %: GR: CB: ST: BD: CN: FL: Kind:	Diagnostic Horz. / Prop.: Kind: Depth:

P.S. Control Section: Ave. Clay %: Ave. Rock Frag %: Depth Range: 4-18in, LS texture	

VEGETATION :

SYMBOL	COMMON NAME	%GD COVER
	grass (grazed to 3in)	50
	Sagebrush / potentilla shrubs	20
	Forbs	10

MISCELLANEOUS FIELD NOTES / SKETCH :

Very prevalent cow dung. Gopher holes prevalent

Butte Highlands W. Welzenbach

Component Name:	TP20	Map Unit Symbol:		Date:	8/27/09

	Obser. Method	Depth (cm) (TOP)	(BOT)	Horizon	Bnd	Matrix Color Dry	Matrix Color Moist	Texture	Rock Frag Knd % Rnd Sz	Structure Grade Sz Type	Sand %	Silt %	Clay %	LEP	Mottles % Sz Cont. Col Mst Shp Loc / Notes
1		0	4	A	wv	2.5Y 2.5/1	2.5Y 2.5/1	SL	Ø	subang. blocky					
2		4	14	B	gr	6/3	5/3	LS	40, ang. 4in	ang. blocky					
3		14	18	Bt	gr	7/2	5/3	CS	30, ang. 4in.	massive					
4		18	60	C	–	7/4	6/4	S	Ø	massive					no agr. sample
5															
6															
7															
8															
9															
10															

Notes: Of horizon present in top 1 in.
Sampling time = 13:30

	Redoximorphic Features Knd % Sz Cont. Col. Mst Shape	Concentrations Knd % Sz Cont. Col Mst Shp Loc	Ped / V. Surface Features Knd % Con Dst Loc Col Mst	Roots Qty Sz Loc	Pores Qty Sz Shp	Notes Ksat	Notes HCl rxn	Notes Unified	Notes
1	—	—	—	very prev. fine roots	btwn. peds		none		dry
2	—	—	—	scarce med.	on ang. gravel				sl. moist
3	—	—	—	sl	NA				sl. moist
4									moist
5									
6									
7									
8									
9									
10									

Butte Highlands
Test Pit Descriptions
Soil Survey - W. Welzenbach
August 26 to 28, 2009

TP1
(depth, inches)

0-1	Organic surface layer. Of horizon.
1-13	Brown sand with 10% angular gravel less than ¾ inch max. dimension. Angular blocky structure, no effervescence, dry. A horizon.
13-26	Brown sand with 70% angular cobbles (greater than 3 inch). Massive structure, no effervescence, dry. C horizon.
26+	Saprolite.

TP2
(depth, inches)

0-3/4	Organic surface layer. Of horizon.
3/4-5	Yellowish brown sandy loam with 30% angular gravel less than 2 inch max. dimension. Subangular blocky structure, no effervescence, dry. A horizon.
5-26	Light yellowish brown sand with 60% angular coarse gravel and cobbles (2 to 4 inches). Massive structure, slight effervescence, dry. C horizon.
26-45	Saprolite.
45+	Rock.

TP3
(depth, inches)

0-1/2	Organic surface layer. Of horizon.
1/2-10	Brown sandy loam with 20% angular gravel less than 2 inch max. dimension. Angular blocky structure, no effervescence, slightly moist. A horizon.
10-32	Light yellowish brown sand with 50% angular gravel and cobbles (less than 6 inch). Weak blocky structure, no effervescence, dry. Bw horizon.
32-38	Light gray sandy loam with 40% angular gravel and cobbles (less than 4 inch). Angular blocky structure, violent effervescence, dry. Bk horizon.
38-50	Pale brown sand with 30% subangular coarse gravel (less than 3 inch). Massive structure, strong effervescence, dry. C1 horizon.
50+	Pale brown sand with 40% angular coarse gravel and cobbles (less than 8 inch). Massive structure, no effervescence, slightly moist. C2 horizon.

TP4
(depth, inches)

0-4	Dark grayish brown clay loam with 20% angular gravel and cobbles less than 4 inch max. dimension. Subangular blocky structure, no effervescence, dry. A horizon.
4-11	Dark grayish brown clay loam with 50% angular medium gravel (less than 1 inch). Angular blocky structure, no effervescence, dry. B1 horizon.
11-20	Light yellowish brown sandy clay loam with 5% subangular gravel and (less than 1 inch). Angular blocky structure, no effervescence (except on white concentrations), dry. B2 horizon.

TP4 - continued
(depth, inches)

20-37	Light reddish brown sandy clay loam with with 5% angular gravel (less than 1 inch). Massive structure, slight effervescence, dry. C1 horizon.
37-60+	Pale red sandy loam with 60% angular cobbles (less than 10 inch). Massive structure, violent effervescence, dry. C2 horizon.

TP5
(depth, inches)

0-2	Organic surface layer. Of horizon.
2-9	Gray loam with 50% cobbles less than 6 inch max. dimension. Subangular blocky structure, no effervescence, dry. A horizon.
9-26	Brown sandy clay loam with 50% subangular coarse gravel (less than 3 inch). Angular blocky structure, no effervescence, dry. B horizon.
26-39	Pale brown clay loam with 30% angular gravel and cobbles (less than 4 inch). Massive structure, violent effervescence, dry. C horizon.
39-60+	Yellow loamy sand (Saprolite). Violent effervescence, dry.

TP6
(depth, inches)

0-3	Organic surface layer. Of horizon.
3-20	Dark gray sandy clay loam with 5% angular gravel less than 1 inch max. dimension. Angular blocky structure, no effervescence, dry. A horizon.
20-44	Light yellowish brown sandy clay loam with 15% angular coarse gravel (less than 3 inch). Massive structure, no effervescence, slightly moist. C1 horizon.
44-60+	Reddish brown clay loam with 70% angular coarse gravel and cobbles (less than 4 inch). Massive structure, no effervescence, very moist. C2 horizon.

TP7
(depth, inches)

0-3	Very dark grayish brown sandy clay loam with 15% angular cobbles and stones less than 24 inch max. dimension. Rounded blocky structure, no effervescence, dry. A horizon.
3-9	Very dark grayish brown sandy loam with 40% angular cobbles (less than 8 inch). Angular blocky structure, no effervescence, dry. B1 horizon.
9-16	Brown loamy sand with 40% angular cobbles (less than 8 inch). Subangular blocky structure, no effervescence, moist. B2 horizon.
16-35	Yellowish brown loamy sand with 5% angular coarse gravel (less than 3 inch). White mottles. Massive structure, strong effervescence, wet. C1 horizon.
35-60+	Yellowish brown silty clay with 35% angular cobbles (mostly less than 4 inch, with one boulder spanning the test pit). Orange mottles. Massive structure, no effervescence, wet. C2 horizon.

(Water observed in test pit at 60 inch depth after ½ day open.)

TP8
(depth, inches)

0-2	Organic surface layer. Of horizon.
2-26	Black silty clay loam with 5% angular medium gravel (less than 1 inch). Granular structure, no effervescence, slightly moist. A horizon.
26-42	Yellowish brown sandy clay loam with 15% angular coarse gravel (less than 2 inch). Slight orange mottling. Massive structure, no effervescence, moist. C1 horizon.
42-60+	Dark yellowish brown sandy clay loam with 70% angular cobbles (larger than 3 inch). Orange mottles. Massive structure, no effervescence, very moist. C2 horizon.

TP9
(depth, inches)

0-4	Organic surface layer. Of horizon.
4-11	Light olive gray sandy loam with 30% angular coarse gravel and cobbles less than 4 inch max. dimension. Angular blocky structure, no effervescence, moist. AB horizon.
11-24	Light olive gray sandy clay with 10% angular gravel (less than 1 inch). Grayish orange mottles. Angular blocky structure, no effervescence, moist. Bt horizon.
24-35	Light olive brown sandy clay, no coarse fragments. Orange mottles. Slight blocky structure, no effervescence, very moist. Bw horizon.
35-46	Olive brown clay with 10% angular gravel (less than 1 inch). Orange and black mottles. Massive structure, no effervescence, wet. C1 horizon.
35-60+	Light olive brown clay with 20% angular gravel (less than 2 inch). Orangish red mottles. Massive structure, no effervescence, wet. C2 horizon.

(Water observed in test pit at 50 inch depth after 2 hours open.)

TP10
(depth, inches)

0-4	Black sandy loam, no coarse fragments. Subangular blocky structure, no effervescence, dry. A horizon.
4-14	Light olive brown loamy sand with 40% angular coarse gravel and cobbles (less than 4 inch). Angular blocky structure, no effervescence, slightly moist. B1 horizon.
14-18	Light olive brown clayey sand with 30% angular coarse gravel and cobbles (less than 4 inch). Massive structure, no effervescence, slightly moist. Bt horizon.
18-60+	Light yellowish brown sand, no coarse fragments. Massive structure, no effervescence, moist. C horizon.

Note: Topography and vegetation information is available on the field forms, including notes regarding the presence of roots in the soil profile. Information is also available on the field forms regarding horizon boundary characteristics.

Butte Highlands
Test Pit Descriptions
Area of Intensive Test Pitting - W. Welzenbach
September 14 and 15, 2009

Column "A" of Test Pit Locations

A200
Setting: Edge between aspen forest and willowy seasonal stream channels and shallow groundwater.
(depth, inches)

0-15	Dark brown sandy loam. A horizon.
15-48	Sandy loam with 10% angular cobbles.
48-60	Sandy loam with 60% angular cobbles. Heavy orange mottling.

A400
Setting: Slightly into forest east above willowy area of seasonal shallow groundwater. Slightly lower elevation than meadow to south. On topographic break from west-sloping meadow to northwest-sloping meadow above stream channels.
(depth, inches)

0-18	Dark brown sandy silt. A horizon. Orange mottling near 18 inch depth.
18-48	Sandy loam with 10% angular cobbles.
48-60	Sandy loam with 60% angular cobbles.

A600
Setting: Meadow with short shrubs (potentilla) approx. 120 feet downhill from edge of aspen grove.
(depth, inches)

0-12	Dark loam with 20% rounded gravel. A horizon.
12-30	Alluvium – gray sandy loam with 60% rounded gravel. Strong blocky structure. Dry.
30-60	Dark brown clay loam. Dry.
60-84+	Grayish dark brown clay loam with very slight orange mottling. Moist.

A800
Setting: Meadow with short shrubs (potentilla) approx. 100 feet downhill from edge of aspen grove.
(depth, inches)

0-16	A horizon. Dry.
16-36	Grayish brown loam. Strong angular blocky structure. Slightly moist.
36-78+	Medium brown sandy clay loam. Orange mottling starting at 3.5 feet, and increasing with depth. Moist.

Column "A" of Test Pit Locations (continued)

A1000
Setting: Meadow with short shrubs (potentilla) approx. 60 feet downhill from edge of aspen grove, and 80 feet uphill from rise before pine regrowth.
(depth, inches)

0-8	A horizon.
8-30	Pale brownish gray loamy sand with 40% slightly rounded gravel. Dry.
30-42	Dark brown loam, 10% large cobbles. Strong blocky structure. Slightly moist.
42-96+	Medium brown clay loam. No coarse material. Massive structure. Moist.

A1200
Setting: Very sparse pine regrowth.
(depth, inches)

0-3	A horizon.
3-24	Light gray sandy loam. E horizon.
24-42	Dark brown clay loam. Strong blocky structure. Moist. Bt horizon.
42-120+	Medium brown loam to clay loam. Moist (no change in moisture with depth).

A1400
Setting: South-facing meadow with shrubs (potentilla), but no trees or stumps.
(depth, inches)

0-7	A horizon.
7-30	Grayish brown sandy loam with rounded gravel. Dry. Alluvium.
30-96+	Dark brown clay loam with slight fine rounded gravel. Moist.

Column "B" of Test Pit Locations

B200
Setting: Willowy area of seasonal stream channels and shallow groundwater. 50 feet from soil survey test pit TP9.
(depth, inches)

0-10	Dark loam with slightly rounded gravel. A horizon in alluvium.
10-24	Medium brown silt with heavy orangish-red mottling. Seasonally high water table up to 10 in.
24+	Lower chroma (more grayish) soil. Standing water at 60 inches in test pit.

B400
Setting: Willowy area of seasonal stream channels and shallow groundwater.
(depth, inches)

0-10	Dark loam with slightly rounded gravel. A horizon in alluvium.
10-30	Medium brown silt with heavy orangish-red mottling and 5% fine gravel. Seasonally high water table up to 10 in.
30+	Lower chroma (more grayish) soil with coarse, angular gravel and cobbles. Standing water at 52 inches in test pit.

B600
Setting: In meadow approx. 100 feet uphill (east) of trees indicating potential alluvium edge.
(depth, inches)

0-7	Grayish dark brown A horizon.
7-24	Gray loam.
24-54	Dark brown clay loam with angular cobbles.
54+	Yellowish light brown clay loam with slight orange mottling. Pit bottom saturated with water at 6 feet.

B800
Setting: In meadow.
(depth, inches)

0-7	Grayish dark brown A horizon.
7-20	Grayish brown loam with prevalent roots.
20-72+	Light brownish yellow loamy sand with angular cobbles. Granite weathered in-place.

Column "B" of Test Pit Locations (continued)

B1000
Setting: Sparse pine trees in formerly logged area. Slight rise above B800.
(depth, inches)

0-4	A horizon.
4-30	Light grayish brown gravelly loam.
30-42	Light grayish brown gravelly loam with 60% cobbles.
42-84+	Sandy weathered granite. Very moist below 4.5 feet. Standing water at 7.1 feet.

B1200
Setting: Pine trees in formerly logged area. Top of rise in sand unit.
(depth, inches)

0-3	A horizon.
3-24	Grayish brown loamy sand with 20% slightly rounded gravel and cobbles.
24-96+	Sandy weathered granite. Moist below 5 feet.

B1400
Setting: Pine trees in formerly logged area.
(depth, inches)

0-3	A horizon.
3-30	Sandy loam with 40% slightly rounded gravel.
30-42	Sandy loam with 80% angular cobbles.
42-84+	Sandy weathered granite (no cohesion).

Column "C" of Test Pit Locations

C600
Setting: In steeper meadow, down-drainage from willowy area of shallow groundwater and season stream channels, and downhill from fir trees on edge of alluvium. Likely to have shallow bedrock, based on shallow rock encountered in C800.
(depth, inches)

0-4	A horizon.
4-44	Grayish brown sandy loam with 30% large angular gravel.
44-72+	85% angular cobbles and stones. Slightly moist. (No orange mottling.)

C800
Setting: Steeper meadow dipping toward Moose Creek. Convex slope (across and up-down). Minimal soil development.
(depth, inches)

0-4	A horizon.
4-44	Grayish brown sandy loam with 30% large angular gravel.
44-72+	85% angular cobbles and stones. Slightly moist. (No orange mottling.)

C1000
Setting: Steeper meadow dipping toward Moose Creek. Convex slope (across and up-down). Minimal soil development.
(depth, inches)

0-4	A horizon.
4-20	Grayish brown sandy loam. Blocky structure. Prevalent roots.
20-26	Fine to medium gravel. Dry.
26-84+	Coarse gravel and cobbles. Dry.

C1200
Setting: Pine trees in formerly logged area.
(depth, inches)

0-3	A horizon.
3-20	Gray Sandy loam with slightly rounded medium gravel. Wavy boundary.
20-96+	Sandy weathered granite. Scarce tree roots to 5 feet. Orange mottling below 5 feet.

C1400
Setting: Pine trees in formerly logged area.
(depth, inches)

0-3	A horizon.
3-40	Grayish brown gravelly, sandy loam. Slightly rounded gravel.
40-60	80% cobbles, with minor loamy sand. Dry
60-84+	Sandy weathered granite with slight cohesion indicating presence of fines. Moist.

Column "C" of Test Pit Locations (continued)

C1600
Setting: Sparse pine trees in formerly logged area. Southern shoulder of sand ridge.
(depth, inches)

0-6	A horizon.
6-72+	Orange and gray weathered granite. Finer grains and more consolidation with depth.

Column "D" of Test Pit Locations

D1000
Setting: Willowy area of seasonal stream channels and shallow groundwater.
(depth, inches)

0-24	Dark clay loam. A horizon.
24-48	Light gray sandy clay. Moist.
48+	Water in pit. Start of heavy orange mottling.

D1200
Setting: Pine trees in formerly logged area. Shoulder of sand ridge.
(depth, inches)

0-2	A horizon.
2-10	Gray silty sand.
10-36	Gray and orange sand and weathered granite.
36-48	Angular cobbles.
48-72+	Sandy weathered granite. Moist.

D1400
Setting: Pine trees in formerly logged area. Shoulder of sand ridge.
(depth, inches)

0-4	Light colored (ochric) A horizon with 30% slightly rounded cobbles.
4-36	Brownish light gray sandy silt. Dry.
36-72+	Orangish gray sand. Moist below 4.5 feet.

D1600
Setting: Southern edge of pine trees in formerly logged area. Adjacent to eroded 3-feet-deep gully. 50 feet above shoulder of sand ridge.
(depth, inches)

0-4	Light colored (ochric) A horizon.
4-36	Brownish light gray sandy silt. No coarse fragments. Dry.
36-72+	Orangish gray sand. Slightly moist.

APPENDIX B
Photographs

Photo #1: TP1 profile

Photo #2: TP1 profile, zoomed in

Photo #3: TP1 vicinity, looking northeast

Photo #4: TP2 profile

Photo #5: TP2 profile, zoomed in

Photo #6: TP2 vicinity, looking north

Photo #7: TP2 vicinity, looking south

Photo #8: TP3 profile

Photo #9: TP3 profile, zoomed in

Photo #10: TP3 vicinity, looking north

Photo #11: TP3 vicinity, looking south

Photo #12: TP4 profile

Photo #13: TP4 profile, zoomed in

Photo #14: Carbonate concentration from depth of 38 to 40 inches in TP4

Photo #15: TP4 vicinity, looking north

Photo #16: TP4 vicinity, looking south

Photo #17: TP5 profile

Photo #18: TP5 profile, zoomed in

Photo #19: TP5 vicinity, looking north

Photo #20: TP5 vicinity, looking southeast

Photo #21: TP6 profile

Photo #22: TP6 profile, zoomed in

Photo #23: TP6 vicinity, looking north

Photo #24: TP6 vicinity, looking south

Photo #25: TP7 profile

Photo #26: TP7 profile, zoomed in

Photo #27: Standing water in TP7

Photo #28: TP7 vicinity, looking north

Photo #29: TP7 vicinity, looking south

Photo #30: TP8 profile

Photo #31: TP8 profile, zoomed in

Photo #32: TP8 vicinity, looking north

Photo #33: TP8 vicinity, looking south

Photo #34: TP9 profile

Photo #35: TP9 profile, zoomed in

Photo #36: Standing water in TP9

Photo #37: TP9 vicinity, looking northeast

Photo #38: TP9 vicinity, looking southwest

Photo #39: TP10 profile

Photo #40: TP10 profile, zoomed in

Photo #41: TP10 vicinity, looking northeast

Photo #42: TP10 vicinity, looking southwest

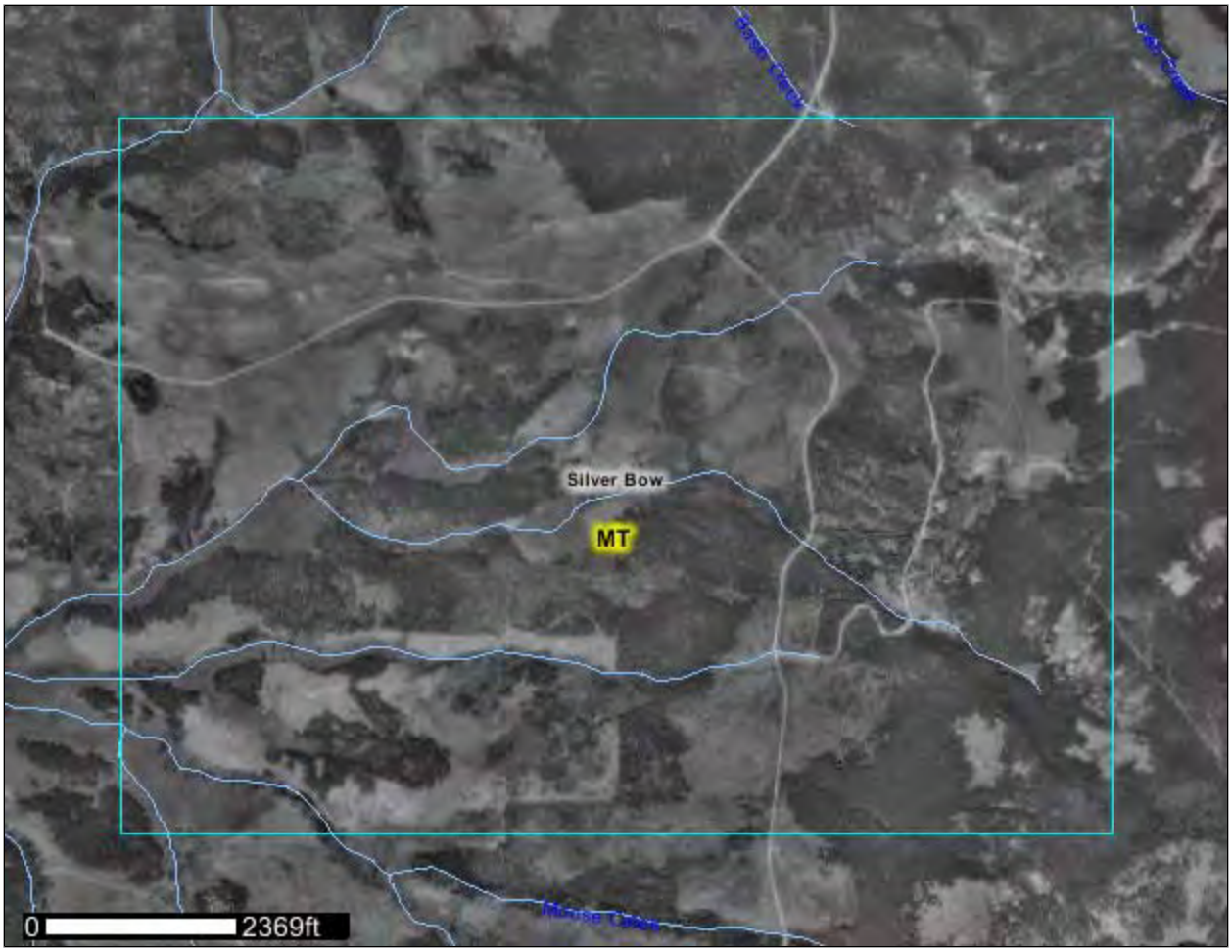
APPENDIX C
NRCS Custom Soil Resource Report

United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Deer Lodge National Forest Area, Montana



September 30, 2009

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://soils.usda.gov/sqi/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://soils.usda.gov/contact/state_offices/).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the

individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

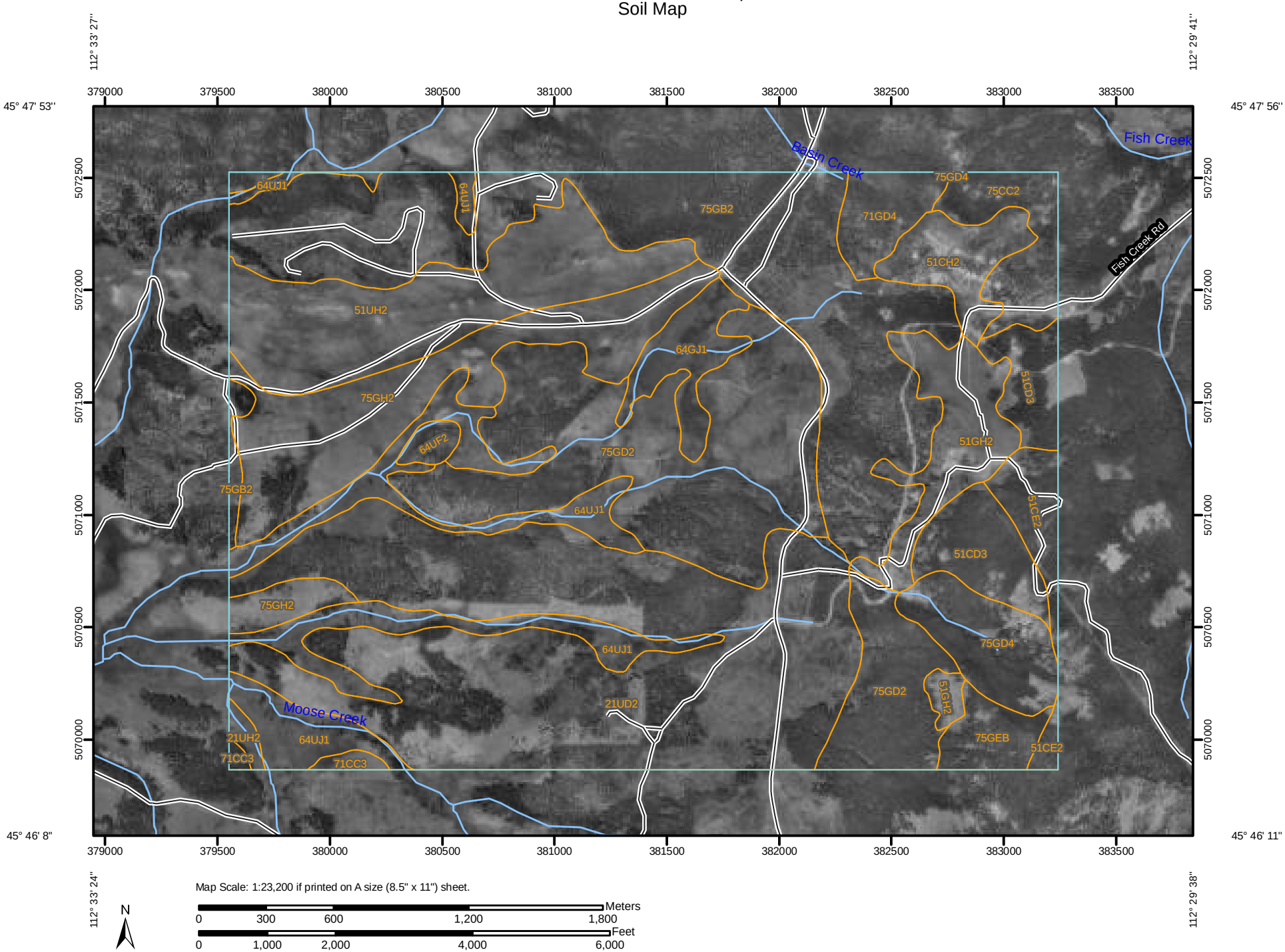
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:23,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Deer Lodge National Forest Area, Montana
Survey Area Data: Version 6, Oct 27, 2008

Date(s) aerial images were photographed: 8/1/1995; 8/20/1995

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Deer Lodge National Forest Area, Montana (MT635)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
21UD2	Garlet-Worock-Waldbillig families, complex, moderately steep young moraines, cool	566.2	23.3%
21UH2	Libeg-Marcetta-Finn families, complex, moderately steep young moraines	6.3	0.3%
51CD3	Whitore-Rumsey families-Rubble land complex, steep ridges and mountain slopes	84.0	3.5%
51CE2	Whitore-Tropal families-Rubble land complex, steep ridges and mountain slopes	38.1	1.6%
51CH2	Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes	49.1	2.0%
51GH2	Opitz-Bavdark families-Rubble land complex, steep ridges and mountain slopes	86.1	3.6%
51UH2	Sebud-Libeg-Marcetta families, complex, steep ridges and mountain slopes	189.8	7.8%
64GJ1	Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains	44.9	1.9%
64UF2	Elve-Finn families-Water complex, rolling stream terraces and flood plains	9.8	0.4%
64UJ1	Finn-Lowder-Dunkleber families, complex, stream terraces and flood plains	174.9	7.2%
71CC3	Helmville-Garlet families, complex, high relief mountain slopes and ridges	7.6	0.3%
71GD4	Blackleed-Ovando-Kurrie families, complex, high relief mountain slopes and ridges	36.5	1.5%
75CC2	Helmville-Relyea-Whitore families, complex, low relief mountain slopes and ridges	54.2	2.2%
75GB2	Windyridge-Como-Hiore families, complex, low relief mountain slopes and ridges	417.3	17.2%
75GD2	Kurrie-Goldflint-Warwood families, complex, low relief mountain slopes and ridges	373.7	15.4%
75GD4	Goldflint family-Rock outcrop-Ovando family, complex, low relief mountain slopes and ridges	63.4	2.6%
75GEB	Leighcan-Kurrie-Jeru families, complex, nivational mountain slopes and ridges	30.3	1.2%
75GH2	Opitz-Bavdark-Marcetta families, complex, low relief mountain slopes and ridges	193.0	8.0%
Totals for Area of Interest		**2,425.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly

indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Deer Lodge National Forest Area, Montana

21UD2—Garlet-Worock-Waldbillig families, complex, moderately steep young moraines, cool

Map Unit Setting

Elevation: 6,000 to 7,700 feet
Mean annual precipitation: 22 to 28 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 60 days

Map Unit Composition

Garlet and similar soils: 35 percent
Worock and similar soils: 20 percent
Waldbillig and similar soils: 15 percent
Minor components: 30 percent

Description of Garlet

Setting

Landform: Ground moraines
Landform position (two-dimensional): Shoulder, backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Drift derived from limestone, sandstone, and shale

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940)

Typical profile

0 to 4 inches: Gravelly sandy loam
4 to 19 inches: Very channery sandy loam
19 to 46 inches: Very cobbly loam
46 to 70 inches: Very cobbly loam

Description of Worock

Setting

Landform: Ground moraines
Landform position (two-dimensional): Toeslope, footslope
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Drift derived from sandstone and shale

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.1 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 19 inches: Stony loam
19 to 53 inches: Very gravelly clay loam
53 to 60 inches: Very gravelly clay loam

Description of Waldbillig

Setting

Landform: Ground moraines
Landform position (two-dimensional): Footslope, toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash over drift derived from sandstone and siltstone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730)

Typical profile

0 to 2 inches: Moderately decomposed plant material
2 to 12 inches: Gravelly ashy silt loam
12 to 28 inches: Very gravelly fine sandy loam
28 to 60 inches: Very gravelly sandy loam

Minor Components

Bata

Percent of map unit: 10 percent
Landform: Ground moraines
Landform position (two-dimensional): Toeslope, footslope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730)

Elvick

Percent of map unit: 10 percent
Landform: Drainageways, ground moraines, depressions
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950)

Loberg

Percent of map unit: 5 percent
Landform: Ground moraines
Landform position (two-dimensional): Toeslope, footslope
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Lowder

Percent of map unit: 3 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650)

Finn

Percent of map unit: 2 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650)

21UH2—Libeg-Marcetta-Finn families, complex, moderately steep young moraines

Map Unit Setting

Elevation: 4,500 to 7,500 feet
Mean annual precipitation: 15 to 27 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Libeg and similar soils: 65 percent
Marcetta and similar soils: 20 percent
Finn and similar soils: 15 percent

Description of Libeg

Setting

Landform: Ground moraines
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Drift derived from sandstone and shale

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.4 inches)

Interpretive groups

Land capability (nonirrigated): 7s

Typical profile

0 to 6 inches: Very stony loam
6 to 16 inches: Very stony loam
16 to 30 inches: Very stony sandy clay loam
30 to 60 inches: Extremely stony sandy loam

Description of Marcetta

Setting

Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Colluvium derived from andesite

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.3 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 10 inches: Gravelly loam
10 to 17 inches: Very gravelly loam
17 to 48 inches: Very gravelly loam
48 to 60 inches: Extremely gravelly loam

Description of Finn

Setting

Landform: Drainageways, ground moraines, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Glaciofluvial deposits derived from sandstone and shale

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 11 inches: Gravelly loam
11 to 17 inches: Very gravelly loam
17 to 23 inches: Very gravelly sandy clay loam
23 to 60 inches: Very cobbly sandy clay loam

51CD3—Whitore-Rumsey families-Rubble land complex, steep ridges and mountain slopes

Map Unit Setting

Elevation: 6,000 to 7,700 feet
Mean annual precipitation: 22 to 28 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 60 days

Map Unit Composition

Whitore and similar soils: 65 percent
Rumsey and similar soils: 20 percent
Rubble land: 15 percent

Description of Whitore

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 8 inches: Very channery loam
8 to 60 inches: Extremely cobbly loam

Description of Rumsey

Setting

Landform: Mountains
Landform position (three-dimensional): Mountainflank, mountainbase
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and silty volcanic ash over gravelly colluvium derived from limestone

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/twinflower (PK660)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 7 inches: Gravelly ashy silt loam
7 to 41 inches: Very gravelly loam
41 to 60 inches: Very gravelly loam

51CE2—Whitore-Tropal families-Rubble land complex, steep ridges and mountain slopes

Map Unit Setting

Elevation: 7,700 to 10,560 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 34 to 37 degrees F
Frost-free period: 20 to 40 days

Map Unit Composition

Whitore and similar soils: 40 percent
Tropal and similar soils: 25 percent
Rubble land: 20 percent
Minor components: 15 percent

Description of Whitore

Setting

Landform: Ridges, mountain slopes, patterned ground
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: subalpine fir/smooth wood-rush (PK830), whitebark pine-subalpine fir (PK850), alpine larch-subalpine fir (PK860), whitebark pine (PK870)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 8 inches: Very channery loam
8 to 60 inches: Extremely cobbly loam

Description of Tropal

Setting

Landform: Ridges, mountain slopes
Landform position (two-dimensional): Shoulder, summit
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Very low (about 1.1 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Other vegetative classification: whitebark pine-subalpine fir (PK850), alpine larch-subalpine fir (PK860), whitebark pine (PK870), subalpine fir/smooth wood-rush (PK830)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 4 inches: Stony loam
4 to 13 inches: Extremely gravelly loam
13 to 18 inches: Extremely gravelly loam
18 to 60 inches: Bedrock

Minor Components

Rock outcrop

Percent of map unit: 10 percent

Rumsey

Percent of map unit: 5 percent
Landform: Mountain slopes, ridges
Landform position (three-dimensional): Mountainbase, mountainflank
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: subalpine fir/twinflower (PK660)

51CH2—Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes

Map Unit Setting

Elevation: 4,500 to 8,500 feet
Mean annual precipitation: 15 to 27 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Hanson and similar soils: 50 percent
Tiban and similar soils: 35 percent
Rubble land: 15 percent

Description of Hanson

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 60 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.5 inches)

Interpretive groups
Land capability (nonirrigated): 6e

Typical profile
0 to 8 inches: Very gravelly loam
8 to 60 inches: Very gravelly loam

Description of Tiban

Setting
Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities
Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.4 inches)

Interpretive groups
Land capability (nonirrigated): 6e

Typical profile
0 to 4 inches: Cobbly loam
4 to 13 inches: Very stony loam
13 to 23 inches: Very gravelly clay loam
23 to 60 inches: Very gravelly clay loam

51GH2—Opitz-Bavdark families-Rubble land complex, steep ridges and mountain slopes

Map Unit Setting
Elevation: 4,500 to 8,000 feet
Mean annual precipitation: 15 to 24 inches

Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Opitz and similar soils: 55 percent
Bavdark and similar soils: 30 percent
Rubble land: 15 percent

Description of Opitz

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy slope alluvium and/or colluvium over residuum weathered from granite

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock; 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Ecological site: Thin Sandy (TSy) 15-19" p.z. (R043BS317MT)

Typical profile

0 to 10 inches: Sandy loam
10 to 15 inches: Gravelly sandy clay loam
15 to 22 inches: Gravelly sandy loam
22 to 36 inches: Gravelly loamy coarse sand
36 to 57 inches: Bedrock
57 to 60 inches: Bedrock

Description of Bavdark

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.1 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Ecological site: Overflow (Ov) 20"+ p.z. NOT KNOWN (R043BS321MT)

Typical profile

0 to 10 inches: Coarse sandy loam
10 to 18 inches: Coarse sandy loam
18 to 42 inches: Sandy clay loam
42 to 60 inches: Coarse sandy loam

51UH2—Sebud-Libeg-Marcetta families, complex, steep ridges and mountain slopes

Map Unit Setting

Elevation: 4,500 to 8,500 feet
Mean annual precipitation: 15 to 30 inches
Mean annual air temperature: 36 to 43 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Sebud and similar soils: 40 percent
Libeg and similar soils: 25 percent
Marcetta and similar soils: 20 percent
Minor components: 15 percent

Description of Sebud

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and siltstone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.0 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: festuca scabrella/agropyron spicatum h.t. (MS0301), festuca scabrella/festuca idahoensis h.t. (MS0303)

Typical profile

0 to 10 inches: Cobbly loam

10 to 60 inches: Very cobbly loam

Description of Libeg

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.4 inches)

Interpretive groups

Land capability (nonirrigated): 7s
Other vegetative classification: festuca scabrella/agropyron spicatum h.t. (MS0301), festuca scabrella/festuca idahoensis h.t. (MS0303)

Typical profile

0 to 7 inches: Extremely cobbly sandy loam
7 to 36 inches: Extremely cobbly sandy clay loam
36 to 60 inches: Extremely cobbly sandy loam

Description of Marcetta

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from sandstone and shale

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.3 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: festuca scabrella/agropyron spicatum h.t. (MS0301), festuca scabrella/festuca idahoensis h.t. (MS0303)

Typical profile

0 to 10 inches: Very gravelly loam
10 to 17 inches: Very gravelly loam

17 to 48 inches: Extremely gravelly loam
48 to 60 inches: Extremely gravelly loam

Minor Components

Ratiopeak

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: festuca scabrella/agropyron spicatum h.t. (MS0301), festuca scabrella/festuca idahoensis h.t. (MS0303)

Tiban

Percent of map unit: 5 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: festuca scabrella/agropyron spicatum h.t. (MS0301), festuca scabrella/festuca idahoensis h.t. (MS0303)

Rock outcrop

Percent of map unit: 5 percent

64GJ1—Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains

Map Unit Setting

Elevation: 4,500 to 7,700 feet
Mean annual precipitation: 15 to 28 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Cryofluvents and similar soils: 55 percent
Finn and similar soils: 30 percent
Water: 15 percent

Description of Cryofluvents

Setting

Landform: Stream terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: Moderate (about 6.1 inches)

Typical profile

0 to 2 inches: Sandy loam
2 to 9 inches: Sandy loam
9 to 36 inches: Sandy loam
36 to 60 inches: Very gravelly loamy sand

Description of Finn

Setting

Landform: Stream terraces, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from granite

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Other vegetative classification: subalpine fir/bluejoint (PK650)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 11 inches: Gravelly loam
11 to 17 inches: Very gravelly loam
17 to 23 inches: Very gravelly sandy clay loam
23 to 60 inches: Very cobbly sandy clay loam

64UF2—Elve-Finn families-Water complex, rolling stream terraces and flood plains

Map Unit Setting

Elevation: 5,000 to 7,000 feet
Mean annual precipitation: 15 to 24 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Elve and similar soils: 65 percent
Finn and similar soils: 15 percent
Water: 10 percent
Minor components: 10 percent

Description of Elve

Setting

Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Typical profile

0 to 2 inches: Slightly decomposed plant material
2 to 5 inches: Very gravelly sandy loam
5 to 12 inches: Very gravelly fine sandy loam
12 to 28 inches: Extremely gravelly fine sandy loam
28 to 60 inches: Extremely gravelly fine sandy loam

Description of Finn

Setting

Landform: Stream terraces, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Other vegetative classification: subalpine fir/bluejoint (PK650)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 11 inches: Gravelly loam
11 to 17 inches: Very gravelly loam
17 to 23 inches: Very gravelly sandy clay loam
23 to 60 inches: Very cobbly sandy clay loam

Minor Components

Worock

Percent of map unit: 5 percent
Landform: Stream terraces
Down-slope shape: Linear
Across-slope shape: Linear

Cryofluvents

Percent of map unit: 5 percent
Landform: Stream terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear

64UJ1—Finn-Lowder-Dunkleber families, complex, stream terraces and flood plains

Map Unit Setting

Elevation: 4,500 to 7,000 feet
Mean annual precipitation: 15 to 22 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Finn and similar soils: 65 percent
Lowder and similar soils: 20 percent
Dunkleber and similar soils: 15 percent

Description of Finn

Setting

Landform: Stream terraces, flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and shale

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)

Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 5.8 inches)

Interpretive groups

Other vegetative classification: subalpine fir/bluejoint (PK650)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 11 inches: Gravelly loam
11 to 17 inches: Very gravelly loam
17 to 23 inches: Very gravelly sandy clay loam
23 to 60 inches: Very cobbly sandy clay loam

Description of Lowder

Setting

Landform: Flood plains, drainageways, stream terraces
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and siltstone

Properties and qualities

Slope: 2 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water capacity: Low (about 4.8 inches)

Interpretive groups

Land capability (nonirrigated): 6w

Typical profile

0 to 7 inches: Very cobbly loam
7 to 33 inches: Very cobbly sandy clay loam
33 to 60 inches: Very gravelly sandy loam

Description of Dunkleber

Setting

Landform: Stream terraces, flood plains, drainageways
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Alluvium derived from sandstone and siltstone

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 0 to 6 inches

Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 13.8 inches)

Typical profile

0 to 12 inches: Mucky peat
12 to 60 inches: Mucky peat

71CC3—Helmville-Garlet families, complex, high relief mountain slopes and ridges

Map Unit Setting

Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 20 to 26 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Helmville and similar soils: 65 percent
Garlet and similar soils: 15 percent
Minor components: 20 percent

Description of Helmville

Setting

Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from argillaceous limestone

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Douglas-fir/twinflower (PK290), Douglas-fir/pinegrass (PK320), Douglas-fir/blue huckleberry (PK280)

Typical profile

0 to 2 inches: Slightly decomposed plant material

2 to 10 inches: Channery loam
10 to 14 inches: Very cobbly clay loam
14 to 25 inches: Very cobbly clay loam
25 to 60 inches: Very cobbly clay loam

Description of Garlet

Setting

Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone, sandstone, and shale

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: Low (about 4.8 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Douglas-fir/twinflower (PK290), Douglas-fir/pinegrass (PK320)

Typical profile

0 to 4 inches: Very channery sandy loam
4 to 19 inches: Very channery sandy loam
19 to 46 inches: Very cobbly sandy clay loam
46 to 70 inches: Extremely cobbly loam

Minor Components

Elvick

Percent of map unit: 10 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650), subalpine fir/menziesia (PK670)

Rock outcrop

Percent of map unit: 5 percent

Worock

Percent of map unit: 5 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Douglas-fir/ninebark (PK260), Douglas-fir/twinflower (PK290), Douglas-fir/dwarf huckleberry (PK250)

71GD4—Blackleed-Ovando-Kurrie families, complex, high relief mountain slopes and ridges

Map Unit Setting

Elevation: 6,000 to 7,700 feet
Mean annual precipitation: 22 to 28 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 60 days

Map Unit Composition

Blackleed and similar soils: 40 percent
Ovando and similar soils: 25 percent
Kurrie and similar soils: 15 percent
Minor components: 20 percent

Description of Blackleed

Setting

Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 45 to 70 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950)

Typical profile

0 to 3 inches: Cobbly coarse sandy loam
3 to 8 inches: Very cobbly coarse sandy loam
8 to 27 inches: Very stony coarse sandy loam
27 to 60 inches: Bedrock

Description of Ovando

Setting

Landform: Mountain slopes

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 45 to 70 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 6 inches: Very stony sandy loam
6 to 17 inches: Very stony loamy coarse sand
17 to 35 inches: Very stony loamy sand
35 to 60 inches: Extremely stony loamy sand

Description of Kurrie

Setting

Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from granite

Properties and qualities

Slope: 45 to 70 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Typical profile

0 to 4 inches: Coarse sandy loam
4 to 23 inches: Very cobbly sandy loam
23 to 41 inches: Very cobbly sandy clay loam
41 to 46 inches: Very gravelly sandy loam
46 to 60 inches: Bedrock

Minor Components

Comad

Percent of map unit: 10 percent
Landform: Mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730)

Elvick

Percent of map unit: 10 percent
Landform: Drainageways, draws
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940)

75CC2—Helmville-Relyea-Whitore families, complex, low relief mountain slopes and ridges

Map Unit Setting

Elevation: 5,000 to 6,500 feet
Mean annual precipitation: 20 to 26 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Helmville and similar soils: 35 percent
Relyea and similar soils: 30 percent
Whitore and similar soils: 25 percent
Minor components: 10 percent

Description of Helmville

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.4 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Douglas-fir/pinegrass (PK320), Douglas-fir/twinflower (PK290)

Typical profile

0 to 2 inches: Slightly decomposed plant material
2 to 10 inches: Cobbly loam
10 to 14 inches: Very cobbly clay loam
14 to 25 inches: Very cobbly clay loam
25 to 60 inches: Very cobbly clay loam

Description of Relyea

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Douglas-fir/dwarf huckleberry (PK250), Douglas-fir/twinflower (PK290)

Typical profile

0 to 3 inches: Gravelly loam
3 to 6 inches: Very gravelly clay loam
6 to 15 inches: Very gravelly clay
15 to 28 inches: Very gravelly clay loam
28 to 60 inches: Extremely cobbly loam

Description of Whitore

Setting

Landform: Mountain slopes, ridges

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from limestone

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: Douglas-fir/pinegrass (PK320)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 8 inches: Very channery loam
8 to 60 inches: Extremely cobbly loam

Minor Components

Rock outcrop

Percent of map unit: 10 percent

75GB2—Windyridge-Como-Hiore families, complex, low relief mountain slopes and ridges

Map Unit Setting

Elevation: 4,500 to 6,000 feet
Mean annual precipitation: 18 to 26 inches
Mean annual air temperature: 36 to 41 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Windyridge and similar soils: 30 percent
Hiore and similar soils: 20 percent
Como and similar soils: 20 percent
Minor components: 30 percent

Description of Windyridge

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Douglas-fir/pinegrass (PK320), Douglas-fir/Idaho fescue (PK220)

Typical profile

0 to 5 inches: Coarse sandy loam
5 to 12 inches: Gravelly loamy coarse sand
12 to 60 inches: Bedrock

Description of Como

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Douglas-fir/Idaho fescue (PK220), Douglas-fir/pinegrass (PK320), Douglas-fir/elk sedge (PK330), Douglas-fir/bluebunch wheatgrass (PK210)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 8 inches: Gravelly sandy loam
8 to 15 inches: Very gravelly sandy loam
15 to 60 inches: Very gravelly sand

Description of Hiore

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium over residuum weathered from granite

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: Douglas-fir/twinflower (PK290), Douglas-fir/pinegrass (PK320)

Typical profile

0 to 2 inches: Gravelly coarse sandy loam
2 to 7 inches: Gravelly coarse sandy loam
7 to 35 inches: Very gravelly loamy coarse sand
35 to 60 inches: Very gravelly loamy coarse sand

Minor Components

Rock outcrop

Percent of map unit: 10 percent

Peeler

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Douglas-fir/pinegrass (PK320)

Caseypeak

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: Douglas-fir/pinegrass (PK320), Douglas-fir/Idaho fescue (PK220)

Opitz

Percent of map unit: 5 percent
Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Thin Sandy (TSy) 15-19" p.z. (R043BS317MT)

Finn

Percent of map unit: 3 percent

Landform: Drainageways, depressions, draws
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650)

Lowder

Percent of map unit: 2 percent
Landform: Drainageways, draws
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Douglas-fir/twinflower (PK290)

75GD2—Kurrie-Goldflint-Warwood families, complex, low relief mountain slopes and ridges

Map Unit Setting

Elevation: 6,000 to 8,590 feet
Mean annual precipitation: 22 to 28 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 60 days

Map Unit Composition

Kurrie and similar soils: 40 percent
Goldflint and similar soils: 20 percent
Warwood and similar soils: 15 percent
Minor components: 25 percent

Description of Kurrie

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium over residuum weathered from granite

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability (nonirrigated): 7e

Other vegetative classification: subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940)

Typical profile

0 to 4 inches: Very cobbly sandy loam
4 to 23 inches: Very cobbly sandy loam
23 to 41 inches: Very cobbly sandy clay loam
41 to 46 inches: Very gravelly sandy loam
46 to 60 inches: Bedrock

Description of Goldflint

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Convex
Across-slope shape: Convex

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 0.5 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 6 inches: Coarse sandy loam
6 to 13 inches: Very gravelly coarse sand
13 to 60 inches: Bedrock

Description of Warwood

Setting

Landform: Ridges, ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Other vegetative classification: lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730)

Typical profile

0 to 2 inches: Moderately decomposed plant material
2 to 10 inches: Loam
10 to 22 inches: Sandy clay loam
22 to 40 inches: Sandy clay loam
40 to 62 inches: Gravelly sandy clay loam

Minor Components

Rock outcrop

Percent of map unit: 10 percent

Ovando

Percent of map unit: 5 percent
Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690)

Blackleed

Percent of map unit: 5 percent
Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear

Lowder

Percent of map unit: 3 percent
Landform: Drainageways, draws
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Douglas-fir/twinflower (PK290)

Finn

Percent of map unit: 2 percent
Landform: Drainageways, draws
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650)

75GD4—Goldflint family-Rock outcrop-Ovando family, complex, low relief mountain slopes and ridges

Map Unit Setting

Elevation: 6,000 to 7,700 feet
Mean annual precipitation: 22 to 28 inches
Mean annual air temperature: 36 to 39 degrees F
Frost-free period: 30 to 60 days

Map Unit Composition

Goldflint and similar soils: 30 percent
Rock outcrop: 25 percent
Ovando and similar soils: 20 percent
Rubble land: 15 percent
Minor components: 10 percent

Description of Goldflint

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Convex
Across-slope shape: Convex

Properties and qualities

Slope: 35 to 70 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 0.5 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 6 inches: Coarse sandy loam
6 to 13 inches: Very gravelly coarse sand
13 to 60 inches: Bedrock

Description of Ovando

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 35 to 70 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940)

Typical profile

0 to 1 inches: Slightly decomposed plant material
1 to 6 inches: Very stony sandy loam
6 to 17 inches: Very stony loamy coarse sand
17 to 35 inches: Very stony loamy sand
35 to 60 inches: Extremely stony loamy sand

Minor Components

Donnelly

Percent of map unit: 5 percent
Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950), subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940)

Caseypeak

Percent of map unit: 5 percent
Landform: Mountain slopes, ridges
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: subalpine fir/beargrass (PK690), subalpine fir/grouse whortleberry (PK730), lodgepole pine/grouse whortleberry (PK940), subalpine fir/dwarf huckleberry (PK640), lodgepole pine/pinegrass (PK950)

75GEB—Leighcan-Kurrie-Jeru families, complex, nivational mountain slopes and ridges

Map Unit Setting

Elevation: 7,700 to 10,000 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 34 to 37 degrees F
Frost-free period: 20 to 40 days

Map Unit Composition

Leighcan and similar soils: 45 percent
Kurrie and similar soils: 20 percent
Jeru and similar soils: 15 percent
Minor components: 20 percent

Description of Leighcan

Setting

Landform: Ridges, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.8 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Other vegetative classification: whitebark pine (PK870), subalpine fir/smooth wood-rush (PK830), whitebark pine-subalpine fir (PK850), alpine larch-subalpine fir (PK860)

Typical profile

0 to 4 inches: Gravelly sandy loam
4 to 9 inches: Very gravelly sandy loam
9 to 60 inches: Extremely gravelly sandy loam

Description of Kurrie

Setting

Landform: Mountain slopes, draws
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Colluvium derived from granite

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: 40 to 58 inches to paralithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: whitebark pine (PK870), subalpine fir/smooth wood-rush (PK830), whitebark pine-subalpine fir (PK850), alpine larch-subalpine fir (PK860)

Typical profile

0 to 4 inches: Stony sandy loam
4 to 23 inches: Very cobbly sandy loam
23 to 41 inches: Very cobbly sandy clay loam
41 to 46 inches: Gravelly coarse sandy loam
46 to 60 inches: Bedrock

Description of Jeru

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite

Properties and qualities

Slope: 25 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.9 inches)

Interpretive groups

Land capability (nonirrigated): 7e
Other vegetative classification: alpine larch-subalpine fir (PK860), whitebark pine (PK870), subalpine fir/smooth wood-rush (PK830), whitebark pine-subalpine fir (PK850)

Typical profile

0 to 4 inches: Bouldery ashy loam
4 to 32 inches: Very cobbly sandy loam
32 to 60 inches: Very cobbly sandy loam

Minor Components

Elvick

Percent of map unit: 10 percent
Landform: Drainageways, draws
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: subalpine fir/smooth wood-rush (PK830), whitebark pine-subalpine fir (PK850), alpine larch-subalpine fir (PK860), whitebark pine (PK870)

Finn

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: subalpine fir/bluejoint (PK650)

Rock outcrop

Percent of map unit: 3 percent

Rubble land

Percent of map unit: 2 percent

75GH2—Opitz-Bavdark-Marcetta families, complex, low relief mountain slopes and ridges

Map Unit Setting

Elevation: 4,500 to 7,000 feet
Mean annual precipitation: 15 to 27 inches
Mean annual air temperature: 39 to 43 degrees F
Frost-free period: 30 to 70 days

Map Unit Composition

Opitz and similar soils: 45 percent
Bavdark and similar soils: 30 percent
Marcetta and similar soils: 20 percent
Minor components: 5 percent

Description of Opitz

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy slope alluvium and/or colluvium over residuum weathered from granite

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock; 40 to 60 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Ecological site: Thin Sandy (TSy) 15-19" p.z. (R043BS317MT)

Typical profile

0 to 10 inches: Sandy loam
10 to 15 inches: Gravelly sandy clay loam
15 to 22 inches: Gravelly sandy loam
22 to 36 inches: Gravelly loamy coarse sand
36 to 57 inches: Bedrock
57 to 60 inches: Bedrock

Description of Bavdark

Setting

Landform: Mountain slopes, ridges
Down-slope shape: Linear
Across-slope shape: Linear

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.1 inches)

Interpretive groups

Land capability (nonirrigated): 6e
Ecological site: Overflow (Ov) 20"+ p.z. NOT KNOWN (R043BS321MT)

Typical profile

0 to 10 inches: Coarse sandy loam
10 to 18 inches: Coarse sandy loam
18 to 42 inches: Sandy clay loam
42 to 60 inches: Coarse sandy loam

Description of Marcetta

Setting

Landform: Swales, mountain slopes
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Colluvium derived from granite

Properties and qualities

Slope: 10 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.3 inches)

Interpretive groups

Land capability (nonirrigated): 6e

Typical profile

0 to 10 inches: Gravelly loam
10 to 17 inches: Very gravelly loam
17 to 48 inches: Very gravelly loam
48 to 60 inches: Extremely gravelly loam

Minor Components

Rubble land

Percent of map unit: 5 percent

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Saturated Hydraulic Conductivity (Ksat), Standard Classes (Butte Highlands)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits. The classes are:

Very low: 0.00 to 0.01

Low: 0.01 to 0.1

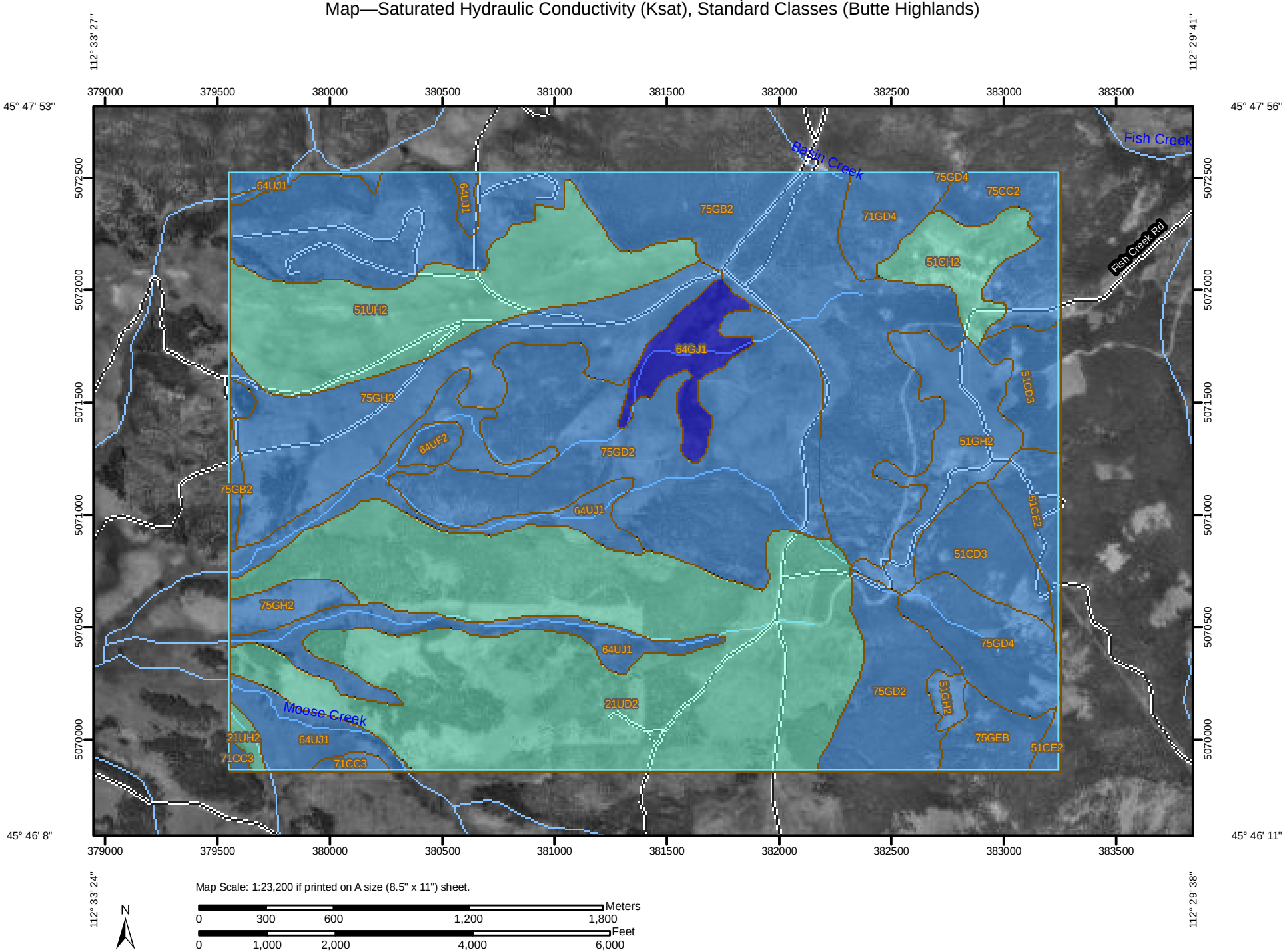
Moderately low: 0.1 to 1.0

Moderately high: 1 to 10

High: 10 to 100

Very high: 100 to 705

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Butte Highlands)



Map Scale: 1:23,200 if printed on A size (8.5" x 11") sheet.

N

Meters
0 300 600 1,200 1,800

Feet
0 1,000 2,000 4,000 6,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

Very Low (0.0 - 0.01)

Low (0.01 - 0.1)

Moderately Low (0.1 - 1)

Moderately High (1 - 10)

High (10 - 100)

Very High (100 - 705)

Not rated or not available

Political Features

Cities

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:23,200 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Deer Lodge National Forest Area, Montana
Survey Area Data: Version 6, Oct 27, 2008

Date(s) aerial images were photographed: 8/1/1995; 8/20/1995

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Butte Highlands)

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — Deer Lodge National Forest Area, Montana				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
21UD2	Garlet-Worock-Waldbillig families, complex, moderately steep young moraines, cool	9.0000	566.2	23.3%
21UH2	Libeg-Marcetta-Finn families, complex, moderately steep young moraines	7.5493	6.3	0.3%
51CD3	Whitore-Rumsey families-Rubble land complex, steep ridges and mountain slopes	11.5855	84.0	3.5%
51CE2	Whitore-Tropal families-Rubble land complex, steep ridges and mountain slopes	11.5855	38.1	1.6%
51CH2	Hanson-Tiban families-Rubble land complex, steep ridges and mountain slopes	9.0000	49.1	2.0%
51GH2	Opitz-Bavdark families-Rubble land complex, steep ridges and mountain slopes	52.6154	86.1	3.6%
51UH2	Sebud-Libeg-Marcetta families, complex, steep ridges and mountain slopes	9.0000	189.8	7.8%
64GJ1	Cryofluvents-Finn family-Water complex, rolling stream terraces and flood plains	101.9803	44.9	1.9%
64UF2	Elve-Finn families-Water complex, rolling stream terraces and flood plains	31.6842	9.8	0.4%
64UJ1	Finn-Lowder-Dunkleber families, complex, stream terraces and flood plains	22.0829	174.9	7.2%
71CC3	Helmville-Garlet families, complex, high relief mountain slopes and ridges	11.7342	7.6	0.3%
71GD4	Blackleed-Ovando-Kurrie families, complex, high relief mountain slopes and ridges	28.0000	36.5	1.5%
75CC2	Helmville-Relyea-Whitore families, complex, low relief mountain slopes and ridges	11.7342	54.2	2.2%
75GB2	Windyridge-Como-Hiore families, complex, low relief mountain slopes and ridges	64.2667	417.3	17.2%
75GD2	Kurrie-Goldflint-Warwood families, complex, low relief mountain slopes and ridges	12.7350	373.7	15.4%

Saturated Hydraulic Conductivity (Ksat), Standard Classes— Summary by Map Unit — Deer Lodge National Forest Area, Montana				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
75GD4	Goldflint family-Rock outcrop-Ovando family, complex, low relief mountain slopes and ridges	70.6364	63.4	2.6%
75GEB	Leighcan-Kurrie-Jeru families, complex, nivational mountain slopes and ridges	28.0000	30.3	1.2%
75GH2	Opitz-Bavdark-Marcetta families, complex, low relief mountain slopes and ridges	52.6154	193.0	8.0%
Totals for Area of Interest			**2,425.3**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat), Standard Classes (Butte Highlands)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: Depth Range

Top Depth: 0

Bottom Depth: 60

Units of Measure: Inches

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APPENDIX D
Laboratory Results

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* 406.252.6325 * FAX 406.252.6069 * eli@energylab.com

ANALYTICAL SUMMARY REPORT

October 05, 2009

Craig Crowell
Timberline Resources
101 E Lakeside Ave
Coeur d'Alene, ID 83814-

Workorder No.: B09090294

Project Name: Butte Highlands 14716

Energy Laboratories Inc received the following 33 samples for Timberline Resources on 9/2/2009 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
B09090294-001	TP 1, 1-13	08/28/09 10:00	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-002	TP1, 13-26	08/28/09 10:00	09/02/09	Soil	Same As Above
B09090294-003	TP2, 0.75-5	08/28/09 11:00	09/02/09	Soil	Same As Above
B09090294-004	TP2, 5-26	08/28/09 11:00	09/02/09	Soil	Same As Above
B09090294-005	TP3, 0.5-10	08/28/09 12:00	09/02/09	Soil	Same As Above
B09090294-006	TP3, 10-32	08/28/09 12:00	09/02/09	Soil	Same As Above
B09090294-007	TP3, 32-38	08/28/09 12:00	09/02/09	Soil	Same As Above
B09090294-008	TP3, 38-50	08/28/09 12:00	09/02/09	Soil	Same As Above
B09090294-009	TP4, 0-4	08/27/09 18:00	09/02/09	Soil	Same As Above
B09090294-010	TP4, 4-11	08/27/09 18:00	09/02/09	Soil	Same As Above
B09090294-011	TP4, 11-20	08/27/09 18:00	09/02/09	Soil	Same As Above
B09090294-012	TP4, 20-37	08/27/09 18:00	09/02/09	Soil	Same As Above
B09090294-013	TP5, 0-2	08/27/09 17:30	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-014	TP5, 2-9	08/27/09 17:30	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand

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ANALYTICAL SUMMARY REPORT

B09090294-015 TP5, 9-26	08/27/09 17:30	09/02/09	Soil	Same As Above
B09090294-016 TP6, 0-3	08/28/09 8:45	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-017 TP6, 3-20	08/28/09 8:45	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-018 TP6, 20-44	08/28/09 8:45	09/02/09	Soil	Same As Above
B09090294-019 TP6, 44-60	08/28/09 8:45	09/02/09	Soil	Same As Above
B09090294-020 TP7, 0-3	08/27/09 19:00	09/02/09	Soil	Same As Above
B09090294-021 TP7, 3-9	08/27/09 19:00	09/02/09	Soil	Same As Above
B09090294-022 TP7, 9-16	08/27/09 19:00	09/02/09	Soil	Same As Above
B09090294-023 TP7, 16-35	08/27/09 19:00	09/02/09	Soil	Same As Above
B09090294-024 TP8, 0-2	08/28/09 8:00	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-025 TP8, 2-26	08/28/09 8:00	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-026 TP8, 26-42	08/28/09 8:00	09/02/09	Soil	Same As Above
B09090294-027 TP9, 0-4	08/27/09 14:30	09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand

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ANALYTICAL SUMMARY REPORT

B09090294-028 TP9, 4-11	08/27/09 14:30 09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-029 TP9, 11-24	08/27/09 14:30 09/02/09	Soil	Same As Above
B09090294-030 TP9, 24-35	08/27/09 14:30 09/02/09	Soil	Same As Above
B09090294-031 TP10, 0-4	08/27/09 13:30 09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-032 TP10, 4-14	08/27/09 13:30 09/02/09	Soil	Metals by ICP/ICPMS, Total or Soluble Conductivity Organic Matter/Organic Carbon-WB pH, Saturated Paste Digestion, Total Metals Particle Size Analysis Saturation Percentage Texture Very Fine Sand
B09090294-033 TP10, 14-18	08/27/09 13:30 09/02/09	Soil	Same As Above

Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

The results as reported relate only to the item(s) submitted for testing.

If you have any questions regarding these tests results, please call.

Report Approved By:

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-001
Client Sample ID: TP 1, 1-13

Report Date: 09/22/09
Collection Date: 08/28/09 10:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	76	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	15	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	9	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	3	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.70	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	31.0	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	2.47	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	51	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:14 / tao
Copper	44	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Manganese	625	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Nickel	10	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:14 / tao
Zinc	39	mg/kg		5		SW6010B	09/15/09 16:14 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-002
Client Sample ID: TP1, 13-26

Report Date: 09/22/09
Collection Date: 08/28/09 10:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	78	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	16	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	6	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	4	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	LS					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.60	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.38	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	24.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	1.00	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	17	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:18 / tao
Copper	38	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Manganese	448	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Nickel	12	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:18 / tao
Zinc	26	mg/kg		5		SW6010B	09/15/09 16:18 / tao

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-003
Client Sample ID: TP2, 0.75-5

Report Date: 09/22/09
Collection Date: 08/28/09 11:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	63	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	27	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	10	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	4	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.30	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.63	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	27.9	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	1.66	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	18	mg/kg		5		SW6010B	09/15/09 16:22 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:22 / tao
Copper	22	mg/kg		5		SW6010B	09/15/09 16:22 / tao
Manganese	480	mg/kg		5		SW6010B	09/15/09 16:22 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:22 / tao
Nickel	16	mg/kg		5		SW6010B	09/15/09 16:22 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:13 / tao
Zinc	30	mg/kg		5		SW6010B	09/15/09 16:22 / tao

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-004
Client Sample ID: TP2, 5-26

Report Date: 09/22/09
Collection Date: 08/28/09 11:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	72	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	21	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	7	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	8	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.45	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	21.1	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.64	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	5	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:27 / tao
Copper	14	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Manganese	299	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Nickel	16	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:27 / tao
Zinc	17	mg/kg		5		SW6010B	09/15/09 16:27 / tao

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-005
Client Sample ID: TP3, 0.5-10

Report Date: 09/22/09
Collection Date: 08/28/09 12:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	26	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	56	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	18	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	3	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SiL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.76	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	50.4	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	3.95	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	31	mg/kg		5		SW6010B	09/15/09 16:35 / tao
Cadmium	1	mg/kg		1		SW6010B	09/15/09 16:35 / tao
Copper	43	mg/kg		5		SW6010B	09/15/09 16:35 / tao
Manganese	1100	mg/kg		5		SW6010B	09/15/09 16:35 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:35 / tao
Nickel	18	mg/kg		5		SW6010B	09/15/09 16:35 / tao
Selenium	ND	mg/kg		5		SW6020	09/17/09 13:27 / jjw
Zinc	68	mg/kg		5		SW6010B	09/15/09 16:35 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-006
Client Sample ID: TP3, 10-32

Report Date: 09/22/09
Collection Date: 08/28/09 12:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	82	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	12	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	6	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	5	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	LS					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.70	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.28	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	18.9	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.40	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:39 / tao
Copper	9	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Manganese	320	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Nickel	6	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:39 / tao
Zinc	14	mg/kg		5		SW6010B	09/15/09 16:39 / tao

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-007
Client Sample ID: TP3, 32-38

Report Date: 09/22/09
Collection Date: 08/28/09 12:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	72	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	18	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	10	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	6	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.47	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	24.5	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	1.28	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:43 / tao
Copper	12	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Manganese	280	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Nickel	9	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:43 / tao
Zinc	14	mg/kg		5		SW6010B	09/15/09 16:43 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-008
Client Sample ID: TP3, 38-50

Report Date: 09/22/09
Collection Date: 08/28/09 12:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	74	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	18	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	8	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	6	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.70	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.27	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	16.0	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.12	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 16:47 / tao
Copper	14	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Manganese	321	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Nickel	9	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 16:47 / tao
Zinc	20	mg/kg		5		SW6010B	09/15/09 16:47 / tao

Report Definitions:
RL - Analyte reporting limit.
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-009
Client Sample ID: TP4, 0-4

Report Date: 09/22/09
Collection Date: 08/27/09 18:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	26	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	52	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	22	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	5	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SiL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.90	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.58	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	69.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	7.95	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	53	mg/kg		5		SW6010B	09/15/09 16:59 / tao
Cadmium	2	mg/kg		1		SW6010B	09/15/09 16:59 / tao
Copper	54	mg/kg		5		SW6010B	09/15/09 16:59 / tao
Manganese	997	mg/kg		5		SW6010B	09/15/09 16:59 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 16:59 / tao
Nickel	22	mg/kg		5		SW6010B	09/15/09 16:59 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:21 / tao
Zinc	94	mg/kg		5		SW6010B	09/15/09 16:59 / tao

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-010
Client Sample ID: TP4, 4-11

Report Date: 09/22/09
Collection Date: 08/27/09 18:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	47	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	32	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	21	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	5	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.57	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	44.4	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	3.28	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	23	mg/kg		5		SW6010B	09/15/09 17:03 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:03 / tao
Copper	29	mg/kg		5		SW6010B	09/15/09 17:03 / tao
Manganese	647	mg/kg		5		SW6010B	09/15/09 17:03 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:03 / tao
Nickel	21	mg/kg		5		SW6010B	09/15/09 17:03 / tao
Selenium	ND	mg/kg		5		SW6020	09/17/09 13:55 / jjw
Zinc	42	mg/kg		5		SW6010B	09/15/09 17:03 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-011
Client Sample ID: TP4, 11-20

Report Date: 09/22/09
Collection Date: 08/27/09 18:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	64	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	21	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	15	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	7	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.42	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	34.4	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	1.41	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	26	mg/kg		5		SW6010B	09/15/09 17:07 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:07 / tao
Copper	28	mg/kg		5		SW6010B	09/15/09 17:07 / tao
Manganese	456	mg/kg		5		SW6010B	09/15/09 17:07 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:07 / tao
Nickel	17	mg/kg		5		SW6010B	09/15/09 17:07 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:29 / tao
Zinc	27	mg/kg		5		SW6010B	09/15/09 17:07 / tao

Report Definitions:
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MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-012
Client Sample ID: TP4, 20-37

Report Date: 09/22/09
Collection Date: 08/27/09 18:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	64	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	21	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	15	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	6	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.46	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	27.8	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	1.07	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	17	mg/kg		5		SW6010B	09/15/09 17:11 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:11 / tao
Copper	26	mg/kg		5		SW6010B	09/15/09 17:11 / tao
Manganese	398	mg/kg		5		SW6010B	09/15/09 17:11 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:11 / tao
Nickel	16	mg/kg		5		SW6010B	09/15/09 17:11 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:33 / tao
Zinc	25	mg/kg		5		SW6010B	09/15/09 17:11 / tao

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-013
Client Sample ID: TP5, 0-2

Report Date: 09/22/09
Collection Date: 08/27/09 17:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Silt	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Clay	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Very Fine Sand	N/A	wt%		1		ASA15-5	09/14/09 07:51 / srm
Texture	N/A					ASA15-5	09/09/09 09:48 / srm
-Unable to analyze due to sample matrix							
SATURATED PASTE							
pH, sat. paste	5.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.27	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	294	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	60.2	%-dry		0.1		S-9.20	09/14/09 15:28 / srm
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:15 / tao
Copper	26	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Manganese	326	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Nickel	8	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 17:15 / tao
Zinc	39	mg/kg		5		SW6010B	09/15/09 17:15 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-014
Client Sample ID: TP5, 2-9

Report Date: 09/22/09
Collection Date: 08/27/09 17:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	48	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	35	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	17	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	8	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.90	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.60	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	43.7	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	5.62	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	17	mg/kg		5		SW6010B	09/15/09 17:19 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:19 / tao
Copper	28	mg/kg		5		SW6010B	09/15/09 17:19 / tao
Manganese	543	mg/kg		5		SW6010B	09/15/09 17:19 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:19 / tao
Nickel	16	mg/kg		5		SW6010B	09/15/09 17:19 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:37 / tao
Zinc	37	mg/kg		5		SW6010B	09/15/09 17:19 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-015
Client Sample ID: TP5, 9-26

Report Date: 09/22/09
Collection Date: 08/27/09 17:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	70	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	19	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	11	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	9	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.20	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.59	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	29.1	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.86	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	09/15/09 17:23 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:23 / tao
Copper	32	mg/kg		5		SW6010B	09/15/09 17:23 / tao
Manganese	335	mg/kg		5		SW6010B	09/15/09 17:23 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:23 / tao
Nickel	14	mg/kg		5		SW6010B	09/15/09 17:23 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:41 / tao
Zinc	21	mg/kg		5		SW6010B	09/15/09 17:23 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-016
Client Sample ID: TP6, 0-3

Report Date: 09/22/09
Collection Date: 08/28/09 08:45
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Silt	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Clay	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Very Fine Sand	N/A	wt%		1		ASA15-5	09/14/09 07:51 / srm
Texture	N/A					ASA15-5	09/09/09 09:48 / srm
-Unable to analyze due to sample matrix							
SATURATED PASTE							
pH, sat. paste	5.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.69	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	180	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	37.6	%-dry		0.1		S-9.20	09/14/09 15:28 / srm
METALS, TOTAL - EPA SW846							
Arsenic	53	mg/kg		5		SW6010B	09/15/09 17:27 / tao
Cadmium	4	mg/kg		1		SW6010B	09/15/09 17:27 / tao
Copper	88	mg/kg		5		SW6010B	09/15/09 17:27 / tao
Manganese	1350	mg/kg		5		SW6010B	09/15/09 17:27 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:27 / tao
Nickel	8	mg/kg		5		SW6010B	09/15/09 17:27 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:53 / tao
Zinc	112	mg/kg		5		SW6010B	09/15/09 17:27 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-017
Client Sample ID: TP6, 3-20

Report Date: 09/22/09
Collection Date: 08/28/09 08:45
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	55	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	29	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	16	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	8	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.80	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.18	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	32.1	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	2.33	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	5	mg/kg		5		SW6010B	09/15/09 17:31 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:31 / tao
Copper	13	mg/kg		5		SW6010B	09/15/09 17:31 / tao
Manganese	296	mg/kg		5		SW6010B	09/15/09 17:31 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:31 / tao
Nickel	9	mg/kg		5		SW6010B	09/15/09 17:31 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 17:57 / tao
Zinc	24	mg/kg		5		SW6010B	09/15/09 17:31 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-018
Client Sample ID: TP6, 20-44

Report Date: 09/22/09
Collection Date: 08/28/09 08:45
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	60	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	28	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	12	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	9	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.00	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.14	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	22.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.36	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	ND	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 17:35 / tao
Copper	11	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Manganese	247	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Nickel	8	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 17:35 / tao
Zinc	21	mg/kg		5		SW6010B	09/15/09 17:35 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-019
Client Sample ID: TP6, 44-60

Report Date: 09/22/09
Collection Date: 08/28/09 08:45
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	56	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	27	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	17	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	12	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.30	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.17	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	29.1	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.21	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/15/09 18:07 / tao
Copper	25	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Manganese	173	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Nickel	17	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Selenium	ND	mg/kg		5		SW6010B	09/15/09 18:07 / tao
Zinc	20	mg/kg		5		SW6010B	09/15/09 18:07 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-020
Client Sample ID: TP7, 0-3

Report Date: 09/22/09
Collection Date: 08/27/09 19:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	36	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	45	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	19	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	14	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.10	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.92	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	66.7	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	12.6	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	56	mg/kg		5		SW6020	09/17/09 13:59 / jjw
Cadmium	2	mg/kg		1		SW6010B	09/15/09 18:12 / tao
Copper	50	mg/kg		5		SW6010B	09/15/09 18:12 / tao
Manganese	673	mg/kg		5		SW6010B	09/15/09 18:12 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/15/09 18:12 / tao
Nickel	17	mg/kg		5		SW6010B	09/15/09 18:12 / tao
Selenium	ND	mg/kg		5		SW6020	09/17/09 13:59 / jjw
Zinc	88	mg/kg		5		SW6020	09/17/09 13:59 / jjw

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-021
Client Sample ID: TP7, 3-9

Report Date: 09/22/09
Collection Date: 08/27/09 19:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	32	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	47	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	21	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	9	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.42	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	48.5	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	3.95	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	14	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:10 / tao
Copper	31	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Manganese	685	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Nickel	18	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:10 / tao
Zinc	47	mg/kg		5		SW6010B	09/16/09 18:10 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-022
Client Sample ID: TP7, 9-16

Report Date: 09/22/09
Collection Date: 08/27/09 19:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	64	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	26	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	10	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	9	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.39	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	25.3	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.64	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	6	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:14 / tao
Copper	20	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Manganese	390	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Nickel	12	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:14 / tao
Zinc	20	mg/kg		5		SW6010B	09/16/09 18:14 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-023
Client Sample ID: TP7, 16-35

Report Date: 09/22/09
Collection Date: 08/27/09 19:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	74	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	19	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	7	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	7	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.60	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.28	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	18.6	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.28	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	8	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:18 / tao
Copper	19	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Manganese	332	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Nickel	11	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:18 / tao
Zinc	18	mg/kg		5		SW6010B	09/16/09 18:18 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-024
Client Sample ID: TP8, 0-2

Report Date: 09/22/09
Collection Date: 08/28/09 08:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Silt	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Clay	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Very Fine Sand	N/A	wt%		1		ASA15-5	09/14/09 07:51 / srm
Texture	N/A					ASA15-5	09/09/09 09:48 / srm
-Unable to analyze due to sample matrix							
SATURATED PASTE							
pH, sat. paste	6.10	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.54	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	130	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	28.8	%-dry		0.1		S-9.20	09/14/09 15:28 / srm
METALS, TOTAL - EPA SW846							
Arsenic	51	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Cadmium	2	mg/kg		1		SW6010B	09/16/09 18:22 / tao
Copper	69	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Manganese	716	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Nickel	11	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:22 / tao
Zinc	97	mg/kg		5		SW6010B	09/16/09 18:22 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-025
Client Sample ID: TP8, 2-26

Report Date: 09/22/09
Collection Date: 08/28/09 08:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	37	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	45	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	18	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	9	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.70	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.36	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	56.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	7.34	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	17	mg/kg		5		SW6020	09/17/09 15:22 / jjw
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:26 / tao
Copper	29	mg/kg		5		SW6010B	09/16/09 18:26 / tao
Manganese	636	mg/kg		5		SW6010B	09/16/09 18:26 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:26 / tao
Nickel	15	mg/kg		5		SW6010B	09/16/09 18:26 / tao
Selenium	ND	mg/kg		5		SW6020	09/17/09 15:22 / jjw
Zinc	47	mg/kg		5		SW6020	09/17/09 15:22 / jjw

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-026
Client Sample ID: TP8, 26-42

Report Date: 09/22/09
Collection Date: 08/28/09 08:00
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	70	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	22	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	8	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	8	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	7.50	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.36	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	21.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.47	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	9	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:30 / tao
Copper	18	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Manganese	366	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Nickel	11	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:30 / tao
Zinc	16	mg/kg		5		SW6010B	09/16/09 18:30 / tao

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

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-027
Client Sample ID: TP9, 0-4

Report Date: 09/22/09
Collection Date: 08/27/09 14:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Silt	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Clay	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Very Fine Sand	N/A	wt%		1		ASA15-5	09/14/09 07:51 / srm
Texture	N/A					ASA15-5	09/09/09 09:48 / srm
-Unable to analyze due to sample matrix							
SATURATED PASTE							
pH, sat. paste	6.40	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.27	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	241	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	55.6	%-dry		0.1		S-9.20	09/14/09 15:28 / srm
METALS, TOTAL - EPA SW846							
Arsenic	88	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:47 / tao
Copper	28	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Manganese	737	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Nickel	23	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:47 / tao
Zinc	21	mg/kg		5		SW6010B	09/16/09 18:47 / tao

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-028
Client Sample ID: TP9, 4-11

Report Date: 09/22/09
Collection Date: 08/27/09 14:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	47	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	32	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	21	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	7	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	L					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.30	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.31	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	44.0	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	4.36	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	11	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:51 / tao
Copper	26	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Manganese	156	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Nickel	18	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:51 / tao
Zinc	34	mg/kg		5		SW6010B	09/16/09 18:51 / tao

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-029
Client Sample ID: TP9, 11-24

Report Date: 09/22/09
Collection Date: 08/27/09 14:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	68	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	23	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	9	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	7	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.70	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.17	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	21.7	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.36	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	7	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:55 / tao
Copper	14	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Manganese	111	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Nickel	11	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:55 / tao
Zinc	18	mg/kg		5		SW6010B	09/16/09 18:55 / tao

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-030
Client Sample ID: TP9, 24-35

Report Date: 09/22/09
Collection Date: 08/27/09 14:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	67	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	24	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	9	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	6	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	6.80	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.19	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	19.9	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.28	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	7	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 18:59 / tao
Copper	17	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Manganese	144	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Nickel	11	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 18:59 / tao
Zinc	21	mg/kg		5		SW6010B	09/16/09 18:59 / tao

Report Definitions:
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MCL - Maximum contaminant level.
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-031
Client Sample ID: TP10, 0-4

Report Date: 09/22/09
Collection Date: 08/27/09 13:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Silt	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Clay	N/A	%		1		ASA15-5	09/09/09 09:48 / srm
Very Fine Sand	N/A	wt%		1		ASA15-5	09/14/09 07:51 / srm
Texture	N/A					ASA15-5	09/09/09 09:48 / srm
-Unable to analyze due to sample matrix							
SATURATED PASTE							
pH, sat. paste	5.80	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.34	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	70.3	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	14.9	%-dry		0.1		S-9.20	09/14/09 15:29 / srm
METALS, TOTAL - EPA SW846							
Arsenic	42	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Cadmium	1	mg/kg		1		SW6010B	09/16/09 19:03 / tao
Copper	34	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Manganese	607	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Nickel	10	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 19:03 / tao
Zinc	70	mg/kg		5		SW6010B	09/16/09 19:03 / tao

Report Definitions:
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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-032
Client Sample ID: TP10, 4-14

Report Date: 09/22/09
Collection Date: 08/27/09 13:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	58	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	27	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	15	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	5	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.90	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.24	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	24.2	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.67	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	9	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 19:07 / tao
Copper	12	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Manganese	236	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Nickel	8	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Selenium	ND	mg/kg		5		SW6010B	09/16/09 19:07 / tao
Zinc	19	mg/kg		5		SW6010B	09/16/09 19:07 / tao

Report Definitions:
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ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: Timberline Resources
Project: Butte Highlands 14716
Lab ID: B09090294-033
Client Sample ID: TP10, 14-18

Report Date: 09/22/09
Collection Date: 08/27/09 13:30
DateReceived: 09/02/09
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Sand	58	%		1		ASA15-5	09/11/09 13:41 / srm
Silt	24	%		1		ASA15-5	09/11/09 13:41 / srm
Clay	18	%		1		ASA15-5	09/11/09 13:41 / srm
Very Fine Sand	8	wt%		1		ASA15-5	09/14/09 13:39 / srm
Texture	SL					ASA15-5	09/11/09 13:41 / srm
- C = Clay, S = Sand(y), Si = Silt(y), L = Loam(y)							
SATURATED PASTE							
pH, sat. paste	5.80	s.u.		0.10		ASAM10-3.2	09/11/09 13:36 / srm
Conductivity, sat. paste	0.18	mmhos/cm		0.01		ASA10-3	09/11/09 13:36 / srm
Saturation	26.6	%		0.1		USDA27a	09/11/09 13:36 / srm
CHEMICAL CHARACTERISTICS							
Organic Matter	0.59	%		0.02		ASA29-3	09/15/09 15:34 / srm
METALS, TOTAL - EPA SW846							
Arsenic	11	mg/kg		5		SW6020	09/17/09 15:50 / jjw
Cadmium	ND	mg/kg		1		SW6010B	09/16/09 19:11 / tao
Copper	16	mg/kg		5		SW6010B	09/16/09 19:11 / tao
Manganese	298	mg/kg		5		SW6010B	09/16/09 19:11 / tao
Molybdenum	ND	mg/kg		5		SW6010B	09/16/09 19:11 / tao
Nickel	8	mg/kg		5		SW6010B	09/16/09 19:11 / tao
Selenium	ND	mg/kg		5		SW6020	09/17/09 15:50 / jjw
Zinc	30	mg/kg		5		SW6020	09/17/09 15:50 / jjw

Report Definitions:
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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA10-3									Batch: R135840
Sample ID: B09090244-001A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	0.480	mmhos/cm	0.010				2.1	30	
Sample ID: B09090294-010A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	0.580	mmhos/cm	0.010				1.7	30	
Sample ID: B09090294-020A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	1.00	mmhos/cm	0.010				8.3	30	
Sample ID: B09090294-030A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	0.180	mmhos/cm	0.010				5.4	30	
Sample ID: B09090611-001A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	9.47	mmhos/cm	0.010				0.3	30	
Sample ID: LCS-0909111336	Laboratory Control Sample				Run: MISC-SOIL_090911C			09/11/09 13:36	
Conductivity, sat. paste	8.15	mmhos/cm	0.010	93	50	150			
Method: ASA15-5									Batch: R135840
Sample ID: B09090294-001A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:41	
Sand	76	%	1.0				0	40	
Silt	15	%	1.0				0	40	
Clay	9.0	%	1.0				0	40	
Sample ID: B09090294-011A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:41	
Sand	65	%	1.0				1.6	40	
Silt	20	%	1.0				4.9	40	
Clay	15	%	1.0				0	40	
Sample ID: B09090294-023A DUP	Sample Duplicate				Run: MISC-SOIL_090911C			09/11/09 13:41	
Sand	74	%	1.0				0	40	
Silt	19	%	1.0				0	40	
Clay	7.0	%	1.0				0	40	
Sample ID: LCS-0909111341	Laboratory Control Sample				Run: MISC-SOIL_090911C			09/11/09 13:41	
Sand	42	%	1.0	102	50	150			
Silt	34	%	1.0	97	50	150			
Clay	24	%	1.0	100	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASA15-5									Batch: R135894
Sample ID: B09090294-001A DUP	Sample Duplicate				Run: MISC-SOIL_090914A				09/14/09 13:39
Very Fine Sand	2.68	wt%	1.0				16	50	
Sample ID: B09090294-011A DUP	Sample Duplicate				Run: MISC-SOIL_090914A				09/14/09 13:39
Very Fine Sand	7.16	wt%	1.0				8.7	50	
Sample ID: B09090294-023A DUP	Sample Duplicate				Run: MISC-SOIL_090914A				09/14/09 13:39
Very Fine Sand	7.20	wt%	1.0				0.3	50	
Sample ID: LCS-0909141339	Laboratory Control Sample				Run: MISC-SOIL_090914A				09/14/09 13:39
Very Fine Sand	9.66	wt%	1.0	121	50	150			
Method: ASA29-3									Batch: R136006
Sample ID: B09081207-001A DUP	Sample Duplicate				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	2.62	%	0.020				6.3	30	
Sample ID: B09081207-011A DUP	Sample Duplicate				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	3.22	%	0.020				3.4	30	
Sample ID: B09090294-001A DUP	Sample Duplicate				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	2.64	%	0.020				6.7	30	
Sample ID: B09090294-011A DUP	Sample Duplicate				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	1.50	%	0.020				6.2	30	
Sample ID: B09090294-023A DUP	Sample Duplicate				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	0.290	%	0.020				3.5	30	
Sample ID: LCS-0909151534	Laboratory Control Sample				Run: MISC-SOIL_090915B				09/15/09 15:34
Organic Matter	2.98	%	0.020	94	50	150			

Qualifiers:
RL - Analyte reporting limit.
ND - Not detected at the reporting limit.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: ASAM10-3.2									Batch: R135840
Sample ID: B09090244-001A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	7.10	s.u.	0.10				1.4	10	
Sample ID: B09090294-010A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	6.50	s.u.	0.10				0	10	
Sample ID: B09090294-020A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	6.20	s.u.	0.10				1.6	10	
Sample ID: B09090294-030A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	6.90	s.u.	0.10				1.5	10	
Sample ID: B09090611-001A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	7.70	s.u.	0.10				0	10	
Sample ID: LCS-0909111336	Laboratory Control Sample				Run: MISC-SOIL_090911C				09/11/09 13:36
pH, sat. paste	6.90	s.u.	0.10	97	90	110			
Method: S-9.20									Batch: R136066
Sample ID: SOL0715	Laboratory Control Sample				Run: MISC-SOIL_090916C				09/14/09 15:28
Organic Matter	6.54	%-dry	0.10	125	50	150			
Sample ID: B09090294-031A DUP	Sample Duplicate				Run: MISC-SOIL_090916C				09/14/09 15:29
Organic Matter	15.0	%-dry	0.10				0.4	50	
Method: USDA27a									Batch: R135840
Sample ID: B09090294-010A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
Saturation	45.6	%	0.10				2.7	30	
Sample ID: B09090294-020A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
Saturation	69.2	%	0.10				3.7	30	
Sample ID: B09090294-030A DUP	Sample Duplicate				Run: MISC-SOIL_090911C				09/11/09 13:36
Saturation	19.9	%	0.10				0	30	
Sample ID: LCS-0909111336	Laboratory Control Sample				Run: MISC-SOIL_090911C				09/11/09 13:36
Saturation	35.9	%	0.10	95	50	150			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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800-735-4489 • 406-252-6325 • 406-252-6069 fax • eli@energylab.com

QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Analytical Run: ICP202-B_090915A
Sample ID: QCS	Initial Calibration Verification Standard								09/15/09 11:47
Arsenic	0.782	mg/L	0.10	98	90	110			
Cadmium	0.403	mg/L	0.010	101	90	110			
Copper	0.787	mg/L	0.010	98	90	110			
Manganese	4.02	mg/L	0.010	100	90	110			
Molybdenum	0.816	mg/L	0.10	102	90	110			
Nickel	0.800	mg/L	0.050	100	90	110			
Selenium	0.815	mg/L	0.10	102	90	110			
Zinc	0.793	mg/L	0.010	99	90	110			
Method: SW6010B									Analytical Run: ICP202-B_090916A
Sample ID: QCS	Initial Calibration Verification Standard								09/16/09 09:45
Arsenic	0.774	mg/L	0.10	97	90	110			
Cadmium	0.398	mg/L	0.010	99	90	110			
Copper	0.780	mg/L	0.010	98	90	110			
Manganese	3.95	mg/L	0.010	99	90	110			
Molybdenum	0.822	mg/L	0.10	103	90	110			
Nickel	0.794	mg/L	0.050	99	90	110			
Selenium	0.816	mg/L	0.10	102	90	110			
Zinc	0.787	mg/L	0.010	98	90	110			
Method: SW6020									Analytical Run: ICPMS203-B_090917A
Sample ID: QCS-090602A,090609B,0	Initial Calibration Verification Standard								09/17/09 08:45
Arsenic	0.0509	mg/L	0.0010	102	90	110			
Selenium	0.0511	mg/L	0.0010	102	90	110			
Zinc	0.0490	mg/L	0.0010	98	90	110			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 41412
Sample ID: MB-41412	Method Blank				Run: ICP202-B_090915A			09/15/09 15:58	
Arsenic	ND	mg/kg	0.9						
Cadmium	ND	mg/kg	0.05						
Copper	ND	mg/kg	0.3						
Manganese	ND	mg/kg	0.1						
Molybdenum	ND	mg/kg	0.2						
Nickel	ND	mg/kg	0.1						
Selenium	ND	mg/kg	2						
Zinc	0.2	mg/kg	0.2						
Sample ID: LCS3-41412	Laboratory Control Sample				Run: ICP202-B_090915A			09/15/09 16:10	
Arsenic	164	mg/kg	5.0	95	70	130			
Cadmium	55.1	mg/kg	1.0	100	70	130			
Copper	78.9	mg/kg	5.0	98	70	130			
Manganese	254	mg/kg	5.0	98	70	130			
Molybdenum	124	mg/kg	5.0	100	70	130			
Nickel	166	mg/kg	5.0	101	70	130			
Selenium	96.6	mg/kg	5.0	84	70	130			
Zinc	159	mg/kg	5.0	96	70	130			
Sample ID: B09090294-004ADIL	Serial Dilution				Run: ICP202-B_090915A			09/15/09 16:31	
Arsenic	ND	mg/kg	5.0		0	0		10	
Cadmium	0.451	mg/kg	1.0		0	0		10	N
Copper	14.1	mg/kg	5.0		0	0	0.3	10	
Manganese	321	mg/kg	5.0		0	0	6.9	10	
Molybdenum	ND	mg/kg	5.0		0	0		10	
Nickel	17.6	mg/kg	5.0		0	0	9.5	10	
Selenium	ND	mg/kg	7.5		0	0		10	
Zinc	18.7	mg/kg	5.0		0	0	8.1	10	
Sample ID: B09090294-020AMS3	Sample Matrix Spike				Run: ICP202-B_090915A			09/15/09 18:16	
Arsenic	102	mg/kg	5.0	80	75	125			
Cadmium	29.7	mg/kg	1.0	88	75	125			
Copper	110	mg/kg	5.0	94	75	125			
Manganese	978	mg/kg	5.0	96	75	125			
Molybdenum	56.0	mg/kg	5.0	87	75	125			
Nickel	71.7	mg/kg	5.0	86	75	125			
Selenium	42.5	mg/kg	5.0	67	75	125			S
Zinc	135	mg/kg	5.0	93	75	125			
Sample ID: B09090294-020AMSD3	Sample Matrix Spike Duplicate				Run: ICP202-B_090915A			09/15/09 18:20	
Arsenic	103	mg/kg	5.0	81	75	125	0.6	20	
Cadmium	30.1	mg/kg	1.0	89	75	125	1.2	20	
Copper	109	mg/kg	5.0	93	75	125	0.6	20	
Manganese	958	mg/kg	5.0	90	75	125	2.1	20	

Qualifiers:

RL - Analyte reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 41412
Sample ID: B09090294-020AMSD3	Sample Matrix Spike Duplicate				Run: ICP202-B_090915A			09/15/09 18:20	
Molybdenum	57.8	mg/kg	5.0	90	75	125	3.3	20	
Nickel	73.5	mg/kg	5.0	89	75	125	2.4	20	
Selenium	42.5	mg/kg	5.0	67	75	125	0	20	S
Zinc	134	mg/kg	5.0	93	75	125	0.4	20	
Sample ID: MB-41412	Method Blank				Run: ICP202-B_090916A			09/16/09 17:08	
Arsenic	ND	mg/kg	0.9						
Cadmium	ND	mg/kg	0.05						
Copper	ND	mg/kg	0.3						
Manganese	ND	mg/kg	0.1						
Molybdenum	ND	mg/kg	0.2						
Nickel	ND	mg/kg	0.1						
Selenium	ND	mg/kg	2						
Zinc	0.2	mg/kg	0.2						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 41436
Sample ID: MB-41436	Method Blank				Run: ICP202-B_090916A			09/16/09 18:02	
Arsenic	ND	mg/kg	0.9						
Cadmium	ND	mg/kg	0.05						
Copper	ND	mg/kg	0.3						
Manganese	ND	mg/kg	0.1						
Molybdenum	ND	mg/kg	0.2						
Nickel	ND	mg/kg	0.1						
Selenium	ND	mg/kg	2						
Zinc	0.3	mg/kg	0.2						
Sample ID: LCS3-41436	Laboratory Control Sample				Run: ICP202-B_090916A			09/16/09 18:06	
Arsenic	162	mg/kg	5.0	94	70	130			
Cadmium	53.6	mg/kg	1.0	97	70	130			
Copper	77.2	mg/kg	5.0	96	70	130			
Manganese	252	mg/kg	5.0	97	70	130			
Molybdenum	124	mg/kg	5.0	100	70	130			
Nickel	162	mg/kg	5.0	98	70	130			
Selenium	96.4	mg/kg	5.0	84	70	130			
Zinc	158	mg/kg	5.0	95	70	130			
Sample ID: B09090294-026ADIL	Serial Dilution				Run: ICP202-B_090916A			09/16/09 18:43	
Arsenic	6.13	mg/kg	5.0		0	0		10	N
Cadmium	0.390	mg/kg	1.0		0	0		10	N
Copper	17.3	mg/kg	5.0		0	0	5.2	10	
Manganese	384	mg/kg	5.0		0	0	4.8	10	
Molybdenum	ND	mg/kg	5.0		0	0		10	
Nickel	11.4	mg/kg	5.0		0	0	3.4	10	
Selenium	ND	mg/kg	8.0		0	0		10	
Zinc	16.9	mg/kg	5.0		0	0	6.8	10	
Sample ID: B09090294-033AMS3	Sample Matrix Spike				Run: ICP202-B_090916A			09/16/09 19:15	
Arsenic	58.1	mg/kg	5.0	85	75	125			
Cadmium	25.5	mg/kg	1.0	88	75	125			
Copper	70.9	mg/kg	5.0	96	75	125			
Manganese	486	mg/kg	5.0	66	75	125			S
Molybdenum	51.2	mg/kg	5.0	90	75	125			
Nickel	59.9	mg/kg	5.0	90	75	125			
Selenium	35.9	mg/kg	5.0	63	75	125			S
Zinc	73.6	mg/kg	5.0	88	75	125			
Sample ID: B09090294-033AMSD3	Sample Matrix Spike Duplicate				Run: ICP202-B_090916A			09/16/09 19:19	
Arsenic	59.9	mg/kg	5.0	88	75	125	2.9	20	
Cadmium	25.2	mg/kg	1.0	87	75	125	1.3	20	
Copper	69.7	mg/kg	5.0	95	75	125	1.6	20	
Manganese	465	mg/kg	5.0	59	75	125	4.4	20	S

Qualifiers:

RL - Analyte reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

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QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B									Batch: 41436
Sample ID: B09090294-033AMSD3	Sample Matrix Spike Duplicate				Run: ICP202-B_090916A			09/16/09 19:19	
Molybdenum	50.5	mg/kg	5.0	89	75	125	1.3	20	
Nickel	59.1	mg/kg	5.0	89	75	125	1.3	20	
Selenium	35.6	mg/kg	5.0	62	75	125	0.9	20	S
Zinc	73.0	mg/kg	5.0	87	75	125	0.9	20	
Method: SW6020									Batch: 41412
Sample ID: MB-41412	Method Blank				Run: ICPMS203-B_090917A			09/17/09 13:09	
Arsenic	0.02	mg/kg	0.02						
Selenium	ND	mg/kg	0.05						
Zinc	ND	mg/kg	0.6						
Sample ID: LCS3-41412	Laboratory Control Sample				Run: ICPMS203-B_090917A			09/17/09 13:13	
Arsenic	182	mg/kg	5.0	105	70	130			
Selenium	123	mg/kg	5.0	108	70	130			
Zinc	166	mg/kg	5.0	99	70	130			
Sample ID: B09090294-005ADIL	Serial Dilution				Run: ICPMS203-B_090917A			09/17/09 13:50	
Arsenic	44.4	mg/kg	5.0		0	0	11	10	R
Selenium	ND	mg/kg	5.0		0	0		10	
Zinc	103	mg/kg	15		0	0		10	N
Sample ID: B09090294-020AMS3	Sample Matrix Spike				Run: ICPMS203-B_090917A			09/17/09 14:04	
Arsenic	120	mg/kg	5.0	100	75	125			
Selenium	64.6	mg/kg	5.0	101	75	125			
Zinc	151	mg/kg	5.0	99	75	125			
Sample ID: B09090294-020AMSD3	Sample Matrix Spike Duplicate				Run: ICPMS203-B_090917A			09/17/09 14:08	
Arsenic	117	mg/kg	5.0	96	75	125	2.2	20	
Selenium	64.8	mg/kg	5.0	101	75	125	0.2	20	
Zinc	146	mg/kg	5.0	92	75	125	3	20	

Qualifiers:

RL - Analyte reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

S - Spike recovery outside of advisory limits.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

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800-735-4489 • 406-252-6325 • 406-252-6069 fax • eli@energylab.com

QA/QC Summary Report

Client: Timberline Resources
Project: Butte Highlands 14716

Report Date: 09/22/09
Work Order: B09090294

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020									Batch: 41436
Sample ID: MB-41436	Method Blank				Run: ICPMS203-B_090917A			09/17/09 15:04	
Arsenic	0.05	mg/kg	0.02						
Selenium	0.06	mg/kg	0.05						
Zinc	ND	mg/kg	0.6						
Sample ID: LCS3-41436	Laboratory Control Sample				Run: ICPMS203-B_090917A			09/17/09 15:08	
Arsenic	176	mg/kg	5.0	102	70	130			
Selenium	121	mg/kg	5.0	105	70	130			
Zinc	160	mg/kg	5.0	96	70	130			
Sample ID: B09090294-025ADIL	Serial Dilution				Run: ICPMS203-B_090917A			09/17/09 15:27	
Arsenic	18.9	mg/kg	5.0		0	0	9.4	10	
Selenium	ND	mg/kg	5.0		0	0		10	
Zinc	55.5	mg/kg	22		0	0		10	N
Sample ID: B09090294-033AMS3	Sample Matrix Spike				Run: ICPMS203-B_090917A			09/17/09 15:54	
Arsenic	68.9	mg/kg	5.0	101	75	125			
Selenium	57.3	mg/kg	5.0	100	75	125			
Zinc	85.8	mg/kg	5.0	97	75	125			
Sample ID: B09090294-033AMSD3	Sample Matrix Spike Duplicate				Run: ICPMS203-B_090917A			09/17/09 15:59	
Arsenic	68.4	mg/kg	5.0	100	75	125	0.7	20	
Selenium	59.1	mg/kg	5.0	103	75	125	3.2	20	
Zinc	85.2	mg/kg	5.0	97	75	125	0.7	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

Energy Laboratories Inc
Workorder Receipt Checklist

Timberline Resources

B09090294

Login completed by: Darwin C. Miller

Date and Time Received: 9/2/2009 9:15 AM

Reviewed by: BL2000\kmcdonald

Received by: lg

Reviewed Date: 9/4/2009 4:30:13 PM

Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature:	19°C		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	No VOA vials submitted ☑
Water - pH acceptable upon receipt?	Yes ☐	No ☐	Not Applicable ☑

Contact and Corrective Action Comments:

Sample TP5, 26-39 did not receive. Did receive TP5 0-2 - per client call cancell TP5 26-39 and add TP5 0-2. Report in order by depth.

CHAIN-OF-CUSTODY RECORD MIS 10085

PROJECT NAME: Butte Highlands | DATE: 9/1/09 | PAGE 1 OF

PROJECT NUMBER: 14716

RESULTS TO: wilhelm_welzenbach@amec.com

TURNAROUND TIME:

SAMPLE SHIPMENT METHOD:

LABORATORY NAME: ~~CLIENT INFORMATION~~ Energy Labs

LABORATORY ADDRESS: 1120 S. 27th Street, Billings, MT 59101

LABORATORY CONTACT: Wynn Pippin

LABORATORY PHONE NUMBER: 406-252-6325

REPORTING REQUIREMENTS:

~~GEOTRACKER REQUIRED~~ ~~YES~~ ~~NO~~

~~SITE SPECIFIC GLOBAL ID NO.~~

SAMPLERS (SIGNATURE): Wilhelm Welzenbach

ANALYSES

*include USDA classes, incl. very fine sand (0.05 to 0.1mm)

DATE	TIME	SAMPLE NUMBER	EC at pH sat. paste	pH sat paste %	Sat. %	Org. Matter %	Particle Size Analysis*								CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/28/09	10:00	TP1, 1-13	X	X	X	X	X								B090902941 1 gal. bag	S					1	
"	"	TP1, 13-26													-002							
8/28/09	11:00	TP2, 0.75-5													-003							
"	"	TP2, 5-26													-004							
8/28/09	12:00	TP3, 0.5-10													-005							
		TP3, 10-32													-006							
		TP3, 32-38													-007							
		TP3, 38-50													-008							
8/27/09	18:00	TP4, 0-4													-009							
		TP4, 4-11													-010							
		TP4, 11-20													-011							
		TP4, 20-37													-012							
8/27/09	17:30	TP5, 2-9 -014													-013							
		TP5, 9-26 -015													-014							
		TP5, ~~26-39~~													-015							

Preliminary call Report in order by

TP5 0-2 Depth

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: Wilhelm Welzenbach	9/1/09		SIGNATURE:		
PRINTED NAME: Wilhelm Welzenbach			PRINTED NAME:		
COMPANY: AMEC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE: Alissa Glancey	9-2-09	9:15
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY: Fed Ex Express 19° no Seal		

TOTAL NUMBER OF CONTAINERS: 33

SAMPLING COMMENTS: Soil Test Pits (LAD areas, main facilities area, roads)

1001 South Higgins Avenue, Building B-1
Missoula, Montana 59801-4144
Tel 406.542.0129 Fax 406.542.0130

Geomatrix

CHAIN-OF-CUSTODY RECORD MIS 10115

PROJECT NAME: Butte Highlands | DATE: 9/1/09 | PAGE 2 OF

PROJECT NUMBER: 14716 | LABORATORY NAME: | CLIENT INFORMATION: | REPORTING REQUIREMENTS:

RESULTS TO: | LABORATORY ADDRESS:

TURNAROUND TIME: (See p.1)

SAMPLE SHIPMENT METHOD: | LABORATORY CONTACT:

~~GEOTRACKER REQUIRED~~ ~~YES~~ ~~NO~~

LABORATORY PHONE NUMBER: | ~~SITE SPECIFIC GLOBAL ID NO.~~

SAMPLERS (SIGNATURE): Wilhelm Welzenbach

ANALYSES: EC, pH, Sat. pg, OM, PSA* (*see p.1)

DATE	TIME	SAMPLE NUMBER	EC	pH	Sat. pg	OM	PSA*	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/28/09	8:45	TP6, 0-3	X	X	X	X	X	B0909029 4-016 1 gal bag	S					1	
		TP6, 3-20						-017							
		TP6, 20-44						-018							
		TP6, 44-60						-019							
8/27/09	14:00	TP7, 0-3						-020							
		TP7, 3-9						-021							
		TP7, 9-16						-022							
		TP7, 16-35						-023							
8/28/09	8:00	TP8, 0-2						-024							
		TP8, 2-26						-025							
		TP8, 26-42						-026							
8/27/09	14:30	TP9, 0-4						-027							
		TP9, 4-11						-028							
		TP9, 11-24						-029							
		TP9, 24-35						-030							

TOTAL NUMBER OF CONTAINERS: 33

SAMPLING COMMENTS:

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: Wilhelm Welzenbach	9/1/09		SIGNATURE:		
PRINTED NAME: Wilhelm Welzenbach			PRINTED NAME:		
COMPANY: AMEC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE: Teresa Yancey	9/2/09	9:15
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

1001 South Higgins Avenue, Building B-1
Missoula, Montana 59801-4144
Tel 406.542.0129 Fax 406.542.0130
Geomatrix

FedEx Express 19° No Seals

CHAIN-OF-CUSTODY RECORD

MIS 10120

PROJECT NAME: Butte Highlands		DATE: 9/1/09	PAGE 3 OF
PROJECT NUMBER: 14716	LABORATORY NAME:	CLIENT INFORMATION:	REPORTING REQUIREMENTS:
RESULTS TO:	LABORATORY ADDRESS:		
TURNAROUND TIME:			
SAMPLE SHIPMENT METHOD: (see p. 1)	LABORATORY CONTACT:		~~ELECTRONICS REQUIRED~~ ~~YES~~ ~~NO~~
	LABORATORY PHONE NUMBER:		~~SITE SPECIFIC GLOBAL ID NO.~~

SAMPLERS (SIGNATURE): Wilhelm Welzenbach

ANALYSES: EC, Hg, Sol, 010, CN, 013, PSA* *(see p. 1)

DATE	TIME	SAMPLE NUMBER	EC	Hg	Sol, 010	CN, 013	PSA*										CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/27/09	13:30	TP10, 0-4	X	X	X	X	X					B0909024	4-031				1 gal. bag	S					1	
↓	↓	TP10, 4-14	↓	↓	↓	↓	↓							-032			↓	↓					↓	
↓	↓	TP10, 14-18	↓	↓	↓	↓	↓							-033			↓	↓					↓	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: Wilhelm Welzenbach	9/1/09		SIGNATURE:		
PRINTED NAME: Wilhelm Welzenbach			PRINTED NAME:		
COMPANY: AMEC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE: Alisa Gancyk		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS: 33

SAMPLING COMMENTS:

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Geomatrix

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CHAIN-OF-CUSTODY RECORD

MIS 10085

PROJECT NAME: Butte Highlands

DATE: 9/1/09 PAGE 1 OF 3

PROJECT NUMBER: 14716

RESULTS TO: Wilhelm.Wolzenhaeb@mwcc.com

TURNAROUND TIME:

SAMPLE SHIPMENT METHOD:

LABORATORY NAME:

LABORATORY ADDRESS:

LABORATORY CONTACT:

LABORATORY PHONE NUMBER:

~~CLIENT INFORMATION~~: Energy Labs, 1120 S. 27th Street, Billings, MT 59101, Wayne Pippin, 406-252-6325

REPORTING REQUIREMENTS:

~~GEOTRACKER REQUIRED~~ YES NO

~~SITE SPECIFIC GLOBAL ID NO~~

SAMPLERS (SIGNATURE): Wilhelm Wolzenhaeb

ANALYSES

*include USDA classes, incl. very fine sand (0.05 to 0.1mm)

DATE	TIME	SAMPLE NUMBER	EC soil (mS/cm)	pH soil (SU)	Sat. %	Org. Matter %	Particle Size Analysis*	Total Metals	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/28/09	10:00	TP1 1-13	X	X	X	X	X	X	Ziploc bag	S					1	Total Metals to be: As, Cd, Cu, Mn, Mo, Ni, Se, Zn
"	"	TP1' 13-26														
8/28/09	11:00	TP2' 0.75-5														
"	"	TP2' 5-26														
8/28/09	12:00	TP3' 0.5-10														
		TP3' 10-32														
		TP3' 32-38														
		TP3' 38-50														
8/27/09	10:00	TP4' 0-4														
		TP4' 4-11														
		TP4' 11-20														
		TP4' 20-37														
8/27/09	17:30	TP5' 2-9														
		TP5' 9-26														
		TP5' 26-39														

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: Wilhelm Wolzenhaeb	9/4/09		SIGNATURE:		
PRINTED NAME: Wilhelm Wolzenhaeb			PRINTED NAME:		
COMPANY: MWCC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS: 33

SAMPLING COMMENTS: Soil test pits (TP) and [illegible] (TP) [illegible] loads

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Geomatrix

CHAIN-OF-CUSTODY RECORD

MIS 10115

PROJECT NAME: Butte Highlands

DATE: 9/1/09 PAGE 2 OF 3

PROJECT NUMBER: 14716

RESULTS TO:

TURNAROUND TIME: (See p. 1)

SAMPLE SHIPMENT METHOD:

LABORATORY NAME:

LABORATORY ADDRESS:

LABORATORY CONTACT:

LABORATORY PHONE NUMBER:

CLIENT INFORMATION:

REPORTING REQUIREMENTS:

~~GEOTRACKER REQUIRED~~ YES ____ NO ____

~~SITE SPECIFIC GLOBAL ID NO.:~~

SAMPLERS (SIGNATURE): Wilhelm Wetzel

ANALYSES: EC, pH, Sol. % O/G, OM %, OSA %, Total Metals X (see p. 1)

DATE	TIME	SAMPLE NUMBER	EC	pH	Sol. % O/G	OM %	OSA %	Total Metals	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/28/09	8:45	TP6, 0-3	X	X	X	X	X	X	1 gal Ziploc	S					1	
		TP6, 3-20														
		TP6, 20-44														
		TP6, 44-60														
8/27/09	9:00	TP7, 0-3														
		TP7, 3-9														
		TP7, 9-16														
		TP7, 16-35														
8/28/09	8:00	TP8, 0-2														
		TP8, 2-26														
		TP8, 26-42														
8/27/09	14:30	TP9, 0-4														
		TP9, 4-11														
		TP9, 11-24														
		TP9, 24-35														

TOTAL NUMBER OF CONTAINERS: 33

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: Wilhelm Wetzel	9/1/09		SIGNATURE:		
PRINTED NAME: Wilhelm Wetzel			PRINTED NAME:		
COMPANY: AMEC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

SAMPLING COMMENTS:

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Geomatrix

CHAIN-OF-CUSTODY RECORD

MIS 10120

PROJECT NAME: Butte Highlands			DATE: 9/1/09 PAGE 3 OF 3
PROJECT NUMBER: 14316	LABORATORY NAME:	CLIENT INFORMATION:	REPORTING REQUIREMENTS:
RESULTS TO:	LABORATORY ADDRESS:		
TURNAROUND TIME: (See P.1)			
SAMPLE SHIPMENT METHOD:	LABORATORY CONTACT:		~~GEOTRACKER REQUIRED~~ ~~YES~~ ~~NO~~
	LABORATORY PHONE NUMBER:		~~SITE SPECIFIC GLOBAL ID NO:~~

SAMPLERS (SIGNATURE): William Wittenbach

ANALYSES

DATE	TIME	SAMPLE NUMBER	EC	pH	Lead, Fe	OM&OS	PSA	Total Metals	* (See P.1)	CONTAINER TYPE AND SIZE	Soil (S), Water (W), Vapor (V), or Other (O)	Filtered	Preservative Type	Cooled	MS/MSD	No. of Containers	ADDITIONAL COMMENTS
8/27/09	13:30	TP10, 1-4	X	X	X	X	X	X		1 gal bag	S					1	
↓	↓	TP10, 4-14	↓	↓	↓	↓	↓	↓		↓	↓					↓	
↓	↓	TP10, 14-18	↓	↓	↓	↓	↓	↓		↓	↓					↓	

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
SIGNATURE: William Wittenbach	9/1/09		SIGNATURE:		
PRINTED NAME: William Wittenbach			PRINTED NAME:		
COMPANY: AMEC Geomatrix			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		
SIGNATURE:			SIGNATURE:		
PRINTED NAME:			PRINTED NAME:		
COMPANY:			COMPANY:		

TOTAL NUMBER OF CONTAINERS: 35

SAMPLING COMMENTS:

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Geomatrix

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GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

Summary of Test Results

Project: Butte Highlands
Report to: AMEC Geomatrix

Report Date: 9/23/09
File Name: TIMRES Z09059A

Test Pit	Depth (inches)	Lab Number	Visual USCS Soil Classification (remarks)	Dry Unit Weight, pcf	Passing No. 200,%	Atterberg Limits LL	Atterberg Limits PI	Fines Class.
1	0-36	B9L1938A	P.G. Sand with Silt		**	N/V*	N/P*	ML
2	0-26	B	P.G. Gravel w/Silt, Sand & Gravel			N/V*	N/P*	ML
3	0-60	C	Silty Sand with Gravel			16	N/P*	ML
3	0-10	D	Sandy Silt	70.7	**			
3	38-50	E	Silty Sand with Gravel	114.2	**			
6	0-60	H	Clayey Sand with Gravel		**	34	16	CL
7	0-60	I	Silty Sand with Gravel			20	2	ML
7	3-9	J	Silty Clay w/Sand & Gravel		**			
7	16-35	K	Silty Sand		**			
7	35-60	L	Silty Clayey Sand		**			
8	0-60	M	Clayey Sand w/Gravel & Cobbles			26	10	CL
8	2-26	N	Sandy Silt (very light weight)	55.5	**			
8	26-42	O	Silty Sand with Gravel	104.7	**			
9	0-60	P	Elastic Silt w/Sand & Gravel			68	21	MH
9	4-11	Q	Silty Clayey Sand		**			
9	11-24	R	Silty Sand with Gravel		**			
9	24-35	S	Silty Sand with Gravel		**			
9	35-46	T	Silty Sand with Gravel		**			
10	0-60	U	P.G. Sand with Clay & Gravel			39	21	CL
10	0-4	V	Silty Sand (with organics)	60.6	**			
10	4-14	W	Silty Clayey Sand w/Gravel	94.9	**			
10	14-18	X	Silty Clayey Sand	108.4	**			
10	18-60	Y	Silty Sand with Gravel	97.6	**			
3	10-32	Z	Silty Sand with Gravel	123.9	**			

* N/V = No Value, N/P = Non Plastic
** See Hydrometer/Gradation Sheet.

Reviewed by: _____

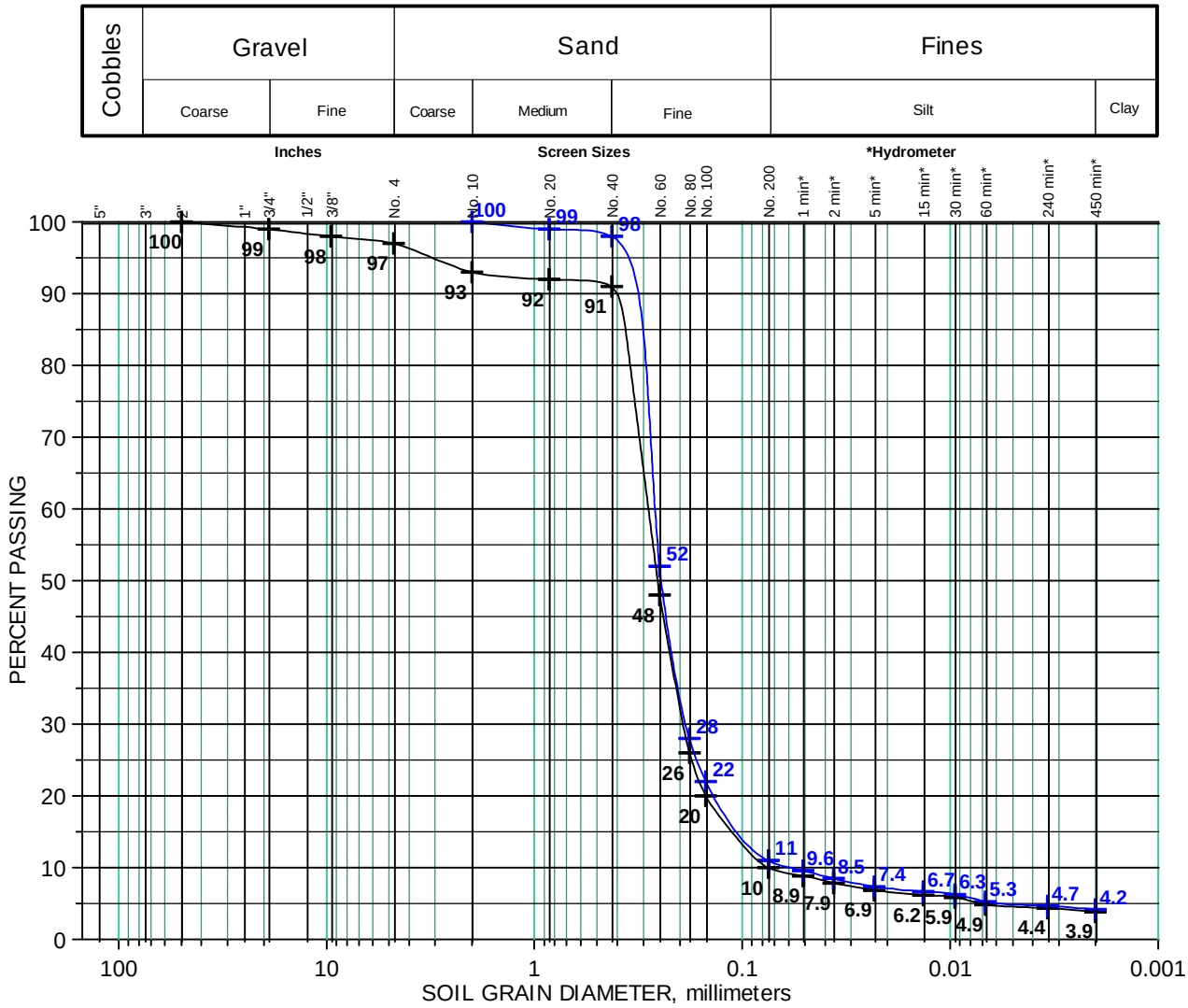
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938A
Sample Location: TP-1 @ 0 - 36"
USCS Soil Class.: P.G. Sand with Silt
Atterberg Limits: LL = N/V, PI = N/P
Date tested: 9/16/09 By: IR

Sand = 89% (V. Fine Sand = 4%)
Silt = 7%
Clay = 4%
Gravel (plus No. 10) = 7%
USDA Soil Class.: Sand

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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Integrity from the Ground Up

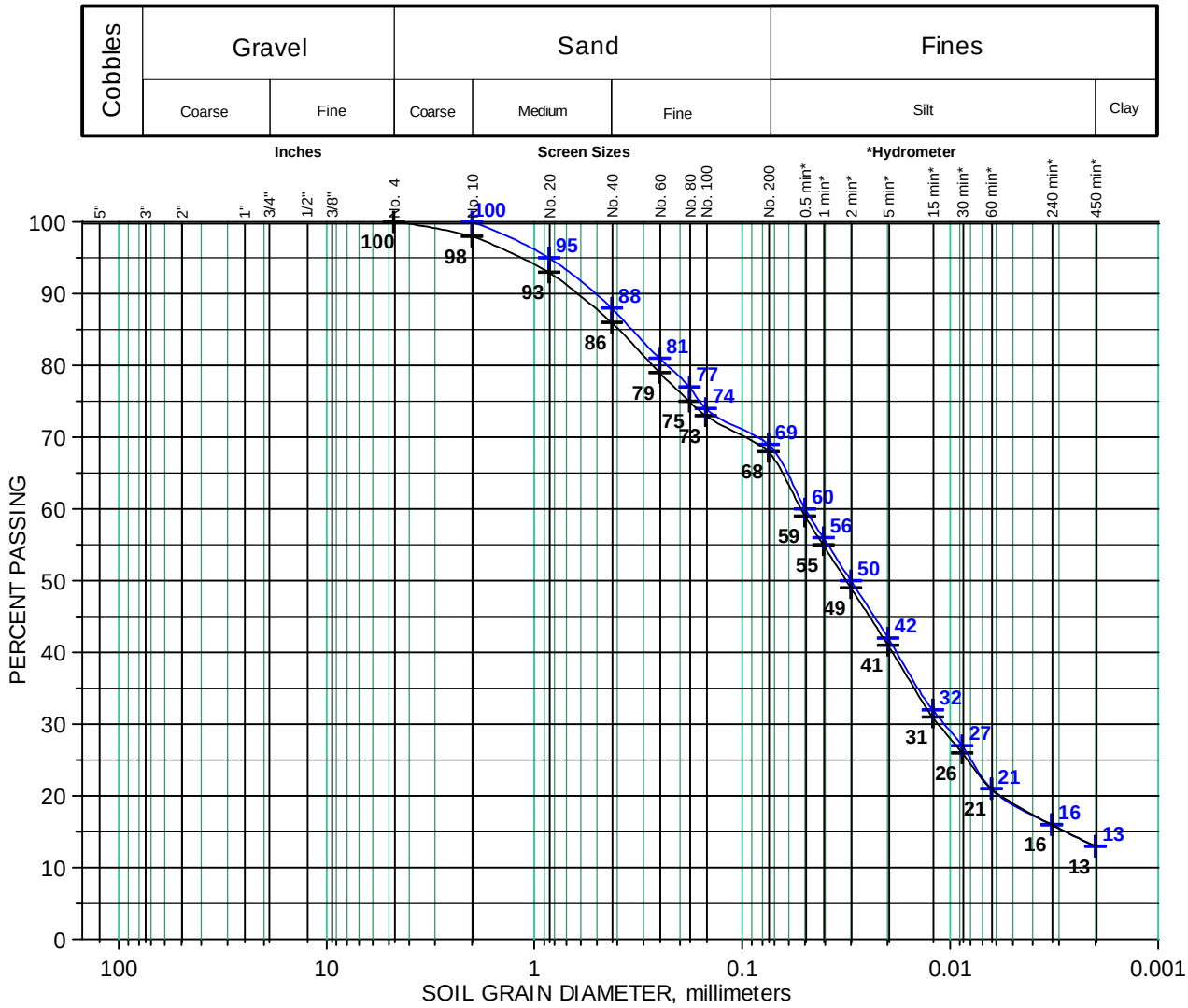
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938D
Sample Location: TP-3 @ 0 - 10"
USCS Soil Class.: Sandy Silt
Dry Unit Weight: 70.7 pcf
Date tested: 9/16/09 By: IR

Sand = 40% (V. Fine Sand = 11%)
Silt = 46%
Clay = 14%
Gravel (plus No. 10) = 2%
USDA Soil Class.: Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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Integrity from the Ground Up

GRADATION ANALYSIS

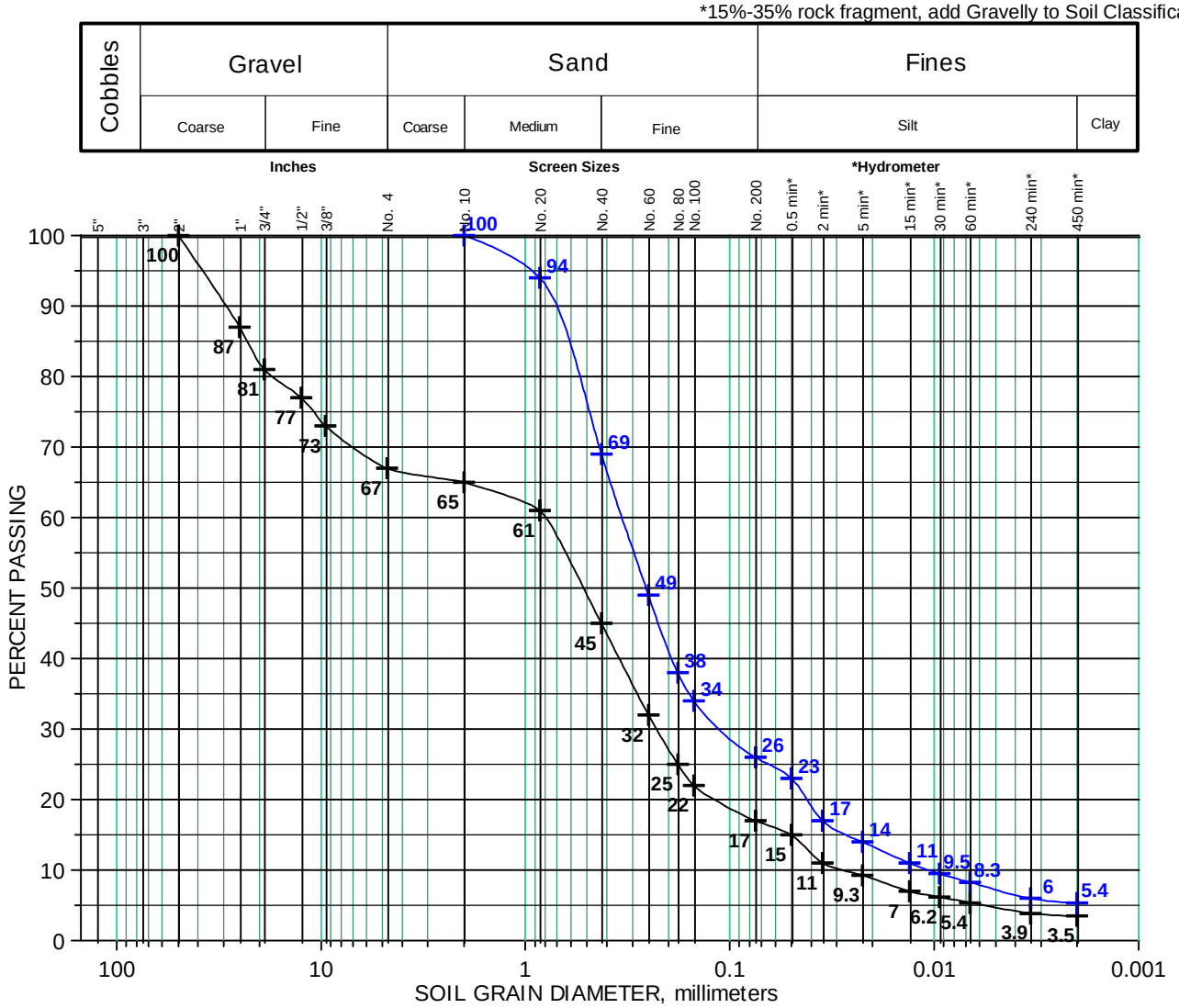
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938Z
Sample Location: TP-3 @ 10 - 32"
USCS Soil Class.: Silty Sand w/Gravel
Dry Unit Weight: 123.9 pcf
Date tested: 9/22/09 By: IR

Sand = 77% (V. Fine Sand = 6%)
Silt = 18%
Clay = 5%
Gravel (plus No. 10) = 35%*
USDA Soil Class.*:
Gravelly Loamy Sand

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiono

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GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

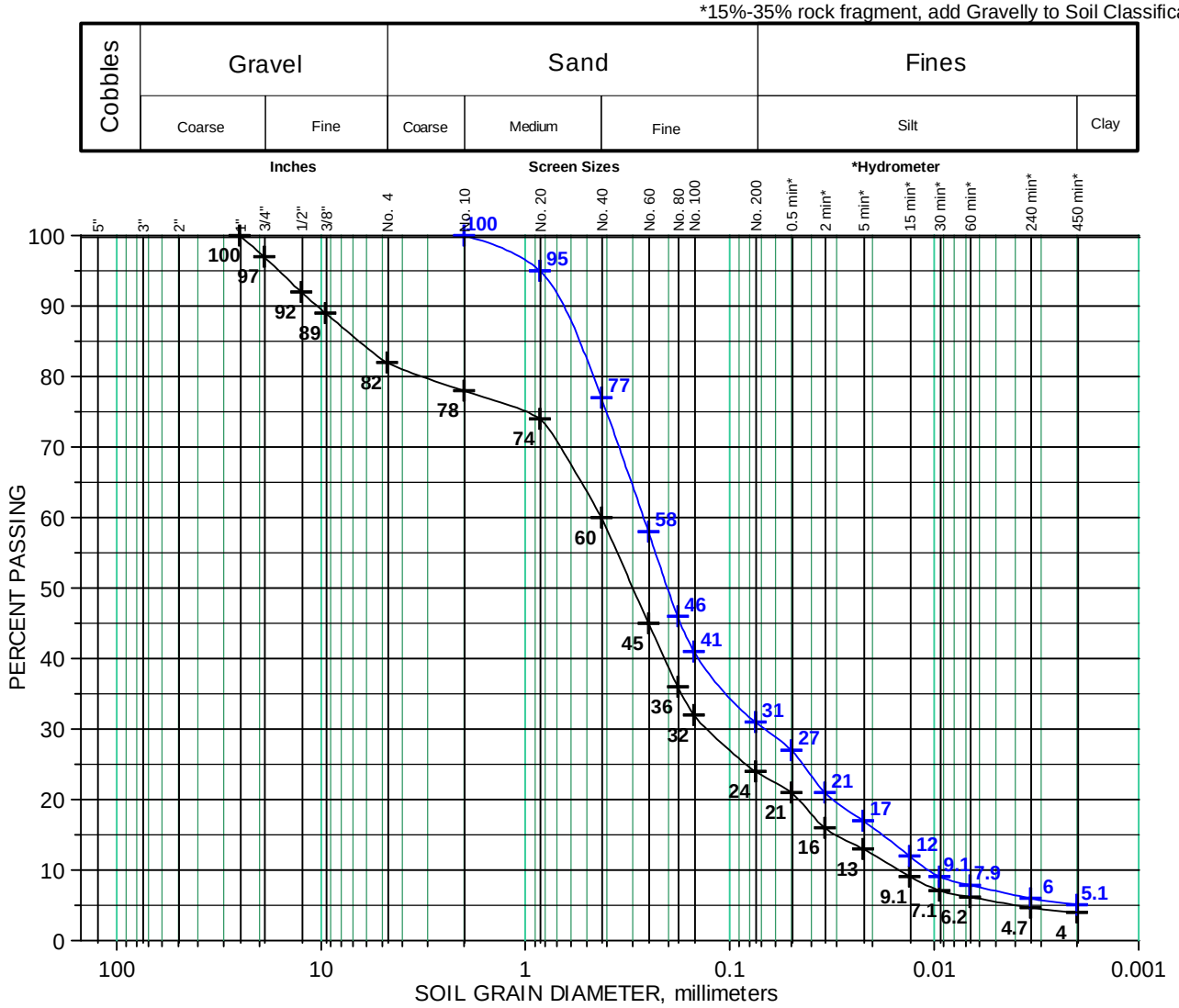
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938E
Sample Location: TP-3 @ 38 - 50"
USCS Soil Class.: Silty Sand w/Gravel
Dry Unit Weight: 114.2 pcf
Date tested: 9/16/09 By: IR

Sand = 73% (V. Fine Sand = 7%)
Silt = 22%
Clay = 5%
Gravel (plus No. 10) = 22%*
USDA Soil Class.*:
Gravelly Sandy Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiono

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Integrity from the Ground Up

GRADATION ANALYSIS

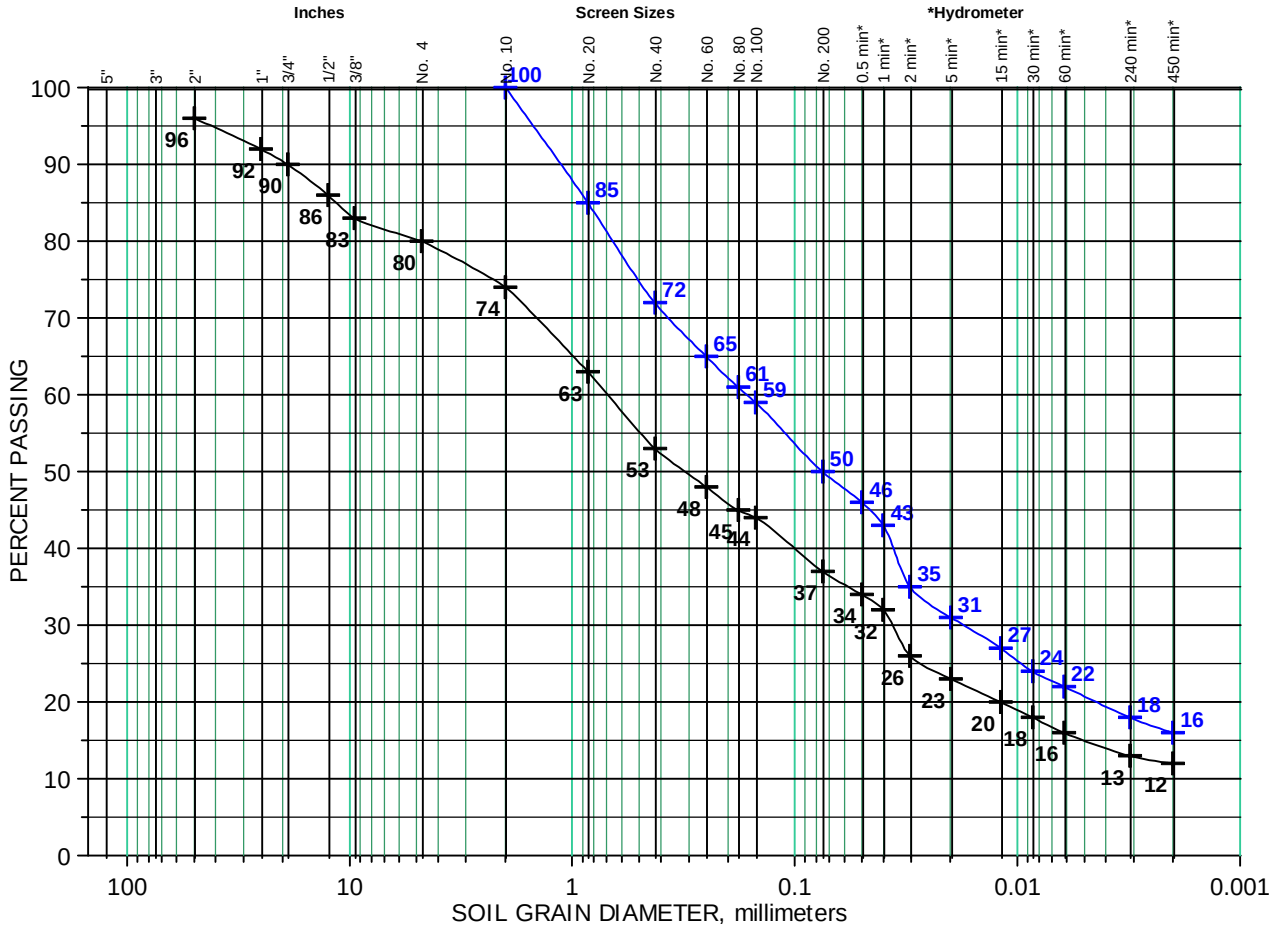
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938H
Sample Location: TP-6 @ 0 - 60"
USCS Soil Class.: Clayey Sand w/Gravel
Atterberg Limits: LL = 34, PI = 16
Date tested: 9/17/09 By: IR

Sand = 54% (V. Fine Sand = 8%)
Silt = 30%
Clay = 16%
Gravel (plus No. 10) = 26%*
USDA Soil Class.*:
Gravelly Sandy Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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Integrity from the Ground Up

GRADATION ANALYSIS

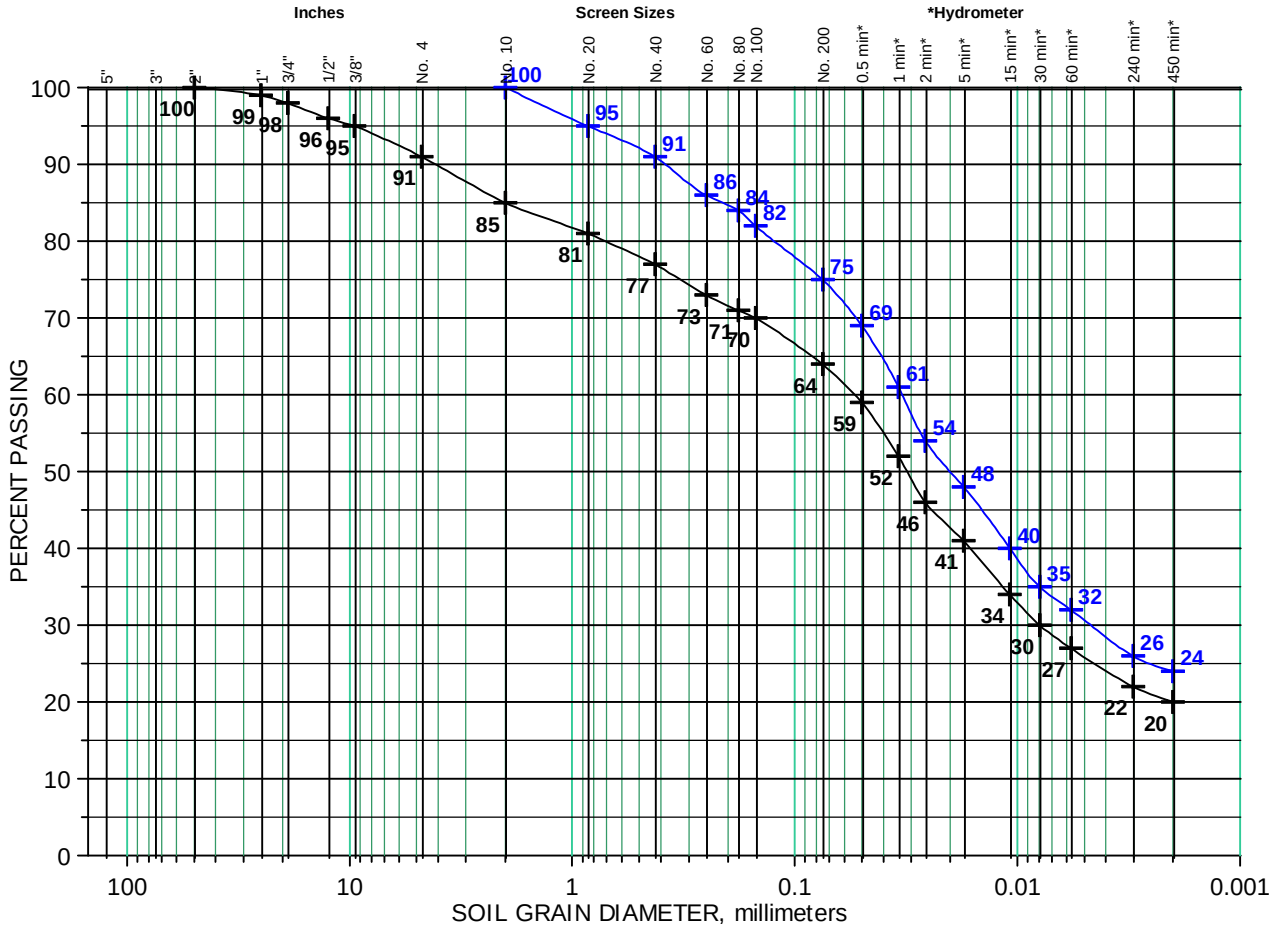
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938J
Sample Location: TP-7 @ 3 - 9"
USCS Soil Class.: Silty Clay with Sand & Gravel
Date tested: 9/17/09 By: IR

Sand = 31% (V. Fine Sand = 9%)
Silt = 46%
Clay = 23%
Gravel (plus No. 10) = 15%*
USDA Soil Class.*: Gravelly Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

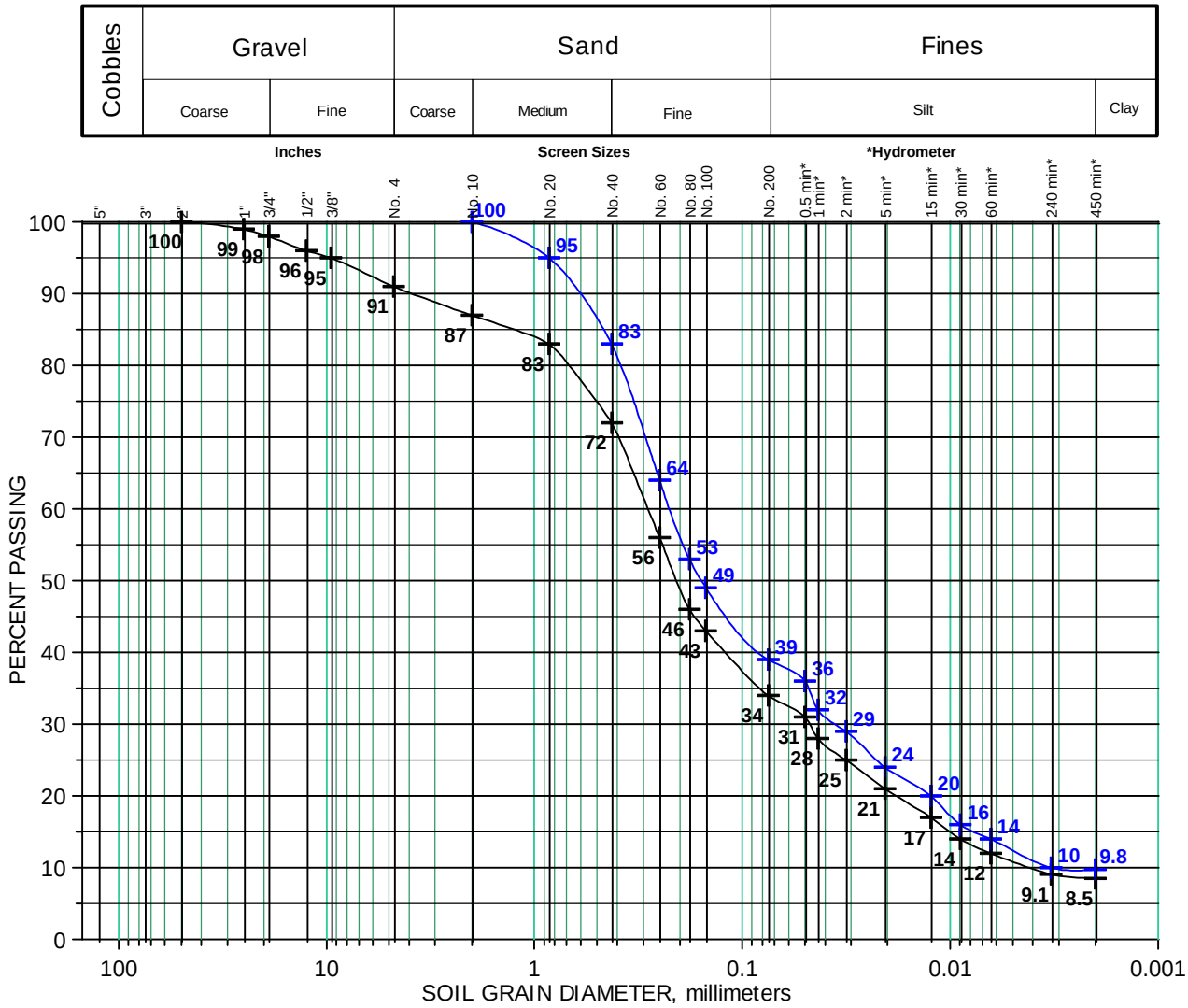
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938K
Sample Location: TP-7 @ 16 - 35"
USCS Soil Class.: Silty Sand
Date tested: 9/17/09 By: IR

Sand = 65% (V. Fine Sand = 6%)
Silt = 25%
Clay = 10%
Gravel (plus No. 10) = 13%
USDA Soil Class.:
Sandy Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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Integrity from the Ground Up

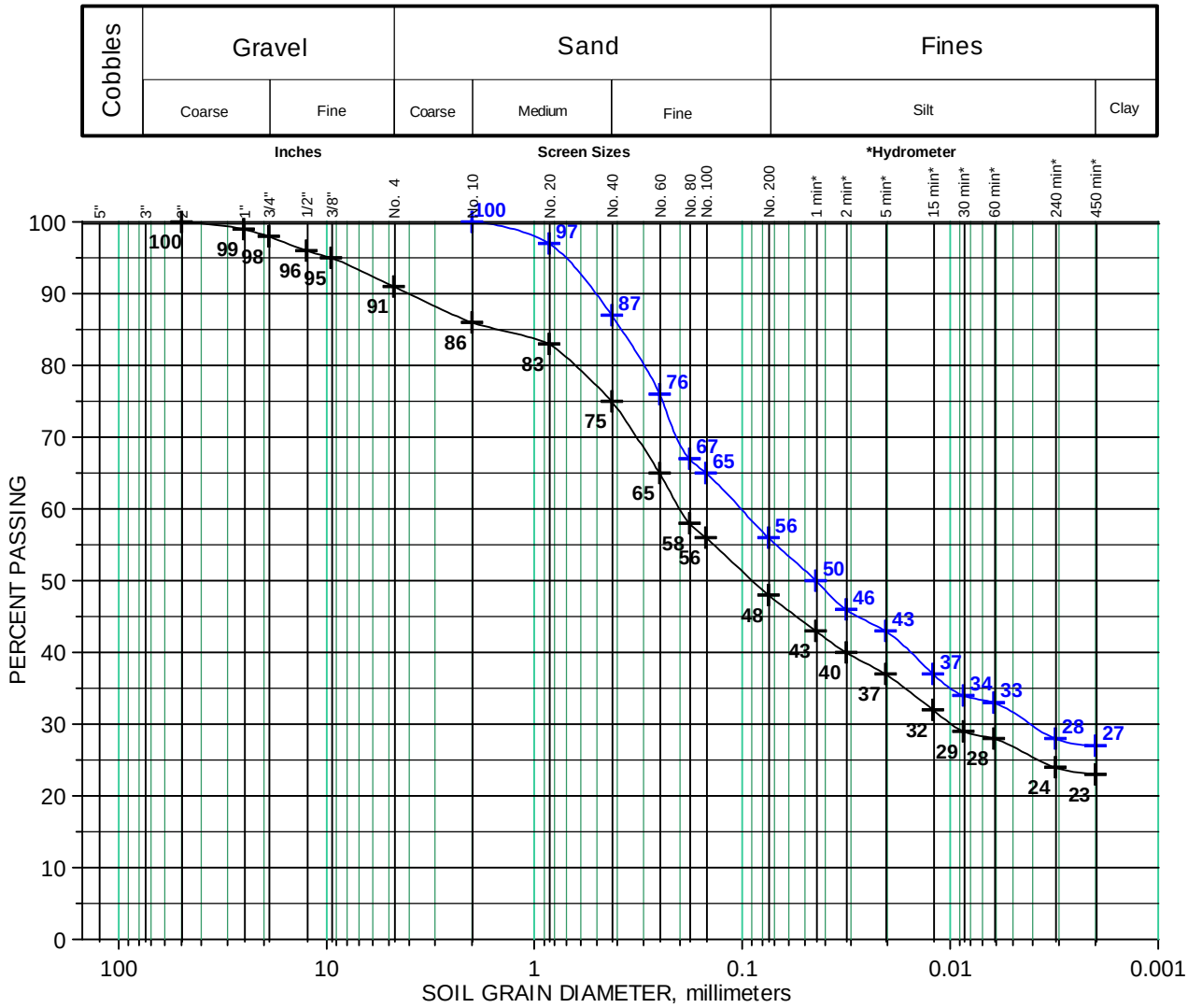
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938L
Sample Location: TP-7 @ 35 - 60"
USCS Soil Class.: Silty Clayey Sand
Date tested: 9/18/09 By: IR

Sand = 44% (V. Fine Sand = 9%)
Silt = 29%
Clay = 27%
Gravel (plus No. 10) = 14%
USDA Soil Class.: Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

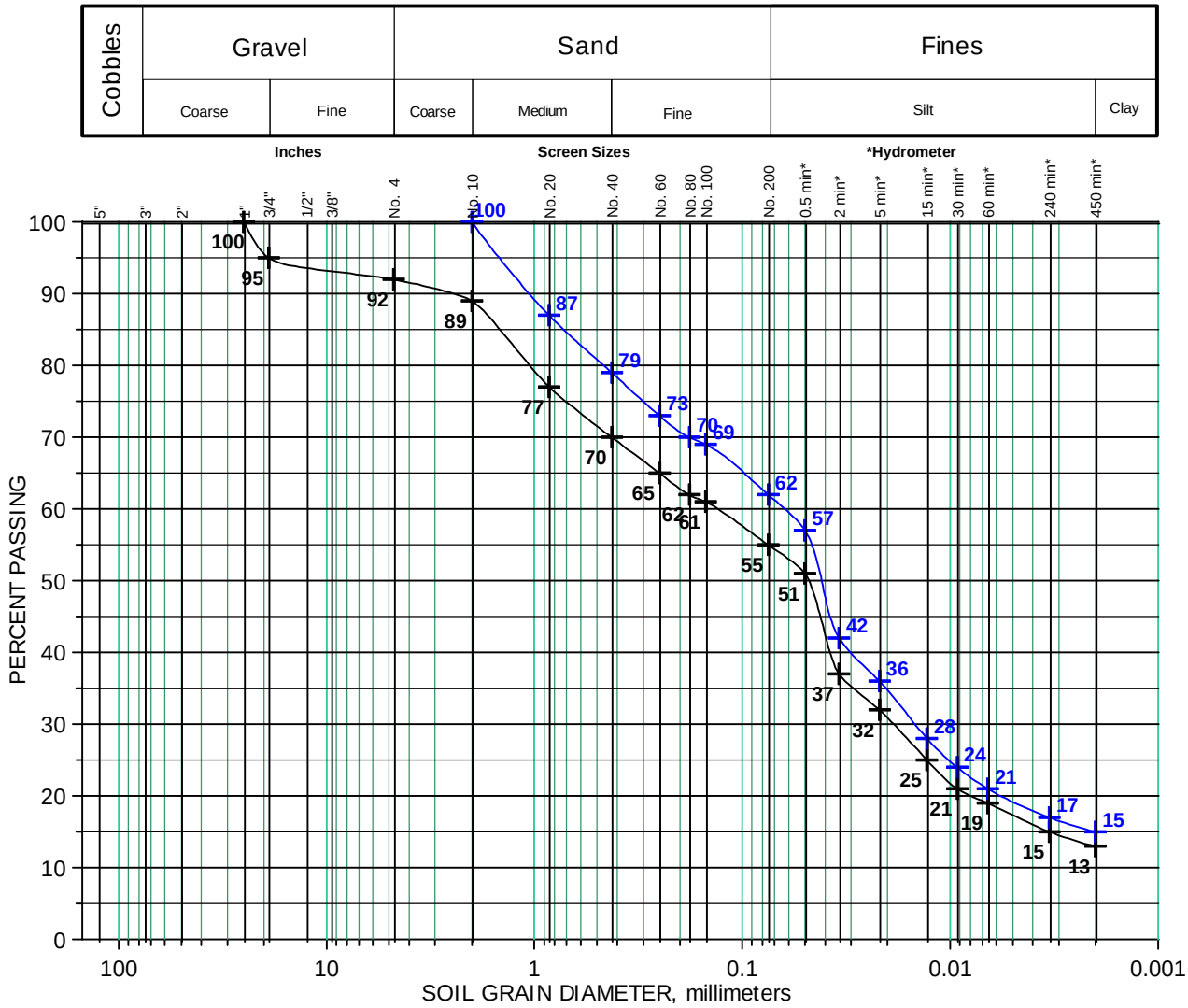
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938N
Sample Location: TP-8 @ 2 - 26"
USCS Soil Class.: Sandy Silt
Dry Unit Weight: 55.5 pcf (very light wt)
Date tested: 9/18/09 By: IR

Sand = 43% (V. Fine Sand = 8%)
Silt = 42%
Clay = 15%
Gravel (plus No. 10) = 11%
USDA Soil Class.: Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiono

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

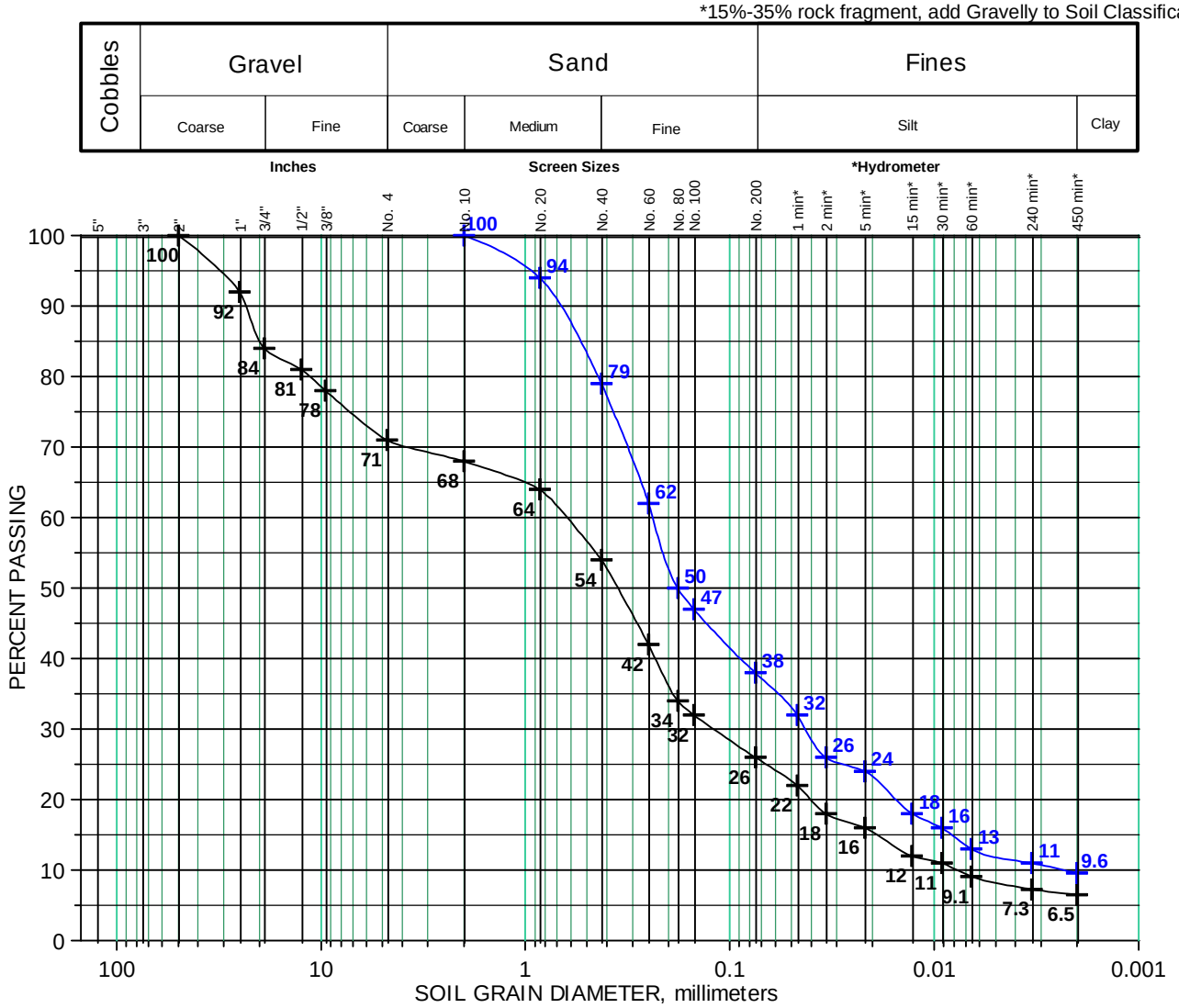
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938O
Sample Location: TP-8 @ 26 - 42"
USCS Soil Class.: Silty Sand w/Gravel
Dry Unit Weight:
Date tested: 9/18/09 By: IR

Sand = 67% (V. Fine Sand = 8%)
Silt = 23%
Clay = 10%
Gravel (plus No. 10) = 32%*
USDA Soil Class.*:
Gravelly Sandy Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

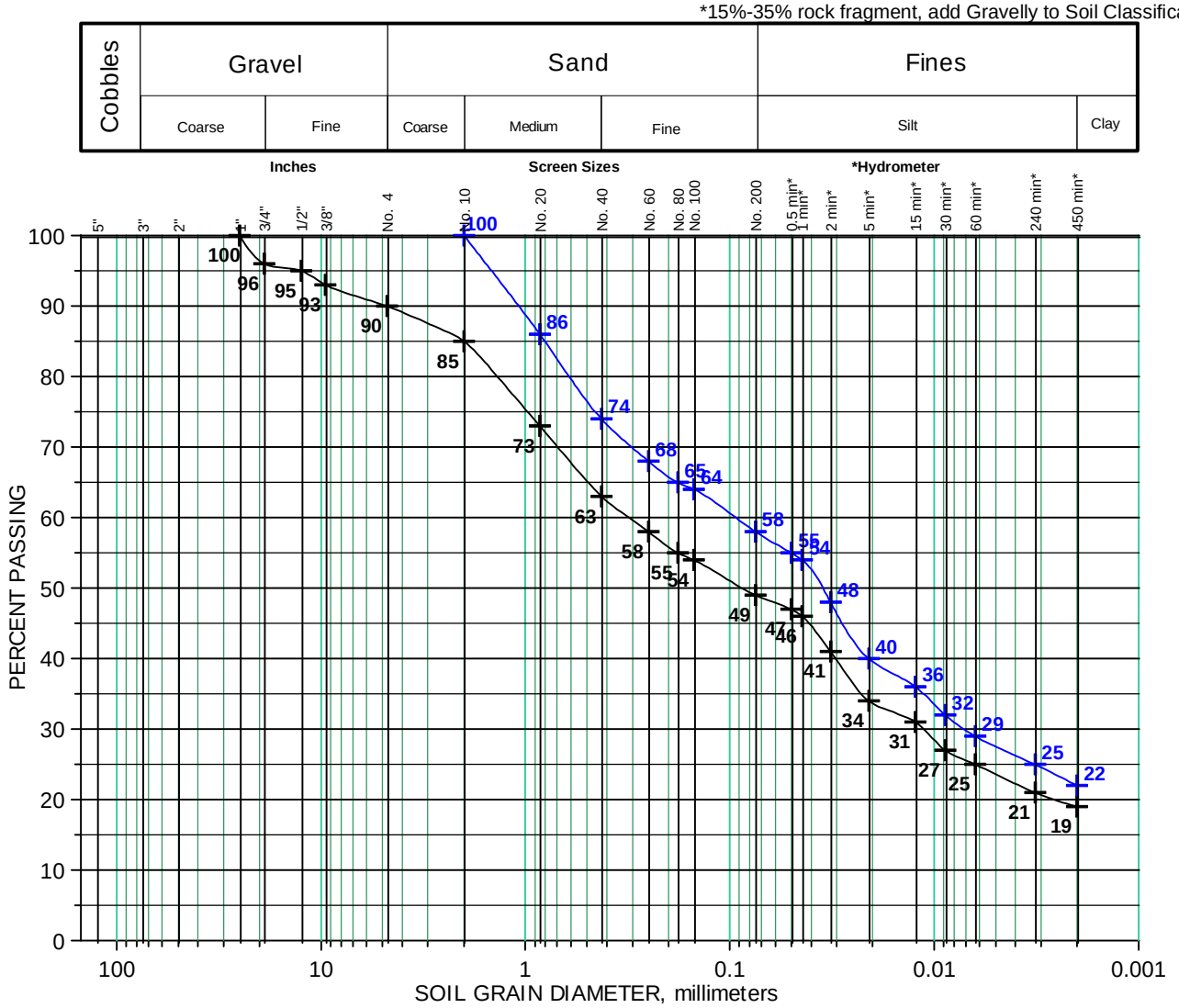
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938Q
Sample Location: TP-9 @ 4 - 11"
USCS Soil Class.: Silty Clayey Sand
Date tested: 9/18/09 By: IR

Sand = 45% (V. Fine Sand = 6%)
Silt = 33%
Clay = 22%
Gravel (plus No. 10) = 15%*
USDA Soil Class.*:
Gravelly Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

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Integrity from the Ground Up

GRADATION ANALYSIS

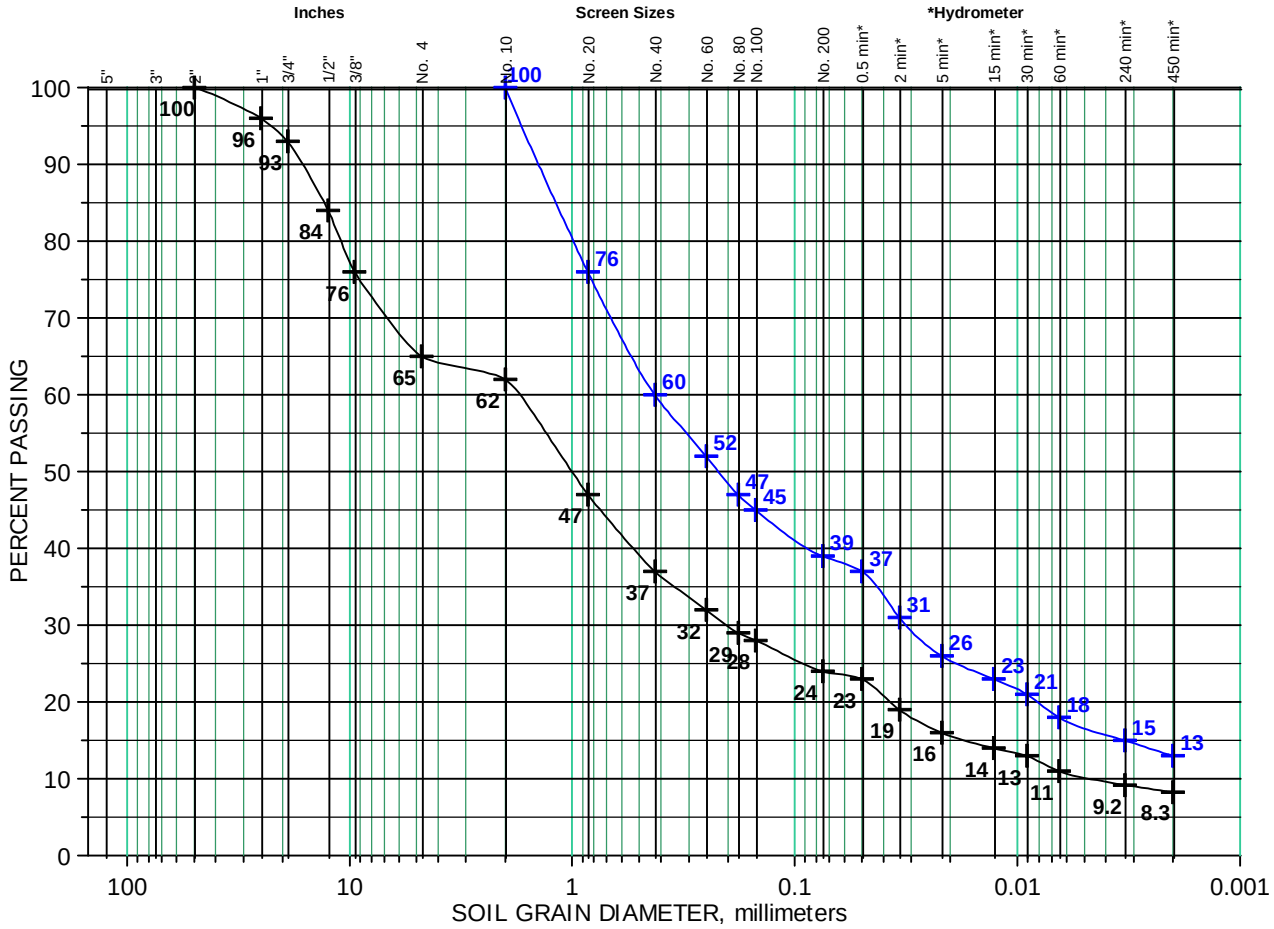
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938R
Sample Location: TP-9 @ 11 - 24"
USCS Soil Class.: Silty Sand w/Gravel
Date tested: 9/19/09 By: IR

Sand = 63% (V. Fine Sand = 4%)
Silt = 24%
Clay = 13%
Gravel (plus No. 10) = 38%*
USDA Soil Class.*:
Very Gravelly Sandy Loam

USCS
USDA

*35%-60% rock fragment, add Very Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiono

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

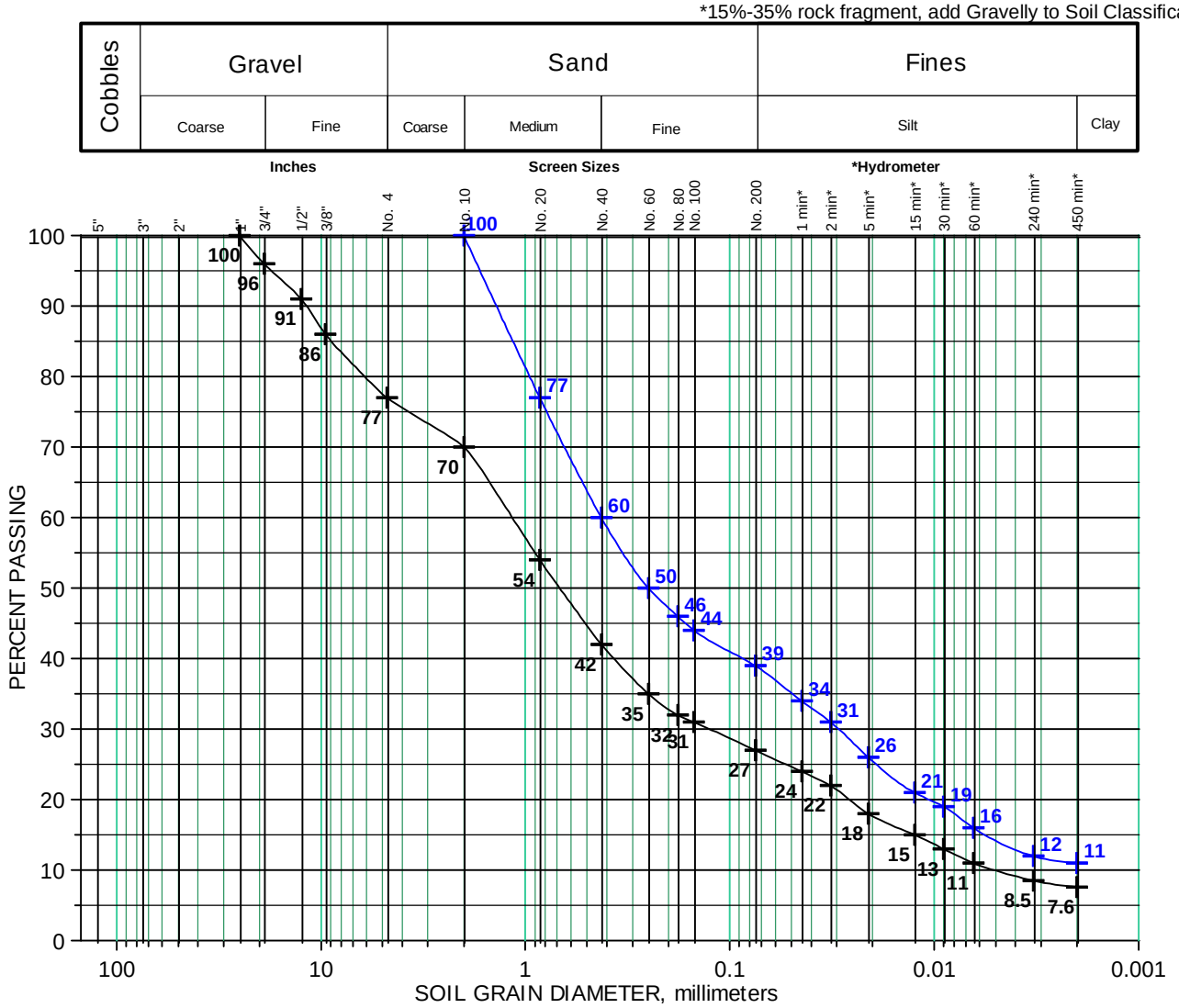
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938S
Sample Location: TP-9 @ 24 - 35"
USCS Soil Class.: Silty Sand w/Gravel
Date tested: 9/19/09 By: IR

Sand = 65% (V. Fine Sand = 6%)
Silt = 24%
Clay = 11%
Gravel (plus No. 10) = 30%*
USDA Soil Class.*:
Gravelly Sandy Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiono

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

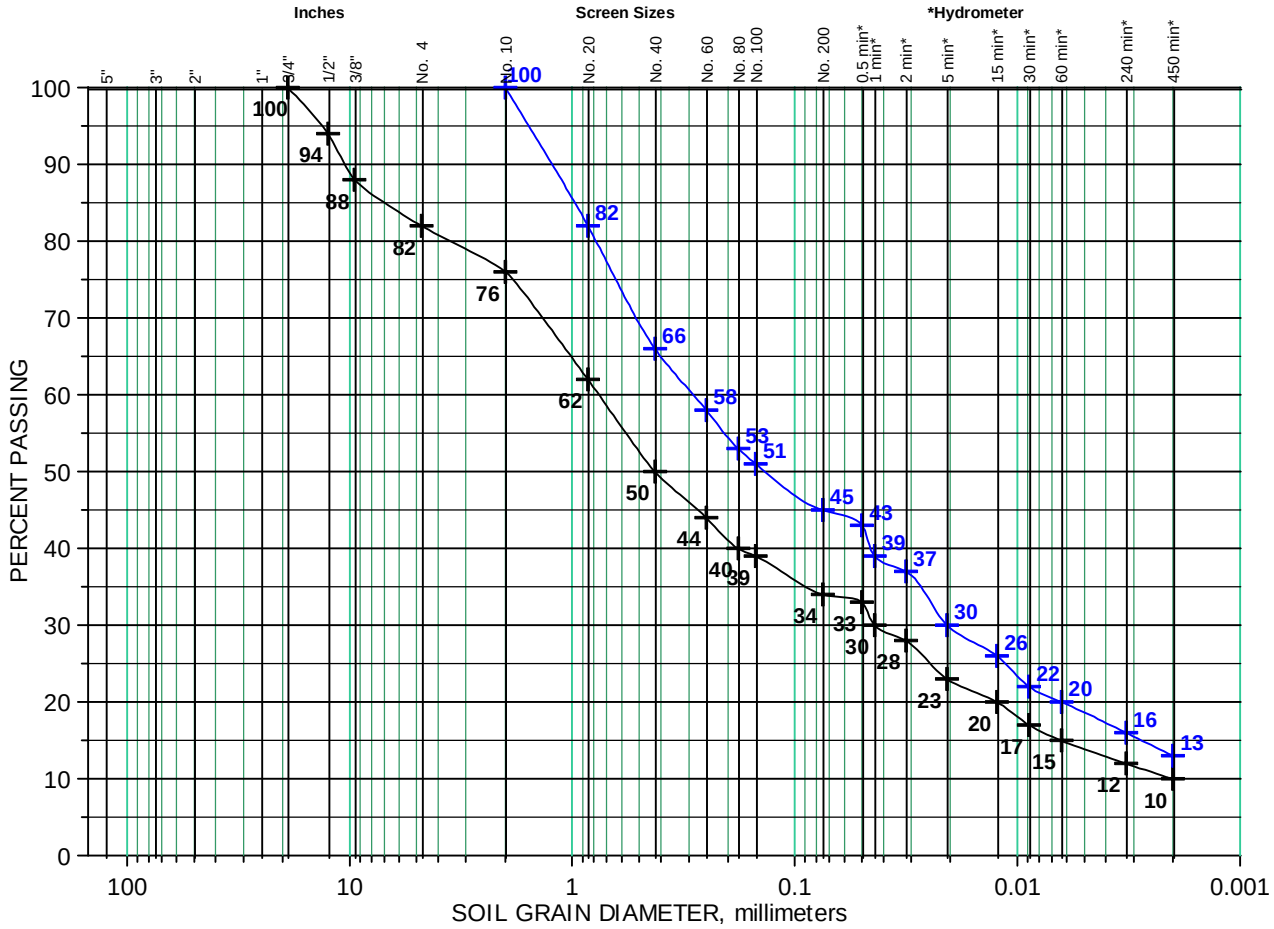
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938T
Sample Location: TP-9 @ 35 - 46"
USCS Soil Class.: Silty Sand w/Gravel
Date tested: 9/19/09 By: IR

Sand = 57% (V. Fine Sand = 3%)
Silt = 30%
Clay = 13%
Gravel (plus No. 10) = 24%*
USDA Soil Class.*:
Gravelly Sandy Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

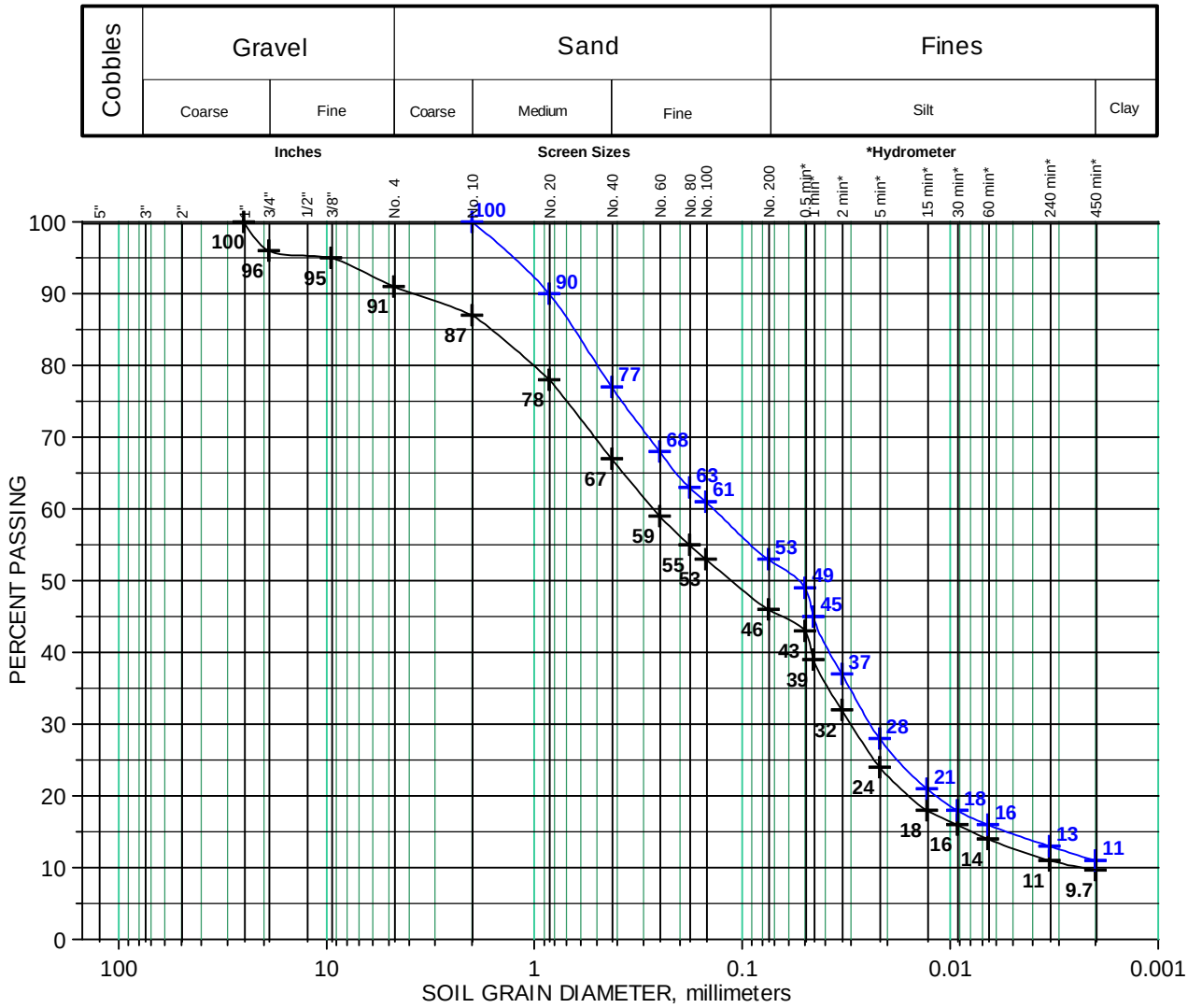
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938V
Sample Location: TP-10 @ 0 - 4"
USCS Soil Class.: Silty Sand
Dry Unit Weight: 60.6 pcf (w/Organics)
Date tested: 9/18/09 By: IR

Sand = 51% (V. Fine Sand = 7%)
Silt = 38%
Clay = 11%
Gravel (plus No. 10) = 13%
USDA Soil Class.: Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiomo

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

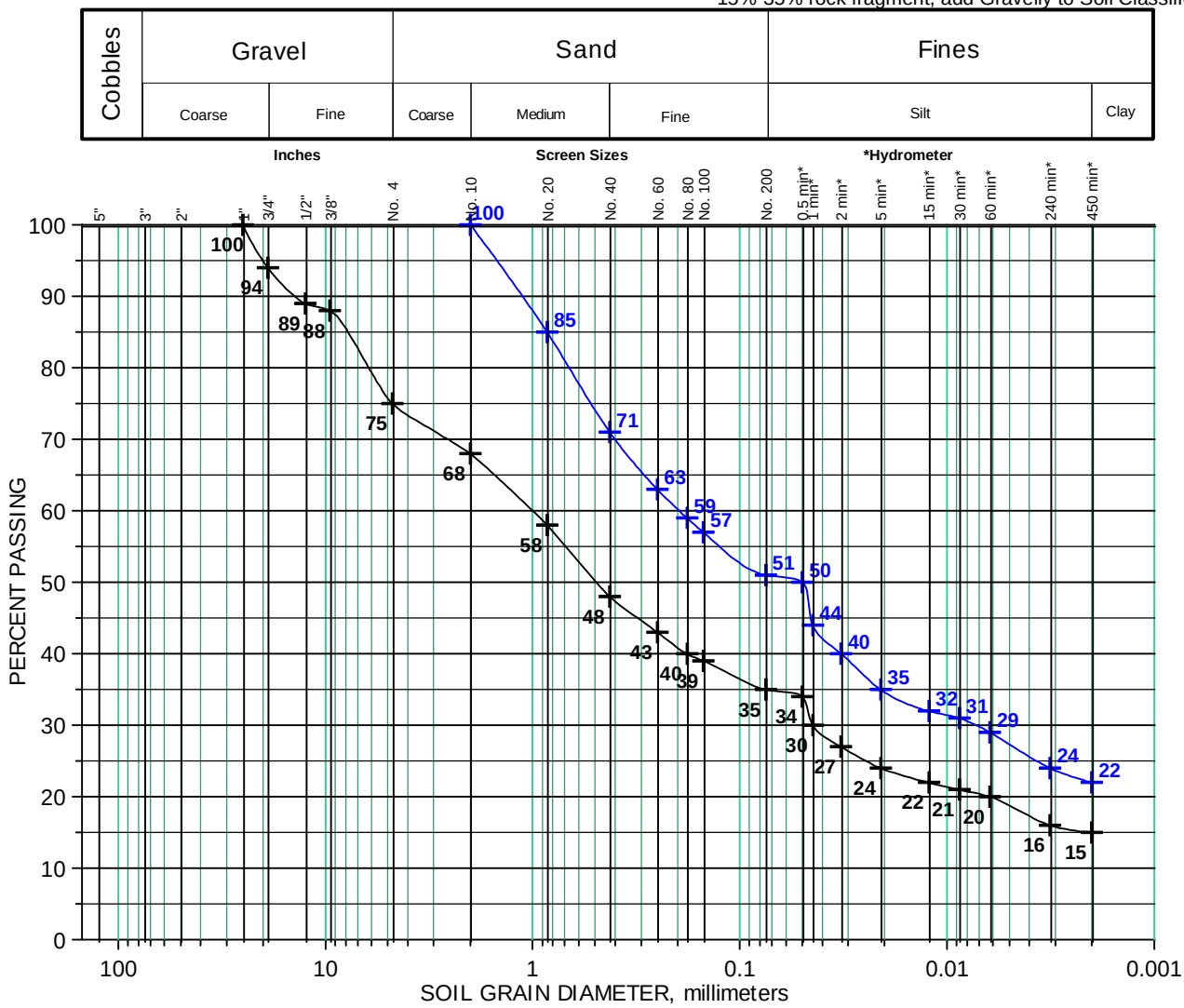
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938W
Sample Location: TP-10 @ 4 - 14"
USCS Soil Class.: Silty Clayey Sand with Gravel
Dry Unit Weight: 94.9 pcf
Date tested: 9/19/09 By: IR

Sand = 50% (V. Fine Sand = 3%)
Silt = 28%
Clay = 22%
Gravel (plus No. 10) = 32%*
USDA Soil Class.*: Gravelly Loam

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiomo

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

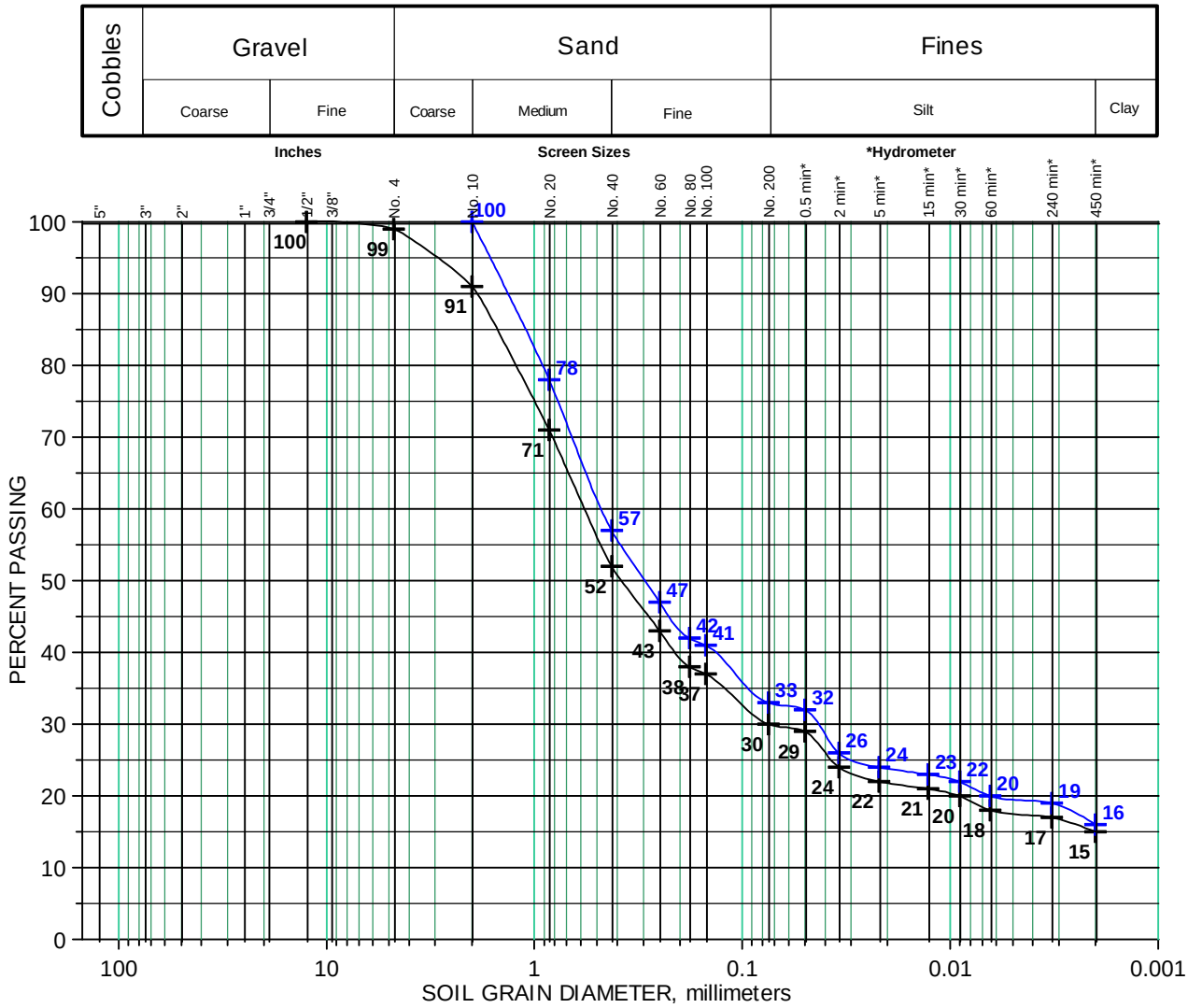
GRADATION ANALYSIS

ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938X
Sample Location: TP-10 @ 14 - 18"
USCS Soil Class.: Silty Clayey Sand
Dry Unit Weight: 108.4 pcf
Date tested: 9/19/09 By: IR

Sand = 68% (V. Fine Sand = 3%)
Silt = 16%
Clay = 16%
Gravel (plus No. 10) = 9%
USDA Soil Class.:
Sandy Loam

USCS
USDA



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alasiomo

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

GRADATION ANALYSIS

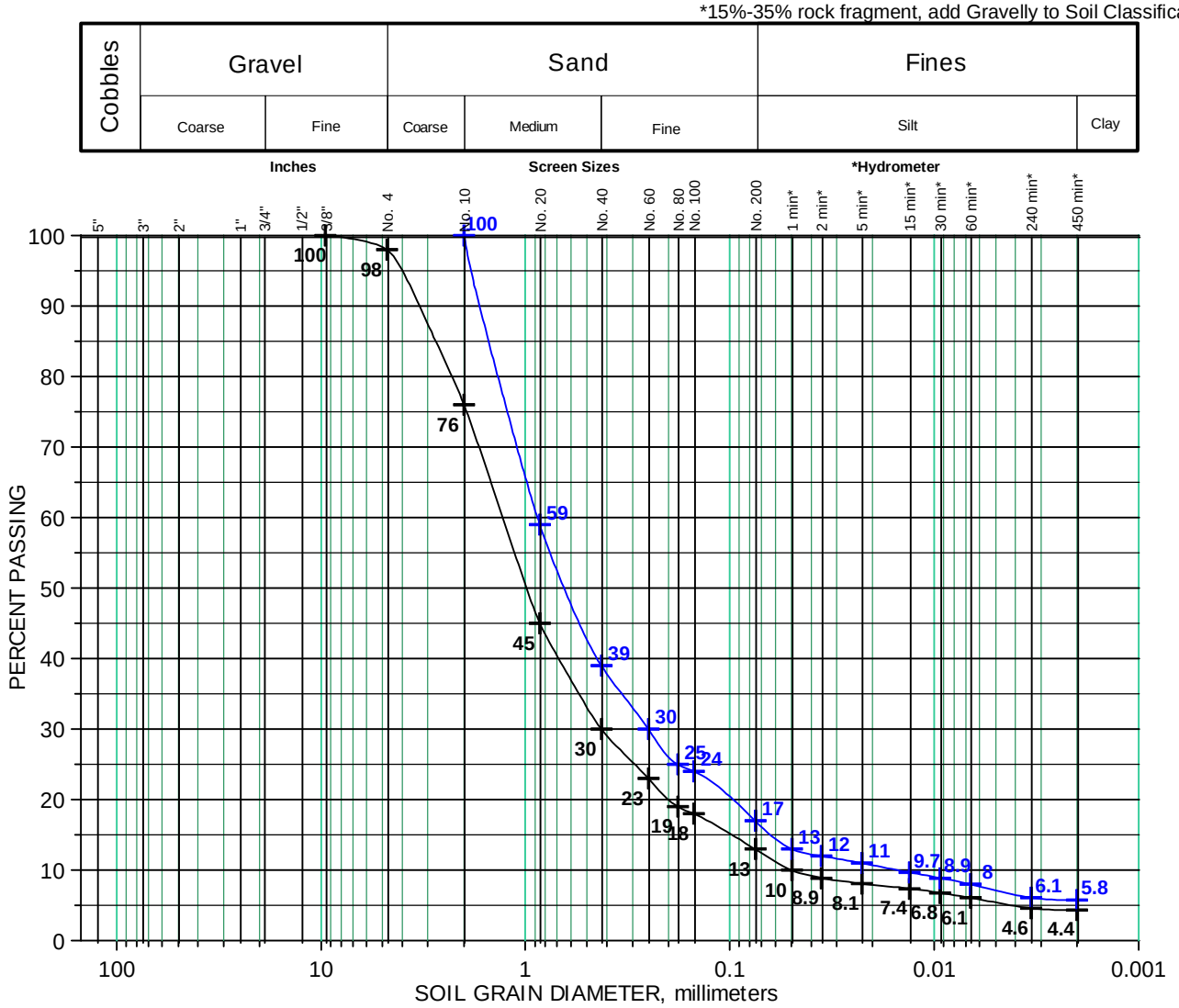
ASTM D422

Project: Butte Highlands
Client: AMEC Geomatrix, Inc.
File: TIMRES Z09059A
Sample Number: B9L1938Y
Sample Location: TP-10 @ 18 - 60"
USCS Soil Class.: Silty Sand w/Gravel
Dry Unit Weight: 97.6 pcf
Date tested: 9/22/09 By: IR

Sand = 87% (V. Fine Sand = 7%)
Silt = 7%
Clay = 6%
Gravel (plus No. 10) = 24%*
USDA Soil Class.*:
Gravelly Loamy Sand

USCS
USDA

*15%-35% rock fragment, add Gravelly to Soil Classification.



Note: USDA Soil Classification based on 100% passing No. 10 Screen.

Reviewed by: Adrian Alessoni

STRATA
GEOTECHNICAL ENGINEERING & MATERIALS TESTING
Integrity from the Ground Up

Land Use Investigation 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

March 31, 2010

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2. Ownership and special areas
3. Management and special sites
4. Grazing allotments
5. Timber harvest classifications
6. Summer recreation allocations
7. Winter recreation allocations

1. Introduction

The Butte Highlands Project will be developed on patented mining claims located within the Deerlodge National Forest (Figure 1). The land use investigation included a search for available information pertaining to public and private jurisdictions and uses.

The study area for the land use investigation is located in Silver Bow County, Montana, approximately 15 miles south of Butte. The Project straddles the Continental Divide within the upper portion of the drainages of Basin Creek, Fish Creek, and Middle Fork Moose Creek. A 2-mile radius circle, centered on the Project, was selected as the study area for the land use analysis.

2. Methods

The revised U.S. Forest Service management plan for the Beaverhead-Deerlodge National Forest was approved on January 14, 2009, and establishes guidance for all resource management activities on lands that directly border the Project (USDA 2009). In addition, the following information sources were investigated or contacted:

- USGS quadrangle maps (1:24,000 scale Mount Humbug and Pipestone Pass quadrangles);
- Aerial photography;
- Natural Resources Conservation Service maps;
- Tim O'Neil, GIS Coordinator, Beaverhead-Deerlodge National Forest;
- Federal, state, and local government documents.

3. Results

Ownership and Jurisdictions

There are two USFS ranger districts within the study area that are separated by the Fish Creek divide; the Butte District to the west and the Jefferson District to the east (Figure 2). There are also two USFS Landscapes in the study area. Uses and objectives for management areas within these landscapes are discussed below. The study area is within Montana Department of Fish, Wildlife, and Parks Commission District 2 and Administrative Region 3

In addition to the Butte Highlands Project patented mining claims, several private inholdings occur in the study area. North of the project, a narrow strip of land that follows Basin Creek is owned by Silver Bow Water Inc. Individual or family-owned parcels occur to the east and southwest of the Project. A private parcel also surrounds the Basin Creek public parking and rest room area. The nearest residences to the Project are several miles to the north, beyond the study area.

Utility, Communication, and Other Facilities

There are no utility or communication sites within the study area. The following facilities are located within the study area (Figure 3):

- Basin Creek and Fish Creek SNOTEL stations;
- Basin Creek public parking area and rest rooms.

Projects

Three projects within the study area are listed in the USFS Schedule of Proposed Actions (Figure 3).

- The Forcella irrigation ditch project, which was cancelled, was to maintain an irrigation ditch on USFS land.
- The roadside safety tree removal project is to remove dead and mountain pine beetle infested lodgepole pine trees along several USFS roads, including roads 84 and 8520.
- The Divide, Little Camp, and Moose Creek improvements project is located west and southwest of the Pony Placer Claim. This project is to cut standing Douglas fir and lodgepole pine trees to put in streams to protect stream banks and willows from herbivore damage.

The Montana Department of Environmental Quality (DEQ) plans to launch the Highland Mine Reclamation Project during the summer of 2010. A design plan is being prepared and a request for bids is planned for the spring of 2010. The Highland Mine operated from the 1930's through 1942. The DEQ Abandoned Mine Section will reclaim approximately 10,800 cubic yards of waste rock and tailings and other materials left from past gold mining and milling in and around

the Main Ripple claim. There is also a DEQ high priority abandoned hardrock mine site (Middle Fork Mill Site) west of the Pony Placer claim that is not currently scheduled for reclamation.

Grazing

The majority of the study area is an active grazing allotment (Figure 4). Exceptions to this are private inholdings and most of the area that is north of the continental divide. This latter area is the Basin Creek Management area, which is managed to protect water quality within the Basin Creek watershed.

Timber

Nearly all present conifer stands in and around the study area are regenerated clear-cuts. The majority of the study area is not suitable for timber harvest (Figure 5). Forestry activities within the study area within the last 10 years have included:

- piling and burning of material;
- pre-commercial and commercial thinning;
- stocking surveys;
- plantings;
- vegetation competition surveys;
- certification of natural regeneration with and without site preparation.

Recreation

Recreational uses of forest lands in the study area include hunting, fishing, camping, firewood collection, snowmobiling, sightseeing, and hiking, including the Continental Divide National Scenic Trail (CDNST). The CDNST will extend 3,100 miles, in its entirety, from Canada to Mexico. Traveling from north to south, the CDNST crosses the upper Project claims, leads to the Basin Creek public parking and rest room area, and continues to the northwest. See the Visual Resources section for more information on the CDNST. The study area also includes several management areas within the Jefferson River and Upper Clark Fork USFS Landscapes. Recreational management of these areas is discussed below (Figure 6 and 7).

The Burton Park Management Area is managed for a variety of recreational opportunities and for secure winter wildlife habitat. Recreation takes place in a range of roaded to semi-primitive, non-motorized settings. Winter closures provide secure habitat for wildlife and accessible winter recreation activities. Visitors may encounter vegetation changes from timber harvest or fire, motor vehicles on roads and trails in summer and fall, skiers, and livestock.

The Humbug Management Area is managed for timber production, livestock grazing, and dispersed recreation in a roaded setting with a mix of modified and natural appearing scenery. Recreation use is heavy during fall hunting seasons. The area is used by snowmobiles in the winter. A non-motorized summer and winter area on the east edge of the unit below Red Mountain provides yearlong wildlife security for species including bighorn sheep. Visitors may encounter vegetation changes from timber harvest or fire, roads for timber harvest, motor vehicles on roads and trails in summer, fall, and winter, historic mining remnants, active mining or reclamation, and livestock.

The Table Mountain Recommended Wilderness Management Area is managed to protect wilderness characteristics and to provide yearlong non-motorized recreation with high levels of challenge and solitude. Hunting is one of the predominant activities in the area. Visitors may encounter quiet natural landscapes, native vegetation changes from fire and other natural events, wildlife including mountain goats and bighorn sheep, and livestock.

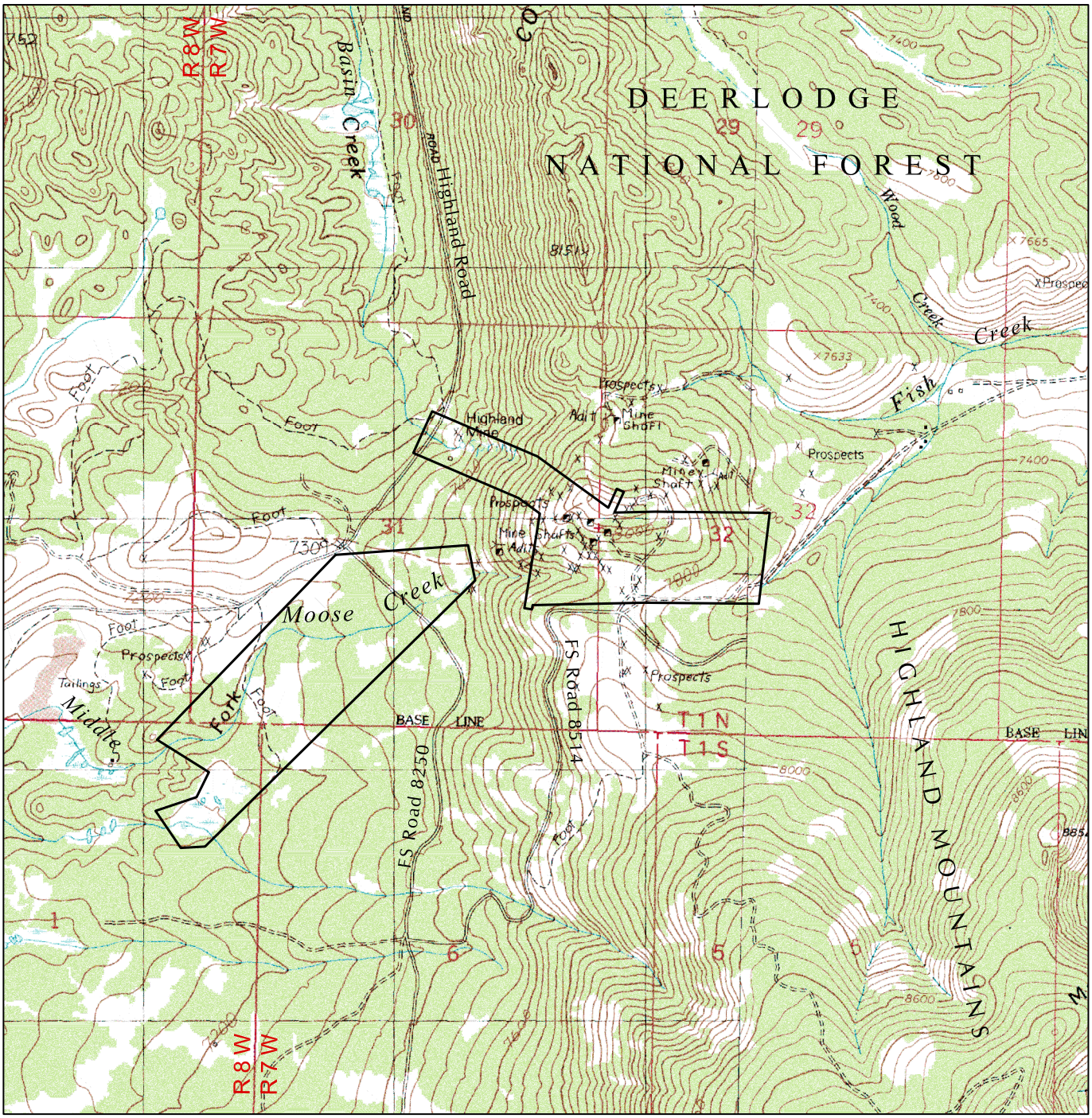
The Basin Creek Management Area is managed to protect water quality within the Basin Creek watershed. None of the watersheds in the study area have fish or restoration emphasis. Entry into a portion of the area is prohibited yearlong. The setting in the Basin Creek Management Area is a mix of roaded and semi-primitive. Recreation use is not encouraged. Winter non-motorized allocations provide wildlife security and protect water quality. Visitors may encounter vegetation changes from timber harvest or fire. The Basin Creek Management Area includes a Research Natural Areas (RNA). RNA's are managed to protect the primary features for which they were identified. The primary features of the Basin Creek RNA are subalpine forest, riparian, and herbaceous type, and spruce.

4. Discussion

Public land in the study area is used for logging, grazing, recreation, watershed protection, wildlife management, and mineral exploration. The Butte Highlands Project is consistent with these uses. The study area includes small portions of four USFS management areas. As such, the above descriptions of the management areas suggest a wider variety of uses than actually exist in the study area.

5. References

U.S. Department of Agriculture, Forest Service. January 2009. Beaverhead-Deerlodge National Forest, Land and Resource Management Plan, Forest Plan.



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

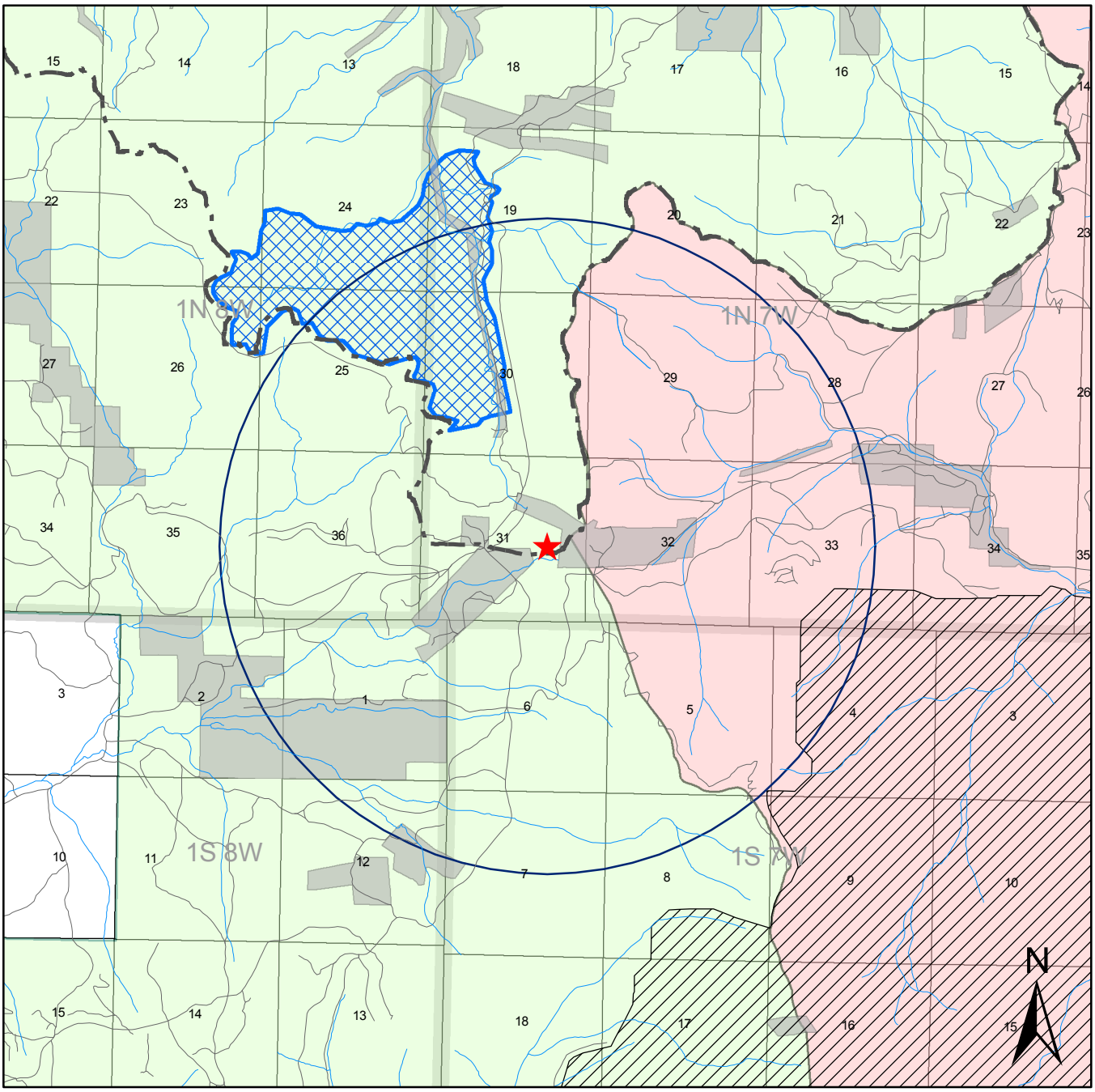
N

Patented Claims

0 2000 ft

Land Use Report
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Project Location Map
Figure 1



Source: Beaverhead-Deerlodge National Forest 2009 Management Plan

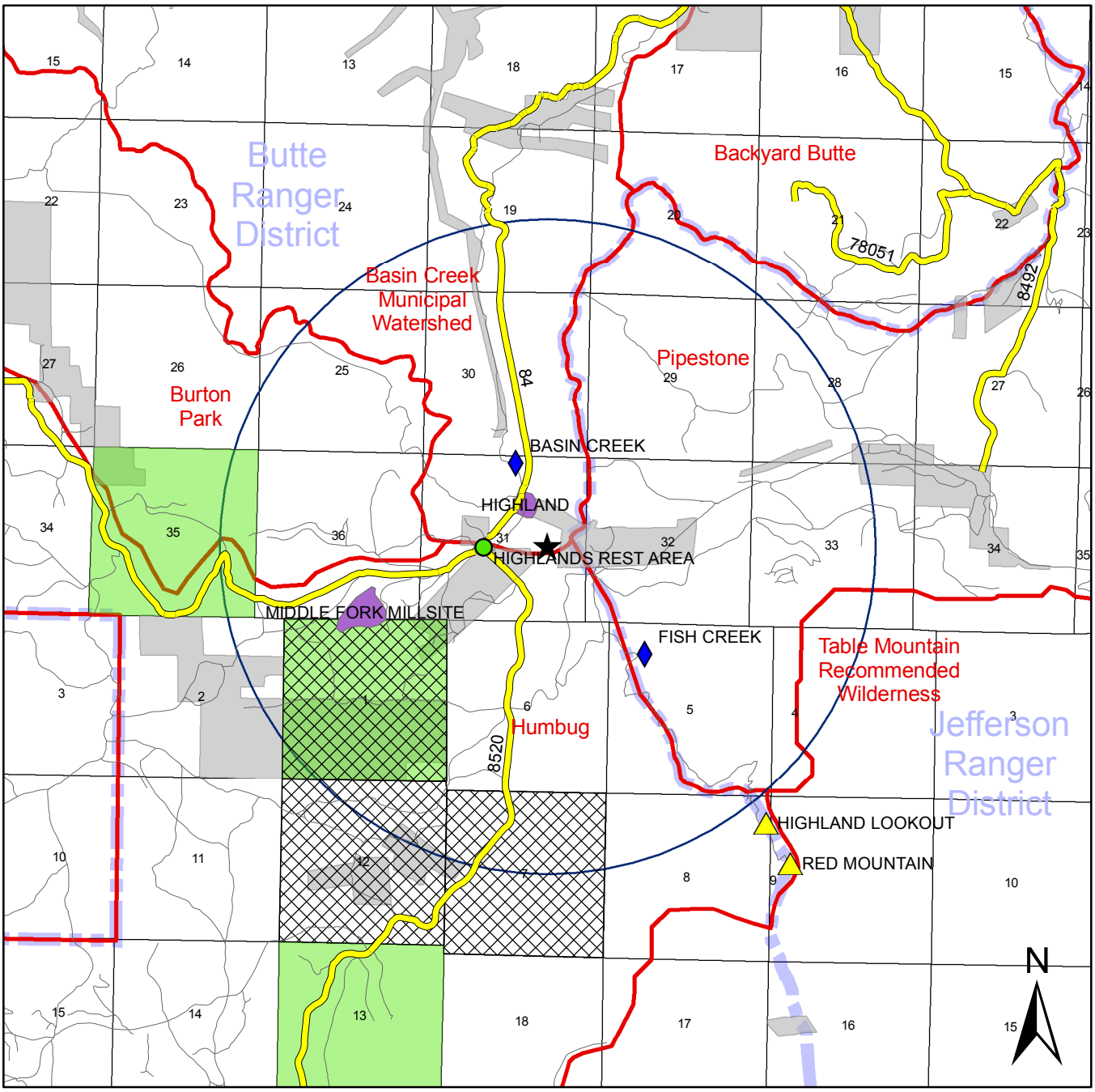
Miles
0 1 2

Legend

- Butte Highlands Project Center
- Continental Divide
- TableMtnRWA
- BasinCreekRNA
- Inholdings within USFS Land
- Butte Ranger District
- Jefferson RangerDistrict
- **2 Mile Radius**

Land Use Report
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Ownership and Special Areas
Figure 2



Source: Beaverhead-Deerlodge National Forest and Montana State

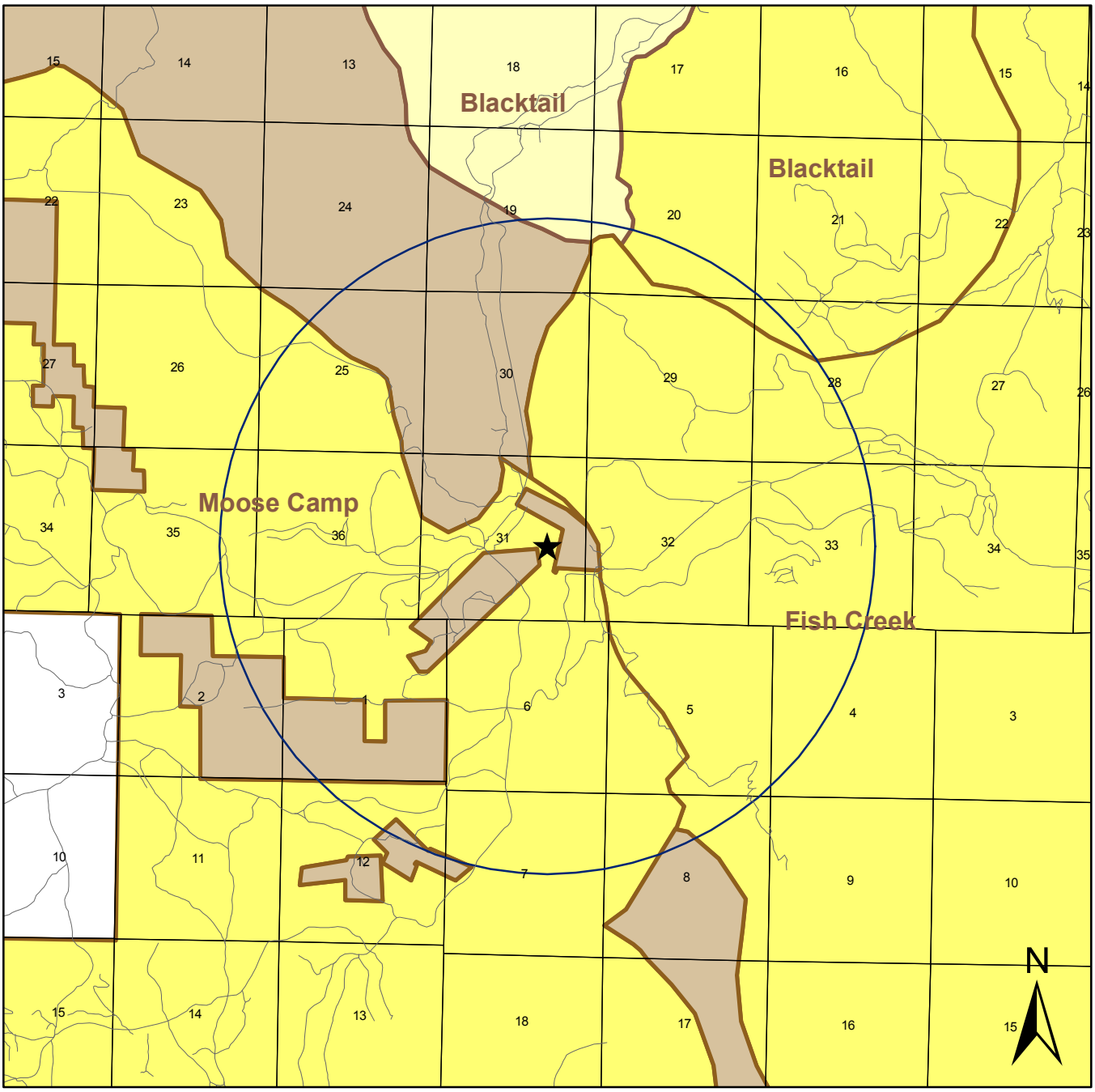
Miles
0 1 2

Legend

- Butte Highlands Project Center
- Communication Sites
- Snotel Sites
- Recreation Sites
- Hi Priority Abandonded Hardrock Mine Sites
- Road Management Project - Tree Removal
- Special Use Management Project - Forcella Irrigation Ditch
- Vegetation Management Project - Divide, Lil Camp, Moose Ck
- Inholdings within USFS Land
- Management Areas
- 2 Mile Radius

Land Use Report
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Management and Special Sites
Figure 3



Source: Beaverhead-Deerlodge National Forest 2009 Management Plan

Miles
0 1 2

Legend

★ Butte Highlands Project Center

○ 2 Mile Radius

Grazing Allotments

- Active
- Closed
- Not an allotment
- Vacant

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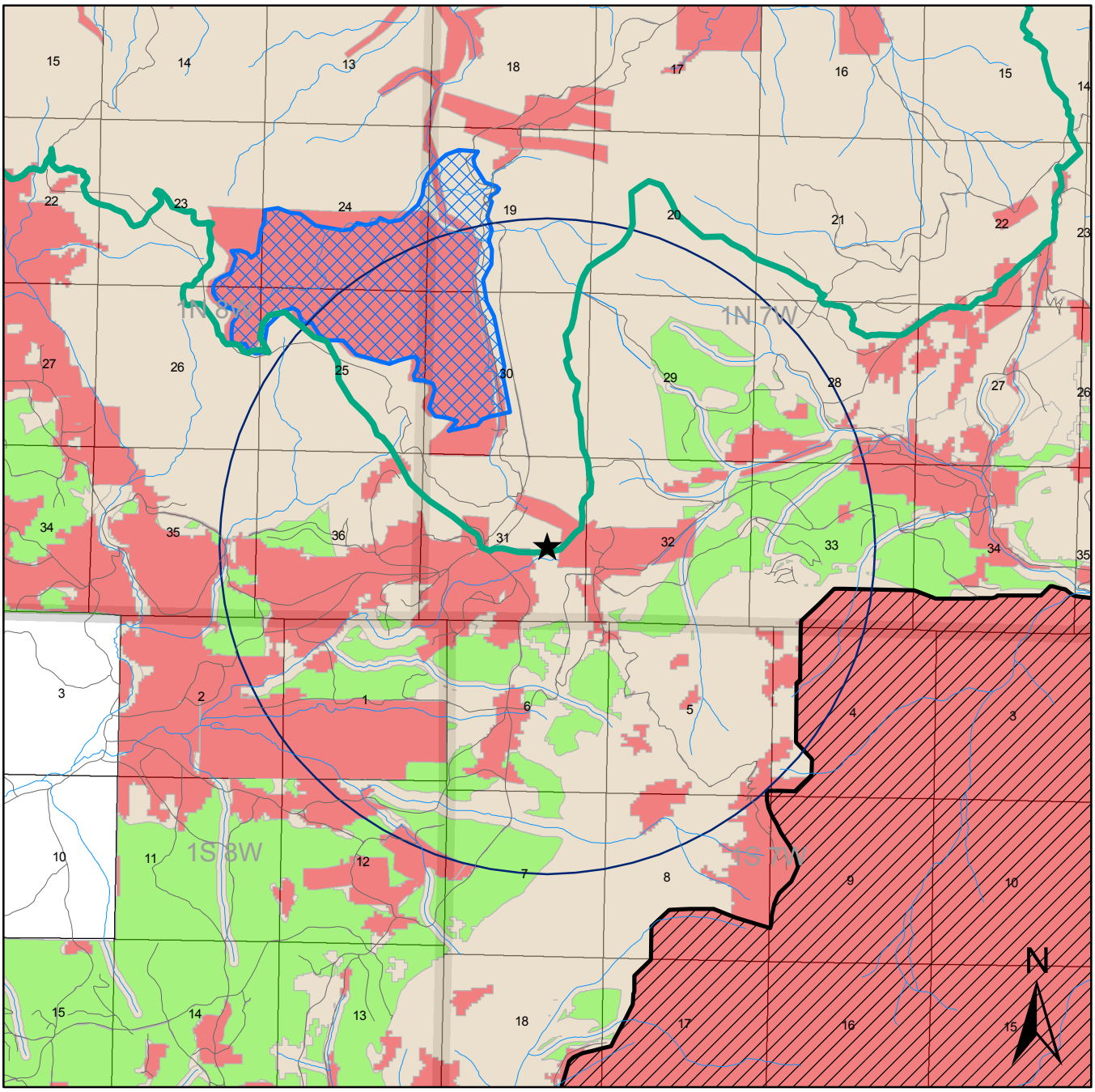
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Grazing Allotments
Figure 4



Source: Beaverhead-Deerlodge National Forest 2009 Management Plan

Miles
0 1 2

Legend

- Butte Highlands Project Center
- Contintental Divide National Scenic Trail Route
- Table Mtn Recommended Wilderness Area
- Bsin Creek RNA
- 2 Mile Radius

Timber Suitability

- Not Suitable, No Harvest Allowed
- Not Suitable, Timber Harvest Allowed
- Suitable for Timber Production

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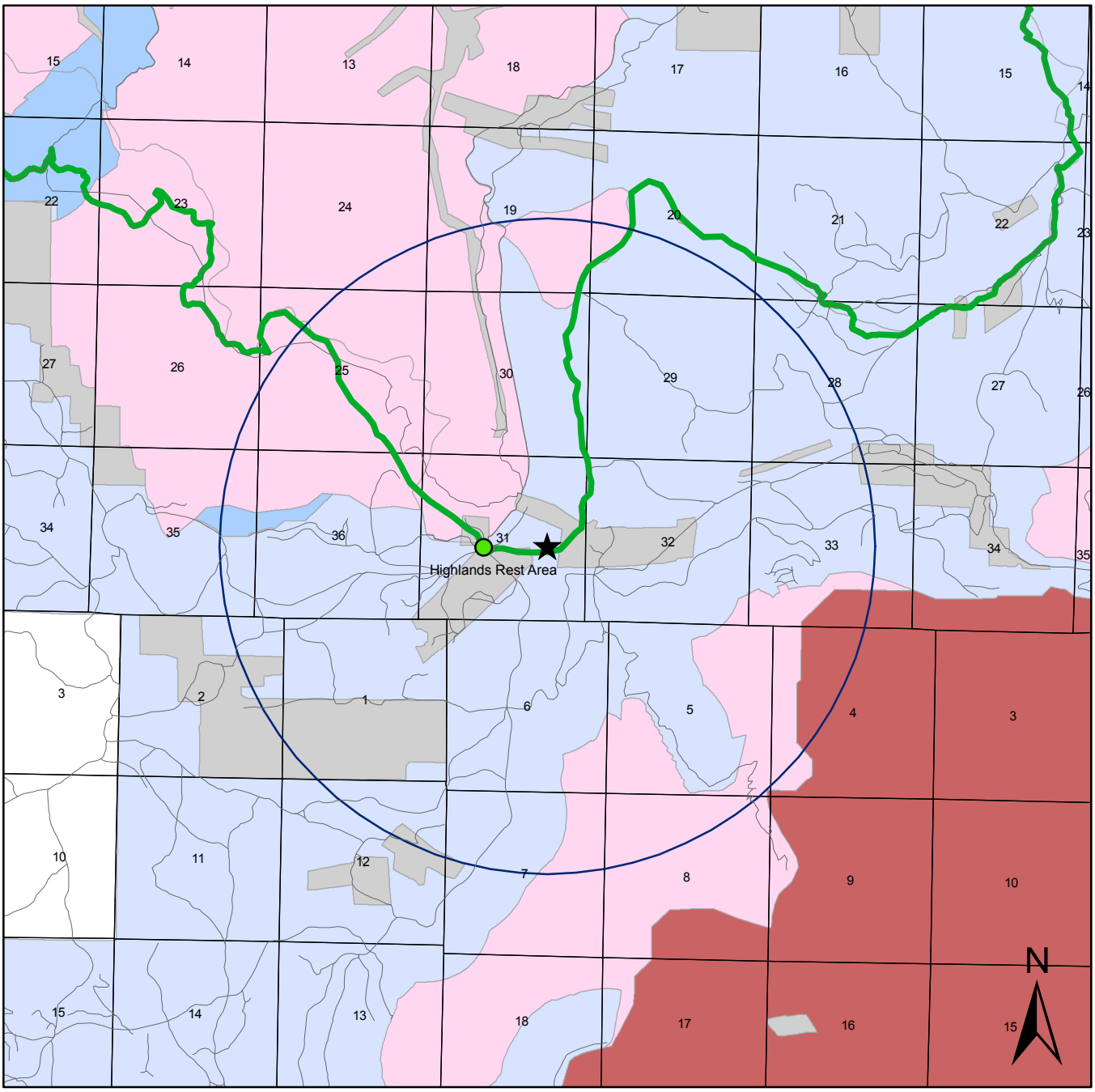
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Timber Harvest Classifications
Figure 5



Source: Beaverhead-Deerlodge National Forest 2009 Management Plan

Miles
0 1 2

Legend

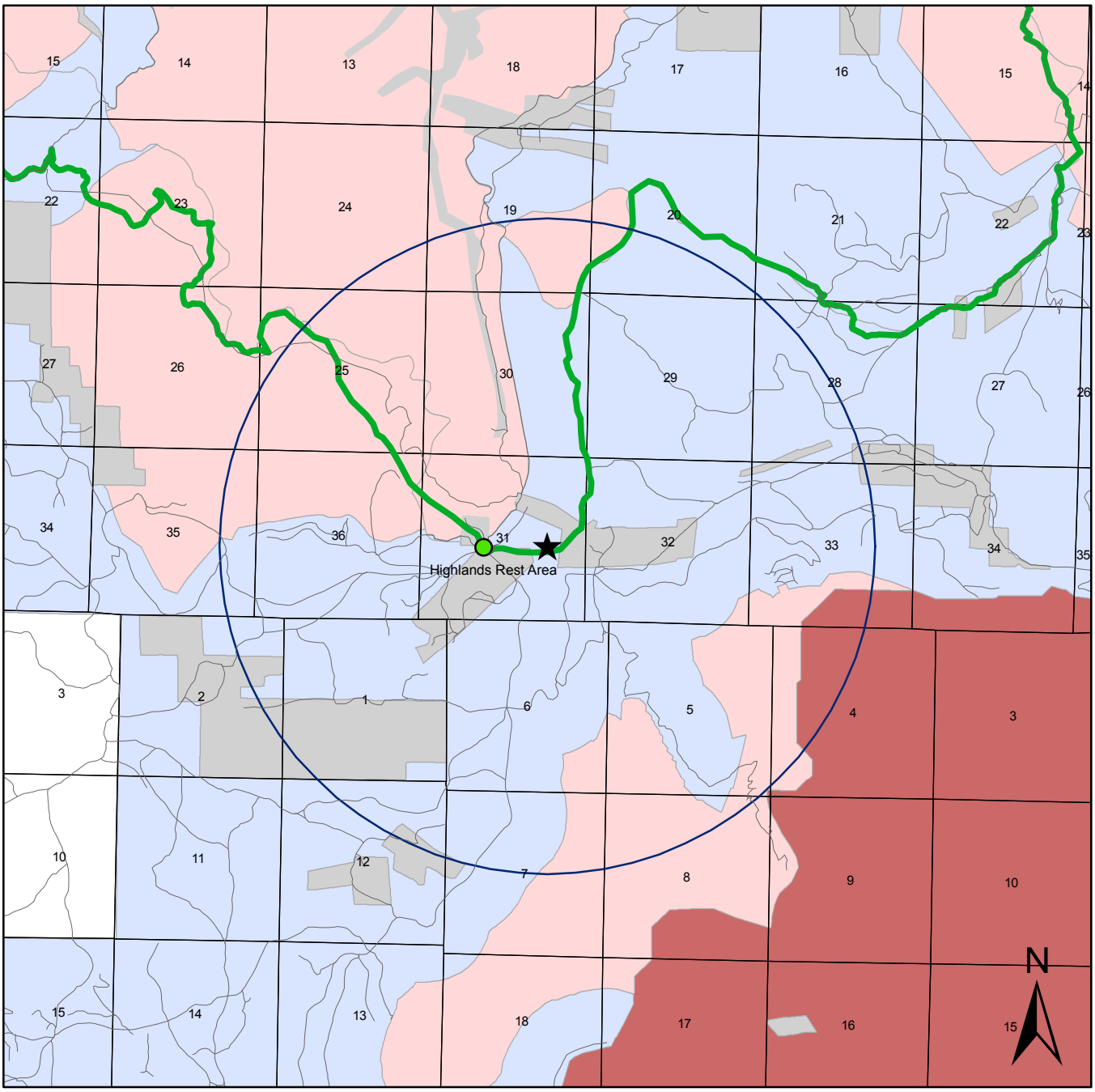
- Recreation Sites
- Butte Highlands Project Center
- Continental Divide National Scenic Trail
- 2 Mile Radius

Summer Recreation

- Recommended Wilderness
- Summer Non-motorized
- Backcountry
- Road-based
- Inholding

Land Use Report
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Summer Recreation Allocations
Figure 6



Source: Beaverhead-Deerlodge National Forest 2009 Management Plan

0 1 2 Miles

Legend

- Recreation Sites
- Butte Highlands Project Center
- Continental Divide National Scenic Trail
- 2 Mile Radius

Winter Recreation

- Recommended Wilderness
- Winter Non-motorized
- Motorized Recreation
- Inholding

Land Use Report
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana
Winter Recreation Allocations
Figure 7

A FILE AND LITERATURE SEARCH OF THE PROPOSED BUTTE HIGHLAND EXPLORATION PROJECT IN SILVER BOW COUNTY, MONTANA

Prepared by

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P.O. Box 2326
Boulder, Colorado 80306

Thomas J. Lennon, Ph.D.
Principal Investigator

Prepared for

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13058 Sherwood Court
Hayden Lake, ID 83835

February 24, 2010

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Table 2. Butte Highland Project Previously Recorded Sites ……..……..……...5

Table 3. Butte Highland Project General Land Office Patent Search Results...…….11

INTRODUCTION

Klepfer Mining Services retained Western Cultural Resource Management, Inc. (WCRM) to gather and assess the known data regarding the cultural resources of the proposed Butte Highland Project in Silver Bow County, Montana (Figure 1). WCRM conducted file and records searches through the Montana State Historic Preservation Office (SHPO), the U.S.D.A. Deerlodge National Forest, and the General Land Office records held by the U.S. Bureau of Land Management. WCRM completed the data gathering work during August and September, 2009 and the final information being found during January 2010. Klepfer Mining Services stated that the study area is on private land and that there is no federal regulatory involvement that would trigger a Section 106 consultation under the National Historic Preservation Act of 1966, as amended. This study was prepared to support mining permit requests to the State of Montana.

METHODS

To complete the file and literature search WCRM undertook the following tasks for the file search area, an area approximately one mile around the 211 acre project area footprint: 1) a thorough literature and records search of the Montana State Historic Preservation Office at the Montana Historical Society including the National Register of Historic Places (NRHP), archaeological and historical documents and records using the Cultural Resource Information System (CRIS) and the Cultural Resource Annotated Bibliography System (CRABS). WCRM used the results of those electronic searches to acquire copies of the relevant site forms and reports from the Montana Archaeological Records Office at the University of Montana. For one site located partially on the Deerlodge National Forest WCRM followed the Records Office's required procedure of contacting the Forest Archaeologist to obtain permission for WCRM to receive a copy of the form for that site. That permission was granted and WCRM ordered the copies of the appropriate site forms. WCRM did not receive permission to obtain copies of forms for sites located in the file search sections but situated completely on Forest Service land. Klepfer Mining had full knowledge of WCRM's contact with the Forest Service and the form copy request procedures. WCRM also did an on - line search of the Government Land Office (GLO) cadastral survey plats, the historic indices of the homestead, mineral survey, and other land records for the file search area. WCRM used the results of that search to order copies of the

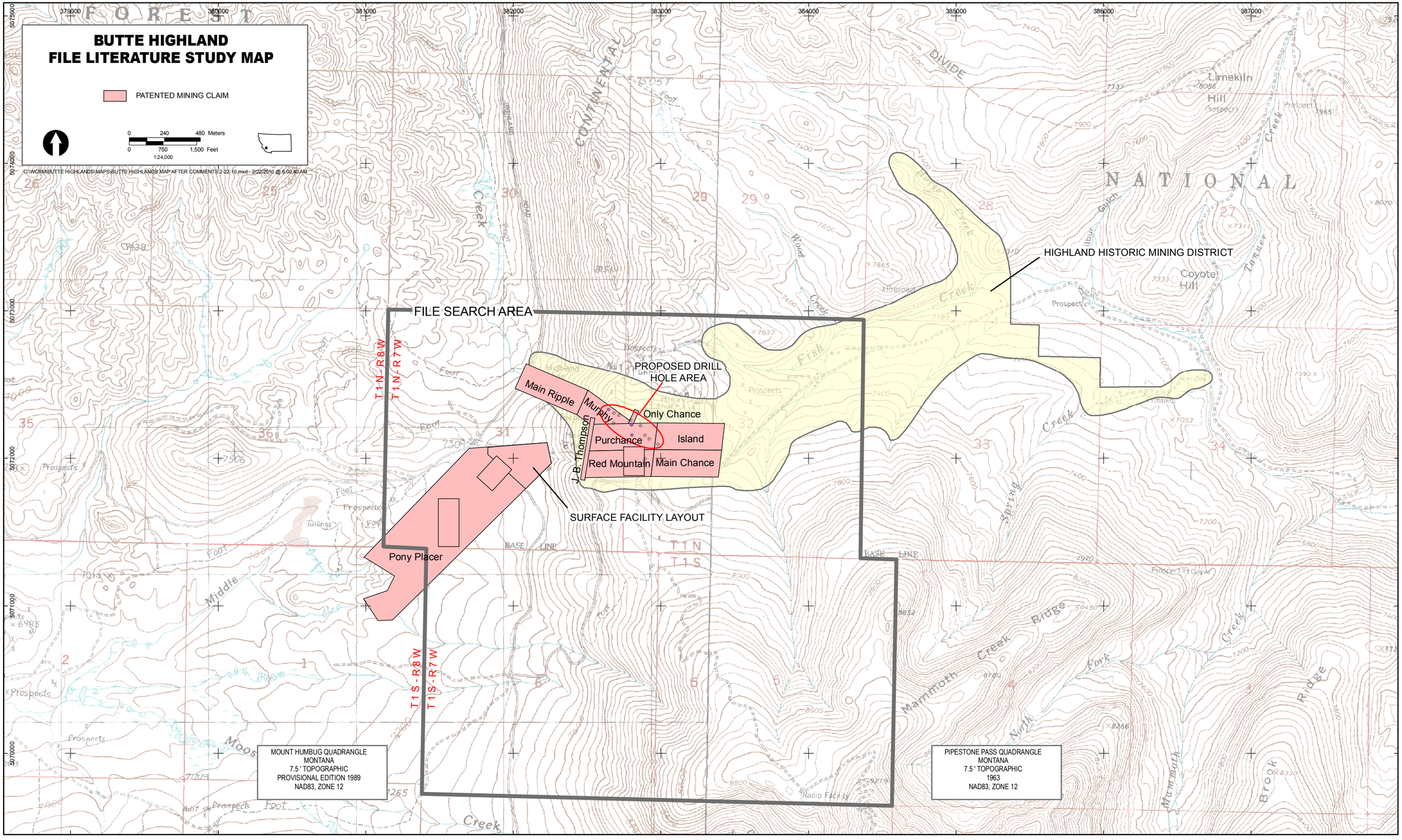
BUTTE HIGHLAND
FILE LITERATURE STUDY MAP
PATENTED MINING CLAIM
0 240 480 Meters
0 750 1,500 Feet
1:24,000
C:\WORK\BUTTE HIGHLANDS\MAPS\BUTTE HIGHLANDS MAP AFTER COMMENTS 2-22-10.mxd - 2/22/2010 @ 6:00:40 AM
HIGHLAND HISTORIC MINING DISTRICT
FILE SEARCH AREA
PROPOSED DRILL HOLE AREA
Main Ripple
Murphy
Only Chance
Purchance
Island
Red Mountain
Main Chance
J.B. Thompson
SURFACE FACILITY LAYOUT
Pony Placer
T 1 N - R 8 W
T 1 N - R 7 W
T 1 S - R 8 W
T 1 S - R 7 W
T 1 N
T 1 S
MOUNT HUMBUG QUADRANGLE
MONTANA
7.5 ' TOPOGRAPHIC
PROVISIONAL EDITION 1989
NAD83, ZONE 12
PIPESTONE PASS QUADRANGLE
MONTANA
7.5 ' TOPOGRAPHIC
1963
NAD83, ZONE 12

Figure 1.

pertinent mineral surveys and plats from the Bureau of Land Management, Montana State Office Public Room.

WCRM undertook on-line searches for the Highland Mining District that found context information about the history of the Highlands Mining District developed by the Montana Department of Environmental Quality (Appendix A).

WCRM GIS staff plotted the available information on electronically produced topographic maps to support the narrative discussions of the file search results. During early September 2009 of the project WCRM has produced and submitted a summary of the file and literature search results in a letter report to Klepfer Mining and discussed the nature of previous work with Klepfer staff.

RESULTS

Review of the available data found that the history of the area of the file search area can be traced to the late gold discoveries of the late 1860s. The first placer gold discoveries occurred in 1866 along Fish Creek. This led to a rush of miners to the new diggings and the organization of the Highland Mining District. The placer mines soon were supplemented by lode mines and among the earliest successful lode claims were the Murphy and the Only Chance. Mines' success led to the founding of two towns, Highland City and Red Mountain City. These towns boomed for a few years until the easily worked deposits played out during the early 1870s. Then the mines went nearly dormant for more than 50 years. The area experienced a second boom during the 1930s. It was during this period that the District's largest mine, the Butte Highlands Mine, worked the combined Only Chance, Murphy, and J. B. Thomson properties. The company rebuilt a cyanide mill and operated it for a short period. The properties were re-opened in 1937 and remained in operation until 1942 when war-time regulations forced the mine and mill to close. For further details see Appendix A. This information led WCRM to anticipate that many of the previously recorded sites were likely to be related to mining.

WCRM contacted the Montana State Historic Preservation Office (SHPO) Cultural Records Office for a records database search on August 26, 2009. The search covered both sections that include the project area (Township 1 North, Range 7 West, Sections 31 and 32) and two adjacent

sections (Township 1 South, Range 7 West, Sections 5 and 6); the file search area. The search identified 27 reports and 15 resources (see Tables 1 and 2 below). WCRM found that the SHPO does not maintain a GIS database for Silver Bow County so shape files of the sites could not be obtained.

The 27 documents listed in the CRABS report from the SHPO's office included 18 annual administrative activity summaries issued by the Deerlodge National Forest and later Beaverhead-Deerlodge National Forest. These do not contain information of the type contained in survey or data recovery reports and were not researched. Two of the other reports, Perriman's Soil Conservation Service Weather Station study (1990) and Wilde's Upper Fish Creek Timber Sale (1977) were reports that involved only Forest Service lands. Those reports included references to historic mining sites 24SB64 (Red Mountain City), 24SB65 (mine), 24SB66 (three log cabins), 24SB67 (Highland City) and 24SB187 (another part of Highland City). All these related to the early development of the Highland Historic Mining District.

Table 1. - Butte Highland Project Previous Reports Other Than Annual Forest Service Activity Reports

Author(s)	Title	Date
James D. Wilde	*Archaeological Investigation Upper Fish Creek Timber Sale, T1N, R7W, Section 32*	1977
Connie Moore and Lynn Fredlund	*Cultural Resource Inventory of Selected Drill Hole Site in the Highland Mountains, Montana*	1988
GCM Service, Inc.	*Addendum to: Cultural Resource Inventory of Selected Drill Hole Site in the Highland Mountains, Montana*	1988
Lynn Fredlund and Connie Moore	*Cultural Resource Inventory in the Highland Mountains, Montana: Limekiln Hill – Fish Creek*	1989
Richard D. Perriman	*Soil Conservation Service Weather Station Survey*	1990
Mary E. McCormick	*Fish Creek Pipeline in the Highland Mountains*	1991
Mary E. McCormick	*Fish Creek Pipeline Historic District: DNF Mitigation Documentation for Impacts From Pipeline Upgrade Proj*ect	1992
Mary E. McCormick	*Highland Mine and Mill Site (24SB589): A Cultural Resource Inventory and Evaluation*	1997
Tammy Cherullo	*Cultural Resources Inventory of the Limekiln CDNST in Silver Bow County, Montana*	2005

Table 2. - Butte Highland Project Previously Recorded Sites

Site #	Township	Range	Section	Quarter Sections	Site Type	Site Type 2	Time Period	Owner	National Register Status
24SB0064	1N	7W	32	SW	Historic Mining	N/A		Forest Service	Undetermined
24SB0065	1N	7W	32	SW	Historic Mining	N/A		Forest Service	Undetermined
24SB0066	1N	7W	32	SW	Historic Euro-American Site	N/A		Forest Service	Undetermined
24SB0067	1N	7W	32	NE	Historic Mining	N/A	Historic Period	Forest Service	Undetermined
24SB0187	1N	7W	31	Unknown	Historic Mining	N/A		Combination	**C**ontributes to **D**istrict
24SB0357	1N	7W	32	NE	Historic Placer Mine	N/A		Private	Undetermined
24SB0443	1N	7W	32	NE	Water Pipeline	N/A	Historic Period	Combination	Eligible
24SB0589	1N	7W	31	NE	Historic Hard Rock Mine	Historic Irrigation System		Combination	Unresolved
24SB599	1S	7W	6	SW	Cribbed Log Structure	Historic Timber Harvesting		Forest Service	Undetermined
24SB600	1S	7W	6	NE, NW	Historic Railroad, Stage Route, Travel	Historic Timber Harvesting		Forest Service	Undetermined
24SB601	1S	7W	6	NW, SW	Historic Timber Harvesting	N/A		Forest Service	Undetermined

Site #	Township	Range	Section	Quarter Sections	Site Type	Site Type 2	Time Period	Owner	National Register Status
24SB0602*	1N	7W	31	Other	Historic Political/ Government	N/A		Forest Service	**C**ontributes to **D**istrict
24SB0602*	1N	7W	31	Other	Historic Political/ Government	N/A		Forest Service	Undetermined
24SB0605	1N	7W	31	SW	Historic Mining	Historic Architecture		Forest Service	Undetermined
24SB0706	1N	7W	32	Combination	Historic Mining	N/A	Historic Multi-decade	Private	Undetermined
24SB0802	1N	7W	32	NE	Historic Mining	Historic Log Structure	Historic Period	Forest Service	Undetermined

*The report from the Montana SHPO includes this site twice with two evaluations

The two 1988 reports by Moore and Fredlund and CGM, *Cultural Resource Inventory of Selected Drill Hole Site in the Highland Mountains, Montana* and the *Addendum to: Cultural Resource Inventory of Selected Drill Hole Site in the Highland Mountains, Montana,* respectively covered parts of the current project area (see Map 1) and included some further study of sites 24SB64, 24SB65, 24SB66, 24SB67, and 24SB187. The first report identified 26 localities related to the mining boom of 1865-1870 and a subsequent revival period from 1930 to 1942. The addendum report focused on defining boundaries for the Highland Historic Mining District and the localities related to certain drill holes to determine whether or not the localities were contributing to the significance of the historic district. The first of the two studies included an intensive level walkover of the eastern one-half of Section 31 and all of Section 32 in Township 1 North, Range 7 West, both public and private lands. The large number of resources located during Moore and Fredlund's walkover led to a modification of the field methods to identify the localities associated with different mines and other activity centers only. No formal recording of the localities was completed so the survey is not considered to be a full-fledged Class III (intensive) survey. This level of effort was determined to be adequate by the Forest Service and SHPO to support the mineral exploration program proposed by Battle Mountain Mining that led to the survey. Moore and Fredlund's work also led to the preliminary delineation of the Highland Historic Mining District that encompassed the Section 32 portion of the current project area.

The definition of the Highland Historic Mining District began with the initial recording of site 24SB187 by the University of Montana (no date on form). That recording did not give any details about the on-the-ground historic resources within the district and it did not offer boundaries. The 1988 report, *Cultural Resource Inventory of Selected Drill Hole Sites in the Highland Mountains, Montana,* by Connie Moore and Lynn Fredlund said that "boundaries of the Historic District have not been determined because of the small amount of inventory conducted" (Moore and Fredlund 1988:5). Their study intended to complete an intensive level survey, but due to the density of the resources in the survey area the methodology was amended and no formal recording took place. The report identified 26 localities related to the mining boom of 1865-1870 and a subsequent revival period from 1930 to 1942. A second report by

CGM, *Addendum to: Cultural Resource Inventory of Selected Drill Hole Sites in the Highland Mountains, Montana* (1989), focused on defining a boundary for the Highland Historic Mining District. The district boundary proposed in the addendum report included approximately seven sections (~4,480acres). Richard Periman, the Deerlodge National Forest Archaeologist in 1990, did further study of the proposed historic district boundary and offered revisions that reduced the size of the district to approximately 900 acres. He argued that the previous boundary encompassed lands that lacked the sufficient density of mining resources with integrity to be considered part of the district. He further argued that the main concentration of district-related resources was found in the Fish Creek drainage. The Montana SHPO concurred with Periman's recommended district boundaries in a letter dated August 7, 1990. Periman's boundary is the one depicted on Figure 1 above.

Lynn Fredlund and Connie Moore's *Cultural Resource Inventory in the Highland Mountains, Montana: Limekiln Hill – Fish Creek* (1989) reported more historic mining activity generally northeast of the current file search area, but they did record the Highland Placer (24SB357) that extends into the northeast corner of the file search area in Section 32.

Mary McCormick's two reports, *Fish Creek Pipeline in the Highland Mountains* (1991) and *Fish Creek Pipeline Historic District: DNF Mitigation Documentation for Impacts from Pipeline Upgrade Project* (1992), focused on the Fish Creek Pipeline, a historic buried water pipeline built by the Butte Water Company during 1911-1912. This site is located near the extreme northeast corner of the file search area and extends beyond the boundaries of the file search area. Mary E. McCormick's *Highland Mine and Mill Site (24SB589): A Cultural Resource Inventory and Evaluation* (1997) focused on one site, the Highland Mine and Mill site within the current file search area. It is the only one that has been intensively recorded and it was recommended as not eligible for inclusion in the NRHP or to be contributing to the Highland Historic Mining District. The field recommendation was questioned and currently the site's eligibility is considered unresolved (see Table 2). She described the site as:

> The Highland Mine and Mill site (24SB589) is at the head of Basin Creek in the Highland Mountains about 17 miles south of Butte. It lies within the boundary for the

> Highland Mining Historic District (24SB 187), which includes several other individual mining properties and historic occupation sites in the upper Fish Creek drainage. The site consists of a collection of 32 industrial and domestic features largely associated with operation of the Highland Mine by the Butte Highlands Mining Company from the early 1930s to 1942. The major industrial features on-site include the collapsed portal to the Highland Mine adit, the structural remnants of a flotation mill that ran for a short period in the mid-1930s, and the probable remains of a cyanide plant that was likely never put into production before the company relocated its milling operation away from Basin Creek in the late 1930s. Most other former buildings and structures at the mine are also in ruins, having been either removed off-site, demolished, or naturally decayed to the point of collapse. The remains of some features are so sparse that their historic function can no longer be precisely determined. Due to these losses, the site no longer has sufficient integrity to convey its historic association as the largest and most productive lode mine ever developed in the Highlands. The site also lacks archaeological integrity, as relatively few artifacts were observed. It is recommended that the site is not eligible for individual listing in the National Register of Historic Places, nor can it be considered a contributing element to the Highland Mining Historic District (McCormick 1996).

Another site, the Highland Flume Placer Claim (24SB706) was reported by the Forest Service without reference to a survey report. Only a small portion of this site is located in the extreme northeast corner of the file search area.

WCRM was not given access to the 2005 *Cultural Resources Inventory of the Limekiln CDNST in Silver Bow County, Montana* prepared by the U.S. Forest Service.

The Montana SHPO also provided WCRM with a copy of a 1990 Section 106 consultation letter from the SHPO to Deerlodge National Forest that concurred with the Forest's revised boundaries for the Highland Historic Mining District. Richard Perriman, the Forest Archaeologist of Deerlodge National Forest, re-evaluated the 1989 CGM proposed district boundaries discussed above and Perriman's revised boundary is depicted on Map 1. The Montana SHPO concurred with his recommended boundary in 1990 (Huppe 1990). The boundary includes much of the northern block of the current project area. This information indicates that parts of the current project area have been examined by qualified professional archaeologists in the past.

Of the 15 sites identified in the Montana SHPO database within the file search area only two are totally on private land (24SB357, 24SB706) and three have combined public and private ownership. WCRM received copies of forms for sites 24SB187, 24SB357, 24SB589, and 24SB706 from the Montana Archaeological Records Center for review.

Fourteen of the 15 sites recorded in the file search area were related to the historic period mining activity, either as mines or support activity centers such as towns, and the other one was part of a water system. No prehistoric sites have been reported in the file search area (Table 2). Generally, National Register eligibility determinations have not been completed for the sites. Twelve have an "undetermined" status for the National Register eligibility and one is "unresolved." One of the undetermined sites (24SB602) is also listed as "contributes to district." One other site, 24SB187, is also listed as "contributes to district," and one site 24SB443, is listed as eligible. With all the sites being historic in nature and generally related to the historic mining development of the Highland Historic Mining District this indicates that any new resources identified in future studies of the project area are likely to be related to historic mining, either directly or indirectly, such as timber harvesting sites (24SB599) or roads (24SB600).

The search of the General Land Office records and information provided by the client identified 12 patented claims (see Table 3). WCRM acquired copies of the Mineral Survey plats and field notes for these claims reports that provided data about the conditions and the built environment at the claims at the time of the mineral surveys. This data was gathered in anticipation of a field reconnaissance and survey of the Butte Highlands Project. The data was intended to be used as a comparative baseline to consider the condition of and types of features observed on the claims during the proposed field work.

Table 3. - Butte Highlands Project General Land Office Patent Search Results

Claim	Location(s)	Patentees	Patent Date	Acres
Pony Placer	T1N, R7W, Sec 31 T1N, R8W, Sec 36 T1S, R7W, Sec 6 T1S, R8W, Sec 1	Roderick D. McRae Thomas Burden Robert M. Ferguson Minerva F. McRae	February 2, 1888	151.32
Claim	**Location(s)**	**Patentees**	**Patent Date**	**Acres**
Red Mountain	Not listed in General Land Office records or LR 2000 records			
Purchance Claim	Not listed in General Land Office records or LR 2000 records			
Only Chance Claim (Lode)	T1N, R7W, Sec 31 T1N, R7W, Sec 32	Abraham Nevins Charles B. Stephenson	October 27, 1869	2.76
J.B. Thompson Claim (Lode)	T1N, R7W, Sec 31	Curtis G. Hussey Charles B. Seely	March 19, 1988	3.21
Murphy Claim (Lode)	T1N, R7W, Sec 31 T1N, R7W, Sec 32 T1N, R7W, Sec. - -	John T. Murphy Abe P. Nevins	August 17, 1893	13.92
Unnamed	T1N, R7W, Secs 27, 28, 32, 33, and 34	Roderick D. Leggat William Owsley James G. Butler Alexander J. Leggat John A. Leggat	August 20, 1879	54.49
Bernard Claim (Lode)	T1N, R7W, Sec 32	Clara Tilton Charles W. Barber	August 28, 1939	9.865
Humbug Placer	T1N, R7W, Sec 32	Butte Water Company	February 14, 1910	20
Atlantic Claim (Lode)	T1N, R7W, Secs 31, 32	Clara Tilton Charles W. Barber	August 28, 1939	63.787
Main Ripple Claim (Lode)	T1N, R7W, Sec 31	Butte Highlands Mining Company	February 6, 1940	20.608
Island Claim (Lode)	T1N, R7W, Sec 32	Butte Highlands Mining Company	October 27, 1942	20.537

CONCLUSION

Klepfer Mining Services has told WCRM there is no federal regulatory involvement that would trigger a Section 106 consultation under the National Historic Preservation Act of 1966, as amended. This study was prepared to support mining permit requests to the State of Montana. WCRM gathered and assessed the known data regarding the cultural resources of the proposed Butte Highland Project in Silver Bow County, Montana for Klepfer Mining Services. WCRM conducted file and records searches through the Montana State Historic Preservation Office (SHPO), the U.S.D.A. Deerlodge National Forest, the General Land Office records held by the U.S. Bureau of Land Management, and on-line information held by the Montana Department of Environmental Quality. WCRM completed the data gathering work during August and September, 2009 with final information being found during January 2010. Analysis of the data was completed in January 2010.

The history of the current file search area can be traced to the late 1860s. The first successful prospectors discovered placer gold in Fish Creek in 1866. Their finds caused a rush of miners to the area that led to the organization of the Highland Mining District. The placer miners soon found themselves competing with lode miners for resources such as timber. Among the earliest successful lode claims were the Murphy and the Only Chance. The prosperity of the mines led to the founding of two towns, Highland City and Red Mountain City. These towns boomed for a few years until the easily worked deposits played out during the early 1870s. Subsequently, the mines went nearly dormant for more than 50 years. The file search area experienced a second boom during the 1930s. It was during this period that the District's largest mine, the Butte Highlands Mine, worked the combined Only Chance, Murphy, and J. B. Thomson properties. The company rebuilt a cyanide mill and operated it for a short period before closing. The mines and mill were re-opened in 1937 and remained in operation until 1942 when war-time regulations forced the mine and mill to close.

Given the history of the file search area it was expected that the majority of the previously recorded sites in the file search area would be related to the historic period mining activity. The

search results bear this out with 14 of the 15 previously recorded sites were related to historic mining. These sites include mines and sites of support activities such as towns or timber harvesting. The fifteenth site was part of a historic water system. Based on the available descriptions of the localities in the Moore and Fredlund report (1988) and the information known about the other previously recorded sites it is expected that further study of those resources will identify more contributing elements to Highland Historic Mining District or individually eligible resources. WCRM's analysis found that parts of the current project area has been previously examined by professional archaeologists for cultural resources but that the majority of the cultural localities they identified have not been formally recorded to current standards for intensive-level surveys (Moore and Fredlund 1988). It is curious that no prehistoric sites have been reported in the file search area and it is likely that further study may find some prehistoric sites in the general area. The causes for the lack of prehistoric sites may be found in the disturbed nature of many of the surveyed lands or the lack of ground visibility due to forest duff. It is likely that intensive cultural resource inventory of the study area would identify prehistoric archaeological sites.

SOURCES CITED

CGM
1989 *Addendum to: Cultural Resource Inventory of Selected Drill Hole Site in the Highland Mountains, Montana*, prepared for Battle Mountain Exploration by GCM Services, Butte, MT.

Huppe, Katherine M.
1990 Letter to Richard Perriman, Archaeologist, Deerlodge National Forest. Copy on file with Montana SHPO, Helena, MT.

McCormick, Mary
1996 "Montana Cultural Resources Information Form for Site 24SB589." Copy on file at Archaeological Records Office at the University of Montana, Missoula, MT.

Moore, Connie and Lynn Fredlund
1988 *Cultural Resource Inventory of Selected Drill Hole Sites in the Highland Mountains, Montana*, prepared for Battle Mountain Exploration by GCM Services, Butte, MT.

APPENDIX A: HISTORIC CONTEXT FROM MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Copied from: Anonymous, *Highland Mining District Historic Context*. Montana Department of Environmental Quality, http://www.deq.state.mt.us/AbandonedMines/linkdocs/techdocs/187tech.asp, accessed 1/8/10.

HISTORIC CONTEXT

On July 25, 1866, E.B. and J.B.S. Coleman and William Crawford discovered placer gold in Fish Creek on the north side of Red Mountain. As miners rushed to the area, the Highland district was soon organized and, to the west, the Moose Creek mines opened up. The camps in this district produced purer gold than the placer diggings on Silver Bow Creek. The principal producing streams were Fish and Basin creeks and their tributaries. The placer deposits were worked heavily during the first few years, and the richest deposits were soon exhausted (Sahinen 1935; Lyden 1948; Wolle 1963).

No sooner had placers been discovered in gulches, than lode gold was found on Nevin Hill and in other parts of the Highlands. The ore, which was free-milling, could be crushed in arrastras or stamp mills. When the placers began to give out within two or three years, the main activity centered in these quartz properties. The oldest location was the Murphy; the richest was the Only Chance. Eight arrastras were built along Fish Creek to mill the ore for the Only Chance. Because the mines were claimed prior to the revision of mining law in 1872, they were restricted to 100 x 200 foot surficial claims. As a result, several claims divided the ownership of the rich ores of Nevin Hill. It has been estimated that 100 lodes were located by 1869 (Bassett and Magee 1869; Sahinen 1950; Wolle 1963).

The two mining towns of the district, Highland City and Red Mountain City, each boasted populations of over a thousand people during the boom days. By the summer of 1867 Red Mountain City was larger than Butte and was recognized as the largest settlement in southern Deer Lodge County. Red Mountain City was so close to Highland City, that in time they were often thought of as one. Red Mountain City had a water system consisting of hydrants and pipes, made from ten-foot long green logs through which a hole was bored (Wolle 1963).

The first mill to be built in the district was at the Ballarat mine. On the recommendation of

George C. Swallow, St. Louis investors erected a 25-stamp mill in 1867. Swallow, a university professor from the midwest, was over-optimistic about the value of the ore. When the mill gave poor returns, the investors sent a mining expert to examine the property. Philip Knabe quickly found the mine to be of little value and recommended the operation cease. After only two years production, the first mill closed. Its closure brought to an end the district's first mining period. The Only Chance, Murphy and the Nevin mines remained open, but at a much lower rate of production. Only Chance ore was worked in three arrastras while the Nevin ore was worked in two. The towns of Highland City and Red Mountain City withered, and by 1874 contained only a few residents (McCormick and Martin 1988).

Two early pioneers who stayed in the area were Ron D. Leggat and John Kern. Leggat built a flume to his placer and worked it until the gold ran out. He then changed to hydraulic mining of the hillsides. As other miners moved on, Leggat would buy up their claims and rework them with his hydraulic setup. By 1885 Leggat had consolidated many of the claims in the upper Fish Creek and Basin drainages. In 1895, Leggat sold out to the Butte Water Company for $160,000. Leggat's properties were purchased as the water company sought to protect the source of Butte's water.

In 1897 the Only Chance mine on Nevin Hill resumed operation on a 220 foot shaft. The enterprise on Nevin Hill, the three-way divide between Fish, Moose, and Basin Creeks, comprises three old mines, the Only Chance, Murphy, and J. B. Thomson, as well as several nearby claims. In 1900, J. P. Tilton discovered the Diamond T on Nevins Hill. Tilton's mill processed Nevin Hill mine ores from 1912 to 1915 (Moore and Fredlund 1988).

From 1908 to 1920, the district saw a small revival. Lode mines were reopened and began to ship ore. Mine operators at the Murphy and the Only Chance built mills adjacent to their shafts. In 1909 the district shipped several hundred tons of ore. In 1911 the Murphy was the primary mine in the district and the return jumped to 6,368 tons of ore. In 1912 the production figure rose to 14,664 tons of ore. However, the boom began to fade, and in 1915 only 128 tons were shipped. Small intermittent production continued to 1922 when 54 tons were shipped out of the district.

The Great Depression saw an increase in placer mining in the Highlands. After the price of gold was raised to $35 per ounce, individuals from the nearby metropolis of Butte headed to the hills to supplement their incomes. Individuals also reopened lode mines. One such, the Ballarat, was relocated by a Mr. Brooks after being idle for decades.

The district's largest mine also began operations in the 1930s. The Butte Highlands Mining Company was organized in 1931 and began mining the combined Only Chance, Murphy, and J. B. Thomson. From these properties, 600 tons of first-class ore were shipped in 1932. The 100 ton cyanide mill, at the head of Basin Creek, was rebuilt in 1932 on the Moose Creek side of the Divide so as not to pollute Butte's water. But the mine and mill shut down the following year. The reorganized company built a mill in 1937 and treated 17,985 tons of ore and old tailings. Both mine and mill shut down in 1942 due to war-time regulations (Wolle 1963; McCormick and Martin 1988).

The Highlands never rated as a major mining region even though an estimated $1,000,000 was recovered from it between 1866 and 1875, and an additional $1,299,533 from 1904 to 1963 (Wolle 1963).

In this district, a series of slates and quartzites underlie a thick limestone unit, all of which are cut by numerous intrusions of quartz monzonite, diorite, pegmatite, and aplite. The sediments are faulted and in the northern part are cut off by the 'granite' of the Boulder batholith. The thick series of quartzites and slates thought to belong to the Belt series, seem to be in fault contact with the limestones which have been correlated with the Gallatin formation of the Three Forks region. The granite probably underlies the Belt series as well as the Paleozoic rocks, as several outliers of granite have been observed jutting through the sediments of all ages in nearby districts. The diorite grades into normal quartz monzonite ("granite") but the aplite and pegmatite occur as dikes in granite and are clearly the result of differentiation within the granite magma (Sahinen 1935).

In addition to placers, which are still worked in a small way, the district has many veins and irregular ore deposits, valued chiefly for their gold content. The Murphy mine, at the head of the

main fork of Fish Creek, is in Paleozoic limestone. The ore occurs in veins, joints, and chimneys, and although not directly on the contact, is said to be of contact origin. The veins are irregular and occasionally faulted, the largest strikes east and dips about 80 degrees north (Sahinen 1935).

BOUNDARIES OF THE DISTRICT

Sahinen (1935) places the district at the head of Fish Creek in the "Highlands" about 20 miles south of Butte by road. McCormick and Martin (1988) and Fredlund (1989) base their boundaries of the district on Sahinen's, but modify the simple definition to follow known boundaries of mining claims and remains on patented claims. Figure 1 shows the boundaries of the Highland mining district modified slightly from Sahinen (1935) and as described below.

The boundaries follow the Continental Divide on the north and west with a deviation on the west to include the Highland Mine. The east and south boundaries coincide with maps of patented claims suggesting mining remains. The east boundary is a section line dividing sections 26 / 27 and 34 / 35. The southern boundary is the township boundary separating Townships 1N from 1S in Range 7W.

The only mining area not within the above boundaries is the Gold Hill area which is often included in the Moose Creek district.

HISTORIES OF SELECTED MINES

Ballarat

The Ballarat mine is located in the southwest quarter of section 33, T1N, R7 W, about half a mile south of Red Mountain City. The property was one of the most important mines in the district during the mining boom of the late 1860s. The mine was said to have been discovered by William Smith, William Baldwin, Daniel McKiever and E. B. Watson. Prior to actually working the ore, the mine was bragged to be fantastically rich. Despite a poor showing at the arrastra, the foursome managed to interest George C. Swallow by producing a completely bogus gold nugget. Swallow was fresh from a university position in the Midwest and had come to Montana to look

at mining investment opportunities. In 1867 the "Professor" had purchased the claim. Also in 1867 the mine had the most developed adit in the district with a length of 45 feet. Investors in St. Louis provided money for a mill that was shipped by steamboat to Ft. Benton and freighted overland to the mine. The 24-stamp mill was the first in the Highland Mountains. Although Swallow erected several cabins at the mill site for his family and workers, the mine failed to thrive. By 1869 the adit was over 500 feet long, but still hadn't reached paying ore. Poor returns from the mill prompted the St. Louis investors to send an expert, Philip Knabe, to assess the situation. Knabe examined the mine and then issued a report that said that the mine was of little value. After only two years of activity, the mill closed. Later it was dismantled and moved to Butte where a silver strike was in progress. The closure of the Ballarat marked the end of the 1860s mining boom in the Highland mountains (Bassett and McGee 1869; Anon 1977; McCormick and Martin 1988).

In 1931 the long-closed mine was reclaimed by a Mr. Brooks. He opened three adits; two had lengths of 80 and 125 feet. Working through the decade, Brooks claimed to have discovered an ore body 45 to 70 feet wide and 800 feet long. After the 1930s, the claim was not worked again until the 1980s (McCormick and Martin 1988).

Bluebird

The Bluebird mine was located in 1938 and produced its first ore the same year. The mine, like all other gold mines in the U. S. was closed in 1942 by Federal Order due to the advent of World War II.

Gold Hill

The Gold Hill mines in the southwest quarter of section 12, T1S, R8W first officially reported production from 1909 to 1912 and then again in 1915 and 1916. The property is composed of three claims patented in 1911: the Monitor, Montreal and Eclipse #2. At the time of patent they were owned by the Free Gold Mining and Milling Company. A quartz mill was shown on the 1916 mineral survey along with shafts, open cuts, stopes, tunnels and buildings. The mill was

built in 1909 and contained a Blake jaw crusher, three Huntington mills, six Spitz-Kasten classifiers, eleven cyanidation tanks and gravity filters. The property may have seen some small scale activity in the 1930s during the Depression driven gold rush (Beck 1987).

Highland Chief

The Highland Chief is located in section 22, T1N, R7W. This claim was originally patented in 1920 by the Butte and Plutus Mining Company as the Ready Cash, Pay Master and U.S. Gold lodes. The Ready Cash and the Pay Master lodes were located in 1913 and the U. S. Gold in 1911. Improvements included a discovery drift, two discovery shafts, a tunnel, crosscut and part of a crosscut.

The mine was patented again in 1931 by Jacob Lambrecht as the Highland Chief Lode. This new claim included a new area to the west of the previous claim plus the U.S. Gold patent area. Improvements at the time of patent included a shaft and tunnel valued at $3,760. In 1940 the mine was owned by E. M. Norris and D. J. McGrath. A Mr. White hauled 40 tons of ore from the lower workings in 1940; the ore was said to return $20.00 to the ton in gold (GLO; Fredlund 1989).

A shaft on the lower workings reached a depth of 100 feet in limestone stained by chrysocolla and malachite. The upper workings consisted of a 35 foot vertical shaft (Sahinen 1950).

Highland Mine

The Highland mine located in section 31, T1N, R7W on Nevin Hill was initially patented in 1916 to Ole J. Larson. The mine consisted of early bonanza mines such as the Only Chance, Murphy and J. B. Thompson. Although the mines were active up to the time they were patented as the Highland, they were idled soon after. Work did not resume until the 1930s when the Butte-Highland Mining Company began operations (See Only Chance). This extensive mining operation was replete with boarding houses and hotels, and a cyanide mill. At its peak of operations in 1937, 65 men were employed on the property. During this 1930s resumption of activity, the mine was known as the Butte-Highlands property (Sahinen 1950; Moore and

Fredlund 1988).

Highland Placer

The Highland placer was patented by Roderick D. Leggat in the 1880s. It was surveyed in 1884; the map showed various cabins, ditches, and excavated areas along Fish Creek. Leggat consolidated many of the smaller claims as miners left the district in the 1870s. The 140-acre claim was sold to the Butte Water Company in 1895 as part of the company's efforts to protect the city's water supply (Fredlund 1989).

J. B. Thompson

The J. B. Thompson in section 31, T1N, R7W and was one of three original mines on Nevins Hill. In 1869 a tunnel was 160 feet long with 75 feet remaining to reach the lode. The mine was patented in 1875 by Curtis G. Hussey and Charles B. Seely. The patent record lists $4,000 in improvements. The mine was later repatented by Hussey and others. Beginning in 1915, the mine was worked in association with the Murphy and the Only Chance as part of the patented Highland mine operations (Bassett and McGee 1869; Moore and Fredlund 1988).

Murphy Mine

The Murphy mine in section 31, T1N, R7W was the first mine to be located on Nevin Hill around 1866 or 1867. The mine was a major producer at the time. The mine's first period of activity ended with the closure of the Ballarat mill. The Murphy mine was patented by John Murphy in 1892. The map of the property shows four shafts valued at $1,098. In 1911 the mine was again active and was the largest producer in the district. The shaft was 300 ft deep and its adit was 600 feet long. A 5-stamp mill was erected on the site to work the ore. After 1915, the mine was worked in conjunction with the Only Chance, and J. B. Thompson as the patented Highland mine of Ole J. Larson (Sahinen 1950; Moore and Fredlund 1988).

Nevin

One of the early mines of the district, the Niven was claimed in the mid-1860s prior to the change in mining law in 1872. As a result several claims worked the same vein and efforts were quickly made to combine operations. The Niven was working in combination with the Thompson lode by 1869 and its ores were processed with those of the Only Chance. Later the mine would be part of the combined Highland mine (Bassett and McGee 1869).

Only Chance

The Only Chance mine is located on Nevin Hill in section 31, T1N, R7W. This property was the largest producer among the early mining claims. The outcrop was discovered in 1867 when a road was graded between the Murphy mine and the arrastras on Fish Creek. The ore from the new mine, along with that of the Murphy, was initially worked in eight arrastras on Fish Creek. In 1867, the mine shaft was reported to be down 50 feet. The property was patented by Abraham Nevins and E. B. Stephonson in 1868 under the guise of the Only Chance Mining Company. The hill on which the mine was located was named Nevins after the locator who also located the Nevins claim on the hill. In 1869, the mine was reported to be working a lode at a depth of 125 feet; the property produced $37,000 in ore in only five months. After the closure of the Ballarat Mill in 1870 or 1871, the Only Chance was worked intermittently on a small scale. In 1871, the mine's ore was again worked in three arrastras on Fish Creek; two others were operated by the Nevin Company.

In 1897, the property was in the hands of the First National Bank of Helena which leased it to Lawson & Co. The lessees employed three miners, four topmen and an engineer to develop the mine. The 2-compartment incline shaft was sunk vertically from the end of the incline at 100 feet to a depth of 220 feet. The mine was worked with a McDowell engine and a 5/8 inch rope. Because P. J. Tilton pushed forward this new activity, the mine became known as the Tilton. In 1912, P. J. Tilton erected a mill on Nevin Hill to work the ore from his Diamond T and other claims. Tilton's Red Mill, as it became known, consisted of a crusher, five stamps and an amalgamation table. The mill processed ore from Nevin Hill mines from 1912 to 1915 and was

still standing in 1935 (GLO; Sahinen 1950; Wolle 1963).

After 1915, the mine was worked in conjunction with the Murphy, and J. B. Thompson as the patented Highland mine of Ole J. Larson (Moore and Fredlund 1988).

The mine was returned to production in the early 1930s as the Butte-Highlands property. The Butte Highlands Mining Company was organized in 1931 and began mining the combined Only Chance, Murphy, and J. B. Thomson claims on Nevin Hill. From these properties, 600 tons of first-class ore were shipped in 1932. A 100 ton cyanide mill, at the head of Basin Creek, was erected to work the ore. The mill soon thereafter rebuilt on the Moose Creek drainage so as not to pollute Butte's water. The mine and mill shut down in 1933 (Sahinen 1950).

In 1937, the reorganized Butte-Highland Mining Company resumed operations in the district. The mill reopened in November with a 75-ton capacity. Sixty tons of ore were mined by a crew of 65. The mine and mill had electric power and drills were operated using compressed air. The mill ultimately treated 17,985 tons of ore and old tailings. Both mine and mill shut down in 1942 due to war-time regulations. Twenty tons of gold was shipped from the mine in 1947. The mine was intermittently operated through the 1960s (Wolle 1963; McCormick and Martin 1988; Moore and Fredlund 1988).

Total production from the mine in the historic period (1867 to 1947) was estimated to be around $2,000,000 with an excess of 63,000 ounces of gold recovered. The Tilton (Diamond T) shaft is credited with $540,000 in gold from a pipe-like shoot in limestone that yielded an average of $1,000 per foot for 540 feet. The mine was also developed from the Only Chance adit with a 400 foot winze, Only Chance shaft, Only Chance glory hole, Nevin adit, Murphy shaft and the J. B. Thompson adit. In the early days, gold was also extracted from the Gold Excel shaft about 80 feet northwest of the Murphy shaft.

Other mines in the district mentioned in the historic literature include the Templeman, Ozark, Brooks, Red Wing, Iron Cliff, Highland View, Bear Cat and E. X. L. (Sahinen 1950).

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Timberline Resources Corporation
Butte Highlands Project

Amended Underground Exploration Plan

Decision Plan

AUGUST 2009

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Project Description

Timberline Resources Corporation (Timberline) is submitting this document as an amendment to the current exploration plan activities approved by the Montana Department of Environmental Quality for the Butte Highlands Project. This revised document includes all the requirements outlined in the August 17, 2009 approval letter issued by the Montana Department of Environmental Quality.

Timberline is currently approved for surface exploration drilling and recently completed a portion of the approved holes. Timberline ceased exploration drilling at the project last fall due to winter weather conditions and intends to initiate surface drilling in the 2nd quarter of 2009.

As part of project development, underground exploration will be necessary to advance the project to the next stage to better understand the resource through underground drilling, technical investigations to support mine planning, and bulk sampling for metallurgical testing.

Project Location

The Butte Highlands Project is located in Silver Bow County, Montana. Specifically, the project is located in Sections 31 and 32 in Township 1 North and Range 7 West on patented mining claims:

Pony Placer Claim
Red Mountain Claim
Purchance Claim
Only Chance Claim
J.B. Thompson Claim
Murphy Claim

Figure 1 and 2 show project location and patented and unpatented mining claims held by Timberline.

Surface Facilities

In order to support the underground exploration and drilling program, the following facilities and/or activities will be required. All planned ground disturbing activities are located on private land at Butte Highlands which are owned and/or controlled by the company:

- Office Complex;
- Portal/Decline/Underground Workings;
- Surface/Shop Facilities;
- On Site Power Generation;
- Fuel and Lubricant Storage;
- Explosives Storage;

- Sediment Control;
- Growth Medium Stockpiles;
- Lay Down Area;
- Water Source;
- Land Application Disposal Areas;
- Water Management; and
- Waste Storage Areas.

As-built drawings of the mine facilities and workings will be provided to the agency in electronic format when they become available as part of the annual report for the project.

Acres of Disturbance

Timberline is proposing additional acres of disturbance to complete the exploration activities. It is estimated that approximately 22.5 acres of private land will be disturbed under this proposed plan. There is an additional 27.4 acres planned for the land application disposal site which is also located on private land. Table 1 provides a breakdown of the acres proposed.

Table 1
Summary of Approved and Proposed Disturbance

Activity	**Acres of Disturbance**	
Currently Approved – Surface Exploration		**1.5**
Hydrology Drill Holes (4)		
Road Access	0.60	
Drill Pads	0.75	
Subtotal – Hydrology Drilling		1.35
Surface Facilities		20.2
Ventilation Raise Area		1.0
LAD Sites		
LAD 1	7.0	
LAD 2	11.3	
LAD 3	6.7	
New Access Road (LAD 1 & 2)/Pipeline	2.32	
New Access Road (LAD 3)	0.10	
Subtotal – LAD Areas		27.42
New Acres		49.97
Total Disturbance		**51.47**

Clearing and Vegetation Removal

Prior to construction activities clearing and grubbing of the disturbance area will be completed. This will include the removing of trees, shrubs, and other similar vegetation. Merchantable timber will be salvaged and sold as appropriate. The remaining limbs and other similar material will be piled as appropriate in slash piles. The facility locations were selected to minimize tree removal where possible.

Slash piles will be burned or disposed of in accordance with applicable laws and/or used for sediment control as sediment filter material. If used for sediment control, it will be placed as slash rows incorporated into the sediment control berms/structures.

Topsoil Salvage

All available topsoil or growth medium will be removed prior to commencing construction activities. It is expected that soil thickness will vary considerably throughout the proposed disturbance area. Salvaged soil material will be stockpiled within the disturbance boundaries. Figure 5 shows the location of the planned stockpile. There may be other stockpiles necessary and these will be documented on to a project map. The stockpiles will be revegetated using an approved seed mixture to reduce erosion, soil loss from wind, and weed invasion.

Seeding will occur either late in the fall or early spring to minimize the invasion of noxious weeds.

Access Road

The project will use existing roads to access the project. The proposed underground portal and surface facilities are located on private land (Pony Placer Claim). Access to the site will be via Highway 2, Roosevelt Road, Highlands Road, and Fish Creek Road. Figure 3 shows the access route planned for exploration activities.

To minimize potential conflicts with road use through the residential areas, Timberline will restrict vendor use and deliveries to daylight hours and week days whenever possible. Under this restriction, deliveries and vendors must pre-schedule trips to the site and will be limited to 8 A.M. to 3 P.M. during week days. Only emergency deliveries will occur during weekends.

Other ancillary roads will be required to support exploration activities. Figure 4 shows the existing and proposed new roads. During bulk sampling activities, an alternative route will be used to haul sample material. The time period required to haul the 10,000 ton bulk sample is relatively short. Haulage would only occur during daylight hours. This will occur when alternative routes are snow free. The use of the alternative routes will reduce potential conflicts with residences along the Roosevelt/Highland route. The roads are controlled by the USFS and/or Silver Bow County and Timberline will use the routes as directed by this agencies.

Office/Dry

An office trailer will be brought to the site to house mine offices, engineering, safety, and other mine support personnel. The trailer will be a standard modular office trailer that is approximately 24 feet wide x 66 feet in length.

To provide an area for employees to change and shower, a portable mine dry will also be brought to the site. The mine dry will be similar to the office trailer and will be approximately 24 feet wide by 66 feet long.

Both the office and mine dry units will be placed on concrete piers and tied down in accordance with applicable building codes in the county.

An on-site wastewater (sewer) system will be constructed to manage wastewater generated from the office trailer and mine dry (Figure 5). The location may change slightly based on field leach tests and the final design approved. The sewage treatment system will be sized to meet the full operational project staffing levels of the project. During construction portable toilets will be used at the site and a local contractor will be used to service the units until the sewage system is in place. As underground mining proceeds, portable toilets may be used underground as well.

A geologic core shed will be located at the project and will house offices for the geologist as well as core storage. The building will be a 30 foot x 50 foot pole barn construction with insulation and steel siding. Figure 5 shows the location of the core shed.

Shop Facilities/Generators/Electrical Power

A small mine shop will be constructed at the site to perform regular maintenance and repairs to mine equipment. The shop is expected to be a fabric covered, steel truss arch building construction system. The shop building will measure approximately 50 feet by 80 feet and will have room for the various equipment and bays required to maintain the mobile equipment fleet.

The shop will also store supplies, parts, small quantities of lubricants, and other items to support the project. A concrete floor will be included in the shop building and will provide containment for fuel, lubricants and other shop fluids.

Two generators are planned for the project. One generator, a 545 kW unit will be the primary source of power. A second unit will provide backup power and will be a 320 kW unit. The 545 kW generator will be housed in a van trailer complete with a "day" fuel tank of approximately 500 gallons. The 320 kW generator is skid mounted and also has a "day" fuel tank with approximately 250 gallons of fuel on board. Fuel will be transferred from the fuel storage area to the generator day tanks as needed via a retractable, pressurized hose reel.

Power will be distributed throughout the property and the lines will be buried to the portal and other facilities. Line power is available near the site; however, this line does not have sufficient power to support all the exploration activities.

Fuel/Oil Storage/Wash Pad

The fuel/lube storage area will also house the wash pad. Figure 6 shows the general arrangement of the fuel/lube/wash pad. The planned items will be arranged in such a manner to fit on one solid concrete pad (50x80 feet). The wash pad width is 20 feet and the width of the fuel/lube area is 30 feet. This is equal to the 50 feet of total width proposed for the full pad area. The length of the wash pad (55 feet) is less than the full 80 feet of the pad as is the fuel/lube area (65-70 feet). This leaves sufficient room for access, lube vans and other items discussed. The pad will slope to a perimeter curb on the outside and toward one end. The fuel/lube area will report to a hydrocarbon containment sump which will be sized for 110% containment of the largest individual tank located in the facility.

The wash pad will slope into a sediment sump that can be cleaned with a piece of mobile equipment. The sediment sump overflows into a hydrocarbon skimming and sediment settling sump. The underflow from this sump will report to a "grey" water sump that will be pumped into a wash pad water recycle system for further cleaning prior to reuse. The water may either be utilized for wash pad water, or it may be included into the mine-wide recycle system. Wash pad sediments and oil-skimming residues will be disposed of in accordance with environmental regulations. Figures 5 and 6 show the location and general arrangement of the facility.

The project will use both diesel and bio-diesel products. Two large diesel storage tanks are planned for the project along with several day tanks and include:

- 1- 8,000 gallon double walled tank (diesel)
- 1- 6,000 gallon double walled tank (bio-diesel)
- 1- 500 gallon day tank (generator)
- 1-250 gallon day tank (generator)

A fuel and lubricant truck will be used to dispense fuel to mobile equipment and a fueling station will be constructed at the fuel tanks as well. The fuel station will be located on the concrete pad with spill containment to capture potential spills from fueling operations.

Various oils and anti-freeze necessary for mine operations will be stored on the same concrete pad as the fuel tanks. A semi-van trailer or conex unit will store lubricants, oils, antifreeze, and other similar material and will be placed near the fuel tanks to complete the fuel/lube station. It is estimated that there will be approximately 2,000 gallons of various oils, including storage for used oil.

No fuel is expected to be stored in the underground workings during exploration activities. Used oil will either be used on site as a fuel source for a shop heater or sent to an appropriate facility off-site.

Silo, Batch Plant and Shotcrete Plant

During mine development, there will be a need for the use of cement for various underground activities. A silo will be located at the site to store bulk cement to be used either in the batch

plant and/or shotcrete plant. The cement silo will be equipped with a baghouse to reduce emission during cement loading and unloading activities. The silo, batch plant and shotcrete plant will be located near the mine portal.

The batch plant may be used on a limited basis to test the cemented rock fill (CRF) for the bulk sample. The batch plant will create a cement slurry that will be blended with reclaimed mine rock from the rock stockpile and mixed in a mixing pit with a surface loader.

The shotcrete plant will operate at an approximate rate of 24 cubic yards per day. A maximum annual production of 8,400 cubic yards is anticipated. In addition to the cement silo, there will be a sand storage area that will contain approximately 100 tons of blended shotcrete aggregate.

Both CRF and shotcrete plants will operate only when needed and they will not operate full time. The modular units, general flow sheet, and photos are shown on Figure 14.

Explosive Storage Area

Explosives will be stored on the surface at the project in two separate explosives magazines. One magazine will be for initiation devices and one will be for high explosives. The surface magazines will be located and constructed in accordance with applicable regulations. The magazines will be surrounded on three sides with large berms. Figure 5 shows the proposed magazine locations

Powder magazines will also be located underground as soon as appropriate sites are developed. Explosives may be delivered directly to the underground powder magazines. The location of the underground powder magazines will change as the decline progresses towards the ore body.

It is expected that emulsion will be the primary explosive used for underground development. Depending on the rock encountered, stick powder, slurries or other similar water resistant explosives products may be used with or instead of emulsion. Emulsion will be stored in 3,000 pound totes at an appropriate distance from the magazines. Once the underground magazines are in service, totes will be filled on surface and delivered to a storage area underground via forklift.

Timberline will implement the following measures to manage explosive and minimize the potential release of elevated nitrates to waste rock and mine water. They include:

- Proper housekeeping and spill cleanup;
- Employee training – equipment, handling, and protocols;
- Proper explosives use – wet holes etc.
- Overloading holes, minimizing spills etc. and
- Education on nitrate issues.

Development Rock Storage Area

A development rock storage area will be located near the mine portal. The storage area will be sized to hold approximately 150,000 tons of mine development rock. The development rock pile will be approximately 80 feet in height at the end of the development program.

The base will be prepared and compacted prior to placing any waste material. In addition, the initial excavated rock from the decline, which is anticipated to be a high carbonate content rock, will be placed over the full base of the storage area as a net neutralizing/buffering material. If high sulfide development rock is encountered during development of the exploration decline, that material can be segregated to minimize acid rock drainage (ARD) issues. The following waste rock characterization/monitoring will be implemented:

- Geologic mapping;
- Maintain tonnage estimate by lithology;
- Collect representative rock samples for testing;
- Documentation of sample collection
- Characterization of waste rock (as appropriate)
    - Metal content
    - Acid/Base accounting
    - Net neutralizing and net acid potential
    - Static/kinetic testing (Select samples)
- Minimum of one sample per rock unit; and/or
- One sample per 1,000 feet of development
- Segregate ARD rock where possible
    - Place back underground
    - Develop an encapsulation plan if significant ARD Waste is encountered
- Sample run-off from the waste pile

The detailed plan is discussed later in this document (Exploration Plan – Waste Rock Characterization).

Run-off from the development rock pile will be collected at the toe of the facility in a diversion ditch where it will be directed to the sediment pond. The diversion ditch will incorporate BMPs to reduce sediment addition into the mine pond. Run-off from the development rock area will be either re-used in the mine operations and/or disposed at the LADs.

Storage and Lay down Areas

A storage facility is planned for the project to hold various parts and supplies. The surface layout includes an area that is approximately 50 feet by 80 feet in size for this facility. Conexes or other temporary material storage units for the project may be placed in this area as well. The area will store bulk material (bolts, wire, etc.) and other similar materials used at the site.

A building is planned that will be approximately 50 feet x 50 feet. In addition, the full area planned to be disturbed will be sized large enough to provide for vehicles/equipment parking, bulk material storage (bolts, wire etc.) and other similar materials used at the site.

Water Source/Tanks

Water for the project is planned to come from several sources. Timberline currently holds five water rights that were originally part of the historic Highlands Mine and Pony Placer Claim. These water rights are current and can be used for mining purposes.

It is also expected that the underground development work will encounter groundwater. AMEC Geomatrix Inc. completed a study (*Hydrogeologic Characterization Report – Butte Highlands Mine Project – January 2009*) for the project. This report is located in Appendix A. The report assessed surface water flow in the area, precipitation, and pump tests from the exploration drill hole to develop a conceptual mine inflow estimate. The report estimates mine inflow rates to range from 90 to 110 gallons per minute (upper predicted range).

The mine water will be managed consistent with the water management plan (*See Mine Pond Section*) and will involve its use for drilling water and other uses.

A water well is planned for the project and will use a portion of the existing water rights to provide potable water for the project. The well will be located near the surface facilities within the proposed disturbance boundary. Final location will be dependent on hydrologic conditions for the development of a water well. A pipeline would be laid from the well to a water storage tank to supply water to the office and mine dry.

Two water tanks are planned for the project. One tank (10,000 gallons) will be used for potable water and make-up water when needed. A second tank (10,000 gallons) will be re-circulated water from the mine pond that will be used during for mine activities (dust control, drill water etc.).

Mine Pond (Sediment and Recycle Water)

Water from the underground workings will be pumped through a series of underground sumps to settle out sediment from mine activities. Hydrocarbon booms or oil skimming capability may be added to the underground sump to remove hydrocarbon contamination. Water from the underground sumps will be pumped to the mine ponds located below the development rock storage area. Two ponds will be built with a combined capacity of approximately 2.5 million gallons. At a de-watering rate of 100 gallons per minute, this results in approximately 2 weeks of storage capacity in the ponds.

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

decant from the Sediment Pond and flow to the Recycle Water Pond, which will have a capacity of approximately 1.0 million gallons.

The ponds will be lined and will 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.

Water from the second pond, the recycle water pond, will either be sent to the land application disposal areas or returned to the 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 land application disposal area (LAD 3) located on patented land (Red Mountain Claim).

The mine ponds will be designed to hold the 25 yr-24 hr storm event from the waste rock area. The catchment area is approximately 400,000 ft^2. The amount of rain for this storm event is approximately 2.5 inches of precipitation in a 24 hour period. With a run-off coefficient of 90 the storm storage required is approximately 561,000 gallons. The total pond capacity is 2.5 million gallons of water.

Pond Design Capacity	2,500,000 gallons
25yr-24hr Event	561,000 gallons
Operating Capacity	1,939,000 gallons

Pond levels will be maintained to ensure the 561,000 gallons of storm capacity is available at all times. The LAD piping system will be sized to handle a minimum of 200 gallons per minute which would be sufficient to handle larger storm events occurring at the site. Additional cells would be activated to bring the pond levels back into compliance should a large storm event occur.

Land Application Disposal

Initially, mine water is expected to be quite low with the majority of the water recycled back for mine use purposes. For planning purposes, we have assumed the LAD use will be consistent with the commencement of underground activities. Collection of mine water would begin immediately and would be diverted to the ponds developed during construction activities. Once these are full, the LADs would be used to dispose of water. The actual time period would be dependent on the amount of water generated and how long it takes to fill up the ponds to the operational levels.

Under the Land Application Disposal (LAD) plan, water would be sent from the mine pond and delivered to one of three LAD areas at the project. Approximately 28 acres of LAD areas are planned with LAD 1 and LAD 2 located on the Pony Placer Claim and LAD 3 located on the Red Mountain Patented Claim. Each site is divided into cells with dimensions of 200 feet by 200 feet for each cell. Application of water would be rotated between cells and LAD areas to ensure the application rates and time periods are low to reduce surface ponding. Figure 9 shows the layout of the LAD sites.

A drip irrigation system is planned to apply water in each cell. If it becomes necessary, a spray irrigation system would be installed during the warmest months to maximize evaporation. The drip irrigation system application design criteria will target 0.10 inches/hour rate for a total application depth of 12 inches. Literature suggests that clay, loam, and sand infiltration (absorption) rates can range from 0.10 to 1.0 inches/hour rate. A 5-day rotation is planned for each cell operated.

Water would be delivered to the LAD 1&2 via a pipeline that would be located on the surface. This main distribution line would go under the Fish Creek Road to gain access to the LAD 1 and 2 sites. Valves would be installed to control water flow to the desired cell(s). Lateral drip lines would be installed perpendicular to the main distribution line for approximately 200 feet on 3 foot centers. Drip emitters would be installed on the same spacing (36 inches) along each lateral drip line.

LAD 1 and 2 will be the primary land application sites and LAD 3 will be a secondary area. A pipeline would run from the underground sump, up the ventilation raise and along the ventilation access road to the LAD 3 area. Because a drip irrigation system is planned, winter disposal will be possible. All drip lines intended to be used during the winter months would be buried. The system will also be constructed to provide for drain-down during non-operational periods.

Based on a spacing of 36 inches and an emitter rate of 0.009 gallons per minute, each cell would operate at 40 gallons per minute. Initially, only one cell would be required. Based on the targeted infiltration rate of 0.10 inches/hour, each cell could operate for 5 days and water would only be applied to a depth of 12 inches which is expected to be well above the groundwater level in these areas.

There are 22 cells in all three LAD areas; the following shows the rotation/rest pattern that would be realized at 80 gallons per minute:

80 gpm discharge x 1 cell/40 gpm = 2 cells operational at one time
22 cells/2 cells = 11 cycles
11 cycles x 5 days/cycle = 55 days to cycle through
55 days/cycle/30 days = 1.8 months rotation

Each cell would be permitted to rest for almost 2 months before water would be applied to the site. This rate of use is extremely low and would likely meet the evapotranspiration rate for the site.

A groundwater monitoring well would be located below each LAD area and monitored for any water quality changes. The site would be visually inspected to ensure surface ponding and run-off is not occurring.

It is expected that seasonal adjustments will be required to the amount/time water is applied to each cell(s) in an LAD. Because the mine discharge rate is expected to be low during the initial

development, there will be an opportunity to better understand application rates and cell rotation.

Exploration Plan

The project is planned to be developed in several phases with each phase required to determine whether the project moves forward. Under the exploration phase of the project, surface drilling will continue (currently approved) and the proposed exploration activities will include: 4 surface hydrology drill holes, approximately 6,700 feet of development drifting, 10-15 drill stations, a ventilation raise, water sumps, and bulk sample collection.

The schedule for the project is dependent on several factors, including drill availability, permitting and other factors. The commencement of surface hydrology drilling and site construction activities are proposed to start sometime in the 3rd quarter of 2009. For obvious reasons, certain start-up activities could occur simultaneously (hydrology drilling, site preparation etc.). Development of the decline would commence immediately after the site construction activities are completed. It is anticipated that driving the drifts, exploration drilling and bulk ore sampling will take approximately one year.

Hydrology Evaluation

Four additional holes are proposed to test groundwater conditions in various areas of the planned underground workings. Figure 9 provides the location of the drill holes. The drill holes will be a maximum depth of 2,500 feet. Three holes would be located above the ore zone and the fourth hole would be located near the portal. Access to the three holes will require a new road starting from an existing road on the Red Mountain Claim. The road would be approximately 1,700 feet long. The three drill hole locations may vary slightly but would remain within this road prism. Approximately 0.25 acres per drill pad will be required.

Groundwater investigations will occur at these sites and may include test pumping to determine groundwater capacity in each area. The holes will remain open until such time that data collection is no longer required. The holes will be closed according to applicable regulations.

Because of historical mine drainage in the area from the Highlands Mine, Timberline specifically selected the location of the portal out of consideration of potential hydrologic issues. Timberline is not planning to intercept any of the old workings as part of this exploration effort. Therefore, water issues with the Highlands discharge and the exploration workings should remain isolated from each other. Based on the drilling that has occurred at the project, it appears that mine water generated from the Highlands Mine is not consistent with the water encountered in the exploration drilling and/or the hydrological test hole completed in 2008. The hydrology hole inflow rates were quite low at and/or near the same elevation of the Highland adit. This suggests that there is limited connectivity between these areas and the general hydrology of the area.

The hydrologic report by Amec Geomatrix indicates a very low mine inflow rate even though the Highlands Mine has a pretty consistent flow rate over a long sampling period by numerous groups and agencies. Timberline intends to update the hydrological conceptual model annually based on the water balance and surface flows monitored during each year.

Underground Development

A portal is planned on the northeast corner of the Pony Placer Claim. It is expected that a small amount of excavation will be required to "collar" the portal in bedrock. The material from the surface excavation will be utilized to create a flat area for the surface facilities.

The cross sectional dimension of the drifts will be approximately 14-ft. wide by 16-ft high. Development is planned in two phases with a total of 6,700 feet of development. The first phase (5,600 feet) is required to provide primary access to the ore zones, drill stations, and other underground workings to support the exploration activities. An additional 1,100 feet of development will be required for technical data collection and bulk sampling from the various ore zones. The second phase (1,100 feet) will be determined after exploration drilling better defines the ore zones and targeted bulk sampling locations. Figure 7 shows the known ore zones that could be tested in the second phase of the exploration activities, as well as general locations of the muck bays, sumps and drill stations. The muck bays and drill stations could also serve as temporary sumps if needed. Permanent sumps are shown as three parallel features in the Red Mountain claim, also on Figure 7. Powder magazines will also be located underground and stored in used muck bays as the decline advances.

The following equipment is anticipated for the exploration activities:

UG Loader	Personnel Tractor
UG Haul Trucks	Grader
Shotcrete Boom Truck	Pickup/Crew Vans
Fork Lift	Compressor
Surface Loader	Generators
Powder Truck	Welder
UG Fuel/Lube Truck	Jackleg Drills
Jumbo Drill	Bolter
Core Drill Rig	Cubex Drill Rig

Several types of regulated and unregulated materials will be used at the site. The following is a general list of materials that could be used at the site. This list can and will change depending on vendors and operational need.

Fuel (Diesel, Bio-diesel & Gasoline)	Wood/Timber
Water Treatment Chemicals	Rock Bolts
Potable Water Treatment Chemicals	Wire Mesh
Shotcrete	Spare Equipment Parts
Grout	Paint/WD-40 etc.
Steel	Emulsions

Stick Powder Primers

All material will be stored and used in accordance with applicable laws and regulations. The quantity of supplies will vary depending on the material. Some material will be staged at the lay down area until needed underground. Other supplies and materials will be stored underground. MSDS sheets will be maintained at the project for all chemicals. Lubricants will be standard products used for heavy equipment and drilling rigs. Appendix C contains MSDS sheets hydrocarbon products planned to be used for this project. These sheets and others will be maintained and updated to include information for additional materials as necessary. A general list of hydrocarbon materials are shown below:

Used Oil – 1,500 gallons
15W-40 Engine Oil – 500 gallons
Tractor/Hydraulic Fluid – 1,500 gallons
30W Drive Train Oil – 500 gallons
Rock Drill Oil – 100 gallons
80-90W Oil – 55 gallons

The planned work schedule is two shifts at 12-hours per shift 7 days per week with 4-crews. Each crew will consist of 5-6 employees for a total of 16 miners. Additional personnel will include the project engineer, site superintendent, chief geologist, field geologists, environmental technician, head mechanic, head electrician, drillers, and surface labor for a total of 50 to 55 people.

Ventilation fans will be located near the portal to provide fresh air to the underground mine workings. Initially, the portal will function as both the intake and exhaust of mine air. Once the development advances under the Butte Highlands patented claims, a ventilation raise will be developed to the surface. This raise will be approximately 12 feet in diameter and will be less than 1,000 feet in length. Approximately one acre of disturbance will be required and the site will be fenced for security purposes.

Once the ventilation raise is in place, the majority of the mine air will exhaust out the ventilation raise. This will also serve as the secondary escape route for miners and a small water pipeline will be located in the raise to deliver water from the underground sump to LAD 3. As part of the secondary escape route, a small portable hoist will be located at the ventilation raise.

The grouting of water-bearing faults and/or fractures is planned as a means to control the minimal amount of mine inflow projected for the project. Records of grouting activities will be completed to document the future value of grouting mine inflow during mine operations. This information, along with the hydrologic information collected (mine discharge flow, mapping of faults and fractures, measure mine inflow rates etc.) during development will assist in understanding the hydrologic system and response to grouting.

Underground Exploration Drilling

As part of the resource definition drilling program, 120 drill holes are planned with an average length of 500 feet resulting in approximately 60,000 feet of core drilling. There will be between 10-15 drill stations planned. Several drill holes may be drilled from one drill station towards the various ore zones to be tested. Dependent on the areas available for drilling, Timberline could have 2 or 3 drill rigs operating during the exploration program.

Additives to drilling water may be required for certain drill holes planned for the project. Drilling water will be segregated from mine water where possible. Sumps will be constructed at each drill station, where appropriate, to contain drill water.

Technical Evaluation

In addition to drilling the ore zones for mineral content, the exploration drilling program will also address technical issues for the project. It is expected that rock mechanics/geotechnical data will be collected during the development and exploration phase. As mentioned previously, hydrologic data will also be collected to support an estimate of mine inflow during mine operations.

In addition to ore zone definition, data will be collected on waste rock, mine water quality, LAD effectiveness, and other critical elements of the project.

Waste Rock Characterization

There has been a significant amount of drilling completed in the past. Part of the geologic logging of the core in the past assessed sulfide content in various geologic units encountered during drilling. Timberline has assembled this data and developed a preliminary waste rock characterization as it pertains to the planned exploration development (Appendix B – *Geologic and Sulfide Characteristics of the Butte Highlands Project Lithologies*).

The project area geology lies within the Cambrian sequence which includes (oldest to youngest) the Flathead Quartzite, the Wolsey Shale, the Meagher Limestone (dolomite), the Park Formation (shale), and the Pilgrim Limestone (marble). These units generally are characterized as quartzite, dolomitic mud stone, dolomitic marble, shales and siltstone. Intrusive rocks range from fine to medium grained diorite to gabbro.

An assessment of iron and sulfide content for the above rock units in both ore and waste was completed. Table 2 provides data from the report:

Table 2
Sulfur/Iron Content
By
Lithology

Lithology	Meters Drilled	Fe weighted average (%)	Range	S weighted average (%)	Range	Sulfide weighted average (%)	Range
Diorite (waste)	156.4	3.77	0.58 to 15.45	0.83	0.03 to 9.0	6.12	0 to 12.5
Diorite (ore)	3.9	4.4	0.7 to 9.21	1.86	0.11 to 4.55	0	na
Transitional Diorite (waste)	13.8	3.99	0.65 to 7.12	0.68	0.04 to 1.26	4.66	0 to 4
Transitional Diorite (ore)	4.5	3.42	2.3 to 4.38	1.02	0.52 to 1.46	1.33	0 to 17.5
Gabbro (waste)	38.8	6.53	3.5 to 8.85	0.5	0.04 to 1.6	4.23	0 to 12.5
Meagher (waste)	216.1	2.41	0.19 to 17.9	0.24	0.01 to 3.67	2.76	0 to 20
Wolsey (waste)	353.3	5.25	0.42 to 45.4	1.15	0.01 to 11.0	5.96	0 to 60
Wolsey (ore)	23	9.95	2.39 to 21.1	4.01	0.01 to 11.0	10.47	0 to 35

In addition, the calcium content was also evaluated and is presented in Table 3. While Timberline understands that predictions based on calcium are not the preferred method, valuable data can be obtained during the initial phase of development. Existing geological data and logging information collected over many years and by several different geologists to provide an overall general rock characterization assessment.

Timberline has outlined the waste rock testing that will be completed to characterize acid potential and other related information. These tests will be a more conventional assessment of the acid/neutralization potential for the various rock units encountered. This information will be used to support a mine application for waste and ore characterization purposes.

Table 3
Weighted Average of Calcium by Lithology

Lithology	Meters Assayed	Overall Calcium Percentage	Range
Diorite (waste)	155.2	4.44	2.45 to 19.4
Diorite (ore)	3.9	3.08	0.42 to 7.3
Transitional Diorite (waste)	13.8	6.39	3.27 to 19.75
Transitional Diorite (ore)	4.5	3.56	3.25 to 3.88
Gabbro (waste)	38.8	8.41	3.41 to 12.4
Pilgrim (waste)	0	Na	na
Park (waste)	0	Na	na
Meagher (waste)	215.5	16.82	4.0 to 28.2
Meagher (ore)	0	Na	na
Wolsey (waste)	354.2	9.06	0.1 to 27.6
Wolsey (ore)	23	6.53	1.7 to 15.4

Based on this data, Timberline estimated the tonnage of rock from each lithology anticipated to be excavated as part of the exploration activities and assessed the sulfide and calcium content of the waste material. The majority of the waste material is low in sulfide content and high in calcium. The net neutralizing potential is equal to or greater than the acid generating potential of the waste rock. This information is shown in Table 4.

Table 4
Projected Development Rock Tonnage by Lithology

Lithology	Projected Tonnage	Calcium Weighted Average (%)	Sulfide Weighted Average (%)
Diorite (waste)	6,682	4.44	2.82
Diorite (ore)	0	3.08	1.86
Transitional Diorite (waste)	0	6.39	1.89
Transitional Diorite (ore)	0	3.56	1.7
Gabbro (waste)	0	8.41	0.91
Pilgrim (waste)	0	na	0.004
Park (waste)	11,028	na	1.32
Meagher (waste)	31,338	16.82	0.68
Meagher (ore)	0	na	0
Wolsey (waste)	58,449	9.06	6.43
Wolsey (ore)	0	6.53	11.68
Unclassified Material	2,331	Na	na

Waste rock monitoring will be completed to characterize waste generated on an on-going basis for the project. Monitoring will include geochemical testing analyses to better understand waste rock composition, acid/base potential and other important elements to assist in proper

management of waste during exploration activities. The following represents the data to be collected for waste rock characterization:

- Map geologic units along with faults/fracture zones;
- Sample collection
  - Minimum of one sample for each rock unit encountered and/or
  - Every 1,000 feet of the decline/workings
- Analyses
  - Whole Rock Analyses
  - Asbestos Testing
  - Acid Base Accounting
  - AGP and ANG
  - Meteoric Water Mobility Test (Selected Samples)
  - Kinetic Testing (Selected Samples)

Sample Collection

Samples of waste rock generated during excavation of the decline and drill stations will be completed to provide a representative set of samples of the material and geology of the rock encountered. A waste rock sample will be collected every 1,000 feet of decline/development excavated. A minimum of one sample for each rock unit will be collected in the event the encountered length is less than 1,000 feet.

A geologist knowledgeable about the deposit will supervise/collect representative samples. Documentation of the sample collection process will be maintained and include sample location, geology/rock unit sampled, and other pertinent information. Sample labels will be directly correlated to lab samples and test results completed.

Depending on the exploration drilling results, core samples may be tested using the same protocols to assess ore/waste characterization during operations. Samples may be collected to supplement waste characterization data collected from excavation for mine workings during exploration.

Whole Rock Analyses

Whole rock analyses will be completed on the samples as the preliminary assessment of the geochemical composition of the sample. The multi-element analysis will follow standard methods and protocols for sample preparation and analyses.

A third party laboratory will be used to complete the whole rock analyses that are anticipated to use an ICP analyses. The following suite of parameters will be analyzed:

Aluminum	Antimony	Arsenic	Barium	Berylium	Bismuth
Boron	Cadmium	Calcium	Chromium	Cobalt	Copper
Gallium	Iron	Lead	Lithium	Magnesium	Manganese
Mercury	Molybdenum	Nickel	Potassium	Scandium	Selenium
Strontium	Thallium	Tin	Titanium	Vanadium	Zinc

Acid Base Accounting (ABA Testing)

Sample will also be tested for their ability to generate acid and neutralizing potential. Standard EPA method will be used for:

- Acid generation potential (calc. on sulfur total)-M600/2-78-054 1.3
- Acid neutralizing potential (calc) - M600/2-78-054 1.3
- Acid/base potential (calc. on sulfur total) - M600/2-78-054 1.3
- Neutralization Potential (calc on sulfur total) – M600/2-78-054 1.3
- Sulfur Forms – M600/2-78-054 3.2.4-MOD
- NP/AP Ratio

The ABA tests will also provide sulfur specifications to that sulfide content can be calculated. The lab will measure total sulfur and sulfate.

Meteoric Water Mobility Tests or Synthetic Precipitation Leaching Process

Meteoric Water Mobility Test (MWMT) also called the Synthetic Precipitation Leaching Process (SPLP) will be completed on the samples as well. They both follow EPA Method 1312. The suite of parameters is typically selected to meet project specific issues. The following will be used as a starting list and may be modified based on whole rock analyses and ABA test results using the DEQ Circular 7 as a guideline.

Parameter	Required Reporting Value (mg/l)
Aluminum	0.030
Antimony	0.003
Arsenic	0.003
Barium	0.005
Beryllium	0.001
Cadmium	0.00008
Chromium	0.001
Copper	0.001
Fluoride	0.1
Iron	0.05
Lead	0.0005
Manganese	0.005
Mercury	0.00001
Nickel	0.01
Phosphorus	0.001
Selenium	0.001
Silver	0.0006
Sulfate	1.0
Thallium	0.0002
Uranium	0.00003
Zinc	0.1

Kinetic Testing (Humidity Cell Tests)

Kinetic testing will be completed on representative samples of each geologic unit unless the whole rock, ABA, and MWMT/SPLP tests suggest otherwise. Composites and/or individual samples may be selected to develop the sample(s) for kinetic testing. Documentation will be prepared on the sample selection process. This information will be important to represent waste encountered and the quantity stored on the surface.

Additional samples may be completed based on the results of the whole rock, ABA, and MWMT/SPLP test results to provide additional data where needed to support the waste rock management plan, reclamation closure, and technical information to support operational permit development. If the humidity cell data demonstrates waste rock issues, a water management plan should be incorporated to address the issues. Water management could involve water treatment to address water discharges to the LAD.

As with the MWMT/SPLP tests, the kinetic tests will use the list of parameters and reporting limits shown above as a starting point for effluent collected from the tests. Modifications may be made to reflect results from other geochemical tests.

The data collected for waste rock characterization and management would be submitted to the agencies as part of the annual report prepared for the project.

Humidity cell tests will provide important information with respect to acid generation and potential metals mobility from the waste piles. Documentation of waste rock volumes, mine water pond water quality, and other critical information should be used in conjunction with the humidity cell tests to determine the potential to generate acid and metal mobility. If this demonstrates an issue exists, Timberline would utilize a contingency plan at closure to install a low permeability cap at closure as a mitigation measure for remaining waste rock.

Metallurgical Sampling

The Butte Highlands Project is not currently planning on-site processing for gold extraction. Regardless, metallurgical testing will be required to test the different types of ore that could be encountered and the appropriate gold process that is required. Ore variability will dictate the metallurgical tests performed.

Bench scale metallurgical testing will be performed on drill samples as well as bulk samples for the various ore zones. These zones will be better defined after drill results are received.

Bulk Process Sample

Because there are several ore zones with different ore characterization, bulk samples will be necessary to adequately test the gold recovery process. Two testing programs are expected that include a large scale pilot plant test along with a large scale operational level test.

Timberline anticipates using toll milling at a facility near the project site. The off-site process facility has not been selected and will be dependent on the metallurgical test and the large scale pilot plant results. This information will be used to obtain interest for off-site milling opportunities.

Bulk samples will be collected that are representative of the ore zones. These samples will be combined as appropriate to match planned mining operation. It is expected that a 10,000 ton sample will be required for all the tests. The location of the samples, the number, compositing and other details will be developed after the drilling program is completed.

A contract trucking firm will be hired to haul the bulk samples for testing. Coordination of this activity and the use of an alternative route will be made with the USFS and/or Silver Bow County authorities.

Sediment Control and Stormwater Management

Best Management Practices (BMPs) will be used to manage storm water at the site. Examples of the BMP's that will be implemented at the site are included in "Water Quality BMP's for Montana Forests" (MSU Extension Service, 2001). Berms will be installed throughout the property to control both stormwater run-on and run-off. Sediment fence and other similar methods will be used to control sediment from the disturbed areas. A Notice of Intent will be filed with the State to cover construction activities at the site during exploration activities. A Stormwater Pollution Prevention Plan will be developed.

The following concepts will be incorporated into the Stormwater Pollution Protection Plan (SWPPP):

- Run-On Diversions – Where required these will be installed to keep run-on from entering the mine disturbance boundaries.
- Run-Off Diversions – These will be primarily located at the surface facilities and will separate contact stormwater water and non-contact stormwater.
- Sediment Fences/Berms/Straw Bales – The use of sediment fence and berms will be installed to contain run-off from disturbed areas which are considered non-contact stormwater.
- Sumps/Sediment Traps – These will be installed for non-contact stormwater occurs and may be used in combination with sediment fences/berms/straw bales.
- Regular Inspections – Inspections will occur after major rain events and/or on a regular basis to ensure the BMPs are functioning properly.

Figure 8 shows the general location and type of BMPs that will be incorporated into the project disturbance boundaries. The SWPPP holds the final layout for the project and will be updated as needed to reflect actual site BMPs used.

Mine Water and Water Treatment

The quantity of water encountered initially during development work will be very limited. As part of baseline data collection, samples were collected by Timberline and AMEC Geomatrix Inc. from the Highlands Mine Adit and the pump test completed for an exploration drill hole. This data is presented in AMEC Geomatrix' hydrology report in Appendix A and summarized in Table 6.

Water quality from the historic Highlands Mine provides insight into the potential water quality that might be encountered during exploration and full operations. Samples were also collected during the pump tests at 805 feet (depth) and 1,085 feet (depth). Water quality data varied slightly with depth but all sampled constituent levels were below the Montana Groundwater Standards.

Based on this data, water quality should not be an issue for land application and the rates proposed. Sediment and nitrates will be the primary constituents of concern and the focus of water management controls. If however, results of humidity cell testing demonstrate waste rock and water quality issues, a water management plan will be developed to address any issues. Water management could involve water treatment for discharges of water from the LAD areas.

Water management will incorporate several levels of sediment removal underground before reaching the stormwater pond on the surface. If needed, flocculants can be added to the sumps underground and to the stormwater pond to enhance settling. In addition, explosive handling will also reduce nitrate levels. Because the application rate is going to be close to the evapotranspiration rate, take up of nutrients by plants and attenuation by LAD soils will reduce these values as well.

Timberline will be prepared to install a portable water treatment facility to treat water in the event monitoring wells below the LAD indicate a change in groundwater quality.

Based on AMEC Geomatrix, Inc.'s analysis, the projected infiltration rates will be directly related to the advancement of the underground workings and are as follow:

Decline Length (ft.)	Cumulative Mine Inflow Range (GPM)
1,000	1-6
2,000	6-12
5,000	6-36
10,000	10-109

Refuse Management

No landfill will be constructed on site. Instead, appropriate garbage containers for specific refuse will be provided. Timberline will contract garbage removal services for regular pickup at the mine site. Recycling will be accomplished where appropriate and applicable.

For refuse that contains food or other similar items that could be an attractant to wildlife, appropriate containers will be properly located to minimize wildlife access and will be frequently removed from the site to reduce the potential for unwanted entry by wildlife.

Site Security

A fence and gate will be constructed on the mine access road near the office to discourage entry to the site facility and mine workings. A berm will be constructed around the remaining surface facilities to minimize vehicle entry to the project site. Signs will be posted to discourage trespassing. In addition, a portal gate will be installed as required by MSHA regulations. Because the operating schedule is anticipated to be 7 days per week, site staff will provide security personnel.

A fence will also be constructed around the ventilation raise to secure this mine entry consistent with MSHA regulations.

Monitoring Program

In addition to the waste rock characterization monitoring and other technical data collection for the project, Timberline proposes to complete environmental monitoring as outlined below:

- Water Balance – a water balance will be developed on a yearly basis to include an estimate of mine inflow and discharge rates for the project;
- Water Quality – Monthly
    - Mine Ponds
    - Surface Water Sites (Moose Creek, Fish Creek, Historic Highlands Mine, and Basin Creek)
- Groundwater Quality – Quarterly
    - LAD Monitor Wells
    - Hydrology Groundwater Exploration Holes – Depth Only

Current surface water monitoring is occurring in Fish Creek and the Highlands Mine. Recently, a site on Moose Creek was added. As required by MDEQ, an additional site on Basin Creek will be established. Figure 12 shows the surface water monitoring sites. The sites will be monitored monthly for the parameters listed below and at the levels recommended by MDEQ Circular 7 for aquatic life standards. This list may be modified after data collection occurs and parameters are of no issue or concern. Monthly monitoring of the sites may not be possible at all times due to winter weather conditions such as snow levels or frozen streams.

SW Sites:

- Highlands Discharge (WS-1)
- South Fork Fish Creek (WS-2)
- Fish Creek Above Confluence of S. Fork (WS-5)
- Middle Fork Moose Creek (WS-6)
- Basin Creek (WS-7)

Table 5: Water Quality Parameter List and Detection Limits

Parameter	Minimum Monitoring Level* (mg/L)	Minimum Monitoring Level* (ug/L)	Parameter	Minimum Monitoring Level* (mg/L)	Minimum Monitoring Level* (ug/L)
Specific Conductivity (μmhos)	1	1000	Aluminum	0.1	100
TSS	1	1000	Antimony	0.003	3
TDS	1	1000	Arsenic	0.001	1
pH (S.U.)	-	-	Barium	0.005	5
Turbidity	0.1	100	Beryllium	0.001	1
Oil & Grease			Bismuth	0.00025	0.25
Sodium	1	1000	Boron	0.0025	2.5
Calcium	1	1000	Cadmium	0.0001	0.1
Magnesium	1	1000	Chromium	0.004	4
Potassium	1	1000	Copper	0.001	1
Carbonate	1	1000	Iron	0.05	50
Bicarbonate	1	1000	Lead	0.00005	0.05
Total Alkalinity	1	1000	Manganese	0.02	20
Total Hardness	1	1000	Mercury	0.00002	0.02
Chloride	1	1000	Nickel	0.01	10
Sulfate	1	1000	Selenium	0.001	1
Ammonia	0.05	50	Silver	0.0002	0.2
Nitrate	0.05	50	Thallium	0.0002	0.2
Nitrate+Nitrite, as N	0.01	10	Zinc	0.002	2
Nitrite	1	1000			
TKN	0.1	100			
Total Nitrogen, as N	0.05	50			
Total Phosphorus as P	0.005	5			
Ortho Phosphorus	0.1	100			

* Detection values are primarily based on aquatic and human health standard values as listed in Montana WQB Circ 7, Feb 2008. Where Circ.7 does not list a standard value, commonly accepted analytical method detection values are used.

Groundwater samples will be collected from the LAD groundwater monitoring wells on a quarterly basis. Figure 9 shows the locations of these wells. The same parameter list above will be used for groundwater samples. The list may be modified after data collection identifies

parameters that are of no issue or concern. Timberline will monitor water quality levels throughout the exploration phase in order to identify any issues. Appropriate action and/or treatment will be taken to meet water quality standards as appropriate in the LAD sites.

Hydrology holes are currently being drilled and data is not available. If the hydrology monitoring holes can provide information, they will be retained and groundwater depth monitored on a quarterly basis. Those holes will be identified in the annual report. The hydrology hole near the portal will likely not exist after commencement of underground development and would not be available for monitoring.

Water data collected for all of the sites listed above will be provided on an annual basis to the agency.

Timberline would propose that monitoring of the surface and groundwater would occur for 5 years after and reclamation has been completed. This should provide sufficient data to determine if conditions have returned to normal and/or determine if additional monitoring is required. Timberline could petition a shorter time period if water quality data supports a stable condition exists.

Timberline does not expect that residual nitrate will be an issue when mine flooding occurs. During operations, nitrate values will be monitoring in mine water quality and will provide data as to the potential levels of nitrate during flooding activities. Because dewatering will continue for some time after exploration activities are completed, issues resulting from nitrate will be addressed during exploration activities. Timberline proposes to use emulsion and other similar blasting agents that are water resistant and reduce the potential to release nitrates into mine water. Over time, it is expected that once exploration activities stop, nitrate levels should decrease to background levels.

Reclamation Plan

Timberline anticipates exploration activities moving into the operational stage; however, for purposes of closure, a general reclamation plan is included. Figure 10 provides the general reclamation planned for the project.

Initiation of Reclamation

Timberline would initiate final closure on the exploration activities if a decision to proceed with operations does not occur within a two year period after completion of exploration activities. Timberline would notify the agencies of the intent to initiate reclamation at the site.

A revised reclamation plan will be submitted at that time for review and approval by the agency.

Post-Mining Land Use

The private land currently has several land uses that include grazing, logging, recreation, wildlife habitat, and other similar rural land uses. Timberline anticipates retaining the pre-mining land uses after mine operations. To maintain the private land value and use, some mine constructed features will be retained for private land management activities.

Reclamation activities will be accomplished to meet mine closure requirements, site stability, minimize erosion, and provide a self-sustaining vegetative plant community. Meeting these objectives will support post-mining land uses.

Site Facility Removal

Timberline is the owner of the private property used for the exploration activities. For this reason, Timberline would retain certain roads on the property to provide access. This would include:

- Main Access to the Surface Facilities; and
- Access to the LAD 1 & 2 Sites.

All other roads associated with this amendment would be reclaimed as part of the effort. In addition, all equipment and supplies would be removed from the site when they were no longer required to support reclamation activities.

Timberline would retain the following structures:

- Geologic Core Shed Building;
- Water Well;
- 1-Water Tank (Potable);
- Septic System/Leach field; and
- Gate/Fence.

These items have value to Timberline and the management of private land after exploration and/or mine operations. The remaining items will be removed from the site when they are no longer needed to support reclamation.

Surface Facility Reclamation

Once the buildings have been removed, regrading of the site will be completed. The waste dump side slopes will be reduced to a 2.5:1 slope. The surface will be graded away from the regraded slopes to promote proper stormwater run-off.

The concrete wash pad will be broken up and buried in place with a minimum of 12 inches of fill material. All pipelines ends would be exposed, capped, and buried for final closure.

Fill material would be placed over the portal (boulders) and regraded to an approximate slope of 3:1 and blended to match the adjacent topography. Figure 11 shows a typical portal closure diagram.

The mine ponds would be regraded to eliminate the ability to store water. Regrading efforts will be done in such a manner as to blend and match the adjacent topography. The fences installed around the mine ponds would be removed as part of closure activities.

The yard area would be scarified to eliminate soil compaction during operations. Only a minor amount of regrading would be completed to preserve the general flat nature of the area for future post-mining land use.

The road, water well, septic system, and geology core shed would be retained for private land use. The gate and site fence will remain as well.

Sediment control would remain until the site demonstrated stability, at which time; the run-on diversions would be regraded and reclaimed.

Once all regrading activities are completed, soil placement will occur. While Timberline will salvage as much soil as possible, it is anticipated that insufficient soil will be present to allow for a thick cover of soil to be placed over all disturbed areas. If this is the case, Timberline will assess the various areas and prioritize soil placement to maximize revegetation opportunities. Some areas may get a thinner soil horizon to ensure adequate soil is available for higher priority areas. Amendments and other means will be reviewed and considered to enhance the opportunity for revegetation success on these areas.

Portal Plugging

The portal will be sealed to prevent access to the underground workings. Prior to plugging the portal, all mobile equipment, unused supplies, explosive, and other similar items will be removed. The pumps will be turned off and the workings permitted to flood.

Based on the current water levels found from drilling, it is not anticipated that a water retaining plug will be required. If data collection indicates differently, the plug design will be modified to meet these new specifications. A non-water retaining plug will be installed at or near the portal. This plug may include the use of cemented rock fill (CFR) or a conventional cement plug. Under the CRF approach, a 10-20 foot zone of cemented rock will be placed into the opening. Timber or other similar structure will be used to temporarily hold the CRF material until the cement has cured forming a solid rock plug. Because this method is planned for mine operations and equipment will be available, this will likely be the most cost effective approach.

Timberline may choose to install a conventional cement plug. In this case, rebar on 3 foot centers will be used and tied in to the adjacent rock. A 6-inch thick concrete plug will be installed. It is assumed the conventional portal plug will be located reasonably close to the portal. The remaining decline that is open to the surface will be backfilled with waste rock. Boulders will be placed over the portal as a final security measure, if available on site.

For either portal plug method used, fill material will be placed over the CRF material/boulders as a final cover for revegetation. The fill will be placed with an approximately 3:1 slope. Figure 11 shows a typical cement portal plug.

Land Application Disposal Areas

Pipelines and other equipment used for land disposal will be removed from the site. It is not anticipated that any work will be required to reclaim the actual disposal area. Watering over the time period should have established a very good stand of vegetative cover.

Reclamation will be completed on roads and the monitor wells. The wells will be plugged in accordance with applicable laws and the casing removed below the surface of the ground. The roads will be lightly scarified to promote revegetation but the road prisms will be retained for private land use. The objective is to maintain the roads in a "two-track" condition that are stable.

Ventilation Raise

A plug will be installed in the ventilation raise as part of closure. All equipment will be removed but the fence will be retained for security purposes. As with the portal plug design, CRF or a conventional plug one foot thick will be used to close the ventilation raise. A soil cover will be placed over the concrete plug or CRF material to promote run-off away from the raise. Rebar will be installed on 1-foot centers and tied to the adjacent rock wall.

A permanent monument will be located at the site in order to provide long-term documentation of the raise location. Figure 13 shows the ventilation raise closure plan.

The site would be regraded to match the adjacent topography. The road and area around the ventilation raise would be regraded and/or scarified to promote revegetation. Soil would be placed over the regraded areas and seeded.

Hydrology Holes

There are 4 holes planned to test hydrologic conditions during exploration. These holes would be plugged according to applicable laws and the casing cut off below ground level. The drill pad areas would be regraded and scarified prior to placing soil over the surface. The road access to the three sites would also be regraded and scarified prior to soil placement.

Once regrading is completed, soil would be placed over the surface and seeded.

Revegetation Efforts

Timberline would propose to use the following seed mixture:

Redtop (*Agrostis gigantean*)
Meadow foxtail (*Alopecurus pratensis*)
Orchardgrass (*Dactylis glomerata*)
Canada bluegrass (*Poa compressa*)
Tall fescue (*Festuca arundinacea*)
Timothy (*Phleum pratense*)
White clover (*Trifolium repens*)

The mixture could change to meet post-mining land uses of grazing, self-sustaining plant community, and long-term stability. The rate of application would be dependent on the recommendation of the seed supplier and/or soil conservation services.

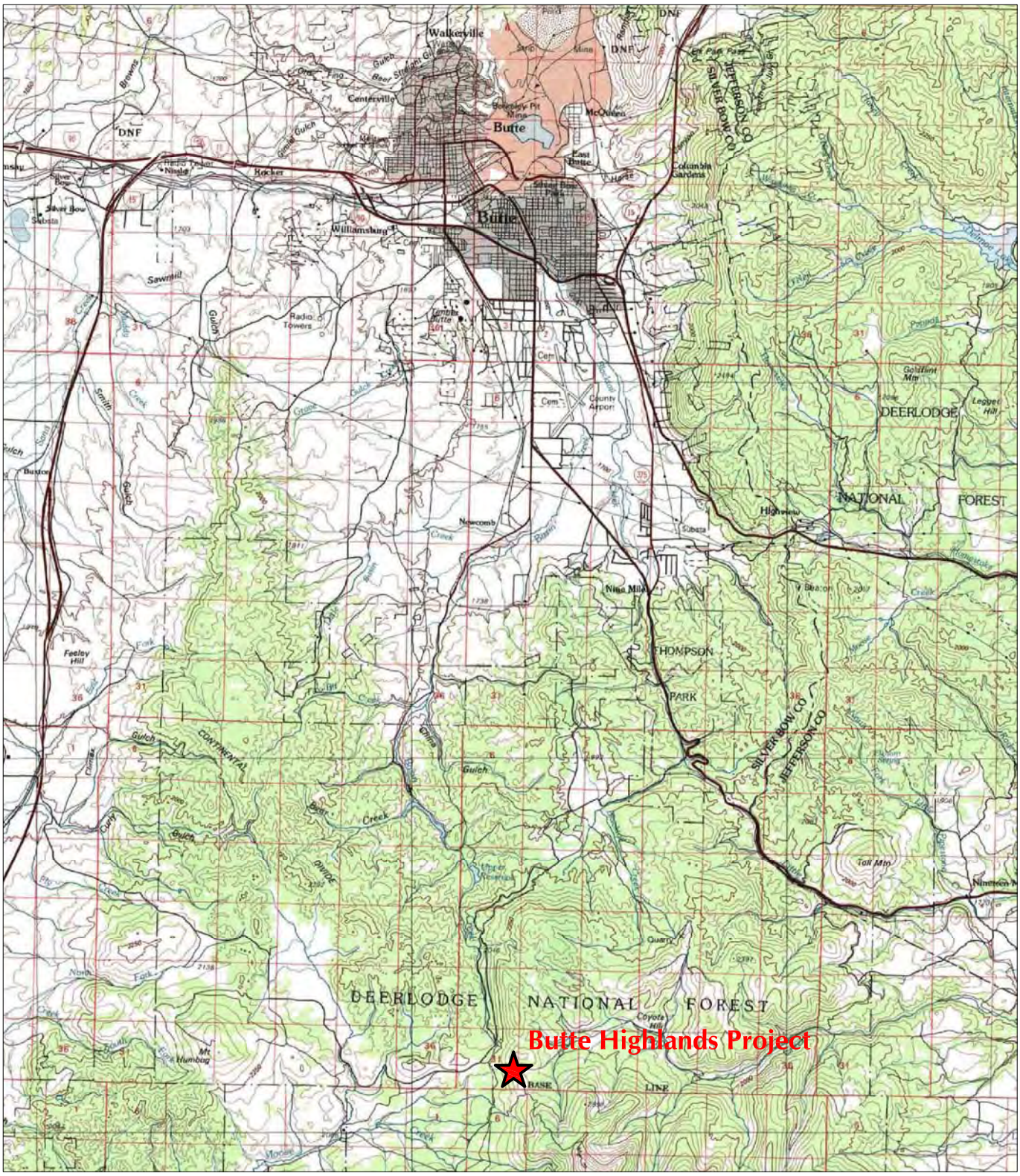
Reseeding efforts would only occur during the last fall and/or early spring time period to improve on revegetation success.

Bond Release

Timberline would request bond release when all reclamation activities are completed and vegetation has successfully returned to the disturbed sites.

Table 6 - Groundwater Quality Data

Location			Groundwater Sample Site								
			Monitoring Borehole				Mine Adit Discharge				
	Montana Standard		BHMW08-01 805 ft		BHMW08-01 1085 ft		WS-1 / BH-1		WS-1 / BH-1		BHIS10H
Parameter	Aquatic Life	Ground water	12/04/08		12/09/08		09/03/08		11/25/08		08/20/93
Field pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.35	---	8.44	---	---	---	7.67	---	8.37
Lab pH (s.u.)	6.5 - 9.0*	6.5 - 8.5 s*	8.4	---	8.5	---	7.6	---	---	---	7.35
TDS (mg/l)	---	500 s*	185	---	180	---	212	---	---	---	
Chloride (mg/l)	230*	250 s*	<1.	---	<1.	---	1	---	---	---	1.6
Sulfate (mg/l)	---	250 s*	6	---	7	---	21	---	---	---	13.8
Fluoride (mg/l)	---	4	<0.1	---	0.1	---		---	---	---	0.17
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	---	0.24
Orthophosphat e (mg/l)	---	---	0.02	---	1.03	---	<0.001	---	---	---	---
Phosphorus, total (mg/l)	---	---	0.01	---	0.96	---	0.009	---	<0.1	---	---
Metals			Diss.	T.R.	Diss.	T.R.	Diss.	T.R.	Diss.	T.R.	(unk)
Aluminum (mg/l)	0.087	0.2 s	<0.03	0.22	0.28	12.11	<0.03	0.04	<0.01	<0.01	<0.03
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	0.017
Beryllium (mg/l)	---	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---
Cadmium (mg/l)	0.000097 h	0.005	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.001	<0.001	<0.002
Chromium (mg/l)	0.0277 h	0.1	<0.001	0.003	0.001	0.024	<0.001	<0.001	<0.001	<0.001	<0.002
Copper (mg/l)	0.00285 h	1.3	<0.001	0.005	<0.001	0.037	0.001	0.003	0.00131	0.00108	<0.002
Iron (mg/l)	1.0	0.3 s	<0.03	3.28	0.67	20.52	<0.05	0.22	0.115	0.0972	0.007
Lead (mg/l)	0.000545 h	0.015	<0.0005	0.0016	<0.0005	0.0032	<0.0005	<0.0005	<0.001	<0.001	<0.002
Manganese (mg/l)	---	0.05 s	0.011	0.089	0.056	0.208	0.016	0.017	0.0112	0.00927	0.005
Mercury (mg/l)	0.00091	0.002	<0.00005	<0.001	<0.00005	<0.001	<0.00001	<0.00001	<0.0001	<0.0001	<0.0001
Nickel (mg/l)	0.0161 h	0.1	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.001	<0.001	<0.002
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	<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	---
Uranium (mg/l)	---	0.03	<0.001	<0.001	0.003	0.004	---	---	0.00131	0.00116	---
Zinc (mg/l)	0.037 h	2.0	<0.01	0.01	<0.01	0.02	<0.01	<0.01	0.00108	<0.001	0.0045

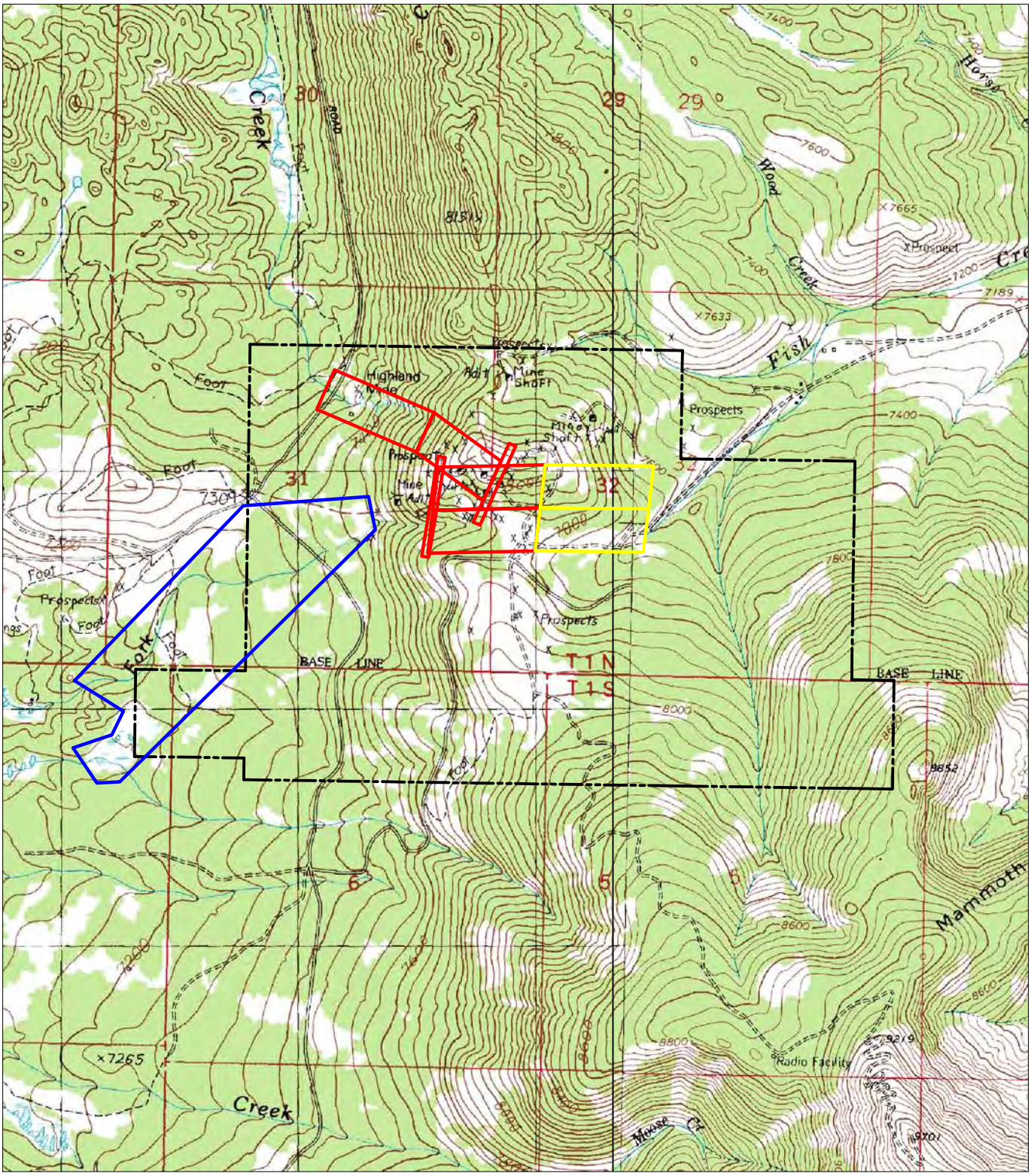


Map Source: USGS 100,000 Topographic Maps: Butte North and South, Montana (presented at 1:150,000 scale)

N

0 2 miles

Figure 1	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **General Location Map** Silver Bow County, Montana	



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

N

BHC Claims 2007

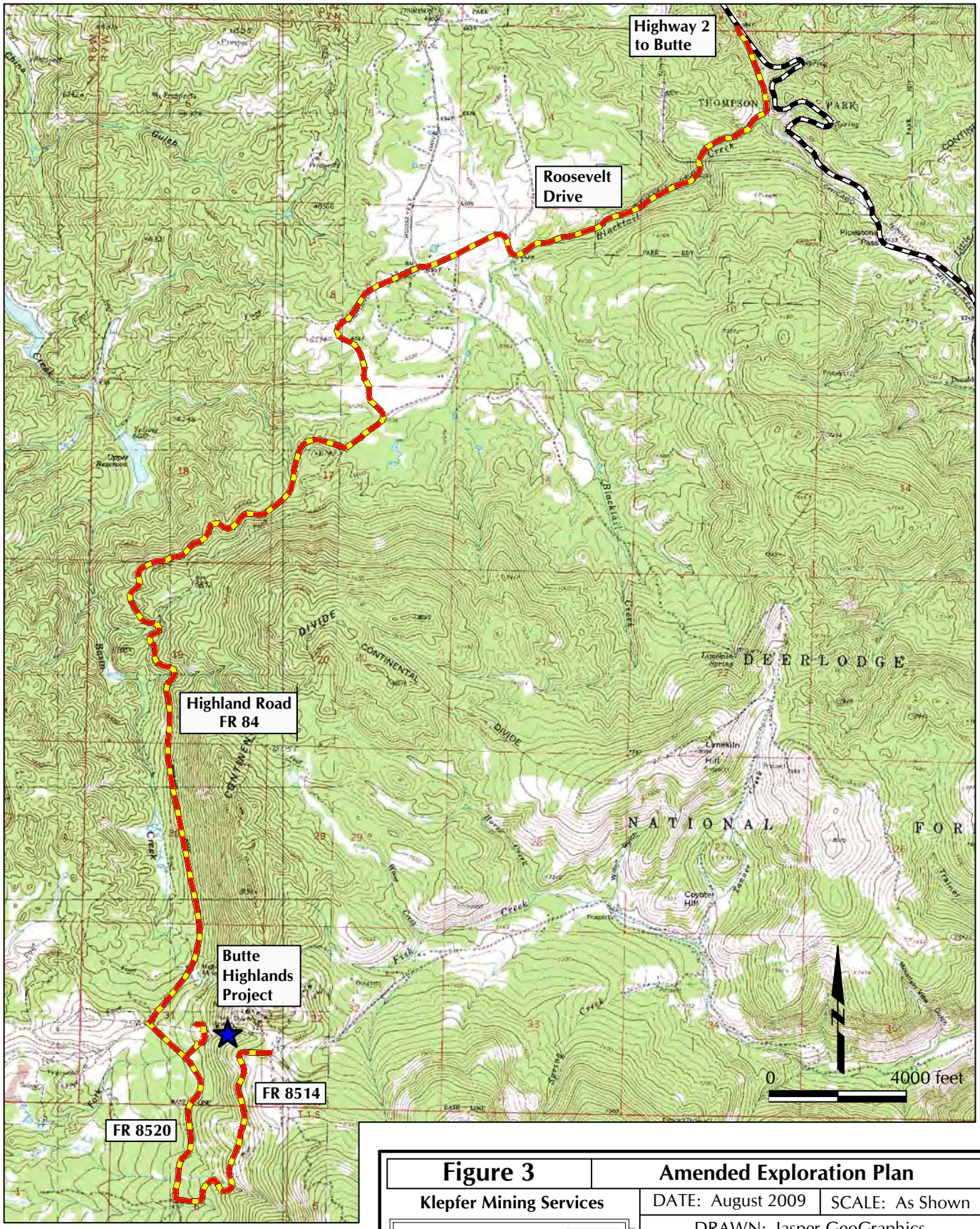
Patented Mineral & Land Rights

Patented Mineral Rights Only

Patented Pony Placer Claim

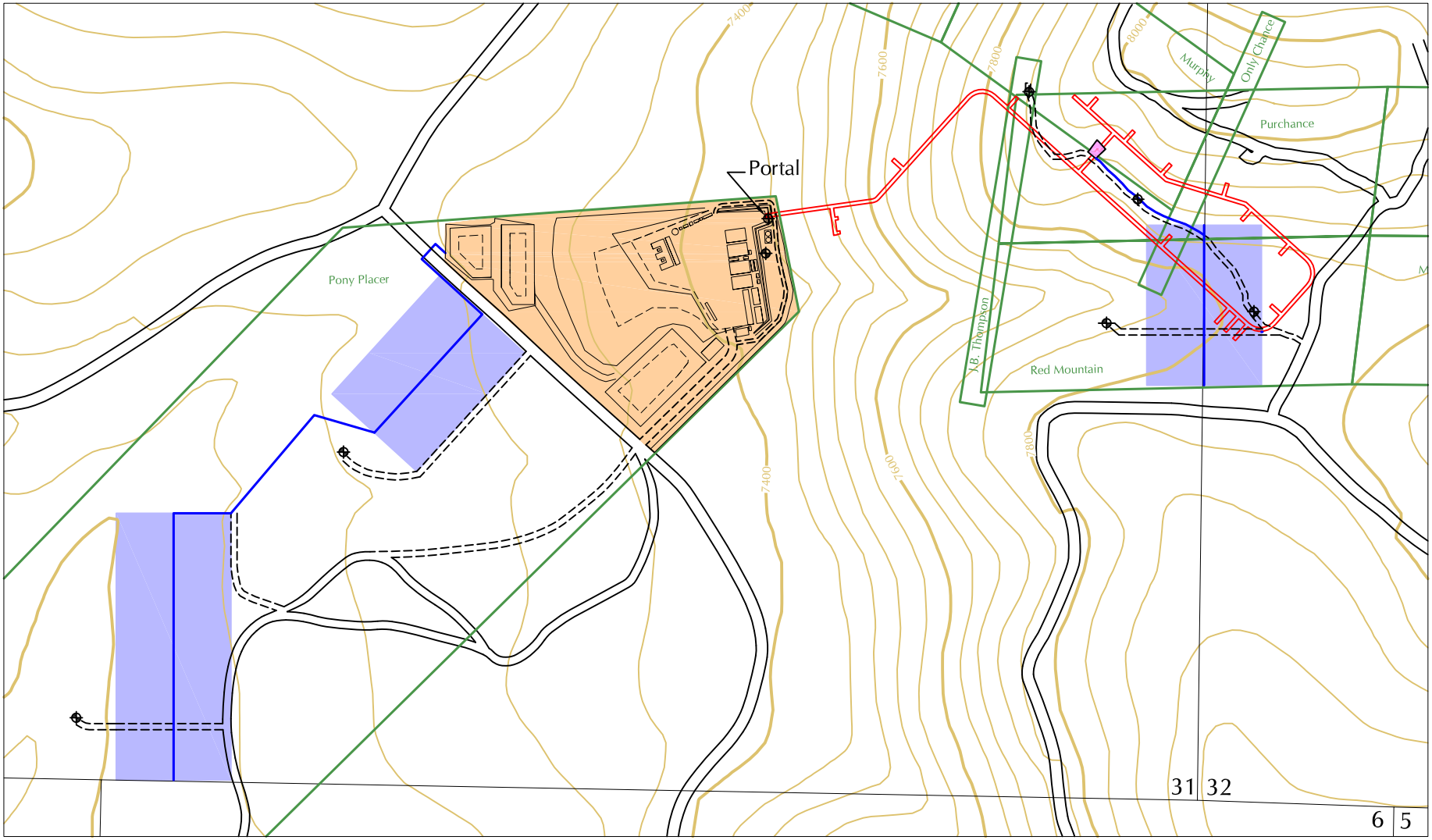
0 2000 feet

Figure 2	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Claim Boundary Map** Silver Bow County, Montana	



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

Figure 3	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Road Access Map** Silver Bow County, Montana	



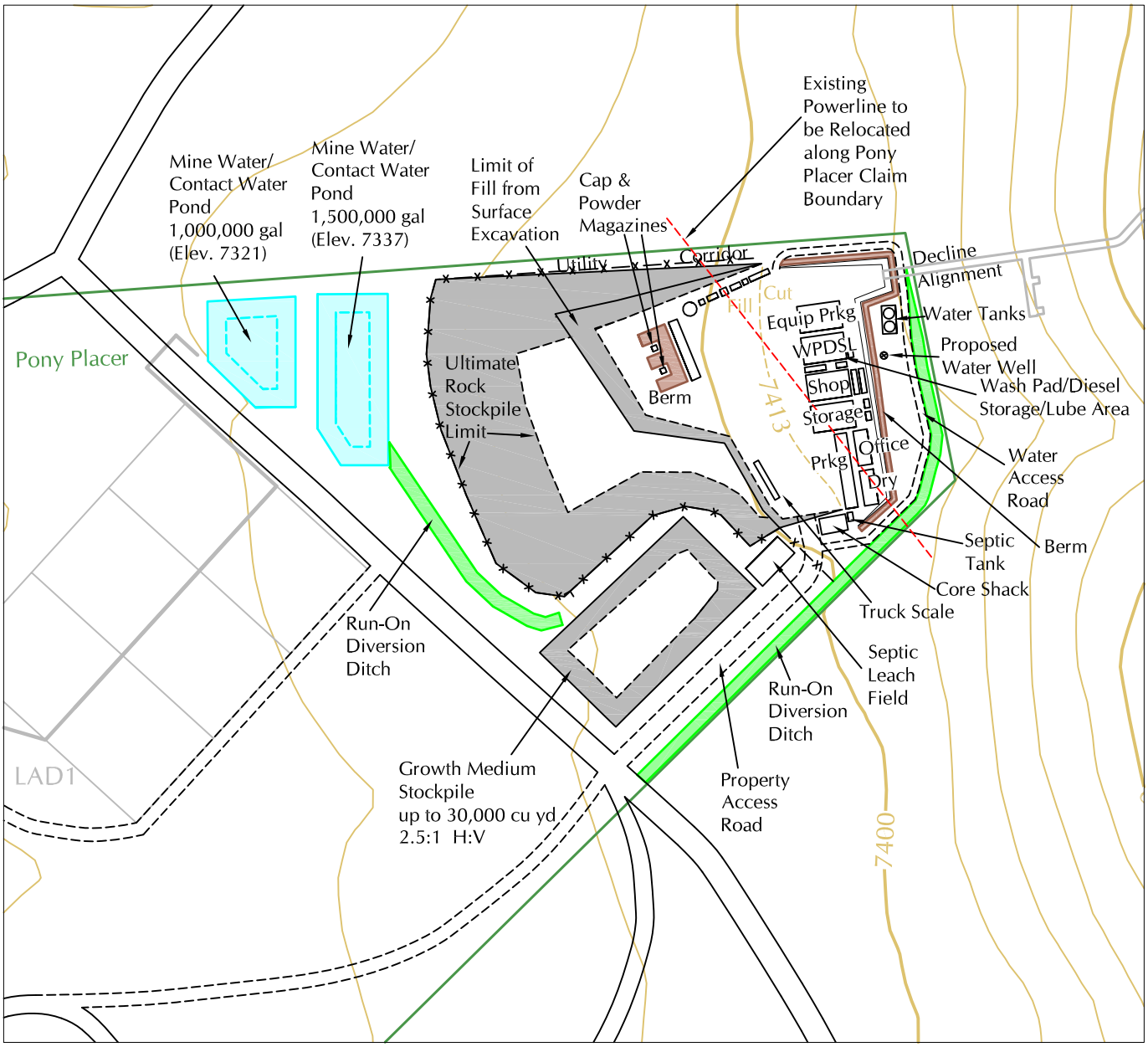
Explanation

- Claim Boundaries
- Existing Roads
- Proposed Roads
- Underground Workings
- Pipeline
- Main Surface Facilities
- LADs
- Vent Raise
- Well

N

0 600 ft

Figure 4	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Proposed Project Facilities** Silver Bow County, Montana	



Explanation

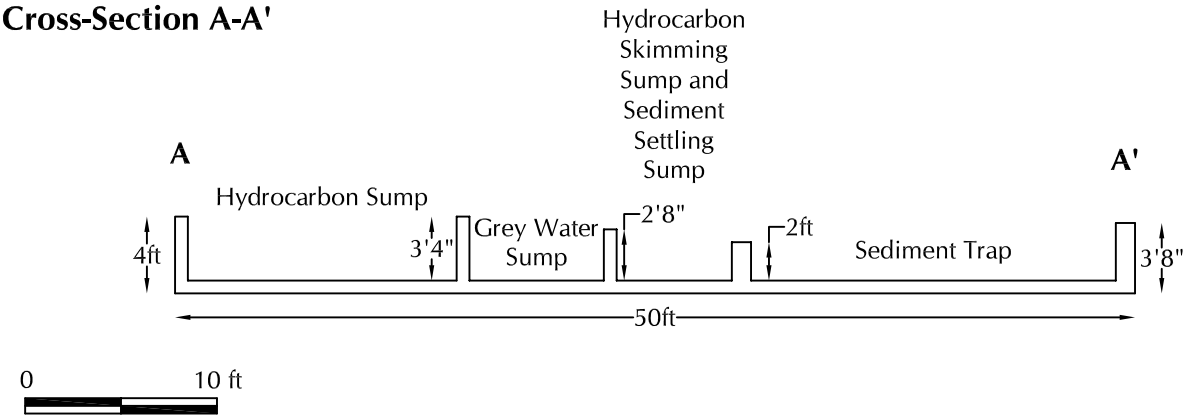
- Claim Boundaries
- Existing Roads
- Proposed Roads
- Fence
- Pond
- Slope
- Ditch
- Berm

N

0 300 ft

Figure 5	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Main Facilities Map** Silver Bow County, Montana	

Cross-Section A-A'



Plan View

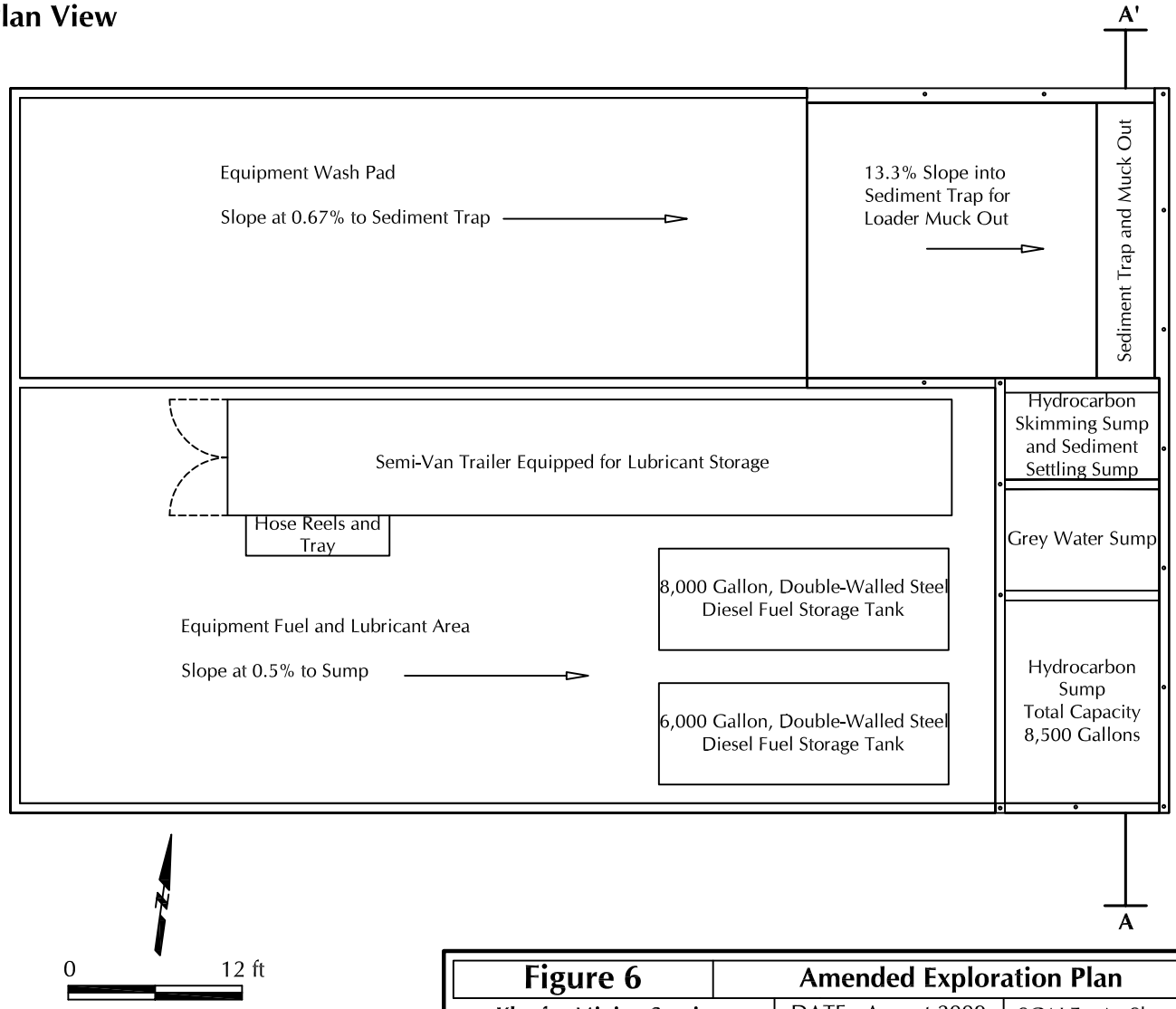
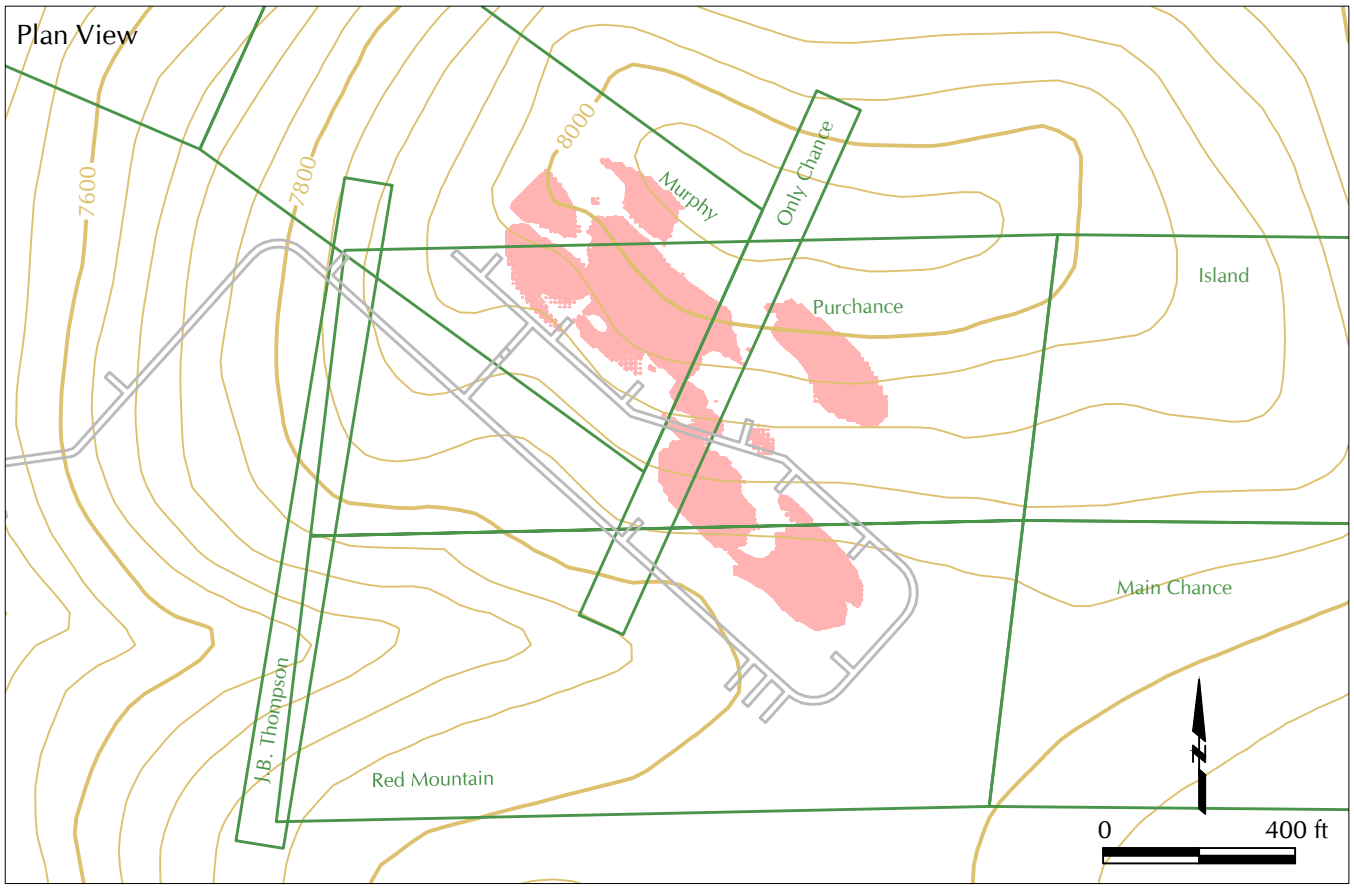
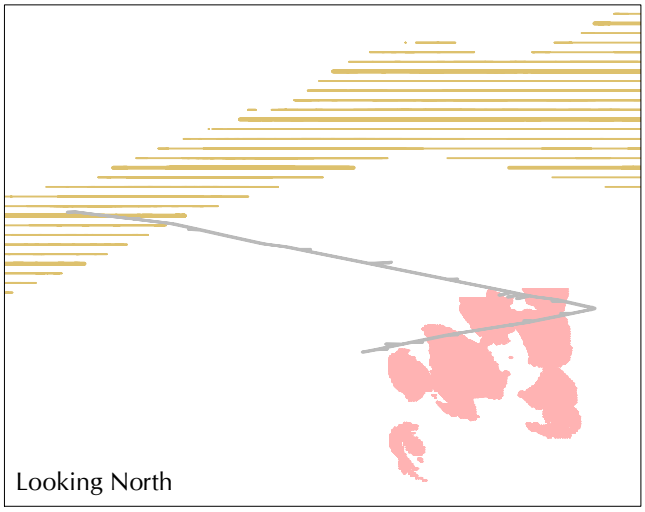


Figure 6	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
Timberline Resources Corporation	DRAWN: Jasper GeoGraphics	
	Butte Highlands Project **Wash Pad/Diesel Storage/Lube Area Facility** Silver Bow County, Montana	



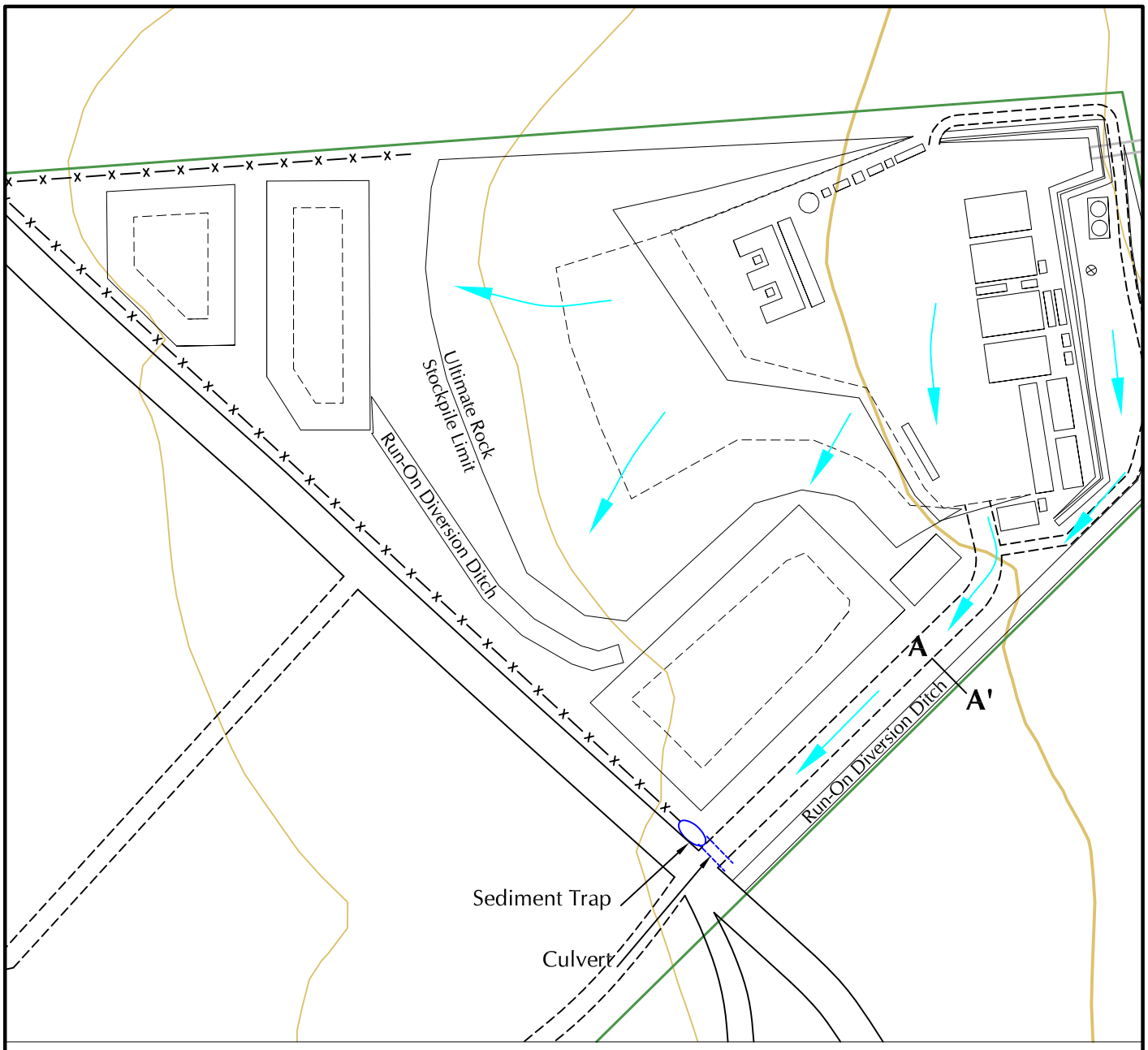


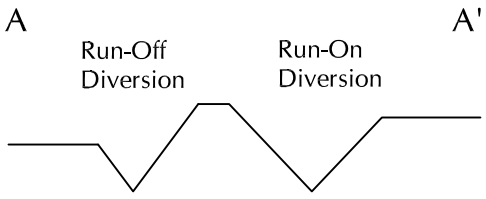
0 800 ft

Explanation

- Claim Boundaries
- Ore Zones
- Underground Workings

Figure 7	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Ore Zone Map** Silver Bow County, Montana	





Typical Arrangement
(Not to Scale)

Explanation

Pony Placer Claim

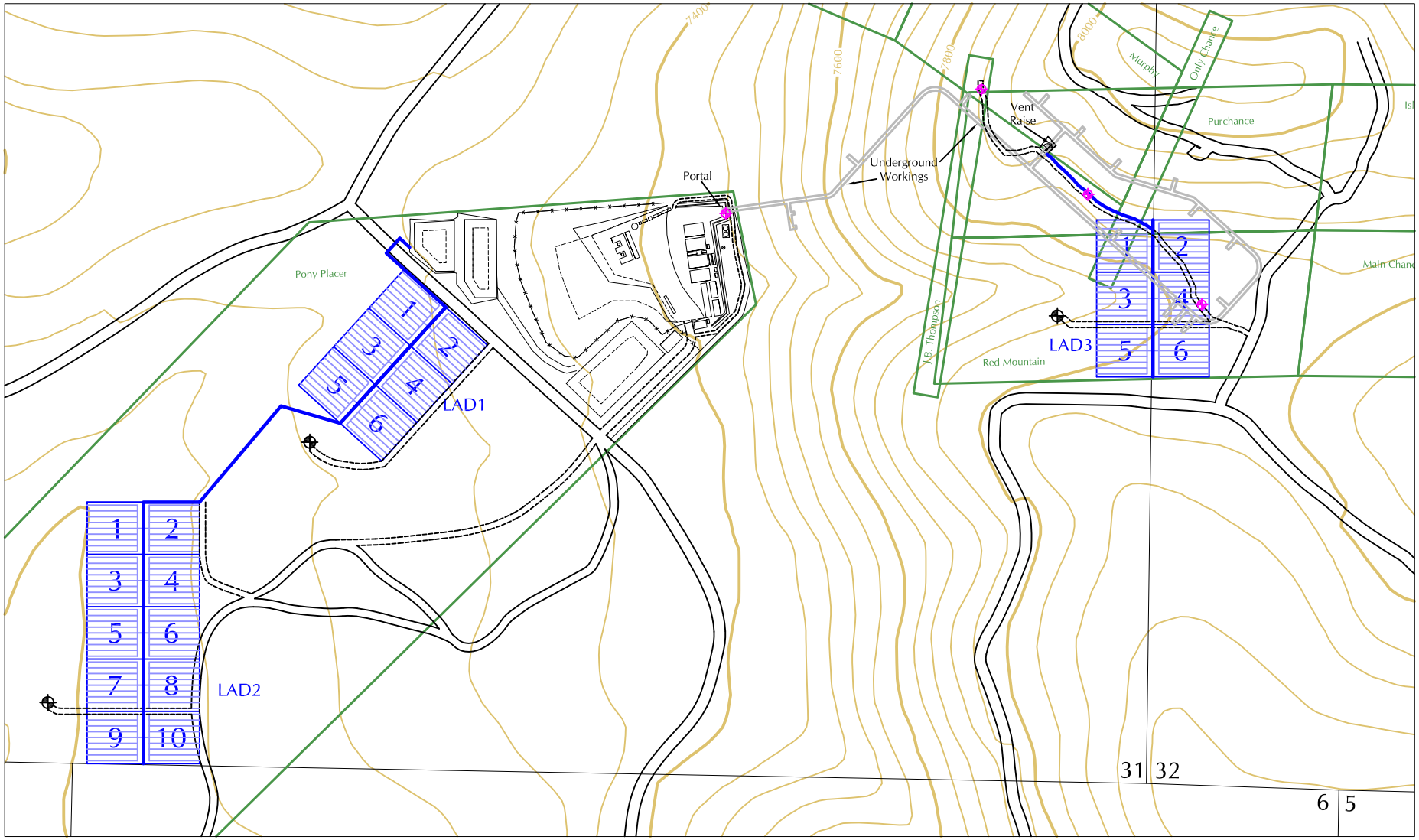
Stormwater Flow Direction

Sediment Fence

N

0 200 ft

Figure 8	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline RESOURCES CORPORATION	Butte Highlands Project **Stormwater Management Plan** Silver Bow County, Montana	



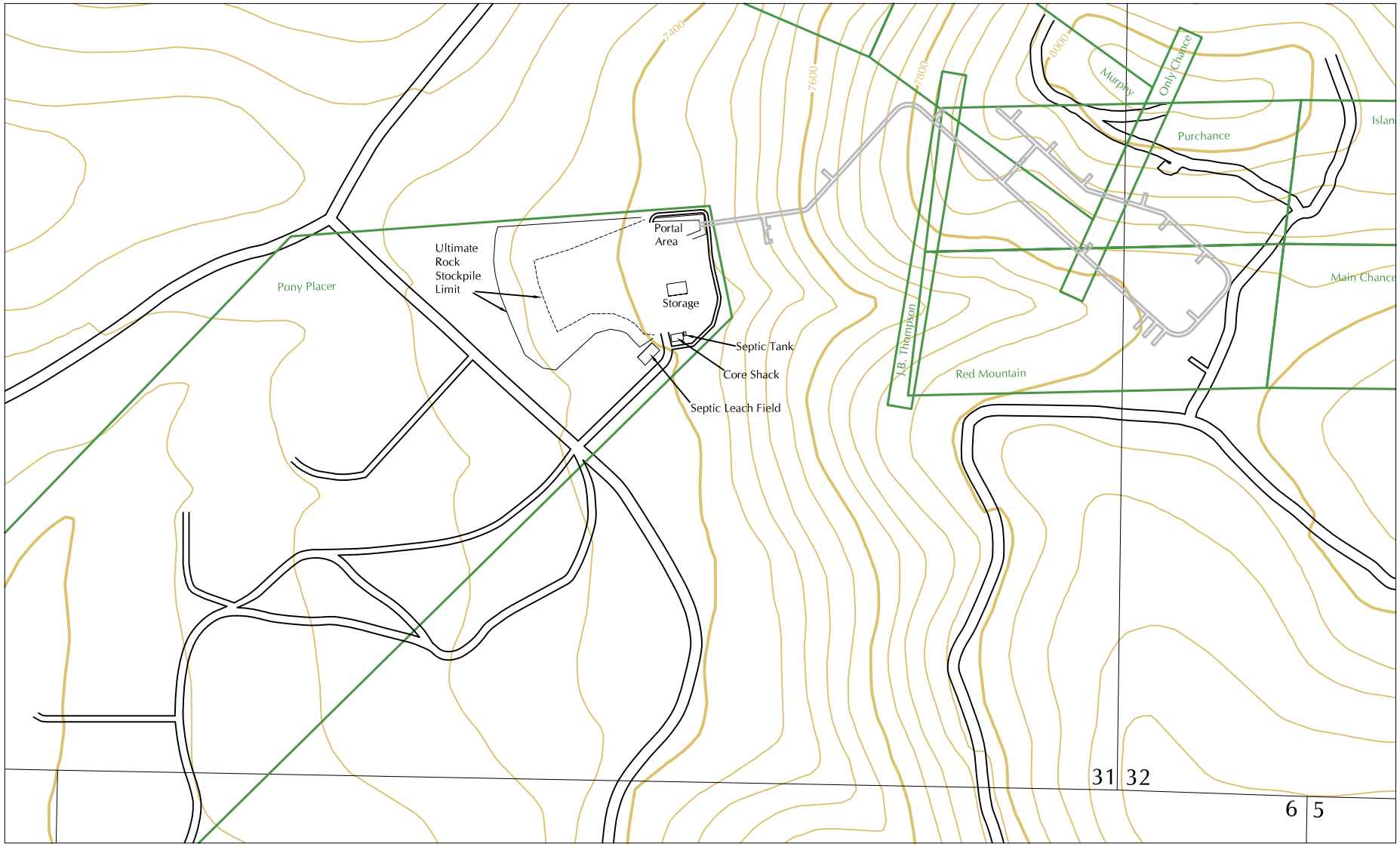
Explanation

- Claim Boundaries
- Monitoring Well
- "Hydro" Holes
- Proposed Road
- LAD cell with lateral drip lines
- Main Distribution Line

N

0 600 ft

Figure 9	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
Timberline RESOURCES CORPORATION	DRAWN: Jasper GeoGraphics	
	Butte Highlands Project **Proposed Monitoring Well & LAD Location Map** Silver Bow County, Montana	

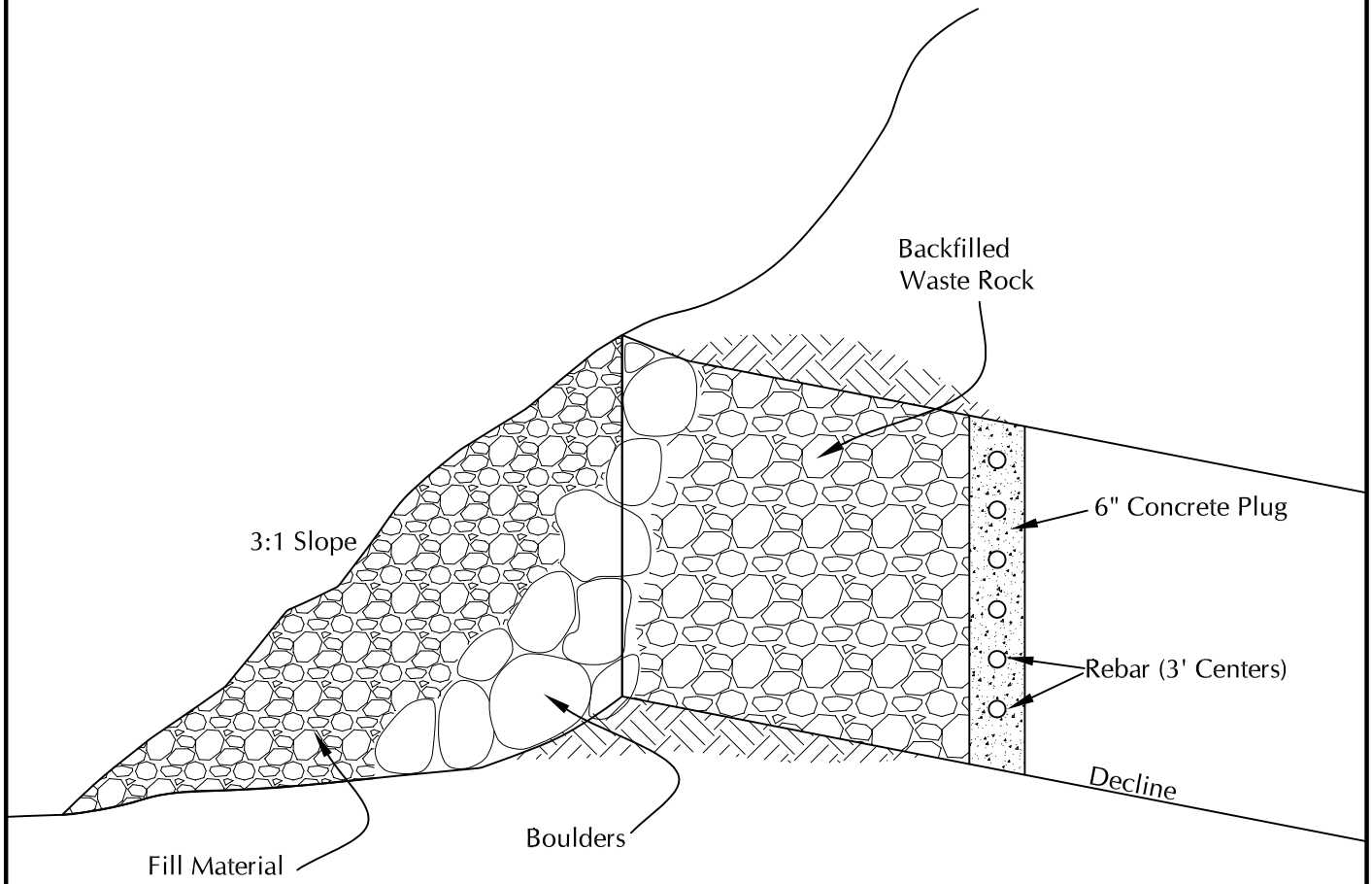


Explanation

Claim Boundaries

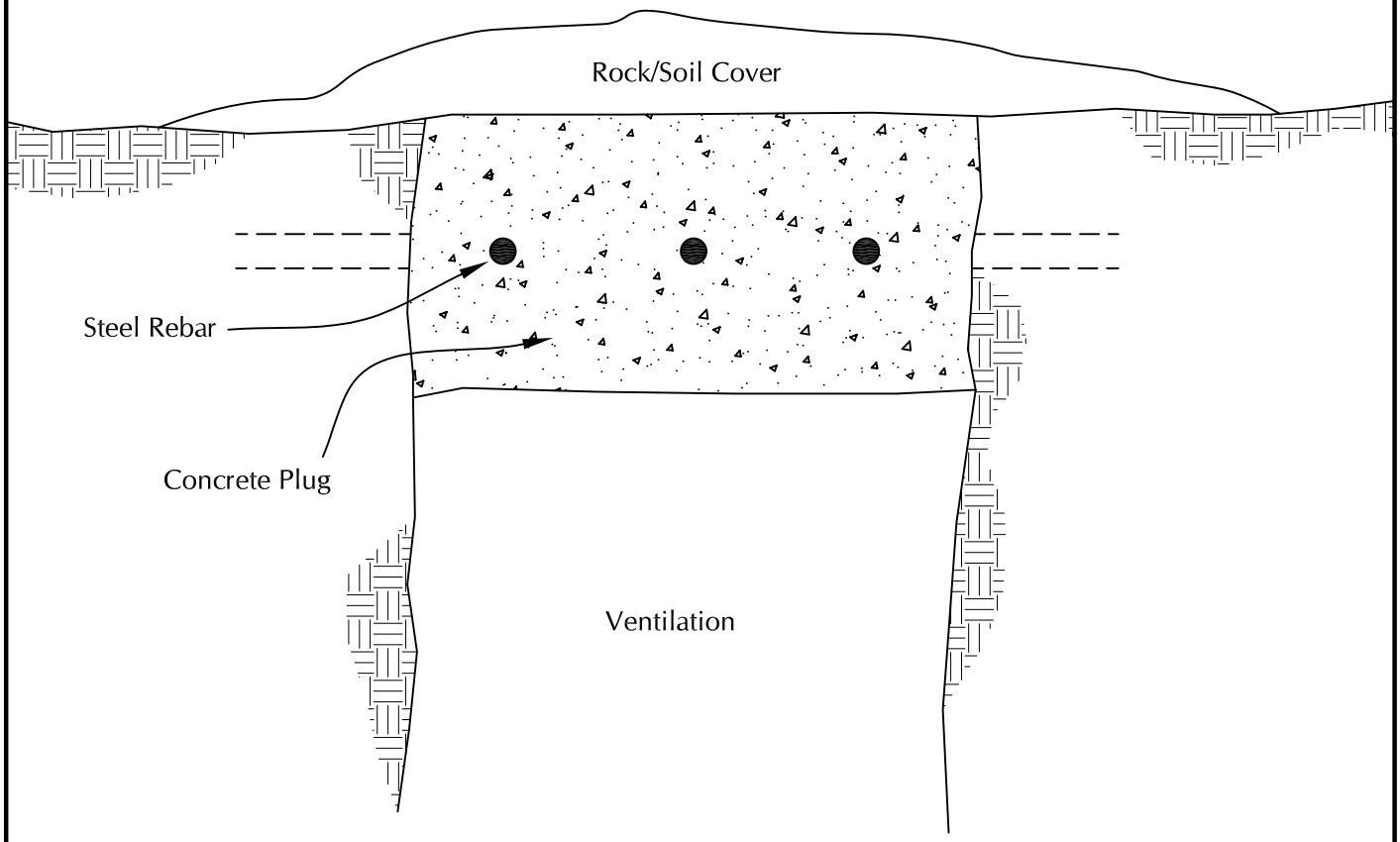
0 600 ft

Figure 10	Amended Exploration Plan
Klepfer Mining Services	DATE: August 2009 / SCALE: As Shown
Timberline RESOURCES CORPORATION	DRAWN: Jasper GeoGraphics
	Butte Highlands Project
	Reclamation Plan
	Silver Bow County, Montana



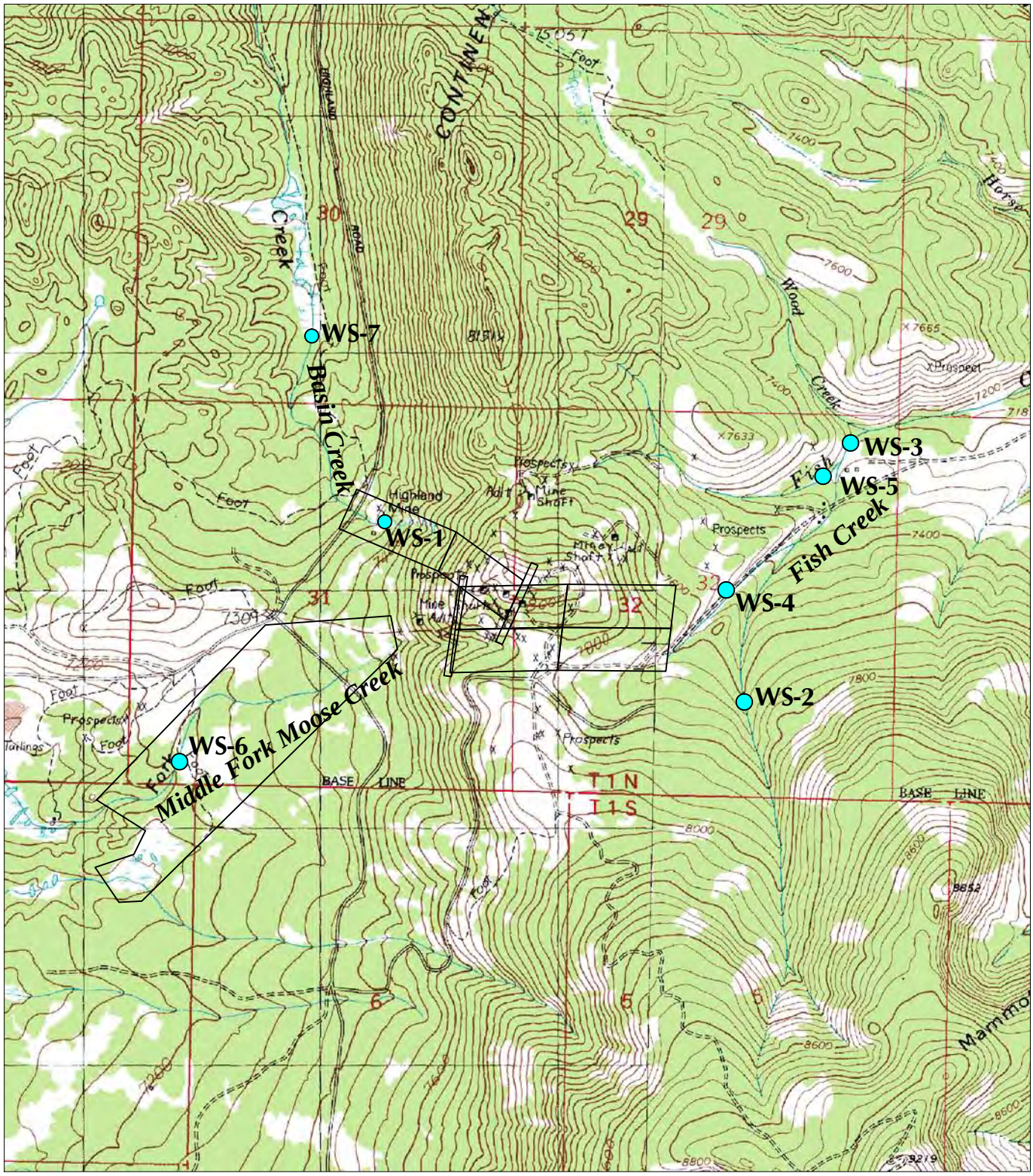
Not to Scale - For representation only

Figure 11	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
Timberline RESOURCES CORPORATION	DRAWN: Jasper GeoGraphics	
	Butte Highlands Project **Typical Portal Closure & Plug** Silver Bow County, Montana	



Not to Scale

Figure 12	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
Timberline RESOURCES CORPORATION	DRAWN: Jasper GeoGraphics	
	Butte Highlands Project **Reclamation Closure Plan** **Cross Section (typ.) Ventilation Raise** Silver Bow County, Montana	



Map Source: USGS 7.5 minute Topographic Maps: Mt. Humbug and Pipestone Pass, Montana (1996)

Surface Water Sample Location

Patented Claims

0 2000 feet

Figure 13	Amended Exploration Plan	
Klepfer Mining Services	DATE: August 2009	SCALE: As Shown
	DRAWN: Jasper GeoGraphics	
Timberline Resources Corporation	Butte Highlands Project **Surface Monitoring Sites** Silver Bow County, Montana	

Figure 14-1

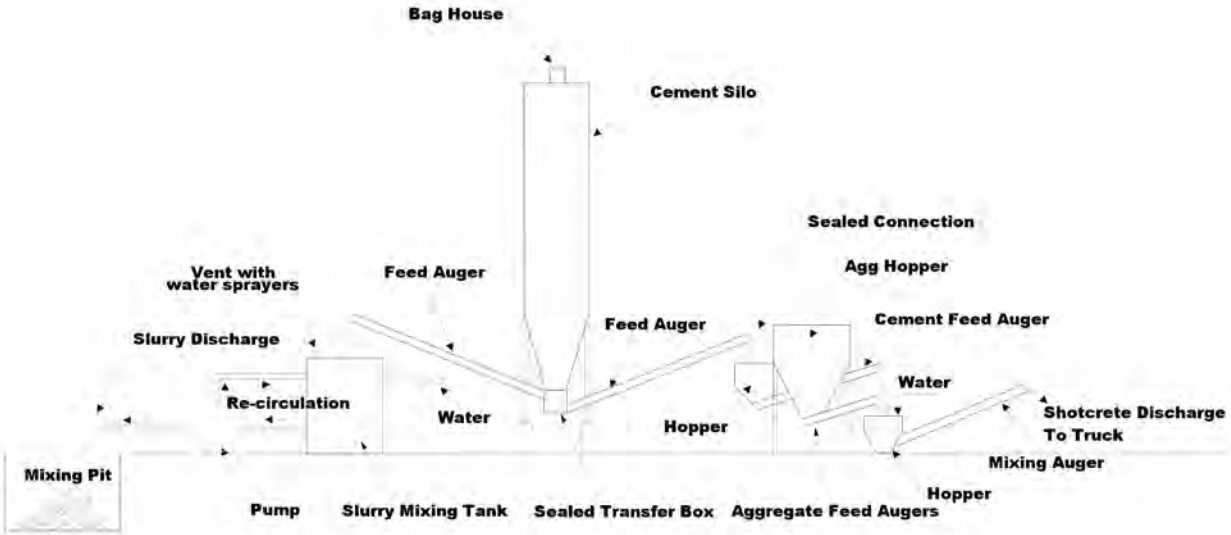
Cement Slurry Plant – Contained within a 20' Conex

Portable Cement Silo

Figure 14-2

Portable Shotcrete Plant

Figure 14-3


Bag House
Cement Silo
Sealed Connection
Agg Hopper
Vent with water sprayers
Feed Auger
Feed Auger
Cement Feed Auger
Slurry Discharge
Water
Re-circulation
Water
Hopper
Shotcrete Discharge To Truck
Mixing Auger
Mixing Pit
Hopper
Pump
Slurry Mixing Tank
Sealed Transfer Box
Aggregate Feed Augers

Appendix A
Hydrogeologic Characterization Report
Butte Highlands Mine Project

See Original Exploration Plan
Submitted in April 2009

Appendix B
Geologic and Sulfide Characteristics of Butte Highlands Project Lithologies

See Original Exploration Plan
Submitted in April 2009

Appendix C
MSDS Sheets

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Chevron Delo 6170 CFO

Product Use: Engine Oil
Product Number(s): CPS235068, CPS235069
Synonyms: Chevron Delo 6170 CFO SAE 40, Chevron Diesel Engine Oil Delo® 6170CFO SAE 20W-40
Company Identification
Chevron Products Company
Chevron Global Lubricants
6001 Bollinger Canyon Rd.
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@chevron.com
Product Information: (800) LUBE TEK
MSDS Requests: (800) 414-6737

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Highly refined mineral oil (C15 - C50)	Mixture	80 - 100 %wt/wt

SECTION 3 HAZARDS IDENTIFICATION

IMMEDIATE HEALTH EFFECTS
Eye: Not expected to cause prolonged or significant eye irritation.
Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Not expected to be harmful if swallowed.
Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and

flush eyes with water.
Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.
Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Cleveland Open Cup) 224 °C (435 °F) (Min)
Autoignition: No Data Available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO_2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR

1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use in a well-ventilated area.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: Nitrile Rubber, Silver Shield, Viton, 4H (PE/EVAL).
Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge. Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Brown
Physical State: Liquid
Odor: Petroleum odor
pH: Not Applicable
Vapor Pressure: <0.01 mmHg @ 37.8 °C (100 °F)
Vapor Density (Air = 1): >1
Boiling Point: >315°C (599°F)
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Specific Gravity: 0.88 - 0.9 @ 15.6°C (60.1°F) / 15.6°C (60.1°F)
Density: 0.8872 kg/l @ 15°C (59°F) (Min)
Viscosity: 14.4 cSt @ 100°C (212°F) (Min)
Evaporation Rate: No Data Available

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: The skin sensitization hazard is based on evaluation of data for similar materials or product components.
Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for similar materials or product components.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B). These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3). During use in engines, contamination of oil with low levels of cancer-causing combustion products occurs. Used motor oils have been shown to cause skin cancer in mice following repeated application and continuous exposure. Brief or intermittent skin contact with used motor oil is not expected to have serious effects in humans if the oil is thoroughly removed by washing with soap and water.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
The toxicity of this material to aquatic organisms has not been evaluated. Consequently, this material should be kept out of sewage and drainage systems and all bodies of water.

ENVIRONMENTAL FATE
Ready Biodegradability: This material is not expected to be readily biodegradable.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: PETROLEUM LUBRICATING OIL, NOT REGULATED AS A HAZARDOUS MATERIAL FOR TRANSPORTATION UNDER 49 CFR
Additional Information:NOT HAZARDOUS BY U.S. DOT. ADR/RID HAZARD CLASS NOT APPLICABLE.

IMO/IMDG Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO TI OR IATA DGR

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES: 1. Immediate (Acute) Health Effects: NO
2. Delayed (Chronic) Health Effects: NO
3. Fire Hazard: NO
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK
	07=PA RTK

No components of this material were found on the regulatory lists above.

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AICS (Australia), DSL (Canada), EINECS (European Union), ENCS (Japan), IECSC (China), KECI (Korea), PICCS (Philippines), TSCA (United States).

NEW JERSEY RTK CLASSIFICATION:
Refer to components listed in Section 2. Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: PETROLEUM OIL (Motor oil)

WHMIS CLASSIFICATION:
This product is not considered a controlled product according to the criteria of the Canadian Controlled Products Regulations.

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 1 Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

LABEL RECOMMENDATION:
Label Category : ENGINE OIL 1 - ENG1

REVISION STATEMENT: This revision updates the following sections of this Material Safety Data Sheet: 1,
Revision Date: December 28, 2007

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - Chevron	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Energy Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Chevron Delo® Synthetic Gear Lubricant SAE 75W-90

Product Use: Gear Lubricant
Product Number(s): CPS236100
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Road
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@Chevron.com
Product Information: (800) LUBE TEK
MSDS Requests: (800) 414-6737

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Distillates, hydrotreated heavy paraffinic	64742-54-7	75 - 100 %weight

SECTION 3 HAZARDS IDENTIFICATION

IMMEDIATE HEALTH EFFECTS
Eye: Not expected to cause prolonged or significant eye irritation.
Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Not expected to be harmful if swallowed.
Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.

Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.
Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.

SECTION 5 FIRE FIGHTING MEASURES

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

NFPA RATINGS: Health: 1 Flammability: 1 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Cleveland Open Cup) 204 °C (400 °F) Minimum
Autoignition: No Data Available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO_2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: Keep out of the reach of children.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77,

'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use in a well-ventilated area.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: 4H (PE/EVAL), Nitrile Rubber, Silver Shield, Viton.
Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge. Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.
Occupational Exposure Limits:

Component	Agency	TWA	STEL	Ceiling	Notation
Distillates, hydrotreated heavy paraffinic	ACGIH	5 mg/m3	10 mg/m3	--	--
Distillates, hydrotreated heavy paraffinic	OSHA Z-1	5 mg/m3	--	--	--

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Amber
Physical State: Liquid
Odor: Pungent
pH: Not Applicable
Vapor Pressure: <0.01 mmHg @ 37.8 °C (100 °F)
Vapor Density (Air = 1): >1
Boiling Point: >315°C (599°F)
Solubility: Soluble in hydrocarbons; insoluble in water

Freezing Point: Not Applicable
Specific Gravity: 0.89 @ 15.6°C (60.1°F)
Viscosity: 15 cSt @ 100°C (212°F) Minimum
Evaporation Rate: No Data Available

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: The skin sensitization hazard is based on evaluation of data for similar materials or product components.
Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for similar materials or product components.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B). These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3).

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
The toxicity of this material to aquatic organisms has not been evaluated. Consequently, this material should be kept out of sewage and drainage systems and all bodies of water.

ENVIRONMENTAL FATE
Ready Biodegradability: This material is not expected to be readily biodegradable. The biodegradability of this material is based on an evaluation of data for the components or a similar material.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: PETROLEUM LUBRICATING OIL, NOT REGULATED AS A HAZARDOUS MATERIAL FOR TRANSPORTATION UNDER 49 CFR
Additional Information:NOT HAZARDOUS BY U.S. DOT. ADR/RID HAZARD CLASS NOT APPLICABLE.

IMO/IMDG Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES: 1. Immediate (Acute) Health Effects: NO
2. Delayed (Chronic) Health Effects: NO
3. Fire Hazard: NO
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK
	07=PA RTK

No components of this material were found on the regulatory lists above.

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: EINECS (European Union), IECSC (China), TSCA (United States).

AICS (Australia), DSL (Canada), ENCS (Japan), KECI (Korea), PICCS (Philippines).

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: (Gear oil)

WHMIS CLASSIFICATION:
This product is not considered a controlled product according to the criteria of the Canadian Controlled Products Regulations.

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 1 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 1 Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

LABEL RECOMMENDATION:
Label Category : INDUSTRIAL OIL 1 - IND1

REVISION STATEMENT: This is a new Material Safety Data Sheet.
Revision Date: February 16, 2007

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - Chevron	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Energy Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Chevron Delo® Trans Fluid ESI

Product Number(s): CPS235062
Company Identification
Chevron Products Company
a division of Chevron U.S.A. Inc.
6001 Bollinger Canyon Road
San Ramon, CA 94583
United States of America
www.chevronlubricants.com

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
email : lubemsds@Chevron.com
Product Information: (800) LUBE TEK
MSDS Requests: (800) 414-6737

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Highly refined mineral oil (C15 - C50)	Mixture	80 - 100 %weight

SECTION 3 HAZARDS IDENTIFICATION

IMMEDIATE HEALTH EFFECTS
Eye: Not expected to cause prolonged or significant eye irritation.
Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Not expected to be harmful to internal organs if absorbed through the skin. High-Pressure Equipment Information: Accidental high-velocity injection under the skin of materials of this type may result in serious injury. Seek medical attention at once should an accident like this occur. The initial wound at the injection site may not appear to be serious at first; but, if left untreated, could result in disfigurement or amputation of the affected part.

Ingestion: Not expected to be harmful if swallowed.
Inhalation: Not expected to be harmful if inhaled. Contains a petroleum-based mineral oil. May cause respiratory irritation or other pulmonary effects following prolonged or repeated inhalation of oil mist at airborne levels above the recommended mineral oil mist exposure limit. Symptoms of respiratory irritation may include coughing and difficulty breathing.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and

flush eyes with water.
Skin: No specific first aid measures are required. As a precaution, remove clothing and shoes if contaminated. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: No specific first aid measures are required. Do not induce vomiting. As a precaution, get medical advice.
Inhalation: No specific first aid measures are required. If exposed to excessive levels of material in the air, move the exposed person to fresh air. Get medical attention if coughing or respiratory discomfort occurs.
Note to Physicians: In an accident involving high-pressure equipment, this product may be injected under the skin. Such an accident may result in a small, sometimes bloodless, puncture wound. However, because of its driving force, material injected into a fingertip can be deposited into the palm of the hand. Within 24 hours, there is usually a great deal of swelling, discoloration, and intense throbbing pain. Immediate treatment at a surgical emergency center is recommended.

SECTION 5 FIRE FIGHTING MEASURES

Leaks/ruptures in high pressure system using materials of this type can create a fire hazard when in the vicinity of ignition sources (eg. open flame, pilot lights, sparks, or electric arcs).

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Cleveland Open Cup) 170 °C (338 °F) (Min)
Autoignition: No Data Available
Flammability (Explosive) Limits (% by volume in air): Lower: Not Applicable Upper: Not Applicable

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO_2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: DO NOT USE IN HIGH PRESSURE SYSTEMS in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed.
Keep out of the reach of children.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
Use in a well-ventilated area.

PERSONAL PROTECTIVE EQUIPMENT
Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances in the workplace. Suggested materials for protective gloves include: 4H (PE/EVAL), Nitrile Rubber, Silver Shield, Viton.
Respiratory Protection: No respiratory protection is normally required.
If user operations generate an oil mist, determine if airborne concentrations are below the occupational exposure limit for mineral oil mist. If not, wear an approved respirator that provides adequate protection from the measured concentrations of this material. For air-purifying respirators use a particulate cartridge. Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.
Occupational Exposure Limits:

Component	Agency	TWA	STEL	Ceiling	Notation
Highly refined mineral oil (C15 - C50)	ACGIH	5 mg/m3	10 mg/m3	--	--
Highly refined mineral oil (C15 - C50)	OSHA Z-1	5 mg/m3	--	--	--

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Brown
Physical State: Liquid
Odor: Petroleum odor
pH: Not Applicable
Vapor Pressure: <0.01 mmHg @ 37.8 °C (100 °F)
Vapor Density (Air = 1): >1
Boiling Point: >315.6°C (600°F)
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: Not Applicable
Specific Gravity: 0.89 @ 15.6°C (60.1°F) / 15.6°C (60.1°F)
Density: 0.88 kg/l - 0.91 kg/l @ 15°C (59°F)
Viscosity: 14 cSt @ 100°C (212°F) (Min)
Evaporation Rate: No Data Available

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: No product toxicology data available.
Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for similar materials or product components.

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains petroleum base oils which may be refined by various processes including severe solvent extraction, severe hydrocracking, or severe hydrotreating. None of the oils requires a cancer warning under the OSHA Hazard Communication Standard (29 CFR 1910.1200). These oils have not been listed in the National Toxicology Program (NTP) Annual Report nor have they been classified by the International Agency for Research on Cancer (IARC) as; carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B). These oils have not been classified by the American Conference of Governmental Industrial Hygienists (ACGIH) as: confirmed human carcinogen (A1), suspected human carcinogen (A2), or confirmed animal carcinogen with unknown relevance to humans (A3).

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
The toxicity of this material to aquatic organisms has not been evaluated. Consequently, this material should be kept out of sewage and drainage systems and all bodies of water.

ENVIRONMENTAL FATE
This material is not expected to be readily biodegradable.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. Oil collection services are available for used oil recycling or disposal. Place contaminated materials in containers and dispose of in a manner consistent with applicable regulations. Contact your sales representative or local environmental or health authorities for approved disposal or recycling methods.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: PETROLEUM LUBRICATING OIL, NOT REGULATED AS A HAZARDOUS MATERIAL FOR TRANSPORTATION UNDER 49 CFR
Additional Information:NOT HAZARDOUS BY U.S. DOT. ADR/RID HAZARD CLASS NOT APPLICABLE.

IMO/IMDG Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER THE IMDG CODE

ICAO/IATA Shipping Description: PETROLEUM LUBRICATING OIL; NOT REGULATED AS DANGEROUS GOODS FOR TRANSPORT UNDER ICAO

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES: 1. Immediate (Acute) Health Effects: NO
2. Delayed (Chronic) Health Effects: NO
3. Fire Hazard: NO
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK
	07=PA RTK

No components of this material were found on the regulatory lists above.

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: ENCS (Japan), IECSC (China), TSCA (United States).

One or more components is listed on ELINCS (European Union). Secondary notification by the importer may be required.

One or more components does not comply with the following chemical inventory requirements: AICS (Australia), DSL (Canada), KECI (Korea), PICCS (Philippines).

NEW JERSEY RTK CLASSIFICATION:
Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: PETROLEUM OIL (Automatic transmission fluid)

WHMIS CLASSIFICATION:
This product is not considered a controlled product according to the criteria of the Canadian Controlled Products Regulations.

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 1 Reactivity: 0

HMIS RATINGS: Health: 1 Flammability: 1 Reactivity: 0
(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

LABEL RECOMMENDATION:
Label Category : INDUSTRIAL OIL 1 - IND1

REVISION STATEMENT: This revision updates the following sections of this Material Safety Data Sheet: 15
Revision Date: August 31, 2006

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit
	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - Chevron	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Energy Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Protect eyes from misting or spraying material.
Protect exposed skin from repeated or prolonged exposure.
Do not store material in open or unmarked containers.
Spills may create a slipping hazard.
0
1
Health Hazard 1
Fire Hazard
Protective Equipment

Material Safety Data Sheet

Trade Name
Synonyms
Product Family
MSDS No.

CITGO Rock Drill Oil 320

Pneumatic tool oil;
CITGO® Material Code: 633217001
CITGO Rock Drill Oil 320
Mixture.
633217001

SECTION 1. PRODUCT IDENTIFICATION

Product Number
CAS Number
633217001
Revision Date 9/27/2007
Industrial oil
Reactivity
HMIS
*** = Chronic Health Hazard**
CITGO Petroleum Corporation
P.O. Box 4689
Houston, TX 77210
0
1
0

Hazard Rankings

IMPORTANT: This MSDS is prepared in accordance with 29 CFR 1910.1200. Read this MSDS before transporting, handling, storing or disposing of this product and forward this information to employees, customers and users of this product.
CHEMTREC Emergency
(United States Only)
(800) 424-9300

Emergency Overview

Technical Contact
Medical Emergency
NFPA
Color
Physical State Liquid.
Amber to dark amber **Odor** Mild petroleum odor
(800) 248-4684
(832) 486-4700
Minimum Recommended
See Section 8 for Details

SECTION 2. COMPOSITION

Component Name(s)

Residual oils, petroleum, solvent-refined 64742-01-4 60 - 80
Distillates, petroleum, solvent-refined heavy paraffinic 64741-88-4 10 - 30
Distillates, petroleum, solvent-refined light paraffinic 64741-89-5 <5
Distillates, petroleum, hydrotreated light paraffinic 64742-55-8 <5
Proprietary Ingredients Proprietary Mixture <5
Sulfurized olefin 68511-50-2 AP 1

CAS Registry No. Concentration (%)

SECTION 3. HAZARDS IDENTIFICATION

Also see Emergency Overview and Hazard Ratings on the top of Page 1 of this MSDS.

Signs and Symptoms of Acute Exposure

Inhalation

Eye Contact

At elevated temperatures or in enclosed spaces, product mist or vapors may irritate the mucous membranes of the nose, the throat, bronchi, and lungs.
This product can cause transient mild eye irritation with short-term contact with liquid sprays or mists. Symptoms include stinging, watering, redness, and swelling.

Major Route(s) of Entry Skin contact.

Chronic Health Effects

Summary

This product contains a petroleum-based mineral oil. Prolonged or repeated skin contact can cause mild irritation and inflammation characterized by drying, cracking, (dermatitis) or oil acne. Repeated or prolonged inhalation of petroleum-based mineral oil mists at concentrations above applicable workplace exposure levels can cause respiratory irritation or other pulmonary effects.

Skin Contact

Ingestion

This material can cause mild skin irritation from prolonged or repeated skin contact.
Injection under the skin can cause inflammation and swelling. Injection of pressurized hydrocarbons can cause severe, permanent tissue damage. Initial symptoms may be minor. Injection of petroleum hydrocarbons requires immediate medical attention.

Target Organs May cause damage to the following organs: skin.

Carcinogenic Potential

Conditions Aggravated by Exposure

Disorders of the following organs or organ systems that may be aggravated by significant exposure to this material or its components include: Skin
If swallowed, large volumes of material can cause generalized depression, headache, drowsiness, nausea, vomiting and diarrhea. Smaller doses can cause a laxative effect.
This product is not known to contain any components at concentrations above 0.1% which are considered carcinogenic by OSHA, IARC or NTP.

OSHA Health Hazard Classification OSHA Physical Hazard Classification
Irritant Sensitizer
Corrosive
Toxic Highly Toxic
Carcinogenic
Combustible
Flammable
Compressed Gas
Explosive
Organic Peroxide
Water-reactive
Pyrophoric

Oxidizer
Unstable

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present,
the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR
1910.1200).

Eye Contact
Skin Contact
Inhalation
Ingestion
Notes to Physician

Check for and remove contact lenses. Flush eyes with cool, clean, low-pressure water while occasionally lifting and lowering eyelids. Seek medical attention if excessive tearing, redness, or pain persists.

If burned by hot material, cool skin by quenching with large amounts of cool water. For contact with product at ambient temperatures, remove contaminated shoes and clothing. Wipe off excess material. Wash exposed skin with mild soap and water. Seek medical attention if tissue appears damaged or if pain or irritation persists. Thoroughly clean contaminated clothing before reuse. Clean or discard contaminated leather goods. If material is injected under the skin, seek medical attention immediately.

Move victim to fresh air. If victim is not breathing, immediately begin rescue breathing. If breathing is difficult, 100 percent humidified oxygen should be administered by a qualified individual. Seek medical attention immediately. Keep the affected individual warm and at rest.

Do not induce vomiting unless directed to by a physician. Do not give anything to drink unless directed to by a physician. Never give anything by mouth to a person who is not fully conscious. If significant amounts are swallowed or irritation or discomfort occurs, seek medical attention immediately.

SECTION 4. FIRST AID MEASURES

INGESTION: The viscosity range of the product(s) represented by this MSDS is greater than 100 SUS at 100°F. There is a low risk of aspiration upon ingestion Careful gastric lavage or emesis may be considered to evacuate large quantities of material.

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid.

For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

NFPA Flammability
Classification
Autoignition
Temperature
Hazardous Combustion
Products
Flash Point
Extinguishing Media
Lower Flammable Limit
Protection of Fire
Fighters

Not available.

NFPA Class-IIIB combustible material.

Carbon dioxide, carbon monoxide, smoke, fumes, unburned hydrocarbons and trace oxides of sulfur and/or nitrogen.

Closed cup: 200°C (392°F). (Pensky-Martens.) Open cup: 260°C (500°F) (Cleveland.).
No data.
Use dry chemical, foam, carbon dioxide or water fog. Water or foam may cause frothing. Carbon dioxide and inert gas can displace oxygen. Use caution when applying carbon dioxide or inert gas in confined spaces.
Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.
This material will release vapors when heated above the flash point temperature that can ignite when exposed to a source of ignition. In enclosed spaces, vapors can ignite with explosive force. Mists or sprays may burn at temperatures below the flash point.
Special Properties

SECTION 5. FIRE FIGHTING MEASURES

Upper Flammable Limit No data.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Do not touch damaged containers or spilled material unless wearing appropriate protective equipment. Slipping hazard; do not walk through spilled material. Stop leak if you can do so without risk. For small spills, absorb or cover with dry earth, sand, or other inert non-combustible absorbent material and place into waste containers for later disposal. Contain large spills to maximize product recovery or disposal. Prevent entry into waterways or sewers. In urban area, cleanup spill as soon as possible. In natural environments, seek cleanup advice from specialists to minimize physical habitat damage. This material will float on water. Absorbent pads and similar materials can be used. Comply with all laws and regulations.
Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For
more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal
Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.
Storage Keep container closed. Store in a cool, dry, well-ventilated area. Do not store with strong oxidizing agents. Do not store at elevated temperatures. Avoid storing product in direct sunlight for extended periods of time. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers or waste residues of this product.
Avoid contamination and extreme temperatures to minimize product degradation. Empty containers may contain product residues that can ignite with explosive force. Do not pressurize, cut, weld, braze solder, drill, grind or expose containers to flames, sparks, heat or other potential ignition sources. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product.
Handling

SECTION 7. HANDLING AND STORAGE

Engineering Controls
Personal Protective
Equipment
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of mists and/or vapors below the recommended exposure limits (see below). An eye wash station and safety shower should be located near the work-station.
Occupational Exposure Guidelines

SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Safety glasses equipped with side shields are recommended as minimum protection in industrial settings. Wear goggles if splashing or spraying is anticipated. Wear goggles and face shield if material is heated above 125°F (51°C). Have suitable eye wash water available.

None required for incidental contact. Use gloves constructed of chemical resistant materials such as heavy nitrile rubber if frequent or prolonged contact is expected. Use heat-protective gloves when handling product at elevated temperatures.

If elevated airborne concentrations above applicable workplace exposure levels are anticipated, a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter should be used. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134).

Eye Protection

Respiratory Protection

Use good personal hygiene practices. Wash hands and other exposed skin areas with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities, or leaving work. DO NOT use gasoline, kerosene, solvents or harsh abrasives as skin cleaners. Since specific exposure standards/control limits have not been established for this product, the "Oil Mist, Mineral" exposure limits shown below are suggested as minimum control guidelines.

General Comments

Use clean protective clothing if splashing or spraying conditions are present. Protective clothing may include long-sleeve outer garment, apron, or lab coat. If significant contact occurs, remove oil-contaminated clothing as soon as possible and promptly shower. Launder contaminated clothing before reuse or discard. Wear heat protective boots and protective clothing when handling material at elevated temperatures.

Hand Protection

Body Protection

Substance Applicable Workplace Exposure Levels

Oil Mist, Mineral **ACGIH (United States).**

TWA: 5 mg/m $_3$ 8 hour(s).

STEL: 10 mg/m$_3$ 15 minute(s).

OSHA (United States).

TWA: 5 mg/m $_3$ 8 hour(s).

Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required.

Not available.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES (TYPICAL)

Melting/Freezing

Point

Boiling Range

Specific Gravity Vapor

Density

Not available.

0.9 (Water = 1) >1 (Air = 1)

Physical State Liquid. **Color** Amber to dark amber

Odor Mild petroleum odor

pH Not Applicable.

Vapor Pressure Volatility

Solubility in
Water
<0.001 kPa (<0.01 mm Hg) (at 20°C) Negligible volatility.
Insoluble in cold water.
Additional
Properties
Gravity, ºAPI (ASTM D287) = 26.4 @ 60º F
Density = 7.46 Lbs/gal.
Viscosity (ASTM D2161) = 1738 SUS @ 100º F
Viscosity 328
(cSt @ 40°C)
Flash Point Closed cup: 200°C (392°F). (Pensky-Martens.) Open cup: 260°C (500°F) (Cleveland.).
Conditions to Avoid
Chemical Stability
Hazardous
Decomposition
Products
Stable.
No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS.

SECTION 10. STABILITY AND REACTIVITY

Keep away from extreme heat, sparks, open flame, and strongly oxidizing conditions.
Materials
Incompatibility
Hazardous Polymerization Not expected to occur.
Oxidizing materials.

SECTION 11. TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 and the Hazards Identification
in Section 3 of this MSDS.
Toxicity Data Distillates, petroleum, solvent-refined heavy paraffin:**ic**
ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].
Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested. Analyses conducted by method IP 346 indicate that the concentration of DMSO extractables in this mineral oil is below 3.0 weight percent.
Residual oils, petroleum, solvent-refined:
ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].
Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.
Distillates, petroleum, solvent-refined light paraffini:**c**

ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].
Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high

concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested. Analyses conducted by method IP 346 indicate that the concentration of DMSO extractables in this mineral oil is below 3.0 weight percent.

Distillates, petroleum, hydrotreated light paraffini:c

ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].
Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.

SECTION 12. ECOLOGICAL INFORMATION

An environmental fate analysis is not available for this specific product. Plants and animals may experience harmful or fatal effects when coated with petroleum products.
Petroleum-based (mineral) lubricating oils normally will float on water. In stagnant or slow-flowing waterways, an oil layer can cover a large surface area. As a result, this oil layer might limit or eliminate natural atmospheric oxygen transport into the water. With time, if not removed, oxygen depletion in the waterway may be sufficient to cause a fish kill or create an anaerobic environment.
Analysis for ecological effects has not been conducted on this product. However, if spilled, this product and any contaminated soil or water may be harmful to human, animal, and aquatic life. Also, the coating action associated with petroleum and petroleum products can be harmful or fatal to aquatic life and waterfowl.

Ecotoxicity

Environmental Fate

SECTION 13. DISPOSAL CONSIDERATIONS

Conditions of use may cause this material to become a "hazardous waste", as defined by federal or state regulations. It is the responsibility of the user to determine if the material is a "hazardous waste" at the time of disposal. Transportation, treatment, storage, and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR 260 through 40 CFR 271). State and/or local regulations may be more restrictive. Contact your regional US EPA office for guidance concerning case specific disposal issues. Empty drums and pails retain residue. DO NOT pressurize, cut, weld, braze, solder, drill, grind, or expose this product's empty container to heat, flame, or other ignition sources. DO NOT attempt to clean it. Empty drums and pails should be drained completely, properly bunged or sealed, and promptly sent to a reconditioner.

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is
the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal
methodologies for spent materials and residues at the time of disposition.

SECTION 14. TRANSPORT INFORMATION

Not regulated.

Placard(s)

Proper Shipping Name Not regulated.

Packing Group Not applicable.

Reportable Quantity A Reportable Quantity (RQ) has not been established for this material.

Hazard Class

UN/NA Number Not regulated.

US DOT Status

MARPOL III Status

Emergency Response

Guide No.

Not a DOT "Marine
Pollutant" per 49 CFR
171.8.

Not applicable.

Not regulated by the U.S. Department of Transportation as a hazardous material.

The shipping description below may not represent requirements for all modes of transportation, shipping
methods or locations outside of the United States.

SECTION 15. REGULATORY INFORMATION

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. This product or refinery stream is not known to contain chemical substances subject to this statute. However, it is recommended that you contact state and local authorities to determine if there are any other reporting requirements in the event of a spill.

TSCA Inventory

SARA 302/304
Emergency Planning
and Notification

SARA 313 Toxic
Chemical Notification
and Release Reporting

CERCLA

California
Proposition 65

SARA 311/312 Hazard
Identification

The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories:

Clean Water Act
(CWA)

This product and/or its components are listed on the Toxic Substances Control Act (TSCA) inventory.

No SARA 311/312 hazard categories identified.

This product contains the following components in concentrations above *de minimis* levels

that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA: No components were identified.
This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.
The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified.

This material may contain the following components which are known to the State of California to cause cancer, birth defects or other reproductive harm, and may be subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5):
Toluene: 0.0006%
Ethyl acrylate: 0.0008%
Additional Remarks
New Jersey
Right-to-Know Label
No additional regulatory remarks.
Petroleum Oil

SECTION 16. OTHER INFORMATION

Revision Date
REVISION INFORMATION
Version Number
9/27/2007
2.1
THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE.
HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED
REGARDING ITS CORRECTNESS. SOME INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE
FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE SUBSTANCE ITSELF. THIS MSDS WAS PREPARED
AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE PRODUCT IS USED AS A COMPONENT IN ANOTHER
PRODUCT, THIS MSDS INFORMATION MAY NOT BE APPLICABLE. USERS SHOULD MAKE THEIR OWN
INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION OR PRODUCTS FOR THEIR
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THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE, AND DISPOSAL OF THE PRODUCT ARE
BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO
NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE
ARISING OUT OF OR IN ANY WAY CONNECTED WITH HANDLING, STORAGE, USE OR DISPOSAL OF THE
PRODUCT.
DISCLAIMER OF LIABILITY

ABBREVIATIONS

AP: Approximately EQ: Equal >: Greater Than <: Less Than NA: Not Applicable ND: No Data NE: Not Establishe
ACGIH: American Conference of Governmental Industrial Hygienists

* * * * * END OF MSDS * * * * *

IARC: International Agency for Research on Cancer
NIOSH: National Institute of Occupational Safety and Health

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

NPCA: National Paint and Coating Manufacturers Association
NFPA: National Fire Protection Association
AIHA: American Industrial Hygiene Association
NTP: National Toxicology Program
OSHA: Occupational Safety and Health Administration
HMIS: Hazardous Materials Information System
EPA: US Environmental Protection Agency

LUCAS MATERIAL SAFETY DATA SHEET
Lucas Universal Hydraulic Fluid Product Code: 10017, 10037, 10038
==========
DIVISION AND LOCATION --- SECTION I
==========
Division: Lucas Oil Products, Inc. • 302 North Sheridan Street • Corona, CA 92880-2067
Emergency Telephone Number: (800) 342-2512
==========
CHEMICAL AND PHYSICAL PROPERTIES --- SECTION II
==========
Chemical Name: Petroleum hydrocarbon plus additives.
Formula: Proprietary information
Hazardous Decomposition Products:
Oil mist - if generated, solvent dewaxed distillate, and heavy paraffin.
Toxic and Hazardous Ingredients: None
Odor: Petroleum Appearance: Liquid Color: Red
Specific Gravity @ 60°F: .8888
Specific Gravity of Vapor: @ 1 ATM (Air=1) Greater than air.
Boiling Point: > 500°F.
Melting Point: Not applicable.
Solubility in Water (by weight %: Negligible @ 25°C.
Stability: Product is stable under normal conditions of storage and handling.
Incompatibility: Avoid contact with acids and strong oxidizing agents.
Viscosity: cSt @ 100°C - Greater than or equal to 9.0.
==========
FIRE AND EXPLOSION DATA --- SECTION III
==========
Special Fire Fighting Procedures: Use dry chemical, foam or water spray.
Hazardous combustion products: Fumes, smoke and carbon monoxide. Toxic gases will form upon
combustion.
Flashpoint: (Method used) Cleveland open cup - 350 degrees F
Extinguishing agent: Dry chemical or Waterfog or CO 2 or Foam or Sand/Earth. Water may cause
frothing.
Closed containers exposed to fire may be cooled with water
==========.==========
HEALTH HAZARD DATA --- SECTION IV

==========
Chronic Effects of Over-Exposure: Harmful if inhaled - avoid breathing oil mist.
Acute Toxicological Properties: No data available
Emergency First Aid Procedures:
Eyes: Slightly irritating - flush with large amounts of water.
Skin: Prolonged or repeated contact may cause skin irritation/dermatitis. Immediately remove soiled clothing and wash skin with soap and water.
Inhalation: Remove exposed person to fresh air if adverse effects are observed.
If Swallowed: Do not induce vomiting - if conscious give two glasses of water and get medical attention.

==========
SPECIAL PROTECTION INFORMATION --- SECTION V
==========
Ventilation type required (local, mechanical, special): NONE
Respiratory protection (specify type): NONE
Protective gloves: None
Eye protection: Chemical safety goggles and, if handled hot, full face shield
Other protective equipment: None
==========
HANDLING OF SPILLS OF LEAKS --- SECTION VI
==========
Spill Control Measures: Eliminate sources of ignition. Prevent additional discharge of material, if possible to do so safely. Contain and/or clean up with sand or earth on land - skimming absorbents on water.
Waste Disposal: Dispose of in accordance with all applicable federal, state, and local regulations. Wear personal protective equipment - gloves, goggles, etc.
==========
SPECIAL PRECAUTIONS --- SECTION VII
==========
Precautions to be taken in handling and storage: Keep container closed until ready for use.
==========
TRANSPORTATION DATA --- SECTION VIII

==========
D.O.T.: Not regulated
Reportable Quantity: Not applicable
Freight Classification: Petroleum Lubricating Oil
Special Transportation Notes: None
==========
ENVIRONMENTAL/SAFETY REGULATIONS --- SECTION IX
==========
Section 313 (Title III Superfund Amendment and Reauthorization Act):
This product does not contain any chemical subject to the reporting requirements of Section 313 of
Title III of
the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
==========
Prepared By: Dell Findley Title: Lab Technician Original Date: 05-01-95 Updated: 10-01-02
==========
We believe the statements, technical information, and recommendations contained herein are reliable,
but they are given without warranty or guarantee of any kind, express or implied, and we assume no
responsibility for any loss, damage, or expense, direct or consequential, arising out of their use.
==========

Material Safety Data Sheet

SECTION I - Material Identity
SECTION II - Manufacturer's Information
SECTION III - Physical/Chemical Characteristics
SECTION IV - Fire and Explosion Hazard Data
SECTION V - Reactivity Data
SECTION VI - Health Hazard Data
SECTION VII - Precautions for Safe Handling and Use
SECTION VIII - Control Measures
SECTION IX - Label Data
SECTION X - Transportation Data
SECTION XI - Site Specific/Reporting Information
SECTION XII - Ingredients/Identity Information

SECTION I - Material Identity

Item Name	
Part Number/Trade Name	CAT TRANSMISSION AND DRIVE TRAIN OIL (TDTO) 50
National Stock Number	9150L4162702027
CAGE Code	3U728
Part Number Indicator	A
MSDS Number	192345
HAZ Code	B

SECTION II - Manufacturer's Information

Manufacturer Name	MOBIL OIL CORP
Street	3225 GALLOWS ROAD
City	FAIRFAX
State	VA
Country	US
Zip Code	22037-0001
Emergency Phone	609-737-4411 /800-424-9300
Information Phone	800-662-4525/856-224-4644

MSDS Preparer's Information

Date MSDS Prepared/Revised	14FEB01

Date of Technical Review	24AUG95
Active Indicator	Y

Alternate Vendors

SECTION III - Physical/Chemical Characteristics

Appearance/Odor	BROWN LIQUID WITH MILD ODOR
Boiling Point	>600F,>316C
Melting Point	NA
Vapor Pressure	<0.1
Vapor Density	>2.0
Specific Gravity	0.906
Evaporation Rate	NE
Solubility in Water	NEGLIGIBLE
Chemical pH	NA
Container Pressure Code	1
Temperature Code	4
Product State Code	L

SECTION IV - Fire and Explosion Hazard Data

Flash Point	446
Flash Point Method	UNK
Lower Explosion Limit	NA
Upper Explosion Limit	NA
Extinguishing Media	CARBON DIOXIDE, FOAM, DRY CHEMICAL AND WATER FOG.WATER OR FOAM MAY CAUSE FROTHING. USE WATER TO COOL FIRE EXPOSE CANS
Special Fire Fighting Procedures	WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURE. PREVENT RUNOFF FROM FIRE CONTROL OR DILUTION FROM ENTERING STREAMS. SEWERS, OR DRINKING WATER SUPPLY. FOR FIRES IN ENCLOSED AREAS, FIRE FIGHTERS MUST USE SCBA
Unusual Fire/Explosion Hazards	NONE

SECTION V - Reactivity Data

Stability	YES
Stability Conditions to Avoid	EXTREME HEAT

Materials to Avoid	STRONG OXIDIZERS
Hazardous Decomposition Products	THERMAL - CARBON MONOXIDE
Hazardous Polymerization	NO
Polymerization Conditions to Avoid	WILL NOT OCCUR

SECTION VI - Health Hazard Data

Route of Entry: Skin	YES
Route of Entry: Ingestion	YES
Route of Entry: Inhalation	YES
Health Hazards - Acute and Chronic	[INGEST] PRACTICALLY NON-TOXIC [SKIN] PRACTICALLY NON-TOXIC [INHAL] NOT ESTABLISHED [EYE] PRACTICALLY NON-IRRITATING
Carcinogenity: NTP	NO
Carcinogenity: IARC	NO
Carcinogenity: OSHA	NO
Explanation of Carcinogenity	NOT CARCINOGENIC
Symptoms of Overexposure	NO SIGINIFICANT EFFECTS EXPECTED
Medical Cond. Aggrevated by Exposure	NONE SPECIFIED BY MANUFACTURER
Emergency/First Aid Procedures	[EYES] FLUSH THOROUGHLY WITH WATER. IF IRRITATION OCCURS, SEE DOCTOR. [SKIN] WASH WITH SOAP AND WATER. HIGH PRESSURE ACCIDENTAL INJECTION INTO SKIN REQUIRES IMMEDIATE MEDICAL ATTENTION. [INHAL] NOTEXPECTED TO BE A PROBLEM. REMOVE FROM FURTHER EXPOSURE. IF RESPIRATORY IRRITATION. DIZZINESS, NAUSEA, OR UNCONSCIOUSNESS OCCURS, SEEK IMMEDIATE MED ATTEN. IF BREATHING HAS STOPPED ASSIST VENTILATION. [INGEST] NOT EXPECTED TO BE A PROBLEM. HOWEVER IF GREATER THAN 1/2 LITER (PINT) INGESTED, SEEK MED ATTEN

SECTION VII - Precautions for Safe Handling and Use

Steps if Material Released/Spilled	SHUT OFF SOURCE OF SPILL. TAKE MEASURES TO MINIMIZE THE EFFECTS ON GROUND WATER. RECOVER BY PUMPING OR CONTAIN SPILLED MATERIAL WITH SAND OR OTHER SUITABLE ABSORBENT AND REMOVE MECHANICALLY INTO CONTAINERS. IF NECESSARY, DISPOSE OF ABSORBED RESIDUES AS DIRECTED. PREVENT MATERIAL FROM ENTERING SEWERS, WATER SOURCES OR LOW LYING AREAS. ADVISE

	THE RELEVANT AUTHORITIES IF IT HAS. EVEN SMALL SPILLS AND LEAKAGES MAY BE SLIP HAZARD
Neutralizing Agent	NONE SPECIFIED BY MANUFACTURER
Waste Disposal Method	PRODUCT IS SUITABLE FOR BURNING IN AN ENCLOSED, CONTROLLED BURNER FOR FUEL VALUE OR DISPOSAL BY SUPERVISED INCINERATION. IN ADDITION, THE PRODUCT IS SUITABLE FOR PROCESSING BY AN APPROVED RECYCLING FACILITY
Handling and Storage Precautions	KEEP CONTAINERS CLOSED WHEN NOT IN USE. DO NOT STORE IN OPEN OR UNLABELLED CONTAINERS. STORE AWAY FROM STRONG OXIDIZING AGENTS AND COMBUSTIBLE MATERIALS. DO NOT STORE NEAR HEAT, SPARKS, FLAME OR STRONG OXIDANTS
Other Precautions	HIGH PRESSURE INJECTION UNDER THE SKIN MAY OCCUR DUE TO RUPTURE OF PRESSURIZED LINES. ALWAYS SEEK MEDICAL ATTENTION

SECTION VIII - Control Measures

Respiratory Protection	NO SPECIAL REQUIREMENTS UNDER ORDINARY CONDITIONS OF USE AND WITH ADEQUATE VENTILATION
Ventilation	NO SPECIAL REQUIREMENTS UNDER ORDINARY CONDITIONS OF USE AND WITH ADEUQATE VENTILATION
Protective Gloves	PRACTICE GOOD HYGIENE
Eye Protection	NORAM INDUSTRIAL EYE PROTECTION
Other Protective Equipment	NONE NORMALLY REQUIRED
Work Hygenic Practices	WASH HANDS AFTER USE AND BEFORE EATING, DRINKING,OR SMOKING. LAUNDER CONTAMINATED CLOTHES BEFORE REUSE
Supplemental Health/Safety Data	NOT REGULATED

SECTION IX - Label Data

Protect Eye	NO
Protect Skin	NO
Protect Respiratory	NO
Chronic Indicator	UNKNOWN
Contact Code	UNKNOWN
Fire Code	UNKNOWN
Health Code	UNKNOWN

React Code UNKNOWN

SECTION X - Transportation Data

SECTION XI - Site Specific/Reporting Information

Volatile Organic Compounds (P/G)	0
Volatile Organic Compounds (G/L)	0

SECTION XII - Ingredients/Identity Information

Ingredient #	01
Ingredient Name	(ZNCPD) ZINC (<0.14%)
CAS Number	7440666
Proprietary	NO
Percent	0.14
Ingredient #	02
Ingredient Name	PETROLEUM HYDROCARBONS
CAS Number	1003
Percent	0
Ingredient #	02
Ingredient Name	ADDITIVES
CAS Number	1003
Percent	0

Geologic and Sulfide Characteristics of the Butte Highlands Project Lithologies

Art Glover, Senior Geologist

February, 2009

Introduction

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.

The purpose of this report is to define the geochemical nature with respect to sulfide content for the various rock types that exist within the Butte Highlands project area. A specific break down of sulfide types will not be attempted as the historic logging does not always provide a specific breakdown. In general pyrrhotite occurs greater than pyrite greater than chalcopyrite with lesser locally occurring molybdenite and possible bismuthinite.

Regional Geology

The project area lies within a sequence of rocks ranging from Proterozoic Belt Super-group to Cambrian sediments on the margins of the Cretaceous Boulder Batholith. Regionally the Proterozoic rocks include fine grained clastic and carbonate rocks of the Missoula group and Helena Formations overlying Archean basement schist and gneiss of the Cherry Creek Formation. A series of Paleozoic clastic and carbonate rocks overlie the Belt rocks. From the bottom up these include the Flathead, the Wolsey, the Meagher, the Park, the Pilgrim, the Dry Creek, The Jefferson, the Three Forks, the Madison, the Amsden, the Quadrant and the Phosphoria Formations. All these sequences have been intruded by a variety of intrusive rocks which are all part of or related to the Boulder Batholith. The intrusive rocks are all Cretaceous or younger in age and include large plutons, small stocks, dikes and sills of varying composition. Diorite is common within the border phase intrusive rocks but often grades to gabbro.

Structural Geology throughout the region is very complex. Intense folding of the sedimentary rocks is common. Large trans-continental scale lineaments transect and help form the regional geology. The Trans-Challis - Great Falls Tectonic Zone is a large scale feature likely formed during the Archean with subsequent recurrent movement from the Proterozoic into the Tertiary.

Project Geology

Lithologies

A Sequence of Cambrian stratigraphy underlies the immediate project area. Cretaceous or younger intrusive of primarily diorite grading to lesser gabbro have intruded the sedimentary formations. The Cambrian sequence from oldest to youngest consists of the Flathead Sandstone (quartzite), the Wolsey Shale, the Meagher Limestone (dolomite), the Park Formation, and the Pilgrim Limestone (marble). Underlying the Cambrian sequence are metamorphosed sediments of the Belt Supergroup. Drilling at Butte Highlands has not penetrated the Belt sequence to any significant depth as it represents the footwall to mineralization.

The Flathead Sandstone has been metamorphosed to quartzite and also represents footwall to the gold skarn ore body. In drill holes at Butte Highlands the top of this rock type is almost always a generally clast supported, poorly sorted breccia with skarn altered clay matrix. Locally it may be a matrix supported breccia. The quartzite itself can be described as a buff tan mottled fine grained fairly pure quartzite. The rock underlying this unit has also often been logged as quartzite but may be better described as a fine grained hornfels that likely represents the upper part of the Belt sequence. In some drill holes the Flathead may be missing due to either faulting and/or replacement by intrusive rocks.

The Wolsey Shale overlies the Flathead Quartzite and is the main host to mineralization. It is described by Ettlinger as being an estimated 65 meter thick sequence of inter-layered dolomitic mud and shale with some silt and carbonates. This thickness seems to vary as indicated by drilling. For instance in BHDDH08-03 this sequence is over 100m thick before giving way to intrusive. In the deposit area the Wolsey is always altered to some degree. The result is a sequence of variable skarn, hornfels and re-crystallized dolomitic marble. Such a variable thickness and variety of rock type changes is likely due to structural thickening either folding and/or faulting.

Overlying the Wolsey is the Meagher Formation. At the Butte Highlands Project area this unit is a ± 200m thick sequence of buff white generally dolomitic marble. The unit is very often bleached and sanded to a very soft friable dolomite. Bedding can be difficult to discern on the surface but at a few localities thin limonitic lines that may represent bedding planes have been folded into tight asymmetric minor folds. This may indicate the overall deformation of this unit. The unit contains little to no sulfides but may contain fine disseminated limonite casts after pyrite. There are also zones of limonite and jasperiod along structures that represent oxidized sulfide replacement mineralization. These zones where historically mined for their gold and base metal content but overall represent a small portion of this lithology.

The Park Formation overlies the Meagher. This unit is an approximate 40 meter thick sequence of highly hornfelsed shale and siltstones. A distinct, cordierite schist is present at its base. The Park is very resistant to weathering and is a very good stratigraphic marker. Ettlinger describes

this unit to contain tight asymmetrical folds with faulted axial planes. This characteristic may apply to other units in the project area.

The Pilgrim Formation overlies the Park and is the uppermost unit of the Cambrian sequence expose to the surface. This unit appears to have been regionally metamorphosed to a white coarsely crystalline dolomitic marble to marble that covers much of the area north and east of the project. Figure one represents the stratigraphic assemblage of the Butte Highlands Project area.

Figure 1

Stratigraphic Column for Butte Highlands Project Area

	Formation	Code
	Pilgrim	Cpi
	Park	Cp
	Meagher	Cm
	Wolsey	Cw
	Flathead	Cf
	undivided Belt	PcB

Intusive Rocks		
	Diorite	Kd
	Transitional Diorite	KdT
	Gabbro	Kgb

Intrusive rocks encountered in the drill holes at Butte Highlands include fine to medium grained diorite and gabbro. These rocks are younger than and can intrude any of the above formations. They occur as fairly massive bodies to very small dikes and/or sills. The diorite often gradually grades to gabbro. The intrusive is likely multi phased and can vary from a fairly fresh rock to a highly altered endoskarn. The intrusive event(s) was likely a very passive emplacement as “bedding” is often preserved as textural bands and contacts can often be very fuzzy, irregular and gradual. Mineralization can also be preserved where it would project from the sedimentary sequence, but is usually weaker in the intrusive. Some areas have been classified as diorite transition zones. These represent areas where the diorite has only partially replaced the Wolsey formation as thin alternating sills. Past loggers have characterized these features as dikelettes but as they are usually parallel with bedding sills would be a more accurate term. The sulfide characteristics of the intrusive rocks are highly variable.

Mineralization

The primary mineralization type at the Butte Highlands Project can be classified as a magnesian gold skarn. The overall skarn mineralogy is dominated by forsteritic olivine, pyroxene and serpentine. This deposit is unusually in its distinct lack of iron oxides and sulfides.

The prograde skarn is dominated by the forsteritic olivine with lesser pyroxene and minor phlogopite. The retrograde alteration of the olivine and pyroxenes results in a mineral assemblage of serpentine, talc, phlogopite, amphibole (tremolite) ± actinolite ± calcite ± pyrrhotite ± chlorite ± magnetite. Not necessarily in that order or containing all of the above minerals. The retrograde alteration is likely staged resulting in several combinations of the above mineralogy. Gold is associated with retrograde alteration. Ettlinger established two associations where gold occurs with phlogopite and pyrrhotite then with clay, chlorite and pyrrhotite. From casual observation of drill core compared to the drill hole assays, it appears gold can occur with tremolite only, tremolite and talc, and in other retrograde assemblages lacking in sulfides. Also the areas with abundant to massive sulfide formation within the skarn are often very low in gold. This suggests that areas with pyrrhotite and ore grade gold occurring together may be a zonation characteristic where the conditions for gold and pyrrhotite deposition overlap.

Ettlinger also suggest that potassic alteration played an important role in gold deposition and the mineral assemblage. This is evidenced by higher gold assays associated with potassium feldspar veinlets within the endoskarn, as well as coarse phlogopite as clots and veinlets cutting the skarn assemblage.

The skarn formation tends to favor the Wolsey Formation and particularly the contact zone between Wolsey and overlying Meagher. Faulting with clay development is sometimes associated with higher grade gold mineralization at or near the contact zone. This may be due to bedding plane slip features at that contact. The mineralization appears to be somewhat strata-form within the Wolsey. There are often repetitions of mineralized skarn ± fine grained hornfels with marble sequences. At this time the understanding does not point to a set pattern that is correlative throughout the deposit area. This suggests the repetition may be due to folding or faulting and not to a set stratigraphic assemblage.

There are several limited areas within the Meagher Formation that contain minor sulfide replacement style mineralization. These areas are small and likely occur along structural zones. The mineralization is usually completely oxidized. Historic mining activity concentrated on this type of mineralization. As this style of mineralization was and is not the target of the more modern operators little recent study has been focused on it.

Faults

The major structural influence in the region is the Trans Challis – Great Falls Tectonic Zone. A major northeast trending linear that is part of this system lies just east and south of the project

area. Sub-ordinate structures to this feature cut the project area. Several of these faults influence the ore body. Other faults that have had some affect are bedding plane faults and possibly axial plane faults along tight folds.

There are several north to northeast trending faults that appear to cause offsets within the ore body. A complete understanding of these faults and their influence on the mineralization is not available at this time.

At the east end of the deposit area there is a fault that appears to offset mineralization in a right lateral sense. The exact trend of this fault has yet to be determined but is likely close to north-south. This particular fault also offsets the Park shale at the surface approximately 150 feet. It is unclear if this is a pure transverse offset or if there is a rotational component that shallows the dip of the sedimentary sequence resulting in a perceived offset of the beds.

The Only Chance Fault is a steeply dipping northeast trending fault that transects Nevin Hill and appears to offset both the Park Shale on the surface and the strata-form mineralization at depth. The sense of movement of this fault is also a right lateral feature. Both the Only Chance Fault and the "East End Fault" appear to have a negative effect on the mineralization. Drilling seems to indicate that the mineralized zones are still present but significantly lower in grade proximal to these two faults.

Just west of the Diamond T shafts and east of BHDDH08-03 there appears to be fault that offsets the mineralized horizons in a left lateral sense. Again it is unclear whether this is due to transverse movement or rotational movement that shallows the dip of the stratigraphy on the west side of the fault. The trend of this fault is unclear but is likely north to northeast. To the west of BHDDH08-03 is a series of north to northeast trending westerly dipping faults. They appear to dip between -55 and -65 degrees west and offset beds left lateral. The main fault in this series is known as the Thompson Fault.
To the west of the Thompson Fault the Park Shale has been rotated approximately 90 degrees to the Southwest. This rotation has been mapped by past workers as a fold. There is little indication other then relative position of such a ductile fold. It is more likely the rotation of the stratigraphy is due to brittle faulting and that there is a rotated block west of the Thompson Fault. It is unclear at this time if these structures have a negative effect on the mineralization.

It appears there has been an overall shortening from west to east across the project area where the stratigraphy at Nevin hill has been shoved to the north to accommodate the compression.

Ore – Waste Geology & Geochemistry

For the purpose of this report "ore" will be classified as material containing greater than 1000 parts per-billion (ppb) gold. This is not necessarily ore based on the economics of the deposit and is only used here for illustrative purposes. Waste is everything not assayed and falling below the 1000 ppb gold level.

The total sulfide content can range from less than 1% to massive sulfide upwards of 85%. In general the sulfide assemblage can be characterized as pyrrhotite > pyrite > chalcopyrite

occurring as fine disseminated grains, blebs, stringers and fracture coating with occasional narrow zones of massive sulfide. All the following percentages stated are anecdotal as they are based on a visual estimate by the logging geologists. Where sulfides were not reported in the logs, it is assumed that the total sulfide percent is 0.

Twelve holes drilled throughout the area of the proposed development were used to establish the sulfide character of the represented lithologies. Within the twelve holes there was 5607 meters of the applicable lithologies drilled. The highest sulfide content is found within the Wolsey Formation followed in decreasing order by diorite, transitional diorite, Park Formation, gabbro, Meagher Formation and finally the Pilgrim Formation. The lower footwall formations will not be discussed here as they will not be affected by the development. Table 1 summarizes the sulfide content based on a weighted average of the lithologies and whether the material was ore or waste.

Table 1
Weighted Average of Sulfide by Lithology

Lithology	Meters Drilled	Overall Sulfide Percentage	Range
Diorite (waste)	622.5	2.81	0 to 25
Diorite (ore)	6.9	1.86	0 to 5
Transitional Diorite (waste)	303.3	1.89	0 to 17.5
Transitional Diorite (ore)	13.9	1.7	0 to 4
Gabbro (waste)	186.4	0.91	0 to 12.5
Pilgrim (waste)	345.7	0.004	0 to 3
Park (waste)	281.9	1.32	0 to 8
Meagher (waste)	2873.9	0.68	0 to 60
Meagher (ore)	1.3	0	na
Wolsey (waste)	1047.8	6.43	0 to 85
Wolsey (ore)	37.6	11.68	0 to 65

Note: Full data spread sheet in Appendix A

Using the four holes drilled in 2008 a comparison was made between visually estimated sulfide content and trace element assay data for iron (Fe) and sulfur (S). The comparison only used assayed intervals and may not reflect the actual sulfide character of the represented lithology. This is especially true of the Meagher as only select intervals that exhibited some mineralization were sampled and assayed. Often these intervals are narrow skarn mineralized shale beds and don't represent the overall carbonate unit. The diorite unit was also not sampled in its entirety. The Wolsey is the only unit that was sampled in its entirety. Table 2 summarizes the results of the sulfide to iron and sulfur content.

Table 2
Sulfur/Iron Content by Lithology

Lithology	Meters Drilled	Fe weighted average (%)	Range	S weighted average (%)	Range	Sulfide weighted average (%)	Range
Diorite (waste)	156.4	3.77	0.58 to 15.45	0.83	0.03 to 9.0	6.12	0 to 12.5
Diorite (ore)	3.9	4.4	0.7 to 9.21	1.86	0.11 to 4.55	0	na
Transitional Diorite (waste)	13.8	3.99	0.65 to 7.12	0.68	0.04 to 1.26	4.66	0 to 4
Transitional Diorite (ore)	4.5	3.42	2.3 to 4.38	1.02	0.52 to 1.46	1.33	0 to 17.5
Gabbro (waste)	38.8	6.53	3.5 to 8.85	0.5	0.04 to 1.6	4.23	0 to 12.5
Meagher (waste)	216.1	2.41	0.19 to 17.9	0.24	0.01 to 3.67	2.76	0 to 20
Wolsey (waste)	353.3	5.25	0.42 to 45.4	1.15	0.01 to 11.0	5.96	0 to 60
Wolsey (ore)	23	9.95	2.39 to 21.1	4.01	0.01 to 11.0	10.47	0 to 35

Note: Full data spread sheet in Appendix B

An attempt was also made to establish average calcium content for the Butte Highlands lithologies. Because of inconsistency in the analytical methods used on the historic drilling only the four drill holes completed in 2008 will be used. The entire hole for each hole drilled was not assayed. Only core that exhibited mineralization or alteration was selected for assay analysis. All intervals that were not assayed were not used in the data set. The result is that there is no calcium data for some lithologies, including the Park Formation. The highest calcium content is found in the Meagher Formation followed in decreasing order by the gabbro, the Wolsey, the transitional diorite and finally the diorite. Table 3 summarizes the calcium content for each lithology based on a weighted average of each assayed interval and whether the material is ore or waste.

Table 3
Weighted Average of Calcium by Lithology

Lithology	Meters Assayed	Overall Calcium Percentage	Range
Diorite (waste)	155.2	4.44	2.45 to 19.4
Diorite (ore)	3.9	3.08	0.42 to 7.3
Transitional Diorite (waste)	13.8	6.39	3.27 to 19.75
Transitional Diorite (ore)	4.5	3.56	3.25 to 3.88
Gabbro (waste)	38.8	8.41	3.41 to 12.4
Pilgrim (waste)	0	na	na
Park (waste)	0	na	na
Meagher (waste)	215.5	16.82	4.0 to 28.2
Meagher (ore)	0	na	na
Wolsey (waste)	354.2	9.06	0.1 to 27.6
Wolsey (ore)	23	6.53	1.7 to 15.4

Note: Full data spread sheet in Appendix C

Exploration Proposal Specifics

The exploration program planned for the Butte Highlands Project will not encounter all the geologic formations described above. Only four of the known lithologies and a small amount of unknown material will be removed during the exploration decline development.

Table 4 provides a summary of the projected development rock tonnage for each lithology (ore/waste). Of the various units that are expected to be encountered, the Wolsey has the highest tonnage of development rock. The sulfide ranges expected, based on the analysis completed, indicates an average sulfide rate of approximately 5 to 6 percent. Because the Wolsey is made up of dolomitic mud and shale with some silt and carbonates, it will also have a neutralizing potential as well. The other lithologies projected to be encountered by the development work have significantly lower sulfide content and much higher calcium content.
Table 5 provides the linear extent of exploration development by lithology for comparison purposes. Additional data collection will be completed as part of the underground exploration program that will help to continue to define ore and waste characteristics.
Figure 2 shows the location of historic drilling in relation to the proposed development.

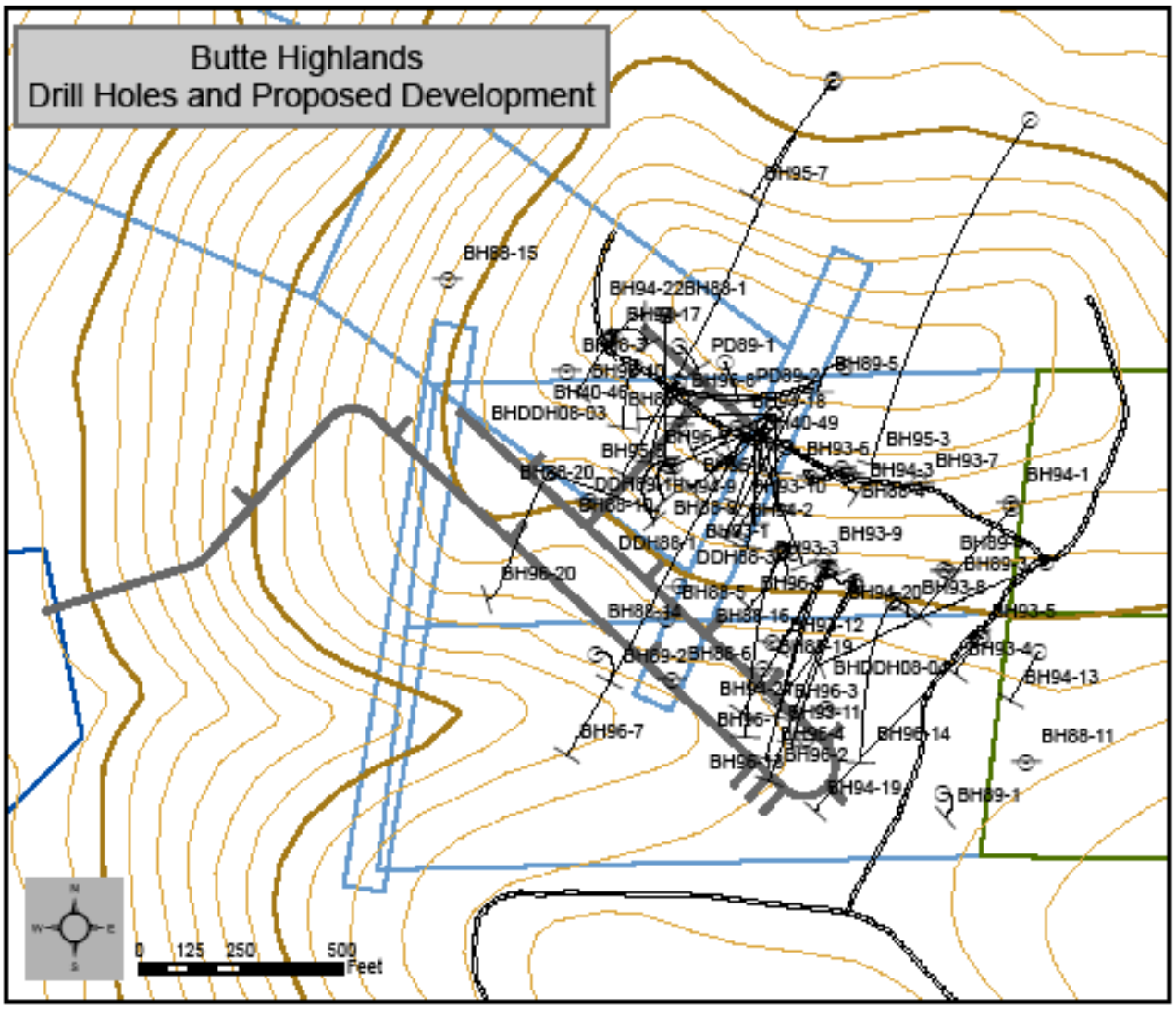
Table 4
Projected Development Rock Tonnage by Lithology

Lithology	Projected Tonnage	Calcium Weighted Average (%)	Sulfide Weighted Average (%)
Diorite (waste)	27741	4.44	2.82
Diorite (ore)	0	3.08	1.86
Transitional Diorite (waste)	0	6.39	1.89
Transitional Diorite (ore)	0	3.56	1.7
Gabbro (waste)	0	8.41	0.91
Pilgrim (waste)	0	na	0.004
Park (waste)	8777	na	1.32
Meagher (waste)	32945	16.82	0.68
Meagher (ore)	0	na	0
Wolsey (waste)	43601	9.06	6.43
Wolsey (ore)	0	6.53	11.68

Table 5
Project Exploration Development by Lithology

Distances in Feet							
Name		Cm	Cw	Kd	Cp	Unknown	Total
Decline		963	1329	1076	389	100	3857
DS 1		50					50
DS 2					50		50
DS 3		36	14				50
DS 4				50			50
DS 5			50				50
DS 6			50				50
DS 7			10	40			50
DS 8			9	41			50
DS 9			50				50
DS 10			50				50
Sump 1			30	44			75
Sump 2			14	61			75
Sump 3				75			75
Vent Raise XC			50				50
Vent Raise		279	449				728
HW Drill Drift		540	430				970
Totals		**1868**	**2535**	**1387**	**439**	**100**	**6329**

Figure 2


Butte Highlands
Drill Holes and Proposed Development
BH95-7
BH88-15
BH94-22
BH88-1
PD89-1
BH89-5
BH40-46
BHDDH08-03
BH40-49
BH95-3
BH93-6
BH93-7
BH94-3
BH94-1
BH88-20
BH93-10
BH94-2
BH93-9
DDH88-1
BH96-20
BH88-14
BH88-16
BH93-5
BH93-4
BH94-13
BH96-3
BH96-7
BH96-14
BH88-11
BH94-19
BH89-1
0
125
250
500
Feet

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Appendix A
(Weighted average Sulfide Data Tables)

Hole_Id	Start	End	From	To	Interval	Sulfide	Formation	Rock_Code	Ore_Waste	Weighted_avg	**Overall_Sulfide**
	ft	ft	m	m		percent				sul_percent	**percent**
BHDDH08-02	1418.6	1422.6	432.4	433.6	1.2	0	Diorite	Kd	Ore	0.00	
BHDDH08-02	1422.5	1422.9	433.6	433.7	0.1	0	Diorite	Kd	Ore	0.00	
BHDDH08-02	1422.9	1425.5	433.7	434.5	0.8	0	Diorite	Kd	Ore	0.00	
BHDDH08-02	1466.8	1471.7	447.1	448.6	1.5	0	Diorite	Kd	Ore	0.00	
BHDDH08-02	1577.4	1578	480.8	481.0	0.2	0	Diorite	Kd	Ore	0.00	
BHDDH08-03	1614.4	1614.7	492.1	492.2	0.1	0	Diorite	Kd	Ore	0.00	
BH95-5	1773.5	1774.5	540.6	540.9	0.3	3	Diorite	Kd	Ore	0.91	
BH95-5	1686.6	1691.5	514.1	515.6	1.5	4	Diorite	Kd	Ore	5.97	
BH95-5	1769.6	1773.5	539.4	540.6	1.2	5	Diorite	Kd	Ore	5.94	
Totals					**6.9**					**12.83**	**1.86**
BH94-9	975.5	1037.8	297.3	316.3	19.0	0	Diorite	Kd	Waste	0.00	
BH95-7	519.9	529.9	158.5	161.5	3.0	0	Diorite	Kd	Waste	0.00	
BH95-7	1493.4	1515	455.2	461.8	6.6	0	Diorite	Kd	Waste	0.00	
BH96-7	1091.6	1118.8	332.7	341.0	8.3	0	Diorite	Kd	Waste	0.00	
BH96-7	1121.8	1129.6	341.9	344.3	2.4	0	Diorite	Kd	Waste	0.00	
BH96-7	1225.7	1255.6	373.6	382.7	9.1	0	Diorite	Kd	Waste	0.00	
BH96-7	1399.2	1409.7	426.5	429.7	3.2	0	Diorite	Kd	Waste	0.00	
BH96-7	1432.7	1452.7	436.7	442.8	6.1	0	Diorite	Kd	Waste	0.00	
BH96-7	1563.6	1629.5	476.6	496.7	20.1	0	Diorite	Kd	Waste	0.00	
BH96-7	1629.5	1956.5	496.7	596.3	99.7	0	Diorite	Kd	Waste	0.00	
BHDDH08-01	1312.3	1319.7	400.0	402.2	2.3	0	Diorite	Kd	Waste	0.00	
BHDDH08-01	1319.5	1322.5	402.2	403.1	0.9	0	Diorite	Kd	Waste	0.00	
BHDDH08-01	1649.5	1655.7	502.8	504.7	1.9	0	Diorite	Kd	Waste	0.00	
BHDDH08-02	1466.5	1466.8	447.0	447.1	0.1	0	Diorite	Kd	Waste	0.00	
BHDDH08-02	1471.7	1493.7	448.6	455.3	6.7	0	Diorite	Kd	Waste	0.00	
BHDDH08-02	1573.6	1577.4	479.6	480.8	1.2	0	Diorite	Kd	Waste	0.00	
BHDDH08-03	1614.7	1665.9	492.2	507.8	15.6	0	Diorite	Kd	Waste	0.00	
BH95-7	434.9	449.9	132.6	137.1	4.6	1	Diorite	Kd	Waste	4.57	
BHDDH08-04	700	729.8	213.4	222.4	9.1	1.5	Diorite	Kd	Waste	13.62	
BHDDH08-04	737.8	779.8	224.9	237.7	12.8	1.5	Diorite	Kd	Waste	19.20	
BH95-7	410	434.9	125.0	132.6	7.6	2	Diorite	Kd	Waste	15.18	
BH95-7	449.9	494.9	137.1	150.8	13.7	2	Diorite	Kd	Waste	27.43	
BH95-7	499.9	519.9	152.4	158.5	6.1	2	Diorite	Kd	Waste	12.19	
BH95-7	529.9	559.9	161.5	170.7	9.1	2	Diorite	Kd	Waste	18.29	
BH95-7	569.9	574.7	173.7	175.2	1.5	2	Diorite	Kd	Waste	2.93	
BH95-7	1187.4	1333.3	361.9	406.4	44.5	2	Diorite	Kd	Waste	88.94	
BH96-7	1083.7	1091.6	330.3	332.7	2.4	2	Diorite	Kd	Waste	4.82	
BH96-7	1290	1305.8	393.2	398.0	4.8	2	Diorite	Kd	Waste	9.63	
BH96-7	1409.7	1432.7	429.7	436.7	7.0	2	Diorite	Kd	Waste	14.02	
BHDDH08-02	1400.6	1415.6	426.9	431.5	4.6	2	Diorite	Kd	Waste	9.14	
BHDDH08-02	1439.6	1448.6	438.8	441.5	2.7	2	Diorite	Kd	Waste	5.49	
BHDDH08-02	1448.6	1466.6	441.5	447.0	5.5	2	Diorite	Kd	Waste	10.97	
BHDDH08-04	729.8	737.8	222.4	224.9	2.4	2.5	Diorite	Kd	Waste	6.10	
BH94-9	1037.8	1093.9	316.3	333.4	17.1	3	Diorite	Kd	Waste	51.30	
BH95-5	1676.4	1679.7	511.0	512.0	1.0	3	Diorite	Kd	Waste	3.02	
BH95-5	1739.7	1769.6	530.3	539.4	9.1	3	Diorite	Kd	Waste	27.34	
BH95-5	1774.5	1779.4	540.9	542.4	1.5	3	Diorite	Kd	Waste	4.48	
BH95-5	1779.4	1834.5	542.4	559.2	16.8	3	Diorite	Kd	Waste	50.38	
BH95-5	1843.7	1986.4	562.0	605.5	43.5	3	Diorite	Kd	Waste	130.48	
BH95-7	559.9	569.9	170.7	173.7	3.0	3	Diorite	Kd	Waste	9.14	
BH96-7	972.8	984.7	296.5	300.1	3.6	3	Diorite	Kd	Waste	10.88	
BH96-7	991.7	1009.7	302.3	307.8	5.5	3	Diorite	Kd	Waste	16.46	
BH96-7	1129.7	1184.7	344.3	361.1	16.8	3	Diorite	Kd	Waste	50.29	
BHDDH08-04	784.8	788.5	239.2	240.3	1.1	3.5	Diorite	Kd	Waste	3.95	
BH95-5	1679.7	1686.6	512.0	514.1	2.1	4	Diorite	Kd	Waste	8.41	
BH95-5	1691.5	1739.7	515.6	530.3	14.7	4	Diorite	Kd	Waste	58.77	
BH95-5	1835.5	1843.5	559.5	561.9	2.4	4	Diorite	Kd	Waste	9.75	
BH95-7	1187	1187.4	361.8	361.9	0.1	4	Diorite	Kd	Waste	0.49	
BHDDH08-02	1352.7	1366.8	412.3	416.6	4.3	4	Diorite	Kd	Waste	17.19	
BHDDH08-02	1425.6	1435.6	434.5	437.6	3.0	4	Diorite	Kd	Waste	12.19	

BHDDH08-02	1539.6	1573.6	469.3	479.6	10.4	4	Diorite	Kd	Waste	41.45	
BHDDH08-02	1578	1620.6	481.0	494.0	13.0	4	Diorite	Kd	Waste	51.94	
BHDDH08-02	1621.6	1642.6	494.3	500.7	6.4	4	Diorite	Kd	Waste	25.60	
BH95-7	1409.7	1444.5	429.7	440.3	10.6	5	Diorite	Kd	Waste	53.04	
BHDDH08-02	1366.8	1396.7	416.6	425.7	9.1	6	Diorite	Kd	Waste	54.68	
BHDDH08-02	1497.6	1539.6	456.5	469.3	12.8	6	Diorite	Kd	Waste	76.81	
BHDDH08-04	672.4	700	204.9	213.4	8.4	6.5	Diorite	Kd	Waste	54.68	
BH95-5	1834.5	1835.5	559.2	559.5	0.3	7	Diorite	Kd	Waste	2.13	
BH96-7	984.7	991.7	300.1	302.3	2.1	7.5	Diorite	Kd	Waste	16.00	
BHDDH08-02	1435.6	1439.6	437.6	438.8	1.2	7.5	Diorite	Kd	Waste	9.14	
BH95-7	1399.2	1409.7	426.5	429.7	3.2	8	Diorite	Kd	Waste	25.60	
BHDDH08-02	1396.7	1400.6	425.7	426.9	1.2	8.5	Diorite	Kd	Waste	10.10	
BHDDH08-04	779.8	784.8	237.7	239.2	1.5	10	Diorite	Kd	Waste	15.24	
BHDDH08-02	1493.7	1497.6	455.3	456.5	1.2	11	Diorite	Kd	Waste	13.08	
BHDDH08-04	1479.6	1637.7	451.0	499.2	48.2	11	Diorite	Kd	Waste	530.08	
BH96-7	1255.6	1256.2	382.7	382.9	0.2	12.5	Diorite	Kd	Waste	2.29	
BHDDH08-02	1415.6	1418.6	431.5	432.4	0.9	12.5	Diorite	Kd	Waste	11.43	
BHDDH08-02	1620.6	1621.6	494.0	494.3	0.3	12.5	Diorite	Kd	Waste	3.81	
BH96-7	1082.7	1083.7	330.0	330.3	0.3	15	Diorite	Kd	Waste	4.57	
BH96-7	1118.7	1121.7	341.0	341.9	0.9	25	Diorite	Kd	Waste	22.86	
Totals					**622.5**					**1751.59**	**2.81**

BH96-7	1220.8	1225.7	372.1	373.6	1.5	0	Transitional Diorite	KdT	Ore	0.00	
BH96-7	1557.7	1559.6	474.8	475.4	0.6	0	Transitional Diorite	KdT	Ore	0.00	
BHDDH08-02	1325.8	1330.7	404.1	405.6	1.5	0	Transitional Diorite	KdT	Ore	0.00	
BHDDH08-02	1335.6	1338.6	407.1	408.0	0.9	0	Transitional Diorite	KdT	Ore	0.00	
BHDDH08-02	1338.6	1340.5	408.0	408.6	0.6	0	Transitional Diorite	KdT	Ore	0.00	
BH95-7	399.8	410	121.9	125.0	3.1	2	Transitional Diorite	KdT	Ore	6.22	
BH96-7	1559.6	1563.6	475.4	476.6	1.2	2	Transitional Diorite	KdT	Ore	2.44	
BH95-5	1545.5	1550.5	471.1	472.6	1.5	3	Transitional Diorite	KdT	Ore	4.57	
BH96-7	1189.7	1194.6	362.6	364.1	1.5	3	Transitional Diorite	KdT	Ore	4.48	
BHDDH08-02	1345.8	1350.7	410.2	411.7	1.5	4	Transitional Diorite	KdT	Ore	5.97	
Totals					**13.9**					**23.68**	**1.70**

BH94-9	870.2	905.6	265.2	276.0	10.8	0	Transitional Diorite	KdT	Waste	0.00	
BH94-9	905.6	907.9	276.0	276.7	0.7	0	Transitional Diorite	KdT	Waste	0.00	
BH95-7	251.9	259.9	76.8	79.2	2.4	0	Transitional Diorite	KdT	Waste	0.00	
BH95-7	370	379.9	112.8	115.8	3.0	0	Transitional Diorite	KdT	Waste	0.00	
BH96-2	644.8	655.7	196.5	199.9	3.3	0	Transitional Diorite	KdT	Waste	0.00	
BH96-2	664.2	689.8	202.4	210.3	7.8	0	Transitional Diorite	KdT	Waste	0.00	
BH96-2	711.8	774.7	217.0	236.1	19.2	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	929.9	947.9	283.4	288.9	5.5	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	955.8	972.8	291.3	296.5	5.2	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1024.7	1029.6	312.3	313.8	1.5	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1041.7	1053.9	317.5	321.2	3.7	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1063.7	1073.9	324.2	327.3	3.1	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1199.8	1220.8	365.7	372.1	6.4	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1305.8	1392.7	398.0	424.5	26.5	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1392.7	1399.2	424.5	426.5	2.0	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1452.7	1491.1	442.8	454.5	11.7	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1511.8	1517.6	460.8	462.6	1.8	0	Transitional Diorite	KdT	Waste	0.00	
BH96-7	1534.7	1557.7	467.8	474.8	7.0	0	Transitional Diorite	KdT	Waste	0.00	
BHDDH08-02	1315.6	1325.1	401.0	403.9	2.9	0	Transitional Diorite	KdT	Waste	0.00	
BHDDH08-02	1330.7	1335.6	405.6	407.1	1.5	0	Transitional Diorite	KdT	Waste	0.00	
BHDDH08-02	1340.5	1342.8	408.6	409.3	0.7	0	Transitional Diorite	KdT	Waste	0.00	
BH94-9	934.8	962.8	284.9	293.5	8.5	1	Transitional Diorite	KdT	Waste	8.53	
BH95-7	199.9	240.1	60.9	73.2	12.3	1	Transitional Diorite	KdT	Waste	12.25	
BH96-20	1188.7	1232.6	362.3	375.7	13.4	1	Transitional Diorite	KdT	Waste	13.38	
BH96-7	1029.6	1041.7	313.8	317.5	3.7	1	Transitional Diorite	KdT	Waste	3.69	
BH96-7	1491.1	1511.6	454.5	460.7	6.2	1	Transitional Diorite	KdT	Waste	6.25	
BH94-9	907.9	915.8	276.7	279.1	2.4	1.5	Transitional Diorite	KdT	Waste	3.61	
BH94-9	962.8	973.8	293.5	296.8	3.4	2	Transitional Diorite	KdT	Waste	6.71	
BH95-7	168.9	180.1	51.5	54.9	3.4	2	Transitional Diorite	KdT	Waste	6.83	

BH95-7	249.9	251.9	76.2	76.8	0.6	2	Transitional Diorite	KdT	Waste	1.22	
BH95-7	269.9	284.9	82.3	86.8	4.6	2	Transitional Diorite	KdT	Waste	9.14	
BH95-7	344.9	370	105.1	112.8	7.7	2	Transitional Diorite	KdT	Waste	15.30	
BH95-7	379.9	399.8	115.8	121.9	6.1	2	Transitional Diorite	KdT	Waste	12.13	
BH95-7	1027.7	1031.7	313.2	314.5	1.2	2	Transitional Diorite	KdT	Waste	2.44	
BH95-7	1333.3	1343.8	406.4	409.6	3.2	2	Transitional Diorite	KdT	Waste	6.40	
BH96-7	947.9	955.8	288.9	291.3	2.4	2	Transitional Diorite	KdT	Waste	4.82	
BH96-7	1517.6	1534.7	462.6	467.8	5.2	2	Transitional Diorite	KdT	Waste	10.42	
BH94-9	973.8	975.5	296.8	297.3	0.5	3	Transitional Diorite	KdT	Waste	1.55	
BH95-5	1461.2	1473.7	445.4	449.2	3.8	3	Transitional Diorite	KdT	Waste	11.43	
BH95-5	1532.4	1545.5	467.1	471.1	4.0	3	Transitional Diorite	KdT	Waste	11.98	
BH95-7	180	199.9	54.9	60.9	6.1	3	Transitional Diorite	KdT	Waste	18.20	
BH95-7	259.9	269.9	79.2	82.3	3.0	3	Transitional Diorite	KdT	Waste	9.14	
BH95-7	284.9	344.9	86.8	105.1	18.3	3	Transitional Diorite	KdT	Waste	54.86	
BH95-7	997.1	1025.7	303.9	312.6	8.7	3	Transitional Diorite	KdT	Waste	26.15	
BH95-7	1031.7	1037.7	314.5	316.3	1.8	3	Transitional Diorite	KdT	Waste	5.49	
BH96-7	1184.7	1189.7	361.1	362.6	1.5	3	Transitional Diorite	KdT	Waste	4.57	
BH96-7	1194.6	1199.8	364.1	365.7	1.6	3	Transitional Diorite	KdT	Waste	4.75	
BH96-7	1266.7	1286.7	386.1	392.2	6.1	3	Transitional Diorite	KdT	Waste	18.29	
BH94-9	915.8	934.8	279.1	284.9	5.8	3.5	Transitional Diorite	KdT	Waste	20.27	
BH95-7	1025.7	1027.7	312.6	313.2	0.6	4	Transitional Diorite	KdT	Waste	2.44	
BH95-7	1343.8	1362.2	409.6	415.2	5.6	4	Transitional Diorite	KdT	Waste	22.43	
BH96-7	1259.5	1266.7	383.9	386.1	2.2	4	Transitional Diorite	KdT	Waste	8.78	
BHDDH08-01	1563.2	1576.4	476.5	480.5	4.0	4	Transitional Diorite	KdT	Waste	16.09	
BHDDH08-02	1342.8	1345.8	409.3	410.2	0.9	4	Transitional Diorite	KdT	Waste	3.66	
BHDDH08-02	1350.7	1352.7	411.7	412.3	0.6	4	Transitional Diorite	KdT	Waste	2.44	
BH96-7	1009.6	1024.7	307.7	312.3	4.6	7.5	Transitional Diorite	KdT	Waste	34.52	
BH96-2	655.7	664.2	199.9	202.4	2.6	12.5	Transitional Diorite	KdT	Waste	32.39	
BH96-7	1256.2	1259.5	382.9	383.9	1.0	12.5	Transitional Diorite	KdT	Waste	12.57	
BHDDH08-01	1524.2	1524.5	464.6	464.7	0.1	12.5	Transitional Diorite	KdT	Waste	1.14	
BHDDH08-01	1524.6	1534.1	464.7	467.6	2.9	13	Transitional Diorite	KdT	Waste	37.64	
BH96-7	1053.7	1063.7	321.2	324.2	3.0	15	Transitional Diorite	KdT	Waste	45.72	
BH96-7	1073.7	1082.7	327.3	330.0	2.7	15	Transitional Diorite	KdT	Waste	41.15	
BHDDH08-02	1325.1	1325.8	403.9	404.1	0.2	17.5	Transitional Diorite	KdT	Waste	3.73	
Totals					**303.3**					**574.52**	**1.89**

BH95-3	1426.5	1609.5	434.8	490.6	55.8	0	Gabbro	Kgb	Waste	0.00	
BH95-3	1617.7	1639.7	493.1	499.8	6.7	0	Gabbro	Kgb	Waste	0.00	
BH95-7	1907.3	2159.6	581.3	658.2	76.9	0	Gabbro	Kgb	Waste	0.00	
BH95-7	2199.6	2216.3	670.4	675.5	5.1	0	Gabbro	Kgb	Waste	0.00	
BH95-7	2159.6	2169.4	658.2	661.2	3.0	1	Gabbro	Kgb	Waste	2.99	
BHDDH08-01	1383.5	1498.3	421.7	456.7	35.0	4	Gabbro	Kgb	Waste	139.96	
BHDDH08-01	1499.6	1509.6	457.1	460.1	3.0	5	Gabbro	Kgb	Waste	15.24	
BH95-3	1426.1	1426.5	434.7	434.8	0.1	7.5	Gabbro	Kgb	Waste	0.91	
BHDDH08-01	1509.5	1512.1	460.1	460.9	0.8	12.5	Gabbro	Kgb	Waste	9.91	
Totals					**186.4**					**169.01**	**0.91**

BH96-7	777.7	782	237.0	238.4	1.3		Meagher	Cm	Ore	0.00

BH94-9	9.8	754.7	3.0	230.0	227.0	0	Meagher	Cm	Waste	0.00
BH94-9	759.6	807.2	231.5	246.0	14.5	0	Meagher	Cm	Waste	0.00
BH94-9	813.8	831.2	248.0	253.3	5.3	0	Meagher	Cm	Waste	0.00
BH94-9	832.1	832.8	253.6	253.8	0.2	0	Meagher	Cm	Waste	0.00
BH94-9	838.7	842.6	255.6	256.8	1.2	0	Meagher	Cm	Waste	0.00
BH95-3	932.8	1349.7	284.3	411.4	127.1	0	Meagher	Cm	Waste	0.00
BH95-3	1354.6	1400.6	412.9	426.9	14.0	0	Meagher	Cm	Waste	0.00
BH95-5	841.6	1409.7	256.5	429.7	173.2	0	Meagher	Cm	Waste	0.00
BH95-7	768.8	940.7	234.3	286.7	52.4	0	Meagher	Cm	Waste	0.00
BH95-7	963.7	976.8	293.7	297.7	4.0	0	Meagher	Cm	Waste	0.00
BH95-7	1652.5	1700.6	503.7	518.3	14.7	0	Meagher	Cm	Waste	0.00
BH95-7	1709.6	1729.6	521.1	527.2	6.1	0	Meagher	Cm	Waste	0.00

BH95-7	1740.4	1853.5	530.5	564.9	34.5	0	Meagher	Cm	Waste	0.00
BH95-7	1859.4	1907.3	566.7	581.3	14.6	0	Meagher	Cm	Waste	0.00
BH95-7	2169.4	2199.6	661.2	670.4	9.2	0	Meagher	Cm	Waste	0.00
BH95-7	2216.3	2274.4	675.5	693.2	17.7	0	Meagher	Cm	Waste	0.00
BH96-10	9.8	109.9	3.0	33.5	30.5	0	Meagher	Cm	Waste	0.00
BH96-10	120	180.1	36.6	54.9	18.3	0	Meagher	Cm	Waste	0.00
BH96-10	186	290	56.7	88.4	31.7	0	Meagher	Cm	Waste	0.00
BH96-10	299.8	370	91.4	112.8	21.4	0	Meagher	Cm	Waste	0.00
BH96-10	379.8	875.8	115.8	266.9	151.2	0	Meagher	Cm	Waste	0.00
BH96-2	9.8	390	3.0	118.9	115.9	0	Meagher	Cm	Waste	0.00
BH96-2	414.9	434.9	126.5	132.6	6.1	0	Meagher	Cm	Waste	0.00
BH96-2	454.9	555.3	138.7	169.3	30.6	0	Meagher	Cm	Waste	0.00
BH96-2	558.9	575	170.4	175.3	4.9	0	Meagher	Cm	Waste	0.00
BH96-20	12.1	808.8	3.7	246.5	242.8	0	Meagher	Cm	Waste	0.00
BH96-20	816.7	852.8	248.9	259.9	11.0	0	Meagher	Cm	Waste	0.00
BH96-7	49.9	731.8	15.2	223.1	207.8	0	Meagher	Cm	Waste	0.00
BH96-7	782	804.9	238.4	245.3	7.0	0	Meagher	Cm	Waste	0.00
BHDDH08-01	4	93.8	1.2	28.6	27.4	0	Meagher	Cm	Waste	0.00
BHDDH08-01	129.9	162	39.6	49.4	9.8	0	Meagher	Cm	Waste	0.00
BHDDH08-01	217.5	974.8	66.3	297.1	230.8	0	Meagher	Cm	Waste	0.00
BHDDH08-01	980.7	992.9	298.9	302.6	3.7	0	Meagher	Cm	Waste	0.00
BHDDH08-02	157.4	495	48.0	150.9	102.9	0	Meagher	Cm	Waste	0.00
BHDDH08-02	572.9	588.9	174.6	179.5	4.9	0	Meagher	Cm	Waste	0.00
BHDDH08-02	590.9	616	180.1	187.8	7.7	0	Meagher	Cm	Waste	0.00
BHDDH08-02	782.9	801.6	238.6	244.3	5.7	0	Meagher	Cm	Waste	0.00
BHDDH08-02	805.6	908.9	245.5	277.0	31.5	0	Meagher	Cm	Waste	0.00
BHDDH08-02	1066.7	1111.7	325.1	338.8	13.7	0	Meagher	Cm	Waste	0.00
BHDDH08-02	1137.7	1158.7	346.8	353.2	6.4	0	Meagher	Cm	Waste	0.00
BHDDH08-03	13.1	301.8	4.0	92.0	88.0	0	Meagher	Cm	Waste	0.00
BHDDH08-03	305	348	93.0	106.1	13.1	0	Meagher	Cm	Waste	0.00
BHDDH08-03	368.9	449.9	112.4	137.1	24.7	0	Meagher	Cm	Waste	0.00
BHDDH08-03	565.9	584.9	172.5	178.3	5.8	0	Meagher	Cm	Waste	0.00
BHDDH08-03	657.8	681.8	200.5	207.8	7.3	0	Meagher	Cm	Waste	0.00
BHDDH08-03	782.8	827.8	238.6	252.3	13.7	0	Meagher	Cm	Waste	0.00
BHDDH08-03	1065.7	1085.7	324.8	330.9	6.1	0	Meagher	Cm	Waste	0.00
BHDDH08-03	1155.9	1199.8	352.3	365.7	13.4	0	Meagher	Cm	Waste	0.00
BHDDH08-04	5.9	6.9	1.8	2.1	0.3	0	Meagher	Cm	Waste	0.00
BHDDH08-04	55.4	118.7	16.9	36.2	19.3	0	Meagher	Cm	Waste	0.00
BHDDH08-04	137.1	519.9	41.8	158.5	116.7	0	Meagher	Cm	Waste	0.00
BHDDH08-04	829.8	839.8	252.9	256.0	3.0	0	Meagher	Cm	Waste	0.00
BHDDH08-04	879.8	904.8	268.2	275.8	7.6	0	Meagher	Cm	Waste	0.00
BHDDH08-04	914.8	929.7	278.8	283.4	4.5	0	Meagher	Cm	Waste	0.00
BHDDH08-04	971.8	1115.7	296.2	340.1	43.9	0	Meagher	Cm	Waste	0.00
BHDDH08-04	1131.7	1169.7	344.9	356.5	11.6	0	Meagher	Cm	Waste	0.00
BH95-5	1409.7	1428.8	429.7	435.5	5.8	1	Meagher	Cm	Waste	5.82
BH95-7	1853.5	1859.4	564.9	566.7	1.8	1	Meagher	Cm	Waste	1.80
BH96-10	290	299.8	88.4	91.4	3.0	1	Meagher	Cm	Waste	2.99
BH96-10	370	379.8	112.8	115.8	3.0	1	Meagher	Cm	Waste	2.99
BHDDH08-01	1039.8	1079.8	316.9	329.1	12.2	1	Meagher	Cm	Waste	12.19
BHDDH08-02	680.9	741.9	207.5	226.1	18.6	1	Meagher	Cm	Waste	18.59
BHDDH08-03	639.8	647.8	195.0	197.4	2.4	1	Meagher	Cm	Waste	2.44
BHDDH08-04	556	594.9	169.5	181.3	11.9	1	Meagher	Cm	Waste	11.86
BHDDH08-04	594.9	634.8	181.3	193.5	12.2	1	Meagher	Cm	Waste	12.16
BHDDH08-04	855.8	859.8	260.8	262.1	1.2	1	Meagher	Cm	Waste	1.22
BHDDH08-04	951.8	971.8	290.1	296.2	6.1	1	Meagher	Cm	Waste	6.10
BHDDH08-01	992.9	1039.8	302.6	316.9	14.3	1.5	Meagher	Cm	Waste	21.44
BHDDH08-03	1085.7	1137.8	330.9	346.8	15.9	1.5	Meagher	Cm	Waste	23.82
BHDDH08-04	797.8	803.8	243.2	245.0	1.8	1.5	Meagher	Cm	Waste	2.74
BHDDH08-04	859.8	879.8	262.1	268.2	6.1	1.5	Meagher	Cm	Waste	9.14
BHDDH08-04	1115.7	1119.7	340.1	341.3	1.2	1.5	Meagher	Cm	Waste	1.83
BHDDH08-04	1125.7	1131.7	343.1	344.9	1.8	1.5	Meagher	Cm	Waste	2.74
BHDDH08-04	1169.7	1185.4	356.5	361.3	4.8	1.5	Meagher	Cm	Waste	7.18
BH96-10	109.9	120	33.5	36.6	3.1	2	Meagher	Cm	Waste	6.16

BHDDH08-01	974.8	980.7	297.1	298.9	1.8	2	Meagher	Cm	Waste	3.60	
BHDDH08-02	908.9	953.8	277.0	290.7	13.7	2	Meagher	Cm	Waste	27.37	
BHDDH08-03	449.9	557.9	137.1	170.0	32.9	2	Meagher	Cm	Waste	65.84	
BHDDH08-04	532	556	162.2	169.5	7.3	2	Meagher	Cm	Waste	14.63	
BHDDH08-04	803.8	808.8	245.0	246.5	1.5	2	Meagher	Cm	Waste	3.05	
BHDDH08-04	808.8	819.8	246.5	249.9	3.4	2	Meagher	Cm	Waste	6.71	
BHDDH08-04	819.8	829.8	249.9	252.9	3.0	2	Meagher	Cm	Waste	6.10	
BHDDH08-02	495	517.9	150.9	157.9	7.0	2.5	Meagher	Cm	Waste	17.45	
BHDDH08-02	531	568.8	161.8	173.4	11.5	2.5	Meagher	Cm	Waste	28.80	
BHDDH08-02	650.8	680.9	198.4	207.5	9.2	2.5	Meagher	Cm	Waste	22.94	
BHDDH08-04	789.8	793.8	240.7	242.0	1.2	2.5	Meagher	Cm	Waste	3.05	
BHDDH08-04	839.8	855.8	256.0	260.8	4.9	2.5	Meagher	Cm	Waste	12.19	
BHDDH08-04	904.8	914.8	275.8	278.8	3.0	2.5	Meagher	Cm	Waste	7.62	
BHDDH08-04	1119.7	1125.7	341.3	343.1	1.8	2.5	Meagher	Cm	Waste	4.57	
BH95-7	1729.6	1730.5	527.2	527.5	0.3	3	Meagher	Cm	Waste	0.82	
BHDDH08-01	1079.8	1082.1	329.1	329.8	0.7	3	Meagher	Cm	Waste	2.10	
BHDDH08-04	929.7	951.8	283.4	290.1	6.7	3	Meagher	Cm	Waste	20.21	
BH95-7	1700.6	1707.1	518.3	520.3	2.0	3.5	Meagher	Cm	Waste	6.93	
BH95-7	1707.1	1709.6	520.3	521.1	0.8	3.5	Meagher	Cm	Waste	2.67	
BHDDH08-02	616	650.8	187.8	198.4	10.6	3.5	Meagher	Cm	Waste	37.12	
BHDDH08-04	788.5	789.8	240.3	240.7	0.4	3.5	Meagher	Cm	Waste	1.39	
BHDDH08-02	760.3	772.8	231.7	235.5	3.8	4	Meagher	Cm	Waste	15.24	
BHDDH08-02	953.8	1039.8	290.7	316.9	26.2	4	Meagher	Cm	Waste	104.85	
BHDDH08-02	1040.7	1060.7	317.2	323.3	6.1	4	Meagher	Cm	Waste	24.38	
BHDDH08-03	827.8	925.7	252.3	282.2	29.8	4	Meagher	Cm	Waste	119.36	
BHDDH08-04	649.8	651.8	198.1	198.7	0.6	4	Meagher	Cm	Waste	2.44	
BHDDH08-04	651.8	669.8	198.7	204.2	5.5	4.5	Meagher	Cm	Waste	24.69	
BHDDH08-02	588.9	590.9	179.5	180.1	0.6	5	Meagher	Cm	Waste	3.05	
BHDDH08-02	568.9	572.9	173.4	174.6	1.2	6	Meagher	Cm	Waste	7.32	
BHDDH08-02	1111.7	1137.7	338.8	346.8	7.9	6	Meagher	Cm	Waste	47.55	
BHDDH08-03	348	368.9	106.1	112.4	6.4	6	Meagher	Cm	Waste	38.22	
BHDDH08-03	647.8	657.8	197.4	200.5	3.0	6	Meagher	Cm	Waste	18.29	
BHDDH08-04	634.8	649.8	193.5	198.1	4.6	6.5	Meagher	Cm	Waste	29.72	
BHDDH08-04	669.8	672.4	204.2	204.9	0.8	6.5	Meagher	Cm	Waste	5.15	
BHDDH08-02	772.8	782.9	235.5	238.6	3.1	7.5	Meagher	Cm	Waste	23.09	
BHDDH08-03	1137.8	1145.7	346.8	349.2	2.4	7.5	Meagher	Cm	Waste	18.06	
BHDDH08-03	1145.7	1155.9	349.2	352.3	3.1	7.5	Meagher	Cm	Waste	23.32	
BHDDH08-04	1185.4	1186.7	361.3	361.7	0.4	7.5	Meagher	Cm	Waste	2.97	
BHDDH08-02	741.9	755.4	226.1	230.2	4.1	8.5	Meagher	Cm	Waste	34.98	
BHDDH08-03	557.9	565.9	170.0	172.5	2.4	8.5	Meagher	Cm	Waste	20.73	
BHDDH08-03	584.9	598.9	178.3	182.5	4.3	8.5	Meagher	Cm	Waste	36.27	
BHDDH08-03	623.9	639.8	190.2	195.0	4.8	8.5	Meagher	Cm	Waste	41.19	
BHDDH08-03	681.8	761.8	207.8	232.2	24.4	8.5	Meagher	Cm	Waste	207.26	
BHDDH08-03	925.7	1017.8	282.2	310.2	28.1	8.5	Meagher	Cm	Waste	238.61	
BHDDH08-03	761.8	782.8	232.2	238.6	6.4	9.5	Meagher	Cm	Waste	60.81	
BHDDH08-02	1039.8	1040.7	316.9	317.2	0.3	10	Meagher	Cm	Waste	2.74	
BHDDH08-02	1158.7	1170.7	353.2	356.8	3.7	10	Meagher	Cm	Waste	36.58	
BH94-9	832.8	834.4	253.8	254.3	0.5	12.5	Meagher	Cm	Waste	6.10	
BHDDH08-03	1034.7	1065.7	315.4	324.8	9.4	12.5	Meagher	Cm	Waste	118.11	
BHDDH08-02	1060.7	1066.7	323.3	325.1	1.8	15	Meagher	Cm	Waste	27.43	
BHDDH08-03	1199.8	1201.7	365.7	366.3	0.6	17.5	Meagher	Cm	Waste	10.13	
BHDDH08-03	1201.7	1206.7	366.3	367.8	1.5	17.5	Meagher	Cm	Waste	26.67	
BHDDH08-04	793.8	797.8	242.0	243.2	1.2	17.5	Meagher	Cm	Waste	21.34	
BHDDH08-03	1017.8	1034.7	310.2	315.4	5.2	19.5	Meagher	Cm	Waste	100.45	
BHDDH08-02	1170.7	1171	356.8	356.9	0.1	20	Meagher	Cm	Waste	1.83	
BH94-9	831.3	832.3	253.4	253.7	0.3	60	Meagher	Cm	Waste	18.29	
Totals					**2873.9**					**1965.56**	**0.68**

BH95-5	1446.5	1449.6	440.9	441.8	0.9	0	Wolsey	Cw	Ore	0.00
BH95-5	1513.7	1517	461.4	462.4	1.0	0	Wolsey	Cw	Ore	0.00
BHDDH08-01	1335.3	1335.6	407.0	407.1	0.1	0	Wolsey	Cw	Ore	0.00
BHDDH08-02	1193.3	1195.9	363.7	364.5	0.8	0	Wolsey	Cw	Ore	0.00
BHDDH08-03	1241.8	1246.7	378.5	380.0	1.5	0	Wolsey	Cw	Ore	0.00

BHDDH08-03	1249.7	1264.8	380.9	385.5	4.6	0	Wolsey	Cw	Ore	0.00	
BHDDH08-03	1272.3	1278.5	387.8	389.7	1.9	0	Wolsey	Cw	Ore	0.00	
BHDDH08-03	1607.9	1614.4	490.1	492.1	2.0	0	Wolsey	Cw	Ore	0.00	
BHDDH08-02	1185.7	1189.7	361.4	362.6	1.2	1	Wolsey	Cw	Ore	1.22	
BH95-5	1449.6	1457	441.8	444.1	2.3	2	Wolsey	Cw	Ore	4.51	
BH95-5	1495.7	1496	455.9	456.0	0.1	2	Wolsey	Cw	Ore	0.18	
BH95-5	1512.1	1513.7	460.9	461.4	0.5	2	Wolsey	Cw	Ore	0.98	
BH95-5	1492.7	1495.7	455.0	455.9	0.9	5	Wolsey	Cw	Ore	4.57	
BHDDH08-02	1178.2	1178.7	359.1	359.3	0.2	7.5	Wolsey	Cw	Ore	1.14	
BHDDH08-02	1178.7	1185.7	359.3	361.4	2.1	7.5	Wolsey	Cw	Ore	16.00	
BH95-5	1430.6	1432.1	436.0	436.5	0.5	10	Wolsey	Cw	Ore	4.57	
BH95-5	1436.6	1439.6	437.9	438.8	0.9	10	Wolsey	Cw	Ore	9.14	
BHDDH08-03	1293.6	1298.6	394.3	395.8	1.5	10	Wolsey	Cw	Ore	15.24	
BH95-5	1439.6	1443.2	438.8	439.9	1.1	15	Wolsey	Cw	Ore	16.46	
BHDDH08-02	1189.7	1193.3	362.6	363.7	1.1	15	Wolsey	Cw	Ore	16.46	
BHDDH08-03	1579.6	1590.8	481.5	484.9	3.4	15	Wolsey	Cw	Ore	51.21	
BHDDH08-02	1171	1178.2	356.9	359.1	2.2	20	Wolsey	Cw	Ore	43.89	
BHDDH08-03	1206.7	1208.7	367.8	368.4	0.6	27.5	Wolsey	Cw	Ore	16.76	
BH95-5	1428.8	1430.6	435.5	436.0	0.5	30	Wolsey	Cw	Ore	16.46	
BHDDH08-03	1559.6	1568.8	475.4	478.2	2.8	30	Wolsey	Cw	Ore	84.12	
BHDDH08-03	1596.6	1600.6	486.6	487.9	1.2	30	Wolsey	Cw	Ore	36.58	
BHDDH08-01	1335.6	1336.6	407.1	407.4	0.3	35	Wolsey	Cw	Ore	10.67	
BH95-5	1432.1	1436.6	436.5	437.9	1.4	65	Wolsey	Cw	Ore	89.15	
Totals					**37.6**					**439.32**	**11.68**

BH94-9	842.6	869.9	256.8	265.1	8.3	0	Wolsey	Cw	Waste	0.00
BH95-3	1400.6	1420.6	426.9	433.0	6.1	0	Wolsey	Cw	Waste	0.00
BH95-3	1609.5	1617.7	490.6	493.1	2.5	0	Wolsey	Cw	Waste	0.00
BH95-3	1639.7	1645.6	499.8	501.6	1.8	0	Wolsey	Cw	Waste	0.00
BH95-3	1647.5	1655.4	502.2	504.6	2.4	0	Wolsey	Cw	Waste	0.00
BH95-3	1661.6	1701	506.5	518.5	12.0	0	Wolsey	Cw	Waste	0.00
BH95-3	1704.6	1729.5	519.6	527.2	7.6	0	Wolsey	Cw	Waste	0.00
BH95-3	1745.6	1761.7	532.1	537.0	4.9	0	Wolsey	Cw	Waste	0.00
BH95-3	1767.6	1775.5	538.8	541.2	2.4	0	Wolsey	Cw	Waste	0.00
BH95-3	1787.5	1845	544.8	562.4	17.5	0	Wolsey	Cw	Waste	0.00
BH95-3	1845.5	1870.6	562.5	570.2	7.7	0	Wolsey	Cw	Waste	0.00
BH95-3	1871.5	1919.5	570.4	585.1	14.6	0	Wolsey	Cw	Waste	0.00
BH95-3	1922.5	1922.7	586.0	586.0	0.1	0	Wolsey	Cw	Waste	0.00
BH95-5	1443.2	1446.5	439.9	440.9	1.0	0	Wolsey	Cw	Waste	0.00
BH95-5	1517	1524.5	462.4	464.7	2.3	0	Wolsey	Cw	Waste	0.00
BH95-7	1125.7	1131.7	343.1	344.9	1.8	0	Wolsey	Cw	Waste	0.00
BH95-7	1139.7	1155.7	347.4	352.3	4.9	0	Wolsey	Cw	Waste	0.00
BH95-7	1515	1563.6	461.8	476.6	14.8	0	Wolsey	Cw	Waste	0.00
BH95-7	1575.7	1643.6	480.3	501.0	20.7	0	Wolsey	Cw	Waste	0.00
BH95-7	2274.4	2499.4	693.2	761.8	68.6	0	Wolsey	Cw	Waste	0.00
BH95-7	2509.2	2575.5	764.8	785.0	20.2	0	Wolsey	Cw	Waste	0.00
BH96-2	575	628.8	175.3	191.7	16.4	0	Wolsey	Cw	Waste	0.00
BH96-2	643.9	644.8	196.3	196.5	0.3	0	Wolsey	Cw	Waste	0.00
BH96-2	689.8	706.8	210.3	215.4	5.2	0	Wolsey	Cw	Waste	0.00
BH96-2	774.7	775.7	236.1	236.4	0.3	0	Wolsey	Cw	Waste	0.00
BH96-2	859.3	930.8	261.9	283.7	21.8	0	Wolsey	Cw	Waste	0.00
BH96-2	949.9	981.7	289.5	299.2	9.7	0	Wolsey	Cw	Waste	0.00
BH96-20	852.8	913.8	259.9	278.5	18.6	0	Wolsey	Cw	Waste	0.00
BH96-20	917.7	931.8	279.7	284.0	4.3	0	Wolsey	Cw	Waste	0.00
BH96-20	933.8	949.9	284.6	289.5	4.9	0	Wolsey	Cw	Waste	0.00
BH96-20	953.8	959.8	290.7	292.5	1.8	0	Wolsey	Cw	Waste	0.00
BH96-20	1003.7	1029.6	305.9	313.8	7.9	0	Wolsey	Cw	Waste	0.00
BH96-20	1032.9	1041.2	314.8	317.4	2.5	0	Wolsey	Cw	Waste	0.00
BH96-7	804.9	929.9	245.3	283.4	38.1	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1082.1	1101.8	329.8	335.8	6.0	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1208	1219	368.2	371.6	3.4	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1209.7	1219.7	368.7	371.8	3.0	0	Wolsey	Cw	Waste	0.00

BHDDH08-01	1322.5	1335.3	403.1	407.0	3.9	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1336.6	1340.5	407.4	408.6	1.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1544.6	1552.8	470.8	473.3	2.5	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1557.7	1563.2	474.8	476.5	1.7	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1576.4	1593.4	480.5	485.7	5.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1593.4	1594.6	485.7	490.9	5.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-01	1610.5	1615.7	490.9	492.5	1.6	0	Wolsey	Cw	Waste	0.00
BHDDH08-02	1195.9	1196.9	364.5	364.8	0.3	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1231.6	1241.8	375.4	378.5	3.1	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1246.7	1249.7	380.0	380.9	0.9	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1264.8	1272.3	385.5	387.8	2.3	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1506.5	1553.1	459.2	473.4	14.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1568.8	1572.8	478.2	479.4	1.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1590.8	1591.5	484.9	485.1	0.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-03	1600.6	1604.6	487.9	489.1	1.2	0	Wolsey	Cw	Waste	0.00
BHDDH08-04	1361.7	1367.8	415.0	416.9	1.9	0	Wolsey	Cw	Waste	0.00
BH95-3	1775.5	1787.5	541.2	544.8	3.7	1	Wolsey	Cw	Waste	3.66
BH95-5	1561.6	1564.6	476.0	476.9	0.9	1	Wolsey	Cw	Waste	0.91
BH95-5	1605.6	1609.6	489.4	490.6	1.2	1	Wolsey	Cw	Waste	1.22
BH95-7	1059.7	1067.7	323.0	325.4	2.4	1	Wolsey	Cw	Waste	2.44
BH95-7	1093.7	1119.7	333.4	341.3	7.9	1	Wolsey	Cw	Waste	7.92
BH95-7	1131.7	1139.7	344.9	347.4	2.4	1	Wolsey	Cw	Waste	2.44
BH95-7	1155.7	1163.7	352.3	354.7	2.4	1	Wolsey	Cw	Waste	2.44
BH95-7	1455.6	1471.6	443.7	448.5	4.9	1	Wolsey	Cw	Waste	4.88
BH95-7	1471.6	1493.4	448.5	455.2	6.6	1	Wolsey	Cw	Waste	6.64
BH95-7	1563.6	1573.7	476.6	479.7	3.1	1	Wolsey	Cw	Waste	3.08
BH96-20	913.8	917.7	278.5	279.7	1.2	1	Wolsey	Cw	Waste	1.19
BH96-20	949.9	953.8	289.5	290.7	1.2	1	Wolsey	Cw	Waste	1.19
BH96-20	1083.7	1085.7	330.3	330.9	0.6	1	Wolsey	Cw	Waste	0.61
BH96-20	1108.5	1113.2	337.9	339.3	1.4	1	Wolsey	Cw	Waste	1.43
BHDDH08-01	1174.7	1208	358.0	368.2	10.1	1	Wolsey	Cw	Waste	10.15
BHDDH08-01	1234.7	1269.7	376.3	387.0	10.7	1	Wolsey	Cw	Waste	10.67
BHDDH08-02	1217.7	1239.7	371.2	377.9	6.7	1	Wolsey	Cw	Waste	6.71
BHDDH08-03	1305.7	1311.7	398.0	399.8	1.8	1	Wolsey	Cw	Waste	1.83
BHDDH08-01	1101.8	1124.7	335.8	342.8	7.0	1.5	Wolsey	Cw	Waste	10.47
BHDDH08-01	1272.7	1299.7	387.9	396.1	8.2	1.5	Wolsey	Cw	Waste	12.34
BHDDH08-01	1379.6	1383.6	420.5	421.7	1.2	1.5	Wolsey	Cw	Waste	1.83
BHDDH08-04	1234.7	1239.7	376.3	377.9	1.5	1.5	Wolsey	Cw	Waste	2.29
BHDDH08-04	1334.7	1347.7	406.8	410.8	4.0	1.5	Wolsey	Cw	Waste	5.94
BHDDH08-04	1353.7	1361.7	412.6	415.0	2.4	1.5	Wolsey	Cw	Waste	3.66
BHDDH08-04	1381.6	1390.7	421.1	423.9	2.8	1.5	Wolsey	Cw	Waste	4.16
BHDDH08-04	1431.6	1443.6	436.4	440.0	3.7	1.5	Wolsey	Cw	Waste	5.49
BHDDH08-04	1473.6	1478.6	449.2	450.7	1.5	1.5	Wolsey	Cw	Waste	2.29
BH95-5	1457	1457.6	444.1	444.3	0.2	2	Wolsey	Cw	Waste	0.37
BH95-5	1473.7	1487.5	449.2	453.4	4.2	2	Wolsey	Cw	Waste	8.41
BH95-5	1496	1507.1	456.0	459.4	3.4	2	Wolsey	Cw	Waste	6.77
BH95-5	1511.6	1512.1	460.7	460.9	0.2	2	Wolsey	Cw	Waste	0.30
BH95-5	1577.6	1594.6	480.9	486.0	5.2	2	Wolsey	Cw	Waste	10.36
BH95-5	1599.6	1605.6	487.6	489.4	1.8	2	Wolsey	Cw	Waste	3.66
BH95-5	1634.6	1636.6	498.2	498.8	0.6	2	Wolsey	Cw	Waste	1.22
BH95-7	976.8	983.7	297.7	299.8	2.1	2	Wolsey	Cw	Waste	4.21
BH95-7	983.7	997.1	299.8	303.9	4.1	2	Wolsey	Cw	Waste	8.17
BH95-7	1057.7	1059.7	322.4	323.0	0.6	2	Wolsey	Cw	Waste	1.22
BH95-7	1091.7	1093.7	332.8	333.4	0.6	2	Wolsey	Cw	Waste	1.22
BH95-7	1119.7	1125.7	341.3	343.1	1.8	2	Wolsey	Cw	Waste	3.66
BH95-7	1444.5	1449.8	440.3	441.9	1.6	2	Wolsey	Cw	Waste	3.23
BH96-20	1041.2	1044.2	317.4	318.3	0.9	2	Wolsey	Cw	Waste	1.83
BHDDH08-03	1428.6	1448.6	435.4	441.5	6.1	2	Wolsey	Cw	Waste	12.19
BHDDH08-03	1449	1495.6	441.7	455.9	14.2	2	Wolsey	Cw	Waste	28.41
BHDDH08-04	1272.7	1284.7	387.9	391.6	3.7	2	Wolsey	Cw	Waste	7.32
BHDDH08-04	1226.7	1234.7	373.9	376.3	2.4	2.5	Wolsey	Cw	Waste	6.10
BHDDH08-04	1239.7	1253.7	377.9	382.1	4.3	2.5	Wolsey	Cw	Waste	10.67
BH95-5	1460.6	1461.2	445.2	445.4	0.2	3	Wolsey	Cw	Waste	0.55

BH95-5	1489.6	1490.6	454.0	454.3	0.3	3	Wolsey	Cw	Waste	0.91
BH95-5	1524.5	1532.4	464.7	467.1	2.4	3	Wolsey	Cw	Waste	7.22
BH95-5	1550.5	1561.6	472.6	476.0	3.4	3	Wolsey	Cw	Waste	10.15
BH95-5	1564.6	1577.6	476.9	480.9	4.0	3	Wolsey	Cw	Waste	11.89
BH95-5	1609.6	1613.6	490.6	491.8	1.2	3	Wolsey	Cw	Waste	3.66
BH95-5	1621.6	1623.6	494.3	494.9	0.6	3	Wolsey	Cw	Waste	1.83
BH95-5	1629.6	1631.6	496.7	497.3	0.6	3	Wolsey	Cw	Waste	1.83
BH95-5	1649.6	1653.6	502.8	504.0	1.2	3	Wolsey	Cw	Waste	3.66
BH95-5	1661.6	1671.6	506.5	509.5	3.0	3	Wolsey	Cw	Waste	9.14
BH95-7	1067.7	1069.7	325.4	326.0	0.6	3	Wolsey	Cw	Waste	1.83
BH95-7	1087.7	1091.7	331.5	332.8	1.2	3	Wolsey	Cw	Waste	3.66
BH95-7	1163.7	1165.7	354.7	355.3	0.6	3	Wolsey	Cw	Waste	1.83
BH95-7	1573.7	1575.7	479.7	480.3	0.6	3	Wolsey	Cw	Waste	1.83
BH96-2	628.8	643.8	191.7	196.2	4.6	3	Wolsey	Cw	Waste	13.72
BH96-2	775.8	778.8	236.5	237.4	0.9	3	Wolsey	Cw	Waste	2.74
BHDDH08-01	1219.7	1229.7	371.8	374.8	3.0	3	Wolsey	Cw	Waste	9.14
BHDDH08-04	1303.7	1319.7	397.4	402.2	4.9	3	Wolsey	Cw	Waste	14.63
BHDDH08-04	1390.7	1396.7	423.9	425.7	1.8	3	Wolsey	Cw	Waste	5.49
BHDDH08-04	1396.7	1401.6	425.7	427.2	1.5	3	Wolsey	Cw	Waste	4.48
BHDDH08-04	1413.6	1431.6	430.9	436.4	5.5	3	Wolsey	Cw	Waste	16.46
BH94-9	869.9	870.2	265.1	265.2	0.1	3.5	Wolsey	Cw	Waste	0.32
BH95-7	2499.4	2509.2	761.8	764.8	3.0	3.5	Wolsey	Cw	Waste	10.45
BHDDH08-04	1443.6	1473.6	440.0	449.2	9.1	3.5	Wolsey	Cw	Waste	32.00
BH95-3	1761.7	1767.5	537.0	538.7	1.8	4	Wolsey	Cw	Waste	7.07
BH95-5	1653.6	1661.6	504.0	506.5	2.4	4	Wolsey	Cw	Waste	9.75
BH95-5	1672.6	1676.6	509.8	511.0	1.2	4	Wolsey	Cw	Waste	4.88
BH95-7	1169.7	1187	356.5	361.8	5.3	4	Wolsey	Cw	Waste	21.09
BH96-20	1182.7	1188.7	360.5	362.3	1.8	4	Wolsey	Cw	Waste	7.32
BHDDH08-01	1299.5	1312.3	396.1	400.0	3.9	4	Wolsey	Cw	Waste	15.61
BHDDH08-01	1615.7	1624.6	492.5	495.2	2.7	4	Wolsey	Cw	Waste	10.85
BHDDH08-02	1259.7	1291.7	384.0	393.7	9.8	4	Wolsey	Cw	Waste	39.01
BHDDH08-02	1293.2	1297.7	394.2	395.5	1.4	4	Wolsey	Cw	Waste	5.49
BHDDH08-03	1212.6	1219.8	369.6	371.8	2.2	4	Wolsey	Cw	Waste	8.78
BHDDH08-03	1332.7	1341.7	406.2	409.0	2.7	4	Wolsey	Cw	Waste	10.97
BHDDH08-03	1345.7	1367.7	410.2	416.9	6.7	4	Wolsey	Cw	Waste	26.82
BHDDH08-03	1374.6	1390.7	419.0	423.9	4.9	4	Wolsey	Cw	Waste	19.63
BHDDH08-03	1417.6	1428.6	432.1	435.4	3.4	4	Wolsey	Cw	Waste	13.41
BHDDH08-03	1574.6	1579.6	479.9	481.5	1.5	4	Wolsey	Cw	Waste	6.10
BHDDH08-03	1604.6	1607.6	489.1	490.0	0.9	4	Wolsey	Cw	Waste	3.66
BHDDH08-04	1319.7	1324.7	402.2	403.8	1.5	4	Wolsey	Cw	Waste	6.10
BHDDH08-04	1324.7	1333.6	403.8	406.5	2.7	4	Wolsey	Cw	Waste	10.85
BH95-3	1729.5	1745.6	527.2	532.1	4.9	5	Wolsey	Cw	Waste	24.54
BH95-5	1487.6	1489.6	453.4	454.0	0.6	5	Wolsey	Cw	Waste	3.05
BH95-5	1490.6	1492.7	454.3	455.0	0.6	5	Wolsey	Cw	Waste	3.20
BH95-5	1507.1	1511.6	459.4	460.7	1.4	5	Wolsey	Cw	Waste	6.86
BH95-5	1594.6	1599.6	486.0	487.6	1.5	5	Wolsey	Cw	Waste	7.62
BH95-5	1614.6	1619.6	492.1	493.7	1.5	5	Wolsey	Cw	Waste	7.62
BH95-5	1623.6	1629.6	494.9	496.7	1.8	5	Wolsey	Cw	Waste	9.14
BH95-5	1631.6	1634.6	497.3	498.2	0.9	5	Wolsey	Cw	Waste	4.57
BH95-5	1636.6	1639.6	498.8	499.8	0.9	5	Wolsey	Cw	Waste	4.57
BH95-7	1040.7	1057.7	317.2	322.4	5.2	5	Wolsey	Cw	Waste	25.91
BH95-7	1069.7	1077.7	326.0	328.5	2.4	5	Wolsey	Cw	Waste	12.19
BH95-7	1165.7	1169.7	355.3	356.5	1.2	5	Wolsey	Cw	Waste	6.10
BH95-7	1379.6	1399.2	420.5	426.5	6.0	5	Wolsey	Cw	Waste	29.87
BH95-7	1449.6	1455.6	441.8	443.7	1.8	5	Wolsey	Cw	Waste	9.14
BH96-20	969.8	974.8	295.6	297.1	1.5	5	Wolsey	Cw	Waste	7.62
BHDDH08-01	1144.7	1154.7	348.9	352.0	3.0	5	Wolsey	Cw	Waste	15.24
BH95-7	1037.7	1040.7	316.3	317.2	0.9	6	Wolsey	Cw	Waste	5.49
BH95-7	1077.7	1087.7	328.5	331.5	3.0	6	Wolsey	Cw	Waste	18.29
BH95-7	1362.2	1379.6	415.2	420.5	5.3	6	Wolsey	Cw	Waste	31.82
BHDDH08-02	1239.7	1259.7	377.9	384.0	6.1	6	Wolsey	Cw	Waste	36.58
BHDDH08-04	1253.7	1272.7	382.1	387.9	5.8	6	Wolsey	Cw	Waste	34.75
BHDDH08-01	1154.7	1174.7	352.0	358.0	6.1	6.1	Wolsey	Cw	Waste	37.19

BHDDH08-02	1196.9	1217.7	364.8	371.2	6.3	6.5	Wolsey	Cw	Waste	41.21
BHDDH08-04	1284.7	1303.7	391.6	397.4	5.8	6.5	Wolsey	Cw	Waste	37.64
BHDDH08-04	1333.6	1334.7	406.5	406.8	0.3	6.5	Wolsey	Cw	Waste	2.18
BHDDH08-04	1367.7	1381.6	416.9	421.1	4.2	6.5	Wolsey	Cw	Waste	27.54
BHDDH08-04	1401.6	1413.6	427.2	430.9	3.7	6.5	Wolsey	Cw	Waste	23.77
BH95-5	1619.6	1621.6	493.7	494.3	0.6	7	Wolsey	Cw	Waste	4.27
BH95-5	1639.6	1649.6	499.8	502.8	3.0	7	Wolsey	Cw	Waste	21.34
BH95-3	1420.6	1426.1	433.0	434.7	1.7	7.5	Wolsey	Cw	Waste	12.57
BH95-3	1645.6	1647.6	501.6	502.2	0.6	7.5	Wolsey	Cw	Waste	4.57
BH95-3	1655.6	1661.6	504.6	506.5	1.8	7.5	Wolsey	Cw	Waste	13.72
BH95-3	1701	1704.6	518.5	519.6	1.1	7.5	Wolsey	Cw	Waste	8.23
BH96-2	778.8	791.8	237.4	241.3	4.0	7.5	Wolsey	Cw	Waste	29.72
BH96-2	855.3	858.3	260.7	261.6	0.9	7.5	Wolsey	Cw	Waste	6.86
BH96-20	961.8	965.3	293.2	294.2	1.1	7.5	Wolsey	Cw	Waste	8.00
BH96-20	1077.2	1080.7	328.3	329.4	1.1	7.5	Wolsey	Cw	Waste	8.00
BH96-20	1104.7	1108.5	336.7	337.9	1.2	7.5	Wolsey	Cw	Waste	8.69
BH96-20	1126.7	1133.7	343.4	345.6	2.1	7.5	Wolsey	Cw	Waste	16.00
BH96-20	1155.2	1169.7	352.1	356.5	4.4	7.5	Wolsey	Cw	Waste	33.15
BHDDH08-01	1624.6	1630.2	495.2	496.9	1.7	7.5	Wolsey	Cw	Waste	12.80
BHDDH08-03	1311.7	1316.7	399.8	401.3	1.5	7.5	Wolsey	Cw	Waste	11.43
BHDDH08-03	1553.7	1559.6	473.6	475.4	1.8	7.5	Wolsey	Cw	Waste	13.49
BHDDH08-03	1591.5	1596.6	485.1	486.6	1.6	7.5	Wolsey	Cw	Waste	11.66
BHDDH08-01	1124.7	1144.7	342.8	348.9	6.1	8	Wolsey	Cw	Waste	48.77
BHDDH08-04	1347.7	1353.7	410.8	412.6	1.8	8	Wolsey	Cw	Waste	14.63
BHDDH08-02	1298.4	1315.7	395.8	401.0	5.3	8.5	Wolsey	Cw	Waste	44.82
BHDDH08-03	1219.8	1229.7	371.8	374.8	3.0	8.5	Wolsey	Cw	Waste	25.65
BHDDH08-03	1229.7	1231.6	374.8	375.4	0.6	8.5	Wolsey	Cw	Waste	4.92
BHDDH08-03	1367.7	1374.6	416.9	419.0	2.1	8.5	Wolsey	Cw	Waste	17.88
BH95-5	1457.6	1460.6	444.3	445.2	0.9	10	Wolsey	Cw	Waste	9.14
BH95-5	1613.6	1614.6	491.8	492.1	0.3	10	Wolsey	Cw	Waste	3.05
BHDDH08-03	1278.7	1293.6	389.7	394.3	4.5	10	Wolsey	Cw	Waste	45.42
BHDDH08-03	1298.6	1305.8	395.8	398.0	2.2	10	Wolsey	Cw	Waste	21.95
BHDDH08-03	1393.6	1417.6	424.8	432.1	7.3	10	Wolsey	Cw	Waste	73.15
BHDDH08-04	1478.6	1479.6	450.7	451.0	0.3	11	Wolsey	Cw	Waste	3.35
BH95-3	1919.5	1922.5	585.1	586.0	0.9	12.5	Wolsey	Cw	Waste	11.43
BH96-2	706.8	711.8	215.4	217.0	1.5	12.5	Wolsey	Cw	Waste	19.05
BHDDH08-01	1512.1	1524.2	460.9	464.6	3.7	12.5	Wolsey	Cw	Waste	46.10
BHDDH08-01	1552.6	1557.7	473.2	474.8	1.6	12.5	Wolsey	Cw	Waste	19.43
BHDDH08-01	1534.1	1544.6	467.6	470.8	3.2	13	Wolsey	Cw	Waste	41.61
BH95-5	1671.6	1672.6	509.5	509.8	0.3	15	Wolsey	Cw	Waste	4.57
BH96-20	931.8	933.8	284.0	284.6	0.6	15	Wolsey	Cw	Waste	9.14
BH96-20	1044.2	1048.2	318.3	319.5	1.2	15	Wolsey	Cw	Waste	18.29
BH96-20	1124.7	1126.7	342.8	343.4	0.6	15	Wolsey	Cw	Waste	9.14
BH96-20	1176.7	1182.7	358.7	360.5	1.8	15	Wolsey	Cw	Waste	27.43
BHDDH08-01	1229.7	1234.7	374.8	376.3	1.5	15	Wolsey	Cw	Waste	22.86
BHDDH08-01	1594.6	1610.6	376.3	490.9	114.6	15	Wolsey	Cw	Waste	1718.61
BHDDH08-04	1198.7	1215.7	365.4	370.5	5.2	15	Wolsey	Cw	Waste	77.72
BH96-20	1140.7	1144.7	347.7	348.9	1.2	17.5	Wolsey	Cw	Waste	21.34
BHDDH08-01	1377.6	1379.6	419.9	420.5	0.6	17.5	Wolsey	Cw	Waste	10.67
BHDDH08-03	1208.7	1212.5	368.4	369.6	1.2	17.5	Wolsey	Cw	Waste	20.27
BHDDH08-03	1341.7	1345.7	409.0	410.2	1.2	17.5	Wolsey	Cw	Waste	21.34
BHDDH08-03	1390.7	1393.6	423.9	424.8	0.9	17.5	Wolsey	Cw	Waste	15.47
BHDDH08-03	1495.6	1506.6	455.9	459.2	3.4	17.5	Wolsey	Cw	Waste	58.67
BHDDH08-01	1340.5	1341.5	408.6	408.9	0.3	20	Wolsey	Cw	Waste	6.10
BHDDH08-01	1341.5	1361.7	408.9	415.0	6.2	20	Wolsey	Cw	Waste	123.14
BHDDH08-01	1361.7	1365.7	415.0	416.3	1.2	20	Wolsey	Cw	Waste	24.38
BHDDH08-01	1365.7	1377.6	416.3	419.9	3.6	20	Wolsey	Cw	Waste	72.54
BHDDH08-02	1291.7	1293.2	393.7	394.2	0.5	20	Wolsey	Cw	Waste	9.14
BHDDH08-02	1297.7	1298.4	395.5	395.8	0.2	20	Wolsey	Cw	Waste	4.27
BHDDH08-03	1316.7	1332.7	401.3	406.2	4.9	20	Wolsey	Cw	Waste	97.54
BHDDH08-03	1448.6	1449	441.5	441.7	0.1	20	Wolsey	Cw	Waste	2.44
BHDDH08-03	1572.8	1574.6	479.4	479.9	0.5	20	Wolsey	Cw	Waste	10.97
BHDDH08-03	1607.6	1607.9	490.0	490.1	0.1	21.5	Wolsey	Cw	Waste	1.97

BHDDH08-04	1190.7	1198.7	362.9	365.4	2.4	22.5	Wolsey	Cw	Waste	54.86	
BH95-3	1870.6	1871.5	570.2	570.4	0.3	25	Wolsey	Cw	Waste	6.86	
BH96-20	959.8	961.8	292.5	293.2	0.6	25	Wolsey	Cw	Waste	15.24	
BH96-20	1029.7	1032.9	313.9	314.8	1.0	25	Wolsey	Cw	Waste	24.38	
BH96-20	1080.7	1083.7	329.4	330.3	0.9	25	Wolsey	Cw	Waste	22.86	
BH96-20	1152.7	1155.2	351.3	352.1	0.8	25	Wolsey	Cw	Waste	19.05	
BH96-20	1169.7	1176.7	356.5	358.7	2.1	25	Wolsey	Cw	Waste	53.34	
BH96-20	1048.2	1057.2	319.5	322.2	2.7	30	Wolsey	Cw	Waste	82.30	
BHDDH08-01	1269.7	1272.7	387.0	387.9	0.9	30	Wolsey	Cw	Waste	27.43	
BH96-2	854.3	855.3	260.4	260.7	0.3	35	Wolsey	Cw	Waste	10.67	
BH96-20	994.7	997.7	303.2	304.1	0.9	35	Wolsey	Cw	Waste	32.00	
BH96-20	998.7	1003.7	304.4	305.9	1.5	35	Wolsey	Cw	Waste	53.34	
BH96-20	1069.2	1074.7	325.9	327.6	1.7	35	Wolsey	Cw	Waste	58.67	
BH96-20	1116.7	1124.7	340.4	342.8	2.4	35	Wolsey	Cw	Waste	85.34	
BHDDH08-04	1215.7	1226.7	370.5	373.9	3.4	35	Wolsey	Cw	Waste	117.35	
BH96-2	935.8	939.8	285.2	286.5	1.2	40	Wolsey	Cw	Waste	48.77	
BH96-2	939.8	941.8	286.5	287.1	0.6	40	Wolsey	Cw	Waste	24.38	
BH96-2	945.8	949.6	288.3	289.4	1.2	40	Wolsey	Cw	Waste	46.33	
BH96-2	949.6	949.9	289.4	289.5	0.1	40	Wolsey	Cw	Waste	3.66	
BH96-20	1136.7	1140.7	346.5	347.7	1.2	40	Wolsey	Cw	Waste	48.77	
BHDDH08-03	1553.1	1553.7	473.4	473.6	0.2	40	Wolsey	Cw	Waste	7.32	
BH96-20	965.3	969.8	294.2	295.6	1.4	45	Wolsey	Cw	Waste	61.72	
BH96-2	807.3	807.8	246.1	246.2	0.2	50	Wolsey	Cw	Waste	7.62	
BH96-20	1113.2	1116.7	339.3	340.4	1.1	50	Wolsey	Cw	Waste	53.34	
BH96-20	1144.7	1152.7	348.9	351.3	2.4	50	Wolsey	Cw	Waste	121.92	
BH95-3	1845	1845.5	562.4	562.5	0.2	55	Wolsey	Cw	Waste	8.38	
BH96-2	858.3	859.3	261.6	261.9	0.3	55	Wolsey	Cw	Waste	16.76	
BH96-2	941.8	945.8	287.1	288.3	1.2	55	Wolsey	Cw	Waste	67.06	
BH96-20	974.8	981.7	297.1	299.2	2.1	55	Wolsey	Cw	Waste	115.67	
BH96-20	981.7	994.7	299.2	303.2	4.0	55	Wolsey	Cw	Waste	217.93	
BH96-20	1057.2	1066.2	322.2	325.0	2.7	55	Wolsey	Cw	Waste	150.88	
BHDDH08-04	1186.7	1190.6	361.7	362.9	1.2	60	Wolsey	Cw	Waste	71.32	
BH96-2	930.8	935.8	283.7	285.2	1.5	70	Wolsey	Cw	Waste	106.68	
BH96-20	1066.2	1069.2	325.0	325.9	0.9	75	Wolsey	Cw	Waste	68.58	
BH96-20	997.7	998.7	304.1	304.4	0.3	80	Wolsey	Cw	Waste	24.38	
BH96-20	1074.7	1077.2	327.6	328.3	0.8	85	Wolsey	Cw	Waste	64.77	
BH96-20	1085.7	1104.7	330.9	336.7	5.8	85	Wolsey	Cw	Waste	492.25	
BH96-20	1133.7	1136.7	345.6	346.5	0.9	85	Wolsey	Cw	Waste	77.72	
Totals					**1047.8**					**6740.42**	**6.43**

BH95-3	589.7	607.8	179.7	185.3	5.5	0	Park	Cp	Waste	0.00
BH95-3	609.8	615	185.9	187.5	1.6	0	Park	Cp	Waste	0.00
BH95-3	618.8	664.9	188.6	202.7	14.1	0	Park	Cp	Waste	0.00
BH95-3	669.8	679.9	204.2	207.2	3.1	0	Park	Cp	Waste	0.00
BH95-3	709.8	720	216.3	219.5	3.1	0	Park	Cp	Waste	0.00
BH95-3	729.8	860.8	222.4	262.4	39.9	0	Park	Cp	Waste	0.00
BH95-3	865.9	932.8	263.9	284.3	20.4	0	Park	Cp	Waste	0.00
BH95-5	269.9	279.8	82.3	85.3	3.0	0	Park	Cp	Waste	0.00
BH95-5	640.9	649.8	195.3	198.1	2.7	0	Park	Cp	Waste	0.00
BH95-5	689.8	695.8	210.3	212.1	1.8	0	Park	Cp	Waste	0.00
BH95-5	739.8	751.8	225.5	229.1	3.7	0	Park	Cp	Waste	0.00
BH95-5	817.7	841.6	249.2	256.5	7.3	0	Park	Cp	Waste	0.00
BH95-7	624.8	644.8	190.4	196.5	6.1	0	Park	Cp	Waste	0.00
BH95-7	669.8	684.8	204.2	208.7	4.6	0	Park	Cp	Waste	0.00
BH95-7	709.8	729.8	216.3	222.4	6.1	0	Park	Cp	Waste	0.00
BHDDH08-02	3	12.1	0.9	3.7	2.8	0	Park	Cp	Waste	0.00
BH95-5	649.8	659.8	198.1	201.1	3.0	1	Park	Cp	Waste	3.05
BH95-5	669.8	689.8	204.2	210.3	6.1	1	Park	Cp	Waste	6.10
BH95-5	751.8	771.8	229.1	235.2	6.1	1	Park	Cp	Waste	6.10
BH95-7	599.8	624.8	182.8	190.4	7.6	1	Park	Cp	Waste	7.62
BH95-7	644.8	659.8	196.5	201.1	4.6	1	Park	Cp	Waste	4.57
BH95-7	684.8	689.8	208.7	210.3	1.5	1	Park	Cp	Waste	1.52
BHDDH08-02	34.1	110.9	10.4	33.8	23.4	1	Park	Cp	Waste	23.41

BHDDH08-02	110.9	111	33.8	33.8	0.0	1	Park	Cp	Waste	0.03	
BHDDH08-02	140.1	152.8	42.7	46.6	3.9	1	Park	Cp	Waste	3.87	
BH95-3	615	618.8	187.5	188.6	1.2	2	Park	Cp	Waste	2.32	
BH95-3	679.9	709.8	207.2	216.3	9.1	2	Park	Cp	Waste	18.23	
BH95-3	720	729.8	219.5	222.4	3.0	2	Park	Cp	Waste	5.97	
BH95-3	860.8	865.9	262.4	263.9	1.6	2	Park	Cp	Waste	3.11	
BH95-5	659.8	669.8	201.1	204.2	3.0	2	Park	Cp	Waste	6.10	
BH95-5	695.8	719.8	212.1	219.4	7.3	2	Park	Cp	Waste	14.63	
BH95-5	719.8	735.8	219.4	224.3	4.9	2	Park	Cp	Waste	9.75	
BH95-5	783.8	789.8	238.9	240.7	1.8	2	Park	Cp	Waste	3.66	
BH95-5	799.8	817.8	243.8	249.3	5.5	2	Park	Cp	Waste	10.97	
BH95-7	574.7	579.9	175.2	176.8	1.6	2	Park	Cp	Waste	3.17	
BH95-7	589.8	594.8	179.8	181.3	1.5	2	Park	Cp	Waste	3.05	
BH95-7	689.8	709.8	210.3	216.3	6.1	2	Park	Cp	Waste	12.19	
BH95-3	607.8	609.8	185.3	185.9	0.6	3	Park	Cp	Waste	1.83	
BH95-5	289.9	294.9	88.4	89.9	1.5	3	Park	Cp	Waste	4.57	
BH95-5	314.9	350	96.0	106.7	10.7	3	Park	Cp	Waste	32.10	
BH95-5	735.8	739.8	224.3	225.5	1.2	3	Park	Cp	Waste	3.66	
BH95-5	775.8	783.8	236.5	238.9	2.4	3	Park	Cp	Waste	7.32	
BH95-5	789.8	799.8	240.7	243.8	3.0	3	Park	Cp	Waste	9.14	
BH95-7	594.8	599.8	181.3	182.8	1.5	3	Park	Cp	Waste	4.57	
BH95-5	294.9	314.9	89.9	96.0	6.1	4	Park	Cp	Waste	24.38	
BH95-7	659.8	669.8	201.1	204.2	3.0	4	Park	Cp	Waste	12.19	
BHDDH08-02	111	140.1	33.8	42.7	8.9	4	Park	Cp	Waste	35.48	
BH95-3	664.9	669.8	202.7	204.2	1.5	5	Park	Cp	Waste	7.47	
BHDDH08-02	12.1	34.1	3.7	10.4	6.7	5	Park	Cp	Waste	33.53	
BH95-7	579.9	589.8	176.8	179.8	3.0	7	Park	Cp	Waste	21.12	
BH95-5	279.8	289.9	85.3	88.4	3.1	8	Park	Cp	Waste	24.63	
Totals					**281.9**					**371.40**	**1.32**

BH95-3	0	524.8	0.0	160.0	160.0	0	Pilgrim	Cpi	Waste	0.00	
BH95-3	529.7	589.7	161.5	179.7	18.3	0	Pilgrim	Cpi	Waste	0.00	
BH95-5	29.8	249.9	9.1	76.2	67.1	0	Pilgrim	Cpi	Waste	0.00	
BH95-5	354.9	474.9	108.2	144.7	36.6	0	Pilgrim	Cpi	Waste	0.00	
BH95-5	504.8	639.9	153.9	195.0	41.2	0	Pilgrim	Cpi	Waste	0.00	
BH95-7	88.9	160.1	27.1	48.8	21.7	0	Pilgrim	Cpi	Waste	0.00	
BH95-5	474.9	476.9	144.7	145.4	0.6	1	Pilgrim	Cpi	Waste	0.61	
BH95-5	639.9	640.9	195.0	195.3	0.3	3	Pilgrim	Cpi	Waste	0.91	
Totals					**345.7**					**1.52**	**0.00**

Appendix B
(Weighted Average Iron/Sulfur Data Tables)

Hole_Id	From	To	Length	Lithology	Code	Ore_Type	Fe	S	Fe_weighted	S_weighted	Sulfide	Sulfide_weighted	Fe_wtd_avg	S-wtd_avg	Sulfide_wtd_avg
	m	m	m				percent	percent			percent				
BHDDH08-02	480.9	481.1	0.2	Diorite	Kd	Ore	0.70	0.11	0.14	0.02	0				
BHDDH08-02	433.8	434.6	0.8	Diorite	Kd	Ore	3.04	0.77	2.43	0.62	0				
BHDDH08-02	447.2	448.7	1.5	Diorite	Kd	Ore	3.97	1.35	5.96	2.03	0				
BHDDH08-02	432.5	433.7	1.2	Diorite	Kd	Ore	5.91	3.15	7.27	3.87	0				
BHDDH08-02	433.7	433.8	0.1	Diorite	Kd	Ore	5.91	3.15	0.59	0.32	0				
BHDDH08-03	492.2	492.3	0.1	Diorite	Kd	Ore	9.21	4.55	0.92	0.46	0				
Totals			**3.9**						**17.31**	**7.31**			**4.40**	**1.86**	**0.00**
BHDDH08-02	450	451.4	1.4	Diorite	Kd	Waste	2.36	0.18	3.30	0.25	0	0.00			
BHDDH08-01	400.8	401.7	0.9	Diorite	Kd	Waste	2.21	0.24	1.99	0.22	0	0.00			
BHDDH08-02	451.4	452.9	1.5	Diorite	Kd	Waste	2.69	0.29	4.04	0.44	0	0.00			
BHDDH08-03	495.3	496.8	1.5	Diorite	Kd	Waste	6.56	0.31	9.97	0.47	0	0.00			
BHDDH08-01	503.8	504.8	1.0	Diorite	Kd	Waste	3.82	0.36	3.82	0.36	0	0.00			
BHDDH08-03	496.8	498.4	1.5	Diorite	Kd	Waste	6.92	0.39	10.59	0.60	0	0.00			
BHDDH08-02	479.8	480.9	1.1	Diorite	Kd	Waste	2.57	0.46	2.83	0.51	0	0.00			
BHDDH08-03	493.8	495.3	1.5	Diorite	Kd	Waste	8.50	0.47	12.92	0.71	0	0.00			
BHDDH08-01	401.7	402.3	0.6	Diorite	Kd	Waste	2.93	0.52	1.76	0.31	0	0.00			
BHDDH08-01	402.3	403.2	0.9	Diorite	Kd	Waste	2.93	0.52	2.64	0.47	0	0.00			
BHDDH08-02	452.9	454.5	1.6	Diorite	Kd	Waste	3.10	0.54	4.96	0.86	0	0.00			
BHDDH08-03	492.3	493.8	1.5	Diorite	Kd	Waste	7.53	0.80	11.30	1.20	0	0.00			
BHDDH08-02	454.5	455.3	0.8	Diorite	Kd	Waste	3.66	0.86	2.93	0.69	0	0.00			
BHDDH08-02	447.1	447.2	0.1	Diorite	Kd	Waste	3.61	1.09	0.36	0.11	0	0.00			
BHDDH08-01	502.9	503.8	0.9	Diorite	Kd	Waste	4.22	1.45	3.80	1.31	0	0.00			
BHDDH08-02	448.7	450.0	1.3	Diorite	Kd	Waste	4.42	1.69	5.75	2.20	0	0.00			
BHDDH08-04	224.9	226.8	1.9	Diorite	Kd	Waste	7.95	0.03	14.79	0.06	1.5	2.79			
BHDDH08-04	226.8	227.7	0.9	Diorite	Kd	Waste	7.76	0.29	6.98	0.26	1.5	1.35			
BHDDH08-02	439	440.4	1.4	Diorite	Kd	Waste	2.62	0.51	3.67	0.71	2	2.80			
BHDDH08-02	440.4	441.6	1.2	Diorite	Kd	Waste	3.00	0.61	3.60	0.73	2	2.40			
BHDDH08-02	441.7	443.5	1.8	Diorite	Kd	Waste	3.15	0.62	5.80	1.14	2	3.68			
BHDDH08-02	438.9	439	0.1	Diorite	Kd	Waste	2.61	0.75	0.23	0.07	2	0.18			
BHDDH08-02	430.1	431.1	1.0	Diorite	Kd	Waste	3.07	0.81	3.07	0.81	2	2.00			
BHDDH08-02	428.5	430.1	1.6	Diorite	Kd	Waste	3.21	0.91	5.14	1.46	2	3.20			
BHDDH08-02	427.0	428.5	1.5	Diorite	Kd	Waste	3.26	0.98	4.82	1.45	2	2.96			
BHDDH08-02	445	446	1.0	Diorite	Kd	Waste	3.60	0.98	3.60	0.98	2	2.00			
BHDDH08-02	446	447.1	1.1	Diorite	Kd	Waste	3.61	1.09	3.97	1.20	2	2.20			
BHDDH08-02	431.1	431.3	0.2	Diorite	Kd	Waste	3.95	1.13	0.79	0.23	2	0.40			
BHDDH08-02	443.5	445	1.5	Diorite	Kd	Waste	3.89	1.48	5.84	2.22	2	3.00			
BHDDH08-02	441.6	441.7	0.1	Diorite	Kd	Waste	15.45	9.00	1.54	0.90	2	0.20			
BHDDH08-04	224.8	224.9	0.1	Diorite	Kd	Waste	7.95	0.03	0.79	0.00	2.5	0.25			
BHDDH08-04	223.4	224.8	1.4	Diorite	Kd	Waste	8.83	0.03	12.36	0.04	2.5	3.50			
BHDDH08-04	239.2	239.3	0.1	Diorite	Kd	Waste	6.37	0.15	0.57	0.01	3.5	0.32			
BHDDH08-04	239.3	240.4	1.1	Diorite	Kd	Waste	6.37	0.15	7.01	0.16	3.5	3.85			
BHDDH08-02	476.4	477.9	1.5	Diorite	Kd	Waste	3.03	0.44	4.55	0.66	4	6.00			

BHDDH08-02	474.9	476.4	1.5	Diorite	Kd	Waste	2.88	0.48	4.32	0.72	4	6.00
BHDDH08-02	481.1	482.5	1.4	Diorite	Kd	Waste	3.04	0.52	4.26	0.73	4	5.60
BHDDH08-02	484	485.5	1.5	Diorite	Kd	Waste	3.07	0.56	4.61	0.84	4	6.00
BHDDH08-02	487.4	488.6	1.2	Diorite	Kd	Waste	3.15	0.57	3.78	0.68	4	4.80
BHDDH08-02	496.2	497.7	1.5	Diorite	Kd	Waste	3.03	0.62	4.55	0.93	4	6.00
BHDDH08-02	485.5	487.4	1.9	Diorite	Kd	Waste	3.19	0.62	6.06	1.18	4	7.60
BHDDH08-02	473.4	474.9	1.5	Diorite	Kd	Waste	3.02	0.63	4.53	0.95	4	6.00
BHDDH08-02	477.9	479.8	1.9	Diorite	Kd	Waste	3.41	0.63	6.48	1.20	4	7.60
BHDDH08-02	482.5	484	1.5	Diorite	Kd	Waste	2.87	0.67	4.31	1.01	4	6.00
BHDDH08-02	494.6	496.2	1.6	Diorite	Kd	Waste	2.87	0.67	4.59	1.07	4	6.40
BHDDH08-02	470.3	471.8	1.5	Diorite	Kd	Waste	3.24	0.68	4.86	1.02	4	6.00
BHDDH08-02	488.6	490.1	1.5	Diorite	Kd	Waste	3.39	0.68	5.09	1.02	4	6.00
BHDDH08-02	412.4	413.3	0.9	Diorite	Kd	Waste	2.48	0.70	2.23	0.63	4	3.60
BHDDH08-02	471.8	473.4	1.6	Diorite	Kd	Waste	3.43	0.74	5.49	1.18	4	6.40
BHDDH08-02	499.3	500.8	1.5	Diorite	Kd	Waste	3.43	0.74	5.15	1.11	4	6.00
BHDDH08-02	435.6	437.5	1.9	Diorite	Kd	Waste	3.08	0.81	5.85	1.54	4	7.60
BHDDH08-02	497.7	499.3	1.6	Diorite	Kd	Waste	3.46	0.85	5.54	1.36	4	6.40
BHDDH08-02	413.3	414.8	1.5	Diorite	Kd	Waste	2.81	0.87	4.22	1.31	4	6.00
BHDDH08-02	491.6	493.7	2.1	Diorite	Kd	Waste	3.56	0.88	7.48	1.85	4	8.40
BHDDH08-02	414.8	416.4	1.6	Diorite	Kd	Waste	2.76	0.90	4.42	1.44	4	6.40
BHDDH08-02	416.4	416.7	0.3	Diorite	Kd	Waste	3.12	0.91	0.94	0.27	4	1.20
BHDDH08-02	434.6	435.6	1.0	Diorite	Kd	Waste	3.18	0.99	3.05	0.95	4	3.84
BHDDH08-02	469.4	470.3	0.9	Diorite	Kd	Waste	3.53	1.00	3.21	0.91	4	3.64
BHDDH08-02	490.1	491.6	1.5	Diorite	Kd	Waste	3.68	1.07	5.52	1.61	4	6.00
BHDDH08-02	493.7	494.1	0.4	Diorite	Kd	Waste	3.07	1.40	1.23	0.56	4	1.60
BHDDH08-02	494.4	494.6	0.2	Diorite	Kd	Waste	3.07	1.40	0.64	0.29	4	0.84
BHDDH08-02	424	425.7	1.7	Diorite	Kd	Waste	2.82	0.65	4.79	1.10	6	10.20
BHDDH08-02	462.4	464.2	1.8	Diorite	Kd	Waste	3.35	0.74	6.03	1.33	6	10.80
BHDDH08-02	417.9	419.4	1.5	Diorite	Kd	Waste	2.68	0.78	4.02	1.17	6	9.00
BHDDH08-02	467.3	468.8	1.5	Diorite	Kd	Waste	3.56	0.83	5.34	1.25	6	9.00
BHDDH08-02	419.4	420.9	1.5	Diorite	Kd	Waste	2.87	0.84	4.31	1.26	6	9.00
BHDDH08-02	422.5	424	1.5	Diorite	Kd	Waste	3.24	0.90	4.86	1.35	6	9.00
BHDDH08-02	456.6	458.1	1.5	Diorite	Kd	Waste	3.52	0.90	5.32	1.36	6	9.06
BHDDH08-02	416.7	417.9	1.2	Diorite	Kd	Waste	3.12	0.91	3.87	1.13	6	7.44
BHDDH08-02	466	467.3	1.3	Diorite	Kd	Waste	3.63	0.92	4.72	1.20	6	7.80
BHDDH08-02	464.2	466	1.8	Diorite	Kd	Waste	3.53	0.93	6.35	1.67	6	10.80
BHDDH08-02	420.9	422.5	1.6	Diorite	Kd	Waste	3.26	0.94	5.22	1.50	6	9.60
BHDDH08-02	468.8	469.4	0.6	Diorite	Kd	Waste	3.53	1.00	2.12	0.60	6	3.60
BHDDH08-02	458.1	459.3	1.2	Diorite	Kd	Waste	4.03	1.11	4.84	1.33	6	7.20
BHDDH08-02	459.3	460.9	1.6	Diorite	Kd	Waste	4.00	1.28	6.40	2.05	6	9.60
BHDDH08-02	460.9	462.4	1.5	Diorite	Kd	Waste	3.65	1.54	5.48	2.31	6	9.00
BHDDH08-04	209.7	211.2	1.5	Diorite	Kd	Waste	7.60	0.07	11.40	0.11	6.5	9.75
BHDDH08-04	205.0	209.7	4.7	Diorite	Kd	Waste	0.58	0.08	2.73	0.38	6.5	30.55
BHDDH08-02	437.5	437.7	0.2	Diorite	Kd	Waste	2.61	0.75	0.52	0.15	7.5	1.50
BHDDH08-02	437.7	438.9	1.2	Diorite	Kd	Waste	2.61	0.75	3.18	0.92	7.5	9.15

BHDDH08-02	425.7	425.8	0.1	Diorite	Kd	Waste	4.14	1.36	0.41	0.14	8.5	0.85			
BHDDH08-02	425.8	427.0	1.2	Diorite	Kd	Waste	4.14	1.36	5.01	1.65	8.5	10.28			
BHDDH08-04	237.7	239.2	1.5	Diorite	Kd	Waste	7.01	0.08	10.23	0.12	10	14.60			
BHDDH08-04	461.8	463.3	1.5	Diorite	Kd	Waste	1.78	0.11	2.72	0.17	11	16.83			
BHDDH08-04	463.3	464.8	1.5	Diorite	Kd	Waste	1.87	0.18	2.84	0.27	11	16.72			
BHDDH08-04	454.3	455.7	1.4	Diorite	Kd	Waste	1.95	0.42	2.69	0.58	11	15.18			
BHDDH08-04	464.8	466.3	1.5	Diorite	Kd	Waste	2.66	0.52	4.04	0.79	11	16.72			
BHDDH08-04	452.8	454.3	1.5	Diorite	Kd	Waste	2.21	0.60	3.36	0.91	11	16.72			
BHDDH08-04	466.3	467.9	1.5	Diorite	Kd	Waste	3.00	0.78	4.59	1.19	11	16.83			
BHDDH08-04	477.0	478.5	1.5	Diorite	Kd	Waste	3.48	0.81	5.32	1.24	11	16.83			
BHDDH08-04	498.4	499.3	0.9	Diorite	Kd	Waste	4.16	0.83	3.79	0.76	11	10.01			
BHDDH08-04	478.5	480.1	1.5	Diorite	Kd	Waste	4.21	0.87	6.40	1.32	11	16.72			
BHDDH08-04	475.5	477.0	1.5	Diorite	Kd	Waste	2.20	0.93	3.34	1.41	11	16.72			
BHDDH08-04	455.7	457.2	1.5	Diorite	Kd	Waste	4.29	0.93	6.52	1.41	11	16.72			
BHDDH08-04	496.8	498.4	1.5	Diorite	Kd	Waste	4.78	0.94	7.31	1.44	11	16.83			
BHDDH08-04	486.2	487.7	1.5	Diorite	Kd	Waste	4.43	0.96	6.73	1.46	11	16.72			
BHDDH08-04	472.4	474.0	1.5	Diorite	Kd	Waste	3.88	0.98	5.90	1.49	11	16.72			
BHDDH08-04	458.7	460.3	1.5	Diorite	Kd	Waste	5.42	0.98	8.29	1.50	11	16.83			
BHDDH08-04	487.7	489.2	1.5	Diorite	Kd	Waste	4.24	1.05	6.44	1.60	11	16.72			
BHDDH08-04	495.3	496.8	1.5	Diorite	Kd	Waste	4.65	1.13	7.07	1.72	11	16.72			
BHDDH08-04	460.3	461.8	1.5	Diorite	Kd	Waste	3.71	1.17	5.64	1.78	11	16.72			
BHDDH08-04	480.1	481.6	1.5	Diorite	Kd	Waste	4.77	1.18	7.25	1.79	11	16.72			
BHDDH08-04	483.1	484.6	1.5	Diorite	Kd	Waste	4.60	1.19	6.99	1.81	11	16.72			
BHDDH08-04	481.6	483.1	1.5	Diorite	Kd	Waste	4.82	1.20	7.37	1.84	11	16.83			
BHDDH08-04	493.8	495.3	1.5	Diorite	Kd	Waste	4.37	1.22	6.64	1.85	11	16.72			
BHDDH08-02	455.3	455.4	0.1	Diorite	Kd	Waste	3.82	1.26	0.38	0.13	11	1.10			
BHDDH08-02	455.4	456.6	1.2	Diorite	Kd	Waste	3.82	1.26	4.66	1.54	11	13.42			
BHDDH08-04	484.6	486.2	1.5	Diorite	Kd	Waste	4.28	1.37	6.55	2.10	11	16.83			
BHDDH08-04	489.2	490.7	1.5	Diorite	Kd	Waste	4.06	1.38	6.21	2.11	11	16.83			
BHDDH08-04	451.1	452.8	1.7	Diorite	Kd	Waste	3.61	1.45	6.14	2.46	11	18.70			
BHDDH08-04	492.8	493.8	1.0	Diorite	Kd	Waste	4.88	1.45	4.78	1.42	11	10.78			
BHDDH08-04	490.7	492.8	2.1	Diorite	Kd	Waste	4.42	1.47	9.15	3.04	11	22.77			
BHDDH08-04	469.4	470.9	1.5	Diorite	Kd	Waste	4.58	1.49	7.01	2.28	11	16.83			
BHDDH08-04	457.2	458.7	1.5	Diorite	Kd	Waste	5.92	1.50	9.00	2.28	11	16.72			
BHDDH08-04	470.9	472.4	1.5	Diorite	Kd	Waste	4.44	1.70	6.75	2.58	11	16.72			
BHDDH08-04	467.9	469.4	1.5	Diorite	Kd	Waste	4.49	1.71	6.82	2.60	11	16.72			
BHDDH08-04	474.0	475.5	1.5	Diorite	Kd	Waste	2.71	2.12	4.15	3.24	11	16.83			
BHDDH08-02	431.3	432.5	1.2	Diorite	Kd	Waste	3.95	1.13	4.78	1.37	12.5	15.12			
BHDDH08-02	494.1	494.4	0.3	Diorite	Kd	Waste	3.07	1.40	0.95	0.43	12.5	3.88			
Totals			**156.4**						**590.17**	**130.12**		**956.28**	**3.77**	**0.83**	**6.12**

BHDDH08-02	410.3	411.8	1.5	Transitional Diorite	KdT	Ore	2.30	0.52	3.45	0.78	4	6.00
BHDDH08-02	407.2	408.1	0.9	Transitional Diorite	KdT	Ore	3.57	1.09	3.21	0.98	0	0.00
BHDDH08-02	408.1	408.7	0.6	Transitional Diorite	KdT	Ore	3.57	1.09	2.14	0.65	0	0.00
BHDDH08-02	404.2	405.7	1.5	Transitional Diorite	KdT	Ore	4.38	1.46	6.57	2.19	0	0.00

Totals			**4.5**						**15.38**	**4.61**		**6.00**	**3.42**	**1.02**	**1.33**
BHDDH08-02	401.1	402.6	1.5	Transitional Diorite	KdT	Waste	2.27	0.11	3.41	0.17	0	0.00			
BHDDH08-02	402.6	404	1.4	Transitional Diorite	KdT	Waste	3.50	0.65	4.90	0.91	0	0.00			
BHDDH08-02	408.7	409.4	0.7	Transitional Diorite	KdT	Waste	2.46	0.74	1.72	0.52	0	0.00			
BHDDH08-02	405.7	407.2	1.5	Transitional Diorite	KdT	Waste	4.66	1.03	6.99	1.55	0	0.00			
BHDDH08-01	476.6	477.9	1.3	Transitional Diorite	KdT	Waste	0.65	0.04	0.84	0.05	4	5.20			
BHDDH08-01	479.5	480.6	1.1	Transitional Diorite	KdT	Waste	3.89	0.32	4.28	0.35	4	4.40			
BHDDH08-02	411.8	412.4	0.6	Transitional Diorite	KdT	Waste	2.48	0.70	1.49	0.42	4	2.40			
BHDDH08-02	409.4	410.3	0.9	Transitional Diorite	KdT	Waste	2.46	0.74	2.21	0.67	4	3.60			
BHDDH08-01	477.9	479.5	1.6	Transitional Diorite	KdT	Waste	7.12	0.78	11.39	1.25	4	6.40			
BHDDH08-01	464.7	464.8	0.1	Transitional Diorite	KdT	Waste	5.03	1.04	0.50	0.10	12.5	1.25			
BHDDH08-01	464.8	466.2	1.4	Transitional Diorite	KdT	Waste	5.03	1.04	6.94	1.44	13	17.94			
BHDDH08-01	466.2	467.7	1.5	Transitional Diorite	KdT	Waste	6.40	1.26	9.60	1.89	13	19.50			
BHDDH08-02	404.0	404.2	0.2	Transitional Diorite	KdT	Waste	3.50	0.65	0.70	0.13	17.5	3.50			
Totals			**13.8**						**54.98**	**9.44**		**64.19**	**3.99**	**0.68**	**4.66**
BHDDH08-01	456.6	456.8	0.2	Gabbro	Kgb	Waste	5.18	1.44	1.04	0.29	0	0.00			
BHDDH08-01	439.8	441.4	1.6	Gabbro	Kgb	Waste	5.92	0.04	9.47	0.06	4	6.40			
BHDDH08-01	424.6	426.1	1.5	Gabbro	Kgb	Waste	7.79	0.07	11.69	0.11	4	6.00			
BHDDH08-01	423.1	424.6	1.5	Gabbro	Kgb	Waste	7.37	0.10	11.06	0.15	4	6.00			
BHDDH08-01	426.1	427.6	1.5	Gabbro	Kgb	Waste	8.10	0.10	12.15	0.15	4	6.00			
BHDDH08-01	442.9	444.4	1.5	Gabbro	Kgb	Waste	4.77	0.12	7.16	0.18	4	6.00			
BHDDH08-01	435.3	436.8	1.5	Gabbro	Kgb	Waste	6.02	0.18	9.03	0.27	4	6.00			
BHDDH08-01	441.4	442.9	1.5	Gabbro	Kgb	Waste	5.73	0.20	8.60	0.30	4	6.00			
BHDDH08-01	445.9	447.4	1.5	Gabbro	Kgb	Waste	3.95	0.23	5.93	0.35	4	6.00			
BHDDH08-01	421.8	423.1	1.3	Gabbro	Kgb	Waste	7.53	0.23	9.79	0.30	4	5.20			
BHDDH08-01	433.7	435.3	1.6	Gabbro	Kgb	Waste	7.95	0.31	12.72	0.50	4	6.40			
BHDDH08-01	432.2	433.7	1.5	Gabbro	Kgb	Waste	8.14	0.38	12.21	0.57	4	6.00			
BHDDH08-01	429.2	430.7	1.5	Gabbro	Kgb	Waste	8.36	0.45	12.54	0.68	4	6.00			
BHDDH08-01	427.6	429.2	1.6	Gabbro	Kgb	Waste	8.50	0.45	13.60	0.72	4	6.40			
BHDDH08-01	444.4	445.9	1.5	Gabbro	Kgb	Waste	7.00	0.55	10.50	0.83	4	6.00			
BHDDH08-01	436.8	438.3	1.5	Gabbro	Kgb	Waste	7.47	0.55	11.21	0.83	4	6.00			
BHDDH08-01	455.1	456.6	1.5	Gabbro	Kgb	Waste	4.08	0.57	6.12	0.86	4	6.00			
BHDDH08-01	447.4	449	1.6	Gabbro	Kgb	Waste	5.25	0.66	8.40	1.06	4	6.40			
BHDDH08-01	430.7	432.2	1.5	Gabbro	Kgb	Waste	8.85	0.77	13.28	1.16	4	6.00			
BHDDH08-01	450.5	452	1.5	Gabbro	Kgb	Waste	7.10	0.79	10.65	1.19	4	6.00			
BHDDH08-01	452	453.5	1.5	Gabbro	Kgb	Waste	5.42	0.80	8.13	1.20	4	6.00			
BHDDH08-01	449	450.5	1.5	Gabbro	Kgb	Waste	7.55	0.84	11.33	1.26	4	6.00			
BHDDH08-01	453.5	455.1	1.6	Gabbro	Kgb	Waste	4.98	1.01	7.97	1.62	4	6.40			
BHDDH08-01	438.3	439.8	1.5	Gabbro	Kgb	Waste	8.42	1.24	12.63	1.86	4	6.00			
BHDDH08-01	458.7	460.2	1.5	Gabbro	Kgb	Waste	3.50	0.22	5.25	0.33	5	7.50			
BHDDH08-01	457.2	458.7	1.5	Gabbro	Kgb	Waste	4.64	0.93	6.96	1.40	5	7.50			
BHDDH08-01	460.2	461.0	0.8	Gabbro	Kgb	Waste	4.79	1.60	3.83	1.28	12.5	10.00			
Totals			**38.8**						**253.21**	**19.45**		**164.20**	**6.53**	**0.50**	**4.23**

BHDDH08-03	172.5	174.0	1.5	Meagher	Cm	Waste	0.19	0.01	0.29	0.01	0	0.00
BHDDH08-01	27.7	28.6	0.9	Meagher	Cm	Waste	0.35	0.01	0.32	0.01	0	0.00
BHDDH08-04	305.4	306.8	1.4	Meagher	Cm	Waste	0.37	0.01	0.53	0.01	0	0.00
BHDDH08-01	48.5	49.4	0.9	Meagher	Cm	Waste	0.40	0.01	0.36	0.01	0	0.00
BHDDH08-01	39.6	48.5	8.9	Meagher	Cm	Waste	0.48	0.01	4.27	0.08	0	0.00
BHDDH08-04	279.2	281.0	1.8	Meagher	Cm	Waste	0.40	0.01	0.72	0.02	0	0.00
BHDDH08-03	329.5	331.0	1.5	Meagher	Cm	Waste	1.87	0.01	2.84	0.02	0	0.00
BHDDH08-03	328.6	329.5	0.9	Meagher	Cm	Waste	2.04	0.01	1.88	0.01	0	0.00
BHDDH08-03	326.4	327.5	1.0	Meagher	Cm	Waste	2.06	0.01	2.14	0.01	0	0.00
BHDDH08-03	327.5	328.6	1.1	Meagher	Cm	Waste	2.63	0.01	2.87	0.01	0	0.00
BHDDH08-03	324.6	326.4	1.8	Meagher	Cm	Waste	3.91	0.01	7.04	0.02	0	0.00
BHDDH08-03	200.3	201.8	1.5	Meagher	Cm	Waste	0.25	0.02	0.38	0.03	0	0.00
BHDDH08-04	307.3	308.9	1.6	Meagher	Cm	Waste	0.35	0.02	0.55	0.03	0	0.00
BHDDH08-02	316.1	316.9	0.8	Meagher	Cm	Waste	0.74	0.02	0.59	0.02	0	0.00
BHDDH08-04	327.8	329.8	2.0	Meagher	Cm	Waste	0.46	0.03	0.94	0.06	0	0.00
BHDDH08-04	334.3	335.9	1.6	Meagher	Cm	Waste	0.44	0.04	0.70	0.06	0	0.00
BHDDH08-04	252.7	254.2	1.5	Meagher	Cm	Waste	0.45	0.04	0.67	0.06	0	0.00
BHDDH08-03	359.1	362.1	3.1	Meagher	Cm	Waste	1.05	0.04	3.20	0.12	0	0.00
BHDDH08-02	337.4	338.9	1.5	Meagher	Cm	Waste	1.65	0.04	2.48	0.06	0	0.00
BHDDH08-02	334.4	335.9	1.5	Meagher	Cm	Waste	2.34	0.05	3.51	0.08	0	0.00
BHDDH08-04	314.6	316.0	1.4	Meagher	Cm	Waste	0.55	0.06	0.79	0.09	0	0.00
BHDDH08-04	254.2	255.7	1.6	Meagher	Cm	Waste	0.62	0.06	0.97	0.09	0	0.00
BHDDH08-02	332.8	334.4	1.6	Meagher	Cm	Waste	0.77	0.06	1.23	0.10	0	0.00
BHDDH08-02	335.9	337.4	1.5	Meagher	Cm	Waste	2.31	0.06	3.47	0.09	0	0.00
BHDDH08-04	329.8	332.0	2.2	Meagher	Cm	Waste	0.51	0.07	1.12	0.15	0	0.00
BHDDH08-04	325.5	327.0	1.5	Meagher	Cm	Waste	0.65	0.07	0.95	0.10	0	0.00
BHDDH08-03	358.2	359.1	0.9	Meagher	Cm	Waste	0.84	0.07	0.71	0.06	0	0.00
BHDDH08-02	329.8	331.3	1.5	Meagher	Cm	Waste	0.44	0.08	0.66	0.12	0	0.00
BHDDH08-01	301.1	302.7	1.6	Meagher	Cm	Waste	1.42	0.08	2.27	0.13	0	0.00
BHDDH08-03	352.0	354.2	2.1	Meagher	Cm	Waste	2.13	0.08	4.56	0.17	0	0.00
BHDDH08-04	296.8	298.1	1.3	Meagher	Cm	Waste	0.57	0.09	0.73	0.12	0	0.00
BHDDH08-03	352.4	356.0	3.6	Meagher	Cm	Waste	9.86	0.09	35.50	0.32	0	0.00
BHDDH08-02	328.3	329.8	1.5	Meagher	Cm	Waste	0.52	0.10	0.78	0.15	0	0.00
BHDDH08-04	317.8	319.6	1.8	Meagher	Cm	Waste	0.63	0.10	1.13	0.18	0	0.00
BHDDH08-02	346.7	348.4	1.7	Meagher	Cm	Waste	1.37	0.11	2.33	0.19	0	0.00
BHDDH08-04	342.4	343.1	0.7	Meagher	Cm	Waste	0.49	0.14	0.35	0.10	0	0.00
BHDDH08-04	282.6	283.3	0.7	Meagher	Cm	Waste	0.64	0.14	0.47	0.10	0	0.00
BHDDH08-02	325.3	326.7	1.4	Meagher	Cm	Waste	0.73	0.14	1.02	0.20	0	0.00
BHDDH08-03	362.1	364.5	2.4	Meagher	Cm	Waste	17.90	0.14	42.60	0.33	0	0.00
BHDDH08-02	326.7	328.3	1.6	Meagher	Cm	Waste	1.53	0.18	2.45	0.29	0	0.00
BHDDH08-02	331.3	332.8	1.5	Meagher	Cm	Waste	0.81	0.22	1.22	0.33	0	0.00
BHDDH08-02	348.4	349.9	1.5	Meagher	Cm	Waste	3.72	0.31	5.58	0.47	0	0.00
BHDDH08-02	351.4	353.3	1.9	Meagher	Cm	Waste	1.62	0.32	3.08	0.61	0	0.00
BHDDH08-04	281.0	282.6	1.6	Meagher	Cm	Waste	5.64	0.32	8.74	0.50	0	0.00

BHDDH08-03	356.0	358.2	2.2	Meagher	Cm	Waste	10.55	0.37	23.10	0.81	0	0.00
BHDDH08-04	278.3	279.2	1.0	Meagher	Cm	Waste	5.87	0.45	5.58	0.43	0	0.00
BHDDH08-03	364.5	365.8	1.3	Meagher	Cm	Waste	1.88	0.60	2.37	0.76	0	0.00
BHDDH08-04	306.8	307.3	0.5	Meagher	Cm	Waste	3.18	0.60	1.46	0.28	0	0.00
BHDDH08-02	349.9	351.4	1.5	Meagher	Cm	Waste	2.72	0.65	4.08	0.98	0	0.00
BHDDH08-04	332.0	333.2	1.2	Meagher	Cm	Waste	6.20	0.67	7.19	0.78	0	0.00
BHDDH08-04	316.0	317.8	1.8	Meagher	Cm	Waste	5.36	0.80	9.43	1.41	0	0.00
BHDDH08-04	333.2	334.3	1.2	Meagher	Cm	Waste	7.07	2.44	8.13	2.81	0	0.00
BHDDH08-04	327.0	327.8	0.8	Meagher	Cm	Waste	8.19	3.19	6.22	2.42	0	0.00
BHDDH08-04	191.4	192.9	1.5	Meagher	Cm	Waste	0.54	0.01	0.83	0.02	1	1.53
BHDDH08-04	185.3	186.8	1.5	Meagher	Cm	Waste	0.63	0.01	0.96	0.02	1	1.52
BHDDH08-04	189.9	191.4	1.5	Meagher	Cm	Waste	0.53	0.04	0.81	0.06	1	1.52
BHDDH08-04	290.1	291.2	1.1	Meagher	Cm	Waste	0.81	0.06	0.87	0.06	1	1.08
BHDDH08-04	192.9	193.6	0.7	Meagher	Cm	Waste	0.56	0.09	0.37	0.06	1	0.66
BHDDH08-04	186.8	188.4	1.5	Meagher	Cm	Waste	0.59	0.09	0.90	0.14	1	1.53
BHDDH08-04	295.6	296.8	1.2	Meagher	Cm	Waste	7.05	0.17	8.53	0.21	1	1.21
BHDDH08-04	294.1	295.6	1.5	Meagher	Cm	Waste	7.39	0.18	10.86	0.26	1	1.47
BHDDH08-01	327.1	328.6	1.5	Meagher	Cm	Waste	0.70	0.19	1.05	0.29	1	1.50
BHDDH08-04	188.4	189.9	1.5	Meagher	Cm	Waste	6.43	0.20	9.77	0.30	1	1.52
BHDDH08-01	322.5	324	1.5	Meagher	Cm	Waste	0.82	0.27	1.23	0.41	1	1.50
BHDDH08-04	260.8	262.1	1.3	Meagher	Cm	Waste	7.15	0.27	9.08	0.34	1	1.27
BHDDH08-01	317.0	317.9	0.9	Meagher	Cm	Waste	0.92	0.32	0.83	0.29	1	0.90
BHDDH08-01	328.6	329.2	0.6	Meagher	Cm	Waste	1.53	0.37	0.92	0.22	1	0.60
BHDDH08-04	292.6	294.1	1.5	Meagher	Cm	Waste	6.86	0.37	10.43	0.56	1	1.52
BHDDH08-01	321	322.5	1.5	Meagher	Cm	Waste	1.18	0.39	1.77	0.59	1	1.50
BHDDH08-01	317.9	319.4	1.5	Meagher	Cm	Waste	0.98	0.40	1.47	0.60	1	1.50
BHDDH08-04	291.2	292.6	1.4	Meagher	Cm	Waste	6.26	0.41	8.95	0.59	1	1.43
BHDDH08-01	325.5	327.1	1.6	Meagher	Cm	Waste	0.97	0.43	1.55	0.69	1	1.60
BHDDH08-01	324	325.5	1.5	Meagher	Cm	Waste	1.17	0.43	1.76	0.65	1	1.50
BHDDH08-01	319.4	321	1.6	Meagher	Cm	Waste	3.10	2.53	4.96	4.05	1	1.60
BHDDH08-03	346.0	346.9	0.9	Meagher	Cm	Waste	0.96	0.01	0.82	0.01	1.5	1.28
BHDDH08-01	308.8	310.3	1.5	Meagher	Cm	Waste	0.77	0.04	1.16	0.06	1.5	2.25
BHDDH08-04	340.2	341.6	1.5	Meagher	Cm	Waste	0.44	0.05	0.64	0.07	1.5	2.19
BHDDH08-01	310.3	311.8	1.5	Meagher	Cm	Waste	0.67	0.06	1.01	0.09	1.5	2.25
BHDDH08-01	313.3	314.2	0.9	Meagher	Cm	Waste	0.50	0.07	0.45	0.06	1.5	1.35
BHDDH08-04	262.1	263.7	1.6	Meagher	Cm	Waste	0.75	0.07	1.18	0.11	1.5	2.37
BHDDH08-01	311.8	313.3	1.5	Meagher	Cm	Waste	0.72	0.08	1.08	0.12	1.5	2.25
BHDDH08-01	302.7	303	0.3	Meagher	Cm	Waste	1.42	0.08	0.43	0.02	1.5	0.45
BHDDH08-04	343.1	343.8	0.7	Meagher	Cm	Waste	0.49	0.14	0.35	0.10	1.5	1.06
BHDDH08-01	314.2	316.4	2.2	Meagher	Cm	Waste	0.64	0.15	1.41	0.33	1.5	3.30
BHDDH08-01	307.2	308.8	1.6	Meagher	Cm	Waste	0.65	0.19	1.04	0.30	1.5	2.40
BHDDH08-01	305.7	307.2	1.5	Meagher	Cm	Waste	0.66	0.20	0.99	0.30	1.5	2.25
BHDDH08-04	360.3	361.5	1.2	Meagher	Cm	Waste	0.75	0.20	0.92	0.25	1.5	1.85
BHDDH08-01	304.2	305.7	1.5	Meagher	Cm	Waste	0.73	0.22	1.10	0.33	1.5	2.25
BHDDH08-01	303	304.2	1.2	Meagher	Cm	Waste	0.83	0.29	1.00	0.35	1.5	1.80

BHDDH08-01	316.4	317	0.6	Meagher	Cm	Waste	0.92	0.32	0.55	0.19	1.5	0.90
BHDDH08-03	168.6	170.1	1.5	Meagher	Cm	Waste	0.25	0.01	0.38	0.01	2	3.06
BHDDH08-04	246.6	248.1	1.5	Meagher	Cm	Waste	0.52	0.05	0.80	0.08	2	3.06
BHDDH08-04	245.2	246.6	1.4	Meagher	Cm	Waste	1.50	0.05	2.10	0.07	2	2.80
BHDDH08-04	248.1	249.9	1.8	Meagher	Cm	Waste	0.55	0.07	1.01	0.13	2	3.66
BHDDH08-04	249.9	251.3	1.3	Meagher	Cm	Waste	6.33	0.07	8.48	0.09	2	2.68
BHDDH08-04	251.3	252.7	1.4	Meagher	Cm	Waste	0.83	0.12	1.16	0.17	2	2.80
BHDDH08-04	275.5	277.1	1.5	Meagher	Cm	Waste	0.43	0.06	0.65	0.09	2.5	3.80
BHDDH08-04	258.8	260.3	1.5	Meagher	Cm	Waste	7.04	0.25	10.70	0.38	2.5	3.80
BHDDH08-04	257.4	258.8	1.4	Meagher	Cm	Waste	7.11	0.27	10.03	0.38	2.5	3.52
BHDDH08-04	260.3	260.8	0.5	Meagher	Cm	Waste	7.15	0.27	3.58	0.14	2.5	1.25
BHDDH08-04	240.7	240.8	0.1	Meagher	Cm	Waste	1.38	0.28	0.18	0.04	2.5	0.33
BHDDH08-04	240.8	242.0	1.2	Meagher	Cm	Waste	1.38	0.28	1.67	0.34	2.5	3.03
BHDDH08-04	277.1	278.3	1.2	Meagher	Cm	Waste	5.67	0.31	6.92	0.38	2.5	3.05
BHDDH08-04	341.6	342.4	0.8	Meagher	Cm	Waste	1.89	0.50	1.44	0.38	2.5	1.90
BHDDH08-04	255.7	257.4	1.6	Meagher	Cm	Waste	5.98	0.65	9.81	1.07	2.5	4.10
BHDDH08-04	289.5	290.1	0.6	Meagher	Cm	Waste	0.81	0.06	0.51	0.04	3	1.89
BHDDH08-04	283.3	285.0	1.7	Meagher	Cm	Waste	6.84	0.06	11.49	0.10	3	5.04
BHDDH08-04	285.0	286.5	1.5	Meagher	Cm	Waste	7.40	0.06	11.25	0.09	3	4.56
BHDDH08-04	288.2	289.5	1.3	Meagher	Cm	Waste	6.62	0.13	8.67	0.17	3	3.93
BHDDH08-04	286.5	288.2	1.7	Meagher	Cm	Waste	7.55	0.33	12.46	0.54	3	4.95
BHDDH08-01	329.2	329.9	0.7	Meagher	Cm	Waste	1.53	0.37	1.07	0.26	3	2.10
BHDDH08-04	240.4	240.7	0.3	Meagher	Cm	Waste	6.37	0.15	1.72	0.04	3.5	0.94
BHDDH08-02	320	321.6	1.6	Meagher	Cm	Waste	0.76	0.09	1.22	0.14	4	6.40
BHDDH08-02	318.6	320	1.4	Meagher	Cm	Waste	0.56	0.10	0.78	0.14	4	5.60
BHDDH08-02	317.1	318.6	1.5	Meagher	Cm	Waste	0.70	0.10	1.05	0.15	4	6.00
BHDDH08-02	321.6	323.3	1.7	Meagher	Cm	Waste	0.78	0.17	1.33	0.29	4	6.80
BHDDH08-04	198.1	198.7	0.6	Meagher	Cm	Waste	5.72	1.61	3.49	0.98	4	2.44
BHDDH08-04	202.2	204.2	2.0	Meagher	Cm	Waste	0.58	0.08	1.18	0.16	4.5	9.14
BHDDH08-04	199.0	200.6	1.6	Meagher	Cm	Waste	5.99	1.02	9.58	1.63	4.5	7.20
BHDDH08-04	200.6	202.2	1.6	Meagher	Cm	Waste	5.29	1.33	8.46	2.13	4.5	7.20
BHDDH08-04	198.7	199.0	0.3	Meagher	Cm	Waste	5.72	1.61	1.54	0.43	4.5	1.22
BHDDH08-03	198.1	199.6	1.5	Meagher	Cm	Waste	0.25	0.01	0.38	0.01	6	9.12
BHDDH08-02	340.5	342	1.5	Meagher	Cm	Waste	0.76	0.05	1.14	0.08	6	9.00
BHDDH08-02	338.9	340.5	1.6	Meagher	Cm	Waste	1.25	0.07	2.00	0.11	6	9.60
BHDDH08-02	342	343.5	1.5	Meagher	Cm	Waste	0.53	0.09	0.80	0.14	6	9.00
BHDDH08-03	199.6	200.3	0.6	Meagher	Cm	Waste	0.64	0.09	0.39	0.05	6	3.66
BHDDH08-02	343.5	345	1.5	Meagher	Cm	Waste	0.48	0.10	0.72	0.15	6	9.00
BHDDH08-02	345	346.7	1.7	Meagher	Cm	Waste	0.48	0.12	0.82	0.20	6	10.20
BHDDH08-04	204.2	205.0	0.8	Meagher	Cm	Waste	0.58	0.08	0.45	0.06	6.5	5.07
BHDDH08-04	193.6	194.0	0.4	Meagher	Cm	Waste	0.56	0.09	0.24	0.04	6.5	2.73
BHDDH08-04	197.7	198.1	0.3	Meagher	Cm	Waste	4.14	1.74	1.41	0.59	6.5	2.21
BHDDH08-04	196.0	197.7	1.7	Meagher	Cm	Waste	6.71	1.77	11.61	3.06	6.5	11.24
BHDDH08-04	194.5	196.0	1.5	Meagher	Cm	Waste	5.37	2.24	8.06	3.36	6.5	9.75
BHDDH08-04	194.0	194.5	0.5	Meagher	Cm	Waste	5.52	3.67	2.87	1.91	6.5	3.38

BHDDH08-03	346.9	347.8	0.9	Meagher	Cm	Waste	1.25	0.01	1.13	0.01	7.5	6.75			
BHDDH08-03	347.8	349.3	1.5	Meagher	Cm	Waste	4.32	0.01	6.57	0.01	7.5	11.40			
BHDDH08-03	349.3	350.5	1.2	Meagher	Cm	Waste	3.29	0.05	3.95	0.06	7.5	9.00			
BHDDH08-03	350.5	352.0	1.5	Meagher	Cm	Waste	3.34	0.15	5.08	0.23	7.5	11.40			
BHDDH08-04	361.5	361.8	0.3	Meagher	Cm	Waste	0.75	0.20	0.23	0.06	7.5	2.25			
BHDDH08-03	170.1	171.6	1.5	Meagher	Cm	Waste	0.30	0.01	0.46	0.01	8.5	12.92			
BHDDH08-03	171.6	172.5	0.9	Meagher	Cm	Waste	0.26	0.01	0.24	0.01	8.5	7.82			
BHDDH08-03	308.8	310.3	1.5	Meagher	Cm	Waste	0.69	0.01	1.04	0.02	8.5	12.75			
BHDDH08-02	316.9	317.1	0.2	Meagher	Cm	Waste	0.98	0.01	0.20	0.00	10	2.00			
BHDDH08-02	356.3	356.9	0.6	Meagher	Cm	Waste	0.34	0.06	0.20	0.04	10	6.00			
BHDDH08-02	354.8	356.3	1.5	Meagher	Cm	Waste	0.51	0.10	0.77	0.15	10	15.00			
BHDDH08-02	353.3	354.8	1.5	Meagher	Cm	Waste	0.58	0.14	0.87	0.21	10	15.00			
BHDDH08-03	322.5	324.0	1.5	Meagher	Cm	Waste	1.10	0.01	1.65	0.01	12.5	18.75			
BHDDH08-03	324.0	324.6	0.6	Meagher	Cm	Waste	1.12	0.01	0.72	0.01	12.5	8.00			
BHDDH08-03	314.9	316.4	1.5	Meagher	Cm	Waste	1.30	0.01	1.98	0.02	12.5	19.00			
BHDDH08-02	324.6	325.3	0.7	Meagher	Cm	Waste	2.08	0.02	1.46	0.01	15	10.50			
BHDDH08-02	323.3	324.6	1.3	Meagher	Cm	Waste	1.78	0.06	2.31	0.08	15	19.50			
BHDDH08-04	242.7	243.2	0.5	Meagher	Cm	Waste	6.75	0.11	3.38	0.06	17.5	8.75			
BHDDH08-03	366.4	367.9	1.5	Meagher	Cm	Waste	1.06	0.19	1.61	0.29	17.5	26.60			
BHDDH08-04	242.0	242.1	0.1	Meagher	Cm	Waste	1.38	0.28	0.14	0.03	17.5	1.75			
BHDDH08-03	365.8	366.4	0.6	Meagher	Cm	Waste	1.88	0.60	1.13	0.36	17.5	10.50			
BHDDH08-03	313.3	314.9	1.5	Meagher	Cm	Waste	0.51	0.01	0.78	0.02	19.5	29.84			
BHDDH08-03	311.8	313.3	1.5	Meagher	Cm	Waste	0.58	0.01	0.88	0.02	19.5	29.64			
BHDDH08-03	310.3	311.8	1.5	Meagher	Cm	Waste	0.63	0.01	0.95	0.02	19.5	29.44			
BHDDH08-02	356.9	357.0	0.1	Meagher	Cm	Waste	0.34	0.06	0.03	0.00	20	1.60			
Totals			**216.1**						**521.84**	**51.97**		**597.02**	**2.41**	**0.24**	**2.76**

BHDDH08-03	388.9	389.8	0.9	Wolsey	Cw	Ore	2.39	0.01	2.20	0.01	0	0.00
BHDDH08-03	387.9	388.9	1.0	Wolsey	Cw	Ore	4.14	0.04	4.14	0.04	0	0.00
BHDDH08-03	381.0	382.7	1.7	Wolsey	Cw	Ore	9.50	0.07	16.15	0.12	0	0.00
BHDDH08-03	382.7	384.1	1.4	Wolsey	Cw	Ore	2.98	0.25	4.17	0.35	0	0.00
BHDDH08-03	384.1	385.6	1.5	Wolsey	Cw	Ore	2.87	0.29	4.31	0.44	0	0.00
BHDDH08-03	378.6	380.1	1.5	Wolsey	Cw	Ore	5.15	1.35	7.73	2.03	0	0.00
BHDDH08-03	490.2	492.2	2.0	Wolsey	Cw	Ore	9.21	4.55	18.42	9.10	0	0.00
BHDDH08-02	363.8	364.6	0.8	Wolsey	Cw	Ore	13.20	9.33	10.56	7.46	0	0.00
BHDDH08-02	358.1	359.2	1.1	Wolsey	Cw	Ore	21.10	10.10	23.21	11.11	0	0.00
BHDDH08-03	394.4	395.9	1.5	Wolsey	Cw	Ore	4.51	0.74	6.77	1.11	10	15.00
BHDDH08-03	481.6	483.1	1.5	Wolsey	Cw	Ore	10.90	4.51	16.35	6.77	15	22.50
BHDDH08-03	483.1	484.0	0.9	Wolsey	Cw	Ore	16.30	6.03	14.83	5.49	15	13.65
BHDDH08-03	484.0	485.0	1.0	Wolsey	Cw	Ore	16.60	6.20	15.77	5.89	15	14.25
BHDDH08-02	357.0	358.1	1.1	Wolsey	Cw	Ore	17.70	9.99	19.47	10.99	20	22.00
BHDDH08-03	367.9	368.5	0.6	Wolsey	Cw	Ore	12.15	11.00	7.29	6.60	27.5	16.50
BHDDH08-03	475.5	475.6	0.1	Wolsey	Cw	Ore	6.28	1.47	0.69	0.16	30	3.30
BHDDH08-03	486.8	488.0	1.2	Wolsey	Cw	Ore	14.15	4.65	17.40	5.72	30	36.90
BHDDH08-03	475.6	476.8	1.2	Wolsey	Cw	Ore	11.35	6.22	13.85	7.59	30	36.60

BHDDH08-03	476.8	478.3	1.5	Wolsey	Cw	Ore	14.10	6.24	21.43	9.48	30	45.60			
BHDDH08-01	407.1	407.2	0.1	Wolsey	Cw	Ore	9.23	4.25	0.92	0.42	35	3.50			
BHDDH08-01	407.2	407.5	0.3	Wolsey	Cw	Ore	9.23	4.25	2.77	1.28	35	10.50			
Totals			**23.0**						**228.43**	**92.15**		**240.30**	**9.95**	**4.01**	**10.47**
BHDDH08-01	482.2	483.7	1.5	Wolsey	Cw	Waste	0.42	0.01	0.63	0.01	0	0.00			
BHDDH08-01	483.7	485.2	1.5	Wolsey	Cw	Waste	0.51	0.01	0.77	0.01	0	0.00			
BHDDH08-01	491.1	492.6	1.5	Wolsey	Cw	Waste	2.46	0.01	3.69	0.01	0	0.00			
BHDDH08-01	371.2	371.8	0.6	Wolsey	Cw	Waste	0.46	0.03	0.28	0.02	0	0.00			
BHDDH08-03	471.8	473.5	1.7	Wolsey	Cw	Waste	0.58	0.04	0.97	0.07	0	0.00			
BHDDH08-01	369.7	371.2	1.5	Wolsey	Cw	Waste	0.53	0.05	0.80	0.08	0	0.00			
BHDDH08-03	459.3	460.9	1.5	Wolsey	Cw	Waste	0.59	0.05	0.90	0.08	0	0.00			
BHDDH08-01	480.6	482.2	1.6	Wolsey	Cw	Waste	1.11	0.08	1.78	0.13	0	0.00			
BHDDH08-01	403.3	403.7	0.4	Wolsey	Cw	Waste	2.17	0.09	0.87	0.04	0	0.00			
BHDDH08-01	405.7	407.1	1.4	Wolsey	Cw	Waste	3.09	0.12	4.33	0.17	0	0.00			
BHDDH08-01	404.8	405.7	0.9	Wolsey	Cw	Waste	1.15	0.13	1.03	0.12	0	0.00			
BHDDH08-03	460.9	462.4	1.5	Wolsey	Cw	Waste	0.66	0.18	1.00	0.27	0	0.00			
BHDDH08-03	467.0	468.5	1.5	Wolsey	Cw	Waste	0.75	0.18	1.15	0.28	0	0.00			
BHDDH08-03	470.0	471.8	1.8	Wolsey	Cw	Waste	0.74	0.19	1.35	0.35	0	0.00			
BHDDH08-03	468.5	470.0	1.5	Wolsey	Cw	Waste	0.77	0.19	1.17	0.29	0	0.00			
BHDDH08-03	463.9	465.4	1.5	Wolsey	Cw	Waste	0.77	0.20	1.17	0.30	0	0.00			
BHDDH08-03	465.4	467.0	1.5	Wolsey	Cw	Waste	0.76	0.22	1.16	0.33	0	0.00			
BHDDH08-01	403.7	404.8	1.1	Wolsey	Cw	Waste	2.14	0.22	2.35	0.24	0	0.00			
BHDDH08-03	385.6	387.9	2.3	Wolsey	Cw	Waste	2.65	0.22	6.09	0.51	0	0.00			
BHDDH08-01	368.2	369.7	1.5	Wolsey	Cw	Waste	1.03	0.27	1.55	0.41	0	0.00			
BHDDH08-03	462.4	463.9	1.5	Wolsey	Cw	Waste	0.78	0.29	1.19	0.44	0	0.00			
BHDDH08-04	415.4	417.2	1.8	Wolsey	Cw	Waste	6.10	0.34	10.80	0.60	0	0.00			
BHDDH08-01	329.9	330.1	0.2	Wolsey	Cw	Waste	1.53	0.37	0.31	0.07	0	0.00			
BHDDH08-01	400	400.8	0.8	Wolsey	Cw	Waste	3.33	0.40	2.66	0.32	0	0.00			
BHDDH08-01	407.5	408.7	1.2	Wolsey	Cw	Waste	1.16	0.42	1.39	0.50	0	0.00			
BHDDH08-03	375.5	377.0	1.5	Wolsey	Cw	Waste	4.37	0.50	6.56	0.75	0	0.00			
BHDDH08-01	403.2	403.3	0.1	Wolsey	Cw	Waste	2.93	0.52	0.29	0.05	0	0.00			
BHDDH08-03	380.1	381.0	0.9	Wolsey	Cw	Waste	4.53	0.59	4.08	0.53	0	0.00			
BHDDH08-03	377.0	378.6	1.6	Wolsey	Cw	Waste	5.00	0.67	8.00	1.07	0	0.00			
BHDDH08-03	478.3	479.5	1.2	Wolsey	Cw	Waste	2.28	0.71	2.74	0.85	0	0.00			
BHDDH08-01	472.1	473.2	1.1	Wolsey	Cw	Waste	2.49	0.73	2.74	0.80	0	0.00			
BHDDH08-01	485.2	485.7	0.5	Wolsey	Cw	Waste	1.75	0.81	0.88	0.41	0	0.00			
BHDDH08-01	474.8	474.9	0.1	Wolsey	Cw	Waste	5.80	0.98	0.58	0.10	0	0.00			
BHDDH08-01	474.9	476.6	1.7	Wolsey	Cw	Waste	5.80	0.98	9.86	1.67	0	0.00			
BHDDH08-01	473.2	473.4	0.2	Wolsey	Cw	Waste	4.34	1.00	0.87	0.20	0	0.00			
BHDDH08-01	470.9	472.1	1.2	Wolsey	Cw	Waste	5.69	1.01	6.83	1.21	0	0.00			
BHDDH08-01	331.6	333.1	1.5	Wolsey	Cw	Waste	6.13	1.46	9.20	2.19	0	0.00			
BHDDH08-01	330.1	331.6	1.5	Wolsey	Cw	Waste	6.05	1.55	9.08	2.33	0	0.00			
BHDDH08-01	334.7	335.9	1.2	Wolsey	Cw	Waste	4.31	1.67	5.17	2.00	0	0.00			
BHDDH08-01	333.1	334.7	1.6	Wolsey	Cw	Waste	6.28	2.56	10.05	4.10	0	0.00			

BHDDH08-03	488.0	489.1	1.1	Wolsey	Cw	Waste	10.00	4.48	11.00	4.93	0	0.00
BHDDH08-01	364.2	365.2	1.0	Wolsey	Cw	Waste	3.75	0.02	3.75	0.02	1	1.00
BHDDH08-01	363.3	364.2	0.9	Wolsey	Cw	Waste	3.64	0.03	3.28	0.03	1	0.90
BHDDH08-01	365.2	366.7	1.5	Wolsey	Cw	Waste	3.76	0.03	5.64	0.05	1	1.50
BHDDH08-01	359.7	361.2	1.5	Wolsey	Cw	Waste	0.54	0.04	0.81	0.06	1	1.50
BHDDH08-01	361.2	362.1	0.9	Wolsey	Cw	Waste	0.70	0.06	0.63	0.05	1	0.90
BHDDH08-02	371.3	372.8	1.5	Wolsey	Cw	Waste	4.29	0.08	6.44	0.12	1	1.50
BHDDH08-01	362.1	363.3	1.2	Wolsey	Cw	Waste	1.16	0.10	1.39	0.12	1	1.20
BHDDH08-02	372.8	374.3	1.5	Wolsey	Cw	Waste	5.10	0.11	7.65	0.17	1	1.50
BHDDH08-01	358.1	358.3	0.2	Wolsey	Cw	Waste	0.89	0.15	0.14	0.02	1	0.16
BHDDH08-01	358.3	359.7	1.4	Wolsey	Cw	Waste	0.89	0.15	1.25	0.21	1	1.40
BHDDH08-01	378.6	380.4	1.8	Wolsey	Cw	Waste	1.65	0.19	2.97	0.34	1	1.80
BHDDH08-01	377.3	378.6	1.3	Wolsey	Cw	Waste	1.28	0.22	1.66	0.29	1	1.30
BHDDH08-02	374.3	375.6	1.3	Wolsey	Cw	Waste	4.56	0.22	5.93	0.29	1	1.30
BHDDH08-01	386.5	387.1	0.6	Wolsey	Cw	Waste	1.77	0.24	1.06	0.14	1	0.60
BHDDH08-01	366.7	368.2	1.5	Wolsey	Cw	Waste	4.63	0.26	6.95	0.39	1	1.50
BHDDH08-01	376.6	377.3	0.7	Wolsey	Cw	Waste	1.61	0.34	1.13	0.24	1	0.70
BHDDH08-01	382.5	383.6	1.1	Wolsey	Cw	Waste	3.27	0.50	3.60	0.55	1	1.10
BHDDH08-03	398.1	399.4	1.3	Wolsey	Cw	Waste	3.71	0.57	4.86	0.75	1	1.31
BHDDH08-01	384.9	386.5	1.6	Wolsey	Cw	Waste	4.32	0.60	6.91	0.96	1	1.60
BHDDH08-01	380.4	381.6	1.2	Wolsey	Cw	Waste	3.65	0.66	4.38	0.79	1	1.20
BHDDH08-01	381.6	382.5	0.9	Wolsey	Cw	Waste	3.89	0.82	3.50	0.74	1	0.90
BHDDH08-02	376.7	378	1.3	Wolsey	Cw	Waste	5.98	0.92	7.77	1.20	1	1.30
BHDDH08-02	375.6	376.7	1.1	Wolsey	Cw	Waste	5.10	1.01	5.61	1.11	1	1.10
BHDDH08-03	399.4	400.0	0.6	Wolsey	Cw	Waste	4.81	1.02	3.08	0.65	1	0.64
BHDDH08-02	361.5	363	1.5	Wolsey	Cw	Waste	2.99	1.15	4.49	1.73	1	1.50
BHDDH08-01	383.6	384.9	1.3	Wolsey	Cw	Waste	5.76	1.43	7.49	1.86	1	1.30
BHDDH08-01	389.5	391.1	1.6	Wolsey	Cw	Waste	1.87	0.08	2.99	0.13	1.5	2.40
BHDDH08-01	394.6	395.2	0.6	Wolsey	Cw	Waste	3.54	0.14	2.12	0.08	1.5	0.90
BHDDH08-01	391.1	392.6	1.5	Wolsey	Cw	Waste	1.98	0.17	2.97	0.26	1.5	2.25
BHDDH08-04	436.4	437.1	0.7	Wolsey	Cw	Waste	6.56	0.17	4.46	0.12	1.5	1.02
BHDDH08-04	408.1	409.6	1.4	Wolsey	Cw	Waste	4.37	0.18	6.25	0.26	1.5	2.15
BHDDH08-04	437.1	439.4	2.4	Wolsey	Cw	Waste	4.53	0.20	10.65	0.47	1.5	3.53
BHDDH08-04	413.5	414.4	0.9	Wolsey	Cw	Waste	4.34	0.25	3.99	0.23	1.5	1.38
BHDDH08-04	421.2	423.5	2.2	Wolsey	Cw	Waste	5.16	0.25	11.51	0.56	1.5	3.34
BHDDH08-01	387.9	388	0.1	Wolsey	Cw	Waste	2.30	0.26	0.23	0.03	1.5	0.15
BHDDH08-01	388.0	389.5	1.5	Wolsey	Cw	Waste	2.30	0.26	3.43	0.39	1.5	2.23
BHDDH08-01	392.6	394.6	2.0	Wolsey	Cw	Waste	3.11	0.26	6.22	0.52	1.5	3.00
BHDDH08-04	439.4	440.0	0.6	Wolsey	Cw	Waste	4.24	0.27	2.42	0.15	1.5	0.85
BHDDH08-04	412.1	413.5	1.4	Wolsey	Cw	Waste	5.62	0.35	7.87	0.49	1.5	2.10
BHDDH08-04	376.3	376.8	0.6	Wolsey	Cw	Waste	7.82	0.38	4.46	0.22	1.5	0.85
BHDDH08-04	407.2	408.1	0.9	Wolsey	Cw	Waste	5.26	0.39	4.84	0.36	1.5	1.38
BHDDH08-04	414.4	415.4	1.0	Wolsey	Cw	Waste	5.66	0.40	5.66	0.40	1.5	1.50
BHDDH08-04	376.8	377.9	1.1	Wolsey	Cw	Waste	3.58	0.43	3.87	0.46	1.5	1.62
BHDDH08-04	409.6	410.6	1.0	Wolsey	Cw	Waste	3.89	0.53	3.93	0.54	1.5	1.51

BHDDH08-01	395.2	396.2	1.0	Wolsey	Cw	Waste	4.27	1.10	4.27	1.10	1.5	1.50
BHDDH08-04	449.3	451.0	1.7	Wolsey	Cw	Waste	3.05	1.20	5.09	2.00	1.5	2.51
BHDDH08-01	420.6	421.8	1.2	Wolsey	Cw	Waste	5.87	1.44	7.16	1.76	1.5	1.83
BHDDH08-01	335.9	336.2	0.3	Wolsey	Cw	Waste	4.31	1.67	1.29	0.50	1.5	0.45
BHDDH08-01	336.2	337.7	1.5	Wolsey	Cw	Waste	6.13	2.36	9.20	3.54	1.5	2.25
BHDDH08-01	340.8	342.3	1.5	Wolsey	Cw	Waste	6.58	2.66	9.87	3.99	1.5	2.25
BHDDH08-01	337.7	339.2	1.5	Wolsey	Cw	Waste	6.76	2.66	10.14	3.99	1.5	2.25
BHDDH08-01	342.3	342.9	0.6	Wolsey	Cw	Waste	6.50	2.70	3.90	1.62	1.5	0.90
BHDDH08-01	339.2	340.8	1.6	Wolsey	Cw	Waste	6.62	2.70	10.59	4.32	1.5	2.40
BHDDH08-04	389.2	390.8	1.5	Wolsey	Cw	Waste	3.79	0.16	5.76	0.24	2	3.04
BHDDH08-03	452.3	453.9	1.5	Wolsey	Cw	Waste	3.04	0.23	4.65	0.35	2	3.06
BHDDH08-04	390.8	391.6	0.9	Wolsey	Cw	Waste	3.94	0.23	3.35	0.20	2	1.70
BHDDH08-03	447.8	449.3	1.5	Wolsey	Cw	Waste	2.99	0.25	4.57	0.38	2	3.06
BHDDH08-04	387.7	389.2	1.5	Wolsey	Cw	Waste	3.98	0.29	6.05	0.44	2	3.04
BHDDH08-03	443.2	444.7	1.5	Wolsey	Cw	Waste	2.62	0.41	3.98	0.62	2	3.04
BHDDH08-03	446.2	447.8	1.5	Wolsey	Cw	Waste	3.11	0.42	4.73	0.64	2	3.04
BHDDH08-03	437.1	438.6	1.5	Wolsey	Cw	Waste	2.86	0.43	4.38	0.66	2	3.06
BHDDH08-03	449.3	450.8	1.5	Wolsey	Cw	Waste	3.69	0.43	5.61	0.65	2	3.04
BHDDH08-03	444.7	446.2	1.5	Wolsey	Cw	Waste	2.98	0.54	4.56	0.83	2	3.06
BHDDH08-03	450.8	452.3	1.5	Wolsey	Cw	Waste	4.40	0.55	6.69	0.84	2	3.04
BHDDH08-03	440.1	441.5	1.4	Wolsey	Cw	Waste	5.41	0.60	7.41	0.82	2	2.74
BHDDH08-03	438.6	440.1	1.5	Wolsey	Cw	Waste	3.47	0.62	5.27	0.94	2	3.04
BHDDH08-03	441.7	443.2	1.5	Wolsey	Cw	Waste	4.67	0.73	7.10	1.11	2	3.04
BHDDH08-03	435.6	437.1	1.5	Wolsey	Cw	Waste	3.81	0.80	5.79	1.22	2	3.04
BHDDH08-03	455.4	456.0	0.6	Wolsey	Cw	Waste	7.47	1.56	4.56	0.95	2	1.22
BHDDH08-03	453.9	455.4	1.5	Wolsey	Cw	Waste	7.20	1.89	10.94	2.87	2	3.04
BHDDH08-04	380.5	382.2	1.7	Wolsey	Cw	Waste	3.67	0.25	6.17	0.42	2.5	4.20
BHDDH08-04	377.9	379.0	1.1	Wolsey	Cw	Waste	3.58	0.43	4.01	0.48	2.5	2.80
BHDDH08-04	374.3	375.2	0.9	Wolsey	Cw	Waste	5.12	0.51	4.71	0.47	2.5	2.30
BHDDH08-04	380.0	380.5	0.5	Wolsey	Cw	Waste	7.69	0.78	4.00	0.41	2.5	1.30
BHDDH08-04	375.2	376.3	1.0	Wolsey	Cw	Waste	4.74	0.96	4.93	1.00	2.5	2.60
BHDDH08-04	379.0	380.0	1.0	Wolsey	Cw	Waste	5.41	2.48	5.41	2.48	2.5	2.50
BHDDH08-04	374.0	374.3	0.3	Wolsey	Cw	Waste	23.50	11.00	7.29	3.41	2.5	0.78
BHDDH08-04	397.2	398.7	1.5	Wolsey	Cw	Waste	4.12	0.16	6.30	0.24	3	4.59
BHDDH08-04	435.4	436.4	1.0	Wolsey	Cw	Waste	6.56	0.17	6.30	0.16	3	2.88
BHDDH08-04	430.8	431.5	0.7	Wolsey	Cw	Waste	5.65	0.25	3.79	0.17	3	2.01
BHDDH08-04	423.5	424.5	1.0	Wolsey	Cw	Waste	6.59	0.28	6.59	0.28	3	3.00
BHDDH08-04	431.5	433.1	1.6	Wolsey	Cw	Waste	4.46	0.37	7.23	0.60	3	4.86
BHDDH08-01	374.6	374.9	0.3	Wolsey	Cw	Waste	2.41	0.40	0.72	0.12	3	0.90
BHDDH08-04	433.1	434.2	1.1	Wolsey	Cw	Waste	4.72	0.40	5.33	0.45	3	3.39
BHDDH08-04	398.7	399.9	1.3	Wolsey	Cw	Waste	4.39	0.52	5.49	0.65	3	3.75
BHDDH08-04	399.9	401.3	1.4	Wolsey	Cw	Waste	4.32	0.94	5.92	1.29	3	4.11
BHDDH08-04	434.2	435.4	1.2	Wolsey	Cw	Waste	7.44	0.98	9.08	1.20	3	3.66
BHDDH08-04	424.5	425.9	1.4	Wolsey	Cw	Waste	7.02	1.28	9.90	1.80	3	4.23
BHDDH08-01	373.9	374.6	0.7	Wolsey	Cw	Waste	6.26	1.31	4.38	0.92	3	2.10

BHDDH08-04	401.3	402.5	1.2	Wolsey	Cw	Waste	6.85	1.44	7.95	1.67	3	3.48
BHDDH08-04	425.9	427.2	1.3	Wolsey	Cw	Waste	7.46	1.48	9.55	1.89	3	3.84
BHDDH08-01	372.9	373.9	1.0	Wolsey	Cw	Waste	5.05	1.55	5.05	1.55	3	3.00
BHDDH08-01	371.8	372.9	1.1	Wolsey	Cw	Waste	3.51	1.69	3.86	1.86	3	3.30
BHDDH08-04	444.0	445.2	1.2	Wolsey	Cw	Waste	6.25	0.05	7.44	0.06	3.5	4.16
BHDDH08-04	442.5	444.0	1.5	Wolsey	Cw	Waste	5.17	0.17	7.86	0.26	3.5	5.32
BHDDH08-04	440.7	442.5	1.8	Wolsey	Cw	Waste	4.71	0.26	8.62	0.48	3.5	6.41
BHDDH08-04	440.0	440.7	0.6	Wolsey	Cw	Waste	4.24	0.27	2.76	0.18	3.5	2.27
BHDDH08-04	445.2	446.2	1.0	Wolsey	Cw	Waste	5.05	0.34	5.25	0.35	3.5	3.64
BHDDH08-04	447.5	449.3	1.8	Wolsey	Cw	Waste	4.67	0.40	8.27	0.71	3.5	6.19
BHDDH08-04	446.2	447.5	1.3	Wolsey	Cw	Waste	7.36	1.18	9.42	1.51	3.5	4.48
BHDDH08-01	492.6	494.1	1.5	Wolsey	Cw	Waste	3.16	0.03	4.74	0.05	4	6.00
BHDDH08-01	494.1	495.2	1.1	Wolsey	Cw	Waste	4.10	0.07	4.51	0.08	4	4.40
BHDDH08-03	369.7	371.3	1.6	Wolsey	Cw	Waste	2.64	0.10	4.22	0.16	4	6.40
BHDDH08-02	394.7	395.5	0.8	Wolsey	Cw	Waste	4.18	0.14	3.34	0.11	4	3.20
BHDDH08-02	391.7	393.2	1.5	Wolsey	Cw	Waste	4.21	0.22	6.32	0.33	4	6.00
BHDDH08-02	387.1	388.6	1.5	Wolsey	Cw	Waste	4.32	0.25	6.48	0.38	4	6.00
BHDDH08-02	384	385.6	1.6	Wolsey	Cw	Waste	4.13	0.27	6.61	0.43	4	6.40
BHDDH08-02	390.1	391.7	1.6	Wolsey	Cw	Waste	4.40	0.29	7.04	0.46	4	6.40
BHDDH08-03	371.3	371.9	0.6	Wolsey	Cw	Waste	3.36	0.30	2.02	0.18	4	2.40
BHDDH08-03	432.5	434.0	1.5	Wolsey	Cw	Waste	2.82	0.36	4.31	0.55	4	6.12
BHDDH08-02	388.6	390.1	1.5	Wolsey	Cw	Waste	4.38	0.38	6.57	0.57	4	6.00
BHDDH08-03	422.5	424.0	1.5	Wolsey	Cw	Waste	3.53	0.39	5.40	0.60	4	6.12
BHDDH08-01	396.2	397.8	1.6	Wolsey	Cw	Waste	3.31	0.40	5.30	0.64	4	6.40
BHDDH08-01	399.3	400	0.7	Wolsey	Cw	Waste	3.33	0.40	2.33	0.28	4	2.80
BHDDH08-04	404.5	406.6	2.1	Wolsey	Cw	Waste	5.30	0.40	11.29	0.85	4	8.52
BHDDH08-03	406.5	407.8	1.4	Wolsey	Cw	Waste	3.41	0.46	4.67	0.63	4	5.48
BHDDH08-04	403.9	404.5	0.6	Wolsey	Cw	Waste	6.37	0.49	3.69	0.28	4	2.32
BHDDH08-03	419.2	420.6	1.4	Wolsey	Cw	Waste	3.49	0.57	4.99	0.82	4	5.72
BHDDH08-03	434.0	435.6	1.5	Wolsey	Cw	Waste	5.39	0.65	8.19	0.99	4	6.08
BHDDH08-03	420.6	422.5	1.8	Wolsey	Cw	Waste	4.48	0.69	8.20	1.26	4	7.32
BHDDH08-02	385.6	387.1	1.5	Wolsey	Cw	Waste	5.31	0.74	7.97	1.11	4	6.00
BHDDH08-03	480.2	481.6	1.4	Wolsey	Cw	Waste	5.08	0.76	7.11	1.06	4	5.60
BHDDH08-03	413.9	415.4	1.5	Wolsey	Cw	Waste	4.95	1.13	7.52	1.72	4	6.08
BHDDH08-03	415.4	417.1	1.6	Wolsey	Cw	Waste	4.88	1.32	7.91	2.14	4	6.48
BHDDH08-01	397.8	399.3	1.5	Wolsey	Cw	Waste	5.36	1.49	8.04	2.24	4	6.00
BHDDH08-03	412.4	413.9	1.5	Wolsey	Cw	Waste	5.25	1.50	8.03	2.30	4	6.12
BHDDH08-03	407.8	409.0	1.2	Wolsey	Cw	Waste	5.62	1.53	6.86	1.87	4	4.88
BHDDH08-03	410.2	410.9	0.7	Wolsey	Cw	Waste	5.76	1.70	3.86	1.14	4	2.68
BHDDH08-04	402.5	403.9	1.4	Wolsey	Cw	Waste	8.25	1.71	11.80	2.45	4	5.72
BHDDH08-03	410.9	412.4	1.5	Wolsey	Cw	Waste	5.21	1.72	7.92	2.61	4	6.08
BHDDH08-03	480.1	480.2	0.1	Wolsey	Cw	Waste	7.79	1.79	1.09	0.25	4	0.56
BHDDH08-03	489.1	489.2	0.1	Wolsey	Cw	Waste	5.12	2.50	0.51	0.25	4	0.40
BHDDH08-03	489.2	490.1	0.9	Wolsey	Cw	Waste	5.12	2.50	4.71	2.30	4	3.68
BHDDH08-01	351.1	352	0.9	Wolsey	Cw	Waste	1.11	0.30	1.00	0.27	5	4.50

BHDDH08-01	349.1	349.7	0.6	Wolsey	Cw	Waste	4.34	0.81	2.60	0.49	5	3.00
BHDDH08-01	348.6	349	0.4	Wolsey	Cw	Waste	7.37	2.03	2.95	0.81	5	2.00
BHDDH08-01	349.0	349.1	0.1	Wolsey	Cw	Waste	7.37	2.03	0.77	0.21	5	0.52
BHDDH08-01	349.7	351.1	1.4	Wolsey	Cw	Waste	7.10	2.50	9.94	3.50	5	7.00
BHDDH08-04	386.1	387.7	1.6	Wolsey	Cw	Waste	3.61	0.56	5.74	0.89	6	9.54
BHDDH08-02	382.5	384	1.5	Wolsey	Cw	Waste	4.50	0.65	6.75	0.98	6	9.00
BHDDH08-04	382.2	384.4	2.1	Wolsey	Cw	Waste	3.85	0.70	8.20	1.49	6	12.78
BHDDH08-02	381	382.5	1.5	Wolsey	Cw	Waste	4.73	0.82	7.10	1.23	6	9.00
BHDDH08-02	378	379.5	1.5	Wolsey	Cw	Waste	5.09	0.87	7.64	1.31	6	9.00
BHDDH08-02	379.5	381	1.5	Wolsey	Cw	Waste	4.44	1.18	6.66	1.77	6	9.00
BHDDH08-04	384.4	386.1	1.8	Wolsey	Cw	Waste	6.12	2.02	10.83	3.58	6	10.62
BHDDH08-01	356.5	357.2	0.7	Wolsey	Cw	Waste	4.41	0.06	3.09	0.04	6.1	4.27
BHDDH08-01	357.2	358.1	0.9	Wolsey	Cw	Waste	4.84	0.10	4.36	0.09	6.1	5.49
BHDDH08-01	352.0	352.2	0.2	Wolsey	Cw	Waste	1.11	0.30	0.17	0.05	6.1	0.95
BHDDH08-01	354.9	356.5	1.6	Wolsey	Cw	Waste	4.04	0.39	6.46	0.62	6.1	9.76
BHDDH08-01	352.2	352.7	0.5	Wolsey	Cw	Waste	3.98	1.26	1.99	0.63	6.1	3.05
BHDDH08-01	352.7	353.8	1.1	Wolsey	Cw	Waste	6.08	1.82	6.69	2.00	6.1	6.71
BHDDH08-01	353.8	354.9	1.1	Wolsey	Cw	Waste	8.67	4.31	9.54	4.74	6.1	6.71
BHDDH08-02	365.5	366.4	0.9	Wolsey	Cw	Waste	3.36	0.04	3.02	0.04	6.5	5.85
BHDDH08-02	369.9	371.3	1.4	Wolsey	Cw	Waste	2.88	0.17	4.03	0.24	6.5	9.10
BHDDH08-04	391.6	392.2	0.6	Wolsey	Cw	Waste	3.94	0.23	2.32	0.14	6.5	3.83
BHDDH08-04	393.8	395.6	1.8	Wolsey	Cw	Waste	4.04	0.31	7.39	0.57	6.5	11.89
BHDDH08-04	395.6	397.2	1.5	Wolsey	Cw	Waste	4.76	0.33	7.24	0.50	6.5	9.88
BHDDH08-04	392.2	393.8	1.6	Wolsey	Cw	Waste	4.74	0.34	7.63	0.55	6.5	10.47
BHDDH08-02	367.7	368.4	0.7	Wolsey	Cw	Waste	6.99	0.43	4.89	0.30	6.5	4.55
BHDDH08-02	368.4	369.9	1.5	Wolsey	Cw	Waste	3.35	0.44	5.03	0.66	6.5	9.75
BHDDH08-04	427.2	428.0	0.8	Wolsey	Cw	Waste	5.07	0.45	4.16	0.37	6.5	5.33
BHDDH08-02	366.4	367.7	1.3	Wolsey	Cw	Waste	4.17	0.59	5.42	0.77	6.5	8.45
BHDDH08-04	429.5	430.8	1.3	Wolsey	Cw	Waste	5.51	0.65	7.05	0.83	6.5	8.32
BHDDH08-04	420.3	421.2	1.0	Wolsey	Cw	Waste	5.01	0.91	4.86	0.88	6.5	6.31
BHDDH08-02	364.6	364.9	0.3	Wolsey	Cw	Waste	4.77	1.00	1.43	0.30	6.5	1.95
BHDDH08-02	364.9	365.5	0.6	Wolsey	Cw	Waste	4.77	1.00	3.10	0.65	6.5	4.22
BHDDH08-04	428.0	429.5	1.5	Wolsey	Cw	Waste	6.39	1.21	9.90	1.88	6.5	10.07
BHDDH08-04	406.6	407.2	0.6	Wolsey	Cw	Waste	6.48	1.43	3.95	0.87	6.5	3.96
BHDDH08-04	418.8	420.3	1.5	Wolsey	Cw	Waste	6.71	1.62	9.80	2.37	6.5	9.49
BHDDH08-04	417.2	418.8	1.6	Wolsey	Cw	Waste	6.61	1.90	10.71	3.08	6.5	10.53
BHDDH08-02	359.2	359.3	0.1	Wolsey	Cw	Waste	2.89	0.20	0.29	0.02	7.5	0.75
BHDDH08-02	359.3	360.8	1.5	Wolsey	Cw	Waste	2.89	0.20	4.34	0.30	7.5	11.25
BHDDH08-01	495.2	497	1.8	Wolsey	Cw	Waste	4.21	0.40	7.58	0.72	7.5	13.50
BHDDH08-03	400.0	401.6	1.6	Wolsey	Cw	Waste	4.53	0.57	7.02	0.88	7.5	11.63
BHDDH08-03	485.0	485.2	0.2	Wolsey	Cw	Waste	6.31	1.18	1.26	0.24	7.5	1.50
BHDDH08-03	485.2	486.8	1.5	Wolsey	Cw	Waste	6.31	1.18	9.65	1.81	7.5	11.47
BHDDH08-03	473.8	475.5	1.7	Wolsey	Cw	Waste	6.28	1.47	10.61	2.48	7.5	12.68
BHDDH08-02	360.8	361.5	0.7	Wolsey	Cw	Waste	4.89	2.33	3.42	1.63	7.5	5.25
BHDDH08-04	410.6	412.1	1.5	Wolsey	Cw	Waste	6.44	0.43	9.79	0.65	8	12.16

BHDDH08-01	346.8	348.6	1.8	Wolsey	Cw	Waste	7.15	2.27	12.87	4.09	8	14.40
BHDDH08-01	343.8	344.8	1.0	Wolsey	Cw	Waste	7.50	2.36	7.50	2.36	8	8.00
BHDDH08-01	345.4	346.8	1.4	Wolsey	Cw	Waste	6.74	2.41	9.44	3.37	8	11.20
BHDDH08-01	342.9	343.8	0.9	Wolsey	Cw	Waste	6.50	2.70	5.85	2.43	8	7.20
BHDDH08-01	344.8	345.4	0.6	Wolsey	Cw	Waste	11.80	5.86	7.08	3.52	8	4.80
BHDDH08-03	372.0	373.4	1.4	Wolsey	Cw	Waste	4.08	0.13	5.71	0.18	8.5	11.90
BHDDH08-02	395.8	396	0.2	Wolsey	Cw	Waste	4.18	0.14	0.84	0.03	8.5	1.70
BHDDH08-02	397.8	399.3	1.5	Wolsey	Cw	Waste	6.03	0.19	9.05	0.29	8.5	12.75
BHDDH08-02	399.3	401.1	1.8	Wolsey	Cw	Waste	4.52	0.26	8.14	0.47	8.5	15.30
BHDDH08-03	371.9	372.0	0.1	Wolsey	Cw	Waste	3.36	0.30	0.34	0.03	8.5	0.85
BHDDH08-02	396	397.8	1.8	Wolsey	Cw	Waste	7.81	0.35	14.06	0.63	8.5	15.30
BHDDH08-03	373.4	374.9	1.5	Wolsey	Cw	Waste	5.85	1.00	8.89	1.52	8.5	12.92
BHDDH08-03	417.1	418.2	1.1	Wolsey	Cw	Waste	6.49	1.57	7.33	1.77	8.5	9.60
BHDDH08-03	374.9	375.5	0.6	Wolsey	Cw	Waste	5.26	1.60	3.16	0.96	8.5	5.10
BHDDH08-03	418.2	419.2	1.0	Wolsey	Cw	Waste	6.95	1.96	6.95	1.96	8.5	8.50
BHDDH08-03	397.2	398.1	0.9	Wolsey	Cw	Waste	4.11	0.15	3.78	0.14	10	9.20
BHDDH08-03	429.5	431.0	1.5	Wolsey	Cw	Waste	3.40	0.25	5.20	0.38	10	15.30
BHDDH08-03	426.4	427.9	1.5	Wolsey	Cw	Waste	2.75	0.29	4.18	0.44	10	15.20
BHDDH08-03	424.9	426.4	1.5	Wolsey	Cw	Waste	3.21	0.60	4.91	0.92	10	15.30
BHDDH08-03	392.9	394.4	1.5	Wolsey	Cw	Waste	3.90	0.65	5.93	0.99	10	15.20
BHDDH08-03	389.8	391.4	1.6	Wolsey	Cw	Waste	4.40	0.88	6.86	1.37	10	15.60
BHDDH08-03	395.9	397.2	1.3	Wolsey	Cw	Waste	4.21	0.90	5.47	1.17	10	13.00
BHDDH08-03	431.0	432.5	1.5	Wolsey	Cw	Waste	4.52	0.99	6.87	1.50	10	15.20
BHDDH08-03	391.4	392.9	1.5	Wolsey	Cw	Waste	4.52	1.04	6.92	1.59	10	15.30
BHDDH08-03	427.9	429.5	1.5	Wolsey	Cw	Waste	5.39	1.15	8.19	1.75	10	15.20
BHDDH08-04	451.0	451.1	0.2	Wolsey	Cw	Waste	3.61	1.45	0.54	0.22	11	1.65
BHDDH08-01	461.0	461.6	0.6	Wolsey	Cw	Waste	1.27	0.28	0.76	0.17	12.5	7.50
BHDDH08-01	463.1	464.7	1.6	Wolsey	Cw	Waste	3.19	0.75	5.10	1.20	12.5	20.00
BHDDH08-01	461.6	463.1	1.5	Wolsey	Cw	Waste	4.25	0.76	6.38	1.14	12.5	18.75
BHDDH08-01	473.4	474.8	1.4	Wolsey	Cw	Waste	4.34	1.00	6.27	1.45	12.5	18.07
BHDDH08-01	467.7	469.2	1.5	Wolsey	Cw	Waste	5.64	1.24	8.46	1.86	13	19.50
BHDDH08-01	469.2	470.9	1.7	Wolsey	Cw	Waste	5.13	2.21	8.72	3.76	13	22.10
BHDDH08-01	488	489.5	1.5	Wolsey	Cw	Waste	2.21	0.03	3.32	0.05	15	22.50
BHDDH08-01	489.5	491.1	1.6	Wolsey	Cw	Waste	2.28	0.03	3.65	0.05	15	24.00
BHDDH08-01	486.6	488	1.4	Wolsey	Cw	Waste	2.37	0.10	3.32	0.14	15	21.00
BHDDH08-01	375.8	376.4	0.6	Wolsey	Cw	Waste	6.57	0.21	3.94	0.13	15	9.00
BHDDH08-01	376.4	376.6	0.2	Wolsey	Cw	Waste	6.57	0.21	1.13	0.04	15	2.58
BHDDH08-01	374.9	375.8	0.9	Wolsey	Cw	Waste	2.41	0.40	2.16	0.36	15	13.44
BHDDH08-01	485.7	486.6	0.9	Wolsey	Cw	Waste	8.21	1.70	7.39	1.53	15	13.50
BHDDH08-02	363	363.8	0.8	Wolsey	Cw	Waste	6.46	3.39	5.17	2.71	15	12.00
BHDDH08-04	368.5	370.0	1.5	Wolsey	Cw	Waste	20.50	8.49	31.36	12.99	15	22.95
BHDDH08-04	370.0	370.6	0.6	Wolsey	Cw	Waste	23.60	11.00	14.40	6.71	15	9.15
BHDDH08-04	365.5	365.7	0.2	Wolsey	Cw	Waste	29.20	11.00	7.01	2.64	15	3.60
BHDDH08-04	365.7	367.3	1.6	Wolsey	Cw	Waste	30.70	11.00	48.51	17.38	15	23.70
BHDDH08-04	367.3	368.5	1.2	Wolsey	Cw	Waste	36.70	11.00	44.77	13.42	15	18.30

BHDDH08-01	420.0	420.6	0.6	Wolsey	Cw	Waste	5.87	1.44	3.58	0.88	17.5	10.67			
BHDDH08-03	456.0	457.0	1.0	Wolsey	Cw	Waste	7.09	1.54	7.37	1.60	17.5	18.20			
BHDDH08-03	409.7	410.2	0.6	Wolsey	Cw	Waste	5.76	1.70	3.17	0.94	17.5	9.63			
BHDDH08-03	424.0	424.9	0.9	Wolsey	Cw	Waste	7.04	2.50	6.41	2.27	17.5	15.92			
BHDDH08-03	457.0	458.7	1.7	Wolsey	Cw	Waste	9.83	2.97	16.71	5.05	17.5	29.75			
BHDDH08-03	368.5	369.7	1.2	Wolsey	Cw	Waste	4.58	3.24	5.31	3.76	17.5	20.30			
BHDDH08-03	409.0	409.7	0.6	Wolsey	Cw	Waste	8.51	3.72	5.19	2.27	17.5	10.67			
BHDDH08-03	458.7	459.3	0.6	Wolsey	Cw	Waste	14.10	5.58	8.60	3.40	17.5	10.67			
BHDDH08-01	417.8	419.3	1.5	Wolsey	Cw	Waste	0.52	0.01	0.78	0.02	20	30.00			
BHDDH08-01	419.3	420	0.7	Wolsey	Cw	Waste	0.83	0.06	0.58	0.04	20	14.00			
BHDDH08-01	416.3	417.8	1.5	Wolsey	Cw	Waste	0.71	0.08	1.07	0.12	20	30.00			
BHDDH08-02	395.5	395.8	0.3	Wolsey	Cw	Waste	4.18	0.14	1.25	0.04	20	6.00			
BHDDH08-01	409.1	410.2	1.1	Wolsey	Cw	Waste	0.79	0.19	0.87	0.21	20	22.00			
BHDDH08-01	410.2	411.5	1.3	Wolsey	Cw	Waste	0.83	0.21	1.08	0.27	20	26.00			
BHDDH08-02	393.2	393.7	0.5	Wolsey	Cw	Waste	4.35	0.31	2.18	0.16	20	10.00			
BHDDH08-02	393.7	394.7	1.0	Wolsey	Cw	Waste	4.35	0.31	4.35	0.31	20	20.00			
BHDDH08-03	403.0	404.5	1.5	Wolsey	Cw	Waste	3.02	0.37	4.59	0.56	20	30.40			
BHDDH08-03	404.5	406.5	2.0	Wolsey	Cw	Waste	3.93	0.41	7.78	0.81	20	39.60			
BHDDH08-03	441.5	441.7	0.2	Wolsey	Cw	Waste	5.41	0.60	0.87	0.10	20	3.20			
BHDDH08-01	412.8	413.9	1.1	Wolsey	Cw	Waste	4.01	0.67	4.41	0.74	20	22.00			
BHDDH08-03	479.5	479.6	0.2	Wolsey	Cw	Waste	2.28	0.71	0.34	0.11	20	3.00			
BHDDH08-01	413.9	415.1	1.2	Wolsey	Cw	Waste	4.58	0.83	5.50	1.00	20	24.00			
BHDDH08-01	415.7	416.3	0.6	Wolsey	Cw	Waste	6.68	1.59	4.01	0.95	20	12.00			
BHDDH08-03	401.6	403.0	1.4	Wolsey	Cw	Waste	5.80	1.76	8.00	2.43	20	27.60			
BHDDH08-03	479.6	480.1	0.5	Wolsey	Cw	Waste	7.79	1.79	3.66	0.84	20	9.40			
BHDDH08-01	411.5	412.8	1.3	Wolsey	Cw	Waste	6.68	1.81	8.68	2.35	20	26.00			
BHDDH08-01	408.7	409.0	0.3	Wolsey	Cw	Waste	6.97	2.69	2.09	0.81	20	6.00			
BHDDH08-01	409.0	409.1	0.1	Wolsey	Cw	Waste	6.97	2.69	0.70	0.27	20	2.00			
BHDDH08-01	415.1	415.7	0.6	Wolsey	Cw	Waste	13.20	5.72	7.42	3.22	20	11.25			
BHDDH08-03	490.1	490.2	0.1	Wolsey	Cw	Waste	5.12	2.50	0.41	0.20	21.5	1.72			
BHDDH08-04	363.2	364.8	1.6	Wolsey	Cw	Waste	24.50	11.00	37.98	17.05	22.5	34.88			
BHDDH08-04	364.8	365.5	0.8	Wolsey	Cw	Waste	29.20	11.00	21.90	8.25	22.5	16.88			
BHDDH08-04	363.0	363.2	0.2	Wolsey	Cw	Waste	45.40	11.00	8.17	1.98	22.5	4.05			
BHDDH08-01	387.1	387.9	0.8	Wolsey	Cw	Waste	6.45	0.80	5.19	0.64	30	24.12			
BHDDH08-04	373.2	374.0	0.8	Wolsey	Cw	Waste	23.50	11.00	18.80	8.80	35	28.00			
BHDDH08-04	370.6	372.3	1.7	Wolsey	Cw	Waste	30.50	11.00	50.63	18.26	35	58.10			
BHDDH08-04	372.3	373.2	0.9	Wolsey	Cw	Waste	32.20	11.00	27.69	9.46	35	30.10			
BHDDH08-03	473.5	473.8	0.3	Wolsey	Cw	Waste	16.45	6.86	4.94	2.06	40	12.00			
BHDDH08-04	361.8	363	1.2	Wolsey	Cw	Waste	45.40	11.00	54.48	13.20	60	72.00			
Totals			**353.3**						**1854.47**	**407.66**		**2106.41**	**5.25**	**1.15**	**5.96**

Appendix C
(Weighted Average Calcium Data Tables)

Hole_Id	From	To	Length	Lithology	Code	Ore_Type	Ca	Weighted_avg	**Overall_Ca**
	m	m	m				percent	Ca_percent	**percent**
BHDDH08-02	480.9	481.1	0.2	Diorite	Kd	Ore	0.42	0.08	
BHDDH08-02	432.5	433.7	1.2	Diorite	Kd	Ore	2.58	3.17	
BHDDH08-02	433.7	433.8	0.1	Diorite	Kd	Ore	2.58	0.26	
BHDDH08-02	433.8	434.6	0.8	Diorite	Kd	Ore	3.26	2.61	
BHDDH08-02	447.2	448.7	1.5	Diorite	Kd	Ore	3.51	5.27	
BHDDH08-03	492.2	492.3	0.1	Diorite	Kd	Ore	7.3	0.73	
Totals			**3.9**					**12.12**	**3.08**
BHDDH08-02	441.6	441.7	0.1	Diorite	Kd	Waste	2.45	0.24	
BHDDH08-02	435.6	437.5	1.9	Diorite	Kd	Waste	2.94	5.59	
BHDDH08-02	470.3	471.8	1.5	Diorite	Kd	Waste	3	4.50	
BHDDH08-02	494.6	496.2	1.6	Diorite	Kd	Waste	3.1	4.96	
BHDDH08-02	420.9	422.5	1.6	Diorite	Kd	Waste	3.11	4.98	
BHDDH08-04	470.9	472.4	1.5	Diorite	Kd	Waste	3.2	4.80	
BHDDH08-02	466	467.3	1.3	Diorite	Kd	Waste	3.2	4.16	
BHDDH08-02	473.4	474.9	1.5	Diorite	Kd	Waste	3.2	4.80	
BHDDH08-02	437.5	437.7	0.2	Diorite	Kd	Waste	3.24	0.65	
BHDDH08-02	437.7	438.9	1.2	Diorite	Kd	Waste	3.24	3.95	
BHDDH08-02	438.9	439	0.1	Diorite	Kd	Waste	3.24	0.29	
BHDDH08-02	424	425.7	1.7	Diorite	Kd	Waste	3.25	5.52	
BHDDH08-02	481.1	482.5	1.4	Diorite	Kd	Waste	3.25	4.55	
BHDDH08-02	476.4	477.9	1.5	Diorite	Kd	Waste	3.26	4.89	
BHDDH08-02	468.8	469.4	0.6	Diorite	Kd	Waste	3.3	1.98	
BHDDH08-02	469.4	470.3	0.9	Diorite	Kd	Waste	3.3	3.00	
BHDDH08-02	434.6	435.6	1.0	Diorite	Kd	Waste	3.32	3.19	
BHDDH08-02	479.8	480.9	1.1	Diorite	Kd	Waste	3.32	3.65	
BHDDH08-02	427.0	428.5	1.5	Diorite	Kd	Waste	3.33	4.93	
BHDDH08-02	454.5	455.3	0.8	Diorite	Kd	Waste	3.33	2.66	
BHDDH08-02	440.4	441.6	1.2	Diorite	Kd	Waste	3.34	4.01	
BHDDH08-02	428.5	430.1	1.6	Diorite	Kd	Waste	3.35	5.36	
BHDDH08-02	430.1	431.1	1.0	Diorite	Kd	Waste	3.35	3.35	
BHDDH08-02	439	440.4	1.4	Diorite	Kd	Waste	3.35	4.69	
BHDDH08-02	459.3	460.9	1.6	Diorite	Kd	Waste	3.35	5.36	
BHDDH08-02	496.2	497.7	1.5	Diorite	Kd	Waste	3.35	5.03	
BHDDH08-02	471.8	473.4	1.6	Diorite	Kd	Waste	3.36	5.38	
BHDDH08-02	490.1	491.6	1.5	Diorite	Kd	Waste	3.36	5.04	
BHDDH08-02	464.2	466	1.8	Diorite	Kd	Waste	3.38	6.08	
BHDDH08-02	452.9	454.5	1.6	Diorite	Kd	Waste	3.4	5.44	
BHDDH08-02	485.5	487.4	1.9	Diorite	Kd	Waste	3.41	6.48	
BHDDH08-02	477.9	479.8	1.9	Diorite	Kd	Waste	3.44	6.54	
BHDDH08-02	422.5	424	1.5	Diorite	Kd	Waste	3.45	5.18	
BHDDH08-02	450	451.4	1.4	Diorite	Kd	Waste	3.45	4.83	
BHDDH08-02	462.4	464.2	1.8	Diorite	Kd	Waste	3.45	6.21	

BHDDH08-02	419.4	420.9	1.5	Diorite	Kd	Waste	3.46	5.19
BHDDH08-02	448.7	450.0	1.3	Diorite	Kd	Waste	3.46	4.50
BHDDH08-02	474.9	476.4	1.5	Diorite	Kd	Waste	3.47	5.21
BHDDH08-02	441.7	443.5	1.8	Diorite	Kd	Waste	3.48	6.40
BHDDH08-02	497.7	499.3	1.6	Diorite	Kd	Waste	3.49	5.58
BHDDH08-04	472.4	474.0	1.5	Diorite	Kd	Waste	3.5	5.30
BHDDH08-02	499.3	500.8	1.5	Diorite	Kd	Waste	3.5	5.25
BHDDH08-02	416.4	416.7	0.3	Diorite	Kd	Waste	3.51	1.05
BHDDH08-02	416.7	417.9	1.2	Diorite	Kd	Waste	3.51	4.35
BHDDH08-02	443.5	445	1.5	Diorite	Kd	Waste	3.51	5.27
BHDDH08-02	488.6	490.1	1.5	Diorite	Kd	Waste	3.54	5.31
BHDDH08-02	482.5	484	1.5	Diorite	Kd	Waste	3.56	5.34
BHDDH08-02	451.4	452.9	1.5	Diorite	Kd	Waste	3.57	5.36
BHDDH08-02	491.6	493.7	2.1	Diorite	Kd	Waste	3.57	7.50
BHDDH08-02	425.7	425.8	0.1	Diorite	Kd	Waste	3.58	0.36
BHDDH08-02	425.8	427.0	1.2	Diorite	Kd	Waste	3.58	4.33
BHDDH08-02	458.1	459.3	1.2	Diorite	Kd	Waste	3.59	4.31
BHDDH08-02	484	485.5	1.5	Diorite	Kd	Waste	3.61	5.42
BHDDH08-02	412.4	413.3	0.9	Diorite	Kd	Waste	3.62	3.26
BHDDH08-04	466.3	467.9	1.5	Diorite	Kd	Waste	3.6	5.55
BHDDH08-02	417.9	419.4	1.5	Diorite	Kd	Waste	3.65	5.48
BHDDH08-02	456.6	458.1	1.5	Diorite	Kd	Waste	3.67	5.54
BHDDH08-01	400.1	401.7	1.6	Diorite	Kd	Waste	3.69	5.90
BHDDH08-02	467.3	468.8	1.5	Diorite	Kd	Waste	3.69	5.54
BHDDH08-04	484.6	486.2	1.5	Diorite	Kd	Waste	3.7	5.69
BHDDH08-02	413.3	414.8	1.5	Diorite	Kd	Waste	3.78	5.67
BHDDH08-04	461.8	463.3	1.5	Diorite	Kd	Waste	3.8	5.78
BHDDH08-02	445	446	1.0	Diorite	Kd	Waste	3.79	3.79
BHDDH08-04	463.3	464.8	1.5	Diorite	Kd	Waste	3.8	5.76
BHDDH08-02	487.4	488.6	1.2	Diorite	Kd	Waste	3.81	4.57
BHDDH08-02	414.8	416.4	1.6	Diorite	Kd	Waste	3.87	6.19
BHDDH08-04	457.2	458.7	1.5	Diorite	Kd	Waste	3.9	5.90
BHDDH08-04	493.8	495.3	1.5	Diorite	Kd	Waste	3.9	5.90
BHDDH08-04	489.2	490.7	1.5	Diorite	Kd	Waste	3.9	6.03
BHDDH08-04	490.7	492.8	2.1	Diorite	Kd	Waste	4.0	8.20
BHDDH08-02	446	447.1	1.1	Diorite	Kd	Waste	3.98	4.38
BHDDH08-02	447.1	447.2	0.1	Diorite	Kd	Waste	3.98	0.40
BHDDH08-04	464.8	466.3	1.5	Diorite	Kd	Waste	4.0	6.08
BHDDH08-04	467.9	469.4	1.5	Diorite	Kd	Waste	4.0	6.10
BHDDH08-04	452.8	454.3	1.5	Diorite	Kd	Waste	4.0	6.13
BHDDH08-04	454.3	455.7	1.4	Diorite	Kd	Waste	4.1	5.59
BHDDH08-04	469.4	470.9	1.5	Diorite	Kd	Waste	4.1	6.20
BHDDH08-04	492.8	493.8	1.0	Diorite	Kd	Waste	4.1	4.00
BHDDH08-04	451.1	452.8	1.7	Diorite	Kd	Waste	4.1	6.97
BHDDH08-04	477.0	478.5	1.5	Diorite	Kd	Waste	4.1	6.30

BHDDH08-04	483.1	484.6	1.5	Diorite	Kd	Waste	4.2	6.32	
BHDDH08-04	486.2	487.7	1.5	Diorite	Kd	Waste	4.2	6.34	
BHDDH08-04	481.6	483.1	1.5	Diorite	Kd	Waste	4.2	6.41	
BHDDH08-04	455.7	457.2	1.5	Diorite	Kd	Waste	4.2	6.40	
BHDDH08-04	480.1	481.6	1.5	Diorite	Kd	Waste	4.2	6.40	
BHDDH08-04	487.7	489.2	1.5	Diorite	Kd	Waste	4.2	6.40	
BHDDH08-04	460.3	461.8	1.5	Diorite	Kd	Waste	4.2	6.43	
BHDDH08-02	431.1	431.3	0.2	Diorite	Kd	Waste	4.26	0.85	
BHDDH08-02	431.3	432.5	1.2	Diorite	Kd	Waste	4.26	5.15	
BHDDH08-04	498.4	499.3	0.9	Diorite	Kd	Waste	4.3	3.88	
BHDDH08-02	460.9	462.4	1.5	Diorite	Kd	Waste	4.4	6.60	
BHDDH08-04	496.8	498.4	1.5	Diorite	Kd	Waste	4.5	6.84	
BHDDH08-04	495.3	496.8	1.5	Diorite	Kd	Waste	4.5	6.86	
BHDDH08-04	458.7	460.3	1.5	Diorite	Kd	Waste	4.5	6.92	
BHDDH08-04	478.5	480.1	1.5	Diorite	Kd	Waste	4.5	6.89	
BHDDH08-02	455.3	455.4	0.1	Diorite	Kd	Waste	4.58	0.46	
BHDDH08-02	455.4	456.6	1.2	Diorite	Kd	Waste	4.58	5.59	
BHDDH08-03	496.8	498.4	1.5	Diorite	Kd	Waste	4.6	7.02	
BHDDH08-01	503.8	504.8	1.0	Diorite	Kd	Waste	5.05	5.05	
BHDDH08-01	401.7	402.3	0.6	Diorite	Kd	Waste	5.08	3.05	
BHDDH08-01	402.3	403.2	0.9	Diorite	Kd	Waste	5.08	4.57	
BHDDH08-04	226.8	227.7	0.9	Diorite	Kd	Waste	5.1	4.62	
BHDDH08-01	502.9	503.8	0.9	Diorite	Kd	Waste	5.37	4.83	
BHDDH08-03	495.3	496.8	1.5	Diorite	Kd	Waste	5.4	8.25	
BHDDH08-04	475.5	477.0	1.5	Diorite	Kd	Waste	5.5	8.39	
BHDDH08-04	237.7	239.2	1.5	Diorite	Kd	Waste	5.9	8.58	
BHDDH08-02	493.7	494.1	0.4	Diorite	Kd	Waste	6.17	2.47	
BHDDH08-02	494.1	494.4	0.3	Diorite	Kd	Waste	6.17	1.91	
BHDDH08-02	494.4	494.6	0.2	Diorite	Kd	Waste	6.17	1.30	
BHDDH08-03	493.8	495.3	1.5	Diorite	Kd	Waste	6.2	9.39	
BHDDH08-03	492.3	493.8	1.5	Diorite	Kd	Waste	6.4	9.53	
BHDDH08-04	223.4	224.8	1.4	Diorite	Kd	Waste	6.4	9.00	
BHDDH08-04	239.3	240.4	1.1	Diorite	Kd	Waste	6.5	7.15	
BHDDH08-04	239.2	239.3	0.1	Diorite	Kd	Waste	6.5	0.59	
BHDDH08-04	224.8	224.9	0.1	Diorite	Kd	Waste	6.6	0.66	
BHDDH08-04	209.7	211.2	1.5	Diorite	Kd	Waste	7.1	10.65	
BHDDH08-04	474.0	475.5	1.5	Diorite	Kd	Waste	7.2	11.05	
BHDDH08-04	205.0	209.7	4.7	Diorite	Kd	Waste	19.4	91.18	
Totals			**155.2**					**689.13**	**4.44**

BHDDH08-02	410.3	411.8	1.5	Transitional Diorite	KdT	Ore	3.25	4.88	
BHDDH08-02	407.2	408.1	0.9	Transitional Diorite	KdT	Ore	3.54	3.19	
BHDDH08-02	408.1	408.7	0.6	Transitional Diorite	KdT	Ore	3.54	2.12	
BHDDH08-02	404.2	405.7	1.5	Transitional Diorite	KdT	Ore	3.88	5.82	
Totals			**4.5**					**16.01**	**3.56**

BHDDH08-01	464.7	464.8	0.1	Transitional Diorite	KdT	Waste	3.27	0.33	
BHDDH08-01	464.8	466.2	1.4	Transitional Diorite	KdT	Waste	3.27	4.51	
BHDDH08-01	477.9	479.5	1.6	Transitional Diorite	KdT	Waste	3.5	5.60	
BHDDH08-01	466.2	467.7	1.5	Transitional Diorite	KdT	Waste	3.51	5.27	
BHDDH08-02	411.8	412.4	0.6	Transitional Diorite	KdT	Waste	3.62	2.17	
BHDDH08-02	408.7	409.4	0.7	Transitional Diorite	KdT	Waste	3.92	2.74	
BHDDH08-02	409.4	410.3	0.9	Transitional Diorite	KdT	Waste	3.92	3.53	
BHDDH08-02	405.7	407.2	1.5	Transitional Diorite	KdT	Waste	6.02	9.03	
BHDDH08-02	402.6	404	1.4	Transitional Diorite	KdT	Waste	6.16	8.62	
BHDDH08-02	404.0	404.2	0.2	Transitional Diorite	KdT	Waste	6.16	1.23	
BHDDH08-02	401.1	402.6	1.5	Transitional Diorite	KdT	Waste	7.38	11.07	
BHDDH08-01	479.5	480.6	1.1	Transitional Diorite	KdT	Waste	7.51	8.26	
BHDDH08-01	476.6	477.9	1.3	Transitional Diorite	KdT	Waste	19.75	25.67	
Totals			**13.8**					**88.04**	**6.39**

BHDDH08-01	456.6	456.8	0.2	Gabbro	Kgb	Waste	3.41	0.68
BHDDH08-01	450.5	452	1.5	Gabbro	Kgb	Waste	5.6	8.40
BHDDH08-01	449	450.5	1.5	Gabbro	Kgb	Waste	5.89	8.84
BHDDH08-01	457.2	458.7	1.5	Gabbro	Kgb	Waste	6.28	9.42
BHDDH08-01	430.7	432.2	1.5	Gabbro	Kgb	Waste	6.52	9.78
BHDDH08-01	427.6	429.2	1.6	Gabbro	Kgb	Waste	6.63	10.61
BHDDH08-01	432.2	433.7	1.5	Gabbro	Kgb	Waste	6.83	10.25
BHDDH08-01	421.8	423.1	1.3	Gabbro	Kgb	Waste	7.13	9.27
BHDDH08-01	458.7	460.2	1.5	Gabbro	Kgb	Waste	7.14	10.71
BHDDH08-01	429.2	430.7	1.5	Gabbro	Kgb	Waste	7.17	10.76
BHDDH08-01	426.1	427.6	1.5	Gabbro	Kgb	Waste	7.29	10.94
BHDDH08-01	433.7	435.3	1.6	Gabbro	Kgb	Waste	7.47	11.95
BHDDH08-01	424.6	426.1	1.5	Gabbro	Kgb	Waste	7.59	11.39
BHDDH08-01	423.1	424.6	1.5	Gabbro	Kgb	Waste	7.6	11.40
BHDDH08-01	460.2	461.0	0.8	Gabbro	Kgb	Waste	7.81	6.25
BHDDH08-01	438.3	439.8	1.5	Gabbro	Kgb	Waste	8.17	12.26
BHDDH08-01	436.8	438.3	1.5	Gabbro	Kgb	Waste	8.48	12.72
BHDDH08-01	444.4	445.9	1.5	Gabbro	Kgb	Waste	8.48	12.72
BHDDH08-01	455.1	456.6	1.5	Gabbro	Kgb	Waste	8.99	13.49
BHDDH08-01	439.8	441.4	1.6	Gabbro	Kgb	Waste	9.46	15.14
BHDDH08-01	435.3	436.8	1.5	Gabbro	Kgb	Waste	10.3	15.45
BHDDH08-01	441.4	442.9	1.5	Gabbro	Kgb	Waste	10.45	15.68
BHDDH08-01	452	453.5	1.5	Gabbro	Kgb	Waste	10.75	16.13
BHDDH08-01	453.5	455.1	1.6	Gabbro	Kgb	Waste	11	17.60
BHDDH08-01	447.4	449	1.6	Gabbro	Kgb	Waste	11.1	17.76
BHDDH08-01	442.9	444.4	1.5	Gabbro	Kgb	Waste	12.2	18.30
BHDDH08-01	445.9	447.4	1.5	Gabbro	Kgb	Waste	12.4	18.60

Totals			**38.8**					**326.45**	**8.41**
BHDDH08-04	332.0	333.2	1.2	Meagher	Cm	Waste	4.0	4.69	
BHDDH08-04	188.4	189.9	1.5	Meagher	Cm	Waste	4.4	6.63	
BHDDH08-04	258.8	260.3	1.5	Meagher	Cm	Waste	4.4	6.63	
BHDDH08-04	278.3	279.2	1.0	Meagher	Cm	Waste	4.4	4.18	
BHDDH08-04	257.4	258.8	1.4	Meagher	Cm	Waste	4.7	6.66	
BHDDH08-04	292.6	294.1	1.5	Meagher	Cm	Waste	4.9	7.40	
BHDDH08-04	277.1	278.3	1.2	Meagher	Cm	Waste	4.9	6.03	
BHDDH08-04	199.0	200.6	1.6	Meagher	Cm	Waste	5.1	8.16	
BHDDH08-04	295.6	296.8	1.2	Meagher	Cm	Waste	5.1	6.18	
BHDDH08-04	294.1	295.6	1.5	Meagher	Cm	Waste	5.3	7.79	
BHDDH08-04	283.3	285.0	1.7	Meagher	Cm	Waste	5.4	8.99	
BHDDH08-04	200.6	202.2	1.6	Meagher	Cm	Waste	5.4	8.62	
BHDDH08-04	291.2	292.6	1.4	Meagher	Cm	Waste	5.6	7.95	
BHDDH08-04	255.7	257.4	1.6	Meagher	Cm	Waste	5.7	9.32	
BHDDH08-04	194.5	196.0	1.5	Meagher	Cm	Waste	5.7	8.61	
BHDDH08-04	288.2	289.5	1.3	Meagher	Cm	Waste	6.0	7.81	
BHDDH08-04	281.0	282.6	1.6	Meagher	Cm	Waste	6.0	9.30	
BHDDH08-04	260.3	262.1	1.8	Meagher	Cm	Waste	6.3	11.20	
BHDDH08-04	240.4	240.7	0.3	Meagher	Cm	Waste	6.5	1.75	
BHDDH08-04	249.9	251.3	1.3	Meagher	Cm	Waste	6.5	8.71	
BHDDH08-04	285.0	286.5	1.5	Meagher	Cm	Waste	6.6	9.96	
BHDDH08-04	198.1	198.7	0.6	Meagher	Cm	Waste	6.8	4.17	
BHDDH08-04	286.5	288.2	1.7	Meagher	Cm	Waste	6.9	11.43	
BHDDH08-04	196.0	197.7	1.7	Meagher	Cm	Waste	7.0	12.06	
BHDDH08-04	327.0	327.8	0.8	Meagher	Cm	Waste	7.1	5.37	
BHDDH08-04	333.2	334.3	1.2	Meagher	Cm	Waste	7.2	8.26	
BHDDH08-04	242.7	243.2	0.5	Meagher	Cm	Waste	7.7	3.84	
BHDDH08-01	27.7	28.6	0.9	Meagher	Cm	Waste	9	8.10	
BHDDH08-04	194.0	194.5	0.5	Meagher	Cm	Waste	10.5	5.46	
BHDDH08-04	316.0	317.8	1.8	Meagher	Cm	Waste	10.9	19.10	
BHDDH08-03	324.6	326.4	1.8	Meagher	Cm	Waste	11.2	20.16	
BHDDH08-03	362.1	364.5	2.4	Meagher	Cm	Waste	11.8	27.96	
BHDDH08-02	316.9	317.1	0.2	Meagher	Cm	Waste	13.05	2.61	
BHDDH08-04	306.8	307.3	0.5	Meagher	Cm	Waste	15.0	6.90	
BHDDH08-03	199.6	200.3	0.6	Meagher	Cm	Waste	15.7	9.58	
BHDDH08-03	356.0	358.2	2.2	Meagher	Cm	Waste	15.7	34.38	
BHDDH08-01	301.1	302.7	1.6	Meagher	Cm	Waste	15.8	25.28	
BHDDH08-01	319.4	321	1.6	Meagher	Cm	Waste	16.2	25.92	
BHDDH08-04	197.7	198.1	0.3	Meagher	Cm	Waste	16.8	5.71	
BHDDH08-02	348.4	349.9	1.5	Meagher	Cm	Waste	16.95	25.43	
BHDDH08-03	352.4	356.0	3.6	Meagher	Cm	Waste	17.2	61.92	
BHDDH08-02	349.9	351.4	1.5	Meagher	Cm	Waste	17.4	26.10	

BHDDH08-03	170.1	171.6	1.5	Meagher	Cm	Waste	17.4	26.45
BHDDH08-03	171.6	172.5	0.9	Meagher	Cm	Waste	17.4	16.01
BHDDH08-03	349.3	350.5	1.2	Meagher	Cm	Waste	17.4	20.88
BHDDH08-01	305.7	307.2	1.5	Meagher	Cm	Waste	17.55	26.33
BHDDH08-01	321	322.5	1.5	Meagher	Cm	Waste	17.65	26.48
BHDDH08-02	334.4	335.9	1.5	Meagher	Cm	Waste	17.65	26.48
BHDDH08-03	327.5	328.6	1.1	Meagher	Cm	Waste	17.7	19.29
BHDDH08-03	350.5	352.0	1.5	Meagher	Cm	Waste	17.7	26.90
BHDDH08-01	304.2	305.7	1.5	Meagher	Cm	Waste	17.75	26.63
BHDDH08-03	347.8	349.3	1.5	Meagher	Cm	Waste	17.8	27.06
BHDDH08-01	307.2	308.8	1.6	Meagher	Cm	Waste	17.8	28.48
BHDDH08-02	324.6	325.3	0.7	Meagher	Cm	Waste	17.8	12.46
BHDDH08-01	303	304.2	1.2	Meagher	Cm	Waste	17.85	21.42
BHDDH08-03	326.4	327.5	1.0	Meagher	Cm	Waste	17.9	18.56
BHDDH08-03	346.9	347.8	0.9	Meagher	Cm	Waste	17.9	16.11
BHDDH08-02	335.9	337.4	1.5	Meagher	Cm	Waste	18.05	27.08
BHDDH08-02	346.7	348.4	1.7	Meagher	Cm	Waste	18.05	30.68
BHDDH08-02	323.3	324.6	1.3	Meagher	Cm	Waste	18.15	23.60
BHDDH08-02	351.4	353.3	1.9	Meagher	Cm	Waste	18.15	34.49
BHDDH08-02	337.4	338.9	1.5	Meagher	Cm	Waste	18.3	27.45
BHDDH08-04	275.5	277.1	1.5	Meagher	Cm	Waste	18.3	27.82
BHDDH08-02	326.7	328.3	1.6	Meagher	Cm	Waste	18.35	29.36
BHDDH08-01	311.8	313.3	1.5	Meagher	Cm	Waste	18.45	27.68
BHDDH08-01	308.8	310.3	1.5	Meagher	Cm	Waste	18.5	27.75
BHDDH08-02	320	321.6	1.6	Meagher	Cm	Waste	18.5	29.60
BHDDH08-02	332.8	334.4	1.6	Meagher	Cm	Waste	18.5	29.60
BHDDH08-01	48.5	49.4	0.9	Meagher	Cm	Waste	18.55	16.70
BHDDH08-03	314.9	316.4	1.5	Meagher	Cm	Waste	18.6	28.20
BHDDH08-01	39.6	48.5	8.9	Meagher	Cm	Waste	18.6	165.54
BHDDH08-02	321.6	323.3	1.7	Meagher	Cm	Waste	18.6	31.62
BHDDH08-02	325.3	326.7	1.4	Meagher	Cm	Waste	18.6	26.04
BHDDH08-02	318.6	320	1.4	Meagher	Cm	Waste	18.65	26.11
BHDDH08-02	345	346.7	1.7	Meagher	Cm	Waste	18.65	31.70
BHDDH08-02	317.1	318.6	1.5	Meagher	Cm	Waste	18.7	28.05
BHDDH08-02	329.8	331.3	1.5	Meagher	Cm	Waste	18.7	28.05
BHDDH08-04	262.1	263.7	1.6	Meagher	Cm	Waste	18.7	29.55
BHDDH08-01	328.6	329.2	0.6	Meagher	Cm	Waste	18.75	11.25
BHDDH08-01	329.2	329.9	0.7	Meagher	Cm	Waste	18.75	13.12
BHDDH08-02	328.3	329.8	1.5	Meagher	Cm	Waste	18.75	28.13
BHDDH08-01	324	325.5	1.5	Meagher	Cm	Waste	18.8	28.20
BHDDH08-02	342	343.5	1.5	Meagher	Cm	Waste	18.8	28.20
BHDDH08-04	240.7	240.8	0.1	Meagher	Cm	Waste	18.8	2.44
BHDDH08-04	240.8	242.0	1.2	Meagher	Cm	Waste	18.8	22.75
BHDDH08-04	246.6	248.1	1.5	Meagher	Cm	Waste	18.8	28.76
BHDDH08-04	254.2	255.7	1.6	Meagher	Cm	Waste	18.8	29.33

BHDDH08-02	331.3	332.8	1.5	Meagher	Cm	Waste	18.85	28.28
BHDDH08-02	340.5	342	1.5	Meagher	Cm	Waste	18.9	28.35
BHDDH08-03	308.8	310.3	1.5	Meagher	Cm	Waste	18.9	28.35
BHDDH08-02	343.5	345	1.5	Meagher	Cm	Waste	18.95	28.43
BHDDH08-03	200.3	201.8	1.5	Meagher	Cm	Waste	19.0	29.07
BHDDH08-02	316.1	316.9	0.8	Meagher	Cm	Waste	19.05	15.24
BHDDH08-01	310.3	311.8	1.5	Meagher	Cm	Waste	19.1	28.65
BHDDH08-01	314.2	316.4	2.2	Meagher	Cm	Waste	19.1	42.02
BHDDH08-01	313.3	314.2	0.9	Meagher	Cm	Waste	19.2	17.28
BHDDH08-04	245.2	246.6	1.4	Meagher	Cm	Waste	19.2	26.88
BHDDH08-03	198.1	199.6	1.5	Meagher	Cm	Waste	19.3	29.26
BHDDH08-02	354.8	356.3	1.5	Meagher	Cm	Waste	19.3	28.95
BHDDH08-02	356.3	356.9	0.6	Meagher	Cm	Waste	19.3	11.58
BHDDH08-02	356.9	357.0	0.1	Meagher	Cm	Waste	19.3	1.54
BHDDH08-03	168.6	170.1	1.5	Meagher	Cm	Waste	19.3	29.53
BHDDH08-01	317.9	319.4	1.5	Meagher	Cm	Waste	19.35	29.03
BHDDH08-04	341.6	342.4	0.8	Meagher	Cm	Waste	19.4	14.71
BHDDH08-03	313.3	314.9	1.5	Meagher	Cm	Waste	19.4	29.68
BHDDH08-04	202.2	204.2	2.0	Meagher	Cm	Waste	19.4	39.38
BHDDH08-04	204.2	205.0	0.8	Meagher	Cm	Waste	19.4	15.13
BHDDH08-01	327.1	328.6	1.5	Meagher	Cm	Waste	19.45	29.18
BHDDH08-03	329.5	331.0	1.5	Meagher	Cm	Waste	19.5	29.56
BHDDH08-01	322.5	324	1.5	Meagher	Cm	Waste	19.5	29.25
BHDDH08-02	353.3	354.8	1.5	Meagher	Cm	Waste	19.5	29.25
BHDDH08-03	172.5	174.0	1.5	Meagher	Cm	Waste	19.5	29.64
BHDDH08-03	311.8	313.3	1.5	Meagher	Cm	Waste	19.5	29.64
BHDDH08-03	322.5	324.0	1.5	Meagher	Cm	Waste	19.5	29.25
BHDDH08-04	252.7	254.2	1.5	Meagher	Cm	Waste	19.5	29.05
BHDDH08-01	325.5	327.1	1.6	Meagher	Cm	Waste	19.55	31.28
BHDDH08-03	310.3	311.8	1.5	Meagher	Cm	Waste	19.8	29.90
BHDDH08-04	279.2	281.0	1.8	Meagher	Cm	Waste	19.9	35.73
BHDDH08-01	316.4	317	0.6	Meagher	Cm	Waste	19.95	11.97
BHDDH08-01	317.0	317.9	0.9	Meagher	Cm	Waste	19.95	17.95
BHDDH08-03	324.0	324.6	0.6	Meagher	Cm	Waste	20.3	12.99
BHDDH08-04	189.9	191.4	1.5	Meagher	Cm	Waste	20.3	30.86
BHDDH08-04	248.1	249.9	1.8	Meagher	Cm	Waste	20.4	37.33
BHDDH08-04	191.4	192.9	1.5	Meagher	Cm	Waste	20.5	31.37
BHDDH08-04	192.9	193.6	0.7	Meagher	Cm	Waste	20.5	13.53
BHDDH08-04	193.6	194.0	0.4	Meagher	Cm	Waste	20.5	8.61
BHDDH08-02	338.9	340.5	1.6	Meagher	Cm	Waste	20.6	32.96
BHDDH08-04	251.3	252.7	1.4	Meagher	Cm	Waste	20.7	28.98
BHDDH08-04	282.6	283.3	0.7	Meagher	Cm	Waste	20.7	15.11
BHDDH08-03	346.0	346.9	0.9	Meagher	Cm	Waste	20.8	17.68
BHDDH08-04	185.3	186.8	1.5	Meagher	Cm	Waste	21.0	31.92
BHDDH08-04	186.8	188.4	1.5	Meagher	Cm	Waste	21.0	32.13

BHDDH08-04	360.3	361.5	1.2	Meagher	Cm	Waste	21.0	25.83	
BHDDH08-04	361.5	361.8	0.3	Meagher	Cm	Waste	21.0	6.30	
BHDDH08-04	289.5	291.2	1.7	Meagher	Cm	Waste	21.1	36.08	
BHDDH08-04	305.4	306.8	1.4	Meagher	Cm	Waste	21.1	30.17	
BHDDH08-03	359.1	362.1	3.1	Meagher	Cm	Waste	21.3	64.97	
BHDDH08-04	317.8	319.6	1.8	Meagher	Cm	Waste	21.4	38.52	
BHDDH08-04	334.3	335.9	1.6	Meagher	Cm	Waste	21.4	34.03	
BHDDH08-04	325.5	327.0	1.5	Meagher	Cm	Waste	21.5	31.39	
BHDDH08-04	327.8	329.8	2.0	Meagher	Cm	Waste	21.6	44.06	
BHDDH08-03	352.0	354.2	2.1	Meagher	Cm	Waste	21.7	46.44	
BHDDH08-04	340.2	341.6	1.5	Meagher	Cm	Waste	21.9	31.97	
BHDDH08-04	314.6	316.0	1.4	Meagher	Cm	Waste	22.1	31.82	
BHDDH08-04	329.8	332.0	2.2	Meagher	Cm	Waste	22.1	48.62	
BHDDH08-04	342.4	343.8	1.4	Meagher	Cm	Waste	22.1	31.60	
BHDDH08-04	307.3	308.9	1.6	Meagher	Cm	Waste	22.2	35.08	
BHDDH08-04	296.8	298.1	1.3	Meagher	Cm	Waste	22.6	28.93	
BHDDH08-03	328.6	329.5	0.9	Meagher	Cm	Waste	24.3	22.36	
BHDDH08-03	358.2	359.1	0.9	Meagher	Cm	Waste	24.9	21.17	
BHDDH08-03	364.5	365.8	1.3	Meagher	Cm	Waste	27.4	34.52	
BHDDH08-03	365.8	366.4	0.6	Meagher	Cm	Waste	27.4	16.44	
BHDDH08-03	366.4	367.9	1.5	Meagher	Cm	Waste	28.2	42.86	
Totals			**215.5**					**3624.26**	**16.82**

BHDDH08-03	381.0	382.7	1.7	Wolsey	Cw	Ore	1.7	2.82	
BHDDH08-03	475.6	476.8	1.2	Wolsey	Cw	Ore	1.9	2.37	
BHDDH08-02	357.0	358.1	1.1	Wolsey	Cw	Ore	3.46	3.81	
BHDDH08-02	358.1	359.2	1.1	Wolsey	Cw	Ore	3.51	3.86	
BHDDH08-03	394.4	395.9	1.5	Wolsey	Cw	Ore	4.6	6.95	
BHDDH08-02	363.8	364.6	0.8	Wolsey	Cw	Ore	4.93	3.94	
BHDDH08-03	476.8	478.3	1.5	Wolsey	Cw	Ore	5.2	7.87	
BHDDH08-03	484.0	485.0	1.0	Wolsey	Cw	Ore	5.3	5.06	
BHDDH08-03	486.8	488.0	1.2	Wolsey	Cw	Ore	5.5	6.73	
BHDDH08-03	475.5	475.6	0.1	Wolsey	Cw	Ore	6.6	0.73	
BHDDH08-03	483.1	484.0	0.9	Wolsey	Cw	Ore	6.7	6.10	
BHDDH08-01	407.1	407.2	0.1	Wolsey	Cw	Ore	6.74	0.67	
BHDDH08-01	407.2	407.5	0.3	Wolsey	Cw	Ore	6.74	2.02	
BHDDH08-03	481.6	483.1	1.5	Wolsey	Cw	Ore	7.3	10.89	
BHDDH08-03	490.2	492.2	2.0	Wolsey	Cw	Ore	7.3	14.54	
BHDDH08-03	378.6	380.1	1.5	Wolsey	Cw	Ore	7.7	11.49	
BHDDH08-03	382.7	385.6	2.9	Wolsey	Cw	Ore	8.2	23.69	
BHDDH08-03	387.9	388.9	1.0	Wolsey	Cw	Ore	13.4	13.40	
BHDDH08-03	367.9	368.5	0.6	Wolsey	Cw	Ore	14.7	8.79	
BHDDH08-03	388.9	389.8	0.9	Wolsey	Cw	Ore	15.4	14.12	
Totals			**23.0**					**149.85**	**6.53**

BHDDH08-04	415.4	417.2	1.8	Wolsey	Cw	Waste	0.1	0.09
BHDDH08-04	364.8	365.5	0.8	Wolsey	Cw	Waste	0.2	0.14
BHDDH08-04	408.1	409.6	1.4	Wolsey	Cw	Waste	0.2	0.26
BHDDH08-04	414.4	415.4	1.0	Wolsey	Cw	Waste	0.2	0.19
BHDDH08-04	365.5	365.7	0.2	Wolsey	Cw	Waste	0.2	0.05
BHDDH08-04	442.5	444.0	1.5	Wolsey	Cw	Waste	0.2	0.30
BHDDH08-04	404.5	406.6	2.1	Wolsey	Cw	Waste	0.3	0.60
BHDDH08-04	444.0	445.2	1.2	Wolsey	Cw	Waste	0.3	0.37
BHDDH08-04	410.6	412.1	1.5	Wolsey	Cw	Waste	0.4	0.58
BHDDH08-03	407.8	409.0	1.2	Wolsey	Cw	Waste	0.4	0.50
BHDDH08-04	407.2	408.1	0.9	Wolsey	Cw	Waste	0.4	0.38
BHDDH08-04	421.2	423.5	2.2	Wolsey	Cw	Waste	0.4	0.94
BHDDH08-04	440.7	442.5	1.8	Wolsey	Cw	Waste	0.4	0.77
BHDDH08-04	363.2	364.8	1.6	Wolsey	Cw	Waste	0.5	0.74
BHDDH08-04	370.6	372.3	1.7	Wolsey	Cw	Waste	0.5	0.80
BHDDH08-04	445.2	446.2	1.0	Wolsey	Cw	Waste	0.5	0.52
BHDDH08-04	437.1	439.4	2.4	Wolsey	Cw	Waste	0.5	1.20
BHDDH08-04	439.4	440.7	1.2	Wolsey	Cw	Waste	0.5	0.65
BHDDH08-03	409.0	409.7	0.6	Wolsey	Cw	Waste	0.6	0.39
BHDDH08-04	423.5	424.5	1.0	Wolsey	Cw	Waste	0.7	0.68
BHDDH08-04	447.5	449.3	1.8	Wolsey	Cw	Waste	0.7	1.27
BHDDH08-04	406.6	407.2	0.6	Wolsey	Cw	Waste	0.7	0.45
BHDDH08-04	430.8	431.5	0.7	Wolsey	Cw	Waste	0.8	0.54
BHDDH08-03	413.9	415.4	1.5	Wolsey	Cw	Waste	0.9	1.34
BHDDH08-03	456.0	457.0	1.0	Wolsey	Cw	Waste	0.9	0.95
BHDDH08-03	409.7	410.9	1.2	Wolsey	Cw	Waste	0.9	1.13
BHDDH08-03	441.7	443.2	1.5	Wolsey	Cw	Waste	1.1	1.66
BHDDH08-03	399.4	400.0	0.6	Wolsey	Cw	Waste	1.3	0.83
BHDDH08-03	455.4	456.0	0.6	Wolsey	Cw	Waste	1.3	0.81
BHDDH08-03	440.1	441.7	1.5	Wolsey	Cw	Waste	1.6	2.42
BHDDH08-04	367.3	368.5	1.2	Wolsey	Cw	Waste	1.6	1.93
BHDDH08-03	452.3	453.9	1.5	Wolsey	Cw	Waste	1.8	2.77
BHDDH08-03	398.1	399.4	1.3	Wolsey	Cw	Waste	2.0	2.67
BHDDH08-04	376.3	376.8	0.6	Wolsey	Cw	Waste	2.2	1.23
BHDDH08-03	450.8	452.3	1.5	Wolsey	Cw	Waste	2.2	3.33
BHDDH08-03	453.9	455.4	1.5	Wolsey	Cw	Waste	2.2	3.34
BHDDH08-04	373.2	374.0	0.8	Wolsey	Cw	Waste	2.3	1.82
BHDDH08-03	429.5	431.0	1.5	Wolsey	Cw	Waste	2.3	3.50
BHDDH08-03	438.6	440.1	1.5	Wolsey	Cw	Waste	2.3	3.48
BHDDH08-04	374.0	374.3	0.3	Wolsey	Cw	Waste	2.3	0.71
BHDDH08-03	437.1	438.6	1.5	Wolsey	Cw	Waste	2.4	3.72
BHDDH08-03	446.2	447.8	1.5	Wolsey	Cw	Waste	2.5	3.75
BHDDH08-01	485.7	486.6	0.9	Wolsey	Cw	Waste	2.74	2.47
BHDDH08-03	443.2	444.7	1.5	Wolsey	Cw	Waste	2.8	4.18
BHDDH08-04	446.2	447.5	1.3	Wolsey	Cw	Waste	2.8	3.52

BHDDH08-03	403.0	404.5	1.5	Wolsey	Cw	Waste	2.9	4.33
BHDDH08-01	463.1	464.7	1.6	Wolsey	Cw	Waste	2.89	4.62
BHDDH08-03	432.5	434.0	1.5	Wolsey	Cw	Waste	2.9	4.45
BHDDH08-04	372.3	373.2	0.9	Wolsey	Cw	Waste	3.0	2.60
BHDDH08-04	380.0	380.5	0.5	Wolsey	Cw	Waste	3.1	1.61
BHDDH08-02	367.7	368.4	0.7	Wolsey	Cw	Waste	3.15	2.20
BHDDH08-03	444.7	446.2	1.5	Wolsey	Cw	Waste	3.2	4.82
BHDDH08-01	470.9	472.1	1.2	Wolsey	Cw	Waste	3.2	3.84
BHDDH08-04	368.5	370.0	1.5	Wolsey	Cw	Waste	3.2	4.90
BHDDH08-01	337.7	339.2	1.5	Wolsey	Cw	Waste	3.28	4.92
BHDDH08-01	469.2	470.9	1.7	Wolsey	Cw	Waste	3.31	5.63
BHDDH08-03	412.4	413.9	1.5	Wolsey	Cw	Waste	3.4	5.22
BHDDH08-03	392.9	394.4	1.5	Wolsey	Cw	Waste	3.4	5.20
BHDDH08-03	406.5	407.8	1.4	Wolsey	Cw	Waste	3.4	4.71
BHDDH08-04	365.7	367.3	1.6	Wolsey	Cw	Waste	3.5	5.56
BHDDH08-02	368.4	369.9	1.5	Wolsey	Cw	Waste	3.67	5.51
BHDDH08-01	400.8	401.7	0.9	Wolsey	Cw	Waste	3.69	3.32
BHDDH08-04	412.1	413.5	1.4	Wolsey	Cw	Waste	3.7	5.17
BHDDH08-01	339.2	340.8	1.6	Wolsey	Cw	Waste	3.75	6.00
BHDDH08-04	425.9	427.2	1.3	Wolsey	Cw	Waste	3.8	4.85
BHDDH08-01	377.3	378.6	1.3	Wolsey	Cw	Waste	3.87	5.03
BHDDH08-03	424.9	426.4	1.5	Wolsey	Cw	Waste	3.9	5.97
BHDDH08-03	427.9	429.5	1.5	Wolsey	Cw	Waste	3.9	5.96
BHDDH08-01	340.8	342.3	1.5	Wolsey	Cw	Waste	3.95	5.93
BHDDH08-01	330.1	331.6	1.5	Wolsey	Cw	Waste	4.03	6.05
BHDDH08-04	433.1	434.2	1.1	Wolsey	Cw	Waste	4.1	4.58
BHDDH08-03	435.6	437.1	1.5	Wolsey	Cw	Waste	4.1	6.17
BHDDH08-04	451.0	451.1	0.2	Wolsey	Cw	Waste	4.1	0.62
BHDDH08-03	401.6	403.0	1.4	Wolsey	Cw	Waste	4.2	5.73
BHDDH08-03	473.5	473.8	0.3	Wolsey	Cw	Waste	4.2	1.26
BHDDH08-04	401.3	402.5	1.2	Wolsey	Cw	Waste	4.2	4.90
BHDDH08-03	447.8	449.3	1.5	Wolsey	Cw	Waste	4.3	6.56
BHDDH08-04	370.0	370.6	0.6	Wolsey	Cw	Waste	4.3	2.62
BHDDH08-01	342.3	342.9	0.6	Wolsey	Cw	Waste	4.3	2.58
BHDDH08-01	342.9	343.8	0.9	Wolsey	Cw	Waste	4.3	3.87
BHDDH08-01	345.4	346.8	1.4	Wolsey	Cw	Waste	4.31	6.03
BHDDH08-03	395.9	397.2	1.3	Wolsey	Cw	Waste	4.4	5.67
BHDDH08-03	415.4	417.1	1.6	Wolsey	Cw	Waste	4.4	7.18
BHDDH08-03	424.0	424.9	0.9	Wolsey	Cw	Waste	4.6	4.17
BHDDH08-02	366.4	367.7	1.3	Wolsey	Cw	Waste	4.62	6.01
BHDDH08-01	389.5	391.1	1.6	Wolsey	Cw	Waste	4.65	7.44
BHDDH08-03	391.4	392.9	1.5	Wolsey	Cw	Waste	4.7	7.15
BHDDH08-01	331.6	333.1	1.5	Wolsey	Cw	Waste	4.76	7.14
BHDDH08-03	389.8	391.4	1.6	Wolsey	Cw	Waste	4.8	7.46
BHDDH08-04	449.3	451.0	1.7	Wolsey	Cw	Waste	4.9	8.10

BHDDH08-03	431.0	432.5	1.5	Wolsey	Cw	Waste	4.9	7.42
BHDDH08-01	346.8	348.6	1.8	Wolsey	Cw	Waste	4.89	8.80
BHDDH08-01	396.2	397.8	1.6	Wolsey	Cw	Waste	5	8.00
BHDDH08-01	403.2	403.3	0.1	Wolsey	Cw	Waste	5.08	0.51
BHDDH08-01	348.6	349	0.4	Wolsey	Cw	Waste	5.11	2.04
BHDDH08-01	349.0	349.1	0.1	Wolsey	Cw	Waste	5.11	0.53
BHDDH08-01	381.6	382.5	0.9	Wolsey	Cw	Waste	5.18	4.66
BHDDH08-01	473.2	473.4	0.2	Wolsey	Cw	Waste	5.19	1.04
BHDDH08-01	473.4	474.8	1.4	Wolsey	Cw	Waste	5.19	7.50
BHDDH08-03	426.4	427.9	1.5	Wolsey	Cw	Waste	5.2	7.90
BHDDH08-01	372.9	373.9	1.0	Wolsey	Cw	Waste	5.28	5.28
BHDDH08-01	380.4	381.6	1.2	Wolsey	Cw	Waste	5.31	6.37
BHDDH08-01	386.5	387.1	0.6	Wolsey	Cw	Waste	5.45	3.27
BHDDH08-01	376.6	377.3	0.7	Wolsey	Cw	Waste	5.56	3.89
BHDDH08-02	376.7	378	1.3	Wolsey	Cw	Waste	5.74	7.46
BHDDH08-04	435.4	437.1	1.6	Wolsey	Cw	Waste	5.9	9.63
BHDDH08-03	410.9	412.4	1.5	Wolsey	Cw	Waste	6.0	9.06
BHDDH08-03	420.6	422.5	1.8	Wolsey	Cw	Waste	6.0	10.93
BHDDH08-01	336.2	337.7	1.5	Wolsey	Cw	Waste	6	9.00
BHDDH08-04	434.2	435.4	1.2	Wolsey	Cw	Waste	6.1	7.41
BHDDH08-01	403.7	404.8	1.1	Wolsey	Cw	Waste	6.11	6.72
BHDDH08-01	349.7	351.1	1.4	Wolsey	Cw	Waste	6.15	8.61
BHDDH08-02	369.9	371.3	1.4	Wolsey	Cw	Waste	6.22	8.71
BHDDH08-01	374.6	374.9	0.3	Wolsey	Cw	Waste	6.29	1.89
BHDDH08-01	374.9	375.8	0.9	Wolsey	Cw	Waste	6.29	5.64
BHDDH08-03	419.2	420.6	1.4	Wolsey	Cw	Waste	6.4	9.15
BHDDH08-04	379.0	380.0	1.0	Wolsey	Cw	Waste	6.4	6.40
BHDDH08-01	467.7	469.2	1.5	Wolsey	Cw	Waste	6.45	9.68
BHDDH08-01	461.6	463.1	1.5	Wolsey	Cw	Waste	6.52	9.78
BHDDH08-01	343.8	344.8	1.0	Wolsey	Cw	Waste	6.53	6.53
BHDDH08-03	473.8	475.5	1.7	Wolsey	Cw	Waste	6.6	11.14
BHDDH08-02	359.2	360.8	1.6	Wolsey	Cw	Waste	6.71	10.74
BHDDH08-01	403.3	403.7	0.4	Wolsey	Cw	Waste	6.78	2.71
BHDDH08-03	458.7	459.3	0.6	Wolsey	Cw	Waste	6.8	4.14
BHDDH08-01	408.7	409.0	0.3	Wolsey	Cw	Waste	6.82	2.05
BHDDH08-01	409.0	409.1	0.1	Wolsey	Cw	Waste	6.82	0.68
BHDDH08-01	333.1	334.7	1.6	Wolsey	Cw	Waste	6.84	10.94
BHDDH08-01	395.2	396.2	1.0	Wolsey	Cw	Waste	6.86	6.86
BHDDH08-03	397.2	398.1	0.9	Wolsey	Cw	Waste	6.9	6.32
BHDDH08-03	380.1	381.0	0.9	Wolsey	Cw	Waste	7.0	6.29
BHDDH08-04	413.5	414.4	0.9	Wolsey	Cw	Waste	7.3	6.68
BHDDH08-01	394.6	395.2	0.6	Wolsey	Cw	Waste	7.29	4.37
BHDDH08-03	449.3	450.8	1.5	Wolsey	Cw	Waste	7.4	11.20
BHDDH08-01	387.9	388	0.1	Wolsey	Cw	Waste	7.46	0.75
BHDDH08-01	388.0	389.5	1.5	Wolsey	Cw	Waste	7.46	11.11

BHDDH08-03	457.0	458.7	1.7	Wolsey	Cw	Waste	7.5	12.68
BHDDH08-04	399.9	401.3	1.4	Wolsey	Cw	Waste	7.6	10.45
BHDDH08-03	400.0	401.6	1.6	Wolsey	Cw	Waste	7.8	12.12
BHDDH08-04	417.2	418.8	1.6	Wolsey	Cw	Waste	7.9	12.81
BHDDH08-04	429.5	430.8	1.3	Wolsey	Cw	Waste	7.9	10.12
BHDDH08-01	378.6	380.4	1.8	Wolsey	Cw	Waste	8.06	14.51
BHDDH08-04	428.0	429.5	1.5	Wolsey	Cw	Waste	8.1	12.49
BHDDH08-03	480.2	481.6	1.4	Wolsey	Cw	Waste	8.1	11.34
BHDDH08-01	391.1	392.6	1.5	Wolsey	Cw	Waste	8.17	12.26
BHDDH08-03	422.5	424.0	1.5	Wolsey	Cw	Waste	8.3	12.76
BHDDH08-02	360.8	361.5	0.7	Wolsey	Cw	Waste	8.38	5.87
BHDDH08-01	387.1	387.1	0.0	Wolsey	Cw	Waste	8.48	0.00
BHDDH08-01	387.1	387.9	0.8	Wolsey	Cw	Waste	8.48	6.82
BHDDH08-03	418.2	419.2	1.0	Wolsey	Cw	Waste	8.5	8.50
BHDDH08-04	402.5	403.9	1.4	Wolsey	Cw	Waste	8.5	12.18
BHDDH08-01	382.5	383.6	1.1	Wolsey	Cw	Waste	8.55	9.41
BHDDH08-04	424.5	425.9	1.4	Wolsey	Cw	Waste	8.6	12.06
BHDDH08-01	420.0	420.6	0.6	Wolsey	Cw	Waste	8.62	5.25
BHDDH08-01	420.6	421.8	1.2	Wolsey	Cw	Waste	8.62	10.51
BHDDH08-03	485.0	485.2	0.2	Wolsey	Cw	Waste	8.7	1.73
BHDDH08-03	485.2	486.8	1.5	Wolsey	Cw	Waste	8.7	13.31
BHDDH08-03	385.6	387.9	2.3	Wolsey	Cw	Waste	8.8	20.22
BHDDH08-01	383.6	384.9	1.3	Wolsey	Cw	Waste	8.8	11.44
BHDDH08-01	411.5	412.8	1.3	Wolsey	Cw	Waste	8.81	11.45
BHDDH08-01	474.8	474.9	0.1	Wolsey	Cw	Waste	9.08	0.91
BHDDH08-01	474.9	476.6	1.7	Wolsey	Cw	Waste	9.08	15.44
BHDDH08-03	377.0	378.6	1.6	Wolsey	Cw	Waste	9.2	14.69
BHDDH08-03	371.3	371.9	0.6	Wolsey	Cw	Waste	9.2	5.52
BHDDH08-03	371.9	372.0	0.1	Wolsey	Cw	Waste	9.2	0.92
BHDDH08-03	489.2	490.1	0.9	Wolsey	Cw	Waste	9.2	8.46
BHDDH08-03	490.1	490.2	0.1	Wolsey	Cw	Waste	9.2	0.74
BHDDH08-03	489.1	489.2	0.1	Wolsey	Cw	Waste	9.2	0.92
BHDDH08-04	418.8	420.3	1.5	Wolsey	Cw	Waste	9.4	13.68
BHDDH08-01	392.6	394.6	2.0	Wolsey	Cw	Waste	9.4	18.80
BHDDH08-01	399.3	400.8	1.5	Wolsey	Cw	Waste	9.43	14.15
BHDDH08-01	397.8	399.3	1.5	Wolsey	Cw	Waste	9.45	14.18
BHDDH08-03	480.1	480.2	0.1	Wolsey	Cw	Waste	9.6	1.34
BHDDH08-03	479.6	480.1	0.5	Wolsey	Cw	Waste	9.6	4.53
BHDDH08-02	365.5	366.4	0.9	Wolsey	Cw	Waste	9.66	8.69
BHDDH08-04	403.9	404.5	0.6	Wolsey	Cw	Waste	9.8	5.68
BHDDH08-03	372.0	373.4	1.4	Wolsey	Cw	Waste	9.9	13.85
BHDDH08-03	374.9	375.5	0.6	Wolsey	Cw	Waste	9.9	5.93
BHDDH08-04	409.6	410.6	1.0	Wolsey	Cw	Waste	10.1	10.15
BHDDH08-04	431.5	433.1	1.6	Wolsey	Cw	Waste	10.1	16.28
BHDDH08-02	364.6	364.9	0.3	Wolsey	Cw	Waste	10.35	3.10

BHDDH08-02	364.9	365.5	0.6	Wolsey	Cw	Waste	10.35	6.73
BHDDH08-03	404.5	406.5	2.0	Wolsey	Cw	Waste	10.4	20.49
BHDDH08-03	488.0	489.1	1.1	Wolsey	Cw	Waste	10.4	11.39
BHDDH08-03	375.5	377.0	1.5	Wolsey	Cw	Waste	10.6	15.90
BHDDH08-02	375.6	376.7	1.1	Wolsey	Cw	Waste	10.7	11.77
BHDDH08-01	405.7	407.1	1.4	Wolsey	Cw	Waste	10.85	15.19
BHDDH08-03	373.4	374.9	1.5	Wolsey	Cw	Waste	11.0	16.72
BHDDH08-04	420.3	421.2	1.0	Wolsey	Cw	Waste	11.2	10.86
BHDDH08-04	398.7	399.9	1.3	Wolsey	Cw	Waste	11.5	14.31
BHDDH08-01	352.7	353.8	1.1	Wolsey	Cw	Waste	11.5	12.65
BHDDH08-04	386.1	387.7	1.6	Wolsey	Cw	Waste	11.7	18.52
BHDDH08-01	404.8	405.7	0.9	Wolsey	Cw	Waste	11.8	10.62
BHDDH08-04	380.5	382.2	1.7	Wolsey	Cw	Waste	11.8	19.82
BHDDH08-01	334.7	335.9	1.2	Wolsey	Cw	Waste	12	14.40
BHDDH08-01	335.9	336.2	0.3	Wolsey	Cw	Waste	12	3.60
BHDDH08-04	392.2	393.8	1.6	Wolsey	Cw	Waste	12.0	19.32
BHDDH08-01	384.9	386.5	1.6	Wolsey	Cw	Waste	12.1	19.36
BHDDH08-01	412.8	413.9	1.1	Wolsey	Cw	Waste	12.1	13.31
BHDDH08-02	371.3	372.8	1.5	Wolsey	Cw	Waste	12.15	18.23
BHDDH08-02	391.7	393.2	1.5	Wolsey	Cw	Waste	12.15	18.23
BHDDH08-03	417.1	418.2	1.1	Wolsey	Cw	Waste	12.3	13.84
BHDDH08-02	382.5	384	1.5	Wolsey	Cw	Waste	12.3	18.45
BHDDH08-04	387.7	389.2	1.5	Wolsey	Cw	Waste	12.4	18.77
BHDDH08-04	393.8	395.6	1.8	Wolsey	Cw	Waste	12.4	22.60
BHDDH08-01	349.1	349.7	0.6	Wolsey	Cw	Waste	12.4	7.44
BHDDH08-01	344.8	345.4	0.6	Wolsey	Cw	Waste	12.5	7.50
BHDDH08-01	375.8	376.4	0.6	Wolsey	Cw	Waste	12.5	7.50
BHDDH08-01	376.4	376.6	0.2	Wolsey	Cw	Waste	12.5	2.15
BHDDH08-01	415.1	415.7	0.6	Wolsey	Cw	Waste	12.5	7.03
BHDDH08-01	353.8	354.9	1.1	Wolsey	Cw	Waste	12.55	13.80
BHDDH08-02	388.6	390.1	1.5	Wolsey	Cw	Waste	12.55	18.83
BHDDH08-02	384	385.6	1.6	Wolsey	Cw	Waste	12.65	20.24
BHDDH08-01	373.9	374.6	0.7	Wolsey	Cw	Waste	12.75	8.93
BHDDH08-02	381	382.5	1.5	Wolsey	Cw	Waste	12.75	19.13
BHDDH08-03	434.0	435.6	1.5	Wolsey	Cw	Waste	12.9	19.53
BHDDH08-02	372.8	374.3	1.5	Wolsey	Cw	Waste	12.9	19.35
BHDDH08-02	387.1	388.6	1.5	Wolsey	Cw	Waste	12.9	19.35
BHDDH08-04	397.2	398.7	1.5	Wolsey	Cw	Waste	12.9	19.74
BHDDH08-02	397.8	399.3	1.5	Wolsey	Cw	Waste	12.95	19.43
BHDDH08-02	399.3	401.1	1.8	Wolsey	Cw	Waste	12.95	23.31
BHDDH08-04	376.8	379.0	2.2	Wolsey	Cw	Waste	13.0	28.49
BHDDH08-02	374.3	375.6	1.3	Wolsey	Cw	Waste	13	16.90
BHDDH08-02	393.2	394.7	1.5	Wolsey	Cw	Waste	13.05	19.58
BHDDH08-04	395.6	397.2	1.5	Wolsey	Cw	Waste	13.1	19.84
BHDDH08-01	489.5	491.1	1.6	Wolsey	Cw	Waste	13.1	20.96

BHDDH08-02	390.1	391.7	1.6	Wolsey	Cw	Waste	13.15	21.04
BHDDH08-01	366.7	368.2	1.5	Wolsey	Cw	Waste	13.2	19.80
BHDDH08-04	389.2	390.8	1.5	Wolsey	Cw	Waste	13.2	20.06
BHDDH08-04	382.2	384.4	2.1	Wolsey	Cw	Waste	13.3	28.22
BHDDH08-01	486.6	488	1.4	Wolsey	Cw	Waste	13.3	18.62
BHDDH08-02	394.7	396	1.3	Wolsey	Cw	Waste	13.3	17.29
BHDDH08-04	374.3	375.2	0.9	Wolsey	Cw	Waste	13.4	12.28
BHDDH08-04	384.4	386.1	1.8	Wolsey	Cw	Waste	13.4	23.63
BHDDH08-01	354.9	356.5	1.6	Wolsey	Cw	Waste	13.45	21.52
BHDDH08-01	495.2	497	1.8	Wolsey	Cw	Waste	13.5	24.30
BHDDH08-03	369.7	371.3	1.6	Wolsey	Cw	Waste	13.6	21.68
BHDDH08-04	427.2	428.0	0.8	Wolsey	Cw	Waste	13.6	11.15
BHDDH08-01	364.2	365.2	1.0	Wolsey	Cw	Waste	13.8	13.80
BHDDH08-04	375.2	376.3	1.0	Wolsey	Cw	Waste	13.8	14.35
BHDDH08-04	390.8	392.2	1.4	Wolsey	Cw	Waste	13.8	19.87
BHDDH08-01	472.1	473.2	1.1	Wolsey	Cw	Waste	13.9	15.29
BHDDH08-02	378	379.5	1.5	Wolsey	Cw	Waste	13.95	20.93
BHDDH08-02	385.6	387.1	1.5	Wolsey	Cw	Waste	14.05	21.08
BHDDH08-01	356.5	357.2	0.7	Wolsey	Cw	Waste	14.2	9.94
BHDDH08-01	494.1	495.2	1.1	Wolsey	Cw	Waste	14.2	15.62
BHDDH08-02	396	397.8	1.8	Wolsey	Cw	Waste	14.2	25.56
BHDDH08-01	363.3	364.2	0.9	Wolsey	Cw	Waste	14.3	12.87
BHDDH08-01	357.2	358.1	0.9	Wolsey	Cw	Waste	14.35	12.92
BHDDH08-01	358.1	358.3	0.2	Wolsey	Cw	Waste	14.35	2.30
BHDDH08-01	365.2	366.7	1.5	Wolsey	Cw	Waste	14.4	21.60
BHDDH08-01	488	489.5	1.5	Wolsey	Cw	Waste	14.7	22.05
BHDDH08-01	415.7	416.3	0.6	Wolsey	Cw	Waste	14.75	8.85
BHDDH08-01	492.6	494.1	1.5	Wolsey	Cw	Waste	15	22.50
BHDDH08-01	413.9	415.1	1.2	Wolsey	Cw	Waste	15.75	18.90
BHDDH08-01	491.1	492.6	1.5	Wolsey	Cw	Waste	15.9	23.85
BHDDH08-02	379.5	381	1.5	Wolsey	Cw	Waste	16.1	24.15
BHDDH08-01	352.2	352.7	0.5	Wolsey	Cw	Waste	16.85	8.43
BHDDH08-03	368.5	369.7	1.2	Wolsey	Cw	Waste	17.4	20.13
BHDDH08-01	329.9	330.1	0.2	Wolsey	Cw	Waste	18.75	3.75
BHDDH08-01	371.8	372.9	1.1	Wolsey	Cw	Waste	19	20.90
BHDDH08-01	407.5	408.7	1.2	Wolsey	Cw	Waste	19.15	22.98
BHDDH08-02	363	363.8	0.8	Wolsey	Cw	Waste	19.5	15.60
BHDDH08-01	485.2	485.7	0.5	Wolsey	Cw	Waste	19.65	9.83
BHDDH08-03	478.3	479.5	1.2	Wolsey	Cw	Waste	19.9	23.88
BHDDH08-03	479.5	479.6	0.2	Wolsey	Cw	Waste	19.9	2.99
BHDDH08-01	351.1	352	0.9	Wolsey	Cw	Waste	20	18.00
BHDDH08-01	352.0	352.2	0.2	Wolsey	Cw	Waste	20	3.12
BHDDH08-01	362.1	363.3	1.2	Wolsey	Cw	Waste	20	24.00
BHDDH08-03	462.4	463.9	1.5	Wolsey	Cw	Waste	20.0	30.60
BHDDH08-01	368.2	369.7	1.5	Wolsey	Cw	Waste	20.2	30.30

BHDDH08-01	461.0	461.6	0.6	Wolsey	Cw	Waste	20.2	12.12	
BHDDH08-01	480.6	482.2	1.6	Wolsey	Cw	Waste	20.2	32.32	
BHDDH08-01	409.1	410.2	1.1	Wolsey	Cw	Waste	20.3	22.33	
BHDDH08-01	410.2	411.5	1.3	Wolsey	Cw	Waste	20.4	26.52	
BHDDH08-01	419.3	420	0.7	Wolsey	Cw	Waste	20.6	14.42	
BHDDH08-03	463.9	465.4	1.5	Wolsey	Cw	Waste	20.6	31.31	
BHDDH08-01	416.3	417.8	1.5	Wolsey	Cw	Waste	20.7	31.05	
BHDDH08-03	465.4	467.0	1.5	Wolsey	Cw	Waste	20.7	31.46	
BHDDH08-01	358.3	359.7	1.4	Wolsey	Cw	Waste	20.8	29.12	
BHDDH08-01	417.8	419.3	1.5	Wolsey	Cw	Waste	20.8	31.20	
BHDDH08-01	483.7	485.2	1.5	Wolsey	Cw	Waste	20.9	31.35	
BHDDH08-03	467.0	468.5	1.5	Wolsey	Cw	Waste	20.9	31.98	
BHDDH08-04	361.8	363.0	1.2	Wolsey	Cw	Waste	21.0	25.20	
BHDDH08-04	363.0	363.2	0.2	Wolsey	Cw	Waste	21.0	3.78	
BHDDH08-03	470.0	471.8	1.8	Wolsey	Cw	Waste	21.2	38.80	
BHDDH08-01	359.7	361.2	1.5	Wolsey	Cw	Waste	21.3	31.95	
BHDDH08-01	482.2	483.7	1.5	Wolsey	Cw	Waste	21.3	31.95	
BHDDH08-03	468.5	470.0	1.5	Wolsey	Cw	Waste	21.3	32.38	
BHDDH08-01	371.2	371.8	0.6	Wolsey	Cw	Waste	21.6	12.96	
BHDDH08-03	460.9	462.4	1.5	Wolsey	Cw	Waste	21.7	32.98	
BHDDH08-03	471.8	473.5	1.7	Wolsey	Cw	Waste	21.7	36.46	
BHDDH08-01	369.7	371.2	1.5	Wolsey	Cw	Waste	21.8	32.70	
BHDDH08-01	361.2	362.1	0.9	Wolsey	Cw	Waste	21.9	19.71	
BHDDH08-03	459.3	460.9	1.5	Wolsey	Cw	Waste	22.5	34.43	
BHDDH08-02	361.5	363	1.5	Wolsey	Cw	Waste	27.6	41.40	
Totals			**354.2**					**3210.03**	**9.06**

Waste Characterization Test Report

BUTTE HIGHLANDS PROJECT

SILVER BOW COUNTY, MONTANA

December 2009

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1.0 Introduction

Timberline Resources Corporation (Timberline) initiated waste rock characterization testing to support the development and permitting effort for the Butte Highlands Gold Project. 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 Deerlodge 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.

The purpose of this report is to present additional geochemical information pertaining to the Butte Highlands Gold Project. Limited waste rock samples are available for the project even though a significant amount of drilling has been completed over the past decade or more. Drill core from the majority of the drilling program was lost in a fire that destroyed the core shed. Only drill core from drilling completed by Timberline remains for waste rock testing.

2.0 Geology

The project area lies within a sequence of rocks ranging from Proterozoic Belt Super-group to Cambrian sediments on the margins of the Cretaceous Boulder Batholith. Regionally the Proterozoic rocks include fine grained clastic and carbonate rocks of the Missoula group and Helena Formations overlying Archean basement schist and gneiss of the Cherry Creek Formation. A series of Paleozoic clastic and carbonate rocks overlie the Belt rocks. From the bottom up these include the Flathead, the Wolsey, the Meagher, the Park, the Pilgrim, the Dry Creek, The Jefferson, the Three Forks, the Madison, the Amsden, the Quadrant and the Phosphoria Formations. All these sequences have been intruded by a variety of intrusive rocks which are all part of or related to the Boulder Batholith. The intrusive rocks are all Cretaceous or younger in age and include large plutons, small stocks, dikes and sills of varying composition. Diorite is common within the border phase intrusive rocks but often grades to gabbro.

Structural Geology throughout the region is very complex. Intense folding of the sedimentary rocks is common. Large trans-continental scale lineaments transect and help form the regional geology. The Trans-Challis - Great Falls Tectonic Zone is a large scale feature likely formed during the Archean with subsequent recurrent movement from the Proterozoic into the Tertiary.

2.1 Project Geology

A sequence of Cambrian stratigraphy underlies the immediate project area. A Cretaceous or younger intrusive layer of primarily diorite grading to lesser gabbro have intruded the sedimentary formations. The Cambrian sequence from oldest to youngest consists of the Flathead Sandstone (quartzite), the Wolsey Shale, the Meagher Limestone (dolomite), the Park Formation, and the Pilgrim Limestone (marble). Underlying the Cambrian sequence are metamorphosed sediments of the Belt Supergroup. Drilling at Butte Highlands has not

penetrated the Belt sequence to any significant depth as it represents the footwall to mineralization.

The Flathead Sandstone has been metamorphosed to quartzite and also represents footwall to the gold skarn ore body. In drill holes at Butte Highlands the top of this rock type is almost always a generally clast supported, poorly sorted breccia with skarn altered clay matrix. Locally it may be a matrix supported breccia. The quartzite itself can be described as a buff tan mottled fine grained fairly pure quartzite. The rock underlying this unit has also often been logged as quartzite but may be better described as a fine grained hornfels that likely represents the upper part of the Belt sequence. In some drill holes the Flathead may be missing due to either faulting and/or replacement by intrusive rocks.

The Wolsey Shale overlies the Flathead Quartzite and is the main host to mineralization. It is described by Ettlinger as being an estimated 65 meter thick sequence of inter-layered dolomitic mud and shale with some silt and carbonates. This thickness seems to vary as indicated by drilling. For instance in drill hole BHDDH08-03 this sequence is over 100m thick before giving way to intrusive. In the deposit area the Wolsey is always altered to some degree. The result is a sequence of variable skarn, hornfels and re-crystallized dolomitic marble. Such a variable thickness and variety of rock type changes is likely due to structural thickening either folding and/or faulting.

Overlying the Wolsey is the Meagher Formation. At the Butte Highlands Project area this unit is a ± 200m thick sequence of buff white generally dolomitic marble. The unit is very often bleached and sanded to a very soft friable dolomite. Bedding can be difficult to discern on the surface but at a few localities thin limonitic lines that may represent bedding planes have been folded into tight asymmetric minor folds. This may indicate the overall deformation of this unit. The unit contains little to no sulfides but may contain fine disseminated limonite casts after pyrite. There are also zones of limonite and jasperiod along structures that represent oxidized sulfide replacement mineralization. These zones where historically mined for their gold and base metal content but overall represent a small portion of this lithology.

The Park Formation overlies the Meagher. This unit is an approximate 40 meter thick sequence of highly hornfelsed shale and siltstones. A distinct, cordierite schist is present at its base. The Park is very resistant to weathering and is a very good stratigraphic marker. Ettlinger describes this unit to contain tight asymmetrical folds with faulted axial planes. This characteristic may apply to other units in the project area.

The Pilgrim Formation overlies the Park and is the uppermost unit of the Cambrian sequence exposed to the surface. This unit appears to have been regionally metamorphosed to a white coarsely crystalline dolomitic marble to marble that covers much of the area north and east of the project.

Intrusive rocks encountered in the drill holes at Butte Highlands include fine to medium grained diorite and gabbro. These rocks are younger than and can intrude any of the above formations. They occur as fairly massive bodies to very small dikes and/or sills. The diorite often gradually grades to gabbro. The intrusive is likely multi phased and can vary from a fairly fresh rock to a

highly altered endoskarn. The intrusive event(s) was likely a very passive emplacement as "bedding" is often preserved as textural bands and contacts can often be very fuzzy, irregular and gradual. Mineralization can also be preserved where it would project from the sedimentary sequence, but is usually weaker in the intrusive. Some areas have been classified as diorite transition zones. These represent areas where the diorite has only partially replaced the Wolsey formation as thin alternating sills. Past loggers have characterized these features as dikelettes but as they are usually parallel with bedding, sills would be a more accurate term. The sulfide characteristics of the intrusive rocks are highly variable.

2.2 Mineralization

The primary mineralization type at the Butte Highlands Project can be classified as a magnesian gold skarn. The overall skarn mineralogy is dominated by forsteritic olivine, pyroxene and serpentine. This deposit is unusual in its distinct lack of iron oxides and sulfides.

The prograde skarn is dominated by the forsteritic olivine with lesser pyroxene and minor phlogopite. The retrograde alteration of the olivine and pyroxenes results in a mineral assemblage of serpentine, talc, phlogopite, amphibole (tremolite) ± actinolite ± calcite ± pyrrhotite ± chlorite ± magnetite. Not necessarily in that order or containing all of the above minerals. The retrograde alteration is likely staged resulting in several combinations of the above mineralogy. Gold is associated with retrograde alteration. Ettlinger established two associations where gold occurs with phlogopite and pyrrhotite then with clay, chlorite and pyrrhotite. From casual observation of drill core compared to the drill hole assays, it appears gold can occur with tremolite only, tremolite and talc, and in other retrograde assemblages lacking in sulfides. Also the areas with abundant to massive sulfide formation within the skarn are often very low in gold. This suggests that areas with pyrrhotite and ore grade gold occurring together may be a zonation characteristic where the conditions for gold and pyrrhotite deposition overlap.

Ettlinger also suggest that potassic alteration played an important role in gold deposition and the mineral assemblage. This is evidenced by higher gold assays associated with potassium feldspar veinlets within the endoskarn, as well as coarse phlogopite as clots and veinlets cutting the skarn assemblage.

The skarn formation tends to favor the Wolsey Formation and particularly the contact zone between Wolsey and overlying Meagher. Faulting with clay development is sometimes associated with higher grade gold mineralization at or near the contact zone. This may be due to bedding plane slip features at that contact. The mineralization appears to be somewhat strata-form within the Wolsey. There are often repetitions of mineralized skarn ± fine grained hornfels with marble sequences. At this time the understanding does not point to a set pattern that is correlative throughout the deposit area. This suggests the repetition may be due to folding or faulting and not to a set stratigraphic assemblage.

There are several limited areas within the Meagher Formation that contain minor sulfide replacement style mineralization. These areas are small and likely occur along structural zones.

The mineralization is usually completely oxidized. Historic mining activity concentrated on this type of mineralization. As this style of mineralization was and is not the target of the more modern operators little recent study has been focused on it.

2.3 Waste Rock

As discussed above, mineralization tends to focus on the Wolsey and Meagher Formations and at or near the contact zone between these two formations. For this reason, mine development expected for the project will be primarily located in these same areas. Total sulfides associated with the various rock formations can range from 1 percent to values reaching close to 85 percent sulfide (massive) content. The sulfide mineralization is reported to be characterized as pyrrhotite>pyrite>chalcopyrite occurring as fine disseminated grains, blebs, stringers and fracture coating with occasional narrow zones of massive sulfide.

Based on the drill logs from all the exploration drilling activities, the highest visually estimated sulfide content was generally found in the Wolsey Formation followed in decreasing order by diorite, transitional diorite, Park Formation, gabbro, Meagher Formation and finally the Pilgrim Formation (*Geologic and Sulfide Characteristics of the Butte Highlands Project Lithologies - March, 2009).* The remaining formations are either not expected to be encountered during mining or have lower sulfur/sulfide content that the Wolsey and Meagher Formations used in the test program. Wolsley and Meagher formations are expected to comprise the largest percentage of waste material encountered. The intervals sampled provides both a spatial range and well as sulfide and sulfur value ranges anticipated.

2.4 Sample Selection

Drill logs and assays from twelve drill holes were used to represent the geologic and sulfide character of the Butte Highlands waste rock. These twelve holes were picked for their wide distribution over the project area and for the detailed sulfide description in the drill logs. Four of the twelve holes were picked to represent more detailed study of the iron and sulfur simply because additional analytical data existed for these holes and core from the holes was readily available. The four drill holes are a close approximation of the initial twelve drill holes because of their distribution across the project area and for the described sulfide character stated on the drill logs. Intervals from the four holes were chosen to represent the waste rock of two lithologies, the Wolsey and the Meagher. These Lithologies represent the majority of waste rock that is expected to be encountered during the mine development. Two samples were composited from the selected intervals, one for each lithology. The intervals for each lithology were selected to represent a wide range of sulfide percentage in order to represent an overall character.

During the original exploration program, iron and sulfur were part of the assay values collected to help characterize drilled material. A comparison of original analytical data for sulfur and iron and results from ACZ Laboratories for total sulfur and total iron form composited material show a close correlation (Table 1). The results for the composited Meagher sample were very close, while the results for Wolsey were somewhat close. In the case of the composited Meagher sample the original analytical results show an overall average of 0.5% iron and 0.078% sulfur. For this sample ACZ reports 0.357% iron and 0.06% total sulfur. For the Wolsey

composite the original analytical results show an overall average of 10.43% iron and 3.914% sulfur. For the Wolsey sample ACZ reports 12.7% total iron and 7.32% total sulfur.

Sample selection was made primarily based on the visual sulfide estimate completed during drilling activities. Based on the composited information from this data, visual estimates collected during geologic logging likely over estimated potential sulfide values. As an example, the Meagher composite the "calculated" overall visual sulfide percentage average is 2.11% while the ACZ results report the sulfur due to pyritic sulfide at 0.02%. The same was true for the Wolsey composite the "calculated" overall visual sulfide percentage is estimated at 7.19% while ACZ reports 1.36% sulfur from pyritic sulfide. The most abundant sulfide content in the selected drill core was pyrrhotite. During the period that visual estimates were collected for the drill core, numerous companies held the property with each company having a different set of geologists. For this reason, it is expected that pyrrhotite was not correctly identified and/or logged consistently. Therefore, visual estimates appear to be consistently over estimating potential sulfide values expected and the results from this test work suggest they are consistenly higher than assayed sulfur/sulfide data. Regardless, future waste chemical work will not rely on visual estimates of sulfides but assays will be collected on selected drill holes to provide consistent data and information for project planning and operation.

Figure 1 provides the spatial representations of the drillholes and material tested. Table 1 provides sulfur assay data and visual logging estimates of sulfides for the 4 drill holes used for Wolsey and Meagher material.

Once the drill hole intervals were selected a composite of Wolsey and Meagher material was prepared from the drill core. Depth intervals selected for the composite were split, in cases where only ½ of the core remained, this core was cut in half and included in the composite. The weight distributions for each interval (Wolsey and Meagher) used to prepare the composite samples is shown in Table 2.

The composited waste material was shipped to ACZ Laboratories, Inc. in Steamboat Springs, Colorado. The sample was much larger than required for the static and kinetic test. To minimize any issue for sample representativeness, the lab was to pulverize the samples and cone and quarter the samples following standard methodologies to generate a bulk homogenous sample of both the Wolsey and Meagher waste. A smaller sample set would be selected from the prepared bulk sample for static and kinetic tests.

Only a portion (approximately 60 to 70%) of the core samples received at the lab was prepared as originally designed for the project. The reason only a portion of the material was pulverized and coned and quartered was due to coding in the laboratory protocols for mercury soil sampling. Under this protocol, the laboratory information system automatically alert the laboratory soils department that mercury will be analyzed for this project. EPA mercury protocols require that a sample not be air dried or prepared using standard methods. This soils preparation methodology is not applicable possible for drill core samples. The individual preparing the samples followed the soil protocol and extracted a portion of the sample. The sample issue was not discovered until after the test work had been initiated.

Because the selection of excluded material was random, it was unknown as to the impact to the overall testing program representativeness. Therefore, separate static and kinetic tests were run on the excluded material to provide information to identify any sampling basis that may have occurred by excluding this material. The issues described above with regard to visual estimate of sulfide content are similar with excluded material. The details of these tests are discussed later in this document.

Table 1
Drill Hole Sample Information

Drill Hole	Start	End	Interval	Lithology/Code		Material Type	Fe %	S %	Weighted Fe	Weighted S	Sulfide %	Weighted Sulfide	Comp. Avg. Suflide
	ft												
BHDDH08-01	998.0	1003.0	4.9	Meagher	Cm	Waste	0.73	0.22	1.10	0.33	1.5	2.25	
BHDDH08-02	1122.0	1127.0	4.9	Meagher	Cm	Waste	0.53	0.09	0.80	0.14	6	9.00	
BHDDH08-03	657.0	662.0	5.0	Meagher	Cm	Waste	0.25	0.02	0.38	0.03	0	0.00	
BHDDH08-04	628.0	633.0	5.0	Meagher	Cm	Waste	0.54	0.01	0.83	0.02	1	1.53	
												12.78	2.11
BHDDH08-01	1118.1	1123.0	4.9	Wolsey	Cw	Waste	6.58	2.66	9.87	3.99	1.5	2.25	
BHDDH08-02	1240.2	1245.1	4.9	Wolsey	Cw	Waste	5.09	0.87	7.64	1.31	6	9.00	
BHDDH08-03	1317.5	1322.0	4.5	Wolsey	Cw	Waste	5.80	1.76	8.00	2.43	20	27.60	
BHDDH08-04	1209.0	1214.0	5.0	Wolsey	Cw	Waste	20.50	8.49	31.36	12.99	15	22.95	
												61.80	7.19

Table 2
Drill Hole Sample Size

Drill Hole ID	Start	End	Interval	Lithology/Code		Material	Sample Weight (lbs)
	Feet						
BHDDH08-01	998.0	1003.0	4.9	Meagher	Cm	Waste	5
BHDDH08-02	1122.0	1127.0	4.9	Meagher	Cm	Waste	4.4
BHDDH08-03	657.0	662.0	5.0	Meagher	Cm	Waste	8
BHDDH08-04	628.0	633.0	5.0	Meagher	Cm	Waste	6.6
						Total Weight	24
BHDDH08-01	1118.1	1123.0	4.9	Wolsey	Cw	Waste	6
BHDDH08-02	1240.2	1245.1	4.9	Wolsey	Cw	Waste	4.6
BHDDH08-03	1317.5	1322.0	4.5	Wolsey	Cw	Waste	3.6
BHDDH08-04	1209.0	1214.0	5.0	Wolsey	Cw	Waste	8
						Total Weight	22.2

3.0 Tests

The following static and kinetic tests were completed on composited samples for the Wolsey and Meagher Formations:

Static Testing

- Metals Analysis
- Acid Generating Potential (Calc. on Sulfur Total)
- Acid Neutralization Potential (Calc)
- Acid-Base Potential (Calc. on Sulfur Total)
- Neutralization Potential – as $CaCO_3$
- Solids, Percent
- Sulfur Forms
    - Sulfur HCL Resudue
    - Sulfur HN O_3 Residue
    - Sulfur Organic
- Residual Mod
    - Sulfur Pyritic Sulfide
    - Sulfur Sulfate
    - Sulfur Total
    - Sulfate

Kinetic Testing – Humidity Cell Tests

- Metal Analysis
- Wet Chemistry
    - Alkalinity as $CaCO_3$
    - Bicarbonate as $CaCO_3$
    - Carbonate as $CaCO_3$
    - Hydroxide as $CaCO_3$
    - Conductivity @ 25C
    - Sulfate

3.1 Static Tests

Static testing was completed on the composited samples of Wolsey and Meagher samples to provide a general rock characterization and to assist in the development of the humidity cell test program. This includes Acid/Base Potential, metals, and sulfur data. Table 3 shows the list of metals analyzed in the static tests and the EPA Methods employed. Based on the results of these tests, a shorter list of metals was selected to provide information pertinent to project specific issues and applicable Montana Water Quality Standards. Test results are shown in Section 4.1

Table 3
Metals Analyzed – Static Test

ANALYTE	METHOD
Aluminum, total	M6010B ICP
Antimony, total	M6020 ICP-MS
Arsenic, total	M6020 ICP-MS
Barium, total	M6010B ICP
Beryllium, total	M6020 ICP-MS
Bismuth, total	M6010B ICP
Boron, total	M6010B ICP
Cadmium, total	M6020 ICP-MS
Calcium, total	M6010B ICP
Chromium, total	M6010B ICP
Cobalt, total	M6010B ICP
Copper, total	M6010B ICP
Gallium, total	M6010B ICP
Iron, total	M6010B ICP
Lead, total	M6020 ICP-MS
Lithium, total	M6010B ICP
Magnesium, total	M6010B ICP
Manganese, total	M6010B ICP
Mercury, total	M7471A CVAA
Molybdenum, total	M6010B ICP
Nickel, total	M6010B ICP
Potassium, total	M6010B ICP
Scandium, total	M6010B ICP
Selenium, total	M6020 ICP-MS
Silver, total	M6010B ICP
Sodium, total	M6010B ICP
Strontium, total	M6010B ICP
Thallium, total	M6010B ICP
Tin, total	M6010B ICP
Titanium, total	M6010B ICP
Vanadium, total	M6010B ICP
Zinc, total	M6010B ICP

3.2 Kinetic Testing

Once results from the static tests were completed the list of parameters was reduced to those with detected results and applicable Montana Water Quality Standards to the project. Table 4 shows the analytes used for the humidity cell tests. Kinetic test procedures followed standard protocols established for kinetic (humidity cell) tests.

Table 4
Metals Analyzed – Kinetic Tests

ANALYTE	METHOD
Aluminum, dissolved	M200.7 ICP
Antimony, dissolved	M200.8 ICP-MS
Arsenic, dissolved	M200.8 ICP-MS
Barium, dissolved	M200.7 ICP
Beryllium, dissolved	M200.7 ICP
Boron, dissolved	M200.7 ICP
Cadmium, dissolved	M200.8 ICP-MS
Calcium, dissolved	M200.7 ICP
Chromium, dissolved	M200.7 ICP
Copper, dissolved	M200.7 ICP
Iron, dissolved	M200.7 ICP
Lead, dissolved	M200.8 ICP-MS
Magnesium, dissolved	M200.7 ICP
Manganese, dissolved	M200.7 ICP
Mercury, dissolved	M245.1 CVAA
Nickel, dissolved	M200.7 ICP
Potassium, dissolved	M200.7 ICP
Selenium, dissolved	M200.8 ICP-MS
Silver, dissolved	M200.7 ICP
Sodium, dissolved	M200.7 ICP
Thallium, dissolved	M200.8 ICP-MS
Zinc, dissolved	M200.7 ICP

Initially, the test was planned to run 21 weeks and was extended to 23 weeks to provide additional data for lead results. Leachate from the humidity cell was collected and sent for laboratory analyses during weeks 1, 5-15, 20-23 for metals. Carbonate, bicarbonate, pH, conductivity, hydroxide, sulfate, and total alkalinity were collected during weeks 1-15, 20-23. Solution was not collected nor analyzed for weeks 17-19.

3.3 Excluded Samples

As described in Section 2.4 Sample Section, some material was excluded due to EPA methods (mercury in soils) that are not applicable to drill core sample preparation. The humidity cell tests were well underway when it was discovered that material had been excluded from both the Wolsey and Meagher samples prepared for testing.

To provide information pertaining to the excluded material, the same static and kinetic tests procedures were followed as described in Section 3.0 Tests. A shorter duration for kinetic

tests was completed as the results in the first 4 weeks were consistent with data obtained for the primary humidity cell tests for both the Wolsey and Meagher composites. This information provides quality and characteristics of the excluded drill core material and can be compared to the other drill core material composited for the primary tests.

4.0 Results

This section provides the results of the static and kinetic test work completed on the drill core selected and the excluded material. Laboratory results are included in Appendix A.

Sample Identification for Laboratory Reports

- L747141 – Meagher/Wolsey – Static Test Results
- L75255 – Meagher Humidity Cell Test Results Wks 1-23
- L75257 – Wolsey Humidity Cell Test Results Wks 1-23
- L77034-1 – Meagher Excluded Material – Static Test Results
- L77034-2 – Wolsey Excluded Material – Static Test Results
- L78192 – Meagher Excluded Material Humidity Cell Test Results Wks 1-4
- L78193 – Wolsey Excluded Material Humidity Cell Test Results Wks 1-4

4.1 Static Results

Whole rock and acid generation potential results are presented in this section. In addition the excluded material results are shown as well. As targeted, the Meagher sample was very low in sulfide content and the Wolsey had a higher targeted sulfide content. As described previously, these samples represent waste rock that will be encountered during operations as part of the mine development activities. Table 5 thru 8 provides the results from the static testing effort.

Whole rock results suggest geochemical make-up of the excluded material falls within expected natural variability for both formations. The kinetic tests will help to understand if this variability will have an effect on geochemical quality of the two formations and if it is critical to the overall waste characterization design that will be implemented for the project during operations.

Acid/base results are as expected. The high carbonate content of the formations play a significant role in the acid neutralizing potential for both sets of composites. Neither composites exhibited an overall acid generating conditions, both had excess neutralization potential. As with the whole rock results, kinetic tests will provide important data to help understand the overall potential waste rock geochemical characteristics.

Table 5
Whole Rock Analyses

ANALYTE	Meagher	Wolsey
	mg/kg	mg/kg
Aluminum, total	2,240	29,200
Antimony, total	<0.2	<0.2
Arsenic, total	4.9	2.4
Barium, total	20.7	22.1
Beryllium, total	<0.05	0.3
Bismuth, total	6	<20
Boron, total	9	<5
Cadmium, total	0.07	0.17
Calcium, total	203,000	20,500
Chromium, total	3	11
Cobalt, total	1	33
Copper, total	5	549
Gallium, total	<10	<50
Iron, total	3,570	127,000
Lead, total	1.27	2.3
Lithium, total	<2	9
Magnesium, total	131,000	49,600
Manganese, total	379	368
Mercury, total	<0.04	<0.04
Molybdenum, total	1	<5
Nickel, total	<1	11
Potassium, total	2,080	6770
Scandium, total	<10	<10
Selenium, total	0.15	3.15
Silver, total	<1	62
Sodium, total	30	1530
Strontium, total	59	73
Thallium, total	<30	<200
Tin, total	<10	<50
Titanium, total	97.9	1390
Vanadium, total	7	38
Zinc, total	4	37

Table 6
Excluded Meagher and Wolsey Material
Whole Rock Analyses

ANALYTES	Meagher mg/kg	Wolsey mg/kg
Aluminum, total	2,780	22,800
Antimony, total	<0.2	<0.2
Arsenic, total	6.7	3.9
Barium, total	26.5	25
Beryllium, total	0.07	0.29
Bismuth, total	<4	<80
Boron, total	11	<20
Cadmium, total	0.14	0.22
Calcium, total	213,000	17,500
Chromium, total	3	<20
Cobalt, total	<1	<20
Copper, total	3	640
Gallium, total	<10	<200
Iron, total	4,640	140,000
Lead, total	3.86	4.69
Lithium, total	<2	7
Magnesium, total	131,000	82,400
Manganese, total	361	500
Mercury, total	<0.03	<0.04
Molybdenum, total	<5	<20
Nickel, total	<1	<20
Potassium, total	2,570	6,390
Scandium, total	<10	<10
Selenium, total	0.07	3.21
Silver, total	<1	<20
Sodium, total	30	1,070
Strontium, total	61	54
Thallium, total	<30	<600
Tin, total	<10	<200
Titanium, total	120	1,000
Vanadium, total	5.8	40
Zinc, total	7	80

Table 7
Acid/Base Characterization
Meagher/Wolsey Material

ANALYTES	Units	Meagher	Wolsey
Acid Generation Potential (calc on Sulfur total)	Tons CaCO3/Kt	2	229
Acid Neutralization Potential (calc)	Tons CaCO3/Kt	976	279
Acid-Base Potential (calc on Sulfur total)	Tons CaCO3/Kt	974	50
Neutralization Potential as CaCO3	Percent	97.6	27.9
Solids, Percent	Percent	99.8	100
Sulfur HCl Residue	Percent	0.02	0.96
Sulfur HNO3 Residue	Percent	<0.01	0.48
Sulfur Organic Residual Mod	Percent	<0.01	0.48
Sulfur Pyritic Sulfide	Percent	0.02	0.48
Sulfur Sulfate	Percent	0.04	6.36
Sulfur Total	Percent	0.06	7.32
Total Sulfur minus Sulfate	Percent	0.02	0.96

Table 8
Acid/Base Characterization
Meagher/Wolsey Excluded Material

ANALYTES	Units	Meagher	Wolsey
Acid Generation Potential (calc on Sulfur total)	Tons CaCO3/Kt	3	218
Acid Neutralization Potential (calc)	Tons CaCO3/Kt	1040	252
Acid-Base Potential (calc on Sulfur total)	Tons CaCO3/Kt	1040	34
Neutralization Potential as CaCO3	Percent	104	25.2
Solids, Percent	Percent	99.9	99.6
Sulfur HCl Residue	Percent	0.02	2.01
Sulfur HNO3 Residue	Percent	<0.01	0.65
Sulfur Organic Residual Mod	Percent	<0.01	0.65
Sulfur Pyritic Sulfide	Percent	0.02	1.36
Sulfur Sulfate	Percent	0.06	4.97
Sulfur Total	Percent	0.08	6.98
Total Sulfur minus Sulfate	Percent	0.02	2.01

Comparing the two materials tested (whole rock and ABA) it is clear the main static test results would not have changed significantly if material from Table 6 had not been excluded during sample preparation. The primary material (composites) tested are reasonably representative of the intended objective and quality targets.

4.2 Kinetic Results

Kinetic testing was completed on the Meagher and Wolsey samples tested under the static test program which included the excluded Meagher and Wolsey material. The following results are provided:

Table 9 – Meagher Humidity Cell Test Results
Table 10 – Wolsey Humidity Cell Test Results
Table 11 – Meagher Humidity Cell Data Summary
Table 12 – Wolsey Humidity Cell Data Summary
Table 13 – Excluded Meagher Humidity Cell Test Results
Table 14 – Excluded Wolsey Humidity Cell Test Results
Table 15 – Comparison Meagher Humidity Cell Test Results
Table 16 – Comparison Wolsey Humidity Cell Test Results

The Meagher material did not exhibit significant metal mobility when comparing minimum and maximum values measured. There were no clear trends to time or metal values. PH remained consistent throughout the 23 week test. Sulfates showed an initial flush but values were very low and remained relatively stable for the test period.

The Wolsey sample exhibited the same trends as the Meagher tests. Little or no significant variation in metal values during the tests were observed. The pH remained constant and was very similar to the Meagher value despite a higher sulfur content.

Both excluded materials tests had relatively stable metal values after 4 weeks. The trend for low metal mobility and stable pH values were observed with composited material. When simply comparing kinetic test results for all materials, there is very little difference in leachate quality. This suggests that the variability seen in the drill core with iron and sulfur does not have a significant impact on kinetic test results. In addition, the excluded material would not have resulted in a significantly different results had the material not been excluded from the original composite.

Table 9 - Meagher Humidity Cell Test Results

CM09 Meagher	Week																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	23
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Aluminum, dissolved	<0.03				<0.03	<0.03	<0.03	0.05	0.03	0.06	<0.03	<0.03	<0.03	<0.03	0.04	0.06	<0.03	0.05	0.04
Antimony, dissolved	0.0011				0.0008	0.0008	0.0009	0.0007	0.0008	0.0007	0.0011	0.0007	0.0006	0.0009	0.0006	<0.004	0.0006	0.0006	0.001
Arsenic, dissolved	0.0015				0.0093	0.0012	0.0107	0.007	0.0078	0.0077	0.0124	0.0038	0.0033	0.0032	0.0037	<0.005	0.0039	0.0042	0.0032
Barium, dissolved	0.005				0.005	0.005	0.008	0.01	0.009	0.01	0.009	0.005	0.008	0.007	0.008	0.015	0.009	0.007	0.011
Beryllium, dissolved	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron, dissolved	0.02				0.04	0.02	0.02	0.03	0.03	0.04	0.03	0.02	0.02	0.02	0.02	0.02	<0.01	<0.01	0.09
Cadmium, dissolved	<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.0001	<0.0001	<0.0001
Calcium, dissolved	7.2				5.8	5.2	6.2	8.2	6.1	6.7	7.2	5.9	6.3	5.8	5.5	5.9	7.1	6.6	5.7
Chromium, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	0.04	0.02
Lead dissolved																	<0.0001	<0.0001	0.0002
Magnesium, dissolved	5.3				3.4	3.8	4.3	5.1	3.1	4.3	3.9	2.8	2.7	3.3	3.3	2.6	2.1	2.6	1.9
Manganese, dissolved	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Mercury, dissolved	<0.0004				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Potassium, dissolved	3.5				2.1	2	2.1	2.9	2.4	2.2	2	1.7	1.6	1.9	1.9	1.8	1.2	1.1	1.9
Selenium, dissolved	0.0005				0.0001	0.0002	0.0009	0.0004	0.0002	0.0003	0.0003	<0.0001	<0.0001	0.0002	0.0001	<0.001	<0.0001	<0.0001	<0.0001
Silver, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium, dissolved	1.2				<0.3	0.3	0.3	0.3	0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4
Thallium, dissolved	<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.004	<0.0001	<0.0001	<0.0001
Zinc, dissolved	0.1				0.03	0.05	0.03	0.05	0.05	0.05	0.06	0.06	0.08	0.05	0.05	0.08	0.06	0.1	0.13
Bicarbonate as CaCO3	29	29	25	32	33	29	27	37	29	30	30	24	26	27	30	25	26	21	21
Carbonate as CaCO3	2	3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2	<2
Conductivity @25C	101	94	95	101	69	70	67	85	59	72	72	56	58	62	63	56	58	47	51
Hydroxide as CaCO3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
pH	9.2	9.1	9	9.2	8.7	9	9.3	9	9.1	9.1	8.5	9.1	8.9	8.9	8.7	8.8	8.7	8.8	9.1
Sulfate	10	9	6	10	4	3	1	5	2	2	1	<1	<1	1	1	1	<1	<1	<1
Total Alkalinity	31	33	25	34	33	30	29	37	29	30	30	24	26	27	30	26	26	23	23

Table 10 – Wolsey Humidity Cell Test Results

CW09 Wolsey	Week																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	20	21	22	23
	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*	mg/l*
Alum., dissolved	0.05				0.07	<0.03	0.12	0.11	0.17	0.11	0.11	0.07	0.12	0.07	0.13	0.24	0.22	0.33	0.22
Antimony., dissolved	0.001				0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0006	0.0005	0.0005	0.0005	<0.0004	0.0008	0.0006	0.0005
Arsenic, dissolved	<0.0005				0.0075	<0.0005	0.0105	0.0067	0.007	0.0067	0.0115	0.002	0.002	0.0021	0.0032	0.006	0.0024	0.003	0.0017
Barium, dissolved	<0.003				<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.008	0.003	<0.003	0.006
Beryllium, dissolved	0.002				<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron, dissolved	0.03				0.05	0.03	0.04	0.05	0.04	0.04	0.05	0.03	0.03	0.03	0.04	0.02	<0.01	0.02	0.02
Cadmium, dissolved	<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium, dissolved	11.2				8.2	7.8	8.2	8.8	8.2	8.5	8.6	6.1	6.1	7.3	8.2	7	6.2	7	8.3
Chromium, issolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	<0.02	<0.02	<0.02	0.14	0.03	<0.02	0.03	0.02	0.06	0.02	0.02	0.03	0.05	0.02	0.04	0.14	0.11	0.32	0.16
Lead dissolved																	<0.0001	<0.0001	0.0002
Magnesium,dissolve	4.7				3.5	3.9	4.1	4.3	4	4.9	5	3.5	3.5	5.5	5.8	4.5	2.8	3.4	4.4
Manganese, dissolve	<0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006
Mercury, dissolved	<0.0004				<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Potassium,dissolved	6.1				4.5	4.7	4.6	5.3	5.2	5.6	5.4	4	3.8	5.2	5.3	5	3.8	3.7	3.7
Selenium, dissolved	0.0003				<0.0001	0.0001	0.0007	0.0002	0.0006	0.0003	0.0002	0.0001	<0.0001	0.0002	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Silver, dissolved	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium, dissolved	4.1				1.6	1.5	1.3	1.5	1.2	1.5	1.4	0.7	0.5	1	0.7	0.4	<0.3	<0.3	0.6
Thallium,dissolved	<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.004	<0.0001	<0.0001	<0.0001
Zinc, dissolved	0.14				0.03	0.05	0.05	0.05	0.05	0.04	0.06	0.05	0.07	0.06	0.04	0.1	0.06	0.1	0.02
Bicarbonate (CaCO3)	20	23	23	21	21	20	17	20	26	21	17	12	11	12	16	14	11	11	10
Carbonate (CaCO3)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Conductivity @25C	149	138	118	91	103	96	101	110	103	112	116	92	82	116	120	102	70	80	105
Hydroxide (CaCO3)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
pH	8.9	8.8	8.8	9	8.5	8.8	9	8.8	8.8	8.9	8.2	8.7	8.4	8.5	8.5	8.6	8.4	8.3	8.7
Sulfate	30	24	18	13	17	16	17	19	21	24	25	21	21	34	33	27	17	22	<1
Total Alkalinity	20	23	23	21	21	20	17	20	26	21	17	12	11	12	16	14	11	11	10

Table 11
Meagher Humidity Cell Data Summary

CM09 Meagher	Min Value mg/l	Max Value mg/l	Geometric Avg. mg/l	Arithmetic Avg. mg/l
Aluminum, dissolved	<0.03	0.06	0.036	0.038
Antimony, dissolved	0.0006	0.0011	0.0009	0.0010
Arsenic, dissolved	0.0012	0.0124	0.0046	0.005
Barium, dissolved	0.005	0.015	0.008	0.008
Beryllium, dissolved	<0.002	0.002	0.002	0.002
Boron, dissolved	<0.01	0.09	0.024	0.028
Cadmium, dissolved	<0.0001	<0.001	0.00012	0.00016
Calcium, dissolved	5.2	8.2	6.3	6.3
Chromium, dissolved	<0.01	<0.01	0.01	0.01
Copper, dissolved	<0.01	<0.01	0.01	0.01
Iron, dissolved	<0.02	0.04	0.022	0.022
Lead dissolved	<0.0001	0.0002	0.0002	0.0002
Magnesium, dissolved	1.9	5.3	3.3	3.4
Manganese, dissolved	<0.005	<0.005	0.005	0.005
Mercury, dissolved	<0.0002	<0.0004	0.00021	0.00021
Nickel, dissolved	<0.01	<0.01	0.01	0.01
Potassium, dissolved	1.1	3.5	1.9	2.0
Selenium, dissolved	<0.0001	<0.001	0.0002	0.0003
Silver, dissolved	<0.01	<0.01	0.01	0.01
Sodium, dissolved	<0.3	1.2	0.43	0.5
Thallium, dissolved	<0.0001	0.004	0.00013	0.00034
Zinc, dissolved	0.03	0.13	0.06	0.06
Bicarbonate as CaCO3	21	37	27.6	27.9
Carbonate as CaCO3	<2	3	2.04	2.1
Conductivity @25C	47	101	68.5	70.3
Hydroxide as CaCO3	<2	<2	2.0	2
pH	8.5	9.3	9.0	9.0
Sulfate	<1	10	2.1	3.2
Total Alkalinity	23	37	28.5	28.7

Table 12
Wolsey Humidity Data Summary

CW09 Wolsey	Min Value mg/l	Max Value mg/l	Geometric Avg. mg/l	Arithmetic Avg. mg/l
Aluminum, dissolved	<0.03	0.33	0.125	0.14
Antimony, dissolved	<0.0004	0.001	0.0006	0.0006
Arsenic, dissolved	<0.0005	0.0115	0.003	0.005
Barium, dissolved	<0.0003	0.008	0.003	0.004
Beryllium, dissolved	<0.002	0.002	0.002	0.002
Boron, dissolved	<0.01	0.05	0.03	0.035
Cadmium, dissolved	<0.0001	<0.0001	0.0001	0.0001
Calcium, dissolved	6.1	11.2	7.8	7.9
Chromium, dissolved	<0.01	<0.01	0.01	0.01
Copper, dissolved	<0.01	<0.01	0.01	0.01
Iron, dissolved	<0.02	0.32	0.04	0.07
Lead dissolved	<0.0001	0.0002	0.0002	0.0002
Magnesium, dissolved	2.8	5.8	4.2	4.2
Manganese, dissolved	<0.005	0.006	0.005	0.005
Mercury, dissolved	<0.0002	0.001	0.00023	0.0003
Nickel, dissolved	<0.01	<0.01	0.01	0.01
Potassium, dissolved	3.7	6.1	4.7	4.7
Selenium, dissolved	<0.0001	0.0007	0.0002	0.0002
Silver, dissolved	<0.01	<0.01	0.01	0.01
Sodium, dissolved	<0.3	4.1	1.1	1.3
Thallium, dissolved	<0.0001	0.004	0.0001	0.0003
Zinc, dissolved	0.02	0.14	0.05	0.06
Bicarbonate as CaCO3	10	26	16.4	17.2
Carbonate as CaCO3	<2	<2	2	2
Conductivity @25C	70	149	103.8	105.5
Hydroxide as CaCO3	<2	<2	2	2
pH	8.2	9	8.7	8.7
Sulfate	13	34	18.3	21.1
Total Alkalinity	10	26	16.4	17.2

Table 13
Excluded Meagher Humidity Cell Test Results

CM09-01 Excluded	Week			
	1	2	3	4
	mg/l*	mg/l*	mg/l*	mg/l*
Aluminum, dissolved	0.08	0.06	0.04	0.03
Antimony, dissolved	0.0007	<0.0004	<0.0004	<0.0004
Arsenic, dissolved	0.0036	0.0032	0.0032	0.0066
Barium, dissolved	0.006	0.005	0.009	0.009
Beryllium, dissolved	<0.002	<0.002	<0.002	<0.002
Boron, dissolved	0.07	0.03	0.14	0.02
Cadmium, dissolved	<0.0001	<0.0001	<0.0001	0.0002
Calcium, dissolved	6.4	8	6.5	7.6
Chromium, dissolved	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	0.08	0.04	<0.02	<0.02
Lead dissolved	<0.0001	<0.0001	0.0004	0.0006
Magnesium, dissolved	4.8	17.7	5.1	4.4
Manganese, dissolved	<0.005	<0.005	<0.005	<0.005
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002
Nickel, dissolved	<0.01	<0.01	<0.01	<0.01
Potassium, dissolved	2.8	7.8	3.1	1.8
Selenium, dissolved	0.0004	0.0003	0.0002	0.0001
Silver, dissolved	<0.01	<0.01	<0.01	<0.01
Sodium, dissolved	0.6	3.1	0.5	0.4
Thallium, dissolved	<0.0001	<0.0001	<0.0001	<0.0001
Zinc, dissolved	0.01	0.03	0.02	0.1
Bicarbonate as CaCO3	29	33	31	42
Carbonate as CaCO3	7	6	5	<2
Conductivity @25C	88	81	90	88
Hydroxide as CaCO3	<2	<2	<2	<2
pH	9.2	9.2	9	9.3
Sulfate	4	3	3	2
Total Alkalinity	36	39	37	42

Table 14
Excluded Wolsey Humidity Cell Test Results

CW09-01 Excluded	Week			
	1	2	3	4
	mg/l*	mg/l*	mg/l*	mg/l*
Aluminum, dissolved	0.09	<0.03	0.05	0.08
Antimony, dissolved	0.0005	<0.002	<0.0004	<0.0004
Arsenic, dissolved	0.0022	0.004	0.005	0.0034
Barium, dissolved	<0.003	0.008	0.004	<0.003
Beryllium, dissolved	<0.002	<0.002	<0.002	<0.002
Boron, dissolved	0.04	0.18	0.06	0.05
Cadmium, dissolved	<0.0001	<0.0005	<0.0001	<0.0001
Calcium, dissolved	9.9	6	8.4	8
Chromium, dissolved	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	0.09	0.02	0.06	0.03
Lead dissolved	<0.0001	<0.0005	<0.0001	<0.0004
Magnesium, dissolved	14.4	4.7	16.2	13.7
Manganese, dissolved	<0.005	<0.005	<0.005	<0.005
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002
Nickel, dissolved	<0.01	<0.01	<0.01	<0.01
Potassium, dissolved	7.6	3.3	7.8	6.5
Selenium, dissolved	<0.0005	<0.0005	0.0004	0.0003
Silver, dissolved	<0.01	<0.01	<0.01	<0.01
Sodium, dissolved	3.1	0.6	2.4	1.6
Thallium, dissolved	<0.0001	<0.0005	<0.0001	<0.0001
Zinc, dissolved	0.02	0.02	0.02	0.1
Bicarbonate as CaCO3	30	34	33	35
Carbonate as CaCO3	4	3	4	<2
Conductivity @25C	222	246	228	195
Hydroxide as CaCO3	<2	<2	<2	<2
pH	9.1	9	8.9	9
Sulfate	36	46	33	38
Total Alkalinity	34	37	37	35

Table 15
Comparison Meagher Vs. Excluded Material Humidity Cell Data Summary (mg/l)

	Min. Value	Max. Value	Geometric Avg.	Arithmetic Avg.		Min Value	Max. Value	Geometric Avg.	Arithmetic Avg.
CM09 Meagher	Original Material					Excluded Material			
Aluminum, dissolved	<0.03	0.06	0.036	0.038		0.03	0.08	0.049	0.053
Antimony, dissolved	0.0006	0.0011	0.0008	0.001		<0.0004	0.0007	0.0005	0.0005
Arsenic, dissolved	0.0012	0.0124	0.0049	0.0058		0.0032	0.0066	0.004	0.004
Barium, dissolved	0.005	0.015	0.008	0.008		0.005	0.009	0.007	0.007
Beryllium, dissolved	<0.002	0.002	0.002	0.002		<0.002	<0.002	0.002	0.002
Boron, dissolved	<0.01	0.09	0.024	0.028		0.02	0.14	0.049	0.065
Cadmium, dissolved	<0.0001	<0.001	0.00012	0.00016		<0.0001	0.0002	0.0001	0.0001
Calcium, dissolved	5.2	8.2	6.2	6.3		6.4	8	7.1	7.1
Chromium, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Copper, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Iron, dissolved	<0.02	0.04	0.022	0.022		<0.02	0.08	0.03	0.04
Lead dissolved	<0.0001	0.0002	0.00013	0.00013		<0.0001	0.0006	0.0002	0.0003
Magnesium, dissolved	1.9	5.3	3.3	3.4		4.4	17.8	6.6	8.0
Manganese, dissolved	<0.005	<0.005	0.005	0.005		<0.005	<0.005	0.005	0.005
Mercury, dissolved	<0.0002	<0.0004	0.00021	0.00021		<0.0002	<0.0002	0.0002	0.0002
Nickel, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Potassium, dissolved	1.1	3.5	1.9	2		1.8	7.8	3.3	3.9
Selenium, dissolved	<0.0001	0.0009	0.0002	0.0003		0.0001	0.0004	0.0002	0.0003
Silver, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Sodium, dissolved	<0.3	1.2	0.34	0.37		0.4	3.1	0.8	1.2
Thallium, dissolved	<0.0001	0.004	0.00013	0.00034		<0.0001	<0.0001	0.0001	0.0001
Zinc, dissolved	0.03	0.13	0.06	0.06		0.01	0.1	0.03	0.04
Bicarbonate as CaCO3	21	37	27.6	27.8		29	42	33	34
Carbonate as CaCO3	<2	3	2	2.1		<2	7	4.5	5.0
Conductivity @25C	47	101	67	68.6		81	90	86.7	86.8
Hydroxide as CaCO3	<2	<2	2	2		<2	<2	2	2
pH	8.5	9.3	8.9	8.9		9	9.3	9.2	9.2
Sulfate	<1	10	1.9	3.2		2	4	2.9	3.0
Total Alkalinity	23	37	28.4	28.6		36	42	38.4	38.5

Table 16
Comparison Wolsey Vs. Excluded Humidity Cell Data Summary (mg/l)

CM09 Wolsey	Min. Value	Max. Value	Geometric Avg.	Arithmetic Avg.		Min Value	Max. Value	Geometric Avg.	Arithmetic Avg.
	Original Material					Excluded Material			
Aluminum, dissolved	<0.03	0.33	0.12	0.14		<0.03	0.9	0.1	0.27
Antimony, dissolved	<0.0004	0.001	0.0006	0.0006		<0.0004	<0.002	0.0006	0.0008
Arsenic, dissolved	<0.0005	0.0115	0.0032	0.0046		0.0022	0.005	0.003	0.004
Barium, dissolved	<0.0003	0.008	0.0033	0.0035		<0.003	0.008	0.0041	0.0045
Beryllium, dissolved	<0.002	0.002	0.0020	0.0020		<0.002	<0.002	0.002	0.002
Boron, dissolved	<0.01	0.05	0.0331	0.0347		0.04	0.18	0.068	0.083
Cadmium, dissolved	<0.0001	<0.0001	0.0001	0.0001		<0.0001	<0.0005	0.0001	0.0002
Calcium, dissolved	6.1	11.2	7.8	7.9		6	9.9	7.9	8.1
Chromium, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Copper, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Iron, dissolved	<0.02	0.32	0.04	0.07		0.02	0.09	0.042	0.05
Lead dissolved	<0.0001	0.0002	0.0002	0.0002		<0.0001	<0.0005	0.00021	0.00028
Magnesium, dissolved	2.8	5.8	4.2	4.2		4.7	16.2	11.1	12.3
Manganese, dissolved	<0.005	0.006	0.0051	0.0051		<0.005	<0.005	0.005	0.005
Mercury, dissolved	<0.0002	0.001	0.0002	0.0003		<0.0002	<0.0002	0.0002	0.0002
Nickel, dissolved	<0.01	<0.01	0.0100	0.0100		<0.01	<0.01	0.01	0.01
Potassium, dissolved	3.7	6.1	4.7	4.7		3.3	7.8	6.0	6.3
Selenium, dissolved	<0.0001	0.0007	0.0002	0.0002		0.0003	<0.0005	0.0004	0.0004
Silver, dissolved	<0.01	<0.01	0.01	0.01		<0.01	<0.01	0.01	0.01
Sodium, dissolved	<0.3	4.1	1.1	1.3		0.6	3.1	1.6	1.9
Thallium, dissolved	<0.0001	0.004	0.0001	0.0003		<0.0001	<0.0005	0.0001	0.0002
Zinc, dissolved	0.02	0.14	0.05	0.06		0.02	0.1	0.030	0.040
Bicarbonate as CaCO3	10	26	16.4	17.2		30	35	32.9	33.0
Carbonate as CaCO3	<2	<2	2.0	2.0		3	4	3.13	3.25
Conductivity @25C	70	149	103.8	105.5		195	246	222.0	222.8
Hydroxide as CaCO3	<2	<2	2.0	2.0		<2	<2	2	2
pH	8.2	9	8.7	8.7		8.9	9.1	9.0	9
Sulfate	13	34	18.3	21.1		33	46	38.0	38.3
Total Alkalinity	10	26	16.4	17.2		34	37	35.7	35.8

5.0 Conclusions

The high carbonate content of both rock formations have a significant capacity to minimize acid generating potential individually and certainly when combined together. Metal content varies between the Meagher and the Wolsey formation but humidity cell test results indicate a limited metal leaching capacity. Table 17 provides a comparison with Montana Water Quality Standards for both surface (aquatic values) and groundwater criteria. All comparable metal values are below or near the standard. The information below is conservative as non-detect values were carried as detected values when calculating average values used for comparison purposes. As mentioned previously, kinetic variability was less pronounced than static results.

Table 17
Montana Water Quality Standards and Kinetic Tests

Parameter	Montana Standards		Wolsey Avg. mg/l	Meagher Avg. mg/l
	Aquatic mg/l	Groundwater mg/l		
Aluminum	0.087	0.2	0.14	0.038
Antimony	--	0.006	0.0006	0.001
Arsenic	0.15	0.01	0.005	0.0058
Barium, dissolved	--	2	0.004	0.008
Beryllium	--	0.004	0.002	0.002
Boron	--	--	0.035	0.028
Cadmium	0.000097	0.005	0.0001	0.00016
Calcium	--	--	7.9	6.3
Chromium	0.0277	0.1	0.01	0.01
Copper	0.00285	1.3	0.01	0.01
Iron	1	0.3	0.07	0.022
Lead	0.000545	0.015	0.0002	0.00013
Magnesium	--	--	4.2	3.4
Manganese	--	0.05	0.005	0.005
Mercury	0.00091	0.002	0.0003	0.00021
Nickel	0.0161	0.1	0.01	0.01
Potassium	--	--	4.7	2
Selenium	0.005	0.05	0.0002	0.0003
Silver	0.000374	0.1	0.01	0.01
Sodium	--	--	1.3	0.37
Thallium	--	--	0.0003	0.00034
Zinc	0.037	2	0.06	0.06
Bicarbonate as CaCO3	--	--	17.2	27.8
Carbonate as CaCO3	--	--	2	2.1
Hydroxide as CaCO3	--	--	2	2
pH	6.5 - 9.0	6.5 - 8.5	8.7	8.9
Sulfate	--	250	21.1	3.2
Total Alkalinity	--	--	17.2	28.6

Appendix 1
Whole Rock Analyses
Laboratory Results

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Revised Analytical Report

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

April 10, 2009

Cc: Art Glover

Project ID: TJV_GENERAL_HUMIDITY
ACZ Project ID: L74714

Eric Klepfer:

Enclosed are revised analytical reports for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on March 05, 2009 and reported on April 02, 2009. Refer to the case narrative for an explanation of the changes. This project was assigned to ACZ's project number, L74714. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L74714. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all the requirements of NELAC.

This report should be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after May 02, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years. Please notify your Project Manager if you have other needs.

If you have any questions, please contact your Project Manager or Customer Service Representative.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp. April 10, 2009

Project ID: TJV_GENERAL_HUMIDITY
ACZ Project ID: L74714

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 2 soil samples from Timberline Resources Corp. on March 5, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L74714. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. This is a revised report due to a sample switch during sample preparation.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CM09-01

ACZ Sample ID: ***L74714-01***
Date Sampled: *02/25/09 11:00*
Date Received: *03/05/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, total (3050)	M6010B ICP	2240		*	mg/Kg	3	20	03/18/09 12:11	aeh
Antimony, total (3050)	M6020 ICP-MS		U	*	mg/Kg	0.2	1	03/24/09 6:22	erf
Arsenic, total (3050)	M6020 ICP-MS	4.9		*	mg/Kg	0.3	1	03/24/09 6:22	erf
Barium, total (3050)	M6010B ICP	20.7		*	mg/Kg	0.3	2	03/18/09 12:11	aeh
Beryllium, total (3050)	M6020 ICP-MS		U		mg/Kg	0.05	0.3	03/30/09 22:31	erf
Bismuth, total (3050)	M6010B ICP	6	B	*	mg/Kg	4	20	03/18/09 12:11	aeh
Boron, total (3050)	M6010B ICP	9		*	mg/Kg	1	5	03/18/09 12:11	aeh
Cadmium, total (3050)	M6020 ICP-MS	0.07	B		mg/Kg	0.05	0.3	03/24/09 6:22	erf
Calcium, total (3050)	M6010B ICP	203000			mg/Kg	100	500	03/19/09 19:54	aeh
Chromium, total (3050)	M6010B ICP	3	B		mg/Kg	1	5	03/18/09 12:11	aeh
Cobalt, total (3050)	M6010B ICP	1	B		mg/Kg	1	5	03/18/09 12:11	aeh
Copper, total (3050)	M6010B ICP	5			mg/Kg	1	5	03/18/09 12:11	aeh
Gallium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	03/18/09 12:11	aeh
Iron, total (3050)	M6010B ICP	3570		*	mg/Kg	2	5	03/18/09 12:11	aeh
Lead, total (3050)	M6020 ICP-MS	1.27			mg/Kg	0.05	0.3	03/30/09 22:31	erf
Lithium, total (3050)	M6010B ICP		U		mg/Kg	2	10	03/18/09 12:11	aeh
Magnesium, total (3050)	M6010B ICP	131000			mg/Kg	100	500	03/19/09 19:54	aeh
Manganese, total (3050)	M6010B ICP	379		*	mg/Kg	0.5	3	03/18/09 12:11	aeh
Mercury, total	M7471A CVAA		U		mg/Kg	0.04	0.2	03/20/09 15:54	pmc
Molybdenum, total (3050)	M6010B ICP	1	B		mg/Kg	1	5	03/18/09 12:11	aeh
Nickel, total (3050)	M6010B ICP		U	*	mg/Kg	1	5	03/18/09 12:11	aeh
Potassium, total (3050)	M6010B ICP	2080			mg/Kg	30	200	03/18/09 12:11	aeh
Scandium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	03/18/09 12:11	aeh
Selenium, total (3050)	M6020 ICP-MS	0.15	B		mg/Kg	0.05	0.3	03/24/09 6:22	erf
Silver, total (3050)	M6010B ICP		U		mg/Kg	1	3	03/18/09 12:11	aeh
Sodium, total (3050)	M6010B ICP	30	B		mg/Kg	30	200	03/18/09 12:11	aeh
Strontium, total (3050)	M6010B ICP	59		*	mg/Kg	1	5	03/18/09 12:11	aeh
Thallium, total (3050)	M6010B ICP		U	*	mg/Kg	30	100	03/18/09 12:11	aeh
Tin, total (3050)	M6010B ICP		U		mg/Kg	10	50	03/18/09 12:11	aeh
Titanium, total (3050)	M6010B ICP	97.9		*	mg/Kg	0.5	3	03/18/09 12:11	aeh
Vanadium, total (3050)	M6010B ICP	7	B		mg/Kg	3	10	03/19/09 19:54	aeh
Zinc, total (3050)	M6010B ICP	4	B		mg/Kg	1	5	03/18/09 12:11	aeh

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CM09-01

ACZ Sample ID: ***L74714-01***
Date Sampled: *02/25/09 11:00*
Date Received: *03/05/09*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	2	B		t CaCO3/Kt	1	5	04/10/09 0:00	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	976			t CaCO3/Kt	1	5	04/10/09 0:00	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	974			t CaCO3/Kt	1	5	04/10/09 0:00	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	97.6		*	%	0.1	0.5	03/19/09 17:00	brd/lwt
Solids, Percent	CLPSOW390, PART F, D-98	99.8		*	%	0.1	0.5	03/12/09 8:45	mjc
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur HNO3 Residue			U	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Sulfate		0.04	B	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Total		0.06	B	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	03/17/09 0:00	mjc/lwt

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/06/09 11:00	mjc
Crush and Pulverize	USDA No. 1, 1972							03/11/09 20:30	brd
Digestion - Hot Plate	M3050B ICP-MS							03/27/09 14:00	mjc
Digestion - Hot Plate	M3050B ICP							03/16/09 23:30	mjc

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01

ACZ Sample ID: ***L74714-02***
Date Sampled: *02/25/09 10:00*
Date Received: *03/05/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, total (3050)	M6010B ICP	29200		*	mg/Kg	20	80	03/19/09 20:08	aeh
Antimony, total (3050)	M6020 ICP-MS		U	*	mg/Kg	0.2	1	03/24/09 6:35	erf
Arsenic, total (3050)	M6020 ICP-MS	2.4		*	mg/Kg	0.3	1	03/24/09 6:35	erf
Barium, total (3050)	M6010B ICP	22.1		*	mg/Kg	0.3	2	03/18/09 12:30	aeh
Beryllium, total (3050)	M6020 ICP-MS	0.30			mg/Kg	0.05	0.3	03/30/09 22:36	erf
Bismuth, total (3050)	M6010B ICP		U	*	mg/Kg	20	100	03/19/09 20:08	aeh
Boron, total (3050)	M6010B ICP		U		mg/Kg	5	30	03/19/09 20:08	aeh
Cadmium, total (3050)	M6020 ICP-MS	0.17	B		mg/Kg	0.05	0.3	03/24/09 6:35	erf
Calcium, total (3050)	M6010B ICP	20500			mg/Kg	100	500	03/19/09 20:08	aeh
Chromium, total (3050)	M6010B ICP	11	B		mg/Kg	5	30	03/19/09 20:08	aeh
Cobalt, total (3050)	M6010B ICP	33			mg/Kg	5	30	03/19/09 20:08	aeh
Copper, total (3050)	M6010B ICP	549			mg/Kg	5	30	03/19/09 20:08	aeh
Gallium, total (3050)	M6010B ICP		U	*	mg/Kg	50	300	03/19/09 20:08	aeh
Iron, total (3050)	M6010B ICP	127000		*	mg/Kg	10	30	03/19/09 20:08	aeh
Lead, total (3050)	M6020 ICP-MS	2.30			mg/Kg	0.05	0.3	03/30/09 22:36	erf
Lithium, total (3050)	M6010B ICP	9	B		mg/Kg	2	10	03/18/09 12:30	aeh
Magnesium, total (3050)	M6010B ICP	49600		*	mg/Kg	20	100	03/18/09 12:30	aeh
Manganese, total (3050)	M6010B ICP	368			mg/Kg	3	10	03/19/09 20:08	aeh
Mercury, total	M7471A CVAA		U		mg/Kg	0.04	0.2	03/20/09 16:01	pmc
Molybdenum, total (3050)	M6010B ICP		U		mg/Kg	5	30	03/19/09 20:08	aeh
Nickel, total (3050)	M6010B ICP	11	B		mg/Kg	5	30	03/19/09 20:08	aeh
Potassium, total (3050)	M6010B ICP	6770			mg/Kg	30	200	03/18/09 12:30	aeh
Scandium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	03/18/09 12:30	aeh
Selenium, total (3050)	M6020 ICP-MS	3.15			mg/Kg	0.05	0.3	03/24/09 6:35	erf
Silver, total (3050)	M6010B ICP	62			mg/Kg	5	10	03/19/09 20:08	aeh
Sodium, total (3050)	M6010B ICP	1530			mg/Kg	30	200	03/18/09 12:30	aeh
Strontium, total (3050)	M6010B ICP	73		*	mg/Kg	1	5	03/18/09 12:30	aeh
Thallium, total (3050)	M6010B ICP		U	*	mg/Kg	200	500	03/19/09 20:08	aeh
Tin, total (3050)	M6010B ICP		U	*	mg/Kg	50	300	03/19/09 20:08	aeh
Titanium, total (3050)	M6010B ICP	1390			mg/Kg	3	10	03/19/09 20:08	aeh
Vanadium, total (3050)	M6010B ICP	38			mg/Kg	3	10	03/19/09 20:08	aeh
Zinc, total (3050)	M6010B ICP	37			mg/Kg	5	30	03/19/09 20:08	aeh

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01

ACZ Sample ID: ***L74714-02***
Date Sampled: *02/25/09 10:00*
Date Received: *03/05/09*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	229			t CaCO3/Kt	1	5	04/10/09 0:00	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	279			t CaCO3/Kt	1	5	04/10/09 0:00	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	50			t CaCO3/Kt	1	5	04/10/09 0:00	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	27.9		*	%	0.1	0.5	03/19/09 20:00	brd/lwt
Solids, Percent	CLPSOW390, PART F, D-98	100		*	%	0.1	0.5	03/12/09 8:45	mjc
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.96		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur HNO3 Residue		0.48		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Organic Residual Mod		0.48		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Pyritic Sulfide		0.48		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Sulfate		6.36		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Sulfur Total		7.32		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt
Total Sulfur minus Sulfate		0.96		*	%	0.01	0.1	03/17/09 0:00	mjc/lwt

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							03/06/09 11:00	mjc
Crush and Pulverize	USDA No. 1, 1972							03/11/09 21:00	brd
Digestion - Hot Plate	M3050B ICP							03/27/09 15:30	mjc
Digestion - Hot Plate	M3050B ICP-MS							03/27/09 15:30	mjc

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995.

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Aluminum, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				3.1	mg/Kg		-9	9			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	10500		12930.7	mg/Kg		5910	15100			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	10500		12604.3	mg/Kg		5910	15100	2.6	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	2240	2364.4	mg/Kg	124.4	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	2240	2447.4	mg/Kg	207.4	75	125	3.45	20	M3
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.86	mg/L	93	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.09	0.09			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.954	mg/L	97.7	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.09	0.09			
WG260962PBS	PBS	03/19/09 19:44				3.7	mg/Kg		-9	9			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	10500		12892.4	mg/Kg		5910	15100			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	10500		12617.4	mg/Kg		5910	15100	2.2	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	2600	2770	mg/Kg	170	75	125			M3
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	2600	2863	mg/Kg	263	75	125	3.3	20	M3

Antimony, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	4		3.752	mg/L	93.8	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.06	0.06			
WG261268													
WG261268ICV	ICV	03/24/09 4:32	MS090318-2	.02		.01915	mg/L	95.8	90	110			
WG261268ICB	ICB	03/24/09 4:39				U	mg/L		-0.0012	0.0012			
L74720-01MS	MS	03/24/09 5:31	MS090311-4	10.05	2.6	10.93	mg/Kg	82.9	75	125			
L74720-01MSD	MSD	03/24/09 5:37	MS090311-4	10.05	2.6	11.17	mg/Kg	85.3	75	125	2.17	20	
WG260962PBS	PBS	03/24/09 5:50				U	mg/Kg		-0.6	0.6			
WG260962LCSS	LCSS	03/24/09 6:09	PCN31553	67.4		66.4	mg/Kg		10.2	124			
WG260962LCSSD	LCSSD	03/24/09 6:16	PCN31553	67.4		65	mg/Kg		10.2	124	2.1	20	
L74714-02MS	MS	03/24/09 6:42	MS090311-4	5	U	1.83	mg/Kg	36.6	75	125			M2
L74714-02MSD	MSD	03/24/09 6:48	MS090311-4	5	U	1.86	mg/Kg	37.2	75	125	1.63	20	M2

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Arsenic, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	4		3.723	mg/L	93.1	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.18	0.18			
WG261268													
WG261268ICV	ICV	03/24/09 4:32	MS090318-2	.05		.05211	mg/L	104.2	90	110			
WG261268ICB	ICB	03/24/09 4:39				U	mg/L		-0.0015	0.0015			
L74720-01MS	MS	03/24/09 5:31	MS090311-4	50.30025	2.1	48.79	mg/Kg	92.8	75	125			
L74720-01MSD	MSD	03/24/09 5:37	MS090311-4	50.30025	2.1	48.85	mg/Kg	92.9	75	125	0.12	20	
WG260962PBS	PBS	03/24/09 5:50				U	mg/Kg		-0.9	0.9			
WG260962LCSS	LCSS	03/24/09 6:09	PCN31553	104		99.7	mg/Kg		80.7	128			
WG260962LCSSD	LCSSD	03/24/09 6:16	PCN31553	104		100.1	mg/Kg		80.7	128	0.4	20	
L74714-02MS	MS	03/24/09 6:42	MS090311-4	25.025	2.4	23.73	mg/Kg	85.2	75	125			
L74714-02MSD	MSD	03/24/09 6:48	MS090311-4	25.025	2.4	23.06	mg/Kg	82.6	75	125	2.86	20	

Barium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-0.9	0.9			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	198		224.33	mg/Kg		158	237			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	198		188.7	mg/Kg		158	237	17.3	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	20.7	63.02	mg/Kg	84.6	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	20.7	64.17	mg/Kg	86.9	75	125	1.81	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.8785	mg/L	93.9	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.009	0.009			

Beryllium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261578													
WG261578ICV	ICV	03/30/09 21:54	MS090326-1	.05		.05139	mg/L	102.8	90	110			
WG261578ICB	ICB	03/30/09 21:58				U	mg/L		-0.0003	0.0003			
WG261479PBS	PBS	03/30/09 22:17				U	mg/Kg		-0.15	0.15			
WG261479LCSS	LCSS	03/30/09 22:22	PCN31553	77.6		77.6	mg/Kg		65	90.1			
WG261479LCSSD	LCSSD	03/30/09 22:27	PCN31553	77.6		81.9	mg/Kg		65	90.1	5.4	20	
L74927-01MS	MS	03/30/09 23:04	MS090311-4	28.028	.86	28.308	mg/Kg	97.9	75	125			
L74927-01MSD	MSD	03/30/09 23:08	MS090311-4	28.028	.86	24.741	mg/Kg	85.2	75	125	13.45	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Bismuth, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-12	12			
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	6	92.5	mg/Kg	86.5	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	6	93	mg/Kg	87	75	125	0.54	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.897	mg/L	94.9	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.12	0.12			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.942	mg/L	97.1	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.12	0.12			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-12	12			
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	U	122	mg/Kg	122	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	U	106	mg/Kg	106	75	125	14.04	20	

Boron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	141		145	mg/Kg		105	176			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	141		139.5	mg/Kg		105	176	3.9	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	9	51	mg/Kg	84	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	9	50.5	mg/Kg	83	75	125	0.99	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.833	mg/L	91.7	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.957	mg/L	97.9	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	141		146.5	mg/Kg		105	176			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	141		139.9	mg/Kg		105	176	4.6	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50.05	16	66.3	mg/Kg	100.5	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50.05	16	66.4	mg/Kg	100.7	75	125	0.15	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Cadmium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.8477	mg/L	92.4	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.015	0.015			
WG261268													
WG261268ICV	ICV	03/24/09 4:32	MS090318-2	.05		.05082	mg/L	101.6	90	110			
WG261268ICB	ICB	03/24/09 4:39				U	mg/L		-0.0003	0.0003			
L74720-01MS	MS	03/24/09 5:31	MS090311-4	50.25	1	47.54	mg/Kg	92.6	75	125			
L74720-01MSD	MSD	03/24/09 5:37	MS090311-4	50.25	1	47.39	mg/Kg	92.3	75	125	0.32	20	
WG260962PBS	PBS	03/24/09 5:50				U	mg/Kg		-0.15	0.15			
WG260962LCSS	LCSS	03/24/09 6:09	PCN31553	60.7		60.85	mg/Kg		49.1	72.4			
WG260962LCSSD	LCSSD	03/24/09 6:16	PCN31553	60.7		58.3	mg/Kg		49.1	72.4	4.3	20	
L74714-02MS	MS	03/24/09 6:42	MS090311-4	25	.17	23.535	mg/Kg	93.5	75	125			
L74714-02MSD	MSD	03/24/09 6:48	MS090311-4	25	.17	22.97	mg/Kg	91.2	75	125	2.43	20	

Calcium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	100		91.99	mg/L	92	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.6	0.6			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	100		98.33	mg/L	98.3	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.6	0.6			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-60	60			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	9870		10059	mg/Kg		8200	11500			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	9870		9760	mg/Kg		8200	11500	3	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	6792.1	203000	210450	mg/Kg	109.7	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	6792.1	203000	210070	mg/Kg	104.1	75	125	0.18	20	

Chromium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	236		242.3	mg/Kg		188	284			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	236		229.3	mg/Kg		188	284	5.5	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	3	40.6	mg/Kg	75.2	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	3	40.7	mg/Kg	75.4	75	125	0.25	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.849	mg/L	92.5	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.951	mg/L	97.6	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	236		247	mg/Kg		188	284			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	236		233.1	mg/Kg		188	284	5.8	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	U	51.3	mg/Kg	102.6	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	U	49.9	mg/Kg	99.8	75	125	2.77	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Cobalt, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	91.2		91.8	mg/Kg		73.9	109			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	91.2		86.7	mg/Kg		73.9	109	5.7	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	1	38.6	mg/Kg	75.2	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	1	38.4	mg/Kg	74.8	75	125	0.52	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2.002		1.887	mg/L	94.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2.002		1.951	mg/L	97.5	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	91.2		94.8	mg/Kg		73.9	109			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	91.2		89.4	mg/Kg		73.9	109	5.9	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	U	50.3	mg/Kg	100.6	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	U	49.3	mg/Kg	98.6	75	125	2.01	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	174		186.3	mg/Kg		140	206			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	174		178	mg/Kg		140	206	4.6	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	5	48.9	mg/Kg	87.8	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	5	49.2	mg/Kg	88.4	75	125	0.61	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.845	mg/L	92.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.954	mg/L	97.7	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	174		178.6	mg/Kg		140	206			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	174		170.2	mg/Kg		140	206	4.8	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	7	55.9	mg/Kg	97.8	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	7	55.6	mg/Kg	97.2	75	125	0.54	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Gallium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-30	30			
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	U	83	mg/Kg	83	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	U	83	mg/Kg	83	75	125	0	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.89	mg/L	94.5	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.3	0.3			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		2.06	mg/L	103	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.3	0.3			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-30	30			
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	U	137	mg/Kg	137	75	125			M4
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	U	132	mg/Kg	132	75	125	3.72	20	M4

Iron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-6	6			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	18000		17736	mg/Kg		9120	26900			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	18000		18316.3	mg/Kg		9120	26900	3.2	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	3570	3549.8	mg/Kg	-20.2	75	125			M3
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	3570	3535.8	mg/Kg	-34.2	75	125	0.4	20	M3
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.845	mg/L	92.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.06	0.06			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.923	mg/L	96.2	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.06	0.06			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-6	6			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	18000		17491.9	mg/Kg		9120	26900			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	18000		18087.1	mg/Kg		9120	26900	3.3	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	4420	4437	mg/Kg	17	75	125			M3
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	4420	4408	mg/Kg	-12	75	125	0.66	20	M3

Lead, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261578													
WG261578ICV	ICV	03/30/09 21:54	MS090326-1	.05		.05204	mg/L	104.1	90	110			
WG261578ICB	ICB	03/30/09 21:58				U	mg/L		-0.0003	0.0003			
WG261479PBS	PBS	03/30/09 22:17				U	mg/Kg		-0.15	0.15			
WG261479LCSS	LCSS	03/30/09 22:22	PCN31553	86		85.9	mg/Kg		67.8	104			
WG261479LCSSD	LCSSD	03/30/09 22:27	PCN31553	86		89.9	mg/Kg		67.8	104	4.6	20	
L74927-01MS	MS	03/30/09 23:04	MS090311-4	28.028	10.3	36.042	mg/Kg	91.8	75	125			
L74927-01MSD	MSD	03/30/09 23:08	MS090311-4	28.028	10.3	32.614	mg/Kg	79.6	75	125	9.99	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Lithium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-6	6			
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	U	108.7	mg/Kg	108.7	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	U	110.3	mg/Kg	110.3	75	125	1.46	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.885	mg/L	94.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.06	0.06			

Magnesium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-60	60			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	4000		4444	mg/Kg		3140	4870			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	4000		4301	mg/Kg		3140	4870	3.3	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	4996.908	114000	118332	mg/Kg	86.7	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	4996.908	114000	119188	mg/Kg	103.8	75	125	0.72	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	100		97.67	mg/L	97.7	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.6	0.6			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	100		104.61	mg/L	104.6	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.6	0.6			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-60	60			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	4000		4544	mg/Kg		3140	4870			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	4000		4436	mg/Kg		3140	4870	2.4	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	5492.9255	131000	137570	mg/Kg	119.6	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	5492.9255	131000	137680	mg/Kg	121.6	75	125	0.08	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Manganese, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-1.5	1.5			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	558		547.34	mg/Kg		453	664			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	558		535.51	mg/Kg		453	664	2.2	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	379	413.72	mg/Kg	69.4	75	125			M3
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	379	415.52	mg/Kg	73	75	125	0.43	20	M3
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.8252	mg/L	91.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.015	0.015			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.9378	mg/L	96.9	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.015	0.015			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-1.5	1.5			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	558		563.95	mg/Kg		453	664			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	558		552.37	mg/Kg		453	664	2.1	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	484	534	mg/Kg	100	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	484	535.2	mg/Kg	102.4	75	125	0.22	20	

Mercury, total M7471A CVAA

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261159													
WG261159ICV	ICV	03/20/09 14:56	II090319-3	.01		.00988	mg/L	98.8	90	110			
WG261159ICB	ICB	03/20/09 14:58				U	mg/L		-0.0006	0.0006			
WG261160													
WG261160PBS	PBS	03/20/09 15:47				U	mg/Kg		-0.12	0.12			
WG261160LCSS	LCSS	03/20/09 15:49	PCN30762	6.24		5.34	mg/Kg		4.44	8.03			
WG261160LCSSD	LCSSD	03/20/09 15:52	PCN30762	6.24		6.24	mg/Kg		4.44	8.03	15.5	20	
L74714-01MS	MS	03/20/09 15:56	II090319-5	.995	U	.917	mg/Kg	92.2	85	115			
L74714-01MSD	MSD	03/20/09 15:58	II090319-5	.99	U	.933	mg/Kg	94.2	85	115	1.73	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Molybdenum, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	48.6		51.8	mg/Kg		38	59.2			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	48.6		49.8	mg/Kg		38	59.2	3.9	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	1	40.2	mg/Kg	78.4	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	1	40.3	mg/Kg	78.6	75	125	0.25	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.887	mg/L	94.4	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.994	mg/L	99.7	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	48.6		52.9	mg/Kg		38	59.2			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	48.6		51.8	mg/Kg		38	59.2	2.1	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	U	53.8	mg/Kg	107.6	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	U	53.4	mg/Kg	106.8	75	125	0.75	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261129													
WG261129LCSS	LCSS	03/19/09 14:00	PCN20880	100		116.12	%	116.1	80	120			
L74714-02DUP	DUP	03/19/09 23:00			27.9	27.47	%				1.6	20	

Nickel, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	134		135.8	mg/Kg		104	165			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	134		128	mg/Kg		104	165	5.9	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	U	37.4	mg/Kg	74.8	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	U	36.9	mg/Kg	73.8	75	125	1.35	20	MA
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2.004		1.811	mg/L	90.4	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2.004		1.914	mg/L	95.5	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	134		139.8	mg/Kg		104	165			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	134		131.5	mg/Kg		104	165	6.1	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	U	54	mg/Kg	108	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	U	54	mg/Kg	108	75	125	0	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Potassium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-90	90			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	4300		4869	mg/Kg		3160	5440			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	4300		4757	mg/Kg		3160	5440	2.3	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	9976.186	2080	11942	mg/Kg	98.9	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	9976.186	2080	12141	mg/Kg	100.9	75	125	1.65	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	20		19.45	mg/L	97.3	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.9	0.9			

Scandium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-30	30			
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	U	85	mg/Kg	85	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	U	85	mg/Kg	85	75	125	0	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.88	mg/L	94	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.3	0.3			

Selenium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	4		3.816	mg/L	95.4	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.18	0.18			
WG261268													
WG261268ICV	ICV	03/24/09 4:32	MS090318-2	.05		.05224	mg/L	104.5	90	110			
WG261268ICB	ICB	03/24/09 4:39				U	mg/L		-0.0003	0.0003			
L74720-01MS	MS	03/24/09 5:31	MS090311-4	25.150125	7.4	31.38	mg/Kg	95.3	75	125			
L74720-01MSD	MSD	03/24/09 5:37	MS090311-4	25.150125	7.4	31.35	mg/Kg	95.2	75	125	0.1	20	
WG260962PBS	PBS	03/24/09 5:50				U	mg/Kg		-0.15	0.15			
WG260962LCSS	LCSS	03/24/09 6:09	PCN31553	286		285.4	mg/Kg		219	352			
WG260962LCSSD	LCSSD	03/24/09 6:16	PCN31553	286		283.5	mg/Kg		219	352	0.7	20	
L74714-02MS	MS	03/24/09 6:42	MS090311-4	12.5125	3.15	14.69	mg/Kg	92.2	75	125			
L74714-02MSD	MSD	03/24/09 6:48	MS090311-4	12.5125	3.15	13.985	mg/Kg	86.6	75	125	4.92	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Silver, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	30.1		28.1	mg/Kg		20	40.2			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	30.1		27.8	mg/Kg		20	40.2	1.1	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	U	40	mg/Kg	80	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	U	40.7	mg/Kg	81.4	75	125	1.73	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	1.002		.934	mg/L	93.2	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	1.002		.99	mg/L	98.8	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	30.1		32.1	mg/Kg		20	40.2			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	30.1		32.1	mg/Kg		20	40.2	0	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	U	53.4	mg/Kg	106.8	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	U	53.7	mg/Kg	107.4	75	125	0.56	20	

Sodium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-90	90			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	1020		1086	mg/Kg		752	1290			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	1020		1017	mg/Kg		752	1290	6.6	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	9821.624	30	9769	mg/Kg	99.2	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	9821.624	30	9801	mg/Kg	99.5	75	125	0.33	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	100		96.87	mg/L	96.9	90	110			
WG261063ICV	ICV	03/19/09 10:55	II090115-3	100		96	mg/L	96	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.9	0.9			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-6	6			

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260832													
L74714-02DUP	DUP	03/12/09 8:45			100	99.95	%				0.1	20	
WG260832PBS	PBS	03/12/09 8:45				U	%		99.9	100.1			

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Strontium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	227		248.2	mg/Kg		181	274			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	227		230.1	mg/Kg		181	274	7.6	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	59	103	mg/Kg	88	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	59	103	mg/Kg	88	75	125	0	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.944	mg/L	97.2	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260837													
L74714-02DUP	DUP	03/17/09 11:00			.48	.53	%				9.9	20	

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260837													
L74714-02DUP	DUP	03/17/09 11:00			.48	.58	%				18.9	20	

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260837													
L74714-02DUP	DUP	03/17/09 11:00			6.36	6.2	%				2.5	20	

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260837													
L74714-02DUP	DUP	03/17/09 11:00			7.32	7.31	%				0.1	20	
WG260837LCSS	LCSS	03/17/09 11:00	PCN31560	4.24		4.29	%	101.2	80	120			
WG260837PBS	PBS	03/17/09 11:00				U	%		-0.03	0.03			

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Thallium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-90	90			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	121		92	mg/Kg		94.6	148			RL
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	121		97	mg/Kg		94.6	148	5.3	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	200	U	157	mg/Kg	78.5	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	200	U	152	mg/Kg	76	75	125	3.24	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	4		3.9	mg/L	97.5	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.9	0.9			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	4		4.14	mg/L	103.5	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.9	0.9			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-90	90			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	121		129	mg/Kg		94.6	148			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	121		130	mg/Kg		94.6	148	0.8	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	200		210	mg/Kg	105	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	200		U	mg/Kg	0	75	125		20	M4

Tin, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-30	30			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	104		105	mg/Kg		75.7	132			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	104		104	mg/Kg		75.7	132	1	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	U	85	mg/Kg	85	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	U	83	mg/Kg	83	75	125	2.38	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.92	mg/L	96	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.3	0.3			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.95	mg/L	97.5	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.3	0.3			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-30	30			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	104		105	mg/Kg		75.7	132			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	104		103	mg/Kg		75.7	132	1.9	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	U	107	mg/Kg	107	75	125			MD
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	U	108	mg/Kg	108	75	125	0.93	20	MD

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Titanium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-1.5	1.5			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	462		662.55	mg/Kg		182	743			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	462		651.1	mg/Kg		182	743	1.7	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	100	97.9	194.46	mg/Kg	96.6	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	100	97.9	195.67	mg/Kg	97.8	75	125	0.62	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.8734	mg/L	93.7	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.015	0.015			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.9836	mg/L	99.2	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.015	0.015			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-1.5	1.5			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	462		664.59	mg/Kg		182	743			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	462		653.51	mg/Kg		182	743	1.7	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	100	116	233.9	mg/Kg	117.9	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	100	116	234.7	mg/Kg	118.7	75	125	0.34	20	

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG260837													
L74714-02DUP	DUP	03/17/09 11:00			.96	1.11	%				14.5	20	

Vanadium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.8558	mg/L	92.8	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.015	0.015			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		2.0383	mg/L	101.9	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.015	0.015			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-1.5	1.5			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	115		124.23	mg/Kg		91.3	139			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	115		121.02	mg/Kg		91.3	139	2.6	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	7	57.5	mg/Kg	101	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	7	56.9	mg/Kg	99.8	75	125	1.05	20	

Timberline Resources Corp. ACZ Project ID: ***L74714***

Project ID: TJV_GENERAL_HUMIDITY

Zinc, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG261069													
WG260962PBS	PBS	03/18/09 12:01				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/18/09 12:04	PCN31553	594		577.2	mg/Kg		472	717			
WG260962LCSSD	LCSSD	03/18/09 12:08	PCN31553	594		555.6	mg/Kg		472	717	3.8	20	
L74714-01MS	MS	03/18/09 12:17	II090313-2	50	4	43.1	mg/Kg	78.2	75	125			
L74714-01MSD	MSD	03/18/09 12:21	II090313-2	50	4	43.3	mg/Kg	78.6	75	125	0.46	20	
WG261063													
WG261063ICV	ICV	03/19/09 10:55	II090115-3	2		1.876	mg/L	93.8	90	110			
WG261063ICB	ICB	03/19/09 10:58				U	mg/L		-0.03	0.03			
WG261107													
WG261107ICV	ICV	03/19/09 19:28	II090115-3	2		1.952	mg/L	97.6	90	110			
WG261107ICB	ICB	03/19/09 19:31				U	mg/L		-0.03	0.03			
WG260962PBS	PBS	03/19/09 19:44				U	mg/Kg		-3	3			
WG260962LCSS	LCSS	03/19/09 19:47	PCN31553	594		591.7	mg/Kg		472	717			
WG260962LCSSD	LCSSD	03/19/09 19:51	PCN31553	594		567.9	mg/Kg		472	717	4.1	20	
L74714-01MS	MS	03/19/09 20:01	II5XSOIL	50	8	59.5	mg/Kg	103	75	125			
L74714-01MSD	MSD	03/19/09 20:05	II5XSOIL	50	8	56.3	mg/Kg	96.6	75	125	5.53	20	

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Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L74714***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L74714-01	WG261069	Aluminum, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG261268	Antimony, total (3050)	M6020 ICP-MS	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Arsenic, total (3050)	M6020 ICP-MS	ZB	The ICP-MS Serial Dilution was not used for data validation because the sample concentration was less than 100 times the MDL.
	WG261069	Barium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Boron, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
		Iron, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Manganese, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Nickel, total (3050)	M6010B ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Strontium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Thallium, total (3050)	M6010B ICP	RL	Recovery for either the LCS or LCS duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Titanium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.

Timberline Resources Corp. ACZ Project ID: ***L74714***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L74714-02	WG261107	Aluminum, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG261268	Antimony, total (3050)	M6020 ICP-MS	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Arsenic, total (3050)	M6020 ICP-MS	ZB	The ICP-MS Serial Dilution was not used for data validation because the sample concentration was less than 100 times the MDL.
	WG261069	Barium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG261107	Gallium, total (3050)	M6010B ICP	M4	The spiked sample required a dilution such that the spike recovery calculation does not provide useful information. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG261069	Magnesium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
		Strontium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG261107	Thallium, total (3050)	M6010B ICP	M4	The spiked sample required a dilution such that the spike recovery calculation does not provide useful information. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Tin, total (3050)	M6010B ICP	MD	The spike recovery (and spike duplicate RPD, if applicable) was not used for data validation because the concentration of the sample and/or the spike was less than the reporting limit.

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Bismuth, total (3050)	M6010B ICP
Gallium, total (3050)	M6010B ICP
Scandium, total (3050)	M6010B ICP

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur Forms	M600/2-78-054 3.2.4-MOD

ACZ Laboratories, Inc.
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Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID:	L74714
Date Received:	3/5/2009
Received By:	
Date Printed:	3/6/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA7988	14.8	22
NA7987	13.7	14

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID: L74714
Date Received: 3/5/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L74714-01	CW09-01									X		
L74714-02	CM09-01									X		

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: _____

ACZ Laboratories, Inc. L74714

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT.
HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE
COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]

If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]

If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE & Pricing
~~Project/PO #:~~ TJV_GENERIC_HUMIDITY CORE — 2009 KS —
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSES	HUMIDITY CORE					
CW09-01	2.25.09 (11)	other	1	✓	✓	✓					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS & (COARSE) REJECT TO TIMBERLINE

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC Klepfer	3.2.09 (3PM)	[illegible]	3.5.09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg 1

ACZ Laboratories, Inc. L74714

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT. HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE &
~~Project/PO #:~~ TJV-GEN-HUMIDITY CELL PRICING - 2009 XLS.
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSIS	HUMIDITY CELL					
Cm09-01	2-25-09 (10)	other	1	✓	✓	✓					
	~~2-25-09 (11)~~										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS/(COARSE) RESETS TO TIMBERLINE RESOURCES

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC KLEPFER	3-2-09 (3PM)	[illegible]	3-5-09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg 2

ACZ Laboratories, Inc.

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

2/13/2009

Eric Klepfer
Timberline Resources Corp.
13058 Sherwood Ct.
Hayden Lake, ID 83835

Quote Number: ROCK-CORE

Matrix: Soil

Waste Rock and Ore samples for total metals and ABA ~ 4 to 6 samples

Parameter	Method	Detection Limit	Cost/Sample
Metals Analysis			
Aluminum, total (3050)	M6010B ICP	3 mg/Kg	$7.20
Antimony, total (3050)	M6020 ICP-MS	0.04 mg/Kg	$14.40
Arsenic, total (3050)	M6020 ICP-MS	0.05 mg/Kg	$14.40
Barium, total (3050)	M6010B ICP	0.3 mg/Kg	$7.20
Beryllium, total (3050)	M6020 ICP-MS	0.01 mg/Kg	$14.40
Bismuth, total (3050)	M6010B ICP	4 mg/Kg	$7.20
Boron, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Cadmium, total (3050)	M6020 ICP-MS	0.01 mg/Kg	$14.40
Calcium, total (3050)	M6010B ICP	20 mg/Kg	$7.20
Chromium, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Cobalt, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Copper, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Gallium, total (3050)	M6010B ICP	10 mg/Kg	$7.20
Iron, total (3050)	M6010B ICP	2 mg/Kg	$7.20
Lead, total (3050)	M6020 ICP-MS	0.01 mg/Kg	$14.40
Lithium, total (3050)	M6010B ICP	2 mg/Kg	$7.20
Magnesium, total (3050)	M6010B ICP	20 mg/Kg	$7.20
Manganese, total (3050)	M6010B ICP	0.5 mg/Kg	$7.20
Mercury, total	M7471A CVAA	0.02 mg/Kg	$18.40
Molybdenum, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Nickel, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Potassium, total (3050)	M6010B ICP	30 mg/Kg	$7.20
Scandium, total (3050)	M6010B ICP	10 mg/Kg	$7.20
Selenium, total (3050)	M6020 ICP-MS	0.01 mg/Kg	$14.40
Silver, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Sodium, total (3050)	M6010B ICP	30 mg/Kg	$7.20
Strontium, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Thallium, total (3050)	M6010B ICP	30 mg/Kg	$7.20
Tin, total (3050)	M6010B ICP	10 mg/Kg	$7.20
Titanium, total (3050)	M6010B ICP	0.5 mg/Kg	$7.20
Vanadium, total (3050)	M6010B ICP	0.5 mg/Kg	$7.20
Zinc, total (3050)	M6010B ICP	1 mg/Kg	$7.20
Misc.			
Electronic Data Deliverable			$0.00

REPAD.09.06.05.01 S/ tv D/ P/

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Quote

Eric Klepfer
Timberline Resources Corp.
13058 Sherwood Ct.
Hayden Lake, ID 83835

2/13/2009

Quality Control Summary			$0.00
Sample Preparation			
Air Dry at 34 Degrees C	USDA No. 1, 1972		$7.00
Crush and Pulverize	USDA No. 1, 1972		$20.00
Digestion - Hot Plate	M3050B ICP		$12.00
Digestion - Hot Plate	M3050B ICP-MS		$0.00
Soil Analysis			
Acid Generation Potential (calc on S	M600/2-78-054 1.3	Calculation	$0.00
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	Calculation	$0.00
Acid-Base Potential (calc on Sulfur t	M600/2-78-054 1.3	Calculation	$0.00
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	0.1 %	$14.00
Solids, Percent	CLPSOW390, PART F, D-98	0.1 %	$5.60
Sulfur Forms	M600/2-78-054 3.2.4-MOD	0.01 %	$68.00
		Cost/Sample:	**$411.40**

Pricing is based on standard TAT for soils of ~three weeks and TAT may vary with workload and analysis requested

Appendix 2
Kinetic Test
Laboratory Results

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

October 01, 2009

Report to:
Eric Klepfer
Klepfer Mining Services LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Bill to:
Craig Crowell
Timberline Resources Corp.
101 E. Lakeside Ave.
Coeur d'Alene, ID 83814

cc: Art Glover

Project ID: TJV_GEN_HUMIDITY CEL
ACZ Project ID: L75255

Eric Klepfer:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on April 13, 2009. This project has been assigned to ACZ's project number, L75255. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L75255. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 01, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp. October 01, 2009

Project ID: TJV_GEN_HUMIDITY CEL
ACZ Project ID: L75255

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 20 soil samples from Timberline Resources Corp. on April 13, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L75255. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses except those qualified with an ACZ 'H' flag were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. The Conductivity analysis (sample -05) was qualified with the ACZ 'N1' & 'R1' flags due to an apparatus issue that caused a failing RPD (Relative Percent Difference). As the data was not reproducible, it was accepted.

2. The Alkalinity analysis (samples -09 & -20) was qualified with the ACZ 'N1' flag due a laboratory control sample failure. There was insufficient sample available for reanalysis and the data was accepted.

3. No data is available for Week 16 through 19 due to an error at the bench level.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01

ACZ Sample ID: ***L75255-01***
Date Sampled: *02/25/09 10:00*
Date Received: *04/13/09*
Sample Matrix: *Soil*

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Humidity Cell Test	M600 12-78-054							04/14/09 10:00	brd

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 1
Locator: WEEK 1

ACZ Sample ID: ***L75255-02***
Date Sampled: *02/25/09 10:00*
Date Received: *04/21/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	04/22/09 20:04	ear
Antimony, dissolved	M200.8 ICP-MS	0.0011	B	*	mg/L	0.0004	0.002	04/23/09 0:14	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0015	B	*	mg/L	0.0005	0.002	04/23/09 0:14	erf
Barium, dissolved	M200.7 ICP	0.005	B	*	mg/L	0.003	0.02	04/22/09 20:04	ear
Beryllium, dissolved	M200.7 ICP	0.002	B	*	mg/L	0.002	0.01	04/22/09 20:04	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	04/22/09 20:04	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	04/23/09 0:14	erf
Calcium, dissolved	M200.7 ICP	7.2		*	mg/L	0.2	1	04/22/09 20:04	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:04	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:04	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	04/22/09 20:04	ear
Magnesium, dissolved	M200.7 ICP	5.3		*	mg/L	0.2	1	04/22/09 20:04	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	04/22/09 20:04	ear
Mercury, dissolved	M245.1 CVAA		UH	*	mg/L	0.0004	0.002	04/23/09 22:14	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:04	ear
Potassium, dissolved	M200.7 ICP	3.5		*	mg/L	0.3	2	04/22/09 20:04	ear
Selenium, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0001	0.0005	04/23/09 0:14	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	04/30/09 10:47	ear
Sodium, dissolved	M200.7 ICP	1.2	B	*	mg/L	0.3	2	04/22/09 20:04	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	04/23/09 0:14	erf
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	04/22/09 20:04	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		29	H	*	mg/L	2	20	04/22/09 0:00	jlf
Carbonate as CaCO3		2	BH	*	mg/L	2	20	04/22/09 0:00	jlf
Hydroxide as CaCO3			UH	*	mg/L	2	20	04/22/09 0:00	jlf
Total Alkalinity		31	H	*	mg/L	2	20	04/22/09 0:00	jlf
Conductivity @25C	SM2510B	101	H	*	umhos/cm	1	10	04/21/09 10:00	lwt
pH (lab)	SM4500H+ B								
pH		9.2	H	*	units	0.1	0.1	04/21/09 0:00	lwt
pH measured at		22.0		*	C	0.1	0.1	04/21/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	10	H	*	mg/L	1	5	04/22/09 16:18	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 2
Locator: WEEK 2

ACZ Sample ID: ***L75255-03***
Date Sampled: *02/25/09 10:00*
Date Received: *04/28/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/01/09 17:52	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		29	H	*	mg/L	2	20	04/30/09 0:00	kah
Carbonate as CaCO3		3	BH	*	mg/L	2	20	04/30/09 0:00	kah
Hydroxide as CaCO3			UH	*	mg/L	2	20	04/30/09 0:00	kah
Total Alkalinity		33	H	*	mg/L	2	20	04/30/09 0:00	kah
Conductivity @25C	SM2510B	94	H	*	umhos/cm	1	10	04/28/09 10:00	lwt
pH (lab)	SM4500H+ B								
pH		9.1	H	*	units	0.1	0.1	04/28/09 0:00	lwt
pH measured at		21.7		*	C	0.1	0.1	04/28/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	9	H	*	mg/L	1	5	05/01/09 11:42	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 3
Locator: WEEK 3

ACZ Sample ID: ***L75255-04***
Date Sampled: *05/05/09 00:00*
Date Received: *05/05/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/07/09 17:24	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		25		*	mg/L	2	20	05/07/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	05/07/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	05/07/09 0:00	jlf
Total Alkalinity		25		*	mg/L	2	20	05/07/09 0:00	jlf
Conductivity @25C	SM2510B	95		*	umhos/cm	1	10	05/05/09 8:30	lwt
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	05/05/09 0:00	lwt
pH measured at		22.0		*	C	0.1	0.1	05/05/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	6		*	mg/L	1	5	05/13/09 13:09	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 4
Locator: WEEK 4

ACZ Sample ID: ***L75255-05***
Date Sampled: *05/12/09 00:00*
Date Received: *05/12/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	05/13/09 20:53	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		32		*	mg/L	2	20	05/13/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/13/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/13/09 0:00	abm
Total Alkalinity		34		*	mg/L	2	20	05/13/09 0:00	abm
Conductivity @25C	SM2510B	101		*	umhos/cm	1	10	05/12/09 10:00	brd
Conductivity @25C	SM2510B	101		*	umhos/cm	1	10	05/12/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.2		*	units	0.1	0.1	05/12/09 0:00	brd
pH measured at		24.0		*	C	0.1	0.1	05/12/09 0:00	brd
Sulfate	375.4 - Turbidimetric	10		*	mg/L	1	5	05/20/09 10:25	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 5
Locator: WEEK 5

ACZ Sample ID: ***L75255-06***
Date Sampled: *05/19/09 00:00*
Date Received: *05/20/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	05/22/09 18:52	ear
Antimony, dissolved	M200.8 ICP-MS	0.0008	B	*	mg/L	0.0004	0.002	05/23/09 4:26	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0093		*	mg/L	0.0005	0.002	05/23/09 4:26	msh
Barium, dissolved	M200.7 ICP	0.005	B	*	mg/L	0.003	0.02	05/22/09 18:52	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	05/22/09 18:52	ear
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	05/28/09 16:37	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	05/23/09 4:26	msh
Calcium, dissolved	M200.7 ICP	5.8		*	mg/L	0.2	1	05/22/09 18:52	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:52	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:52	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/22/09 18:52	ear
Magnesium, dissolved	M200.7 ICP	3.4		*	mg/L	0.2	1	05/22/09 18:52	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	05/22/09 18:52	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	05/26/09 17:17	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:52	ear
Potassium, dissolved	M200.7 ICP	2.1		*	mg/L	0.3	2	05/22/09 18:52	ear
Selenium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	05/23/09 4:26	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	05/28/09 16:37	aeh
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	05/22/09 18:52	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	05/23/09 4:26	msh
Zinc, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	05/22/09 18:52	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		33		*	mg/L	2	20	05/22/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/22/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/22/09 0:00	abm
Total Alkalinity		33		*	mg/L	2	20	05/22/09 0:00	abm
Conductivity @25C	SM2510B	69		*	umhos/cm	1	10	05/19/09 8:00	brd/bjl
pH (lab)	SM4500H+ B								
pH		8.7		*	units	0.1	0.1	05/19/09 0:00	brd/bjl
pH measured at		25.0		*	C	0.1	0.1	05/19/09 0:00	brd/bjl
Sulfate	375.4 - Turbidimetric	4	B	*	mg/L	1	5	05/27/09 12:52	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 6
Locator: WEEK 6

ACZ Sample ID: ***L75255-07***
Date Sampled: *05/26/09 00:00*
Date Received: *05/26/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	06/01/09 23:58	ear
Antimony, dissolved	M200.8 ICP-MS	0.0008	B	*	mg/L	0.0004	0.002	06/03/09 10:38	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0012	B	*	mg/L	0.0005	0.002	06/03/09 10:38	erf
Barium, dissolved	M200.7 ICP	0.005	B	*	mg/L	0.003	0.02	06/01/09 23:58	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/01/09 23:58	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	06/01/09 23:58	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/03/09 10:38	erf
Calcium, dissolved	M200.7 ICP	5.2		*	mg/L	0.2	1	06/01/09 23:58	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/01/09 23:58	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/01/09 23:58	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	06/01/09 23:58	ear
Magnesium, dissolved	M200.7 ICP	3.8		*	mg/L	0.2	1	06/01/09 23:58	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/01/09 23:58	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	05/28/09 16:51	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/01/09 23:58	ear
Potassium, dissolved	M200.7 ICP	2.0	B	*	mg/L	0.3	2	06/01/09 23:58	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	06/03/09 10:38	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/01/09 23:58	ear
Sodium, dissolved	M200.7 ICP	0.3	B	*	mg/L	0.3	2	06/01/09 23:58	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/03/09 10:38	erf
Zinc, dissolved	M200.7 ICP	0.05		*	mg/L	0.01	0.05	06/03/09 11:55	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		29		*	mg/L	2	20	05/27/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/27/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/27/09 0:00	abm
Total Alkalinity		30		*	mg/L	2	20	05/27/09 0:00	abm
Conductivity @25C	SM2510B	70		*	umhos/cm	1	10	05/26/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	05/26/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	05/26/09 0:00	brd
Sulfate	375.4 - Turbidimetric	3	B	*	mg/L	1	5	05/27/09 12:52	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 7
Locator: WEEK 7

ACZ Sample ID: ***L75255-08***
Date Sampled: *06/02/09 00:00*
Date Received: *06/03/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	06/04/09 20:08	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0009	B	*	mg/L	0.0004	0.002	06/10/09 9:21	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0107		*	mg/L	0.0005	0.002	06/06/09 0:21	msh
Barium, dissolved	M200.7 ICP	0.008	B	*	mg/L	0.003	0.02	06/04/09 20:08	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/04/09 20:08	aeh
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	06/04/09 20:08	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/06/09 0:21	msh
Calcium, dissolved	M200.7 ICP	6.2		*	mg/L	0.2	1	06/04/09 20:08	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:08	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:08	aeh
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	06/04/09 20:08	aeh
Magnesium, dissolved	M200.7 ICP	4.3		*	mg/L	0.2	1	06/04/09 20:08	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/04/09 20:08	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/10/09 15:59	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:08	aeh
Potassium, dissolved	M200.7 ICP	2.1		*	mg/L	0.3	2	06/04/09 20:08	aeh
Selenium, dissolved	M200.8 ICP-MS	0.0009		*	mg/L	0.0001	0.0005	06/06/09 0:21	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/04/09 20:08	aeh
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	06/04/09 20:08	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/06/09 0:21	msh
Zinc, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	06/04/09 20:08	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		27		*	mg/L	2	20	06/04/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	06/04/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	06/04/09 0:00	jlf
Total Alkalinity		29		*	mg/L	2	20	06/04/09 0:00	jlf
Conductivity @25C	SM2510B	67		*	umhos/cm	1	10	06/02/09 18:00	brd
pH (lab)	SM4500H+ B								
pH		9.3		*	units	0.1	0.1	06/02/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/02/09 0:00	brd
Sulfate	375.4 - Turbidimetric	1	B	*	mg/L	1	5	06/08/09 11:22	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 8
Locator: WEEK 8

ACZ Sample ID: ***L75255-09***
Date Sampled: *06/09/09 00:00*
Date Received: *06/10/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.03	0.2	06/11/09 18:56	ear
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	06/11/09 6:46	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0070		*	mg/L	0.0005	0.002	06/11/09 6:46	msh
Barium, dissolved	M200.7 ICP	0.010	B	*	mg/L	0.003	0.02	06/11/09 18:56	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/12/09 14:50	aeh
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	06/11/09 18:56	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/11/09 6:46	msh
Calcium, dissolved	M200.7 ICP	8.2		*	mg/L	0.2	1	06/11/09 18:56	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/12/09 14:50	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/11/09 18:56	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	06/11/09 18:56	ear
Magnesium, dissolved	M200.7 ICP	5.1		*	mg/L	0.2	1	06/11/09 18:56	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/11/09 18:56	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/12/09 16:20	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/11/09 18:56	ear
Potassium, dissolved	M200.7 ICP	2.9		*	mg/L	0.3	2	06/11/09 18:56	ear
Selenium, dissolved	M200.8 ICP-MS	0.0004	B	*	mg/L	0.0001	0.0005	06/12/09 21:26	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/12/09 14:50	aeh
Sodium, dissolved	M200.7 ICP	0.3	B	*	mg/L	0.3	2	06/11/09 18:56	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/11/09 6:46	msh
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	06/11/09 18:56	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		37		*	mg/L	2	20	06/15/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	06/15/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	06/15/09 0:00	abm
Total Alkalinity		37		*	mg/L	2	20	06/15/09 0:00	abm
Conductivity @25C	SM2510B	85		*	umhos/cm	1	10	06/09/09 9:00	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	06/09/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/09/09 0:00	brd
Sulfate	375.4 - Turbidimetric	5	B	*	mg/L	1	5	06/10/09 11:03	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 9
Locator: WEEK 9

ACZ Sample ID: ***L75255-10***
Date Sampled: *06/16/09 00:00*
Date Received: *06/17/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.03	0.2	06/17/09 21:09	ear
Antimony, dissolved	M200.8 ICP-MS	0.0008	B	*	mg/L	0.0004	0.002	06/25/09 9:01	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0078		*	mg/L	0.0005	0.002	06/24/09 10:08	erf
Barium, dissolved	M200.7 ICP	0.009	B	*	mg/L	0.003	0.02	06/17/09 21:09	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/17/09 21:09	ear
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	06/17/09 21:09	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/24/09 10:08	erf
Calcium, dissolved	M200.7 ICP	6.1		*	mg/L	0.2	1	06/17/09 21:09	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/18/09 16:56	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/17/09 21:09	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	06/17/09 21:09	ear
Magnesium, dissolved	M200.7 ICP	3.1		*	mg/L	0.2	1	06/17/09 21:09	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/17/09 21:09	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/23/09 18:52	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/17/09 21:09	ear
Potassium, dissolved	M200.7 ICP	2.4		*	mg/L	0.3	2	06/17/09 21:09	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	06/24/09 10:08	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/18/09 16:56	aeh
Sodium, dissolved	M200.7 ICP	0.5	B	*	mg/L	0.3	2	06/17/09 21:09	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/24/09 10:08	erf
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	06/17/09 21:09	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		29		*	mg/L	2	20	06/18/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	06/18/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	06/18/09 0:00	kah
Total Alkalinity		29		*	mg/L	2	20	06/18/09 0:00	kah
Conductivity @25C	SM2510B	59		*	umhos/cm	1	10	06/16/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		9.1		*	units	0.1	0.1	06/16/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/16/09 0:00	brd
Sulfate	375.4 - Turbidimetric	2	B	*	mg/L	1	5	06/25/09 10:51	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 10
Locator: WEEK 10

ACZ Sample ID: ***L75255-11***
Date Sampled: *06/23/09 00:00*
Date Received: *06/24/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.06	B	*	mg/L	0.03	0.2	06/24/09 18:53	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	06/25/09 9:06	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0077		*	mg/L	0.0005	0.002	06/25/09 9:06	erf
Barium, dissolved	M200.7 ICP	0.010	B	*	mg/L	0.003	0.02	06/24/09 18:53	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/24/09 18:53	aeh
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	06/24/09 18:53	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/25/09 9:06	erf
Calcium, dissolved	M200.7 ICP	6.7		*	mg/L	0.2	1	06/24/09 18:53	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:53	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:53	aeh
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	06/25/09 15:43	aeh
Magnesium, dissolved	M200.7 ICP	4.3		*	mg/L	0.2	1	06/24/09 18:53	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/24/09 18:53	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/25/09 14:01	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:53	aeh
Potassium, dissolved	M200.7 ICP	2.2		*	mg/L	0.3	2	06/24/09 18:53	aeh
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	06/25/09 9:06	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/24/09 18:53	aeh
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	06/24/09 18:53	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/25/09 9:06	erf
Zinc, dissolved	M200.7 ICP	0.05		*	mg/L	0.01	0.05	06/25/09 15:43	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		30		*	mg/L	2	20	06/24/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	06/24/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	06/24/09 0:00	abm
Total Alkalinity		30		*	mg/L	2	20	06/24/09 0:00	abm
Conductivity @25C	SM2510B	72		*	umhos/cm	1	10	06/23/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		9.1		*	units	0.1	0.1	06/23/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/23/09 0:00	brd
Sulfate	375.4 - Turbidimetric	2	B	*	mg/L	1	5	06/25/09 10:51	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 11
Locator: WEEK 11

ACZ Sample ID: ***L75255-12***
Date Sampled: *06/30/09 00:00*
Date Received: *07/01/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	07/02/09 19:26	ear
Antimony, dissolved	M200.8 ICP-MS	0.0011	B	*	mg/L	0.0004	0.002	07/08/09 21:56	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0124		*	mg/L	0.0005	0.002	07/08/09 21:56	msh
Barium, dissolved	M200.7 ICP	0.009	B	*	mg/L	0.003	0.02	07/02/09 19:26	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/02/09 19:26	ear
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	07/02/09 19:26	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/08/09 21:56	msh
Calcium, dissolved	M200.7 ICP	7.2		*	mg/L	0.2	1	07/02/09 19:26	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/07/09 10:19	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/02/09 19:26	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	07/02/09 19:26	ear
Magnesium, dissolved	M200.7 ICP	3.9		*	mg/L	0.2	1	07/02/09 19:26	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/06/09 18:36	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/09/09 15:26	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/02/09 19:26	ear
Potassium, dissolved	M200.7 ICP	2.0	B	*	mg/L	0.3	2	07/02/09 19:26	ear
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	07/10/09 0:37	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/02/09 19:26	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	07/02/09 19:26	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/08/09 21:56	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	07/06/09 18:36	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		30		*	mg/L	2	20	07/06/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	07/06/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	07/06/09 0:00	abm
Total Alkalinity		30		*	mg/L	2	20	07/06/09 0:00	abm
Conductivity @25C	SM2510B	72		*	umhos/cm	1	10	06/30/09 12:00	brd
pH (lab)	SM4500H+ B								
pH		8.5		*	units	0.1	0.1	06/30/09 0:00	brd
pH measured at		25.0		*	C	0.1	0.1	06/30/09 0:00	brd
Sulfate	375.4 - Turbidimetric	1	B	*	mg/L	1	5	07/09/09 14:59	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 12
Locator: WEEK 12

ACZ Sample ID: ***L75255-13***
Date Sampled: *07/08/09 00:00*
Date Received: *07/08/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	07/13/09 20:15	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	07/10/09 0:41	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0038		*	mg/L	0.0005	0.002	07/10/09 0:41	msh
Barium, dissolved	M200.7 ICP	0.005	B	*	mg/L	0.003	0.02	07/08/09 21:07	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/13/09 20:15	aeh
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	07/08/09 21:07	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/10/09 0:41	msh
Calcium, dissolved	M200.7 ICP	5.9		*	mg/L	0.2	1	07/08/09 21:07	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:07	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:07	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	07/08/09 21:07	ear
Magnesium, dissolved	M200.7 ICP	2.8		*	mg/L	0.2	1	07/08/09 21:07	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/08/09 21:07	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/10/09 13:02	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:07	ear
Potassium, dissolved	M200.7 ICP	1.7	B	*	mg/L	0.3	2	07/08/09 21:07	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/10/09 0:41	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/08/09 21:07	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	07/08/09 21:07	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/10/09 0:41	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	07/08/09 21:07	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		24		*	mg/L	2	20	07/10/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	07/10/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	07/10/09 0:00	abm
Total Alkalinity		24		*	mg/L	2	20	07/10/09 0:00	abm
Conductivity @25C	SM2510B	56		*	umhos/cm	1	10	07/08/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.1		*	units	0.1	0.1	07/08/09 0:00	brd
pH measured at		23.0		*	C	0.1	0.1	07/08/09 0:00	brd
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	07/09/09 14:59	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 13
Locator: WEEK 13

ACZ Sample ID: ***L75255-14***
Date Sampled: *07/14/09 00:00*
Date Received: *07/15/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	07/16/09 21:54	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	07/22/09 5:20	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0033		*	mg/L	0.0005	0.002	07/21/09 8:56	erf
Barium, dissolved	M200.7 ICP	0.008	B	*	mg/L	0.003	0.02	07/16/09 21:54	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/16/09 21:54	aeh
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	07/16/09 21:54	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 8:56	erf
Calcium, dissolved	M200.7 ICP	6.3		*	mg/L	0.2	1	07/16/09 21:54	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/20/09 11:16	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/16/09 21:54	aeh
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	07/16/09 21:54	aeh
Magnesium, dissolved	M200.7 ICP	2.7		*	mg/L	0.2	1	07/16/09 21:54	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/20/09 11:16	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/20/09 13:17	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/16/09 21:54	aeh
Potassium, dissolved	M200.7 ICP	1.6	B	*	mg/L	0.3	2	07/17/09 16:32	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 8:56	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/20/09 11:16	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	07/17/09 16:32	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 8:56	erf
Zinc, dissolved	M200.7 ICP	0.08		*	mg/L	0.01	0.05	07/17/09 16:32	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		26		*	mg/L	2	20	07/23/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Total Alkalinity		26		*	mg/L	2	20	07/23/09 0:00	kah
Conductivity @25C	SM2510B	58		*	umhos/cm	1	10	07/14/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		8.9		*	units	0.1	0.1	07/14/09 0:00	brd
pH measured at		23.5		*	C	0.1	0.1	07/14/09 0:00	brd
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	07/20/09 15:20	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 14
Locator: WEEK 14

ACZ Sample ID: ***L75255-15***
Date Sampled: *07/21/09 00:00*
Date Received: *07/22/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	07/22/09 17:32	ear
Antimony, dissolved	M200.8 ICP-MS	0.0009	B	*	mg/L	0.0004	0.002	07/29/09 21:15	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0032		*	mg/L	0.0005	0.002	07/26/09 21:12	msh
Barium, dissolved	M200.7 ICP	0.007	B	*	mg/L	0.003	0.02	07/22/09 17:32	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/22/09 17:32	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	07/22/09 17:32	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/26/09 21:12	msh
Calcium, dissolved	M200.7 ICP	5.8		*	mg/L	0.2	1	07/22/09 17:32	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:32	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:32	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	07/22/09 17:32	ear
Magnesium, dissolved	M200.7 ICP	3.3		*	mg/L	0.2	1	07/22/09 17:32	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/23/09 13:02	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/23/09 17:27	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:32	ear
Potassium, dissolved	M200.7 ICP	1.9	B	*	mg/L	0.3	2	07/22/09 17:32	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	07/27/09 22:00	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/22/09 17:32	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	07/22/09 17:32	ear
Thallium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	07/26/09 21:12	msh
Zinc, dissolved	M200.7 ICP	0.05		*	mg/L	0.01	0.05	07/23/09 13:02	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		27		*	mg/L	2	20	07/23/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Total Alkalinity		27		*	mg/L	2	20	07/23/09 0:00	kah
Conductivity @25C	SM2510B	62		*	umhos/cm	1	10	07/21/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		8.9		*	units	0.1	0.1	07/21/09 0:00	brd
pH measured at		22.4		*	C	0.1	0.1	07/21/09 0:00	brd
Sulfate	375.4 - Turbidimetric	1	B	*	mg/L	1	5	07/30/09 11:57	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 15
Locator: WEEK 15

ACZ Sample ID: ***L75255-16***
Date Sampled: *07/28/09 00:00*
Date Received: *07/29/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.03	0.2	07/29/09 17:14	ear
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	07/30/09 2:45	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0037		*	mg/L	0.0005	0.002	07/30/09 2:45	msh
Barium, dissolved	M200.7 ICP	0.008	B	*	mg/L	0.003	0.02	07/29/09 17:14	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/29/09 17:14	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	07/29/09 17:14	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/30/09 2:45	msh
Calcium, dissolved	M200.7 ICP	5.5		*	mg/L	0.2	1	07/29/09 17:14	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:14	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:14	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	07/29/09 17:14	ear
Magnesium, dissolved	M200.7 ICP	3.3		*	mg/L	0.2	1	07/29/09 17:14	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/29/09 17:14	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/29/09 17:32	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:14	ear
Potassium, dissolved	M200.7 ICP	1.9	B	*	mg/L	0.3	2	07/29/09 17:14	ear
Selenium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	07/30/09 14:32	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/29/09 17:14	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	07/29/09 17:14	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/30/09 2:45	msh
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	07/29/09 17:14	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		30		*	mg/L	2	20	08/03/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	08/03/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	08/03/09 0:00	kah
Total Alkalinity		30		*	mg/L	2	20	08/03/09 0:00	kah
Conductivity @25C	SM2510B	63		*	umhos/cm	1	10	07/28/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		8.7		*	units	0.1	0.1	07/28/09 0:00	brd
pH measured at		23.0		*	C	0.1	0.1	07/28/09 0:00	brd
Sulfate	375.4 - Turbidimetric	1	B	*	mg/L	1	5	07/30/09 11:57	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 20
Locator: WEEK 20

ACZ Sample ID: ***L75255-17***
Date Sampled: *09/02/09 00:00*
Date Received: *09/03/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.06	B	*	mg/L	0.03	0.2	09/03/09 23:22	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.004	0.02	09/08/09 13:00	msh
Arsenic, dissolved	M200.8 ICP-MS		U	*	mg/L	0.005	0.02	09/08/09 13:00	msh
Barium, dissolved	M200.7 ICP	0.015	B	*	mg/L	0.003	0.02	09/03/09 23:22	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/03/09 23:22	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	09/08/09 10:43	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.001	0.005	09/08/09 13:00	msh
Calcium, dissolved	M200.7 ICP	5.9		*	mg/L	0.2	1	09/04/09 11:29	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:22	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:22	ear
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	09/03/09 23:22	ear
Magnesium, dissolved	M200.7 ICP	2.6		*	mg/L	0.2	1	09/03/09 23:22	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/03/09 23:22	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/04/09 19:32	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:22	ear
Potassium, dissolved	M200.7 ICP	1.8	B	*	mg/L	0.3	2	09/03/09 23:22	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.001	0.005	09/08/09 15:00	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/03/09 23:22	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	09/03/09 23:22	ear
Thallium, dissolved	M200.8 ICP-MS	0.004	B	*	mg/L	0.001	0.005	09/08/09 13:00	msh
Zinc, dissolved	M200.7 ICP	0.08		*	mg/L	0.01	0.05	09/03/09 23:22	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		25		*	mg/L	2	20	09/08/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	09/08/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/08/09 0:00	abm
Total Alkalinity		26		*	mg/L	2	20	09/08/09 0:00	abm
Conductivity @25C	SM2510B	56		*	umhos/cm	1	10	09/03/09 10:20	brd
pH (lab)	SM4500H+ B								
pH		8.8	H	*	units	0.1	0.1	09/03/09 0:00	brd
pH measured at		24.8		*	C	0.1	0.1	09/03/09 0:00	brd
Sulfate	375.4 - Turbidimetric	1	B	*	mg/L	1	5	09/03/09 13:00	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 21
Locator: WEEK 21

ACZ Sample ID: ***L75255-18***
Date Sampled: *09/08/09 00:00*
Date Received: *09/08/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	09/09/09 22:32	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	09/19/09 0:30	rct
Arsenic, dissolved	M200.8 ICP-MS	0.0039		*	mg/L	0.0005	0.002	09/14/09 19:29	msh
Barium, dissolved	M200.7 ICP	0.009	B	*	mg/L	0.003	0.02	09/09/09 22:32	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/09/09 22:32	aeh
Boron, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 21:07	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:29	msh
Calcium, dissolved	M200.7 ICP	7.1		*	mg/L	0.2	1	09/09/09 22:32	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 12:17	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/09/09 22:32	aeh
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	09/09/09 22:32	aeh
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:29	msh
Magnesium, dissolved	M200.7 ICP	2.1		*	mg/L	0.2	1	09/09/09 22:32	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/10/09 12:17	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/10/09 13:00	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 21:07	aeh
Potassium, dissolved	M200.7 ICP	1.2	B	*	mg/L	0.3	2	09/09/09 22:32	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:29	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/10/09 12:17	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	09/09/09 22:32	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:29	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	09/10/09 12:17	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		26		*	mg/L	2	20	09/11/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	09/11/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/11/09 0:00	abm
Total Alkalinity		26		*	mg/L	2	20	09/11/09 0:00	abm
Conductivity @25C	SM2510B	58		*	umhos/cm	1	10	09/08/09 10:00	brd/itk
pH (lab)	SM4500H+ B								
pH		8.7		*	units	0.1	0.1	09/08/09 0:00	brd/itk
pH measured at		23.0		*	C	0.1	0.1	09/08/09 0:00	brd/itk
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	09/09/09 13:46	ccp

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 22
Locator: WEEK 22

ACZ Sample ID: ***L75255-19***
Date Sampled: *09/15/09 00:00*
Date Received: *09/15/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.03	0.2	09/18/09 16:23	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	09/19/09 0:35	rct
Arsenic, dissolved	M200.8 ICP-MS	0.0042		*	mg/L	0.0005	0.002	09/22/09 5:42	erf
Barium, dissolved	M200.7 ICP	0.007	B	*	mg/L	0.003	0.02	09/18/09 16:23	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/17/09 20:04	ear
Boron, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/18/09 16:23	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:35	rct
Calcium, dissolved	M200.7 ICP	6.6		*	mg/L	0.2	1	09/17/09 20:04	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/18/09 16:23	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/17/09 20:04	ear
Iron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.02	0.05	09/18/09 16:23	aeh
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:35	rct
Magnesium, dissolved	M200.7 ICP	2.6		*	mg/L	0.2	1	09/17/09 20:04	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/18/09 16:23	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/24/09 18:24	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/18/09 16:23	aeh
Potassium, dissolved	M200.7 ICP	1.1	B	*	mg/L	0.3	2	09/17/09 20:04	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:35	rct
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/17/09 20:04	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	09/17/09 20:04	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:35	rct
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	09/17/09 20:04	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		21		*	mg/L	2	20	09/17/09 0:00	jlf
Carbonate as CaCO3		2	B	*	mg/L	2	20	09/17/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	09/17/09 0:00	jlf
Total Alkalinity		23		*	mg/L	2	20	09/17/09 0:00	jlf
Conductivity @25C	SM2510B	47		*	umhos/cm	1	10	09/15/09 9:00	brd
pH (lab)	SM4500H+ B								
pH		8.8		*	units	0.1	0.1	09/15/09 0:00	brd
pH measured at		23.8		*	C	0.1	0.1	09/15/09 0:00	brd
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	09/18/09 15:50	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01 WEEK 23
Locator: WEEK 23

ACZ Sample ID: ***L75255-20***
Date Sampled: *09/22/09 00:00*
Date Received: *09/22/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.03	0.2	09/25/09 20:04	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0010	B	*	mg/L	0.0004	0.002	10/01/09 1:12	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0032		*	mg/L	0.0005	0.002	09/29/09 9:45	msh
Barium, dissolved	M200.7 ICP	0.011	B	*	mg/L	0.003	0.02	09/24/09 22:46	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/25/09 20:04	aeh
Boron, dissolved	M200.7 ICP	0.09		*	mg/L	0.01	0.05	09/24/09 22:46	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:45	msh
Calcium, dissolved	M200.7 ICP	5.7		*	mg/L	0.2	1	09/24/09 22:46	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/24/09 22:46	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/24/09 22:46	ear
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	09/24/09 22:46	ear
Lead, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	09/29/09 9:45	msh
Magnesium, dissolved	M200.7 ICP	1.9		*	mg/L	0.2	1	09/24/09 22:46	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/24/09 22:46	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/24/09 18:58	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/28/09 12:10	aeh
Potassium, dissolved	M200.7 ICP	1.9	B	*	mg/L	0.3	2	09/25/09 20:04	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:45	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/24/09 22:46	ear
Sodium, dissolved	M200.7 ICP	0.4	B	*	mg/L	0.3	2	09/24/09 22:46	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:45	msh
Zinc, dissolved	M200.7 ICP	0.13		*	mg/L	0.01	0.05	09/24/09 22:46	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		21		*	mg/L	2	20	09/24/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	09/24/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	09/24/09 0:00	jlf
Total Alkalinity		23		*	mg/L	2	20	09/24/09 0:00	jlf
Conductivity @25C	SM2510B	51		*	umhos/cm	1	10	09/22/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.1		*	units	0.1	0.1	09/22/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	09/22/09 0:00	brd
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	09/25/09 15:13	aml

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Timberline Resources Corp. ACZ Project ID: ***L75255***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75255-02	WG262686	Mercury, dissolved	M245.1 CVAA	DJ	Sample dilution required due to insufficient sample.
			M245.1 CVAA	H3	Sample was received and analyzed past holding time.
	WG262966	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	QA	Sample container with preservation type specified by the method was not available for analysis. Alternate sample container was used.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG262619	Bicarbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Carbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Hydroxide as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG262623	Sulfate	375.4 - Turbidimetric	H3	Sample was received and analyzed past holding time.
			375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RC	For a solid matrix, the matrix duplicate precision assessment (RPD or RER) exceeded the control limit, which is attributable to the non-homogeneity of the sample.
	WG262619	Total Alkalinity	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
L75255-03	WG263000	Bicarbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Carbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG262860	Conductivity @25C	SM2510B	H3	Sample was received and analyzed past holding time.
	WG263000	Hydroxide as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG263028	Sulfate	375.4 - Turbidimetric	H3	Sample was received and analyzed past holding time.
			375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG263000	Total Alkalinity	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
L75255-04	WG263215	Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG263463	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG263304	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
			SM2320B - Titration	RD	For a solid matrix, the duplicate RPD (spike or matrix) exceeded the control limit, which is attributable to the non-homogeneity of the sample.
L75255-05	WG263491	Conductivity @25C	SM2510B	N1	See Case Narrative.
			SM2510B	R1	RPD exceeded the method or laboratory acceptance limit. See Case Narrative.
	WG263853	Sulfate	375.4 - Turbidimetric	RC	For a solid matrix, the matrix duplicate precision assessment (RPD or RER) exceeded the control limit, which is attributable to the non-homogeneity of the sample.
	WG263544	Total Alkalinity	SM2320B - Titration	RD	For a solid matrix, the duplicate RPD (spike or matrix) exceeded the control limit, which is attributable to the non-homogeneity of the sample.

Timberline Resources Corp. ACZ Project ID: ***L75255***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75255-06	WG264174	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG264208	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-07	WG264469	Iron, dissolved	M200.7 ICP	LA	Recovery for target analyte in the control sample (LCS or LFB) exceeded the acceptance criteria. Target analyte was not detected in the sample [< MDL].
		Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG264208	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG264181	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
L75255-08	WG264737	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG264880	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-09	WG265186	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265127	Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG265037	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265262	Total Alkalinity	SM2320B - Titration	N1	See Case Narrative.

Timberline Resources Corp. ACZ Project ID: ***L75255***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75255-10	WG265480	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265888	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265502	Total Alkalinity	SM2320B - Titration	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-11	WG265826	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265888	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265832	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
L75255-12	WG266386	Manganese, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG266222	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG266674	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-13	WG266588	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG266674	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-14	WG267145	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG267191	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Timberline Resources Corp. ACZ Project ID: ***L75255***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75255-15	WG267317	Calcium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Magnesium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG267853	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-16	WG267760	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG267853	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-17	WG269770	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG269784	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-18	WG269985	Potassium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG270046	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG269985	Sodium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG269998	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

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Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L75255***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75255-19	WG270547	Aluminum, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG270976	Mercury, dissolved	M245.1 CVAA	QA	Sample container with preservation type specified by the method was not available for analysis. Alternate sample container was used.
	WG270475	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG270572	Thallium, dissolved	M200.8 ICP-MS	BE	Target analyte in continuing calibration blank (CCB) at or above the acceptance criteria. Target analyte was not detected in the sample [< MDL].
	WG270589	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75255-20	WG270875	Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271068	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG270982	Total Alkalinity	SM2320B - Titration	N1	See Case Narrative.

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Aluminum, dissolved	M200.7 ICP
Antimony, dissolved	M200.8 ICP-MS
Arsenic, dissolved	M200.8 ICP-MS
Barium, dissolved	M200.7 ICP
Beryllium, dissolved	M200.7 ICP
Boron, dissolved	M200.7 ICP
Cadmium, dissolved	M200.8 ICP-MS
Calcium, dissolved	M200.7 ICP
Chromium, dissolved	M200.7 ICP
Copper, dissolved	M200.7 ICP
Iron, dissolved	M200.7 ICP
Lead, dissolved	M200.8 ICP-MS
Magnesium, dissolved	M200.7 ICP
Manganese, dissolved	M200.7 ICP
Mercury, dissolved	M245.1 CVAA
Nickel, dissolved	M200.7 ICP
Potassium, dissolved	M200.7 ICP
Selenium, dissolved	M200.8 ICP-MS
Silver, dissolved	M200.7 ICP
Sodium, dissolved	M200.7 ICP
Thallium, dissolved	M200.8 ICP-MS
Zinc, dissolved	M200.7 ICP

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Alkalinity as CaCO3	SM2320B - Titration
Conductivity @25C	SM2510B
pH (lab)	SM4500H+ B
Sulfate	375.4 - Turbidimetric

L75255 - Relog

ACZ Laboratories, Inc. ~~L74714~~ L75255

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT.
HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE
COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE &
~~Project/PO #:~~ TJV-GEN-HUMIDITY CELL PRICING - 2009 RES.
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

	SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSIS	HUMIDITY CELL					
-01.	Cm09-01	2.25.09 (10)	other	1	✓	✓	✓					
		~~2.25.09 (11)~~										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS/(COARSE) REJECTS TO TIMBERLINE RESOURCES

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC KLEPFER	3.2.09 (3PM)	LBG	3.5.09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

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ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

October 01, 2009

Report to:
Eric Klepfer
Klepfer Mining Services LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Bill to:
Craig Crowell
Timberline Resources Corp.
101 E. Lakeside Ave.
Coeur d'Alene, ID 83814

cc: Art Glover

Project ID: TJV_GENERAL_HUMIDITY
ACZ Project ID: L75257

Eric Klepfer:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on April 13, 2009. This project has been assigned to ACZ's project number, L75257. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L75257. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after November 01, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp. October 01, 2009

Project ID: TJV_GENERAL_HUMIDITY
ACZ Project ID: L75257

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 20 soil samples from Timberline Resources Corp. on April 13, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L75257. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses except those qualified with an ACZ 'H' flag were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. The Conductivity analysis (sample -05) was qualified with the ACZ 'N1' & 'R1' flags due to an apparatus issue that caused a failing RPD (Relative Percent Difference). As the data was not reproducible, it was accepted.

2. The Alkalinity analysis (sample -09 & -20) was qualified with the ACZ 'N1' flag due a laboratory control sample failure. There was insufficient sample available for reanalysis and the data was accepted.

3. No data is available for Week 16 through 19 due to an error at the bench level.

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01

ACZ Sample ID: ***L75257-01***
Date Sampled: *02/25/09 11:00*
Date Received: *04/13/09*
Sample Matrix: *Soil*

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Humidity Cell Test	M600 12-78-054							04/14/09 10:00	brd

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 1
Locator: WEEK 1

ACZ Sample ID: ***L75257-02***
Date Sampled: *02/25/09 11:00*
Date Received: *04/21/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.03	0.2	04/22/09 20:07	ear
Antimony, dissolved	M200.8 ICP-MS	0.0010	B	*	mg/L	0.0004	0.002	04/23/09 0:19	erf
Arsenic, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.002	04/23/09 0:19	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	04/22/09 20:07	ear
Beryllium, dissolved	M200.7 ICP	0.002	B	*	mg/L	0.002	0.01	04/22/09 20:07	ear
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	04/22/09 20:07	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	04/23/09 0:19	erf
Calcium, dissolved	M200.7 ICP	11.2		*	mg/L	0.2	1	04/22/09 20:07	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:07	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:07	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	04/22/09 20:07	ear
Magnesium, dissolved	M200.7 ICP	4.7		*	mg/L	0.2	1	04/22/09 20:07	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	04/22/09 20:07	ear
Mercury, dissolved	M245.1 CVAA		UH	*	mg/L	0.0004	0.002	04/23/09 22:17	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	04/22/09 20:07	ear
Potassium, dissolved	M200.7 ICP	6.1		*	mg/L	0.3	2	04/22/09 20:07	ear
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	04/23/09 0:19	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	04/30/09 10:50	ear
Sodium, dissolved	M200.7 ICP	4.1		*	mg/L	0.3	2	04/22/09 20:07	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	04/23/09 0:19	erf
Zinc, dissolved	M200.7 ICP	0.14		*	mg/L	0.01	0.05	04/22/09 20:07	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		20	H	*	mg/L	2	20	04/22/09 0:00	jlf
Carbonate as CaCO3			UH	*	mg/L	2	20	04/22/09 0:00	jlf
Hydroxide as CaCO3			UH	*	mg/L	2	20	04/22/09 0:00	jlf
Total Alkalinity		20	H	*	mg/L	2	20	04/22/09 0:00	jlf
Conductivity @25C	SM2510B	149	H	*	umhos/cm	1	10	04/21/09 11:20	lwt
pH (lab)	SM4500H+ B								
pH		8.9	H	*	units	0.1	0.1	04/21/09 0:00	lwt
pH measured at		22.0		*	C	0.1	0.1	04/21/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	30	H	*	mg/L	1	5	04/22/09 16:18	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 2
Locator: WEEK 2

ACZ Sample ID: ***L75257-03***
Date Sampled: *02/25/09 11:00*
Date Received: *04/28/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/01/09 17:56	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		23	H	*	mg/L	2	20	04/30/09 0:00	kah
Carbonate as CaCO3			UH	*	mg/L	2	20	04/30/09 0:00	kah
Hydroxide as CaCO3			UH	*	mg/L	2	20	04/30/09 0:00	kah
Total Alkalinity		23	H	*	mg/L	2	20	04/30/09 0:00	kah
Conductivity @25C	SM2510B	138	H	*	umhos/cm	1	10	04/28/09 13:20	lwt
pH (lab)	SM4500H+ B								
pH		8.8	H	*	units	0.1	0.1	04/28/09 0:00	lwt
pH measured at		21.7		*	C	0.1	0.1	04/28/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	24	H	*	mg/L	1	5	05/01/09 11:42	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 3
Locator: WEEK 3

ACZ Sample ID: ***L75257-04***
Date Sampled: *05/05/09 00:00*
Date Received: *05/05/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/07/09 17:27	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		23		*	mg/L	2	20	05/07/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	05/07/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	05/07/09 0:00	jlf
Total Alkalinity		23		*	mg/L	2	20	05/07/09 0:00	jlf
Conductivity @25C	SM2510B	118		*	umhos/cm	1	10	05/05/09 10:10	lwt
pH (lab)	SM4500H+ B								
pH		8.8		*	units	0.1	0.1	05/05/09 0:00	lwt
pH measured at		22.0		*	C	0.1	0.1	05/05/09 0:00	lwt
Sulfate	375.4 - Turbidimetric	18		*	mg/L	1	5	05/13/09 13:09	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 4
Locator: WEEK 4

ACZ Sample ID: ***L75257-05***
Date Sampled: *05/12/09 00:00*
Date Received: *05/12/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Iron, dissolved	M200.7 ICP	0.14		*	mg/L	0.02	0.05	05/13/09 20:56	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		21		*	mg/L	2	20	05/13/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/13/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/13/09 0:00	abm
Total Alkalinity		21		*	mg/L	2	20	05/13/09 0:00	abm
Conductivity @25C	SM2510B	91		*	umhos/cm	1	10	05/12/09 13:20	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	05/12/09 0:00	brd
pH measured at		24.0		*	C	0.1	0.1	05/12/09 0:00	brd
Sulfate	375.4 - Turbidimetric	13		*	mg/L	1	5	05/20/09 10:26	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 5
Locator: WEEK 5

ACZ Sample ID: ***L75257-06***
Date Sampled: *05/19/09 00:00*
Date Received: *05/20/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.07	B	*	mg/L	0.03	0.2	05/22/09 18:55	ear
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	05/23/09 4:31	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0075		*	mg/L	0.0005	0.002	05/23/09 4:31	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	05/22/09 18:55	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	05/22/09 18:55	ear
Boron, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	05/28/09 16:40	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	05/23/09 4:31	msh
Calcium, dissolved	M200.7 ICP	8.2		*	mg/L	0.2	1	05/22/09 18:55	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:55	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:55	ear
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	05/22/09 18:55	ear
Magnesium, dissolved	M200.7 ICP	3.5		*	mg/L	0.2	1	05/22/09 18:55	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	05/22/09 18:55	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	05/26/09 19:25	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/22/09 18:55	ear
Potassium, dissolved	M200.7 ICP	4.5		*	mg/L	0.3	2	05/22/09 18:55	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	05/23/09 4:31	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	05/28/09 16:40	aeh
Sodium, dissolved	M200.7 ICP	1.6	B	*	mg/L	0.3	2	05/22/09 18:55	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	05/23/09 4:31	msh
Zinc, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	05/22/09 18:55	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		21		*	mg/L	2	20	05/22/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/22/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/22/09 0:00	abm
Total Alkalinity		21		*	mg/L	2	20	05/22/09 0:00	abm
Conductivity @25C	SM2510B	103		*	umhos/cm	1	10	05/19/09 14:00	brd/bjl
pH (lab)	SM4500H+ B								
pH		8.5		*	units	0.1	0.1	05/19/09 0:00	brd/bjl
pH measured at		25.0		*	C	0.1	0.1	05/19/09 0:00	brd/bjl
Sulfate	375.4 - Turbidimetric	17		*	mg/L	1	5	05/27/09 12:52	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 6
Locator: WEEK 6

ACZ Sample ID: ***L75257-07***
Date Sampled: *05/26/09 00:00*
Date Received: *05/26/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	05/30/09 0:32	ear
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	06/03/09 10:43	erf
Arsenic, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.002	06/03/09 10:43	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	05/30/09 0:32	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	05/30/09 0:32	ear
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	06/01/09 19:44	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/03/09 10:43	erf
Calcium, dissolved	M200.7 ICP	7.8		*	mg/L	0.2	1	05/30/09 0:32	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/30/09 0:32	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/30/09 0:32	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	05/30/09 0:32	ear
Magnesium, dissolved	M200.7 ICP	3.9		*	mg/L	0.2	1	05/30/09 0:32	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	05/30/09 0:32	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	05/28/09 16:58	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	05/30/09 0:32	ear
Potassium, dissolved	M200.7 ICP	4.7		*	mg/L	0.3	2	05/30/09 0:32	ear
Selenium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	06/03/09 10:43	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/02/09 12:04	ear
Sodium, dissolved	M200.7 ICP	1.5	B	*	mg/L	0.3	2	05/30/09 0:32	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/03/09 10:43	erf
Zinc, dissolved	M200.7 ICP	0.05		*	mg/L	0.01	0.05	06/01/09 19:44	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		20		*	mg/L	2	20	05/27/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	05/27/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	05/27/09 0:00	abm
Total Alkalinity		20		*	mg/L	2	20	05/27/09 0:00	abm
Conductivity @25C	SM2510B	96		*	umhos/cm	1	10	05/26/09 16:20	brd
pH (lab)	SM4500H+ B								
pH		8.8		*	units	0.1	0.1	05/26/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	05/26/09 0:00	brd
Sulfate	375.4 - Turbidimetric	16		*	mg/L	1	5	05/27/09 12:52	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 7
Locator: WEEK 7

ACZ Sample ID: ***L75257-08***
Date Sampled: *06/06/09 00:00*
Date Received: *06/03/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.12	B	*	mg/L	0.03	0.2	06/04/09 20:12	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	06/10/09 9:25	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0105		*	mg/L	0.0005	0.002	06/06/09 0:24	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	06/04/09 20:12	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/04/09 20:12	aeh
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	06/04/09 20:12	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/06/09 0:24	msh
Calcium, dissolved	M200.7 ICP	8.2		*	mg/L	0.2	1	06/04/09 20:12	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:12	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:12	aeh
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	06/04/09 20:12	aeh
Magnesium, dissolved	M200.7 ICP	4.1		*	mg/L	0.2	1	06/04/09 20:12	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/04/09 20:12	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/10/09 16:06	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/04/09 20:12	aeh
Potassium, dissolved	M200.7 ICP	4.6		*	mg/L	0.3	2	06/04/09 20:12	aeh
Selenium, dissolved	M200.8 ICP-MS	0.0007		*	mg/L	0.0001	0.0005	06/06/09 0:24	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/04/09 20:12	aeh
Sodium, dissolved	M200.7 ICP	1.3	B	*	mg/L	0.3	2	06/04/09 20:12	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/06/09 0:24	msh
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	06/04/09 20:12	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		17	B	*	mg/L	2	20	06/04/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	06/04/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	06/04/09 0:00	jlf
Total Alkalinity		17	B	*	mg/L	2	20	06/04/09 0:00	jlf
Conductivity @25C	SM2510B	101		*	umhos/cm	1	10	06/02/09 20:40	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	06/02/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/02/09 0:00	brd
Sulfate	375.4 - Turbidimetric	17		*	mg/L	1	5	06/08/09 11:22	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 8
Locator: WEEK 8

ACZ Sample ID: ***L75257-09***
Date Sampled: *06/09/09 00:00*
Date Received: *06/10/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.11	B	*	mg/L	0.03	0.2	06/11/09 18:59	ear
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	06/11/09 6:51	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0067		*	mg/L	0.0005	0.002	06/11/09 6:51	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	06/11/09 18:59	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/12/09 14:53	aeh
Boron, dissolved	M200.7 ICP	0.05		*	mg/L	0.01	0.05	06/11/09 18:59	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/11/09 6:51	msh
Calcium, dissolved	M200.7 ICP	8.8		*	mg/L	0.2	1	06/11/09 18:59	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/12/09 14:53	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/11/09 18:59	ear
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	06/11/09 18:59	ear
Magnesium, dissolved	M200.7 ICP	4.3		*	mg/L	0.2	1	06/11/09 18:59	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/11/09 18:59	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/12/09 16:26	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/11/09 18:59	ear
Potassium, dissolved	M200.7 ICP	5.3		*	mg/L	0.3	2	06/11/09 18:59	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	06/12/09 21:28	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/12/09 14:53	aeh
Sodium, dissolved	M200.7 ICP	1.5	B	*	mg/L	0.3	2	06/11/09 18:59	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/11/09 6:51	msh
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	06/11/09 18:59	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		20		*	mg/L	2	20	06/15/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	06/15/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	06/15/09 0:00	abm
Total Alkalinity		20		*	mg/L	2	20	06/15/09 0:00	abm
Conductivity @25C	SM2510B	110		*	umhos/cm	1	10	06/09/09 11:40	brd
pH (lab)	SM4500H+ B								
pH		8.8		*	units	0.1	0.1	06/09/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/09/09 0:00	brd
Sulfate	375.4 - Turbidimetric	19		*	mg/L	1	5	06/10/09 11:03	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 9
Locator: WEEK 9

ACZ Sample ID: ***L75257-10***
Date Sampled: *06/16/09 00:00*
Date Received: *06/17/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.17	B	*	mg/L	0.03	0.2	06/17/09 21:12	ear
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	06/25/09 9:11	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0070		*	mg/L	0.0005	0.002	06/24/09 10:13	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	06/17/09 21:12	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/17/09 21:12	ear
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	06/17/09 21:12	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/24/09 10:13	erf
Calcium, dissolved	M200.7 ICP	8.2		*	mg/L	0.2	1	06/17/09 21:12	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/18/09 17:00	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/17/09 21:12	ear
Iron, dissolved	M200.7 ICP	0.06		*	mg/L	0.02	0.05	06/17/09 21:12	ear
Magnesium, dissolved	M200.7 ICP	4.0		*	mg/L	0.2	1	06/17/09 21:12	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/17/09 21:12	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	06/23/09 18:59	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/17/09 21:12	ear
Potassium, dissolved	M200.7 ICP	5.2		*	mg/L	0.3	2	06/17/09 21:12	ear
Selenium, dissolved	M200.8 ICP-MS	0.0006		*	mg/L	0.0001	0.0005	06/24/09 10:13	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/18/09 17:00	aeh
Sodium, dissolved	M200.7 ICP	1.2	B	*	mg/L	0.3	2	06/17/09 21:12	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/24/09 10:13	erf
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	06/17/09 21:12	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		26		*	mg/L	2	20	06/18/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	06/18/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	06/18/09 0:00	kah
Total Alkalinity		26		*	mg/L	2	20	06/18/09 0:00	kah
Conductivity @25C	SM2510B	103		*	umhos/cm	1	10	06/16/09 17:00	brd
pH (lab)	SM4500H+ B								
pH		8.8		*	units	0.1	0.1	06/16/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/16/09 0:00	brd
Sulfate	375.4 - Turbidimetric	21		*	mg/L	1	5	06/25/09 10:51	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 10
Locator: WEEK 10

ACZ Sample ID: ***L75257-11***
Date Sampled: *06/23/09 00:00*
Date Received: *06/24/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.11	B	*	mg/L	0.03	0.2	06/24/09 18:56	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	06/25/09 9:16	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0067		*	mg/L	0.0005	0.002	06/25/09 9:16	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	06/24/09 18:56	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	06/24/09 18:56	aeh
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	06/24/09 18:56	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/25/09 9:16	erf
Calcium, dissolved	M200.7 ICP	8.5		*	mg/L	0.2	1	06/24/09 18:56	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:56	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:56	aeh
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	06/25/09 15:46	aeh
Magnesium, dissolved	M200.7 ICP	4.9		*	mg/L	0.2	1	06/24/09 18:56	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	06/24/09 18:56	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/02/09 17:02	jws
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	06/24/09 18:56	aeh
Potassium, dissolved	M200.7 ICP	5.6		*	mg/L	0.3	2	06/24/09 18:56	aeh
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	06/25/09 9:16	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	06/24/09 18:56	aeh
Sodium, dissolved	M200.7 ICP	1.5	B	*	mg/L	0.3	2	06/24/09 18:56	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	06/25/09 9:16	erf
Zinc, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	06/25/09 15:46	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		21		*	mg/L	2	20	06/24/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	06/24/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	06/24/09 0:00	abm
Total Alkalinity		21		*	mg/L	2	20	06/24/09 0:00	abm
Conductivity @25C	SM2510B	112		*	umhos/cm	1	10	06/23/09 17:00	brd
pH (lab)	SM4500H+ B								
pH		8.9		*	units	0.1	0.1	06/23/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	06/23/09 0:00	brd
Sulfate	375.4 - Turbidimetric	24		*	mg/L	1	5	06/25/09 10:51	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 11
Locator: WEEK 11

ACZ Sample ID: ***L75257-12***
Date Sampled: *06/30/09 00:00*
Date Received: *07/01/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.11	B	*	mg/L	0.03	0.2	07/02/09 19:30	ear
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	07/08/09 22:00	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0115		*	mg/L	0.0005	0.002	07/08/09 22:00	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	07/02/09 19:30	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/02/09 19:30	ear
Boron, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	07/02/09 19:30	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/08/09 22:00	msh
Calcium, dissolved	M200.7 ICP	8.6		*	mg/L	0.2	1	07/02/09 19:30	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/07/09 10:22	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/02/09 19:30	ear
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	07/02/09 19:30	ear
Magnesium, dissolved	M200.7 ICP	5.0		*	mg/L	0.2	1	07/02/09 19:30	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/06/09 18:39	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/09/09 15:33	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/02/09 19:30	ear
Potassium, dissolved	M200.7 ICP	5.4		*	mg/L	0.3	2	07/02/09 19:30	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	07/10/09 0:44	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/02/09 19:30	ear
Sodium, dissolved	M200.7 ICP	1.4	B	*	mg/L	0.3	2	07/02/09 19:30	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/08/09 22:00	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	07/06/09 18:39	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		17	B	*	mg/L	2	20	07/06/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	07/06/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	07/06/09 0:00	abm
Total Alkalinity		17	B	*	mg/L	2	20	07/06/09 0:00	abm
Conductivity @25C	SM2510B	116		*	umhos/cm	1	10	06/30/09 13:20	brd
pH (lab)	SM4500H+ B								
pH		8.2		*	units	0.1	0.1	06/30/09 0:00	brd
pH measured at		25.0		*	C	0.1	0.1	06/30/09 0:00	brd
Sulfate	375.4 - Turbidimetric	25		*	mg/L	1	5	07/09/09 14:59	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 12
Locator: WEEK 12

ACZ Sample ID: ***L75257-13***
Date Sampled: *07/08/09 00:00*
Date Received: *07/08/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.07	B	*	mg/L	0.03	0.2	07/13/09 20:18	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	07/10/09 0:47	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0020		*	mg/L	0.0005	0.002	07/10/09 0:47	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	07/08/09 21:10	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/13/09 20:18	aeh
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	07/08/09 21:10	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/10/09 0:47	msh
Calcium, dissolved	M200.7 ICP	6.1		*	mg/L	0.2	1	07/08/09 21:10	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:10	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:10	ear
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	07/08/09 21:10	ear
Magnesium, dissolved	M200.7 ICP	3.5		*	mg/L	0.2	1	07/08/09 21:10	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/08/09 21:10	ear
Mercury, dissolved	M245.1 CVAA	0.0010		*	mg/L	0.0002	0.001	07/10/09 13:10	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/08/09 21:10	ear
Potassium, dissolved	M200.7 ICP	4.0		*	mg/L	0.3	2	07/08/09 21:10	ear
Selenium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	07/10/09 0:47	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/08/09 21:10	ear
Sodium, dissolved	M200.7 ICP	0.7	B	*	mg/L	0.3	2	07/08/09 21:10	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/10/09 0:47	msh
Zinc, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	07/08/09 21:10	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		12	B	*	mg/L	2	20	07/10/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	07/10/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	07/10/09 0:00	abm
Total Alkalinity		12	B	*	mg/L	2	20	07/10/09 0:00	abm
Conductivity @25C	SM2510B	92		*	umhos/cm	1	10	07/08/09 12:40	brd
pH (lab)	SM4500H+ B								
pH		8.7		*	units	0.1	0.1	07/08/09 0:00	brd
pH measured at		23.0		*	C	0.1	0.1	07/08/09 0:00	brd
Sulfate	375.4 - Turbidimetric	21		*	mg/L	1	5	07/09/09 14:59	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 13
Locator: WEEK 13

ACZ Sample ID: ***L75257-14***
Date Sampled: *07/14/09 00:00*
Date Received: *07/15/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.12	B	*	mg/L	0.03	0.2	07/16/09 21:57	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0004	0.002	07/22/09 5:25	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0020		*	mg/L	0.0005	0.002	07/21/09 9:01	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	07/16/09 21:57	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/16/09 21:57	aeh
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	07/16/09 21:57	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 9:01	erf
Calcium, dissolved	M200.7 ICP	6.1		*	mg/L	0.2	1	07/16/09 21:57	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/20/09 11:19	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/16/09 21:57	aeh
Iron, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.02	0.05	07/16/09 21:57	aeh
Magnesium, dissolved	M200.7 ICP	3.5		*	mg/L	0.2	1	07/16/09 21:57	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/20/09 11:19	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/20/09 13:23	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/16/09 21:57	aeh
Potassium, dissolved	M200.7 ICP	3.8		*	mg/L	0.3	2	07/17/09 16:36	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 9:01	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/20/09 11:19	ear
Sodium, dissolved	M200.7 ICP	0.5	B	*	mg/L	0.3	2	07/17/09 16:36	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/21/09 9:01	erf
Zinc, dissolved	M200.7 ICP	0.07		*	mg/L	0.01	0.05	07/17/09 16:36	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		11	B	*	mg/L	2	20	07/23/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Total Alkalinity		11	B	*	mg/L	2	20	07/23/09 0:00	kah
Conductivity @25C	SM2510B	82		*	umhos/cm	1	10	07/14/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		8.4		*	units	0.1	0.1	07/14/09 0:00	brd
pH measured at		23.5		*	C	0.1	0.1	07/14/09 0:00	brd
Sulfate	375.4 - Turbidimetric	21		*	mg/L	1	5	07/20/09 15:20	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 14
Locator: WEEK 14

ACZ Sample ID: ***L75257-15***
Date Sampled: *07/21/09 00:00*
Date Received: *07/22/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.07	B	*	mg/L	0.03	0.2	07/22/09 17:36	ear
Antimony, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0004	0.002	07/29/09 21:19	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0021		*	mg/L	0.0005	0.002	07/26/09 21:17	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	07/22/09 17:36	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/22/09 17:36	ear
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	07/22/09 17:36	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/26/09 21:17	msh
Calcium, dissolved	M200.7 ICP	7.3		*	mg/L	0.2	1	07/22/09 17:36	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:36	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:36	ear
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	07/22/09 17:36	ear
Magnesium, dissolved	M200.7 ICP	5.5		*	mg/L	0.2	1	07/22/09 17:36	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/23/09 13:05	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/23/09 17:34	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/22/09 17:36	ear
Potassium, dissolved	M200.7 ICP	5.2		*	mg/L	0.3	2	07/22/09 17:36	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	07/27/09 22:03	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/22/09 17:36	ear
Sodium, dissolved	M200.7 ICP	1.0	B	*	mg/L	0.3	2	07/22/09 17:36	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/26/09 21:17	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	07/23/09 13:05	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		12	B	*	mg/L	2	20	07/23/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	07/23/09 0:00	kah
Total Alkalinity		12	B	*	mg/L	2	20	07/23/09 0:00	kah
Conductivity @25C	SM2510B	116		*	umhos/cm	1	10	07/21/09 13:00	brd
pH (lab)	SM4500H+ B								
pH		8.5		*	units	0.1	0.1	07/21/09 0:00	brd
pH measured at		22.4		*	C	0.1	0.1	07/21/09 0:00	brd
Sulfate	375.4 - Turbidimetric	34		*	mg/L	1	5	07/30/09 11:57	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 15
Locator: WEEK 15

ACZ Sample ID: ***L75257-16***
Date Sampled: *07/28/09 00:00*
Date Received: *07/29/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.13	B	*	mg/L	0.03	0.2	07/29/09 17:17	ear
Antimony, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0004	0.002	07/30/09 2:50	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0032		*	mg/L	0.0005	0.002	07/30/09 2:50	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	07/29/09 17:17	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	07/29/09 17:17	ear
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	07/29/09 17:17	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/30/09 2:50	msh
Calcium, dissolved	M200.7 ICP	8.2		*	mg/L	0.2	1	07/29/09 17:17	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:17	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:17	ear
Iron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.02	0.05	07/29/09 17:17	ear
Magnesium, dissolved	M200.7 ICP	5.8		*	mg/L	0.2	1	07/29/09 17:17	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	07/29/09 17:17	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	07/29/09 17:39	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	07/29/09 17:17	ear
Potassium, dissolved	M200.7 ICP	5.3		*	mg/L	0.3	2	07/29/09 17:17	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	07/30/09 14:35	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	07/29/09 17:17	ear
Sodium, dissolved	M200.7 ICP	0.7	B	*	mg/L	0.3	2	07/29/09 17:17	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	07/30/09 2:50	msh
Zinc, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	07/29/09 17:17	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		16	B	*	mg/L	2	20	08/03/09 0:00	kah
Carbonate as CaCO3			U	*	mg/L	2	20	08/03/09 0:00	kah
Hydroxide as CaCO3			U	*	mg/L	2	20	08/03/09 0:00	kah
Total Alkalinity		16	B	*	mg/L	2	20	08/03/09 0:00	kah
Conductivity @25C	SM2510B	120		*	umhos/cm	1	10	07/29/09 5:00	brd
pH (lab)	SM4500H+ B								
pH		8.5	H	*	units	0.1	0.1	07/29/09 0:00	brd
pH measured at		23.0		*	C	0.1	0.1	07/29/09 0:00	brd
Sulfate	375.4 - Turbidimetric	33		*	mg/L	1	5	08/03/09 13:13	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 20
Locator: WEEK 20

ACZ Sample ID: ***L75257-17***
Date Sampled: *09/02/09 00:00*
Date Received: *09/03/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.24		*	mg/L	0.03	0.2	09/03/09 23:25	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.004	0.02	09/08/09 13:05	msh
Arsenic, dissolved	M200.8 ICP-MS	0.006	B	*	mg/L	0.005	0.02	09/08/09 13:05	msh
Barium, dissolved	M200.7 ICP	0.008	B	*	mg/L	0.003	0.02	09/03/09 23:25	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/03/09 23:25	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	09/08/09 10:46	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.001	0.005	09/08/09 13:05	msh
Calcium, dissolved	M200.7 ICP	7.0		*	mg/L	0.2	1	09/04/09 11:32	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:25	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:25	ear
Iron, dissolved	M200.7 ICP	0.14		*	mg/L	0.02	0.05	09/03/09 23:25	ear
Magnesium, dissolved	M200.7 ICP	4.5		*	mg/L	0.2	1	09/03/09 23:25	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/03/09 23:25	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/04/09 19:38	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/03/09 23:25	ear
Potassium, dissolved	M200.7 ICP	5.0		*	mg/L	0.3	2	09/03/09 23:25	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.001	0.005	09/08/09 15:03	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/03/09 23:25	ear
Sodium, dissolved	M200.7 ICP	0.4	B	*	mg/L	0.3	2	09/03/09 23:25	ear
Thallium, dissolved	M200.8 ICP-MS	0.004	B	*	mg/L	0.001	0.005	09/08/09 13:05	msh
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	09/03/09 23:25	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		14	B	*	mg/L	2	20	09/08/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	09/08/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/08/09 0:00	abm
Total Alkalinity		14	B	*	mg/L	2	20	09/08/09 0:00	abm
Conductivity @25C	SM2510B	102		*	umhos/cm	1	10	09/03/09 10:23	brd
pH (lab)	SM4500H+ B								
pH		8.6	H	*	units	0.1	0.1	09/03/09 0:00	brd
pH measured at		24.8		*	C	0.1	0.1	09/03/09 0:00	brd
Sulfate	375.4 - Turbidimetric	27		*	mg/L	1	5	09/03/09 13:00	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 21
Locator: WEEK 21

ACZ Sample ID: ***L75257-18***
Date Sampled: *09/08/09 00:00*
Date Received: *09/08/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.22		*	mg/L	0.03	0.2	09/09/09 22:35	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0008	B	*	mg/L	0.0004	0.002	09/19/09 0:50	rct
Arsenic, dissolved	M200.8 ICP-MS	0.0024		*	mg/L	0.0005	0.002	09/14/09 19:33	msh
Barium, dissolved	M200.7 ICP	0.003	B	*	mg/L	0.003	0.02	09/09/09 22:35	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/09/09 22:35	aeh
Boron, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 21:10	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:33	msh
Calcium, dissolved	M200.7 ICP	6.2		*	mg/L	0.2	1	09/09/09 22:35	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 12:20	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/09/09 22:35	aeh
Iron, dissolved	M200.7 ICP	0.11		*	mg/L	0.02	0.05	09/09/09 22:35	aeh
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:33	msh
Magnesium, dissolved	M200.7 ICP	2.8		*	mg/L	0.2	1	09/09/09 22:35	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/10/09 12:20	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/10/09 13:08	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/10/09 21:10	aeh
Potassium, dissolved	M200.7 ICP	3.8		*	mg/L	0.3	2	09/09/09 22:35	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:33	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/10/09 12:20	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	09/09/09 22:35	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/14/09 19:33	msh
Zinc, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	09/10/09 12:20	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		11	B	*	mg/L	2	20	09/11/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	09/11/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/11/09 0:00	abm
Total Alkalinity		11	B	*	mg/L	2	20	09/11/09 0:00	abm
Conductivity @25C	SM2510B	70		*	umhos/cm	1	10	09/08/09 13:40	brd/itk
pH (lab)	SM4500H+ B								
pH		8.4		*	units	0.1	0.1	09/08/09 0:00	brd/itk
pH measured at		23.0		*	C	0.1	0.1	09/08/09 0:00	brd/itk
Sulfate	375.4 - Turbidimetric	17		*	mg/L	1	5	09/09/09 13:46	ccp

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 22
Locator: WEEK 22

ACZ Sample ID: ***L75257-19***
Date Sampled: *09/15/09 00:00*
Date Received: *09/15/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.33		*	mg/L	0.03	0.2	09/18/09 16:26	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0006	B	*	mg/L	0.0004	0.002	09/19/09 0:55	rct
Arsenic, dissolved	M200.8 ICP-MS	0.0030		*	mg/L	0.0005	0.002	09/22/09 5:47	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	09/18/09 16:26	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/17/09 20:07	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	09/18/09 16:26	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:55	rct
Calcium, dissolved	M200.7 ICP	7.0		*	mg/L	0.2	1	09/17/09 20:07	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/18/09 16:26	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/17/09 20:07	ear
Iron, dissolved	M200.7 ICP	0.32		*	mg/L	0.02	0.05	09/18/09 16:26	aeh
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:55	rct
Magnesium, dissolved	M200.7 ICP	3.4		*	mg/L	0.2	1	09/17/09 20:07	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	09/18/09 16:26	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/24/09 18:33	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/18/09 16:26	aeh
Potassium, dissolved	M200.7 ICP	3.7		*	mg/L	0.3	2	09/17/09 20:07	ear
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:55	rct
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/17/09 20:07	ear
Sodium, dissolved	M200.7 ICP		U	*	mg/L	0.3	2	09/17/09 20:07	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/19/09 0:55	rct
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	09/17/09 20:07	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		11	B	*	mg/L	2	20	09/17/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	09/17/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	09/17/09 0:00	jlf
Total Alkalinity		11	B	*	mg/L	2	20	09/17/09 0:00	jlf
Conductivity @25C	SM2510B	80		*	umhos/cm	1	10	09/16/09 2:20	brd
pH (lab)	SM4500H+ B								
pH		8.3	H	*	units	0.1	0.1	09/16/09 0:00	brd
pH measured at		23.8		*	C	0.1	0.1	09/16/09 0:00	brd
Sulfate	375.4 - Turbidimetric	22		*	mg/L	1	5	09/18/09 15:50	aml

** Please refer to Qualifier Reports for details.*

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Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GENERAL_HUMIDITY
Sample ID: CW09-01 WEEK 23
Locator: WEEK 22

ACZ Sample ID: ***L75257-20***
Date Sampled: *09/22/09 00:00*
Date Received: *09/22/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.22		*	mg/L	0.03	0.2	09/25/09 20:07	aeh
Antimony, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0004	0.002	10/01/09 1:15	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0017	B	*	mg/L	0.0005	0.002	09/29/09 9:48	msh
Barium, dissolved	M200.7 ICP	0.006	B	*	mg/L	0.003	0.02	09/24/09 22:50	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	09/25/09 20:07	aeh
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	09/24/09 22:50	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:48	msh
Calcium, dissolved	M200.7 ICP	8.3		*	mg/L	0.2	1	09/24/09 22:50	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/24/09 22:50	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/24/09 22:50	ear
Iron, dissolved	M200.7 ICP	0.16		*	mg/L	0.02	0.05	09/24/09 22:50	ear
Lead, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	09/29/09 9:48	msh
Magnesium, dissolved	M200.7 ICP	4.4		*	mg/L	0.2	1	09/24/09 22:50	ear
Manganese, dissolved	M200.7 ICP	0.006	B	*	mg/L	0.005	0.03	09/24/09 22:50	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	09/24/09 18:35	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	09/28/09 12:13	aeh
Potassium, dissolved	M200.7 ICP	3.7		*	mg/L	0.3	2	09/25/09 20:07	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:48	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	09/24/09 22:50	ear
Sodium, dissolved	M200.7 ICP	0.6	B	*	mg/L	0.3	2	09/24/09 22:50	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	09/29/09 9:48	msh
Zinc, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	09/24/09 22:50	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		10	B	*	mg/L	2	20	09/24/09 0:00	jlf
Carbonate as CaCO3			U	*	mg/L	2	20	09/24/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	09/24/09 0:00	jlf
Total Alkalinity		10	B	*	mg/L	2	20	09/24/09 0:00	jlf
Conductivity @25C	SM2510B	105		*	umhos/cm	1	10	09/22/09 14:00	brd
pH (lab)	SM4500H+ B								
pH		8.7		*	units	0.1	0.1	09/22/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	09/22/09 0:00	brd
Sulfate	375.4 - Turbidimetric		U	*	mg/L	1	5	09/25/09 15:13	aml

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

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Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L75257***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75257-02	WG262686	Mercury, dissolved	M245.1 CVAA	DJ	Sample dilution required due to insufficient sample.
			M245.1 CVAA	H3	Sample was received and analyzed past holding time.
	WG262966	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	QA	Sample container with preservation type specified by the method was not available for analysis. Alternate sample container was used.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG262619	Bicarbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Carbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Hydroxide as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG262623	Sulfate	375.4 - Turbidimetric	H3	Sample was received and analyzed past holding time.
			375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG262619	Total Alkalinity	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
L75257-03	WG263000	Bicarbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
		Carbonate as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG262860	Conductivity @25C	SM2510B	H3	Sample was received and analyzed past holding time.
	WG263000	Hydroxide as CaCO3	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
	WG263028	Sulfate	375.4 - Turbidimetric	H3	Sample was received and analyzed past holding time.
			375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG263000	Total Alkalinity	SM2320B - Titration	H3	Sample was received and analyzed past holding time.
L75257-04	WG263215	Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG263463	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG263304	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
			SM2320B - Titration	RD	For a solid matrix, the duplicate RPD (spike or matrix) exceeded the control limit, which is attributable to the non-homogeneity of the sample.
L75257-05	WG263491	Conductivity @25C	SM2510B	N1	See Case Narrative.
			SM2510B	R1	RPD exceeded the method or laboratory acceptance limit. See Case Narrative.
	WG263853	Sulfate	375.4 - Turbidimetric	RC	For a solid matrix, the matrix duplicate precision assessment (RPD or RER) exceeded the control limit, which is attributable to the non-homogeneity of the sample.
	WG263544	Total Alkalinity	SM2320B - Titration	RD	For a solid matrix, the duplicate RPD (spike or matrix) exceeded the control limit, which is attributable to the non-homogeneity of the sample.

Timberline Resources Corp. ACZ Project ID: ***L75257***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75257-06	WG264174	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG264208	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-07	WG264523	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG264381	Sodium, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG264208	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG264181	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
L75257-08	WG264737	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG264880	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-09	WG265186	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265127	Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG265037	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265262	Total Alkalinity	SM2320B - Titration	N1	See Case Narrative.

Timberline Resources Corp. ACZ Project ID: ***L75257***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75257-10	WG265480	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265888	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265502	Total Alkalinity	SM2320B - Titration	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-11	WG265826	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG265888	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG265832	Total Alkalinity	SM2320B - Titration	B4	Target analyte detected in blank at or above the acceptance criteria.
L75257-12	WG266386	Manganese, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG266222	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG266674	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-13	WG266588	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG266674	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-14	WG267145	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG267191	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Timberline Resources Corp. ACZ Project ID: ***L75257***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75257-15	WG267317	Calcium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Magnesium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG267853	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-16	WG267760	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
L75257-17	WG269770	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG269784	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-18	WG269985	Potassium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG270046	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG269985	Sodium, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG269998	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L75257***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L75257-19	WG270547	Aluminum, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG270976	Mercury, dissolved	M245.1 CVAA	QA	Sample container with preservation type specified by the method was not available for analysis. Alternate sample container was used.
	WG270475	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG270572	Thallium, dissolved	M200.8 ICP-MS	BE	Target analyte in continuing calibration blank (CCB) at or above the acceptance criteria. Target analyte was not detected in the sample [< MDL].
	WG270589	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L75257-20	WG270875	Iron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271068	Sulfate	375.4 - Turbidimetric	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
	WG270982	Total Alkalinity	SM2320B - Titration	N1	See Case Narrative.

Timberline Resources Corp. ACZ Project ID: ***L75257***

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Aluminum, dissolved	M200.7 ICP
Antimony, dissolved	M200.8 ICP-MS
Arsenic, dissolved	M200.8 ICP-MS
Barium, dissolved	M200.7 ICP
Beryllium, dissolved	M200.7 ICP
Boron, dissolved	M200.7 ICP
Cadmium, dissolved	M200.8 ICP-MS
Calcium, dissolved	M200.7 ICP
Chromium, dissolved	M200.7 ICP
Copper, dissolved	M200.7 ICP
Iron, dissolved	M200.7 ICP
Lead, dissolved	M200.8 ICP-MS
Magnesium, dissolved	M200.7 ICP
Manganese, dissolved	M200.7 ICP
Mercury, dissolved	M245.1 CVAA
Nickel, dissolved	M200.7 ICP
Potassium, dissolved	M200.7 ICP
Selenium, dissolved	M200.8 ICP-MS
Silver, dissolved	M200.7 ICP
Sodium, dissolved	M200.7 ICP
Thallium, dissolved	M200.8 ICP-MS
Zinc, dissolved	M200.7 ICP

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Alkalinity as CaCO3	SM2320B - Titration
Conductivity @25C	SM2510B
pH (lab)	SM4500H+ B
Sulfate	375.4 - Turbidimetric

L75257-Reloox

ACZ Laboratories, Inc. — CHAIN of CUSTODY

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493 · L74714 · L7524.3.09

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT. HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE & Pricing
~~Project/PO #:~~ TJV_GENERIC_HUMIDITY CORE 2009 YES
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSES	HUMIDITY CORE					
-02. CW09-01	2.25.09 (11)	other	1	✓	✓	✓					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS & REJECT (COARSE) TO TIMBERLINE

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC Klepfer	3.2.09 (3PM)	[illegible]	3.5.09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg 1

Appendix 3
Excluded Material
Whole Rock and Kinetic Tests
Laboratory Results

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

August 07, 2009

Report to:
Eric Klepfer
Klepfer Mining Services LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Bill to:
Craig Crowell
Timberline Resources Corp.
101 E. Lakeside Ave.
Coeur d'Alene, ID 83814

cc: Art Glover

Project ID: TJV_GEN_HUMIDITY CEL
ACZ Project ID: L77034

Eric Klepfer:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on July 20, 2009. This project has been assigned to ACZ's project number, L77034. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan, version 12.0. The enclosed results relate only to the samples received under L77034. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after September 07, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp. August 07, 2009

Project ID: TJV_GEN_HUMIDITY CEL
ACZ Project ID: L77034

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 2 soil samples from Timberline Resources Corp. on July 20, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L77034. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses except those qualified with an ACZ 'H' flag were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. This report constitutes reanalysis of the project previously reported as L74714, samples -01 & -02.

2. The Total Hg Analysis was qualified with the ACZ 'N1' flag as the sample was analyzed after crushing & pulverization versus as received.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01

ACZ Sample ID: ***L77034-01***
Date Sampled: *02/25/09 00:00*
Date Received: *07/20/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, total (3050)	M6010B ICP	2780		*	mg/Kg	3	20	07/31/09 13:36	ear
Antimony, total (3050)	M6020 ICP-MS		U		mg/Kg	0.2	1	08/03/09 18:24	erf
Arsenic, total (3050)	M6020 ICP-MS	6.7		*	mg/Kg	0.3	1	08/03/09 18:24	erf
Barium, total (3050)	M6010B ICP	26.5			mg/Kg	0.3	2	07/31/09 13:36	ear
Beryllium, total (3050)	M6020 ICP-MS	0.07	B		mg/Kg	0.05	0.3	08/03/09 18:24	erf
Bismuth, total (3050)	M6010B ICP		U	*	mg/Kg	4	20	07/31/09 13:36	ear
Boron, total (3050)	M6010B ICP	11			mg/Kg	1	5	07/31/09 13:36	ear
Cadmium, total (3050)	M6020 ICP-MS	0.14	B		mg/Kg	0.05	0.3	08/03/09 18:24	erf
Calcium, total (3050)	M6010B ICP	213000		*	mg/Kg	100	500	08/03/09 11:14	ear
Chromium, total (3050)	M6010B ICP	3	B		mg/Kg	1	5	07/31/09 13:36	ear
Cobalt, total (3050)	M6010B ICP		U		mg/Kg	1	5	07/31/09 13:36	ear
Copper, total (3050)	M6010B ICP	3	B		mg/Kg	1	5	07/31/09 13:36	ear
Gallium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	07/31/09 13:36	ear
Iron, total (3050)	M6010B ICP	4640			mg/Kg	10	30	08/03/09 11:14	ear
Lead, total (3050)	M6020 ICP-MS	3.86			mg/Kg	0.05	0.3	08/03/09 18:24	erf
Lithium, total (3050)	M6010B ICP		U		mg/Kg	2	10	07/31/09 13:36	ear
Magnesium, total (3050)	M6010B ICP	131000			mg/Kg	100	500	08/03/09 11:14	ear
Manganese, total (3050)	M6010B ICP	361			mg/Kg	0.5	3	07/31/09 13:36	ear
Mercury, total	M7471A CVAA		UH	*	mg/Kg	0.03	0.2	07/21/09 18:41	pmc
Molybdenum, total (3050)	M6010B ICP		U	*	mg/Kg	5	30	08/03/09 11:14	ear
Nickel, total (3050)	M6010B ICP		U		mg/Kg	1	5	07/31/09 13:36	ear
Potassium, total (3050)	M6010B ICP	2570		*	mg/Kg	30	200	07/31/09 13:36	ear
Scandium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	07/31/09 13:36	ear
Selenium, total (3050)	M6020 ICP-MS	0.07	B		mg/Kg	0.05	0.3	08/04/09 17:18	erf
Silver, total (3050)	M6010B ICP		U		mg/Kg	1	3	07/31/09 13:36	ear
Sodium, total (3050)	M6010B ICP	30	B		mg/Kg	30	200	07/31/09 13:36	ear
Strontium, total (3050)	M6010B ICP	61			mg/Kg	1	5	07/31/09 13:36	ear
Thallium, total (3050)	M6010B ICP		U		mg/Kg	30	100	07/31/09 13:36	ear
Tin, total (3050)	M6010B ICP		U		mg/Kg	10	50	07/31/09 13:36	ear
Titanium, total (3050)	M6010B ICP	120			mg/Kg	0.5	3	07/31/09 13:36	ear
Vanadium, total (3050)	M6010B ICP	5.8		*	mg/Kg	0.5	3	07/31/09 13:36	ear
Zinc, total (3050)	M6010B ICP	7		*	mg/Kg	1	5	07/31/09 13:36	ear

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CM09-01

ACZ Sample ID: ***L77034-01***
Date Sampled: *02/25/09 00:00*
Date Received: *07/20/09*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	3	B		t CaCO3/Kt	1	5	08/05/09 16:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	1040			t CaCO3/Kt	1	5	08/05/09 16:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	1040			t CaCO3/Kt	1	5	08/05/09 16:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	104		*	%	0.1	0.5	07/30/09 0:15	mjc
Solids, Percent	CLPSOW390, PART F, D-98	99.9		*	%	0.1	0.5	07/21/09 6:26	itk/brd
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		0.02	B	*	%	0.01	0.1	07/29/09 0:00	mjc
Sulfur HNO3 Residue			U	*	%	0.01	0.1	07/29/09 0:00	mjc
Sulfur Organic Residual Mod			U	*	%	0.01	0.1	07/29/09 0:00	mjc
Sulfur Pyritic Sulfide		0.02	B	*	%	0.01	0.1	07/29/09 0:00	mjc
Sulfur Sulfate		0.06	B	*	%	0.01	0.1	07/29/09 0:00	mjc
Sulfur Total		0.08	B	*	%	0.01	0.1	07/29/09 0:00	mjc
Total Sulfur minus Sulfate		0.02	B	*	%	0.01	0.1	07/29/09 0:00	mjc

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							07/20/09 10:45	itk
Crush and Pulverize	USDA No. 1, 1972							07/27/09 10:45	brd/bsu
Digestion - Hot Plate	M3050B ICP							07/30/09 10:30	mjc
Digestion - Hot Plate	M3050B ICP-MS							07/30/09 10:30	mjc

Note: This report is for the re-analysis of the sample previously reported as ACZ project L74714-01.

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CW09-01

ACZ Sample ID: ***L77034-02***
Date Sampled: *02/25/09 00:00*
Date Received: *07/20/09*
Sample Matrix: *Soil*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, total (3050)	M6010B ICP	22800		*	mg/Kg	3	20	07/31/09 13:39	ear
Antimony, total (3050)	M6020 ICP-MS		U		mg/Kg	0.2	1	08/03/09 18:29	erf
Arsenic, total (3050)	M6020 ICP-MS	3.9		*	mg/Kg	0.3	1	08/03/09 18:29	erf
Barium, total (3050)	M6010B ICP	25.0			mg/Kg	0.3	2	07/31/09 13:39	ear
Beryllium, total (3050)	M6020 ICP-MS	0.29	B		mg/Kg	0.05	0.3	08/03/09 18:29	erf
Bismuth, total (3050)	M6010B ICP		U	*	mg/Kg	80	400	08/03/09 15:14	ear
Boron, total (3050)	M6010B ICP		U	*	mg/Kg	20	100	08/03/09 11:18	ear
Cadmium, total (3050)	M6020 ICP-MS	0.22	B		mg/Kg	0.05	0.3	08/03/09 18:29	erf
Calcium, total (3050)	M6010B ICP	17500		*	mg/Kg	400	2000	08/03/09 11:18	ear
Chromium, total (3050)	M6010B ICP		U	*	mg/Kg	20	100	08/03/09 15:14	ear
Cobalt, total (3050)	M6010B ICP		U		mg/Kg	20	100	08/03/09 11:18	ear
Copper, total (3050)	M6010B ICP	640		*	mg/Kg	20	100	08/03/09 11:18	ear
Gallium, total (3050)	M6010B ICP		U	*	mg/Kg	200	1000	08/03/09 15:14	ear
Iron, total (3050)	M6010B ICP	140000		*	mg/Kg	40	100	08/03/09 11:18	ear
Lead, total (3050)	M6020 ICP-MS	4.69			mg/Kg	0.05	0.3	08/03/09 18:29	erf
Lithium, total (3050)	M6010B ICP	7	B		mg/Kg	2	10	07/31/09 13:39	ear
Magnesium, total (3050)	M6010B ICP	82400			mg/Kg	20	100	07/31/09 13:39	ear
Manganese, total (3050)	M6010B ICP	500			mg/Kg	10	50	08/03/09 11:18	ear
Mercury, total	M7471A CVAA		UH	*	mg/Kg	0.04	0.2	07/21/09 18:44	pmc
Molybdenum, total (3050)	M6010B ICP		U		mg/Kg	20	100	08/03/09 11:18	ear
Nickel, total (3050)	M6010B ICP		U	*	mg/Kg	20	100	08/03/09 11:18	ear
Potassium, total (3050)	M6010B ICP	6390		*	mg/Kg	30	200	07/31/09 13:39	ear
Scandium, total (3050)	M6010B ICP		U	*	mg/Kg	10	50	07/31/09 13:39	ear
Selenium, total (3050)	M6020 ICP-MS	3.21			mg/Kg	0.05	0.3	08/04/09 17:22	erf
Silver, total (3050)	M6010B ICP		U	*	mg/Kg	20	50	08/03/09 11:18	ear
Sodium, total (3050)	M6010B ICP	1070			mg/Kg	30	200	07/31/09 13:39	ear
Strontium, total (3050)	M6010B ICP	54			mg/Kg	1	5	07/31/09 13:39	ear
Thallium, total (3050)	M6010B ICP		U		mg/Kg	600	2000	08/03/09 11:18	ear
Tin, total (3050)	M6010B ICP		U		mg/Kg	200	1000	08/03/09 11:18	ear
Titanium, total (3050)	M6010B ICP	1000		*	mg/Kg	10	50	08/03/09 11:18	ear
Vanadium, total (3050)	M6010B ICP	40	B	*	mg/Kg	10	50	08/03/09 15:14	ear
Zinc, total (3050)	M6010B ICP	80	B		mg/Kg	20	100	08/03/09 11:18	ear

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: TJV_GEN_HUMIDITY CEL
Sample ID: CW09-01

ACZ Sample ID: ***L77034-02***
Date Sampled: *02/25/09 00:00*
Date Received: *07/20/09*
Sample Matrix: *Soil*

Soil Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Acid Generation Potential (calc on Sulfur total)	M600/2-78-054 1.3	218			t CaCO3/Kt	1	5	08/05/09 16:58	calc
Acid Neutralization Potential (calc)	M600/2-78-054 1.3	252			t CaCO3/Kt	1	5	08/05/09 16:58	calc
Acid-Base Potential (calc on Sulfur total)	M600/2-78-054 1.3	34			t CaCO3/Kt	1	5	08/05/09 16:58	calc
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3	25.2		*	%	0.1	0.5	07/30/09 8:07	mjc
Solids, Percent	CLPSOW390, PART F, D-98	99.6		*	%	0.1	0.5	07/21/09 9:00	itk/brd
Sulfur Forms	M600/2-78-054 3.2.4-MOD								
Sulfur HCl Residue		2.01		*	%	0.01	0.1	07/30/09 0:00	mjc
Sulfur HNO3 Residue		0.65		*	%	0.01	0.1	07/30/09 0:00	mjc
Sulfur Organic Residual Mod		0.65		*	%	0.01	0.1	07/30/09 0:00	mjc
Sulfur Pyritic Sulfide		1.36		*	%	0.01	0.1	07/30/09 0:00	mjc
Sulfur Sulfate		4.97		*	%	0.01	0.1	07/30/09 0:00	mjc
Sulfur Total		6.98		*	%	0.01	0.1	07/30/09 0:00	mjc
Total Sulfur minus Sulfate		2.01		*	%	0.01	0.1	07/30/09 0:00	mjc

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Air Dry at 34 Degrees C	USDA No. 1, 1972							07/20/09 10:50	itk
Crush and Pulverize	USDA No. 1, 1972							07/27/09 11:00	brd/bsu
Digestion - Hot Plate	M3050B ICP							07/30/09 11:00	mjc
Digestion - Hot Plate	M3050B ICP-MS							07/30/09 11:00	mjc

Note: This report is for the re-analysis of the sample previously reported as ACZ project L74714-02.

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Aluminum, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.057	mg/L	102.9	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.09	0.09			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-9	9			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	11000		12953.4	mg/Kg		6130	15800			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	11000		12638.2	mg/Kg		6130	15800	2.5	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	557	994.9	mg/Kg	437.9	75	125			M3
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	557	997.8	mg/Kg	440.8	75	125	0.29	20	M3

Antimony, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267941													
WG267941ICV	ICV	08/03/09 17:41	MS090727-2	.02		.01825	mg/L	91.3	90	110			
WG267941ICB	ICB	08/03/09 17:47				U	mg/L		-0.0012	0.0012			
WG267830PBS	PBS	08/03/09 18:08				U	mg/Kg		-0.6	0.6			
WG267830LCSS	LCSS	08/03/09 18:13	PCN32621	81.5		111.7	mg/Kg		0	166			
WG267830LCSSD	LCSSD	08/03/09 18:19	PCN32621	81.5		108.2	mg/Kg		0	166	3.2	20	
L77047-02MS	MS	08/03/09 18:56	MS090723-2	5	.2	5.27	mg/Kg	101.4	75	125			
L77047-02MSD	MSD	08/03/09 19:01	MS090723-2	5	.2	5.53	mg/Kg	106.6	75	125	4.81	20	

Arsenic, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267941													
WG267941ICV	ICV	08/03/09 17:41	MS090727-2	.05		.05001	mg/L	100	90	110			
WG267941ICB	ICB	08/03/09 17:47				U	mg/L		-0.0015	0.0015			
WG267830PBS	PBS	08/03/09 18:08				U	mg/Kg		-0.9	0.9			
WG267830LCSS	LCSS	08/03/09 18:13	PCN32621	158		188.2	mg/Kg		129	187			RL
WG267830LCSSD	LCSSD	08/03/09 18:19	PCN32621	158		184.1	mg/Kg		129	187	2.2	20	
L77047-02MS	MS	08/03/09 18:56	MS090723-2	25.025	2.9	27.86	mg/Kg	99.7	75	125			
L77047-02MSD	MSD	08/03/09 19:01	MS090723-2	25.025	2.9	31.92	mg/Kg	116	75	125	13.58	20	

Barium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.0818	mg/L	104.1	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.009	0.009			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-0.9	0.9			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	348		348.41	mg/Kg		281	415			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	348		341.78	mg/Kg		281	415	1.9	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	99.4	145.87	mg/Kg	92.9	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	99.4	144.3	mg/Kg	89.8	75	125	1.08	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Beryllium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267941													
WG267941ICV	ICV	08/03/09 17:41	MS090727-2	.05		.04539	mg/L	90.8	90	110			
WG267941ICB	ICB	08/03/09 17:47				U	mg/L		-0.0003	0.0003			
WG267830PBS	PBS	08/03/09 18:08				U	mg/Kg		-0.15	0.15			
WG267830LCSS	LCSS	08/03/09 18:13	PCN32621	106		112.4	mg/Kg		86.5	126			
WG267830LCSSD	LCSSD	08/03/09 18:19	PCN32621	106		105.55	mg/Kg		86.5	126	6.3	20	
L77047-02MS	MS	08/03/09 18:56	MS090723-2	25.025	.1	25.575	mg/Kg	101.8	75	125			
L77047-02MSD	MSD	08/03/09 19:01	MS090723-2	25.025	.1	27.445	mg/Kg	109.3	75	125	7.05	20	

Bismuth, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		1.977	mg/L	98.9	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.12	0.12			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-12	12			
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	U	99.7	mg/Kg	99.7	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	U	100.3	mg/Kg	100.3	75	125	0.6	20	
WG267997													
WG267997ICV	ICV	08/03/09 14:47	II090721-3	2		1.941	mg/L	97.1	90	110			
WG267997ICB	ICB	08/03/09 14:50				U	mg/L		-0.12	0.12			
WG267830PBS	PBS	08/03/09 15:04				U	mg/Kg		-12	12			
L77047-01MS	MS	08/03/09 15:23	II090729-2	100	U	95.9	mg/Kg	95.9	75	125			
L77047-01MSD	MSD	08/03/09 15:33	II090729-2	100	U	97.5	mg/Kg	97.5	75	125	1.65	20	

Boron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.014	mg/L	100.7	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	136		142.6	mg/Kg		99.8	172			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	136		138.7	mg/Kg		99.8	172	2.8	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	2	50.3	mg/Kg	96.6	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	2	49.7	mg/Kg	95.4	75	125	1.2	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		2.024	mg/L	101.2	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	136		136.6	mg/Kg		99.8	172			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	136		133.5	mg/Kg		99.8	172	2.3	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	U	51.8	mg/Kg	103.6	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	U	52.4	mg/Kg	104.8	75	125	1.15	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Cadmium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267941													
WG267941ICV	ICV	08/03/09 17:41	MS090727-2	.05		.04836	mg/L	96.7	90	110			
WG267941ICB	ICB	08/03/09 17:47				U	mg/L		-0.0003	0.0003			
WG267830PBS	PBS	08/03/09 18:08				U	mg/Kg		-0.15	0.15			
WG267830LCSS	LCSS	08/03/09 18:13	PCN32621	187		205.85	mg/Kg		154	220			
WG267830LCSSD	LCSSD	08/03/09 18:19	PCN32621	187		191.1	mg/Kg		154	220	7.4	20	
L77047-02MS	MS	08/03/09 18:56	MS090723-2	25	1.28	26.43	mg/Kg	100.6	75	125			
L77047-02MSD	MSD	08/03/09 19:01	MS090723-2	25	1.28	28.18	mg/Kg	107.6	75	125	6.41	20	

Calcium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	100		100.45	mg/L	100.5	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.6	0.6			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-60	60			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	9650		9822	mg/Kg		7800	11500			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	9650		9686	mg/Kg		7800	11500	1.4	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	6799.734	73500	77429	mg/Kg	57.8	75	125			M3
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	6799.734	73500	76957	mg/Kg	50.8	75	125	0.61	20	M3

Chromium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.001	mg/L	100.1	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	89.5		89.4	mg/Kg		70.5	108			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	89.5		86.7	mg/Kg		70.5	108	3.1	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	212	269.4	mg/Kg	114.8	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	212	267.2	mg/Kg	110.4	75	125	0.82	20	
WG267997													
WG267997ICV	ICV	08/03/09 14:47	II090721-3	2		1.886	mg/L	94.3	90	110			
WG267997ICB	ICB	08/03/09 14:50				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 15:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 15:07	PCN32621	89.5		86.6	mg/Kg		70.5	108			
WG267830LCSSD	LCSSD	08/03/09 15:10	PCN32621	89.5		83.1	mg/Kg		70.5	108	4.1	20	
L77047-01MS	MS	08/03/09 15:23	II090729-2	50	204	259	mg/Kg	110	75	125			
L77047-01MSD	MSD	08/03/09 15:33	II090729-2	50	204	255.2	mg/Kg	102.4	75	125	1.48	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Cobalt, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2.002		2.035	mg/L	101.6	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	277		276	mg/Kg		224	330			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	277		263.9	mg/Kg		224	330	4.5	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	U	43.8	mg/Kg	87.6	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	U	44.1	mg/Kg	88.2	75	125	0.68	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2.002		1.968	mg/L	98.3	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	277		277.8	mg/Kg		224	330			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	277		266.1	mg/Kg		224	330	4.3	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	U	47.5	mg/Kg	95	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	U	47.3	mg/Kg	94.6	75	125	0.42	20	

Copper, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.019	mg/L	101	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	129		128.3	mg/Kg		108	151			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	129		124.2	mg/Kg		108	151	3.2	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	4	52.3	mg/Kg	96.6	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	4	51.8	mg/Kg	95.6	75	125	0.96	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		1.99	mg/L	99.5	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	129		126.5	mg/Kg		108	151			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	129		123.3	mg/Kg		108	151	2.6	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	6	56.3	mg/Kg	100.6	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	6	56.6	mg/Kg	101.2	75	125	0.53	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Gallium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.06	mg/L	103	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.3	0.3			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-30	30			
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	U	103	mg/Kg	103	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	U	104	mg/Kg	104	75	125	0.97	20	
WG267997													
WG267997ICV	ICV	08/03/09 14:47	II090721-3	2		1.93	mg/L	96.5	90	110			
WG267997ICB	ICB	08/03/09 14:50				U	mg/L		-0.3	0.3			
WG267830PBS	PBS	08/03/09 15:04				U	mg/Kg		-30	30			
L77047-01MS	MS	08/03/09 15:23	II090729-2	100	U	102	mg/Kg	102	75	125			
L77047-01MSD	MSD	08/03/09 15:33	II090729-2	100	U	103	mg/Kg	103	75	125	0.98	20	

Iron, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		1.952	mg/L	97.6	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.06	0.06			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-6	6			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	18600		18807.8	mg/Kg		9380	27700			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	18600		18173.6	mg/Kg		9380	27700	3.4	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	100	2200	2302.5	mg/Kg	102.5	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	100	2200	2287.4	mg/Kg	87.4	75	125	0.66	20	

Lead, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267941													
WG267941ICV	ICV	08/03/09 17:41	MS090727-2	.05		.04671	mg/L	93.4	90	110			
WG267941ICB	ICB	08/03/09 17:47				U	mg/L		-0.0003	0.0003			
WG267830PBS	PBS	08/03/09 18:08				U	mg/Kg		-0.15	0.15			
WG267830LCSS	LCSS	08/03/09 18:13	PCN32621	172		174.55	mg/Kg		136	207			
WG267830LCSSD	LCSSD	08/03/09 18:19	PCN32621	172		161.8	mg/Kg		136	207	7.6	20	
L77047-02MS	MS	08/03/09 18:56	MS090723-2	25.025	.57	25.74	mg/Kg	100.6	75	125			
L77047-02MSD	MSD	08/03/09 19:01	MS090723-2	25.025	.57	27.575	mg/Kg	107.9	75	125	6.88	20	

Lithium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.065	mg/L	103.3	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.06	0.06			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-6	6			
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	U	111	mg/Kg	111	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	U	109.4	mg/Kg	109.4	75	125	1.45	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Magnesium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	100		101.22	mg/L	101.2	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.6	0.6			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-60	60			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	5030		5284	mg/Kg		3960	6100			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	5030		5100	mg/Kg		3960	6100	3.5	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	5000.889	3110	7869	mg/Kg	95.2	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	5000.889	3110	7868	mg/Kg	95.1	75	125	0.01	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	100		102.05	mg/L	102.1	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.6	0.6			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-60	60			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	5030		5444	mg/Kg		3960	6100			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	5030		5282	mg/Kg		3960	6100	3	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	5000.889	3180	8217	mg/Kg	100.7	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	5000.889	3180	8280	mg/Kg	102	75	125	0.76	20	

Manganese, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.0048	mg/L	100.2	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	633		636.01	mg/Kg		518	747			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	633		606.02	mg/Kg		518	747	4.8	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	58.9	104.67	mg/Kg	91.5	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	58.9	104.64	mg/Kg	91.5	75	125	0.03	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		1.9655	mg/L	98.3	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	633		635.65	mg/Kg		518	747			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	633		606.35	mg/Kg		518	747	4.7	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	61.8	111.98	mg/Kg	100.4	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	61.8	111.61	mg/Kg	99.6	75	125	0.33	20	

Mercury, total M7471A CVAA

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267280													
WG267280ICV	ICV	07/21/09 18:19	II090623-5	.01		.01019	mg/L	101.9	90	110			
WG267280ICB	ICB	07/21/09 18:21				U	mg/L		-0.0006	0.0006			
WG267280PBS	PBS	07/21/09 18:24				U	mg/Kg		-0.12	0.12			
WG267280LCSS	LCSS	07/21/09 18:26	PCN30762	6.24		6.11	mg/Kg		4.44	8.03			
WG267280LCSSD	LCSSD	07/21/09 18:28	PCN30762	6.24		6.39	mg/Kg		4.44	8.03	4.5	20	
L76913-01MS	MS	07/21/09 18:32	II090721-8	1.33	U	1.335	mg/Kg	100.4	85	115			
L76913-01MSD	MSD	07/21/09 18:35	II090721-8	1.31	U	1.327	mg/Kg	101.3	85	115	0.6	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Molybdenum, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		2.049	mg/L	102.5	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	80.4		86.3	mg/Kg		64	96.8			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	80.4		86.8	mg/Kg		64	96.8	0.6	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	4	53.1	mg/Kg	98.2	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	4	55.3	mg/Kg	102.6	75	125	4.06	20	

Neutralization Potential as CaCO3 M600/2-78-054 3.2.3

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267718													
WG267718LCSS	LCSS	07/29/09 16:22	PCN20880	100		86.78	%	86.8	80	120			
L77034-02DUP	DUP	07/30/09 16:00			25.2	25.09	%				0.4	20	

Nickel, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2.002		2.003	mg/L	100	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	99		99.3	mg/Kg		80.4	118			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	99		94.8	mg/Kg		80.4	118	4.6	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	10	53.4	mg/Kg	86.8	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	10	53.7	mg/Kg	87.4	75	125	0.56	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2.002		1.923	mg/L	96.1	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	99		97.9	mg/Kg		80.4	118			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	99		94.9	mg/Kg		80.4	118	3.1	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	11	56.1	mg/Kg	90.2	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	11	55.6	mg/Kg	89.2	75	125	0.9	20	

Potassium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	20		21.24	mg/L	106.2	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.9	0.9			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-90	90			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	4010		4468	mg/Kg		2950	5070			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	4010		4473	mg/Kg		2950	5070	0.1	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	10000.31	190	10723	mg/Kg	105.3	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	10000.31	190	10614	mg/Kg	104.2	75	125	1.02	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Scandium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.06	mg/L	103	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.3	0.3			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-30	30			
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	U	97	mg/Kg	97	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	U	97	mg/Kg	97	75	125	0	20	

Selenium, total (3050) M6020 ICP-MS

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG268074													
WG268074ICV	ICV	08/04/09 16:47	MS090727-2	.05		.05003	mg/L	100.1	90	110			
WG268074ICB	ICB	08/04/09 16:51				U	mg/L		-0.0003	0.0003			
WG267830PBS	PBS	08/04/09 17:06				U	mg/Kg		-0.15	0.15			
WG267830LCSS	LCSS	08/04/09 17:10	PCN32621	148		141	mg/Kg		116	179			
WG267830LCSSD	LCSSD	08/04/09 17:14	PCN32621	148		138.7	mg/Kg		116	179	1.6	20	
L77047-02MS	MS	08/04/09 17:41	MS090529-3	12.5125	.57	11.025	mg/Kg	83.6	75	125			
L77047-02MSD	MSD	08/04/09 17:45	MS090529-3	12.5125	.57	10.43	mg/Kg	78.8	75	125	5.55	20	

Silver, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	1.002		.993	mg/L	99.1	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	66		57.5	mg/Kg		43.7	88.2			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	66		57.2	mg/Kg		43.7	88.2	0.5	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	U	44.6	mg/Kg	89.2	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	U	44.6	mg/Kg	89.2	75	125	0	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	1.002		1.015	mg/L	101.3	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	66		49.2	mg/Kg		43.7	88.2			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	66		49.3	mg/Kg		43.7	88.2	0.2	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	U	51.5	mg/Kg	103	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	U	52	mg/Kg	104	75	125	0.97	20	

Sodium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	100		106.51	mg/L	106.5	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.9	0.9			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-90	90			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	883		961	mg/Kg		651	1110			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	883		923	mg/Kg		651	1110	4	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	9997.081	120	10644	mg/Kg	105.3	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	9997.081	120	10550	mg/Kg	104.3	75	125	0.89	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Solids, Percent CLPSOW390, PART F, D-98

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267137													
WG267137PBS	PBS	07/20/09 10:00				U	%		99.9	100.1			
L77026-01DUP	DUP	07/20/09 20:13			49.3	48.78	%				1.1	20	

Strontium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.143	mg/L	107.2	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	176		193.9	mg/Kg		143	209			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	176		186.6	mg/Kg		143	209	3.8	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	107	155	mg/Kg	96	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	107	153.7	mg/Kg	93.4	75	125	0.84	20	

Sulfur Organic Residual Mod M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267721													
L77034-02DUP	DUP	07/30/09 15:15			.65	.76	%				15.6	20	

Sulfur Pyritic Sulfide M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267721													
L77034-02DUP	DUP	07/30/09 15:15			1.36	1.3	%				4.5	20	

Sulfur Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267721													
L77034-02DUP	DUP	07/30/09 15:15			4.97	5.04	%				1.4	20	

Sulfur Total M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267721													
WG267721PBS	PBS	07/29/09 8:30				U	%		-0.03	0.03			
WG267721LCSS	LCSS	07/29/09 16:11	PCN32051	4.24		4.3	%	101.4	80	120			
L77034-02DUP	DUP	07/30/09 15:15			6.98	7.1	%				1.7	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Thallium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	4		4.23	mg/L	105.8	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.9	0.9			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-90	90			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	268		260	mg/Kg		208	328			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	268		250	mg/Kg		208	328	3.9	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	200	U	182	mg/Kg	91	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	200	U	184	mg/Kg	92	75	125	1.09	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	4		4.29	mg/L	107.3	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.9	0.9			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-90	90			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	268		288	mg/Kg		208	328			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	268		272	mg/Kg		208	328	5.7	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	200	U	191	mg/Kg	95.5	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	200	U	200	mg/Kg	100	75	125	4.6	20	

Tin, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.03	mg/L	101.5	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.3	0.3			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-30	30			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	123		122	mg/Kg		97.2	148			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	123		115	mg/Kg		97.2	148	5.9	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	U	97	mg/Kg	97	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	U	98	mg/Kg	98	75	125	1.03	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		2.04	mg/L	102	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.3	0.3			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-30	30			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	123		121	mg/Kg		97.2	148			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	123		120	mg/Kg		97.2	148	0.8	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	100	U	104	mg/Kg	104	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	100	U	103	mg/Kg	103	75	125	0.97	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Titanium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.058	mg/L	102.9	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	448		650.15	mg/Kg		176	720			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	448		637.04	mg/Kg		176	720	2	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	100	6.3	103.83	mg/Kg	97.5	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	100	6.3	103.46	mg/Kg	97.2	75	125	0.36	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		2.0505	mg/L	102.5	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	448		660.38	mg/Kg		176	720			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	448		645.3	mg/Kg		176	720	2.3	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	100	7	109.75	mg/Kg	102.8	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	100	7	109.66	mg/Kg	102.7	75	125	0.08	20	

Total Sulfur Minus Sulfate M600/2-78-054 3.2.4-MOD

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267721													
L77034-02DUP	DUP	07/30/09 15:15			2.01	2.06	%				2.5	20	

Vanadium, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		2.0443	mg/L	102.2	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	194		201.15	mg/Kg		154	233			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	194		196.78	mg/Kg		154	233	2.2	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	10.5	57.32	mg/Kg	93.6	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	10.5	57.08	mg/Kg	93.2	75	125	0.42	20	
WG267997													
WG267997ICV	ICV	08/03/09 14:47	II090721-3	2		1.9507	mg/L	97.5	90	110			
WG267997ICB	ICB	08/03/09 14:50				U	mg/L		-0.015	0.015			
WG267830PBS	PBS	08/03/09 15:04				U	mg/Kg		-1.5	1.5			
WG267830LCSS	LCSS	08/03/09 15:07	PCN32621	194		191.5	mg/Kg		154	233			
WG267830LCSSD	LCSSD	08/03/09 15:10	PCN32621	194		186.18	mg/Kg		154	233	2.8	20	
L77047-01MS	MS	08/03/09 15:23	II090729-2	50	10.1	54.35	mg/Kg	88.5	75	125			
L77047-01MSD	MSD	08/03/09 15:33	II090729-2	50	10.1	53.59	mg/Kg	87	75	125	1.41	20	

Timberline Resources Corp. ACZ Project ID: ***L77034***

Project ID: TJV_GEN_HUMIDITY CEL

Zinc, total (3050) M6010B ICP

ACZ ID	Type	Analyzed	PCN/SCN	QC	Sample	Found	Units	Rec	Lower	Upper	RPD	Limit	Qual
WG267916													
WG267916ICV	ICV	07/31/09 13:06	II090721-3	2		1.998	mg/L	99.9	90	110			
WG267916ICB	ICB	07/31/09 13:09				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	07/31/09 13:23				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	07/31/09 13:26	PCN32621	394		370.7	mg/Kg		317	470			
WG267830LCSSD	LCSSD	07/31/09 13:29	PCN32621	394		361.6	mg/Kg		317	470	2.5	20	
L77047-01MS	MS	07/31/09 13:55	II090729-2	50	21	63.9	mg/Kg	85.8	75	125			
L77047-01MSD	MSD	07/31/09 13:59	II090729-2	50	21	64.2	mg/Kg	86.4	75	125	0.47	20	
WG267973													
WG267973ICV	ICV	08/03/09 10:49	II090721-3	2		1.96	mg/L	98	90	110			
WG267973ICB	ICB	08/03/09 10:52				U	mg/L		-0.03	0.03			
WG267830PBS	PBS	08/03/09 11:04				U	mg/Kg		-3	3			
WG267830LCSS	LCSS	08/03/09 11:08	PCN32621	394		375.9	mg/Kg		317	470			
WG267830LCSSD	LCSSD	08/03/09 11:11	PCN32621	394		368.5	mg/Kg		317	470	2	20	
L77047-01MS	MS	08/03/09 11:28	II090729-2	50	22	68.6	mg/Kg	93.2	75	125			
L77047-01MSD	MSD	08/03/09 11:31	II090729-2	50	22	68.8	mg/Kg	93.6	75	125	0.29	20	

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L77034***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L77034-01	WG267916	Aluminum, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG267941	Arsenic, total (3050)	M6020 ICP-MS	RL	Recovery for either the LCS or LCS duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG267973	Calcium, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG267280	Mercury, total	M7471A CVAA	H3	Sample was received and analyzed past holding time.
			M7471A CVAA	N1	See Case Narrative.
	WG267973	Molybdenum, total (3050)	M6010B ICP	DB	Sample required dilution due to low bias result.
	WG267916	Potassium, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
		Vanadium, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
		Zinc, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.

Timberline Resources Corp. ACZ Project ID: ***L77034***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L77034-02	WG267916	Aluminum, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG267941	Arsenic, total (3050)	M6020 ICP-MS	RL	Recovery for either the LCS or LCS duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG267973	Boron, total (3050)	M6010B ICP	DB	Sample required dilution due to low bias result.
			M6010B ICP	EA	Concentration estimated. Analytical result was less than the negative MDL due to matrix interferences.
		Calcium, total (3050)	M6010B ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
			M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG267997	Chromium, total (3050)	M6010B ICP	ZH	Serial Dilution exceeded the acceptance criteria. Matrix interference [physical or chemical] is suspected.
	WG267973	Copper, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
		Iron, total (3050)	M6010B ICP	D2	Sample required dilution. Target analyte exceeded calibration range.
	WG267280	Mercury, total	M7471A CVAA	H3	Sample was received and analyzed past holding time.
			M7471A CVAA	N1	See Case Narrative.
	WG267973	Nickel, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG267916	Potassium, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG267973	Silver, total (3050)	M6010B ICP	DB	Sample required dilution due to low bias result.
			M6010B ICP	EA	Concentration estimated. Analytical result was less than the negative MDL due to matrix interferences.
		Titanium, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.
	WG267997	Vanadium, total (3050)	M6010B ICP	ZG	The ICP Serial Dilution was not used for data validation because the sample concentration was less than 50 times the MDL.

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Bismuth, total (3050)	M6010B ICP
Gallium, total (3050)	M6010B ICP
Scandium, total (3050)	M6010B ICP

Soil Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.	
Neutralization Potential as CaCO3	M600/2-78-054 3.2.3
Solids, Percent	CLPSOW390, PART F, D-98
Sulfur Forms	M600/2-78-054 3.2.4-MOD

L77034 - Relog

ACZ Laboratories, Inc. ~~L74714~~ L77034-20-09

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SILVERWOOD CT. HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE &
~~Project/PO #:~~ TJV-GEN-HUMIDITY CELL PRICING - 2009 RLS.
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

	SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSIS	HUMIDITY CELL					
-01	Cm09-01	2-25-09 (10)	other	1	✓	✓	✓					
		~~2-25-09 (AM)~~										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS/(COARSE) REJECTS TO TIMBERLINE RESOURCES

COPY

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC KLEPFER	3-2-09 (3PM)	LOG	3-5-09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg 2

L77034-Relog

ACZ Laboratories, Inc. L77711

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT. HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-RESOURCES.COM
Address: 101 E. LAKESIDE AVE COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE &
~~Project/PO #:~~ TJV_GENERIC_HUMIDITY CORE Pricing 2009 KS
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED *(attach list or use quote number)*

	SAMPLE IDENTIFICATION	DATE:TIME	Matrix	# of Containers	METALS	SOIL ANALYSES	HUMIDITY CORE					
-02.	GW09-01	2.25.09 (11)	other	1	✓	✓	✓					

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - pulps & (COARSE) REJECT TO TIMBERLINE

COPY

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY:	DATE:TIME	RECEIVED BY:	DATE:TIME
ERIC Klepfer	3-2-09 (3PM)	[illegible]	3-5-09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg1

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 02, 2009

Report to:
Eric Klepfer
Klepfer Mining Services LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Bill to:
Craig Crowell
Timberline Resources Corp.
101 E. Lakeside Ave.
Coeur d'Alene, ID 83814

cc: Art Glover

Project ID: Humidity Cell
ACZ Project ID: L78193

Eric Klepfer:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on September 16, 2009. This project has been assigned to ACZ's project number, L78193. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L78193. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 02, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp.

November 02, 2009

Project ID: Humidity Cell
ACZ Project ID: L78193

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 5 soil samples from Timberline Resources Corp. on September 16, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L78193. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. This report constitutes reanalysis of the previously reported ACZ project, L75257. The only significant differences found involved Conductivity results. Associated workgroups were re-reviewed and no exception were noted. There will be no charge.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CW09-01

ACZ Sample ID: ***L78193-01***
Date Sampled: *02/25/09 11:00*
Date Received: *09/16/09*
Sample Matrix: *Soil*

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Humidity Cell Test	M600 12-78-054							09/22/09 8:00	brd

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CW09-01 WEEK 1

ACZ Sample ID: ***L78193-02***
Date Sampled: *09/29/09 00:00*
Date Received: *09/29/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.09	B	*	mg/L	0.03	0.2	10/01/09 10:58	ear
Antimony, dissolved	M200.8 ICP-MS	0.0005	B	*	mg/L	0.0004	0.002	10/07/09 9:16	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0022		*	mg/L	0.0005	0.002	10/07/09 9:16	erf
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	10/02/09 15:46	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/01/09 10:58	ear
Boron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.01	0.05	10/01/09 10:58	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 9:16	erf
Calcium, dissolved	M200.7 ICP	9.9		*	mg/L	0.2	1	10/01/09 10:58	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/01/09 10:58	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/01/09 10:58	ear
Iron, dissolved	M200.7 ICP	0.09		*	mg/L	0.02	0.05	10/01/09 10:58	ear
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 9:16	erf
Magnesium, dissolved	M200.7 ICP	14.4		*	mg/L	0.2	1	10/01/09 10:58	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/01/09 10:58	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/06/09 17:01	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/05/09 19:07	aeh
Potassium, dissolved	M200.7 ICP	7.6		*	mg/L	0.3	2	10/01/09 10:58	ear
Selenium, dissolved	M200.8 ICP-MS	0.0005		*	mg/L	0.0001	0.0005	10/07/09 20:52	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/02/09 15:46	aeh
Sodium, dissolved	M200.7 ICP	3.1		*	mg/L	0.3	2	10/01/09 10:58	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 20:52	erf
Zinc, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	10/01/09 10:58	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		30		*	mg/L	2	20	09/29/09 0:00	abm
Carbonate as CaCO3		4	B	*	mg/L	2	20	09/29/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/29/09 0:00	abm
Total Alkalinity		34		*	mg/L	2	20	09/29/09 0:00	abm
Conductivity @25C	SM2510B	222		*	umhos/cm	1	10	09/29/09 13:20	brd
pH (lab)	SM4500H+ B								
pH		9.1		*	units	0.1	0.1	09/29/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	09/29/09 0:00	brd
Sulfate	375.4 - Turbidimetric	36		*	mg/L	5	30	10/09/09 12:50	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CW09-01 WEEK 2

ACZ Sample ID: ***L78193-03***
Date Sampled: *10/06/09 00:00*
Date Received: *10/07/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP		U	*	mg/L	0.03	0.2	10/09/09 19:47	aeh
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.002	0.01	10/14/09 9:19	erf
Arsenic, dissolved	M200.8 ICP-MS	0.004	B	*	mg/L	0.003	0.01	10/14/09 9:19	erf
Barium, dissolved	M200.7 ICP	0.008	B	*	mg/L	0.003	0.02	10/09/09 19:47	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/09/09 19:47	aeh
Boron, dissolved	M200.7 ICP	0.18		*	mg/L	0.01	0.05	10/09/09 19:47	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.003	10/14/09 9:19	erf
Calcium, dissolved	M200.7 ICP	6.0		*	mg/L	0.2	1	10/09/09 19:47	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/09/09 19:47	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/09/09 19:47	aeh
Iron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.02	0.05	10/09/09 19:47	aeh
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.003	10/14/09 9:19	erf
Magnesium, dissolved	M200.7 ICP	4.7		*	mg/L	0.2	1	10/09/09 19:47	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/09/09 19:47	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/14/09 19:37	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/13/09 18:58	ear
Potassium, dissolved	M200.7 ICP	3.3		*	mg/L	0.3	2	10/09/09 19:47	aeh
Selenium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.003	10/14/09 9:19	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/14/09 13:09	ear
Sodium, dissolved	M200.7 ICP	0.6	B	*	mg/L	0.3	2	10/09/09 19:47	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0005	0.003	10/14/09 9:19	erf
Zinc, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	10/09/09 19:47	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		34		*	mg/L	2	20	10/08/09 0:00	jlf
Carbonate as CaCO3		3	B	*	mg/L	2	20	10/08/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	10/08/09 0:00	jlf
Total Alkalinity		37		*	mg/L	2	20	10/08/09 0:00	jlf
Conductivity @25C	SM2510B	246		*	umhos/cm	1	10	10/06/09 13:20	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	10/06/09 0:00	brd
pH measured at		21.0		*	C	0.1	0.1	10/06/09 0:00	brd
Sulfate	375.4 - Turbidimetric	46		*	mg/L	5	30	10/09/09 12:50	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CW09-01 WEEK 3

ACZ Sample ID: ***L78193-04***
Date Sampled: *10/13/09 00:00*
Date Received: *10/13/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.03	0.2	10/15/09 21:10	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0004	0.002	10/20/09 6:23	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0050		*	mg/L	0.0005	0.002	10/20/09 6:23	erf
Barium, dissolved	M200.7 ICP	0.004	B	*	mg/L	0.003	0.02	10/15/09 21:10	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/15/09 21:10	ear
Boron, dissolved	M200.7 ICP	0.06		*	mg/L	0.01	0.05	10/15/09 21:10	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/20/09 6:23	erf
Calcium, dissolved	M200.7 ICP	8.4		*	mg/L	0.2	1	10/15/09 21:10	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/16/09 18:22	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/15/09 21:10	ear
Iron, dissolved	M200.7 ICP	0.06		*	mg/L	0.02	0.05	10/15/09 21:10	ear
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/20/09 6:23	erf
Magnesium, dissolved	M200.7 ICP	16.2		*	mg/L	0.2	1	10/15/09 21:10	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/15/09 21:10	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/14/09 19:44	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/16/09 18:22	aeh
Potassium, dissolved	M200.7 ICP	7.8		*	mg/L	0.3	2	10/15/09 21:10	ear
Selenium, dissolved	M200.8 ICP-MS	0.0004	B	*	mg/L	0.0001	0.0005	10/20/09 6:23	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/15/09 21:10	ear
Sodium, dissolved	M200.7 ICP	2.4		*	mg/L	0.3	2	10/15/09 21:10	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/20/09 6:23	erf
Zinc, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	10/16/09 18:22	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		33		*	mg/L	2	20	10/14/09 0:00	jjc
Carbonate as CaCO3		4	B	*	mg/L	2	20	10/14/09 0:00	jjc
Hydroxide as CaCO3			U	*	mg/L	2	20	10/14/09 0:00	jjc
Total Alkalinity		37		*	mg/L	2	20	10/14/09 0:00	jjc
Conductivity @25C	SM2510B	228		*	umhos/cm	1	10	10/13/09 16:40	brd
pH (lab)	SM4500H+ B								
pH		8.9		*	units	0.1	0.1	10/13/09 0:00	brd
pH measured at		21.0		*	C	0.1	0.1	10/13/09 0:00	brd
Sulfate	375.4 - Turbidimetric	33		*	mg/L	5	30	10/21/09 16:22	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CW09-01 WEEK 4

ACZ Sample ID: ***L78193-05***
Date Sampled: *10/20/09 00:00*
Date Received: *10/21/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.08	B	*	mg/L	0.03	0.2	10/21/09 18:40	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0004	0.002	10/26/09 20:53	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0034		*	mg/L	0.0005	0.002	10/26/09 20:53	msh
Barium, dissolved	M200.7 ICP		U	*	mg/L	0.003	0.02	10/21/09 18:40	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/21/09 18:40	ear
Boron, dissolved	M200.7 ICP	0.05	B	*	mg/L	0.01	0.05	10/21/09 18:40	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/26/09 20:53	msh
Calcium, dissolved	M200.7 ICP	8.0		*	mg/L	0.2	1	10/21/09 18:40	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/21/09 18:40	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/21/09 18:40	ear
Iron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.02	0.05	10/21/09 18:40	ear
Lead, dissolved	M200.8 ICP-MS	0.0004	B	*	mg/L	0.0001	0.0005	10/28/09 14:05	msh
Magnesium, dissolved	M200.7 ICP	13.7		*	mg/L	0.2	1	10/21/09 18:40	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/21/09 18:40	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/27/09 17:00	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/22/09 11:31	aeh
Potassium, dissolved	M200.7 ICP	6.5		*	mg/L	0.3	2	10/21/09 18:40	ear
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	10/26/09 20:53	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/21/09 18:40	ear
Sodium, dissolved	M200.7 ICP	1.6	B	*	mg/L	0.3	2	10/21/09 18:40	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/28/09 14:05	msh
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	10/21/09 18:40	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		35		*	mg/L	2	20	10/28/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	10/28/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	10/28/09 0:00	abm
Total Alkalinity		35		*	mg/L	2	20	10/28/09 0:00	abm
Conductivity @25C	SM2510B	195		*	umhos/cm	1	10	10/20/09 14:40	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	10/20/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	10/20/09 0:00	brd
Sulfate	375.4 - Turbidimetric	38		*	mg/L	1	5	10/21/09 16:16	aml

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Timberline Resources Corp. ACZ Project ID: ***L78193***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78193-02	WG271301	Boron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Calcium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Chromium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Magnesium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Manganese, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271396	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG271301	Sodium, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Zinc, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG271925	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78193-03	WG272121	Antimony, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
		Arsenic, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
		Cadmium, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
		Lead, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
		Selenium, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
	WG272147	Silver, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG271940	Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG272121	Thallium, dissolved	M200.8 ICP-MS	DJ	Sample dilution required due to insufficient sample.
	WG271925	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L78193***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78193-04	WG272109	Aluminum, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG272487	Cadmium, dissolved	M200.8 ICP-MS	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
	WG272109	Manganese, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Potassium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG272627	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78193-05	WG272635	Silver, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG272627	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Aluminum, dissolved	M200.7 ICP
Antimony, dissolved	M200.8 ICP-MS
Arsenic, dissolved	M200.8 ICP-MS
Barium, dissolved	M200.7 ICP
Beryllium, dissolved	M200.7 ICP
Boron, dissolved	M200.7 ICP
Cadmium, dissolved	M200.8 ICP-MS
Calcium, dissolved	M200.7 ICP
Chromium, dissolved	M200.7 ICP
Copper, dissolved	M200.7 ICP
Iron, dissolved	M200.7 ICP
Lead, dissolved	M200.8 ICP-MS
Magnesium, dissolved	M200.7 ICP
Manganese, dissolved	M200.7 ICP
Mercury, dissolved	M245.1 CVAA
Nickel, dissolved	M200.7 ICP
Potassium, dissolved	M200.7 ICP
Selenium, dissolved	M200.8 ICP-MS
Silver, dissolved	M200.7 ICP
Sodium, dissolved	M200.7 ICP
Thallium, dissolved	M200.8 ICP-MS
Zinc, dissolved	M200.7 ICP

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Bicarbonate as CaCO3	SM2320B - Titration
Carbonate as CaCO3	SM2320B - Titration
Conductivity @25C	SM2510B
Hydroxide as CaCO3	SM2320B - Titration
pH	SM4500H+ B
pH measured at	SM4500H+ B
Sulfate	375.4 - Turbidimetric
Total Alkalinity	SM2320B - Titration

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID: L74714
Date Received: 3/5/2009
Received By:
Date Printed: 3/6/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA7988	14.8	22
NA7987	13.7	14

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID: L74714
Date Received: 3/5/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L74714-01	CW09-01									X		
L74714-02	CM09-01									X		

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: _____

L78193-Relog
~~L75257-Relog~~ L069.16.09

ACZ Laboratories, Inc. L74711

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493 · L0604.3.09

CHAIN of CUSTODY

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT.
HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-resources.com
Address: 101 E. LAKESIDE AVE
COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION — **YOUR VOC REQUESTED (circle for volatile analysis)**

Quote #: ROCK-CORE &
~~Project/PO #:~~ TJV_GENERIC_HUMIDITY CORE Pricing
Reporting state for compliance testing: 2009 WES
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

	SAMPLE IDENTIFICATION	DATE TIME	Matrix	# of Containers	METALS	SOIL ANALYSES	HUMIDITY CORE				
-02.	CW09-01	2.25.09 (11)	other	1	✓	✓	✓				

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - pulps & (COARSE) REJECT TO TIMBERLINE

Please refer to ACZ's terms & conditions located on the reverse side of this COC.

RELINQUISHED BY	DATE TIME	RECEIVED BY	DATE TIME
ERIC Klepfer	3.2.09 (3PM)	[illegible]	3.5.09 11:10

FRMAD050.01.15.09 White - Return with sample. Yellow - Retain for your records.

pg 1

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Analytical Report

November 02, 2009

Report to:
Eric Klepfer
Klepfer Mining Services LLC
13058 Sherwood Ct.
Hayden Lake, ID 83835

Bill to:
Craig Crowell
Timberline Resources Corp.
101 E. Lakeside Ave.
Coeur d'Alene, ID 83814

cc: Art Glover

Project ID: Humidity Cell
ACZ Project ID: L78192

Eric Klepfer:

Enclosed are the analytical results for sample(s) submitted to ACZ Laboratories, Inc. (ACZ) on September 16, 2009. This project has been assigned to ACZ's project number, L78192. Please reference this number in all future inquiries.

All analyses were performed according to ACZ's Quality Assurance Plan. The enclosed results relate only to the samples received under L78192. Each section of this report has been reviewed and approved by the appropriate Laboratory Supervisor, or a qualified substitute.

Except as noted, the test results for the methods and parameters listed on ACZ's current NELAC certificate letter (#ACZ) meet all requirements of NELAC.

This report shall be used or copied only in its entirety. ACZ is not responsible for the consequences arising from the use of a partial report.

All samples and sub-samples associated with this project will be disposed of after December 02, 2009. If the samples are determined to be hazardous, additional charges apply for disposal (typically less than $10/sample). If you would like the samples to be held longer than ACZ's stated policy or to be returned, please contact your Project Manager or Customer Service Representative for further details and associated costs. ACZ retains analytical reports for five years.

If you have any questions or other needs, please contact your Project Manager.

Tony Antalek has reviewed and approved this report.

Timberline Resources Corp.

November 02, 2009

Project ID: Humidity Cell
ACZ Project ID: L78192

Sample Receipt

ACZ Laboratories, Inc. (ACZ) received 5 soil samples from Timberline Resources Corp. on September 16, 2009. The samples were received in good condition. Upon receipt, the sample custodian removed the samples from the cooler, inspected the contents, and logged the samples into ACZ's computerized Laboratory Information Management System (LIMS). The samples were assigned ACZ LIMS project number L78192. The custodian verified the sample information entered into the computer against the chain of custody (COC) forms and sample bottle labels.

Holding Times

All analyses were performed within EPA recommended holding times.

Sample Analysis

These samples were analyzed for inorganic parameters. The individual methods are referenced on both the ACZ invoice and the analytical reports. The extended qualifier reports may contain footnotes qualifying specific elements due to QC failures. In addition the following has been noted with this specific project:

1. This report constitutes reanalysis of the previously reported ACZ project, L75255. There will be no charge.

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CM09-01

ACZ Sample ID: ***L78192-01***
Date Sampled: *02/25/09 10:00*
Date Received: *09/16/09*
Sample Matrix: *Soil*

Soil Preparation

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Humidity Cell Test	M600 12-78-054							09/22/09 8:00	brd

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CM09-01 WEEK 1

ACZ Sample ID: ***L78192-02***
Date Sampled: *09/29/09 00:00*
Date Received: *09/29/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.08	B	*	mg/L	0.03	0.2	10/01/09 10:54	ear
Antimony, dissolved	M200.8 ICP-MS	0.0007	B	*	mg/L	0.0004	0.002	10/07/09 9:11	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0036		*	mg/L	0.0005	0.002	10/07/09 9:11	erf
Barium, dissolved	M200.7 ICP	0.006	B	*	mg/L	0.003	0.02	10/02/09 15:42	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/01/09 10:54	ear
Boron, dissolved	M200.7 ICP	0.07		*	mg/L	0.01	0.05	10/01/09 10:54	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 9:11	erf
Calcium, dissolved	M200.7 ICP	6.4		*	mg/L	0.2	1	10/01/09 10:54	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/01/09 10:54	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/01/09 10:54	ear
Iron, dissolved	M200.7 ICP	0.08		*	mg/L	0.02	0.05	10/01/09 10:54	ear
Lead, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 9:11	erf
Magnesium, dissolved	M200.7 ICP	4.8		*	mg/L	0.2	1	10/01/09 10:54	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/01/09 10:54	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/06/09 16:54	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/05/09 19:04	aeh
Potassium, dissolved	M200.7 ICP	2.8		*	mg/L	0.3	2	10/01/09 10:54	ear
Selenium, dissolved	M200.8 ICP-MS	0.0004	B	*	mg/L	0.0001	0.0005	10/07/09 20:47	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/02/09 15:42	aeh
Sodium, dissolved	M200.7 ICP	0.6	B	*	mg/L	0.3	2	10/01/09 10:54	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/07/09 20:47	erf
Zinc, dissolved	M200.7 ICP	0.01	B	*	mg/L	0.01	0.05	10/01/09 10:54	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		29		*	mg/L	2	20	09/29/09 0:00	abm
Carbonate as CaCO3		7	B	*	mg/L	2	20	09/29/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	09/29/09 0:00	abm
Total Alkalinity		36		*	mg/L	2	20	09/29/09 0:00	abm
Conductivity @25C	SM2510B	88		*	umhos/cm	1	10	09/29/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.2		*	units	0.1	0.1	09/29/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	09/29/09 0:00	brd
Sulfate	375.4 - Turbidimetric	4	B	*	mg/L	1	5	10/09/09 12:42	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CM09-01 WEEK 2

ACZ Sample ID: ***L78192-03***
Date Sampled: *10/06/09 00:00*
Date Received: *10/07/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.06	B	*	mg/L	0.03	0.2	10/09/09 19:44	aeh
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0004	0.002	10/14/09 9:00	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0032		*	mg/L	0.0005	0.002	10/14/09 9:00	erf
Barium, dissolved	M200.7 ICP	0.005	B	*	mg/L	0.003	0.02	10/09/09 19:44	aeh
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/09/09 19:44	aeh
Boron, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	10/09/09 19:44	aeh
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/14/09 9:00	erf
Calcium, dissolved	M200.7 ICP	8.0		*	mg/L	0.2	1	10/09/09 19:44	aeh
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/09/09 19:44	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/09/09 19:44	aeh
Iron, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.02	0.05	10/09/09 19:44	aeh
Lead, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	10/14/09 9:00	erf
Magnesium, dissolved	M200.7 ICP	17.7		*	mg/L	0.2	1	10/09/09 19:44	aeh
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/09/09 19:44	aeh
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/13/09 17:13	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/13/09 18:55	ear
Potassium, dissolved	M200.7 ICP	7.8		*	mg/L	0.3	2	10/09/09 19:44	aeh
Selenium, dissolved	M200.8 ICP-MS	0.0003	B	*	mg/L	0.0001	0.0005	10/14/09 9:00	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/14/09 13:06	ear
Sodium, dissolved	M200.7 ICP	3.1		*	mg/L	0.3	2	10/09/09 19:44	aeh
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/14/09 9:00	erf
Zinc, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.01	0.05	10/09/09 19:44	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		33		*	mg/L	2	20	10/08/09 0:00	jlf
Carbonate as CaCO3		6	B	*	mg/L	2	20	10/08/09 0:00	jlf
Hydroxide as CaCO3			U	*	mg/L	2	20	10/08/09 0:00	jlf
Total Alkalinity		39		*	mg/L	2	20	10/08/09 0:00	jlf
Conductivity @25C	SM2510B	81		*	umhos/cm	1	10	10/06/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.2		*	units	0.1	0.1	10/06/09 0:00	brd
pH measured at		21.0		*	C	0.1	0.1	10/06/09 0:00	brd
Sulfate	375.4 - Turbidimetric	3	B	*	mg/L	1	5	10/09/09 12:42	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CM09-01 WEEK 3

ACZ Sample ID: ***L78192-04***
Date Sampled: *10/13/09 00:00*
Date Received: *10/13/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.04	B	*	mg/L	0.03	0.2	10/15/09 21:06	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0004	0.002	10/14/09 9:05	erf
Arsenic, dissolved	M200.8 ICP-MS	0.0032		*	mg/L	0.0005	0.002	10/14/09 9:05	erf
Barium, dissolved	M200.7 ICP	0.009	B	*	mg/L	0.003	0.02	10/15/09 21:06	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/15/09 21:06	ear
Boron, dissolved	M200.7 ICP	0.14		*	mg/L	0.01	0.05	10/15/09 21:06	ear
Cadmium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/14/09 9:05	erf
Calcium, dissolved	M200.7 ICP	6.5		*	mg/L	0.2	1	10/15/09 21:06	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/16/09 18:19	aeh
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/15/09 21:06	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	10/15/09 21:06	ear
Lead, dissolved	M200.8 ICP-MS	0.0004	B	*	mg/L	0.0001	0.0005	10/14/09 9:05	erf
Magnesium, dissolved	M200.7 ICP	5.1		*	mg/L	0.2	1	10/15/09 21:06	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/15/09 21:06	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/20/09 17:36	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/16/09 18:19	aeh
Potassium, dissolved	M200.7 ICP	3.1		*	mg/L	0.3	2	10/15/09 21:06	ear
Selenium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	10/14/09 9:05	erf
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/15/09 21:06	ear
Sodium, dissolved	M200.7 ICP	0.5	B	*	mg/L	0.3	2	10/15/09 21:06	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/14/09 9:05	erf
Zinc, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	10/16/09 18:19	aeh

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		31		*	mg/L	2	20	10/14/09 0:00	jjc
Carbonate as CaCO3		5	B	*	mg/L	2	20	10/14/09 0:00	jjc
Hydroxide as CaCO3			U	*	mg/L	2	20	10/14/09 0:00	jjc
Total Alkalinity		37		*	mg/L	2	20	10/14/09 0:00	jjc
Conductivity @25C	SM2510B	90		*	umhos/cm	1	10	10/13/09 16:00	brd
pH (lab)	SM4500H+ B								
pH		9.0		*	units	0.1	0.1	10/13/09 0:00	brd
pH measured at		21.0		*	C	0.1	0.1	10/13/09 0:00	brd
Sulfate	375.4 - Turbidimetric	3	B	*	mg/L	1	5	10/21/09 16:16	aml

** Please refer to Qualifier Reports for details.*

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Analytical Results

Timberline Resources Corp.
Project ID: Humidity Cell
Sample ID: CM09-01 WEEK 4

ACZ Sample ID: ***L78192-05***
Date Sampled: *10/20/09 00:00*
Date Received: *10/21/09*
Sample Matrix: *Leachate*

Metals Analysis

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Aluminum, dissolved	M200.7 ICP	0.03	B	*	mg/L	0.03	0.2	10/21/09 18:37	ear
Antimony, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0004	0.002	10/26/09 20:48	msh
Arsenic, dissolved	M200.8 ICP-MS	0.0066		*	mg/L	0.0005	0.002	10/26/09 20:48	msh
Barium, dissolved	M200.7 ICP	0.009	B	*	mg/L	0.003	0.02	10/21/09 18:37	ear
Beryllium, dissolved	M200.7 ICP		U	*	mg/L	0.002	0.01	10/21/09 18:37	ear
Boron, dissolved	M200.7 ICP	0.02	B	*	mg/L	0.01	0.05	10/21/09 18:37	ear
Cadmium, dissolved	M200.8 ICP-MS	0.0002	B	*	mg/L	0.0001	0.0005	10/26/09 20:48	msh
Calcium, dissolved	M200.7 ICP	7.6		*	mg/L	0.2	1	10/21/09 18:37	ear
Chromium, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/21/09 18:37	ear
Copper, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/21/09 18:37	ear
Iron, dissolved	M200.7 ICP		U	*	mg/L	0.02	0.05	10/21/09 18:37	ear
Lead, dissolved	M200.8 ICP-MS	0.0006		*	mg/L	0.0001	0.0005	10/28/09 14:02	msh
Magnesium, dissolved	M200.7 ICP	4.4		*	mg/L	0.2	1	10/21/09 18:37	ear
Manganese, dissolved	M200.7 ICP		U	*	mg/L	0.005	0.03	10/21/09 18:37	ear
Mercury, dissolved	M245.1 CVAA		U	*	mg/L	0.0002	0.001	10/26/09 19:41	pmc
Nickel, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.05	10/22/09 11:28	aeh
Potassium, dissolved	M200.7 ICP	1.8	B	*	mg/L	0.3	2	10/21/09 18:37	ear
Selenium, dissolved	M200.8 ICP-MS	0.0001	B	*	mg/L	0.0001	0.0005	10/26/09 20:48	msh
Silver, dissolved	M200.7 ICP		U	*	mg/L	0.01	0.03	10/21/09 18:37	ear
Sodium, dissolved	M200.7 ICP	0.4	B	*	mg/L	0.3	2	10/21/09 18:37	ear
Thallium, dissolved	M200.8 ICP-MS		U	*	mg/L	0.0001	0.0005	10/28/09 14:02	msh
Zinc, dissolved	M200.7 ICP	0.10		*	mg/L	0.01	0.05	10/21/09 18:37	ear

Wet Chemistry

Parameter	EPA Method	Result	Qual	XQ	Units	MDL	PQL	Date	Analyst
Alkalinity as CaCO3	SM2320B - Titration								
Bicarbonate as CaCO3		42		*	mg/L	2	20	10/28/09 0:00	abm
Carbonate as CaCO3			U	*	mg/L	2	20	10/28/09 0:00	abm
Hydroxide as CaCO3			U	*	mg/L	2	20	10/28/09 0:00	abm
Total Alkalinity		42		*	mg/L	2	20	10/28/09 0:00	abm
Conductivity @25C	SM2510B	88		*	umhos/cm	1	10	10/20/09 10:00	brd
pH (lab)	SM4500H+ B								
pH		9.3		*	units	0.1	0.1	10/20/09 0:00	brd
pH measured at		22.0		*	C	0.1	0.1	10/20/09 0:00	brd
Sulfate	375.4 - Turbidimetric	2	B	*	mg/L	1	5	10/21/09 16:16	aml

** Please refer to Qualifier Reports for details.*

Report Header Explanations

Batch	A distinct set of samples analyzed at a specific time
Found	Value of the QC Type of interest
Limit	Upper limit for RPD, in %.
Lower	Lower Recovery Limit, in % (except for LCSS, mg/Kg)
MDL	Method Detection Limit. Same as Minimum Reporting Limit. Allows for instrument and annual fluctuations.
PCN/SCN	A number assigned to reagents/standards to trace to the manufacturer's certificate of analysis
PQL	Practical Quantitation Limit, typically 5 times the MDL.
QC	True Value of the Control Sample or the amount added to the Spike
Rec	Amount of the true value or spike added recovered, in % (except for LCSS, mg/Kg)
RPD	Relative Percent Difference, calculation used for Duplicate QC Types
Upper	Upper Recovery Limit, in % (except for LCSS, mg/Kg)
Sample	Value of the Sample of interest

QC Sample Types

AS	Analytical Spike (Post Digestion)	LCSWD	Laboratory Control Sample - Water Duplicate
ASD	Analytical Spike (Post Digestion) Duplicate	LFB	Laboratory Fortified Blank
CCB	Continuing Calibration Blank	LFM	Laboratory Fortified Matrix
CCV	Continuing Calibration Verification standard	LFMD	Laboratory Fortified Matrix Duplicate
DUP	Sample Duplicate	LRB	Laboratory Reagent Blank
ICB	Initial Calibration Blank	MS	Matrix Spike
ICV	Initial Calibration Verification standard	MSD	Matrix Spike Duplicate
ICSAB	Inter-element Correction Standard - A plus B solutions	PBS	Prep Blank - Soil
LCSS	Laboratory Control Sample - Soil	PBW	Prep Blank - Water
LCSSD	Laboratory Control Sample - Soil Duplicate	PQV	Practical Quantitation Verification standard
LCSW	Laboratory Control Sample - Water	SDL	Serial Dilution

QC Sample Type Explanations

Blanks	Verifies that there is no or minimal contamination in the prep method or calibration procedure.
Control Samples	Verifies the accuracy of the method, including the prep procedure.
Duplicates	Verifies the precision of the instrument and/or method.
Spikes/Fortified Matrix	Determines sample matrix interferences, if any.
Standard	Verifies the validity of the calibration.

ACZ Qualifiers (Qual)

B	Analyte concentration detected at a value between MDL and PQL. The associated value is an estimated quantity.
H	Analysis exceeded method hold time. pH is a field test with an immediate hold time.
U	The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Method References

(1)	EPA 600/4-83-020. Methods for Chemical Analysis of Water and Wastes, March 1983.
(2)	EPA 600/R-93-100. Methods for the Determination of Inorganic Substances in Environmental Samples, August 1993.
(3)	EPA 600/R-94-111. Methods for the Determination of Metals in Environmental Samples - Supplement I, May 1994.
(5)	EPA SW-846. Test Methods for Evaluating Solid Waste, Third Edition with Update III, December 1996.
(6)	Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995 & 20th edition (1998).

Comments

(1)	QC results calculated from raw data. Results may vary slightly if the rounded values are used in the calculations.
(2)	Soil, Sludge, and Plant matrices for Inorganic analyses are reported on a dry weight basis.
(3)	Animal matrices for Inorganic analyses are reported on an "as received" basis.

For a complete list of ACZ's Extended Qualifiers, please click: http://www.acz.com/public/extquallist.pdf

Timberline Resources Corp. ACZ Project ID: ***L78192***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78192-02	WG271301	Boron, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Calcium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Chromium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Iron, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Magnesium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Manganese, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271396	Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
	WG271301	Sodium, dissolved	M200.7 ICP	M3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The recovery of the associated control sample (LCS or LFB) was acceptable.
		Zinc, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG271925	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78192-03	WG272147	Silver, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG271940	Sodium, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG271925	Sulfate	375.4 - Turbidimetric	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).
L78192-04	WG272109	Aluminum, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Manganese, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
		Potassium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
		Silver, dissolved	M200.7 ICP	M2	Matrix spike recovery was low, the recovery of the associated control sample (LCS or LFB) was acceptable.
			M200.7 ICP	ZA	Poor recovery for Silver quality control is accepted due to low Silver solubility in samples, digestates, or extracts that do not contain sufficient Hydrochloric acid.
		Sodium, dissolved	M200.7 ICP	M1	Matrix spike recovery was high, the recovery of the associated control sample (LCS or LFB) was acceptable.
	WG272627	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Inorganic Extended Qualifier Report

Timberline Resources Corp. ACZ Project ID: ***L78192***

ACZ ID	WORKNUM	PARAMETER	METHOD	QUAL	DESCRIPTION
L78192-05	WG272635	Silver, dissolved	M200.7 ICP	MA	Recovery for either the spike or spike duplicate was outside of the acceptance limits; the RPD was within the acceptance limits.
	WG272627	Sulfate	375.4 - Turbidimetric	RA	Relative Percent Difference (RPD) was not used for data validation because the sample concentration is too low for accurate evaluation (< 10x MDL).

Metals Analysis

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Aluminum, dissolved	M200.7 ICP
Antimony, dissolved	M200.8 ICP-MS
Arsenic, dissolved	M200.8 ICP-MS
Barium, dissolved	M200.7 ICP
Beryllium, dissolved	M200.7 ICP
Boron, dissolved	M200.7 ICP
Cadmium, dissolved	M200.8 ICP-MS
Calcium, dissolved	M200.7 ICP
Chromium, dissolved	M200.7 ICP
Copper, dissolved	M200.7 ICP
Iron, dissolved	M200.7 ICP
Lead, dissolved	M200.8 ICP-MS
Magnesium, dissolved	M200.7 ICP
Manganese, dissolved	M200.7 ICP
Mercury, dissolved	M245.1 CVAA
Nickel, dissolved	M200.7 ICP
Potassium, dissolved	M200.7 ICP
Selenium, dissolved	M200.8 ICP-MS
Silver, dissolved	M200.7 ICP
Sodium, dissolved	M200.7 ICP
Thallium, dissolved	M200.8 ICP-MS
Zinc, dissolved	M200.7 ICP

Wet Chemistry

The following parameters are not offered for certification or are not covered by NELAC certificate #ACZ.

Bicarbonate as CaCO3	SM2320B - Titration
Carbonate as CaCO3	SM2320B - Titration
Conductivity @25C	SM2510B
Hydroxide as CaCO3	SM2320B - Titration
pH	SM4500H+ B
pH measured at	SM4500H+ B
Sulfate	375.4 - Turbidimetric
Total Alkalinity	SM2320B - Titration

ACZ Laboratories, Inc.
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Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID: L74714
Date Received: 3/5/2009
Received By:
Date Printed: 3/6/2009

Receipt Verification

	YES	NO	NA
1) Does this project require special handling procedures such as CLP protocol?			X
2) Are the custody seals on the cooler intact?			X
3) Are the custody seals on the sample containers intact?			X
4) Is there a Chain of Custody or other directive shipping papers present?	X		
5) Is the Chain of Custody complete?	X		
6) Is the Chain of Custody in agreement with the samples received?	X		
7) Is there enough sample for all requested analyses?	X		
8) Are all samples within holding times for requested analyses?	X		
9) Were all sample containers received intact?	X		
10) Are the temperature blanks present?			X
11) Is the trip blank for Cyanide present?			X
12) Is the trip blank for VOA present?			X
13) Are samples requiring no headspace, headspace free?			X
14) Do the samples that require a Foreign Soils Permit have one?			X

Exceptions: If you answered no to any of the above questions, please describe

N/A

Contact (For any discrepancies, the client must be contacted)

N/A

Shipping Containers

Cooler Id	Temp (°C)	Rad (µR/hr)
NA7988	14.8	22
NA7987	13.7	14

Client must contact ACZ Project Manager if analysis should not proceed for samples received outside of thermal preservation acceptance criteria.

Notes

ACZ Laboratories, Inc.
2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

Sample Receipt

Timberline Resources Corp.
TJV_GENERAL_HUMIDITY

ACZ Project ID: L74714
Date Received: 3/5/2009
Received By:

Sample Container Preservation

SAMPLE	CLIENT ID	R < 2	G < 2	BK < 2	Y< 2	YG< 2	B< 2	O < 2	T >12	N/A	RAD	ID
L74714-01	CW09-01									X		
L74714-02	CM09-01									X		

Sample Container Preservation Legend

Abbreviation	Description	Container Type	Preservative/Limits
R	Raw/Nitric	RED	pH must be < 2
B	Filtered/Sulfuric	BLUE	pH must be < 2
BK	Filtered/Nitric	BLACK	pH must be < 2
G	Filtered/Nitric	GREEN	pH must be < 2
O	Raw/Sulfuric	ORANGE	pH must be < 2
P	Raw/NaOH	PURPLE	pH must be > 12 *
T	Raw/NaOH Zinc Acetate	TAN	pH must be > 12
Y	Raw/Sulfuric	YELLOW	pH must be < 2
YG	Raw/Sulfuric	YELLOW GLASS	pH must be < 2
N/A	No preservative needed	Not applicable	
RAD	Gamma/Beta dose rate	Not applicable	must be < 250 µR/hr

* pH check performed by analyst prior to sample preparation

Sample IDs Reviewed By: _____

L78192-Reloog
~~L75255-Reloog~~

ACZ Laboratories, Inc. ~~L74714~~ L64.13.09

2773 Downhill Drive Steamboat Springs, CO 80487 (800) 334-5493

CHAIN of CUSTODY

LEG 9.16.09

Report to:

Name: ERIC KLEPFER
Company: KLEPFER MINING SVC.
E-mail: eric@klepfermining.com
Address: 13058 SHERWOOD CT. HAYDEN, ID 83835
Telephone: 208-772-6993

Copy of Report to:

Name: ART GLOVER
Company: TIMBERLINE RESOURCES CORP
E-mail: glover@TIMBERLINE-RESOURCES.COM
Telephone: 208-664-4859

Invoice to:

Name: CRAIG CROWELL
Company: TIMBERLINE RESOURCES
E-mail: Crowell@timberline-Resources.com
Address: 101 E. LAKESIDE AVE COEUR d'ALENE, ID 83814
Telephone: 208-664-4859

If sample(s) received past holding time (HT), or if insufficient HT remains to complete analysis before expiration, shall ACZ proceed with requested short HT analyses? YES [ ] NO [ ]
If "NO" then ACZ will contact client for further instruction. If neither "YES" nor "NO" is indicated, ACZ will proceed with the requested analyses, even if HT is expired, and data will be qualified.

Are samples for CO DW Compliance Monitoring? YES [ ] NO [X]
If yes, please include state forms. Results will be reported to PQL.

PROJECT INFORMATION

Quote #: ROCK-CORE &
Project/PO #: TJV-GEN-HUMIDITY CELL PRICING - 2009 RES.
Reporting state for compliance testing:
Sampler's Name: ERIC KLEPFER
Are any samples NRC licensable material? Yes No

ANALYSES REQUESTED (attach list or use quote number)

	SAMPLE IDENTIFICATION	DATE TIME	Matrix	# of Containers	METALS	SOIL ANALYSIS	HUMIDITY CELL					
-01.	Cm09-01	2.25.09 (10)	other	1	✓	✓	✓					
		~~2.25.09 (11)~~										

Matrix: SW (Surface Water) · GW (Ground Water) · WW (Waste Water) · DW (Drinking Water) · SL (Sludge) · SO (Soil) · OL (Oil) · Other (Specify)

REMARKS

PREP SAMPLES - CONE & QUARTER METHOD
RETURN - PULPS/(COARSE) RESETS TO TIMBERLINE RESOURCES

When signed, refer to ACZ's terms & conditions located on the reverse side of this COC.

RELEASED BY	DATE/TIME	RECEIVED BY	DATE/TIME
ERIC KLEPFER	3.2.09 (3PM)	LBG	3.5.09 11:10

FRMAD080.01.15.09 White - Return with sample. Yellow - Retain for your records.

Pg 2

Stream Monitoring Plan 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

March 16, 2010

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1.0 Background

The Butte Highlands Project is a proposed underground gold mine located in Silver Bow County, Montana, approximately 15 miles south of Butte. The Project straddles the Continental Divide within the upper portion of the drainages of Basin Creek, Fish Creek, and Middle Fork Moose Creek (Figure 1). 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*)

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, and native, genetically pure westslope cutthroat trout in the upper 6.9 stream miles, including the upper 0.2 stream miles that are within the Main Ripple Claim (MFISH). Both species are reported to be common, year-round residents. A 2009 stream habitat survey indicated that fish are unlikely to occur in the upper 0.27 miles of Basin Creek (Figure 1, Kline Environmental Research and Klepfer Mining Services 2010).

Middle Fork Moose Creek has been mapped as originating in the Red Mountain Claim and flowing 2.7 stream miles to its confluence with Moose Creek (MFISH). 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 (MFISH). The 2009 stream survey revealed that Middle Fork Moose Creek originates down-gradient from FS Road 8250 in the Pony Placer Claim, and that the headwaters reach is isolated by wetlands and unlikely to support fish (Kline Environmental Research and Klepfer Mining Services 2010). The 2009 survey also revealed that

Tributary 1 and Tributary 1A provide a far greater quality and abundance of fish habitat than does the upper reach of Middle Fork Moose Creek (Figure 1).

Fish Creek flows 25.6 stream miles from its origin to the Jefferson River. Two unnamed tributaries to Fish Creek originate near the Project area (Figure 1). The upper limits of fish distribution in Fish Creek are reported to be 0.1 stream miles downstream of the confluence of Tributary 2. Introduced brook trout and native westslope cutthroat trout are reported to be year-round residents, but rare, in this portion of Fish Creek (MFISH). The 2009 stream habitat survey supports the assumption that the upper limit of fish occurrence may be near the confluence with Tributary 2 (Kline Environmental Research and Klepfer Mining Services 2010).

The objective of this monitoring plan is to assess potential impacts to fish-bearing streams resulting from construction and operation of the Butte Highlands Project.

2.0 General Approach

Potential impacts from the Project are partial dewatering of the upper reaches and tributaries of Basin Creek, Middle Fork Moose Creek, and Fish Creek, altered water quality in Basin Creek and Middle Fork Moose Creek, and sediment loading in Middle Fork Moose Creek. Standardized methods for the region that are designed to detect the potential impacts and can be used in the 1st and 2nd order streams in the Project area were selected. Assessment of impacts will be based on comparison of data that are collected before, during, and after construction and operation of the Project, comparison to a reference reach in Tributary 1A of Middle Fork Moose Creek, and comparison to MDEQ biotic indices for similar streams in Montana (Stribling *et al*. 2008). Fish and fish habitat surveys will be used to monitor the potential impact of dewatering in all monitoring reaches. Benthic macroinvertebrates will be used as biological indicators of potential impacts to water quality in Basin Creek and tributaries 1 and 1A to Middle Fork Moose Creek because their diversity and life histories provide the opportunity to detect a variety of acute and chronic stressors, and because of their dependence on primary productivity and role as fish prey. The fish habitat survey methods will include collection of data for assessment of sediment loading.

3.0 Methods

Monitoring methods were based on appropriate components of U.S. Forest Service (USFS) R1/R4 fish habitat inventory procedures (Overton *et al*. 1997) and the Montana Department of Environmental Quality (MDEQ) Standard Operating Procedure (SOP) for determining the health of macroinvertebrate communities for use in water quality assessments (MDEQ 2006).

3.1 Timing and Locations

To minimize seasonal variability and improve the ability to assess results of reference condition models, the MDEQ SOP specifies that data should be collected within the index period of June 21 to September 21, not during extreme runoff or drought, and as close as possible to the same date each year. The USFS methods (Overton *et al*. 1997) are designed to be conducted during baseflow conditions. Based on data from the Natural Resources Conservation Service SNOTEL station at Basin Creek (www.wcc.nrcs.usda.gov/snotel/), baseflow conditions usually occur during August or September in streams and rivers in the Butte area. Monitoring will be conducted once annually within these time constraints.

The MDEQ (2006) methods state that they are intended for use in 2nd or higher order wadeable streams, but may be used in 1st order streams when data are properly analyzed and interpreted. Due to the location of the Project on the continental divide, monitoring of 1st order streams is unavoidable if monitoring objectives are to be met. Monitoring will be conducted in four stream reaches that are likely to support resident fish populations, based on the 2009 baseline survey (Kline Environmental Research and Klepfer Mining Services 2010), and are either potentially impacted because they are down-gradient of Project activities or are up-gradient of Project activities and serve as a reference. The approximate locations of the monitoring reaches are indicated in Figure 1. Final reach locations will be determined in the field prior to the first monitoring event. Determination of impact versus reference reaches was based on surface drainage patterns. To allow assessment of benthic macroinvertebrate assemblages while minimizing the influence of habitat differences, all selected reaches include low gradient riffles, have some sections with gravel or small cobble substrate, and are mainly single channel. The four monitoring reaches will each be 1,000 feet in length. Tributary 1A to Middle Fork Moose Creek was the only reference reach that met the reach selection criteria.

Most tasks will be conducted in all four monitoring reaches (Table 1). Benthic macroinvertebrates will be collected in three riffles in each of the monitoring reaches in Basin Creek, and Middle Fork Moose Creek Tributary 1 and Tributary 1A and will be composited into one sample per reach. Periphyton will be assessed only in the riffles where benthic macroinvertebrates are collected. Substrate and canopy coverage will be assessed in three riffles in each of the four monitoring reaches.

Table 1. Summary of stream monitoring tasks.

Category	Task	Location
Habitat	R1/R4 surveys	full length all reaches
	substrate size, embeddedness, fine sediment	3 riffles all reaches
	canopy coverage	3 riffles all reaches
Biota	benthic macroinvertebrates	3 riffles in Basin Creek and in 2 Middle Fork Moose Creek reaches
	periphyton coverage	3 riffles in Basin Creek and in 2 Middle Fork Moose Creek reaches
	fish counts by species and size	full length all reaches
Other	discharge	downstream end all reaches
	temperature (air and water)	downstream end all reaches
	field pH and conductivity	downstream end all reaches
	photo points	downstream and upstream ends and 3 riffles all reaches
	observed erosion or human influence	full length all reaches

3.2 Monitoring Tasks

3.2.1 Habitat

Macrohabitat units will be categorized as cascade, step run, high gradient riffle, low gradient riffle, run, glide, or pool. The following will be quantified along each entire reach following USFS methods (Overton *et al*. 1997):

- length of habitat units;
- wetted width;
- wetted depth;
- number and depth of pocket pools;
- pool type, position, and formative feature;
- pool maximum and crest depth;
- number and depth of step pools.
- bank stability and type;
- channel shape.

The riparian cover group will be measured along each bank as an indicator of canopy coverage and future input of large woody debris. Functioning large woody debris will be tallied within each habitat unit and categorized as individuals, aggregates, or rootwads (Overton *et al.* 1997). A concave spherical densitometer will be used to measure canopy closure in three riffle habitats in each reach (Bauer and Burton 1993).

Wolman pebble counts will be conducted in three low-gradient riffles in each reach (Wolman 1954). An underwater viewing scope will be used to estimate the percent of substrate that is covered by fine grained material and the average percent embeddeness, determined without excavation.

3.2.2 Biota

Benthic macroinvertebrates will be collected from three riffles in Basin Creek and each of the two monitoring reaches in the Middle Fork Moose Creek drainage using the traveling kick method (MDEQ 2006). The three samples per reach will be combined into one for taxonomic

analysis. The selected riffles will be the same as where substrate and canopy coverage are assessed.

Periphyton coverage in the riffles where benthic macroinvertebrates are collected will be categorized on a 5-point scale ranging from light to heavy to assist in interpretation of benthic macroinvertebrate data.

Relative fish abundance by species and size class will be determined using the direct enumeration snorkeling technique (Thurow 1994, cited in Overton *et al.* 1997). Day and night snorkel surveys will be conducted from downstream to upstream, using a dive light at night. Fish species and length will be documented to the extent practical without capturing fish. Data will be tallied separately for each macrohabitat type. If portions of reaches are too shallow for snorkeling, they will be surveyed from the banks. Bank surveys will also be conducted to tally young of the year fish.

3.2.3 Other

The following will be conducted at the downstream end of each reach. Stream discharge will be measured using a flow meter based on the velocity-area principle and the six-tenths-depth method. Air temperature will be measured in the shade and away from large objects that may elevate readings. Water temperature will be measured just below the water surface and away from any apparent springs or seeps. Field pH and conductivity will be measured near the water temperature measurement location using a calibrated electronic meter.

Digital photographs will be taken at the upstream and downstream ends of each monitoring reach and at the three riffles where substrate is assessed. Any other relevant observations will also be photographed and described, including sediment sources and human influences.

4.0 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) procedures will be followed to generate unbiased data with known and traceable accuracy and precision. QA/QC guidelines will be employed during data collection, sample handling, sample analysis, and data entry.

Field data will be collected either by or under the supervision of an environmental professional. Field data will be collected in a bound field notebook with numbered pages or on data sheets that will be prepared in advance. Field data will be recorded in ball point ink. The signature of the field crew leader will accompany field data and calibration records. When field data recording errors are made, the error will be crossed out with a single line and initialed. Procedures for sample collection and related activities are described above. Changes to these procedures during sample collection will be documented in the field log book and on the field data sheets. All field measurements will be made with calibrated instruments. If instruments are not within their calibrations, they will be recalibrated and rechecked. Maintenance of instruments will be performed when necessary.

Sample custody in the field and prior to shipment will be maintained by keeping the samples in sight, on the person of the sampler, or in a locked vehicle or building. During shipment, custody will be maintained by sealing the samples and chain of custody form inside a package with signed and dated evidence tape. Upon receipt of the containers at the laboratories, a sample custodian will note the conditions of the custody seals and the package contents on the chain of custody form. Once samples have arrived at the laboratories, they will be considered under custody within the laboratory environment. Chain of custody records will comprise part of the final permanent analytical report.

Specific QA/QC procedures will be provided by the laboratories. QA/QC data will be included with laboratory reports. A collection of all benthic macroinvertebrate taxa from the Project will be created. The collection will be reviewed by a second taxonomist. Ten percent of the samples will be re-identified by a second taxonomist.

The laboratory will issue full laboratory reports describing the results of analysis for each sample submitted. Prior to issuance of the analytical report, the laboratory's QA manager will review and approve the report.

All data will be entered into a relational database after a QA review. Associated qualifiers will also be entered. Data entry will be performed by individuals who are familiar with reading the data sheets, electronic data transfer, and using the database. All data that are manually entered into the database will be verified against the hard copies.

5.0 References

Bauer, S.B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. EPA910/R-93-017.

Kline Environmental Research, LLC and Klepfer Mining Services, LLC. 2010. July 2009 stream habitat survey for the Butte Highlands Project.

Montana Department of Environmental Quality (MDEQ). 2006. Sample collection, sorting, and taxonomic identification of benthic macroinvertebrates. Water Quality Planning Bureau, Standard Operating Procedure, WQPBWQM-009, 9/8/2006.

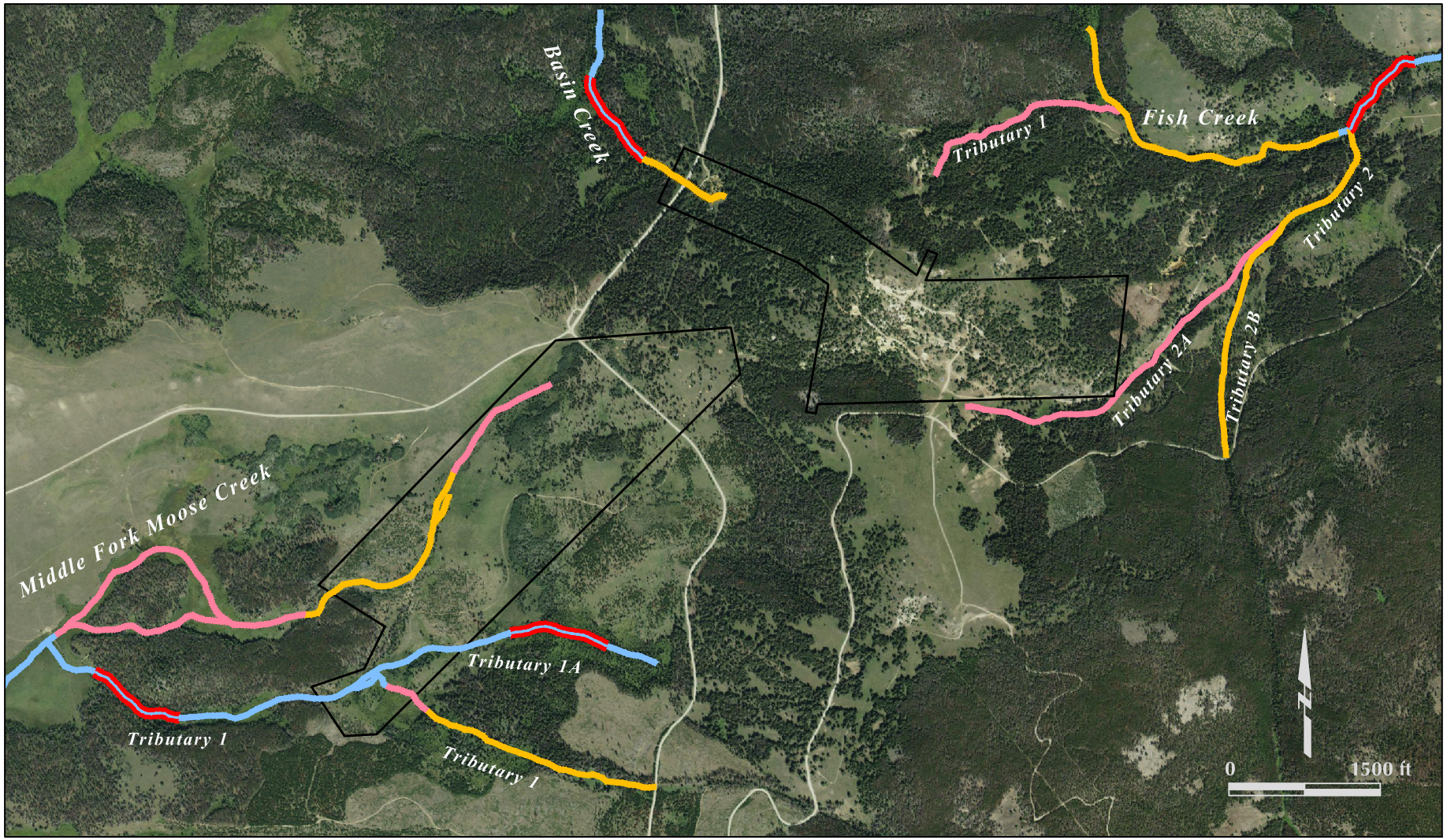
Montana Fisheries Information System database (MFISH, http://fwp.mt.gov/fishing/mfish/)

Natural Resources Conservation Service (www.wcc.nrcs.usda.gov/snotel/),

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

Thurow, R.F. 1994. Underwater methods for study of salmonids in the Intermountain West, U.S. Forest Service, Intermountain Research Station, General Technical Report INT-GTR-307.

Wolman, M.G. 1954. A method of sampling coarse river-bed gravel. Transactions of American Geophysical Union 35: 951-956.



Source: 2009 USDA NAIP Imagery

Explanation

- Patented Claims
- Stream Reach Probably Inhabited by Fish
- Stream Reach Possibly Inhabited by Fish
- Stream Reach with no Significant Fish Habitat
- Monitoring Reach, Probably Inhabited by Fish

Stream Monitoring Plan
March 2010
Kline Environmental Research, LLC
Klepfer Mining Services, LLC
Jasper Geographics

Butte Highlands Project
Silver Bow County, Montana

Stream Monitoring Reaches
Figure 1

Memorandum of Understanding
Between
Butte Highlands Joint Venture and Golden Sunlight Mine

This Memorandum of Understanding (MOU) is developed between the Butte Highlands Joint Venture (Butte Highlands) and the Golden Sunlight Mine, Inc. (Golden Sunlight) for purposes of processing ore from the Butte Highlands Project. Specifically, both Butte Highlands and Golden Sunlight are entering into discussions with regard to the direct shipping and processing of gold bearing ores from the Butte Highlands Project at the Golden Sunlight mill.

Under this MOU, it is understood that no final terms and or considerations have been agreed to, and the negotiations may be terminated by either party with the appropriate notification. The purpose of the MOU is to serve notice to the regulatory agencies that the inclusion of custom milling in Butte Highlands' application to the State of Montana and the U.S. Forest Service for processing the Golden Sunlight mill is acceptable to both parties.

The MOU is a non-binding agreement but provides and acknowledges that both companies may and can discuss, make application, amend, or initiate other activities with the regulatory community as may be appropriate to advance the permitting process that is required for the Butte Highlands Project.

Notification will be given to the regulatory agencies by Butte Highlands in the event a final agreement is not reached between the companies.

Butte Highlands Joint Venture

By: HENRY J. BOGERT, as Manager of the Joint Venture

1/5/10

Signature Date

HENRY J. BOGERT, JOINT VENTURE MGR.

Print Name Title

Golden Sunlight Mines, Inc.

1/5/10

Signature Date

Timothy B. Dimock, General Manager

Print Name Title