
**Alder Gold and Copper Company Site
Integrated Assessment Report
Twisp, Washington
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Region 10

START-2

Superfund Technical Assessment and Response Team Two

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**ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT REPORT
TWISP, WASHINGTON**

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LIST OF ACRONYMS

<u>Acronym</u>	<u>Definition</u>
%R	percent recovery
Alder	Alder Gold and Copper Company
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
B	less than the CRDL but greater than the instrument detection limit
bgs	below ground surface
BOM	United States Bureau of Mines
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Superfund)
cfs	cubic feet per second
CLP	Contract Laboratory Program
CLPAS	Contract Laboratory Program Analytical Service
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DQOs	data quality objectives
E & E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
EP Tox	Extraction Procedure Toxicity
GPS	Global Positioning System
H	high bias
IA	Integrated Assessment
IDW	investigation-derived waste
J	estimated quantity
K	unknown bias
L	low bias
MCL	Maximum Contaminant Level

LIST OF ACRONYMS (CONTINUED)

<u>Acronym</u>	<u>Definition</u>
MEL	Manchester Environmental Laboratory
MTCA	Model Toxics Control Act
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MS/MSD	matrix spike/matrix spike duplicate
No.	Number
NPL	National Priorities List
OCHD	Okanogan County Health District
OSC	On-Scene Coordinator
PA	preliminary assessment
PPE	probable point of entry
PRGs	Preliminary Remediation Goals
PVC	polyvinyl chloride
Q	less than the CRQL
QA/QC	quality assurance/quality control
RA	removal assessment
RPD	relative percent difference
SI	Site Inspection
SOP	standard operating procedure
SPLP	Synthetic Precipitate Leaching Procedure
SQAP	sampling and quality assurance plan
SQL	sample quantitation limit
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
TD	total depth
TDD	Technical Direction Document
TDL	target distance limit

LIST OF ACRONYMS (CONTINUED)

<u>Acronym</u>	<u>Definition</u>
TDS	total dissolved solids
TOC	total organic carbon
U	not detected
UJ	estimated detection limit
UTP	Upper Tailings Pond
USCS	Unified Soil Classification System
µg/L	micrograms per liter

**ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT REPORT
TWISP, WASHINGTON**

1. INTRODUCTION

The United States Environmental Protection Agency (EPA) has tasked Ecology and Environment, Inc. (E & E) to provide technical support and conduct an Integrated Assessment (IA) at the Alder Gold and Copper Company (Alder) site located in Twisp, Washington. E & E completed the IA activities under Technical Direction Document (TDD) Number 02-01-0007 issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-2 Contract Number 68-S0-01-01.

The specific goals for this IA, intended to address both removal assessment (RA) and site assessment objectives, are presented below:

- Conduct a RA of potentially contaminated soil, surface water, sediment and groundwater located at the site;
- Collect and analyze samples to characterize the potential sources discussed in Section 6;
- Determine off-site migration of contaminants;
- Determine whether arsenic contamination detected in off-site drinking water wells is likely attributable to potential on-site sources;
- Provide EPA with adequate information to determine whether the site is eligible for placement on the National Priorities List (NPL);
- Document threats or potential threats to public health or the environment posed by the site; and
- Determine whether removal actions are warranted.

Completion of the IA included reviewing site information, determining waste characteristics, collecting information on receptors within the site's range of influence, executing a site-specific sampling plan, and preparing this report.

This document includes a discussion of site background information ([Section 2](#)), field activities and analytical protocols ([Section 3](#)), quality assurance/quality control (QA/QC) criteria ([Section 4](#)), analytical results reporting and background samples ([Section 5](#)), potential sources ([Section 6](#)), migration/exposure pathways and targets ([Section 7](#)), removal assessment ([Section 8](#)), a summary and conclusions section ([Section 9](#)), and references ([Section 10](#)).

2. SITE BACKGROUND

This section presents the site location (Section 2.1), site description (Section 2.2), site ownership history (Section 2.3), site operations and waste characteristics (Section 2.4), site characterization (Section 2.5), and a summary of IA investigation locations (Section 2.6).

2.1 SITE LOCATION

Site Name:	Alder Gold and Copper Company
CERCLIS ID:	WAD980722847
Location:	Approximately 0.4 mile south of Twisp, Washington
Latitude:	48° 21' 16" North
Longitude:	120° 07' 17" West
Legal Description:	Sections 17, 18, 19, and 20, Township 33 North, Range 22 East Willamette Meridian
County:	Okanogan
Site Owner:	Alder Gold and Copper Company 1100 SW 6 th Street, #1504 Portland, Oregon 97204 (503) 248-9535
Site Contact:	Eugene Feltz Alder Gold and Copper Company 1100 SW 6 th Street, #1504 Portland, Oregon 97204 (503) 248-9535

2.2 SITE DESCRIPTION

The Alder site is a former gold and copper ore processing facility situated on a 75-acre plot approximately 0.4 mile south of the town of Twisp, Okanogan County, Washington (Figure 2-1). The elevation at the mill site is approximately 1,860 feet above mean sea level. The overall slope at the site is approximately 6 percent (USGS 1969a, 1969b). The site is bordered by private property, some of which

is used for livestock production. Features at the site include the mill building and two tailings impoundments referred to in this report as the Upper Tailings Pond (UTP), located southwest of the mill building, and the Mill Pond, located below and northeast of the mill building (Figure 2-2). The UTP is approximately 650 feet long, 150 feet wide, an average of 12 feet deep, with a maximum observed thickness of 20 feet. The UTP contains approximately 43,300 cubic yards of tailings impounded behind an earthen dam (Stewart et al. 1995). The UTP was deposited in the southeast-trending valley of the intermittent stream that originates approximately one half mile southwest of the UTP. The stream flows northward for approximately one half mile before turning abruptly toward the southeast (USGS 1969a, 1969b). The drainage is the topographic expression of a southeast-trending high-angle fault (Brunning 1992, Burnet 1976, Stewart et al. 1995). A standing water pond is located at the upper end of the UTP. Downstream of the UTP, the stream continues toward the southeast past the Krinke residence before joining the irrigation raceway maintained by the Methow Valley Irrigation District. The irrigation raceway passes within approximately 400 feet of the eastern side of the Mill Pond (Figure 2-2). The tailings within the UTP were deposited on calcareous, carbonaceous lake bed sediments of unknown lateral extent (Stewart et al. 1995). Based upon observations made by the START-2, the Mill Pond is approximately 150 feet long, up to 50 feet wide, and up to 5 feet deep. The Mill Pond is estimated to contain approximately 1,333 cubic yards of tailings. The Mill Pond tailings are deposited on a layer of calcareous, carbonaceous pond sediments similar to those described (e.g. Stewart et al. 1995) and observed during the IA at the UTP.

Current access to the Alder site is via a dirt road that crosses private property, and enters the site from the west via Lookout Mountain Road. Access was previously provided by a gravel road that entered the site from the southeast. Vehicle access to the site via this road is not currently possible due to damage to the bridge over the irrigation raceway. The site is not fenced, and there is evidence of trespassing at the site. The mill building structure is largely intact, although it has been vandalized. Equipment remaining in the mill building includes an ore bin, primary crusher, ball mill, flotation circuit(s), copper circuit conditioner tank, clarifier tank, concentrate storage, and a load-out area.

Other features in the vicinity of the site include several mines and prospects. These mines and prospects are described briefly in Section 7.2.

2.3 SITE OWNERSHIP HISTORY

The site currently is owned by the Alder Gold and Copper Company of Portland, Oregon. A review of previous owners was not performed during the IA.

2.4 SITE OPERATIONS AND WASTE CHARACTERISTICS

The Alder Gold and Copper Company mill was constructed in the late 1940s to process sulfide ore mined at the Alder Mine, located approximately 2.8 miles southwest of the Alder Mill. In the late 1930s and early 1940s, prior to construction of the mill, ore from Alder Mine was processed at the Asarco smelter in Tacoma, Washington, and at the Red Shirt Mill, located in Twisp, Washington (San Juan 1992). The Alder Mill operated between 1949 and 1952 (Ecology 1986). The Alder mill processed ore with a conventional dual-circuit flotation system maintained at a pH of 10 or higher with lime (Stewart et al. 1995). Cyanide was reportedly used in small quantities as a suppressant during the flotation process; no available records or other evidence indicate that cyanide leaching was conducted at the mill. The principal ore minerals were chalcopyrite (copper-bearing sulfide mineral) and sphalerite (zinc sulfide mineral), with some gold (Stewart et al. 1995). Other sulfide minerals documented in the Alder Mine ore include pyrite (iron sulfide mineral), galena (lead sulfide mineral), and pyrrhotite (iron sulfide mineral).

Tailings were deposited as a slurry in the UTP, and to a much lesser extent, in the Mill Pond. The UTP tailings consist predominantly of silt- and sand- sized tailings particles. Grain size of the tailings varies somewhat with depth and location within the UTP. Between approximately 85 percent and 98 percent of tailings sampled analyzed for grain size analysis passed a 100-mesh U.S. Standard Sieve size. The tailings of the UTP comprise approximately 95 percent gangue minerals (primarily quartz and plagioclase) and 5 percent sulfide minerals, consisting chiefly of pyrite, with lesser chalcopyrite and sphalerite, and trace amounts of galena. (Stewart et al. 1995)

In 1952, approximately six months before ceasing operations, the UTP impoundment reportedly failed due to heavy rain. Waste water and tailings washed down the unnamed intermittent stream, spread out around the former Krinke well, and continued down the drainage and into the irrigation raceway (Ecology 1986). Tailings are still located along the length of the drainage below the UTP impoundment, and are locally concentrated behind two small earthen dams downstream of the primary earthen dam impounding the UTP.

2.5 SITE CHARACTERIZATION

The site has been the subject of numerous previous investigations. This section includes a description of investigations performed prior to the IA.

2.5.1 Previous Investigations

The following is a list of previous inspections, investigations and actions performed at the Alder site:

- Potential Hazardous Waste Site Preliminary Assessment (PA), performed by the Washington State Department of Ecology (Ecology) in November 1984 (Ecology 1984);
- Site Inspection (SI), performed by Ecology in 1986 (Ecology 1986);
- Ecology memorandum identifying additional action items and providing a summary assessment of Alder Mine and Alder Mill (San Juan 1992);
- Revised SIP Report for Alder Mill Site in Twisp, Washington (SAIC 1993);
- Site Hazard Ranking, prepared by Ecology (Ecology 1993);
- *Soil Bioassay Pilot Study* (Norton and Stinson 1993);
- *Phase 1 and Phase 2 Preliminary Assessment/Site Inspection (PA/SI), Alder Mine Site* (E & E 2000);
- *Screening Level Investigation of Water and Sediment Quality of Creeks in Ten Eastern Washington Mining Districts, with Emphasis on Metals* (Ecology 2000a);
- Domestic well and soil/sediment sampling activities performed by Ecology (Ecology 2000b);
- *Dispersion of Metals from Abandoned Mines and Their Effects on Biota in the Methow River, Okanogan County, Washington - Annual Report, 3/15/00 through 3/14/01* (Peplow and Edmonds 2001);
- Domestic well sampling for metals performed by Okanogan County Health District between May 2001 and June 2002 (OCHD 2002);
- *Dangerous Waste Characterization, Alder Millsite, Twisp, Washington*, prepared for Alder Gold-Copper Company (HydroSolutions Associates 2001a);
- *Analysis Report - Preliminary Model Toxics Control Act (MTCA) Characterization, Alder Millsite, Twisp, Washington*, prepared for Alder Gold-Copper Company (HydroSolutions Associates 2001b); and
- Re-scoring/re-ranking of Alder Mill site (Ecology 2002a).

Investigation activities, including field activities conducted at the Alder Mill over a period of several years beginning in the late 1980s, were performed by United States Bureau of Mines (BOM) personnel. Results of the investigations are summarized in the following reports:

- *Determining Heavy Metal Leaching and Transport from Abandoned Mine Wastes* (Williams et al. 1989);
- *Report on NaCl Trace Injection at Alder Mine* (Stewart 1989);

- *Effects of Pyritic Tailings in an Abandoned Impoundment on Downgradient Ground Water Quality* (Stewart et al. 1992);
- *Hydrochemical Characteristics of an Unconsolidated Aquifer Downgradient from an Oxidized, Sulfidic Mine Tailings Impoundment* (Lambeth 1992);
- *An Investigation of Hydrochemical Mechanisms in an Abandoned Sulfide Tailings Impoundment and Underlying Aquifer* (Lambeth et al. 1992);
- *Comparison of Multivariate Statistics and the Geochemical Code WATEQ4F for Water Quality Interpretation in Acidic Tailings* (Williams 1992);
- *Factors Controlling the Release and Attenuation of Contaminants in a Sulfidic Tailings Impoundment* (Stewart et al. 1993);
- *Investigation of Acid Production, Leaching, and Transport of Dissolved Metals at an Abandoned Sulfide Tailings Impoundment: Monitoring and Physical Properties*, United States Department of the Interior, Bureau of Mines, Report of Investigations 9577 (Stewart et al. 1995);
- *Natural Attenuation of Acidic Drainage from Sulfide Tailings at a Site in Washington State* (Lambeth 1999);

Results of the investigations listed above are briefly described in the sections below, and are incorporated as appropriate elsewhere in this report.

2.5.1.1 1984 Potential Hazardous Waste Site Preliminary Assessment

A PA performed by Ecology identified tailings in unlined impoundments containing high levels of metals, and the possibility that metal contamination could migrate off-site. A SI was recommended. (Ecology 1984)

2.5.1.2 1986 Site Inspection

Sampling and other activities were performed by Ecology to evaluate the presence of metals contamination at on-site and off-site locations. The report also documented a 1952 failure of the UTP, which resulted in a slurry of tailings washing down the unnamed intermittent streambed for a distance of approximately 0.6 miles to its intersection with the irrigation canal. Prior to entering into the irrigation canal, the tailings spread across the Krinke and Harry Jolley properties. Helen Krinke reported poor water quality in the well resulted from the discharge. Groundwater samples were collected from three domestic wells (Krinke, Jolley, and Andersen); surface water samples were collected from the standing water pond at the head of the UTP and from a background location at an off-site pond; and surface soil samples were collected from the UTP, the Mill Pond, the drainage ditch downgradient from the Mill

Pond, and a background location in the hillside southwest of the UTP. All groundwater and surface water samples were analyzed for dissolved priority pollutant metals; the surface water samples also were analyzed for total cyanide. The surface soil samples were analyzed for metals, total cyanide, and Extraction Procedure Toxicity (EP Tox) metals. (Ecology 1986)

Arsenic was detected in the well samples at concentrations as high as 30 micrograms per liter ($\mu\text{g/L}$, Jolley well). Arsenic was detected in the on-site pond and background pond at concentrations of 9 $\mu\text{g/L}$ and 8 $\mu\text{g/L}$, respectively. Arsenic was detected in the soil samples from the UTP and Mill Pond at concentrations of 32 milligrams per kilogram (mg/kg) and 24 mg/kg , respectively. Arsenic was detected in the drainage ditch at 150 mg/kg , and in the background soil sample at 217 mg/kg . (Ecology 1986)

The report concluded that, based upon the SI sample results, there was no evidence indicating a current off-site migration of previously documented heavy metal-containing tailings. It was noted that the tailings exhibited lead, mercury, and silver at concentrations exceeding background soil concentrations. (Ecology 1986)

2.5.1.3 BOM and Associated Investigations

Beginning in the late 1980s, the BOM investigated the UTP and its impacts on downgradient groundwater. The field work and laboratory analysis were conducted over several years. Evaluation of the data and publication of results by the original BOM investigators have continued through at least 1999. For the purpose of brevity, the individual reports (Williams et al. 1989; Stewart 1989; Stewart et al. 1992; Lambeth 1992; Lambeth et al. 1992; Williams 1992; Stewart et al. 1993; Stewart et al. 1995; Lambeth 1999) are summarized collectively below.

Monitoring wells and piezometers were installed at multiple locations and depths within the tailings, beneath the tailings, and in shallow alluvium/colluvium and bedrock upgradient and downgradient of the UTP to determine the effects of acid generation in the sulfidic tailings. Groundwater conditions, including groundwater elevation; water quality parameters (pH, Eh, dissolved oxygen, conductivity, and temperature); and concentrations of dissolved aluminum, calcium, copper, iron, potassium, magnesium, manganese, sodium, lead, silica, zinc, sulfur, and sulfate were monitored on a monthly basis between January 1988 and October 1989. Groundwater from both the vadose and saturated zones was evaluated. Other aspects of the investigation included: stratigraphic characterization of the tailings and native materials located beneath the tailings and in upgradient and downgradient locations; analysis of tailings samples for mineralogy, grain size, specific gravity, clay content, moisture

content, and base metals loading; measurement of tailings temperature, hydrostatic head, pore pressure, in situ moisture and density, and in situ hydraulic conductivity; sodium chloride tracer test; pore gas analysis for oxygen and carbon dioxide; and analysis of iron and arsenic speciation in groundwater samples. Reports indicate that arsenic was detected at trace concentrations in groundwater samples, but that the concentrations were too low for accurate measurement by inductively coupled plasma. Results of iron and arsenic speciation analyses are not provided in the reports. Following the field investigation, all of the piezometers and monitoring wells were abandoned except for the following: BOM BKG-21, BOM BKG-66, BOM BKG-142, BOM M4-24, BOM M4-32, BOM M5-13, BOM M5-75, and BOM M5-175.

Selected results of the investigation are summarized in the paragraphs below.

The UTP is located in a tension gash fault valley. The UTP measures approximately 650 feet long and 150 feet wide, has an average depth of 12 feet, and a maximum depth of 20 feet. The impoundment contains approximately 43,300 cubic yards of tailings comprising approximately 95% gangue minerals (chiefly quartz and feldspar) and 5% sulfide minerals (mostly pyrite [iron sulfide], with minor chalcopyrite [copper-iron sulfide], sphalerite [zinc sulfide], and trace galena [lead sulfide]). The tailings are underlain carbonaceous and calcareous lake bed sediments of unknown lateral extent. The lake sediments are underlain by colluvium and alluvium. Bedrock underlying the alluvium/colluvium consists of highly fractured andesite.

Shallow groundwater is in contact with the tailings in the UTP. The water table of the unconfined aquifer within the UTP fluctuates by approximately 3 feet between lows in the fall and highs in the spring. The lateral groundwater gradient is toward the southeast in the UTP drainage. The gradient is low in the area of the UTP ($4.4E-4$ from BOM BKG to piezometer P6 at the upper end of the UTP; $5.7E-3$ between P6 and piezometer P1 at the lower end of the UTP). Gradient increases below the lower end of the UTP ($4.0E-2$ between wells BOM M2 and BOM M4). A vertical gradient was observed in the nested well clusters (BOM BKG, BOM M2, BOM M4, and BOM M5) within the UTP drainage. The gradient is upward at several locations. For example, in BOM BKG, the gradient was upward ($1.5E-2$ to $1.6E-2$) between the 66-foot deep shallow bedrock completion (BOM BKG-66) and the 21-foot deep alluvial/colluvial completion (BOM BKG-21), but downward ($1E-3$ to $2E-3$) between BOM BKG-66 and the 142-foot deep bedrock well (BOM BKG-142). In the BOM M2 wells, three alluvial/colluvial completions at 13 feet (BOM M2-13), 20 feet (BOM M2-20), and 41 feet (BOM M2-41), the gradient was reported to be upward between all wells except during late summer between BOM M2-20 and BOM M2-13. At well BOM M4, a downward vertical groundwater gradient was observed

between the 24-foot deep alluvium/colluvium well (BOM M4-24) and the 32-foot deep bedrock well (BOM M4-32). Further downgradient at BOM M5, with an alluvial/colluvial completion at 13 feet (BOM M5-13) and bedrock completions at 75 feet (BOM M5-75) and 175 feet (BOM M5-175), an upward gradient was observed between BOM M5-75 and BOM M5-13, and a downward gradient was observed between BOM M5-75 and BOM M5-175. The presence of ponds along the trace of the northwest-trending fault (including the standing water pond at the head of the UTP) was attributed to upwelling of water from the fault zone.

Groundwater flow through the UTP tailings has resulted in reduced pH (3.6 in the vadose zone and 4.5 in the saturated zone) and increased concentrations in groundwater of aluminum, boron, cadmium, calcium, copper, iron, lead, magnesium, manganese, nickel, potassium, silica, sodium, sulfur, and zinc as a result of sulfide oxidation. Most of the constituents (aluminum, boron, cadmium, copper, iron, lead, nickel, silica, zinc, and pH) attenuated to background levels a short distance downgradient of the UTP. Magnesium, manganese, potassium, and sulfur attenuated, although not down to background levels. Sodium levels increased downgradient.

The attenuation is attributed to dispersion, dilution (from fault groundwater upwelling), and precipitation due to increase in pH. Results of numerical modeling of groundwater quality parameters and species concentrations with an equilibrium thermodynamic speciation model were interpreted to indicate the likelihood that some mineral species would precipitate from groundwater downgradient of the UTP with changes in pH and Eh. The model predicted precipitation of jarosite [$\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$] and ferrihydrite [$\text{Fe}(\text{OH})_3$], as well as alunite [$\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$], aluminum hydroxy-sulfates [e.g. $\text{Al}_4(\text{OH})_{10}(\text{SO}_4)_3$], goethite [$\text{Fe}_2\text{O}_3\text{-H}_2\text{O}$], hematite [Fe_2O_3], cuprous ferrite [CuFe_2O_4], and cupric ferrite [CuFe_2O_4]. It was concluded that the organic-rich calcareous lake sediments underlying the tailings in the UTP may act to attenuate some of the metals concentrations.

2.5.1.4 1992 Ecology Memorandum

Available information on the Alder Mill and Alder Mine sites, including recently published BOM publications on impacts of the UTP on groundwater, was summarized. Remedial actions at the tailings ponds at the Alder Mill were recommended. (Ecology 1992)

2.5.1.5 1993 Revised SIP Report

This report summarized results of previous investigations of the Alder Mill site, and recommended access controls, deed restrictions on the use of on-site groundwater, and runoff control measures (SAIC 1993).

2.5.1.6 1993 Ecology Site Hazard Ranking

Ecology prepared a site hazard ranking assessment for the Alder Mill site incorporating analytical results of previous investigations. A ranking of 2 on a scale of 1 to 5 (with 1 the highest rank) was assigned to the site. Potential environmental impacts of the UTP and Mill Pond were noted. (Ecology 1993)

2.5.1.7 1993 Soil Bioassay Pilot Study

As part of Ecology's effort to develop guidelines for addressing environmental protection at hazardous waste sites under MTCA, Ecology conducted a pilot study to evaluate toxicity of soils and sediments. Soil and sediment samples were evaluated at several sites in Washington state contaminated by metals, creosote, pesticides, and petroleum products, including the Alder Mill site. At the Alder Mill site, surface soil and subsurface soil samples were collected from locations near BOM background monitoring well BOM BKG, and from two locations within the UTP. Copper and zinc were identified as the primary contaminants of concern. Copper was detected at concentrations ranging from 58 mg/kg to 1,400 mg/kg. Zinc was detected at concentrations ranging from 85 mg/kg to 990 mg/kg. Arsenic was detected at a concentration of 84 mg/kg near BOM BKG, and at concentrations of 46 mg/kg (estimated) and 45 mg/kg in the tailings samples. (Norton and Stinson 1993)

2.5.1.8 2000 Phase I and Phase 2 Preliminary Assessment/Site Inspection, Alder Mine Site

The START performed a PA/SI at the Alder Mine. As part of the investigation, the START also collected several samples from the Alder Mill site, including collocated surface water and sediment samples from a location in the standing water pond located at the head of the UTP (MP01); a sediment sample, consisting predominantly or entirely of tailings, from a location downstream of the dam at the lower end of the UTP (ML01); a groundwater sample from the White residence domestic well (ML04); and a background soil sample from a location approximately 2 miles southwest of the Alder Mill (BG01).

The groundwater sample from the White well contained arsenic at a concentration of 374 µg/L. The surface water sample from MP01 contained arsenic at 15.6 µg/L. Sediment samples from MP01 and

ML01 contained arsenic at 30.6 mg/kg and 30.3 mg/kg, respectively. The background surface soil sample from BG01 contained arsenic at a concentration of 18.8 mg/kg. (E & E 2000)

2.5.1.9 2000 Ecology Screening Level Investigation of Water and Sediment Quality

Ecology conducted a screening level investigation of water and sediment quality at creeks in ten eastern Washington mining districts, including Alder Creek downstream of Alder Mine. As part of the investigation, field parameters (temperature, pH, and conductivity) were also measured in the standing water pond at the head of the UTP and in a seep below the UTP. Measured pH values were 7.94 and 3.44, respectively. Report conclusions included a discussion of the existence and importance of seasonal variations in water quality. (Ecology 2000a)

2.5.1.10 2000 Ecology Sampling

Ecology collected groundwater samples from Twisp area domestic wells for hardness, sulfate, and metals analysis. Arsenic was detected in one of the groundwater samples at 360 µg/L (White well). None of the other groundwater samples contained arsenic above the detection limit of 50 µg/L. (Ecology 2000b)

2.5.1.11 2001 Study on Dispersion of Metals from Abandoned Mines

An areal study of releases of metals from abandoned mine sites and their effect on biota in the Methow River was performed. As part of the study, samples were collected from the tailings pond(s) at the Alder Mill and from several nearby domestic wells. Domestic well samples were collected directly from the well casings with disposable Teflon™ bailers. Tailings pore water was sampled from temporary piezometers installed within the tailings. Tailings soil samples also were collected. Water samples were analyzed for metals by inductively coupled plasma atomic emission spectrophotometry. Water samples also were analyzed for arsenic by hydride-generated atomic fluorescence spectrophotometry. Mineralogy and metals analyses were performed on the tailings samples. (Peplow and Edmonds 2001)

2.5.1.12 2001-2002 Domestic Well Sampling by OCHD

The Okanogan County Health District (OCHD) collected groundwater samples from area domestic wells between May 2001 and June 2002. Samples were analyzed for Target Analyte List (TAL) metals. Arsenic was detected in area wells at concentrations as high as 509 µg/L (White well). Results indicated a large degree of variability in area arsenic groundwater concentrations, but were

generally high in wells located in close proximity to the Alder Mill site. Notable exceptions include the Echelbarger well (465 µg/L) and the McKinney well (249 µg/L), located in the Twisp River valley, approximately 1.4 miles northwest of the Alder Mill site. (OCHD 2002)

2.5.1.13 2001 Dangerous Waste Characterization

HydroSolutions Associates, on behalf of Alder Gold and Copper Company, collected soil samples from the UTP for the purpose of dangerous waste characterization. Subsurface samples were collected from the UTP with a hand auger and analyzed for Toxicity Characteristic Leaching Procedure (TCLP), Ecology Static Acute Fish Toxicity Test, and corrosivity (paste pH). Analytical results indicated no exceedances of regulatory criteria. The report notes that cyanide may have been used as a suppressant during flotation processing, but that it was not likely to have been used in large quantities such as would be expected at a cyanide leaching facility. (HydroSolutions Associates 2001a)

2.5.1.14 2001 MTCA Characterization

Concurrent with the dangerous waste characterization (HydroSolutions Associates 2001a), HydroSolutions Associates collected tailings subsurface soil samples and groundwater samples for the purpose of determining site closure options under the Washington State MTCA. Subsurface soil tailings samples were analyzed for metals and total sulfur. Groundwater samples were collected from three BOM monitoring wells: background well BOM BKG-21; downgradient (from the UTP) well BOM M4-24; and distant downgradient (from the UTP) well BOM M5-13. Groundwater samples were analyzed for total cyanide, ammonia, total organic carbon (TOC), total dissolved solids (TDS), chloride, fluoride, nitrate, sulfate, calcium, potassium, magnesium, sodium, silver, arsenic (total and dissolved), barium, cadmium (total and dissolved), chromium, copper, iron, mercury, manganese, lead (total and dissolved), selenium, and zinc. (HydroSolutions Associates 2001b)

Metals detected in tailings soil samples include arsenic (15.1 to 37.2 mg/kg), cadmium (1.3 to 4.5 mg/kg), copper (1,110 to 2,640 mg/kg), zinc (144 to 636 mg/kg), and barium (930 to 4,840 mg/kg).

Amongst the metals detected in the groundwater samples, total arsenic was detected in well BOM BKG-21 (18 µg/L), BOM M4-24 (12 µg/L), and BOM M5-13 (31 µg/L). Dissolved arsenic concentrations were identical to or slightly below the corresponding total arsenic concentrations in all samples except for the sample from BOM BKG-21, in which dissolved arsenic was detected at 9 µg/L. (HydroSolutions Associates 2001b)

2.5.1.15 2002 Ecology Re-scoring of Alder Mill Site

In February 2002, Ecology reevaluated the Alder Mill site based upon review of newly available data. A site score of 1 on a scale of 1 to 5 (with 1 the highest rank) was assigned. (Ecology 2002a)

2.6 SUMMARY OF IA INVESTIGATION LOCATIONS

Based on a review of historical and background information and discussions with site representatives and EPA and Ecology representatives, areas and features within the site were identified for investigation during the IA as potential sources of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances. In addition, on- and off-site locations were identified as possible receptors of contamination originating from these sources. These potential sources and receptors are listed below.

Potential Sources:

- **Tailings Pond Soils.** Potential contaminants of concern in the area of the two tailings ponds (UTP and Mill Pond) are TAL metals.
- **Surface soils near mill building.** Potential contaminants of concern are TAL metals.

Potential Receptors:

- **Domestic Wells, Municipal Wells, and Nearby Groundwater.** Potential contaminants of concern in the nearby groundwater are TAL metals. In addition, due to the proximity of some of the area wells to agricultural areas, other potential contaminants of concern include chlorinated pesticides.
- **Surface Water and Sediments.** Potential discharges from the Alder site may be impacting the surface water and sediments in downstream surface water bodies, including the unnamed intermittent stream, the irrigation raceway, and the Methow River. Potential contaminants of concern include TAL metals.
- **Surface and Subsurface Soils.** Surface and subsurface soil at and in the vicinity of the Alder site may be impacted from site operations. Potential contaminants of concern include TAL metals.

3. FIELD ACTIVITIES AND ANALYTICAL PROTOCOLS

A sampling and quality assurance plan (SQAP) was developed by the START-2 prior to field sampling (E & E 2002). The SQAP describes the sampling strategy, sampling methodology and analytical program used to investigate potential hazardous substance sources and potential targets. The IA field activities were conducted in accordance with the approved SQAP, except as documented in the Sample Plan Alteration Form included in Appendix A. The EPA On-Scene Coordinator (OSC) and TM were contacted daily during field activities. Deviations from the SQAP were approved by the EPA, and are discussed where applicable below.

IA field work was conducted from May 20 through 24, 2002, and included installation of soil borings and monitoring wells, and collection of groundwater, surface soil, subsurface soil, surface water, and sediment samples. In addition, one sample of mill process material located in a conditioner tank within the mill building was collected.

A total of 69 samples (33 groundwater samples from 30 wells, 13 subsurface soil samples, 13 surface soil samples, 3 surface water samples, 6 sediment samples, and 1 mill process material sample), including background but excluding QA samples (rinsate blanks), were collected by the START-2 from on-site and off-site locations during the IA. Results of one surface soil sample and one sediment sample collected during the Alder Mine PA/SI (E & E 2000) are incorporated into the IA as applicable. A description of all samples collected for fixed laboratory analysis under the IA, as well as the two samples from the Alder Mine PA/SI, is provided in [Table 3-1](#). Sample types and methods of collection are described below. Photographic documentation of IA field activities is presented in Appendix B.

Each sample was assigned a unique EPA regional tracking number. In addition to the EPA regional tracking number, a unique descriptive alphanumeric sample identifier was applied by the START-2 to each sample. A key to these alphanumeric sample identifiers is provided in [Table 3-2](#). The first four characters of each identifier corresponds to the sample location (e.g., MW02, SB03). Sample locations are discussed in this report in terms of these alphanumeric location identifiers except for subsurface soil samples, groundwater samples from drinking water wells, and from monitoring wells previously installed at the site by BOM. Because more than one subsurface soil sample may have been

collected from a given soil boring, subsurface soil samples are identified by the full-length alphanumeric identifiers. Drinking water well sample locations are referred to by the name of the owner or resident using the well.

Sample locations are illustrated in **Figures 3-1 through 3-4**. Sample locations were surveyed using Global Positioning System (GPS) receivers and data loggers. Due to steep terrain, it was not possible to obtain GPS satellite coverage at locations SB02, MW02, US02, IR01, MB01, and MB02. These sample locations are approximated in **Figures 3-1 through 3-4** based on field observations and measured distances from map features or surveyed sample locations.

This section describes sampling methodology (**Section 3.1**), analytical protocol (**Section 3.2**), GPS data (**Section 3.3**), and investigation-derived waste (IDW; **Section 3.4**).

3.1 SAMPLING METHODOLOGY

Sampling for soil, groundwater, sediment, and surface water followed the standard operating procedures (SOPs) contained in the SQAP (E & E 2002). In general, all grass, leaves, and other vegetative material, and rocks and other debris unsuitable for analysis were removed from soil and sediment samples to the extent practicable before the samples were placed into appropriate containers. Sample material for all soil and sediment analyses was homogenized in dedicated plastic bowls prior to containerization. Dedicated plastic scoops were used to extract, homogenize, and place sampled material into sample containers for all samples collected for chemical analysis. Soil samples collected for engineering parameters (soil classification, direct shear test, and California Bearing Ratio) were collected using a shovel. All analytical samples were stored on ice in coolers continuously maintained under the custody of START-2 personnel. Specific sampling methodologies are discussed below.

3.1.1 Surface Soil Samples

A total of 13 surface soil samples were collected at on- and off-site locations. Surface soil samples were collected from UTP locations SB01 and SB02, Mill Pond locations SB03 and SB04, and location MB02 (approximately 40 feet east of the northeast corner of the Mill building) for analysis for TAL metals.

Surface soil was sampled at off-site location TW01 to characterize near-site background surface soil conditions. The sample was analyzed for TAL metals. TAL metals results for the background surface soil sample (BG01), collected from approximately 2 miles southwest of the Mill during the 2000

Alder Mine PA/SI (E & E 2000), are incorporated into the IA report to provide information on background soil conditions farther from the Alder Mill site.

Off-site surface soil samples were collected from six locations during the IA for the purpose of providing additional information regarding the mineralization in the immediate vicinity of the site and other locations in the study area. Samples of waste rock were collected from the Floyd-Rattlesnake Mine prospects (FR01, FR02, and FR03) and the Spokane Mine (SM01). A sample of intact mineralized vein material was sampled at the Twisp View Mine (TV01). Due to closure activities at the Twisp View Mine (Forest Service 2001), waste rock was not collected at the mine.

The samples described above were analyzed for TAL metals. In addition, composite soil samples from the UTP (from SB01 and SB02) and Mill Pond (from SB03 and SB04) were collected for laboratory geotechnical analysis for United Soil Classification, direct shear, and California Bearing Ratio.

A description of surface soil samples is provided in [Table 3-1](#). All surface soil sample locations except for BG01 are illustrated in [Figure 3-1](#). BG01 is located south of the area of map coverage illustrated in [Figure 3-1](#).

3.1.2 Soil Boring and Monitoring Well Installation

Eight soil borings were installed during the IA with a drill rig utilizing both hollow-stem auger and air rotary drilling techniques. Environmental West Exploration, Inc., under subcontract to the START-2, provided drilling services, assisted with collection of subsurface soil samples, and installed monitoring wells. A total of eight boreholes were drilled at locations within the UTP (SB01 and SB02) and Mill Pond (SB03 and SB04), and locations southeast of the UTP (MW02), east of the Mill Pond (MW03), and west of the Mill Pond (MW04 and MW01). Monitoring wells were installed in native materials at four of the locations (MW01, MW02, MW03, and MW04). The remaining boreholes were abandoned by backfilling with bentonite grout. The boring and monitoring well locations are illustrated in [Figures 3-2 and 3-3](#).

SB01 and SB02 were each drilled through tailings to a total depth of 22.5 feet below ground surface (bgs). SB03 and SB04 were drilled to total depths of 20 and 21 feet bgs, respectively. Continuous split-tube soil samples were collected from 2.5 feet bgs to the total depth of each borehole for geologic logging and sampling for various analytical parameters at selected depth intervals. Native materials were encountered beneath the tailings in SB01 and SB02 at depths of approximately 16 and 19.5 feet bgs, respectively. Native materials beneath the tailings at the Mill Pond locations were encountered at approximately 2.5 feet bgs (SB03) and 5 feet bgs (SB04). Sample intervals, soil

descriptions, Unified Soil Classification System (USCS) classifications, moisture content, staining, and other pertinent information are provided in the boring logs (Appendix C) and well logs (Appendix D).

MW01, MW03, and MW04 were drilled into bedrock to total depths of 40, 40.3, and 20 feet bgs, respectively. Monitoring wells were installed within bedrock in each of these borings. Monitoring well MW02 was drilled to a total depth of 26.5 feet in alluvium/colluvium that underlies a layer (less than five feet thick) of tailings material that has discharged from the UTP. A well drilled to a total depth of 22 feet bgs was installed in MW02 within the alluvium/colluvium. Sampling with split-tube soil samplers was limited due to the presence of bedrock and the rocky nature of the overlying alluvium/colluvium. Each monitoring well was constructed with 2-inch diameter polyvinyl chloride (PVC) riser, screen, and silt trap. Each well was installed with a ten-foot long, 0.010-inch slot PVC screen. A 10/20 washed silica sand pack was installed a minimum of two feet above the top of the screen. Hydrated bentonite chips were used to seal above the sand pack. The remaining annulus was backfilled with bentonite grout. Each well was completed with an above-ground 8 inch diameter steel outer casing, with surrounding bollards. Sample intervals, soil descriptions, USCS classifications, moisture content, staining, and well construction details and other pertinent information are presented in well logs, provided in Appendix D.

3.1.2.1 Subsurface Soil Samples

A total of 13 analytical subsurface soil samples were collected from seven of the boreholes. No subsurface soil was sampled at MW01 because the location is in close proximity to MW04, and subsurface soil had been previously sampled at MW04. Subsurface soil samples were collected from decontaminated 2-foot long, 3-inch diameter stainless steel split-tube samplers using dedicated plastic spoons and dedicated plastic bowls. The augers and air rotary drilling equipment were decontaminated between boring locations. Samples were selected for analysis for TAL metals and/or Synthetic Precipitate Leaching Procedure (SPLP) metals, SPLP anions, SPLP carbonate and bicarbonate, and SPLP TDS. Sample depths, descriptions, and selected analyses are presented in [Table 3-1](#) and the borehole/well logs. Subsurface soil sample locations are illustrated in [Figure 3-2](#).

3.1.3 Groundwater Samples from Monitoring Wells

New monitoring wells were installed as described in [Section 3.1.2](#). Following installation, wells were developed by a combination of pumping, surging, and bailing. Well MW04 was not developed because it was dry. Well MW03 produced insufficient water to allow development by pumping and was therefore partially developed by bailing until dry several times. Development of MW01 and MW02 was

conducted until measured field water quality parameters (pH, conductivity, temperature, dissolved oxygen, and turbidity) stabilized.

Groundwater samples were collected from each of the new wells except for MW04. In addition, groundwater samples were collected from several of the existing monitoring BOM wells (BOM BKG-21, BOM BKG-66, BOM M4-24, and BOM M4-32). All samples were collected using a low-flow purging/sampling technique with a peristaltic or bladder pump fitted with dedicated disposable Teflon™ tubing except for the sample from MW03. Due to slow recharge in MW03, the well could not be sampled by pumping with a peristaltic or bladder pump. MW03 was therefore sampled using a dedicated disposable polyethylene bailer. All monitoring well groundwater samples were filtered with 0.45 micron filters. All samples collected with a peristaltic pump or bladder pump were filtered in-line, and placed directly into the appropriate pre-labeled sample containers. The sample from MW03 was filtered by pumping recovered groundwater from one clean sample container through a filter into the final sample container using a peristaltic pump. Samples were preserved as appropriate. Samples for TAL metals analysis were preserved to a pH less than approximately 1.5.

In addition, a grab groundwater sample was collected from a temporary well point installed in saturated tailings in the Mill Pond at location TP01. The well point was installed in a boring hand-augered to a total depth of 5.1 feet bgs. A 2-inch PVC well screen was placed in the boring, and a pore water sample was collected using a peristaltic pump and dedicated disposable Teflon™ tubing. The TAL metals sample was filtered in-line with a 0.45 micron filter; the sample collected for other analyses was not filtered.

Groundwater samples collected from the monitoring wells and the temporary well point were analyzed for dissolved TAL metals, major anions (nitrate, nitrite, chloride, and sulfate), carbonate and bicarbonate, and total dissolved solids. Sample descriptions and selected analyses are presented in [Table 3-1](#). Groundwater sample locations are illustrated in [Figure 3-3](#).

3.1.4 Groundwater Samples from Drinking Water Wells

A total of 23 groundwater samples were collected from 20 drinking water wells, including one municipal well (Town of Twisp #3). Sample locations were selected to provide broad areal coverage in the vicinity of the Alder Mill, to investigate a broad variety of hydrogeological conditions (e.g. deep fractured bedrock, shallow Methow River alluvial materials), and to verify results of previous well sampling by OCHD and others. To the greatest extent possible, a well was selected for sampling only if it could be verified that a well log with depth, well construction, and lithologic information was available

for the well (Ecology 2002b). Exceptions were made when no other suitable wells with well logs were located in the desired sampling area. In some cases where well logs were not available, information on well depth and geologic materials (e.g. alluvial/colluvial material vs. bedrock) was obtained by interviewing the well owners. Available information on well depth and geologic materials is summarized in [Table 3-1](#). Assistance obtaining access to wells was provided prior to and during the field event by OCHD.

Each well was purged for a minimum of fifteen minutes prior to sample collection except for the Town of Twisp #3 well, which was purged at a high flow rate onto the ground for approximately ten minutes prior to sampling. This well had not been in service for the previous four months, and was turned on specifically for the IA sampling event. Field water quality parameters (pH, conductivity, temperature, dissolved oxygen, and turbidity) were measured at each well with a Horiba U-10 water quality meter using a flow-through cell during purging. None of the samples collected from drinking water wells were filtered. Each sample was sampled for total TAL metals, chlorinated pesticides, major anions (nitrate, nitrite, chloride, and sulfate), carbonate and bicarbonate, silica, TOC, hardness, total dissolved solids, and total suspended solids. In addition, three samples also were analyzed for arsenic speciation. A separate “first flush” sample was also collected from three of the wells prior to purging. These “first flush” samples were analyzed for TAL metals to test for possible variations in detected metals concentrations resulting from different sampling techniques (i.e. purging vs. non-purging). All samples were collected directly into the appropriate pre-labeled sample containers. Samples were preserved as appropriate. Samples for TAL metals analysis were preserved to pH less than approximately 1.5.

Sample descriptions, including well name, well depth, geologic materials (bedrock vs. alluvial/colluvial), and selected analyses are presented in [Table 3-1](#). Groundwater sample locations are illustrated in [Figure 3-3](#).

3.1.5 Surface Water and Sediment Samples

Three collocated surface water and sediment sample sets were collected from the irrigation raceway. Samples were collected at the confluence with the unnamed intermittent stream (IR02); at the probable point of entry of the shallow drainage ditch serving as an overland route from the Mill Pond (IR03); and from a background location (IR01) approximately 150 feet upstream of IR03. Sample collection began at the most downstream location and proceeded upstream. At each location, surface water samples were collected prior to sediment samples. None of the surface water samples were

filtered. Each surface water sample was analyzed for TAL metals, major anions (nitrate, nitrite, chloride, and sulfate), carbonate and bicarbonate, and total dissolved solids. Sediment samples were analyzed for TAL metals.

In addition, sediment samples were collected from three locations along the dry streambed of the unnamed intermittent stream. Sample locations US01 and US02 are upgradient from the UTP; US01 also is upgradient of the Floyd-Rattlesnake mine prospects; US02 is located downgradient of the mine prospects. HK01 is located approximately 2,200 feet downstream of the lower end of the UTP, near the Krinke residence. The sample at HK01 appeared to consist of tailings, likely deposited during the reported 1952 tailings pond failure (Ecology 1986). Each sediment sample was analyzed for TAL metals.

During the 2000 Alder Mine PA/SI, a sediment sample was collected from the unnamed intermittent stream at a location (ML01) immediately below the lower end of the UTP (E & E 2000). TAL metal results of this sample are incorporated into the IA report to provide additional information regarding conditions in the unnamed intermittent stream.

A description of surface water and sediment samples is provided in [Table 3-1](#). Sample locations are illustrated in [Figure 3-4](#).

3.1.6 Mill Building Process Sample

A sample of white powder with localized blue-green and yellow coloration was sampled from the interior of the conditioner tank within the Mill building at location MB01. The sample is described in [Table 3-1](#). The sample was analyzed for TAL metals.

3.2 ANALYTICAL PROTOCOL

IA samples were submitted for fixed laboratory analysis to Contract Laboratory Program Analytical Service (CLPAS), Manchester Environmental Laboratory (MEL), and/or by START-2 subcontracted commercial laboratories. Surface soil, subsurface soil, groundwater, surface water, sediment, and process material samples were analyzed for TAL metals (EPA Contract Laboratory Program [CLP] SOW ILM04.1) by Chemtech Consulting Group, Englewood, New Jersey. Groundwater chlorinated pesticides analyses (EPA Method 8082) were performed by MEL, Port Orchard, Washington. Groundwater arsenic speciation analyses (modified EPA Method 1632) were performed by Brooks Rand LLC, Seattle, Washington. Water sample analyses for bicarbonate alkalinity (modified EPA Method 310.1), carbonate alkalinity (modified EPA Method 310.1), total alkalinity (modified EPA Method

310.1), chloride, nitrate as nitrogen, nitrite as nitrogen, sulfate (all EPA Method 300.0), total dissolved solids (EPA Method 160.1), hardness as calcium carbonate (EPA Method 130.2), nitrate/nitrite (EPA Method 353.2), silica as silica dioxide (EPA Method 370.1), total organic carbon (modified EPA Method 9060), and total suspended solids (EPA Method 160.2) were performed by Laucks Testing Services, Seattle, Washington. Analysis of SPLP extract (EPA Method 1312) - TAL metals (EPA Methods 6010 and/or 7470), and SPLP modified extract (modified EPA Method 1312) - bicarbonate alkalinity (modified EPA Method 310.1), carbonate alkalinity (modified EPA Method 310.1), total alkalinity (modified EPA Method 310.1), total dissolved solids (EPA Method 160.1), and chloride, nitrate as nitrogen, nitrite as nitrogen, sulfate (all EPA Method 300.0) were performed by Laucks Testing Services, Seattle, Washington. Geotechnical analyses for Unified Soil Classification System (American Society for Testing and Materials [ASTM] Method D-2487) and California Bearing Ratio (ASTM Method D-1883) were performed by Soil Technology, Inc., Bainbridge Island, Washington. Direct Shear Test (ASTM Method D-3080) analysis was performed by Knight-Piesold Consulting, Inc.

3.3 GLOBAL POSITIONING SYSTEM

Trimble Pathfinder Professional GPS survey units and Corvalis data loggers were used by START-2 personnel to survey the approximate horizontal coordinates of most for the IA sample locations. Sample locations illustrated in **Figures 3-1 through 3-4** are based on GPS coordinates provided in Appendix E, except for locations SB02, MW02, US02, IR01, MB01, and MB02. Because of steep terrain in the vicinity of these locations, inadequate GPS satellite coverage was available to survey the locations. These sample locations are approximated in **Figures 3-1 through 3-4** based on field observations and measured distances from map features or surveyed sample locations.

3.4 INVESTIGATION-DERIVED WASTE

IDW generated during the sampling effort consisted of several bags of solid disposable sampling and personal protective equipment, six 55-gallon drums of well development and/or purge water, one 55-gallon drum of decontamination water, and eight 55-gallon drums of drill cuttings. The solid IDW (except for drill cuttings) was double-bagged and disposed of in a municipal landfill. The disposal of the water and soil IDW is pending possible removal actions at the site, with the disposal method to be determined.

Table 3-1

**SAMPLE COLLECTION AND ANALYTICAL SUMMARY
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA REGIONAL TRACKING NUMBER	CLP INORGANIC ID	STATION ID	SAMPLE ID	MATRIX	DEPTH (feet bgs)	SAMPLER	DATE	TIME	ANALYSES														SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION		
									TAL Metals	Pesticides	Arsenic	Speciation	Anions	Carbonate/Bicarbonate	Silica	Hardness	TDS	ISS	TOC	USC	Direct Shear	CBR				
02214150	MJ0PH9	MW03	MW03SB01	SB	10-12	JF	5/20/02	09:40	X																Monitoring well MW03, located west of Mill Pond. Well installed to total depth of 39.7 feet bgs in bedrock.	Silty sand, medium brown, fine grained, medium dense, dry, silty sand; and poorly graded gravel, angular, grey, dry, medium dense.
02214151	MJ0PJ0	MW04	MW04SB01	SB	5-7	JF	5/20/02	15:55	X																Monitoring well MW04, located east-northeast of Mill Pond. Well installed to total depth of 19.5 feet bgs in bedrock.	Well graded sand with silt and gravel, very fine to very coarse sand with fine to coarse subrounded to subangular gravel with silt, medium brown, dry, very dense.
02214152	MJ0PJ1	SB04	SB04SS01	SS	0-0.5	JF	5/21/02	07:30	X																Soil boring SB04, western portion of Mill Pond.	Tailings consisting of poorly graded sand, tan, very fine to fine grained, rust colored, loose.
02214153	NA	SB03 / SB04	SB03 / SB04-SS01	SS	0-2	AJ	5/21/02	7:30													X	X	X		Soil boring SB03, eastern portion of Mill Pond, and SB04, western portion of Mill Pond.	Composite of upper 2 feet of tailings from SB03 and SB04. Poorly graded sand, tan, very fine to fine grained, rust colored, loose.
02214156	NA	SB04	SB04SB01	SB	5-10	JF	5/21/02	8:50	X ^a			X ^a	X ^a		X ^a										Soil boring SB04, western portion of Mill Pond.	Silty sand, light grey, moist loose, fine sand with silt, no bedding or laminate, small vertical sand dikes observed. From below tailings
02214158	MJ0PJ2	SB03	SB03SS01	SS	0-0.5	JF	5/21/02	10:50	X																Soil boring SB03, eastern portion of Mill Pond.	Tailings consisting of poorly graded sand, tan, fine to very fine, dry, oxidation staining, loose.
02214160	NA	SB03	SB03SB01	SB	2.5-7.5	JF	5/21/02	11:40	X ^a			X ^a	X ^a		X ^a										Soil boring SB03, eastern portion of Mill Pond.	Silty sand, light grey, medium dense, dry sand, no bedding, no laminae. From below tailings.
02214162	MJ0PJ3	MW02	MW02SB01	SB	6.5-8	JF	5/21/02	16:00	X																Monitoring well MW02, located approximately 25 feet east-southeast of dam at Upper Tailings Pond. Well installed to total depth of 26.5 feet bgs in alluvium / colluvium.	Sandy silt, grey, moist to dry, firm with well graded sand and rounded fine gravel, abundant plant matter.
02214163	MJ0PK9	SB02	SB02SS01	SS	0-0.5	JF	5/22/02	08:00	X																Soil boring SB02, located in the southeastern portion of the Upper Tailings Pond.	Tailings consisting of sandy silt, tan, dry, loose.
02214164	MJ0PL0	SB02	SB02SB01	SB	7.5-10	JF	5/22/02	08:35	X																Soil boring SB02, located in the southeastern portion of the Upper Tailings Pond.	Silty sand, poorly graded, grey to tan, dry loose, fine grained tailings, less oxidation staining evident by color, increased moisture, increased clay.
02214165	NA	SB02	SB02SB02	SB	7.5-12.5	JF	5/22/02	8:45	X ^a			X ^a	X ^a		X ^a										Soil boring SB02, located in the southeastern portion of the Upper Tailings Pond.	Tailings consisting of silty sand, poorly graded, grey to tan, dry loose, less oxidation staining evident by color, increased moisture, increased clay, moist to wet.
02214166	MJ0PL1	SB02	SB02SB03	SB	17.5-20	JF	5/22/02	09:20	X																Soil boring SB02, located in the southeastern portion of the Upper Tailings Pond.	Tailings consisting of silty sand, poorly graded, grey to tan, dry loose, wet.
02214167	NA	SB01 / SB02	SB01 / SB02-SS01	SS	0-2	JF	5/22/02	8:00													X	X	X		Soil boring SB01, located in the central portion of the Upper Tailings Pond, and SB02, located in the southeastern portion of the Upper Tailings Pond.	Composite of upper 2 feet of tailings from SB01 and SB02. Sandy silt and silty sand, very fine grained, tan to orange-tan, with oxidation staining, dry, loose.

Table 3-1

**SAMPLE COLLECTION AND ANALYTICAL SUMMARY
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA REGIONAL TRACKING NUMBER	CLP INORGANIC ID	STATION ID	SAMPLE ID	MATRIX	DEPTH (feet bgs)	SAMPLER	DATE	TIME	ANALYSES													SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION		
									TAL Metals	Pesticides	Arsenic	Speciation	Anions	Carbonate/Bicarbonate	Silica	Hardness	TDS	ISS	TOC	USC	Direct Shear			CBR	
02214169	MJ0PL2	SB01	SB01SS01	SS	0-0.5	JF	5/22/02	10:30	X															Soil boring SB01, located in the central portion of the Upper Tailings Pond.	Tailings consisting of silty sand, very fine, with silt, loose, dry, orange-tan, with oxidation staining.
02214170	MJ0PL3	SB01	SB01SB01	SB	2.5-5	JF	5/22/02	12:05	X															Soil boring SB01, located in the central portion of the Upper Tailings Pond.	Tailings consisting of silty sand, very fine, dry, loose, lacking oxidation staining.
02214171	NA	SB01	SB01SB02	SB	2.5-7.5	JF	5/22/02	12:05	X ^a			X ^a	X ^a		X ^a									Soil boring SB02, located in the southeastern portion of the Upper Tailings Pond.	Composite of tailings from 2.5 to 7.5 feet consisting of silty sand, very fine, light tan to brown, dry to moist, lack of oxidation staining below 3 feet bgs.
02214172	MJ0PL4	SB01	SB01SB02	SB	17.5-20	JF	5/22/02	12:40	X															Soil boring SB01, located in the central portion of the Upper Tailings Pond.	Silt with very fine sand and some clay, light brown, very soft, plastic.
02214174	MJ0PH8	RB01	RB01RB01	Field QC	-	JF	5/22/02	13:15	X															-	Soil sampling equipment (split-tube sampler) rinsate.
02214175	MJ0PL5	SB04	SB04SB02	SB	3-3.5	JF	5/23/02	12:00	X ^b			X ^a	X ^a		X ^a									Soil boring SB04, western portion of Mill Pond.	Tailings consisting of poorly graded sand, very fine to fine, light tan to medium brown, oxidation staining, moist.
02214176	MJ0PL6	SB03	SB03SB02	SB	2.5-3	JF	5/23/02	11:45	X ^b			X ^a	X ^a		X ^a									Soil boring SB03, eastern portion of Mill Pond.	Tailings consisting of poorly graded sand, tan, fine to very fine, dry, oxidation staining, loose.
02214177	MJ0PL7	TP01	TP01GW01	GW	5.1	JF	5/23/02	12:30	X															Temporary well point installed in hand-augered boring near SB03 in Mill Pond. Total depth 5.1 feet bgs in saturated tailings. Water level approximately 4.1 feet bgs.	Pore water sample collected with peristaltic pump from temporary well point installed in hand-augered boring installed in Mill Pond tailings.
02214178	NA	TP01	TP01GW02	GW	5.1	JF	5/23/02	16:10				X	X		X									Temporary well point installed in hand-augered boring near SB03 in Mill Pond. Total depth 5.1 feet bgs in saturated tailings. Water level approximately 4.1 feet bgs.	Pore water sample collected with peristaltic pump from temporary well point installed in hand-augered boring installed in Mill Pond tailings.
02214179	MJ0PL8	MW03	MW03GW01	GW	-	JF	5/23/02	14:10	X															Monitoring well MW03, located west of Mill Pond. Well installed to total depth of 39.7 feet bgs in bedrock.	Groundwater collected with bailer from MW03, filtered.
02214180	NA	MW03	MW03GW01	GW	-	JF	5/23/02	17:11				X	X		X									Monitoring well MW03, located west of Mill Pond. Well installed to total depth of 39.7 feet bgs in bedrock.	Groundwater collected with bailer from MW3, filtered.
02214181	MJ0PL9	BOM BKG 21	BK01GW01	GW	-	JF	5/24/02	08:55	X			X	X		X									Bureau of Mines monitoring well BKG, with three nested wells (21, 66, and 142 feet bgs), located west-northwest of Upper Tailings pond. BOM BKG-21 well installed to 21 feet bgs in alluvium / colluvium.	Groundwater collected with bladder pump.

Table 3-1

**SAMPLE COLLECTION AND ANALYTICAL SUMMARY
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TWISP, WASHINGTON**

EPA REGIONAL TRACKING NUMBER	CLP INORGANIC ID	STATION ID	SAMPLE ID	MATRIX	DEPTH (feet bgs)	SAMPLER	DATE	TIME	ANALYSES													SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION		
									TAL Metals	Pesticides	Arsenic Speciation	Anions	Carbonate/Bicarbonate	Silica	Hardness	TDS	ISS	TOC	USC	Direct Shear	CBR				
02214182	MJ0PM0	BOM BKG 66	BK02GW01	GW	-	JF	5/24/02	10:00	X				X	X			X							Bureau of Mines monitoring well BKG, with three nested wells (21, 66, and 142 feet bgs), located west-northwest of Upper Tailings pond. BOM BKG-66 well installed to 66 feet bgs in fractured andesite porphyry bedrock.	Groundwater sample collected with peristaltic pump. Clear.
02214183	MJ0PM1	MW02	MW02GW01	GW	-	ML	5/24/02	11:30	X				X	X			X							Monitoring well MW02, located approximately 25 feet east-southeast of dam at Upper Tailings Pond. Well installed to total depth of 26.5 feet bgs in alluvium / colluvium.	Groundwater sample collected with peristaltic pump. Clear.
02214184	MJ0PM2	BOM M4-32	M401GW01	GW	-	JF	5/24/02	13:45	X				X	X			X							Bureau of Mines monitoring well M4, with three nested wells (17, 24, and 32 feet bgs), located approximately 1,100 feet southeast of Upper Tailings pond. BOM M4-32 well installed to 32 feet bgs in andesite porphyry bedrock.	Groundwater sample collected with peristaltic pump. Clear.
02214185	MJ0PM3	BOM M4-24	M402GW01	GW	-	JF	5/24/02	14:15	X				X	X			X							Bureau of Mines monitoring well M4, with three nested wells (17, 24, and 32 feet bgs), located approximately 1,100 feet southeast of Upper Tailings pond. BOM M4-24 well installed to 24 feet bgs in colluvium.	Groundwater sample collected with peristaltic pump.
02214186	MJ0PM4	RB02	RB02RB02	Field QC	-	JF	5/28/02	11:00	X				X	X			X							-	Groundwater sampling equipment (bladder pump) rinsate.
02214201	MJ0PF3	DW01	DW01DW01	GW	-	MB	5/20/02	12:09	X															Tom White domestic well. TD estimated 130 feet; bedrock.	Clear, no odor, "first flush" sample.
02214202	MJ0PF4	DW01	DW01DW02	GW	-	MB	5/20/02	12:25	X	X	X	X	X	X	X	X	X	X	X	X				Tom White domestic well. TD estimated 130 feet; bedrock.	Clear, no odor.
02214203	MJ0PF5	DW02	DW02DW01	GW	-	MB	5/20/02	15:00	X	X			X	X	X	X	X	X	X	X				Keith Strickland domestic well. TD 345 feet; bedrock, flowing artesian well.	Initially rusty-colored during purging, becoming clear, no odor.
02214204	MJ0PF6	DW03	DW03DW01	GW	-	MB	5/20/02	15:35	X	X			X	X	X	X	X	X	X	X				Keith Strickland spring. Bedrock.	Clear, no odor.
02214205	MJ0PF7	DW04	DW04DW01	GW	-	MB	5/21/02	09:50	X	X	X		X	X	X	X	X	X	X	X				Fran Johnson domestic well. TD estimated 85 feet.	Clear, no odor.
02214206	MJ0PF8	DW05	DW05DW01	GW	-	MB	5/21/02	11:00	X	X			X	X	X	X	X	X	X	X				Ron Sutherland domestic well. TD estimated 265 feet.	Clear, no odor.
02214207	MJ0PF9	DW06	DW06DW01	GW	-	MB	5/22/02	12:05	X	X	X		X	X	X	X	X	X	X	X				Tara Simmons domestic well. TD 126 feet; bedrock.	Clear, no odor.
02214208	MJ0PG2	DW07	DW07DW01	GW	-	MB	5/21/02	13:10	X	X			X	X	X	X	X	X	X	X				Janice Johnson domestic well. Well completion not known.	Clear, no odor.
02214209	MJ0PG3	DW08	DW08DW01	GW	-	MB	5/21/02	14:10	X	X			X	X	X	X	X	X	X	X				Helen Krinke domestic well. Well completion not known.	Clear, no odor.

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TWISP, WASHINGTON**

EPA REGIONAL TRACKING NUMBER	CLP INORGANIC ID	STATION ID	SAMPLE ID	MATRIX	DEPTH (feet bgs)	SAMPLER	DATE	TIME	ANALYSES														SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION
									TAL Metals	Pesticides	Arsenic	Speciation	Anions	Carbonate/Bicarbonate	Silica	Hardness	TDS	ISS	TOC	USC	Direct Shear	CBR		
02214210	MJ0PG4	DW09	DW09DW01	GW	-	MB	5/21/02	14:55	X	X			X	X	X	X	X	X	X	X			Steve Alexander domestic well. TD 262 feet; bedrock.	Clear, no odor.
02214211	MJ0PG5	DW10	DW10DW01	GW	-	MB	5/21/02	15:45	X	X			X	X	X	X	X	X	X	X			Al McKinney domestic well. TD 126 feet; bedrock.	Clear, no odor.
02214212	MJ0PG6	DW11	DW11DW01	GW	-	MB	5/21/02	16:30	X	X			X	X	X	X	X	X	X	X			Tom Echelbarger domestic well. TD estimated 106.5 feet. Bedrock assumed.	Clear, no odor
02214213	MJ0PG7	DW12	DW12DW01	GW	-	MB	5/21/02	17:55	X	X			X	X	X	X	X	X	X	X			Kathleen Russel domestic well. TD 44.5 feet; alluvial.	Clear, no odor
02214214	MJ0PG8	DW13	DW13DW01	GW	-	MB	5/22/02	11:30	X	X			X	X	X	X	X	X	X	X			Town of Twisp #3 municipal water supply well. TD 88 feet; alluvial.	Clear, no odor
02214215	MJ0PG9	DW14	DW14DW01	GW	-	MB	5/22/02	12:50	X	X			X	X	X	X	X	X	X	X			Ann Port domestic well. TD 70 feet; alluvial.	Clear, no odor
02214216	MJ0PH0	DW15	DW15DW01	GW	-	MB	5/22/02	13:25	X	X			X	X	X	X	X	X	X	X			James Madison domestic well. TD 40 feet; alluvial.	Clear, no odor
02214217	MJ0PH1	DW16	DW16DW02	GW	-	MB	5/22/02	14:00	X	X			X	X	X	X	X	X	X	X			Dale Johnson domestic well. TD 302 feet; bedrock.	Clear, no odor
02214218	MJ0PH2	DW17	DW17DW01	GW	-	MB	5/22/02	15:10	X	X			X	X	X	X	X	X	X	X			Glen Kominak domestic well. TD 166 feet; bedrock.	Clear, no odor
02214219	MJ0PH3	DW18	DW18DW01	GW	-	MB	5/22/02	16:00	X	X			X	X	X	X	X	X	X	X			Jim Harvey domestic well. TD 105 feet; bedrock.	Clear, no odor
02214220	MJ0PH4	DW19	DW19DW01	GW	-	MB	5/22/02	10:00	X	X			X	X	X	X	X	X	X	X			Vaughn Jolley domestic well. TD 410 or 460 feet; bedrock.	Clear, no odor
02214221	MJ0PH5	DW16	DW16DW01	GW	-	MB	5/22/02	13:39	X														Dale Johnson domestic well. TD 302 feet; bedrock.	Clear, no odor, "first flush" sample.
02214222	MJ0PH6	DW12	DW12DW02	GW	-	MB	5/22/02	16:30	X														Kathleen Russel domestic well. TD 44.5 feet; alluvial.	Clear, no odor, "first flush" sample.
02214223	MJ0PH7	DW20	DW20DW01	GW	-	MB	5/22/02	18:30	X	X			X	X	X	X	X	X	X	X			Scott Michaels domestic well. TD estimated 117 feet.	Clear, no odor
02214224	MJ0PJ4	TV01	TV01SS01	SS	0-0.5	ML	5/23/02	11:45	X														Twisp View Mine, vein outcrop in lower pit near shaft.	Friable, iron-stained vein material.
02214225	MJ0PJ5	SM01	SM01SS01	SS	0-0.5	ML	5/23/02	13:25	X														Spokane Mine, waste dump at adit.	Fines (silt and smaller), and sand, and gravel sized, iron -stained, angular rock fragments.
02214226	MJ0PJ6	FR01	FR01SS01	SS	0-0.5	ML	5/23/02	14:20	X														Floyd-Rattlesnake mine prospect area. Waste dump at Adit 2.	Rusty brown waste rock material, fines, sand, and small gravel.
02214227	MJ0PJ7	FR02	FR02SS01	SS	0-0.5	ML	5/23/02	14:30	X														Floyd-Rattlesnake mine prospect area. Waste dump at Adit 1.	Bright orange waste rock; fines, sand, and gravel.
02214228	MJ0PJ8	TW01	TW01SS01	SS	0-0.5	ML	5/23/02	15:15	X														Surface soil at location near Tom White residence.	Grayish brown silty sand.
02214229	MJ0PJ9	HK01	HK01SD01	SD	0-0.5	ML	5/23/02	15:30	X														Sediment from unnamed intermittent stream near Helen Krinke residence.	Buff to orange colored silty material similar in appearance to tailings from Upper Tailings Pond.

Table 3-1

**SAMPLE COLLECTION AND ANALYTICAL SUMMARY
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA REGIONAL TRACKING NUMBER	CLP INORGANIC ID	STATION ID	SAMPLE ID	MATRIX	DEPTH (feet bgs)	SAMPLER	DATE	TIME	ANALYSES													SAMPLE LOCATION DESCRIPTION	SAMPLE DESCRIPTION		
									TAL Metals	Pesticides	Arsenic	Speciation	Anions	Carbonate/Bicarbonate	Silica	Hardness	TDS	ISS	TOC	USC	Direct Shear			CBR	
02214230	MJ0PK0	IR02	IR02SW01	SW	-	ML	5/23/02	16:10	X				X	X			X							Surface water from IR02, irrigation raceway	Clear, no odor.
02214231	MJ0PK1	IR02	IR02SD01	SD	0-0.5	ML	5/23/02	16:20	X															Sediment from IR02, irrigation raceway, depositional bank.	Brown, fine to medium sand with some fines.
02214232	MJ0PK2	IR03	IR03SW01	SW	-	ML	5/23/02	17:35	X			X	X				X							Surface water from PPE1, irrigation raceway	Clear, no odor.
02214233	MJ0PK3	IR03	IR03SD01	SD	0-0.5	ML	5/23/02	17:40	X															Sediment from PPE1, irrigation raceway, from small depositional feature.	Fine sand with fines, brown.
02214234	MJ0PK4	IR01	IR01SW01	SW	-	ML	5/23/02	17:55	X			X	X				X							Surface water from background location on irrigation raceway, approximately 150 feet upstream of PPE1.	Clear, no odor.
02214235	MJ0PK5	IR01	IR01SD01	SD	0-0.5	ML	5/23/02	18:00	X															Sediment from background location on irrigation raceway, approximately 150 feet upstream of PPE1.	Dark brown fine to coarse sand with brown fines.
02214236	MJ0PK6	MB01	MB01MM01	Process material	0-0.5	ML	5/23/02	19:10	X															Material from interior of conditioner tank on ball mill level of mill building.	Blue-green- and yellow-tinted, generally white powder, semi-consolidated.
02214237	MJ0PK7	MB02	MB02SS02	SS	0-0.5	ML	5/23/02	19:20	X															Approximately 40 feet east of east corner of Mill building.	Silt and sand, rusty colored, moist.
02214238	MJ0PK8	MW01	MW01GW01	GW	-	ML	5/24/02	10:35	X			X	X				X							Monitoring well MW01, located east-northeast of Mill Pond. Well installed to total depth of 39.5 feet bgs in bedrock.	Groundwater sample collected with bladder pump. Clear, no odor.
02214239	MJ0PM5	FR03	FR03SS01	SS	0-0.5	ML	5/24/02	14:25	X															Floyd-Rattlesnake mine workings area. Waste rock dump at adit located west of Tom White residence.	Waste rock, fine to gravel sized, predominately sandy, orange-brown and yellow-brown, dry to moist.
02214240	MJ0PM6	US01	US01SD01	SD	0-0.5	ML	5/24/02	14:45	X															Dry streambed, north-flowing unnamed intermittent stream at location southwest of Tom White residence and upstream of mine workings located west of Tom White residence.	Dry, grayish, brown, organic rich loam.
02214241	MJ0PM7	US02	US02SD01	SD	0-0.5	ML	5/24/02	15:20	X															Dry streambed, east-flowing unnamed intermittent stream at location upstream of mine workings located west of Tom White residence and upstream of Upper Tailings Pond.	Buff colored loam, dry.
00234357 °	NA	ML01	ML01SD01	SD	0-0.5	RP	6/6/00	9:15	X															Bed of unnamed intermittent stream downstream of Upper Tailings Pond dam.	Tan/orange silt with fine sand and clay.
00234393 °	NA	BG01	BG01SS01	SS	0-0.5	DB	6/7/00	18:15	X															Surface soil from location along Lookout Mountain Road approximately 2 miles southwest of the mill.	Dry, light brown sand, little gravel, sand fine to medium.

Key:

a	= Sample analyzed for Synthetic Precipitate Leaching Procedure (SPLP).
b	= Sample analyzed for SPLP and TAL Metals.C83
c	= Sample collected as part of 2000 Alder Mine Site Phase 1 and Phase 2 Preliminary Assessment/Site Inspection.
AJ	= Alan Jensen
bgs	= Below ground surface
CBR	= California Bearing Ratio
CLP	= Contract Laboratory Program
DB	= Dave Brown
EPA	= United States Environmental Protection Agency
GW	= Groundwater
ID	= Identification
JF	= Jeff Fowlow
MB	= Mike Berger
ML	= Mark Longtine
NA	= Not Applicable
Pesticides	= Chlorinated pesticides
QC	= Quality control
SB	= Subsurface soil
SD	= Sediment
SS	= Surface soil
SW	= Surface water
TAL	= Target Analyte List
TDS	= Total dissolved solids
TOC	= Total organic carbon
TSS	= Total suspended solids
USC	= Unified Soil Classification

Table 3-2

**SAMPLE IDENTIFICATION CODING
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

Characters	Description	Example
1, 2	Source Code	BG Background Soil Location* BK BOM BKG Monitoring Well DW Drinking Water Well FR Floyd-Rattlesnake Mine HK Helen Krinke Residence IR Irrigation Raceway M2 BOM M2 Monitoring Well M4 BOM M4 Monitoring Well MB Mill Building ML Unnamed Intermittent Stream* MW IA Monitoring Well RB Rinsate Blank SB Soil Boring SM Spokane Mine TP Tailings Pond TV Twisp View Mine TW Tom White Residence US Unnamed Intermittent Stream
3, 4	Consecutive Number Per Source Code	01 01
5, 6	Matrix Code	DW Drinking Water GW Groundwater MM Mill Building Process Material RB Rinsate Blank SB Subsurface Soil SD Sediment SS Surface Soil SW Surface Water
7, 8	Consecutive Number Per Matrix and Source Code	01 01

* From Alder Mine PA/SI (E & E 2000)

Example: SB01SB02 is the second subsurface soil sample collected from soil boring SB01.

4. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware and reagents. Specific QC requirements for laboratory analyses are incorporated in the *Contract Laboratory Program Statement of Work for Organic Analyses* (EPA 1999b) and in the *Contract Laboratory Program Statement of Work for Inorganic Analyses* (EPA 2000a). These QC requirements or equivalent requirements were followed for analytical work on the IA. This section describes the QA/QC measures taken for the IA and provides an evaluation of the usability of data presented in this report.

All samples were collected following the guidance of the SQAP (E & E 2002). TAL inorganic analyses were performed at Chemtech Consulting Group, Englewood, New Jersey, a CLP laboratory, following the *CLP Statement of Work for Inorganic Analyses* (EPA 2000a). Chlorinated pesticide analyses were performed at the EPA MEL, Port Orchard, Washington, following EPA SW-846 Method 8082. Water quality parameter analyses, including major anions (chloride, nitrate, nitrite, sulfate - EPA 300 Series Methods), bicarbonate alkalinity (modified EPA Method 310.1), carbonate alkalinity (modified EPA Method 310.1), nitrate/nitrite (EPA Method 353.2), SPLP (EPA Method 1312) - inorganics, alkalinity, major anions, and total dissolved solids (EPA Methods 6010 and 7470, 310.1 modified, 300.0 and 160.1, respectively), total alkalinity (EPA Method 310.1), silica (EPA Method 370.1), total suspended solids (EPA Method 160.2), total organic carbon (modified EPA Method 9060), hardness (EPA Method 130.2), and total dissolved solids (EPA Method 160.1), were performed by Laucks Testing Services, Seattle, Washington, a START-2 subcontracted commercial laboratory. Arsenic speciation analyses (modified EPA Method 1632) were performed by Brooks Rand, LLC, Seattle, Washington, a START-2 subcontracted commercial laboratory. Unified soil classification system (ASTM Method D-2487), direct shear (ASTM Method D-3080), and California bearing ratio (ASTM Method D-1883) tests were performed by Soil Technology, Inc., Bainbridge Island, Washington, a START-2 subcontracted commercial laboratory.

Data from analyses performed by the CLP laboratory were reviewed and validated by EPA chemists. Data from analyses performed by the MEL were reviewed and validated by MEL chemists.

Data from the START-2 subcontracted commercial laboratories were reviewed and validated by E & E chemists. Data qualifiers were applied as necessary according to the following guidance:

- *EPA (1990) Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures;*
- *EPA (1994a) Contract Laboratory Program National Functional Guidelines for Inorganic Data Review;* and
- *EPA (1999a) Contract Laboratory Program National Functional Guidelines for Organic Data Review.*

In the absence of other QC guidance, method-specific QC limits were also utilized to apply qualifiers to the data. Copies of the data QA memoranda are included in Appendix F.

4.1 SATISFACTION OF DATA QUALITY OBJECTIVES

The following EPA (2000b) guidance document was used to establish data quality objectives (DQOs) for this IA:

- *Guidance for the Data Quality Objectives Process, EPA 600-R-96-055.*

The EPA OSC and TM determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the field work produced data that met the DQOs stated in the SQAP (E & E 2002). A detailed discussion of accomplished IA objectives is presented in the following sections.

4.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA samples included equipment rinsate blank samples. Trip blank samples were not required as volatile organic analyses were not performed. Two rinsate blank samples were collected from non-dedicated sample collection equipment. QC samples included matrix spike/matrix spike duplicate (MS/MSD) samples for organic analyses or MS/duplicate samples for inorganic analyses at a rate of one MS/MSD or one MS/duplicate per 20 samples per matrix. Temperature blanks were included in sample coolers to assist in determining sample temperatures.

4.3 PROJECT-SPECIFIC DATA QUALITY OBJECTIVES

The laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' abilities to meet project DQOs for precision, accuracy and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratories and the field team were able to meet DQOs for the project.

4.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/MSD samples measure the precision of the analytical method.

The RPD values were reviewed for all laboratory samples. A total of 70 results (approximately 2.8% of the data) were qualified as estimated quantities (J) based on laboratory duplicate QC outliers. The DQO for precision of 85% was met.

4.3.2 Accuracy

Accuracy measures the reproducibility of the sampling and analytical methodology. Laboratory accuracy is defined as the surrogate spike percent recovery (%R) for each pesticide analysis or the MS %Rs for all appropriate analyses. The surrogate %R values were reviewed for all appropriate sample analyses. All surrogate recoveries were within QC limits. None of the data were qualified based on surrogate results.

The MS %R values were reviewed for all MS/MSD analyses. A total of 58 results (approximately 2.4% of the data) were qualified as estimated quantities (J) based on spike QC outliers. Overall, the project DQO for accuracy of 85% was met.

4.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All laboratory data were reviewed for data validation and usability. None of the data were rejected, therefore the project DQO for completeness of 90% was met.

4.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or environmental

condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQO for representativeness of 85% was met.

4.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this site followed applicable field sampling techniques and specific analytical methodology. The DQO for comparability was met.

4.4 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PARAMETERS

The laboratory data also were reviewed for holding times, laboratory blank samples and rinsate samples. These QA/QC parameters are summarized below. In general, the laboratory and field QA/QC parameters were considered acceptable.

4.4.1 Holding Times

Four results (0.2% of the data) were qualified as estimated detection limits (UJ) based on holding time outliers. Nitrate and nitrite analyses for samples 02214184 and 02214185 exceeded the holding time limits of 48 hours resulting in four qualifications. Associated sample detection limits were qualified as estimated quantities (UJ).

4.4.2 Laboratory Blanks

All laboratory blanks met the frequency criteria. The following potential contaminants of concern were detected in the laboratory blanks:

TAL Inorganics: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc.

A total of 64 TAL inorganic results were qualified as not detected (U) and 240 TAL inorganic results were qualified as estimated quantities (J or UJ) based on laboratory blank contamination. Associated sample results less than five times the positive blank contamination (10 times for common laboratory contaminants) were qualified as not detected (U). Associated sample results less than five times the absolute value of negative inorganic blank contamination were qualified as estimated quantities

(J or UJ). See the data validation memoranda in Appendix F for results that were qualified based on blank contamination.

4.4.3 Rinsate Blanks

Table 4-1 summarizes the rinsate blank results. Rinsate blank sample 02214174 was collected from decontaminated subsurface soil sampling equipment (split-tube sampler), and is associated with the subsurface soil samples. Rinsate blank sample 02214186 was collected from the decontaminated bladder pump, and is associated with groundwater samples 02214181 and 02214238. The frequency criteria of one rinsate blank per 20 samples per associated sample collection method for non-dedicated equipment was met. Copper, iron, and manganese were detected in samples 02214174 and 02214186, and mercury was detected in sample 02214186.

Two TAL inorganic results (copper and mercury in groundwater sample 02214181) were qualified as not detected (U) based on the rinsate blank contaminants. These rinsate blank qualifications were applied to the tables and Form I's, but were not discussed in the associated data validation memoranda.

Table 4-1

**RINSATE BLANK SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
TWISP, WASHINGTON**

EPA Sample Number	02214174	02214186
CLP Inorganic Number	MJ0PH8	MJ0PM4
CLP Organic Number	NA	NA
Location ID Number	RB01RB01	RB02RB02
Inorganics (µg/L)		
Copper	2.4 JK	2.4 JK
Iron	18.8 BJ	29.8 JK
Manganese	0.31 JK	0.9 JK
Mercury	0.2 U	0.21 JH

Note: Only results for elements which were detected in at least one sample were reported.
 Bold type indicates concentrations above the CRDL.

Key:

- B = Analyte detected below the CRDL but at or above the instrument detection limit.
- CLP = Contract Laboratory Program.
- CRDL = Contract Required Detection Limit.
- EPA = United States Environmental Protection Agency.
- H = High bias.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical result is an estimate.
- K = Unknown bias.
- µg/L = Micrograms per liter.
- NA = Not applicable.
- QC = Quality control.
- RB = Rinsate blank.
- U = The analyte was not detected. The associated numerical result is the CRDL.

5. ANALYTICAL RESULTS REPORTING AND BACKGROUND SAMPLES

This section describes the reporting and methods applied to EPA CLP, MEL, and subcontracted laboratory analytical results presented in **Sections 6 and 7** of this report, and discusses background sample locations and results. **Table 3-1** describes all samples collected during the IA for laboratory analysis, as well as two samples collected during the Alder Mine PA/SI (E & E 2000).

Analytical results from the EPA CLP, MEL, and subcontracted laboratories are presented in the summary tables in Sections 6 and 7. All analytes detected above the Contract Required Detection Limit (CRDL) or Contract Required Quantitation Limit (CRQL) for CLP analyses, or sample quantitation/detection limits for MEL and commercial laboratory analyses, are shown in bold type. No chlorinated pesticides were detected in any of the samples submitted to MEL; therefore, these results are not presented in the summary tables.

Analytical results indicating significant concentrations of contaminants in source samples with respect to concentrations in selected background samples are shown underlined and in bold type (**Section 6**). Similarly, analytical results indicating elevated concentrations of contaminants in target samples with respect to concentrations in selected background samples are underlined and in bold type (**Section 7**).

Soil and groundwater analytical results are compared to applicable or relevant and appropriate requirements (ARARs). Soil analytical results are compared to regulatory cleanup levels (EPA Region 9 Preliminary Remedial Goals [PRGs]; MTCA Method B Unrestricted cleanup levels; and MTCA Method B Protection of Groundwater soil cleanup levels). Soil sample results that exceed any of the regulatory cleanup levels are shaded in the soil sample analytical results summary tables in Section 6. Soil analytical results also are compared to MTCA Ecological Indicators for Soil, Vegetation, and Wildlife (Ecological Indicators). Soil sample results that exceed the Ecological Indicators are shown in italics in the analytical results summary tables in Section 6. Groundwater analytical results are compared to EPA Maximum Contaminant Levels (MCLs), EPA Region 9 Tap Water PRGs, and MTCA Method B cleanup levels. Groundwater sample results exceeding any of the regulatory cleanup levels are shaded in the analytical results summary tables in Section 7. A discussion of analytical results in comparison to ARARs is presented in **Section 8**.

5.1 ANALYTICAL RESULTS EVALUATION CRITERIA

For the purposes of this investigation, significant/elevated concentrations of TAL metals in samples are those concentrations that are:

- Equal to or greater than the CRQL/CRDL or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the selected background sample's CRQL/CRDL or SQL when the background sample concentration is below detection limits; or
- At least three times greater than the selected background sample's concentration when the background sample concentration equals or exceeds the detection limit.

The analytical summary tables in Sections 6 and 7 present all detected analytes. Only detected analytes at potential sources targets meeting the significant/elevated concentration criteria are discussed in the report text, except for results of groundwater characterization analyses (e.g. major anions and cations) and engineering analyses. All detected results are discussed for background samples, including those results that were below the CRDL, CRQL, or SQL. Only results above the CRDL, CRQL, or SQL are used for evaluation purposes.

For comparison purposes, the CRQL/CRDL/SQL is provided in parentheses for background results that are qualified because they are below the CRQL/CRDL when the analyte is detected in target samples. When samples were diluted for re-analysis at a laboratory, the dilution results were considered for evaluation and are provided in the tables. All hazardous substances detected using EPA CLP, MEL, and START-2 subcontracted commercial laboratory results at source and target locations and meeting evaluation criteria can be used to document an observed release from the site to the target. For target locations, only those analytes that also were detected in a source at the site were evaluated to determine whether their concentrations were elevated.

5.2 SAMPLE RESULTS REPORTING

When four or more analytes are significant or elevated for an analytical suite (e.g., TAL metals) in Sections 6 and 7, the number of such analytes and the concentration ranges are given. When three or fewer analytes are significant or elevated for an analytical suite, the specific analyte and associated concentrations are provided. Based on EPA Region 10 policy, evaluation of aluminum, calcium, iron, magnesium, potassium and sodium (common earth crust elements) generally is employed only in water mass tracing. Several of these cations (calcium, magnesium, potassium, and sodium), as well as major

anions (chloride, carbonate, bicarbonate, nitrate, and sulfate), total dissolved solids, total suspended solids, total organic carbon, hardness as calcium carbonate, carbonate and bicarbonate, silica, and hardness were evaluated for groundwater characterization purposes. These results are summarized in [Section 7](#).

5.3 BACKGROUND SAMPLES

Background samples were collected for surface soil, subsurface soil, groundwater, surface water, and sediment matrices. Results for the applicable background sample(s) are provided in the leftmost column(s) of the analytical results summary tables in Sections 6 and 7 for comparison against source or target results. It should be noted that the results of the selected background samples do not necessarily represent background conditions throughout the study area. Concentrations of arsenic and other metals in soils exhibit a high degree of naturally occurring variability throughout the study area, as discussed in [Section 6](#). Similarly, concentrations of arsenic and other metals in groundwater exhibit a high degree of variability throughout the study area, as discussed in [Section 7](#).

5.3.1 Background Surface Soil

5.3.1.1 Sample Locations

One background surface soil sample was collected during the IA from 0 to 6 inches bgs from a location (TW01) near the Tom White residence west of the mill site. The sample consisted of grayish brown silty sand. No odor or staining or other indication of possible contamination was observed in the soil. The sample location was selected to provide information on soil conditions within the valley of the unnamed intermittent stream immediately upstream of the UTP. It should be noted that the sample was collected in relatively close proximity to the UTP, as well as the mine prospects comprising the Floyd-Rattlesnake mine (see [Figure 3-1](#)).

A background surface soil sample was collected by the START during the PA/SI performed at the Alder Mine Site (E & E 2000). This sample was collected at a location (BG01) along Lookout Mountain Road approximately 2 miles southwest of the mill building, and consisted of dry, light brown fine to silty sand with some gravel. This sample was selected as a background sample in this study to provide additional information on background soil conditions within the study area. The sample was collected at a location not in close proximity to documented mineralized bedrock or mining activities.

5.3.1.2 Sample Results

Sample results for the selected background surface soil samples are presented in [Tables 6-1, 6-2, and 6-6](#). A total of eight TAL metals were detected in the background surface soil sample from TW01. Arsenic was detected at 68.8 mg/kg; barium was detected at 176 mg/kg; chromium was detected at an estimated concentration of 9.0 JK mg/kg; copper was detected at 29.8 mg/kg; lead was detected at 17.9 mg/kg; manganese was detected at 393 mg/kg; vanadium was detected at 32.0 mg/kg; and zinc was detected at 80.3 mg/kg.

A total of ten TAL metals were detected in the background surface soil sample from BG01. Arsenic was detected at 18.8 mg/kg; barium was detected at an estimated concentration of 160 JL mg/kg; chromium was detected at 18.9 mg/kg; copper was detected at 139 mg/kg; lead was detected at 16.3 mg/kg; manganese was detected at 1660 mg/kg; mercury was detected at 0.0345 mg/kg; silver was detected at 1.75 mg/kg; vanadium was detected at 81.9 mg/kg; and zinc was detected at 252 mg/kg.

It should be noted that the background surface soil sample collected during the 1986 Alder Mill SI contained arsenic at a concentration of 217 mg/kg (Ecology 1986). It should also be noted that other surface soil samples collected during the IA from area mines and prospects contained arsenic at significant concentrations (as high as 24,400 mg/kg).

5.3.2 Background Subsurface Soil

5.3.2.1 Sample Locations

One background subsurface soil sample was collected at monitoring well location MW03 from between 10 and 12 feet bgs. MW03 was drilled in native soil (colluvium) and underlying bedrock west of the Mill Pond. Sampled material consisted of brown, silty fine sand.

5.3.2.2 Sample Results

Subsurface soil sample results are presented in [Table 6-3](#). A total of eleven TAL metals were detected in the background subsurface soil sample at MW03. Antimony was detected at an estimated concentration of 2.2 JK mg/kg; arsenic was detected at 275 mg/kg; barium was detected at 71.7 mg/kg; chromium was detected at an estimated concentration of 15.1 JK mg/kg; cobalt was detected at 12.8 mg/kg; copper was detected at 45.6 mg/kg; lead was detected at 109 mg/kg; manganese was detected at 564 mg/kg; nickel was detected at 13.5 mg/kg; vanadium was detected at 65.1 mg/kg; and zinc was detected at 107 mg/kg.

5.3.3 Background Groundwater

5.3.3.1 Sample Locations

One background groundwater sample location was selected. The sample collected from the Harvey well, located approximately 2.5 miles west-northwest of the site within the Twisp River valley, is used as the background sample. It should be noted, however, that concentrations of arsenic and other metals exhibit a high degree of naturally occurring variability in the study area, and that the selected background well sample does not necessarily represent background conditions for the entire study area.

5.3.3.2 Sample Results

Groundwater sample analytical results are summarized in [Tables 7-3 and 7-4](#). A total of four TAL metals were detected in the background groundwater sample. Cobalt was detected at an estimated concentration of 0.66 JK $\mu\text{g/L}$; copper was detected at an estimated concentration of 1.5 JK $\mu\text{g/L}$; lead was detected at 3.3 $\mu\text{g/L}$; and zinc was detected at an estimated concentration of 183 JK $\mu\text{g/L}$.

5.3.4 Background Surface Water

5.3.4.1 Sample Locations

One background surface water sample was collected during the IA from location IR01 on the irrigation raceway, approximately 150 feet upstream of the probable point of entry (PPE) of the ditch draining eastward from the Mill Pond to the irrigation raceway.

5.3.4.2 Sample Results

Surface water sample analytical results are summarized in [Table 7-6](#). A total of three TAL metals were detected in the background surface water sample. Barium was detected at an estimated concentration of 5.4 JK $\mu\text{g/L}$; manganese was detected at an estimated concentration of 7.5 JK $\mu\text{g/L}$; and zinc was detected at an estimated concentration of 24.0 JK $\mu\text{g/L}$.

5.3.5 Background Sediment

5.3.5.1 Sample Locations

Three background sediment samples were collected during the IA from location IR01 on the irrigation raceway, and locations US01 and US02 on the unnamed intermittent stream upstream of the UTP.

5.3.5.2 Sample Results

Sediment sample analytical results are summarized in [Tables 7-7a, 7-7b, and 7-7c](#). A total of nine TAL metals were detected in the background sediment sample from IR01. Arsenic was detected at 16.8 mg/kg; barium was detected at 110 mg/kg; chromium was detected at an estimated concentration of 19.9 JK mg/kg; copper was detected at 30.2 mg/kg; lead was detected at 5.0 mg/kg; manganese was detected at 14.7 mg/kg; nickel was detected at 14.7 mg/kg; vanadium was detected at 65.4 mg/kg; and zinc was detected at 71.9 mg/kg.

A total of nine TAL metals were detected in the background sediment sample from US01. Arsenic was detected at an estimated concentration of 31.3 JL mg/kg; barium was detected at 70.9 mg/kg; cadmium was detected at an estimated concentration of 0.33 JK mg/kg; chromium was detected at 6.0 mg/kg; copper was detected at an estimated concentration of 28.6 JK mg/kg; lead was detected at 7.1 mg/kg; manganese was detected at 278 mg/kg; vanadium was detected at 28.6 mg/kg; and zinc was detected at 67.6 mg/kg.

A total of seven TAL metals were detected in the background sediment sample from US02. Arsenic was detected at an estimated concentration of 12.9 JL mg/kg; barium was detected at 204 mg/kg; cadmium was detected at an estimated concentration of 0.84 JK mg/kg; copper was detected at an estimated concentration of 36.4 JK mg/kg; lead was detected at 4.8 mg/kg; manganese was detected at 446 mg/kg; and zinc was detected at 125 mg/kg.

6. POTENTIAL SOURCES

This section describes sample locations and analytical results of IA samples collected from potential sources. The sampling locations, sampling rationale and analytical results are summarized in the following sections. [Tables 6-1 through 6-5 and 6-7](#) summarize results for analytes detected at each potential source investigated. [Table 6-6](#) summarizes analytical results for additional samples collected from off-site locations. Laboratory data sheets of analytical results for all samples are provided in Appendix F.

6.1 TAILINGS POND SURFACE SOIL SAMPLES

Tailings pond surface soil sample results are presented in [Table 6-1](#). A total of ten TAL metals were detected in the tailings pond surface soil samples at significant concentrations relative to those in one or both of the selected background samples. Antimony was detected at a significant concentration in one sample (SB03) at an estimated 4.7 JK mg/kg. Arsenic was detected at significant concentrations of 78.0 mg/kg (SB03) and 137 mg/kg (SB04). Barium was detected at significant concentrations in all four soil samples ranging from 3,830 mg/kg (SB01) to 6,850 mg/kg (SB04). Copper was detected at significant concentrations of 651 mg/kg (SB04), 303 mg/kg (SB03), and 140 mg/kg (SB01). Lead was detected at significant concentrations in all four samples ranging from 71.1 mg/kg (SB01) to 1,800 mg/kg (SB04). Mercury was detected at significant concentrations in all four samples ranging from an estimated 0.31 JH mg/kg (SB02) to an estimated 9.7 JH mg/kg (SB03). Selenium was detected at significant concentrations in all four samples ranging from 1.3 mg/kg (SB01) to 17.0 mg/kg (SB04). Silver was detected at significant concentrations of 13.5 mg/kg (SB03) and 26.7 mg/kg (SB04). Thallium was detected at a significant concentration in one sample at 2.2 mg/kg (SB04). Zinc was detected at a significant concentration in one sample at 313 mg/kg (SB03).

6.2 MILL BUILDING SURFACE SOIL SAMPLE

Soil sample results for the sample collected from near the Mill building (MB02) are presented in [Table 6-2](#). A total of eight TAL metals were detected at significant concentrations relative to those in one or both of the selected background samples. Antimony was detected at a significant estimated

concentration of 6.9 JK mg/kg. Arsenic was detected at a significant concentration of 240 mg/kg. Barium was detected at a significant concentration of 1,350 mg/kg. Copper was detected at a significant concentration of 1,420 mg/kg. Lead was detected at a significant concentration of 668 mg/kg. Mercury was detected at a significant estimated concentration of 5.9 JH mg/kg. Selenium was detected at a significant estimated concentration of 13.6 mg/kg. Silver was detected at a significant concentration of 16.2 mg/kg.

6.3 TAILINGS POND SUBSURFACE SOIL SAMPLES

Tailings pond subsurface soil samples results are presented in [Table 6-3](#). A total of eight TAL metals were detected in the tailings pond subsurface soil samples at significant concentrations relative to those in the selected background sample. Barium was detected at significant concentrations in all six samples ranging from 488 mg/kg (SB01SB02) to 11,300 mg/kg (SB03SB02). Cadmium was detected at significant concentrations in two samples ranging from an estimated concentration of 0.65 JK mg/kg (SB01SB02) to 1.1 mg/kg (SB02SB03). Copper was detected at significant concentrations in four samples ranging from an estimated concentration of 352 JK mg/kg (SB04SB02) to 1,720 mg/kg (SB02SB01). Lead was detected at a significant concentration of 750 mg/kg in sample SB03SB02. Mercury was detected at significant concentrations in three samples, including an estimated concentration of 0.15 JH mg/kg (SB02SB01), an estimated concentration of 0.30 JH mg/kg (SB04SB02), and an estimated concentration of 5.6 JH mg/kg (SB03SB02). Selenium was detected at significant concentrations in four samples ranging from 2.2 mg/kg (SB01SB02) to 5.9 mg/kg (SB02SB01). Silver was detected at significant concentrations in three samples, including 3.3 mg/kg (SB02SB01), 2.9 mg/kg (SB04SB02), and 10.2 mg/kg (SB03SB02). Zinc was detected at significant concentrations in three samples including 332 mg/kg (SB01SB01), 1,840 mg/kg (SB01SB02), and 586 mg/kg (SB02SB01).

6.3.1 SPLP Analysis

Subsurface soil samples were collected from the UTP and Mill Pond for SPLP TAL metals analysis. Based upon visual observations, samples from the UTP were collected from intervals below the oxidized zone in SB01 (sample SB01SB02, collected from 2.5 to 7.5 feet bgs) and SB02 (sample SB02SB02, collected from 7.5 to 12.5 feet bgs). Tailings samples collected for SPLP analysis from the Mill Pond were collected from intervals of 3 to 3.5 feet bgs in SB04 (SB04SB02) and 2.5 to 3 feet bgs in SB03 (SB03SB02). All tailings observed in SB03 and SB04 were oxidized based upon visual observations.

Analytical results are summarized in [Table 6-4](#). Cadmium was detected in the samples from both tailings ponds (6.5 µg/L in SB02 and 7.6 µg/L in SB04). Cobalt was detected in one sample from the Mill Pond (SB04) at an estimated concentration of 5.9 J µg/L. Copper was detected in all samples at concentrations ranging from 1,220 µg/L (SB03) to 5,590 µg/L (SB04). Manganese was detected in all four samples at estimated concentrations ranging from 18.3 J µg/L (SB01) to 178 J µg/L (SB04). Nickel was detected in the samples from SB02 (1.9 J µg/L), SB03 (5.2 J µg/L), and SB04 (1.6 J µg/L). Zinc was detected in all four samples at estimated concentrations ranging from 183 J µg/L (SB01) to 1,130 J µg/L (SB03).

6.3.2 Geotechnical Analysis

For engineering analysis, tailings samples were collected from the UTP and Mill Pond for California Bearing Ratio, Unified Soil Classification System, and Direct Shear Test analysis. Results are summarized in [Table 6-5](#).

6.4 WASTE ROCK AND NATIVE MINERALIZED ROCK SAMPLES

Waste rock and native mineralized rock material samples were collected from selected mines and prospects in the vicinity in order to provide additional information on the soil conditions that exist in the vicinity of the site, including the mineralization that has occurred locally within bedrock and fault zones. Waste rock and native mineralized vein material sample results are presented in [Table 6-6](#). A total of twelve TAL metals were detected at significant concentrations in the waste rock and vein material samples. Antimony was detected at significant concentrations in four samples ranging from an estimated 4.4 JK mg/kg (FR02) to 658 mg/kg (TV01). Arsenic was detected at significant concentrations in four samples ranging from an estimated 108 JL mg/kg (FR03) to 24,400 mg/kg (TV01). Cadmium was detected at significant concentrations of 373 mg/kg (TV01), 10.4 mg/kg (SM01), and an estimated 2.6 JK mg/kg (FR01). Cobalt was detected at significant concentrations in four samples ranging from an estimated 0.8 JK mg/kg (FR02) to 23.6 mg/kg (TV01). Copper was detected at significant concentrations in all five samples ranging from 112 mg/kg (SM01) to an estimated 720 JK mg/kg (FR03). Lead was detected at significant concentrations in four samples ranging from 70.8 mg/kg (FR02) to 865 mg/kg (TV01). Manganese was detected at significant concentrations of 2,590 mg/kg (TV01), 1,200 mg/kg (SM01), and 1,800 mg/kg (FR01). Mercury was detected at significant concentrations in all five samples ranging from an estimated 0.33 JH mg/kg (FR02) to an estimated 1.3 JH mg/kg (FR01). Nickel was detected at significant concentrations of 26.2 mg/kg (TV01), an estimated 1.0 JK (FR03), and 28.5 mg/kg

(SM01). Selenium was detected at significant concentrations of 1.3 mg/kg (FR01), 12.8 mg/kg (FR02), and 16.2 mg/kg (FR03). Silver was detected at significant concentrations in all five samples ranging from 5.8 mg/kg (FR01) to 77.9 mg/kg (TV01). Zinc was detected at significant concentrations of 27,100 mg/kg (TV01), 1,150 mg/kg (SM01), and 340 mg/kg (FR01).

6.5 MILL PROCESS MATERIAL SAMPLE

A sample of material located in the conditioner tank in the mill building was collected. The sample consisted of a white powder with localized blue-green and yellow coloration. The sample contained detectable concentrations of arsenic (44.2 mg/kg), barium (57.8 mg/kg), cadmium (4,450 mg/kg), chromium (estimated 11.6 JK mg/kg), copper (13,200 mg/kg), lead (44.7 mg/kg), manganese (1,710 mg/kg), nickel (75.2 mg/kg), selenium (7.1 mg/kg), and zinc (173,000 mg/kg).

Table 6-1

**TAILINGS POND SURFACE SOIL SAMPLE ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	00234393	02214228	02214152	02214158	02214163	02214169	EPA Region 9 PRGs Residential	MTCA Method B Unrestricted	MTCA Method B Protection of Groundwater	MTCA Ecological Indicators for Soil, Vegetation, Wildlife (Table 749-3)
CLP Sample ID	NA	MJ0PJ8	MJ0PJ1	MJ0PJ2	MJ0PK9	MJ0PL2				
Station ID	BG01	TW01	SB04	SB03	SB02	SB01				
Sample Depth (inches bgs)	0-6	0-6	0-6	0-6	0-6	0-6				
Description	Background	Background	Mill Pond	Mill Pond	Upper Tailings Pond	Upper Tailings Pond				
TAL Metals (mg/kg)										
Aluminum	17900	9410	809	684	930	2880	76000	NA	NA	50 ^P
Antimony	4.5 U	1.1 U	6.3 JB	4.7 JK	1.9 JB	1.0 U	31	29	5.4	5 ^P
Arsenic	18.8	68.8	137	78.0	50.6	20.3	22 ^a , 0.39 ^b	0.60	5.8	7 ^w
Barium	160 JL	176	6850	6060	3890	3830	5400	5045	1648	102 ^w
Calcium	4140	6570	313 JB	759 JB	488 JB	516 JB	NA	NA	NA	NA
Chromium	18.9	9.0 JK	4.1 JK	5.2 JK	2.0 JK	3.5 JK	210	216	38.4	42 ^{P,s}
Copper	139	29.8	651	303	85.9	140	2900	2667	577	50 ^t
Iron	43100	15000	29100	31600	18700	23200	23000	NA	NA	NA
Lead	16.3	17.9	1800	1050	83.4	71.1	400	NA	NA	50 ^P
Magnesium	10400	3990	213 JB	323 JB	529 JB	1880	NA	NA	NA	NA
Manganese	1660	393	5.0	7.1	11.8	44.0	1800	10090	NA	1100 ^P
Mercury	0.0345	0.11 U	4.4 JH	9.7 JH	0.31 JH	0.33 JH	23	22	2.09	0.1 ^s
Potassium	1810	1750 JK	1420 JK	933 JK	489 JK	585 JK	NA	NA	NA	NA
Selenium	0.5 U	0.68 U	17.0	5.6	3.1	1.3	390	360	5.2	0.3 ^w
Silver	1.75	0.23 U	26.7	13.5	2.5 JB	1.6 JB	390	360	17	2 ^P
Sodium	176	291 JK	325 JK	152 JK	89.8 UJK	75.7 UJK	NA	NA	NA	NA
Thallium	0.75 UJL	1.2 U	2.2	1.2 U	1.4 U	1.2 U	5.2	NA	NA	1 ^P
Vanadium	81.9	32.0	10.8	11.3	14.2	17.0	550	504	2240	2 ^P
Zinc	252	80.3	167	313	74.0	126	23000	21600	6220	86 ^P

Note: Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are significant as defined in Section 5.

Solid shading indicates exceedance of one or more regulatory benchmarks shown in the table.

Italics indicate exceedance of MTCA ecological indicator level.

Key:

^a = Cancer endpoint

^b = Non-cancer endpoint

B = The reported concentration is between the instrument detection limit and the contract required detection limit.

bgs = below ground surface.

CLP = Contract Laboratory Program.

EPA = United States Environmental Protection Agency.

H = High bias.

ID = Identification.

J = The analyte was positively identified. The associated numerical value is an estimate.

K = Unknown bias.

L = Low bias.

mg/kg = milligrams per kilogram.

MTCA = Washington State Model Toxics Control Act.

NA = Not applicable.

^P = Value is protective of plants.

PRG = Preliminary Remediation Goal.

^s = Value is protective of soil biota receptors.

TAL = Target Analyte List.

U = The analyte was not detected. The associated numerical values is the contract required detection limit.

^w = Value is protective of wildlife receptors.

Table 6-2

**MILL BUILDING SURFACE SOIL SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	00234393	02214228	02214237	EPA Region 9 PRGs Residential	MTCA Method B Unrestricted	MTCA Method B Protection of Groundwater	MTCA Ecological Indicators for Soil, Vegetation, Wildlife (Table 749-3)
CLP Sample ID	NA	MJOPJ8	MJOPK7				
Station ID	BG01	TW01	MB02				
Sample Depth (inches bgs)	0-6	0-6	0-6				
Description	Background	Background	Mill Building Area				
TAL Metals (mg/kg)							
Aluminum	17900	9410	7110	76000	NA	NA	50 ^P
Antimony	4.5 U	1.1 U	<u>6.9 JK</u>	31	29	5.42	5 ^P
Arsenic	18.8	68.8	<u>240</u>	22 ^a , 0.39 ^b	0.60	5.84	7 ^w
Barium	<i>160 JL</i>	<i>176</i>	<u>1350</u>	5400	5045	1648	102 ^w
Calcium	4140	6570	1150 JB	NA	NA	NA	NA
Chromium	18.9	9.0 JK	7.0 JK	210	216	38.4	42 ^{P,a}
Copper	<i>139</i>	29.8	<u>1420</u>	2900	2667	577	50 ^s
Iron	43100	15000	82800	23000	NA	NA	NA
Lead	16.3	17.9	<u>668</u>	400	NA	NA	50 ^P
Magnesium	10400	3990	4560	NA	NA	NA	NA
Manganese	<i>1660</i>	393	150	1800	10090	NA	1100 ^P
Mercury	0.0345	0.11 U	<u>5.9 JH</u>	23	22	2.09	0.1 ^s
Potassium	1810	1750 JK	1390 JK	NA	NA	NA	NA
Selenium	0.5 U	0.68 U	<u>13.6</u>	390	360	5.2	0.3 ^w
Silver	1.75	0.23 U	<u>16.2</u>	390	360	17	2 ^P
Sodium	176	291 JK	111 JK	NA	NA	NA	NA
Vanadium	81.9	32.0	83.9	550	504	2240	2 ^P
Zinc	252	80.3	128	23000	21600	6220	86 ^P

Note: Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are significant as defined in Section 5.

Solid shading indicates exceedance of one or more regulatory benchmarks shown in the table.

Italics indicate exceedance of MTCA ecological indicator level.

Key:

^a = Cancer endpoint

^b = Non-cancer endpoint

B = The reported concentration is between the instrument detection limit and the contract required detection limit.

bgs = below ground surface.

CLP = Contract Laboratory Program.

EPA = United States Environmental Protection Agency.

H = High bias.

ID = Identification.

J = The analyte was positively identified. The associated numerical value is an estimate.

K = Unknown bias.

L = Low bias.

mg/kg = milligrams per kilogram.

MTCA = Washington State Model Toxics Control Act.

NA = Not applicable.

^P = Value is protective of plants.

PRG = Preliminary Remediation Goal.

^s = Value is protective of soil biota receptors.

TAL = Target Analyte List.

U = The analyte was not detected. The associated numerical values is the contract required detection limit.

^w = Value is protective of wildlife receptors.

Table 6-3

**TAILINGS POND SUBSURFACE SOIL SAMPLE ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214150	02214151	02214162	02214164	02214166	02214170	02214172	02214175	02214176	EPA Region 9 PRGs Residential	MTCA Method B Unrestricted	MTCA Method B Protection of Groundwater	MTCA Ecological Indicators for Soil, Vegetation, Wildlife (Table 749-3)
CLP Sample ID	MJ0PH9	MJ0PJ0	MJ0PJ3	MJ0PL0	MJ0PL1	MJ0PL3	MJ0PL4	MJ0PL5	MJ0PL6				
Sample ID	MW03SB01	MW04SB01	MW02SB01	SB02SB01	SB02SB03	SB01SB01	SB01SB02	SB04SB02	SB03SB02				
Sample Depth (feet bgs)	10 - 12	5 - 7	6.5 - 8	7.5 - 10	17.5 - 20	2.5 - 5	17.5 - 20	3 - 3.5	2.5 - 3				
Description	Subsurface Soil, Native, West of Mill Pond, Background	Subsurface Soil, Native, East of Mill Pond	Subsurface Soil, Native, Southeast of Upper Tailings Pond	Tailings, Upper Tailings Pond	Tailings, Upper Tailings Pond	Tailings, Upper Tailings Pond	Native Soil Beneath Tailings, Upper Tailings Pond	Tailings, Mill Pond	Tailings, Mill Pond				
TAL Metals (mg/kg)													
Aluminum	16500	28600	16100	8250	2440	5720	1350	1170	1010	76000	NA	NA	50 ^p
Antimony	2.2 JK	3.6 JK	1.3 UJK	2.7 JK	1.7 U	2.2 JK	1.6 U	1.7 UJK	4.5 JK	31	29	5.42	5 ^p
Arsenic	275	631	149	45.8	50.9	38.8	26.6 JL	57.8 JL	139 JL	22 ^a , 0.39 ^p	0.60	5.84	7 ^w
Barium	71.7	110	99.5	4050	728	3430	488	3860	11300	5400	5045	1648	102 ^w
Cadmium	0.22 UJK	0.79 UJK	0.10 UJK	1.1 UJK	1.1 JK	0.71 UJK	0.65 JK	0.10 UJK	0.10 UJK	37	72	0.69	4 ^p
Calcium	10800	58900	5730	850 JB	151000	653 JB	205000	359 JB	2010	NA	NA	NA	NA
Chromium	15.1 JK	18.6 JK	12.0 JK	4.6 JK	2.4 UJK	8.0 JK	0.79 U	1.9 JK	5.4 JK	210	216	38.4	42 ^{p,s}
Cobalt	12.8	22.4	11.0 JB	3.7 JB	3.2 JB	3.0 JB	6.9 JB	1.4 JK	3.7 JB	4700	NA	NA	20 ^p
Copper	45.6	93.4	6.1 JB	1720	62.9	1130	55.5 JK	352 JK	432 JK	2900	2667	577	50 ^s
Iron	29800	47700	39300	38100	12000	23800	16300	33200	29500	23000	NA	NA	NA
Lead	109	12.4	8.2	143	10	130	13.4	133	750	400	NA	NA	50 ^p
Magnesium	6380	15700	8530	4650	3060	3620	3460	446 JB	504 JB	NA	NA	NA	NA
Manganese	564	1190	320	87.9	433	72.0	384	12.2	9.1	1800	10090	NA	1100 ^p
Mercury	0.11 U	0.10 U	0.13 U	0.15 JH	0.18 U	0.12 U	0.17 U	0.30 JH	5.6 JH	23	22	2.09	0.1 ^s
Nickel	13.5	16.3	8.4 JB	1.9 JB	2.0 JB	1.3 JB	6.0 JB	0.68 JK	0.74 JK	1600	NA	NA	30 ^p
Potassium	682 JK	1230 JK	1090 JK	990 JK	237 JK	752 JK	153 JK	646 JK	1130 JK	NA	NA	NA	NA
Selenium	0.65 U	0.67 U	1.3 U	5.9	2.4	2.9	2.2	3.4 JK	5.1	390	360	5.2	0.3 ^w
Silver	1.4 JB (0.22 SQL)	1.1 JB	0.25 U	3.3	0.37 U	1.5 JB	0.34 U	2.9	10.2	390	360	17	2 ^p
Sodium	326 JK	439 JK	260 JK	87 UJK	202 JK	83.2 UJK	346 JK	86.6 UJK	87.4 UJK	NA	NA	NA	NA
Vanadium	65.1	125	42.3	26.7	26.6	19.9	14.3 JB	16.1	9.3 JB	550	504	2240	2 ^p
Zinc	107	402	1240	586	148	332	1840	134	126	23000	21600	6220	86 ^p

Note: Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are significant as defined in Section 5.

Solid shading indicates exceedance of one or more regulatory benchmarks shown in the table.

Italics indicate exceedance of MTCA ecological indicator level (applies only to soil at a depth of 0 to 15 feet bgs).

Key:

^a = Cancer endpoint

^b = Non-cancer endpoint

B = The reported concentration is between the instrument detection limit and the contract required detection limit.

bgs = below ground surface.

CLP = Contract Laboratory Program.

EPA = United States Environmental Protection Agency.

H = High bias.

ID = Identification.

J = The analyte was positively identified. The associated numerical value is an estimate.

K = Unknown bias.

mg/kg = milligrams per kilogram.

MTCA = Washington State Model Toxics Control Act.

NA = Not applicable.

^p = Value is protective of plants.

PRG = Preliminary Remediation Goal.

^s = Value is protective of soil biota receptors.

TAL = Target Analyte List.

U = The analyte was not detected. The associated numerical values is the contract required detection limit.

^w = Value is protective of wildlife receptors.

PRG = Preliminary Remediation Goal.

SQL = Sample quantitation limit.

TAL = Target Analyte List.

U = The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 6-4

**TAILINGS SYNTHETIC PRECIPITATE LEACHING PROCEDURE SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214165	02214171	02214175	02214176
Sample ID	SB02SB02	SB01SB02	SB04SB02	SB03SB02
Sample Depth (feet bgs)	7.5-12.5	2.5-7.5	3-3.5	2.5-3
Description	Upper Tailings Pond	Upper Tailings Pond	Mill Pond	Mill Pond
SPLP TAL Metals (ug/L)				
Aluminum	136 UJ	95.4 UJ	223 U	9450
Antimony	2.6 UJ	2.4 U	4.3 UJ	2.6 UJ
Arsenic	4.3 U	4.3 U	4.3 U	4.3 U
Barium	106 UJ	231 UJ	149 UJ	85.6 UJ
Beryllium	0.7 UJ	0.7 UJ	0.7 UJ	0.7 UJ
Cadmium	6.5	0.5 U	1.7 UJ	7.6
Calcium	24700 UJ	2420 UJ	1940 J	72500 J
Chromium	0.7 U	0.7 U	0.7 U	0.7 U
Cobalt	0.7 UJ	0.7 UJ	0.7 U	5.9 J
Copper	4260	3300	1220	5590
Iron	578	44.5 J	237	148 U
Lead	3.4 UJ	5.6 UJ	4.2 UJ	5.7 UJ
Magnesium	1220 J	778 J	1570 J	7460
Manganese	47.5 J	18.3 J	41.1 J	178 J
Mercury	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	1.9 J	1.4 U	1.6 J	5.2 J
Potassium	413 J	880 J	236 UJ	381 J
Selenium	2.8 U	2.8 U	2.8 U	2.8 U
Silver	0.3 U	0.3 U	0.3 U	0.3 U
Sodium	2080 UJ	3320 UJ	1970 UJ	2780 UJ
Thallium	5.3 U	5.3 U	5.3 U	5.3 U
Vanadium	0.6 U	0.6 U	0.6 U	0.6 U
Zinc	680 J	183 J	373 J	1130 J
SPLP Anions and Total Dissolved Solids (mg/L)				
Alkalinity, Total as CaCO ₃	8 U	8 U	8 U	8 U
Bicarb. Alkalinity, HCO ₃	8 U	8 U	8 U	8 U
Carb. Alkalinity, CO ₃	8 U	8 U	8 U	8 U
Chloride	1 U	1 U	1 U	1 U
Nitrate as N	0.2	0.2 U	0.2 U	0.2 U
Nitrite as N	0.1 U	0.1 U	0.1 U	0.1 U
Sulfate	84	17	45	300
Total Dissolved Solids	110	10	26	430

Note: Bold type indicates sample concentration is above the detection limit.

Key:

EPA = United States Environmental Protection Agency.
 ID = Identification.
 J = The analyte was positively identified. The associated numerical value is an estimate.
 mg/L = milligrams per liter.
 SPLP = Synthetic Precipitate Leaching Procedure.
 TAL = Target Analyte List.
 ug/L = micrograms per liter.
 U = The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 6-5

**TAILINGS GEOTECHNICAL SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASESMENT
TWISP, WASHINGTON**

EPA Sample ID	02214153			02214167		
Station ID	SB03 / SB04			SB01 / SB02		
Sample Depth (feet bgs)	0-2			0-2		
Description	Mill Pond			Upper Tailings Pond		
California Bearing Ratio						
Molding Moisture Content (%)	12.6 ^a	18.6	22.4	10.5 ^a	19.1	23.3
Wet Density (pcf)	112.8	121.7	116.6	104.5	117.8	115.8
Dry Density (pcf)	100.2	102.6	95.3	94.6	98.9	93.9
CBR Value at 0.2 Inches	25.3	11.1	0.9	23.4	24.1	1.9
Unified Soil Classification	Silty Sand (SM)			Silty Sand (SM)		
Direct Shear Test^b						
Molding Moisture Content (%)	12.2 ^a	12.2 ^a	12.2 ^a	10.2 ^a	10.2 ^a	10.2 ^a
Normal stress (psf)	300	1000	2000	300	1000	2000
Wet Density (pcf)	106.6	106.6	106.6	98.4	98.4	98.4
Dry Density (pcf)	95.0	95.0	95.0	89.3	89.3	89.3

Key:

^a = As-received moisture content.

^b = Samples remolded with minimal compactive effort at as-received moisture content.

EPA = United States Environmental Protection Agency.

ID = Identification.

pcf = Pounds per cubic foot.

psf = Pounds per square foot.

Table 6-6

**WASTE ROCK AND NATIVE MINERALIZED ROCK SAMPLE ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	00234393	02214228	02214224	02214225	02214226	02214227	02214239
CLP Sample ID	NA	MJ0PJ8	MJ0PJ4	MJ0PJ5	MJ0PJ6	MJ0PJ7	MJ0PMS
Station ID	BG01	TW01	TV01	SM01	FR01	FR02	FR03
Sample Depth (inches bgs)	0-6	0-6	0-6	0-6	0-6	0-6	0-6
Description	Background Surface Soil	Background Surface Soil	Twisp View Mine Vein Material	Spokane Mine, Surface Soil, Waste Rock Pile	Floyd-Rattlesnake Mine, Surface Soil, Waste Rock Piles		
TAL Metals (mg/kg)							
Aluminum	17900	9410	920	3730	11700	2480	22400
Antimony	4.5 U	1.1 U	658	52.0	10.5 JB	4.4 JK	6.0 JK
Arsenic	18.8	68.8	24400	5860	3640	52.6	108 JL
Barium	160 JL	176	34.1 JB	93.9	327	246	160
Cadmium	1.07	0.51 JB (0.09 U SQL)	373	10.4	2.6 JK	0.10 UJK	0.08 UJK
Calcium	4140	6570	5550	19600	451 JB	337 JB	318 JB
Chromium	18.9	9.0 JK	2.2 JK	7.7 JK	2.0 JK	1.9 JK	0.70 UJK
Cobalt	16.2	6.4 JB (0.14 U SQL)	23.6	19.5	13.6	0.80 JK	3.8 JB
Copper	139	29.8	332	112	184	419	720 JK
Iron	43100	15000	44000	41100	56200	99500	90900
Lead	16.3	17.9	865	668	693	70.8	11.6
Magnesium	10400	3990	584 JB	6950	8910	1070 JB	22000
Manganese	1660	393	2590	1200	1800	52.9	590
Mercury	0.0345	0.11 U	0.55 JH	1.2 JH	1.3 JH	0.33 JH	0.91 JH
Nickel	11.0	5.9 JB (0.41 U SQL)	26.2	28.5	0.78 JB	0.45 U	1.0 JK
Potassium	1810	1750 JK	647 JK	1220 JK	364 JK	3250 JK	1870 JK
Selenium	0.5 U	0.68 U	0.70 U	0.83 JB	1.3	12.8	16.2
Silver	1.75	0.23 U	77.9	12.1	5.8	13.5	17.2
Sodium	176	291 JK	2410	98.9 JK	75.8 UJK	88.1 UJK	74.5 UJK
Vanadium	81.9	32.0	8.6 JB	50.2	40.1	58.3	47.6
Zinc	252	80.3	27100	1150	340	66.8	43.7

Note: Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are significant as defined in Section 5.

Key:

- B = The reported concentration is between the instrument detection limit and the contract required detection limit.
- bgs = below ground surface.
- CLP = Contract Laboratory Program.
- EPA = United States Environmental Protection Agency.
- H = High bias.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical value is an estimate.
- K = Unknown bias.
- mg/kg = milligrams per kilogram.
- SQL = Sample quantitaion limit.
- TAL = Target Analyte List.
- U = The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 6-7

**MILL PROCESS MATERIAL SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214236
CLP Sample ID	MJ0PK6
Station ID	MB01
Sample Depth (inches bgs)	0-6
Description	Process Material
TAL Metals (mg/kg)	
Aluminum	3360
Arsenic	44.2
Barium	57.8
Cadmium	4450
Chromium	11.6 JK
Copper	13200
Iron	89900
Lead	44.7
Manganese	1710
Nickel	75.2
Potassium	46.1 JK
Selenium	7.1
Sodium	12000
Zinc	173000

Note: **Bold type indicates sample concentration is above the detection limit.**

Key:

- bgs = below ground surface.
- CLP = Contract Laboratory Program.
- EPA = United States Environmental Protection Agency.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical value is an estimate.
- K = Unknown bias.
- mg/kg = milligrams per kilogram.
- TAL = Target Analyte List.

7. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

The following sections describe migration/exposure pathways and targets within the site's range of influence applicable to each pathway. Analytical data forms from laboratory analyses (Form Is) are provided in Appendix F. This section discusses the soil exposure pathway ([Section 7.1](#)), the groundwater migration pathway ([Section 7.2](#)), the surface water migration pathway ([Section 7.3](#)), and the air migration pathway ([Section 7.4](#)).

7.1 SOIL EXPOSURE PATHWAY

Public access to the site is limited. Vehicular access is via a dirt road that crosses private property, and pedestrian access is possible via a gravel road that enters the site from the southeast. The site is not fenced, and there is evidence of trespassing (litter, graffiti, etc.). The mill building structure is largely intact, although it has been vandalized. No people live or work at the site. The population within a 1-mile radius of the site is estimated to be 870 (USCB 2000). The Krinke residence is located approximately 200 feet from tailings deposited in the drainage of the unnamed intermittent stream downstream of the UTP. These tailings were reportedly deposited in the drainage as a result of there ported failure of the UTP in 1952 (Ecology 1986). A sediment sample that apparently consists of these tailings deposits was collected from near the Krinke residence (HK01). This sample is discussed further in [Section 7.3](#) below.

7.2 GROUNDWATER MIGRATION PATHWAY

This section describes the site's geology, hydrogeology, groundwater targets, sample locations, and analytical results.

7.2.1 Geology and Hydrogeology

Bedrock in the area of the site comprises Cretaceous-Jurassic sedimentary and volcanic rocks of the Newby Group (Bunning 1992), originally mapped as the Buck Mountain Formation (Barksdale 1975). Bedrock is locally overlain by colluvium, alluvium (e.g. bed of unnamed intermittent stream), and calcareous and carbonaceous lake bed sediments such as those noted beneath the tailings deposited in the

UTP (e.g. Stewart et al. 1995; this IA) and Mill Pond (this IA). Alluvial deposits of the Methow River are present within the Methow River valley.

Sedimentary rocks of the Newby Group include interbedded fine to coarse grained feldspathic-volcanic lithic sandstone, conglomerate, argillite, siltstone, dark black shales, and volcanic breccia, with local lenses of carbonates in the vicinity of the Alder Mill (Bunning 1992). Newby Group volcanic rocks include massive andesite and interbedded tuffs interpreted to be of epiclastic and pyroclastic origin (Bunning 1992). Dacite, rhyolite, and latite also are mapped locally (Bunning 1992, Burnet 1976).

Pyrite is ubiquitous in these lithologies, although most of the sulfide mineralization targeted by the local mining and exploration activity occurs in the dacites and rhyolites. In mineralized areas, silicification, chloritization, and sericitization are common, and are attributed to a regional metamorphic event. Sulfide minerals include pyrite with lesser sphalerite, chalcopyrite, galena, pyrrhotite, and arsenopyrite. Mineral values include gold and silver. Silicified dacite breccia is the primary host rock at the Alder Mine, Spokane Mine, and several prospects in the vicinity. (Burnet 1976)

Sulfide mineralization has also occurred within fault zones cutting across various rock types throughout the area. Mining and exploration targeting fault-related mineralization has occurred at the Twisp View Mine, and several prospects, including the Floyd-Rattlesnake and other prospects located in close proximity to the site. Sulfides observed in the fault zone deposits include pyrite, sphalerite, galena, chalcopyrite, and arsenopyrite (Burnet 1976). Mineralization and mining/exploration are discussed further below.

Groundwater occurs within bedrock and overlying alluvial and colluvial materials. Area drinking water wells are completed in all of these materials. Many of the bedrock wells in the area are completed in zones of fractured bedrock, although some wells completed in sedimentary bedrock units may also produce from zones of primary porosity (Ecology 2002b). Bedrock units and overlying alluvium/colluvium are, at least locally, in hydraulic communication. Both upward and downward hydraulic gradients between and within bedrock and alluvium/colluvium are observed (e.g. Stewart et al. 1995; this study). Groundwater flow in the area is complicated by localized fracture flow. Lateral groundwater flow within the drainage of the unnamed intermittent stream is down the axis of the drainage (e.g. Stewart et al. 1995; this study). Determination of groundwater flow direction elsewhere in the area is beyond the scope of this assessment. Existing information on lateral and vertical groundwater gradient and flow are discussed further below.

7.2.2 Targets

An estimated 1,662 individuals use groundwater for drinking water within the 4-mile target distance limit (TDL). The nearest well is located 0.12 mile from the UTP. The Town of Twisp operates two municipal wells that supply drinking water to an estimated 1,000 individuals (McConnell 2002). The nearest active municipal well (Town of Twisp #3) is located approximately 0.5 mile northeast of the site. The other active municipal well (Town of Twisp #2) is located approximately 0.7 mile north of the site. The START-2 assumes that the municipal drinking water usage is divided equally between the two active municipal wells. An estimated 309 domestic wells also are located within the 4-mile TDL (Ecology 2002b). The number of individuals using these wells for drinking water was estimated using a county-wide average of 2.07 persons per household (USCB 2000). [Table 7-1](#) summarizes information on the number of wells and number of individuals using groundwater for drinking water within the 4-mile TDL. [Table 7-2](#) contains additional information on the municipal wells. The 4-mile TDL is illustrated in [Figure 7-1](#).

Groundwater within the 4-mile TDL is used for irrigation of more than 5 acres of commercial crops or commercial forage crops. The site is located within a Safe Drinking Water Act wellhead protection area (Town of Twisp 1999).

Groundwater samples were collected from target wells during the IA. Samples were collected from nineteen private drinking water wells and one municipal well. In addition, seven monitoring wells and a temporary well point were sampled to characterize groundwater in the immediate vicinity of and upgradient and downgradient of the site sources.

7.2.3 Sample Results

Analytical results for groundwater samples collected from monitoring wells and a temporary well point are presented in [Table 7-3](#). Results for samples collected from drinking water wells are presented in [Table 7-4](#). For comparison, analytical results of monitoring wells and drinking water wells are compared to the Harvey domestic well, a bedrock well located in the Twisp River valley approximately 2.5 miles northwest of the site. It is noted that groundwater concentrations of arsenic and other metals vary widely throughout the area, and that the Harvey well is therefore not necessarily representative of background groundwater conditions throughout the study area.

The following analytes were detected at elevated concentrations relative to those in the selected background sample: antimony at an estimated 33.6 JK $\mu\text{g/L}$ (MW02) and 105 $\mu\text{g/L}$ (MW03); arsenic in four samples at concentrations ranging from 35.8 $\mu\text{g/L}$ (BOM M4-32) to 723 $\mu\text{g/L}$ (BOM BKG-21);

barium at estimated concentrations of 7.3 JK $\mu\text{g/L}$ (BOM BKG-21), 7.7 JK $\mu\text{g/L}$ (BOM BKG-66), and 9.9 JK (TP01); beryllium at 5.0 $\mu\text{g/L}$ (TP01); cadmium at 285 $\mu\text{g/L}$ (TP01); copper at 174,000 $\mu\text{g/L}$ (TP01); lead at 22.0 $\mu\text{g/L}$ (TP01); manganese in eight samples at concentrations ranging from an estimated 11.1 JK $\mu\text{g/L}$ (BOM BKG-21) to 6,690 $\mu\text{g/L}$ (MW02); mercury at estimated concentrations of 0.21 JH $\mu\text{g/L}$ (BOM M4-24), 0.24 JH $\mu\text{g/L}$ (TP01), and 0.34 JH $\mu\text{g/L}$ (BOM BKG-66); nickel at 216 $\mu\text{g/L}$ (TP01); selenium at 5.9 $\mu\text{g/L}$ (MW02) and 59.2 $\mu\text{g/L}$ (TP01); thallium at an estimated 20.8 JK $\mu\text{g/L}$ (TP01); vanadium at 295 $\mu\text{g/L}$ (TP01), and zinc at estimated concentrations of 12,800 JK $\mu\text{g/L}$ (MW02) and 38,100 JK $\mu\text{g/L}$ (TP01).

The following analytes were detected in the drinking water wells in concentrations that are elevated relative to those in the selected background sample: antimony at estimated concentrations of 4.7 JK $\mu\text{g/L}$ (Strickland spring) and 5.2 JK $\mu\text{g/L}$ (Krinke); arsenic in eleven samples at concentrations ranging from 16.6 $\mu\text{g/L}$ (Port) to 501 $\mu\text{g/L}$ (White); barium at an estimated 9.5 JK $\mu\text{g/L}$ (D. Johnson “first flush”); copper in nine samples at concentrations ranging from an estimated 4.7 JK $\mu\text{g/L}$ (F. Johnson) to 102 $\mu\text{g/L}$ (J. Johnson); manganese in twelve samples at concentrations ranging from an estimated 2.2 JK $\mu\text{g/L}$ (D. Johnson “first flush”) to 291 $\mu\text{g/L}$ (Strickland well); selenium at an estimated concentration of 3.0 JK $\mu\text{g/L}$ (Echelbarger) to 11.2 $\mu\text{g/L}$ (Krinke); and zinc at estimated concentrations of 636 JK $\mu\text{g/L}$ (D. Johnson), 1,200 JK $\mu\text{g/L}$ (White “first flush”), and 3,180 JK $\mu\text{g/L}$ (D. Johnson “first flush”).

Arsenic groundwater sample analytical results are illustrated in [Figure 7-2](#).

Several wells sampled during the IA were sampled previously by OCHD (OCHD 2002). IA arsenic groundwater results compare well with previous OCHD results with several exceptions. Arsenic was detected at 60.3 $\mu\text{g/L}$ in the sample collected by OCHD from the D. Johnson residence; arsenic was not detected in the IA sample from this well. Arsenic was detected at 33.5 $\mu\text{g/L}$ in the OCHD sample from the Sutherland well; the IA sample contained arsenic at 63.4 $\mu\text{g/L}$. Arsenic was detected in OCHD samples collected in early spring from the McKinney and Echelbarger wells at 249 $\mu\text{g/L}$ and 465 $\mu\text{g/L}$, respectively; arsenic was detected in IA samples from these wells at 181 $\mu\text{g/L}$ and 107 $\mu\text{g/L}$, respectively. Groundwater concentrations of metals and other analytes may exhibit a high degree of seasonal variation. Such possible variation could explain the differences between the OCHD and IA samples from these wells.

Elevated concentrations of arsenic in the monitoring wells and drinking water wells cannot be positively attributed to the sources at the site. Several of the metals detected in the monitoring wells and drinking water wells could be attributed to on-site sources, although other sources of these analytes are

possible. Elevated concentrations of manganese and zinc in monitoring well MW02, installed immediately downgradient of the UTP, are possibly attributable to leaching from the UTP. Elevated concentrations of manganese in other wells downgradient of the UTP (BOM M4-24, BOM M4-32), and in the monitoring well immediately downgradient of the Mill Pond (MW01) may be partly attributable to the leaching from the tailings ponds. Elevated concentrations of manganese in other wells throughout the area (e.g. Strickland, Jolley, and Michaels) could also be partly attributable to on-site sources, although such attribution seems less likely. The elevated concentrations of antimony and selenium in the MW02 and the Krinke well could be partly attributable to the UTP.

Evaluation of the attribution of the area arsenic groundwater contamination is discussed below.

7.2.4 Evaluation of Alder Mill as Source of Area Arsenic Groundwater Contamination

The START-2 evaluated existing and IA analytical data and other geologic and hydrogeologic information to determine whether the arsenic and other inorganic analytes detected in area drinking water wells is attributable to on-site sources. Although there is some evidence suggesting that arsenic groundwater contamination in area wells sources at the site could be partially attributed to on-site sources, the majority of the available evidence suggests that arsenic occurs at naturally high concentrations locally within the study area, and that arsenic detected at elevated concentrations relative to the selected background sample is not readily attributed to on-site sources. Results of the evaluation are summarized in the sections below.

7.2.4.1 Proximity to Alder Mill Sources

Several monitoring wells and drinking water wells with elevated arsenic concentrations (relative to the selected background sample) are located in close proximity to site sources, including the BOM BKG-21, BOM BKG-66, White, Alexander, MW02, BOM M4-32, Jolley, Michaels, Simmons, Fran Johnson, Sutherland, and Simmons wells. This geographic association suggests the possibility that the on-site sources are responsible for the elevated arsenic concentrations. However, arsenic was not detected in groundwater sampled from several other wells in close proximity to the site sources (MW01, MW03, BOM M4-24, D. Johnson, J. Johnson, Madison, and Krinke) suggesting the possibility that the on-site sources may not be the source of arsenic in area groundwater. Furthermore, IA and OCHD samples from several wells located in the Twisp River drainage more than one mile northwest of the site (McKinney and Echalbarger) contained arsenic at relatively high concentrations (up to 181 µg/L in IA

samples and 465 µg/L in OCHD samples), suggesting a likely alternative or additional source(s) of arsenic.

7.2.4.2 Documented Release of Metals from UTP to Groundwater

Per the BOM investigation (e.g. Stewart et al. 1995), groundwater flow through the UTP tailings has resulted in reduced pH and increased concentrations in groundwater of aluminum, boron, cadmium, calcium, copper, iron, lead, magnesium, manganese, nickel, potassium, silica, sodium, sulfur, and zinc. Arsenic results were not reported due to analytical difficulties. Most of the constituents (aluminum, boron, cadmium, copper, iron, lead, nickel, silica, zinc, and pH) attenuated to background levels a short distance downgradient of the UTP. Magnesium, manganese, potassium, and sulfur attenuated, although not down to the levels observed in the wells upgradient of the UTP. Sodium levels increased downgradient from the UTP (e.g. Stewart et al. 1995). The results of groundwater samples collected during the IA from MW02 and BOM monitoring wells are consistent with BOM results.

BOM attributed the attenuation of most constituents to dispersion, dilution (from fault groundwater upwelling), and precipitation due to increase in pH. Calcareous lake sediments directly underlie the tailings in the UTP, and these sediments may act to increase the pH (e.g. Stewart et al. 1995). Co-precipitation of metals with iron and manganese is cited as a possible reason for the downgradient attenuation (Lambeth 1999).

7.2.4.3 Lateral Groundwater Flow Direction

The groundwater gradient in the UTP drainage is generally down the axis of the unnamed intermittent stream valley. The gradient is low in the area of the UTP (4.4E-4 from BOM BKG to the upper end of the UTP; 5.7E-3 between P6 at the upper end of the UTP and P1 at the lower end of the UTP). The gradient increases below the lower end of the UTP (4.0E-2 between M2 and M4). The gradient and flow direction in the area downgradient of BOM M5 is not known, but it is likely that shallow groundwater continues to flow in a direction generally down the axis of the surface drainage. The gradient and flow direction are not known in the area north and west of the UTP and White and BOM BKG wells. (e.g. Stewart et al. 1995)

Shallow groundwater flow direction in the immediate vicinity of the Mill Pond has not been determined, but is expected to be toward the east, generally similar to the surface drainage.

Some of the wells with elevated concentrations of arsenic (relative to the selected background sample) are located in an area generally assumed to be downgradient of the UTP (e.g. Jolley and

Michaels). Other wells with elevated arsenic concentrations are located in an area assumed to be generally downgradient of the mill and Mill Pond area (e.g. Sutherland, Simmons, F. Johnson, and Port). However, arsenic was not detected in several wells downgradient of the UTP (e.g. BOM M4-24, Krinke) and likely downgradient of the Mill Pond (e.g. Madison, D. Johnson, and J. Johnson).

Wells with the highest arsenic concentrations are located upgradient of the UTP (BOM BKG-21, BOM BKG-66, White) suggesting a source(s) other than the UTP.

If the UTP is a significant source of arsenic in area groundwater, higher arsenic concentrations would be expected in wells immediately downgradient of the UTP (MW02 and BOM M4-32), and one would expect arsenic to have been detected in BOM M4-24 and the Krinke well. Similarly, if the Mill Pond is a significant source of arsenic in groundwater, one would expect arsenic to have been detected in MW01, located immediately downgradient of the Mill Pond.

Arsenic was detected at a relatively high concentration in the Alexander well, located on the other side of a slight topographic divide between it and the UTP, and is possibly cross-gradient to shallow groundwater flow from the UTP. Relatively high arsenic concentrations in the McKinney and Echelbarger wells located in the Twisp River drainage indicate the likely existence of source(s) of arsenic groundwater contamination not related to the on-site sources.

7.2.4.4 Mineralized Faults and Area Mines and Prospects

Several high angle faults are mapped in the area (Burnet 1976, Brunning 1992). Several mapped fault traces are illustrated in [Figure 7-3](#). Documented faults include: the northwest-trending fault that defines the UTP drainage; a west-northwest-trending fault; and three shorter east-northeast-trending fault segments. The west-northwest-trending fault, the northwest-trending fault, and one of the east-northeast-trending faults all intersect in the area adjacent to the White and BOM BKG wells (Brunning 1992). Other nearby faults include the north-trending fault associated with the Twisp View Mine and the southwest-trending fault in the vicinity of the Spokane Mine.

The fault zones are locally highly mineralized (e.g. Burnet 1976, this investigation). Local mining and exploration activities have targeted the mineralized veins located in the fault zones, as well as the dacite and andesite breccia bodies located in the area. Locations and descriptions of area mines and prospects are summarized in [Table 7-5](#). Pyrite has been documented at all of the mines and prospects. Other sulfide minerals documented at some of the mines and prospects include chalcopyrite, sphalerite, galena, and pyrrhotite (Burnet 1976). In addition, arsenopyrite, an arsenic-containing sulfide mineral, has been documented at the Twisp View Mine, Spokane Mine, and the Floyd-Rattlesnake prospects

(Burnet 1976). Arsenic was detected at concentrations well above background levels in IA samples of waste rock or intact vein material from the Twisp View Mine (24,400 mg/kg), Spokane Mine (5,860 mg/kg), and Floyd-Rattlesnake Mine prospects (up to 3,640 mg/kg). Pyrite was described in deep bedrock drill cuttings from BOM BKG well (e.g. Stewart et al. 1995).

All of the wells in which arsenic has been detected at elevated concentrations during the IA are located in close proximity to mapped fault zones. Fracturing of bedrock within and adjacent to fault zones likely results in enhanced groundwater flow. It is possible that such enhanced groundwater flow could result in accelerated dissolution of arsenopyrite and other sulfide minerals deposited within the veins. Mining and exploratory activities at the mines and prospects have also possibly enhanced groundwater flow within the fault zones and other adjacent bedrock. In addition, mining and prospecting activities may locally have resulted in accelerated release of arsenic and other metals at the surface due to enhanced exposure of sulfide minerals to water and oxygen.

7.2.4.5 Vertical Groundwater Gradient and Flow

A vertical groundwater gradient has been documented in the nested BOM wells (BOM BKG, M2, M4, and M5 well clusters) within the UTP drainage (e.g. Stewart et al. 1995). The gradient is upward at several locations. For example, in BOM BKG, the gradient was upward ($1.5E-2$ to $1.6E-2$) between the shallow bedrock completion (BOM BKG-66) and the alluvial/colluvial completion (BOM BKG-21), but downward ($1E-3$ to $2E-3$) between the shallow bedrock well and the deep bedrock well (BOM BKG-142; e.g. Stewart et al. 1995). Similar observations were made at BOM BKG during the IA. In the BOM M2 wells (3 alluvial/colluvial completions at 13, 20, and 41 feet depths), the gradient was reported by BOM to be upward between all wells except between BOM M2-20 and BOM M2-13 in late summer (e.g. Stewart et al. 1995).

At the BOM M4 location, the vertical groundwater gradient was reported to be downward between alluvium/colluvium (BOM M4-24) and bedrock (BOM M4-23; e.g. Stewart et al. 1995).

Further downgradient at BOM M5, with an alluvial/colluvial completion at 13 feet bgs (BOM M5-13) and bedrock completions at 75 (BOM M5-75) and 175 feet bgs (BOM M5-175), an upward gradient was observed between BOM M5-75 and BOM M5-13, although a downward gradient was observed between BOM M5-75 and BOM M5-175 (e.g. Stewart et al. 1995).

The presence of ponds along the trace of the northwest-trending fault (including the standing water pond at the head of the UTP) is likely due to upwelling of water from the fault zone. A strong

upward vertical gradient is observed in the Strickland well, which is a 345 foot deep bedrock flowing artesian well.

The existence of an upward vertical gradient in the area of the UTP and elsewhere within the fault-defined valley of the UTP, coupled with the locally elevated arsenic concentrations, suggests a bedrock source of arsenic within and/or adjacent to the fault zone(s).

7.2.4.6 Bedrock Association

Most of the groundwater samples with elevated arsenic concentrations were collected from wells completed in bedrock (BOM BKG-66, BOM M4-32, White, Alexander, Simmons, Sutherland, Michaels, Jolley), including the Twisp River area wells (McKinney and Echelbarger). The groundwater sample from bedrock well BOM M4-32 contained arsenic at 35.8 µg/L, whereas arsenic was not detected in the collocated shallow alluvial/colluvial well BOM M4-24. These observations suggest a bedrock source of arsenic contamination, although they do not rule out groundwater contaminated by arsenic from a surface source migrating to deeper fractured bedrock. It is noted that the highest arsenic groundwater concentration detected in IA samples was collected from alluvial/colluvial well BOM BKG-21 (723 µg/L).

7.2.4.7 Tailings Pond Characterization

IA TAL metals analytical results indicate arsenic in the UTP surface soil tailings samples at concentrations (20.3 mg/kg and 50.6 mg/kg) similar to those in the selected background surface soil samples (18.8 mg/kg and 68.8 mg/kg). Mill Pond surface soil arsenic concentrations were elevated (78.0 mg/kg and 137 mg/kg) relative to concentrations in the selected IA background surface soil samples. It should be noted that the background surface soil sample collected during the 1986 Alder Mill SI contained arsenic at a concentration of 217 mg/kg (Ecology 1986). It should also be noted that other surface soil samples collected during the IA from area mines and prospects contained arsenic at significant concentrations (as high as 24,400 mg/kg).

Arsenic was detected in tailings subsurface soil samples from the UTP (38.8 mg/kg, 45.8 mg/kg, and 50.9 mg/kg) and Mill Pond (estimated concentrations of 57.8 JL mg/kg and 139 JL mg/kg). Arsenic was detected in native subsurface soil samples collected from MW03 and MW04 at concentrations of 275 mg/kg and 631 mg/kg, respectively.

Subsurface soil samples of tailings collected from the UTP and Mill Pond also were submitted for SPLP analysis during the IA. Arsenic was not detected in the SPLP leachates. Extraction Procedure

Toxicity analytical results of tailings surface soil samples collected from the UTP by Ecology indicated no detectable levels of arsenic (Ecology 1986).

Arsenic was not present above the detection limit in the IA groundwater sample from MW01, installed in bedrock immediately downgradient from the Mill Pond. Arsenic was not detected in the groundwater sample collected during the IA from the temporary well point (TP01) installed within the Mill Pond tailings. Tailings pore water samples collected by Peplow (2001) contained copper and cadmium at concentrations of up to 41,000 µg/L and 600 µg/L, respectively, but contained up to only 2 µg/L arsenic.

Tailings in the UTP are in contact with the standing water pond at the head of the UTP. A surface water sample from the standing water pond collected during the 2000 Alder Mine PA/SI contained a low arsenic concentration (15.6 µg/L). However, although it is likely that surface water in this standing water pond is in hydraulic connection with shallow groundwater within the UTP, the surface water sample is not necessarily considered representative of groundwater conditions.

7.2.4.8 Major Cation-Anion Evaluation

Concentrations and relative proportions of major cations (calcium, potassium, magnesium, and sodium) and anions (chloride, carbonate, bicarbonate, nitrate, and sulfate) were compared for groundwater samples collected from monitoring wells and drinking water wells during the IA. The evaluation was performed in accordance with the *Characterization of Mine Leachates and the Development of a Ground-Water Monitoring Strategy for Mine Sites* (EPA 1999c). Such evaluations can help to distinguish between waters whose chemical signatures are derived from or altered by flowing through different hydrogeological environments (e.g. mineralized bedrock, alluvial aquifers, mine waste piles/impoundments). For instance, groundwater and surface water impacted by acid rock drainage and acid mine drainage typically contains relatively high TDS concentrations, with sulfate comprising a large portion of the TDS. Mixing of waters from different hydrogeological environments occurs in the area (e.g. upward or downward flow between bedrock and alluvium/colluvium), making clear distinctions between water types difficult. Nonetheless, differences in major cation-anion signatures are observed between wells grouped based upon location (e.g. position downgradient of the UTP or proximity to mineralized faults) and arsenic concentrations. Concentrations of major cations and anions are summarized in [Tables 7-3 and 7-4](#). Specific observations are discussed below.

- Wells Downgradient of the UTP.** The groundwater sample from MW02, a monitoring well installed in alluvium/colluvium immediately downgradient of the UTP, contained relatively high TDS (3,900 milligrams per liter [mg/L]), and was dominated by sulfate (2,500 mg/L, 64% of TDS), as would be expected immediately downgradient from a sulfidic tailings impoundment. Similar concentrations were observed in BOM M4-32 (2,300 mg/L TDS; 1,200 mg/L sulfate; sulfate 52% of TDS) and BOM M4-24 (2,200 mg/L TDS; 1,200 mg/L sulfate; sulfate 55% of TDS). Further downgradient within the drainage, the Krinke well (unknown well depth or completion) sample also contained relatively high concentrations of TDS (1,700 mg/L) and sulfate (980 mg/L; 58% of TDS). Arsenic was detected at 75 µg/L in MW02 and 35.8 µg/L in BOM M4-32; arsenic was not detected in BOM M4-24 or the Krinke well.
- Monitoring Well Downgradient of the Mill Pond.** The groundwater sample from MW01, installed in bedrock immediately downgradient of the Mill Pond, contained lower TDS (620 mg/kg) than the monitoring wells downgradient from the UTP. The MW01 sample also contained relatively less sulfate (300 mg/L, 48% of TDS) and a higher proportion of bicarbonate (160 mg/L, 26% of TDS) than the well immediately downgradient from the UTP (MW02). The lower TDS and sulfate content may be due to the comparatively lower acid-producing potential of the much smaller Mill Pond (an estimated 1,333 cubic yards vs. 43,300 cubic yards for the UTP). Arsenic was not detected in MW01.
- High Arsenic Wells Immediately Upgradient of the UTP.** Samples from the White well (bedrock, estimated 130 feet total depth [TD]), BOM BKG-21 (colluvium, 21 feet TD), and BOM BKG-66 (bedrock, 66 feet TD) have very similar cation-anion signatures. TDS ranged from 640 to 680 mg/L. Sulfate ranged from 230 to 270 mg/L (36 to 40% TDS); bicarbonate ranged from 230 to 250 mg/L (35 to 39% of TDS); and sodium was detected at high concentrations relative to all other wells sampled, ranging from 97.6 to 189 mg/L (15 to 29% TDS). Arsenic was detected at concentrations of 723 µg/L (BOM BKG-21), 322 µg/L (BOM BKG-66), and 501 µg/L (White). The low TDS and sulfate concentrations and sulfate/TDS ratios relative to those in MW02 suggest an arsenic source other than the UTP. Relatively low concentrations of iron, manganese, and zinc detected in the upgradient wells relative to MW02 further support this conclusion. The reported (e.g. Stewart et al. 1995) increase in sodium in some wells downgradient from the UTP could be due to localized contribution of sodium-rich (and arsenic-rich) bedrock-derived groundwater such as that observed in the White and BOM BKG wells.
- Wells East of Mill Pond.** Samples from the Simmons well (bedrock, 126 feet TD) and Fran Johnson well (estimated depth 85 feet, bedrock assumed) contained relatively low TDS (210 and 230 mg/L, respectively) and had proportions of sulfate, bicarbonate, and sodium similar to the White and BOM BKG wells. The samples contained arsenic at 56.5 µg/L (Simmons) and 77.8 µg/L (F. Johnson). The relatively low TDS and sulfate concentrations and sulfate/TDS ratios suggest an arsenic source other than the sulfidic mine waste located in the on-site tailings ponds.
- Sutherland and Michaels Wells.** Samples from the Sutherland well (bedrock assumed, 265 foot TD estimated) and Michaels well (bedrock, 117 foot TD) contained relatively low TDS at 200 mg/L and 280 mg/L, respectively. The water is dominated by bicarbonate (200 and 100 mg/L; 71 and 50% of TDS, respectively), and contained low concentrations of sulfate (14 and 36 mg/L; 7 and 13% of TDS, respectively). Arsenic was detected at 63.4 µg/L

(Sutherland) and 32.9 µg/L (Michaels). The relatively low TDS and sulfate concentrations and sulfate/TDS ratios suggest an arsenic source other than the sulfidic mine waste located in the tailings ponds.

- **McKinney and Echelbarger Wells.** The McKinney well (bedrock, 128 feet TD) and Echelbarger well (bedrock assumed, 106.5 feet TD) are located in the Twisp River valley, and are likely not impacted by sources at the Alder Mill. Groundwater samples from the McKinney and Echelbarger wells contained TDS at 210 and 350 mg/L, respectively. Groundwater from these wells is dominated by bicarbonate (180 and 240 mg/L, 86 to 69% of TDS, respectively) and calcium (53.9 and 68.1 mg/L, 26 to 19% of TDS, respectively) with comparatively low sulfate (12 and 70 mg/L, 6 to 20% TDS, respectively). The McKinney and Echelbarger wells contained arsenic at 181 and 107 µg/L, respectively. Samples collected from these wells by OCHD contained arsenic at 249µg/L and 465 µg/L, respectively. The relatively low TDS and sulfate concentrations and sulfate/TDS ratios suggest an arsenic source other than the sulfidic mine waste located in the tailings ponds.

7.3 SURFACE WATER MIGRATION PATHWAY

The site is located in an area with an average annual precipitation rate of 9.8 to 14.9 inches per year (Peplow 1999). The two-year, 24-hour rainfall event is 1.03 inches (WRCC 1999). Soils in the area are described as the Newbon Series, gravelly loam, 25 to 45 percent slopes. As much as 15 percent of the total acreage of this map unit is comprised of Newbon very gravelly loam, eroded; and approximately 10 percent comprises Dinkelman gravelly sandy loam and Conconully gravelly sandy loam. Also included are several areas where slopes are less than 25 percent. Runoff is rapid, and the hazard of erosion is high. Areas with this soil type are used mainly for range. (USDA SCS 1980)

The UTP is located within the valley of an unnamed intermittent stream. The PPE of the UTP in the unnamed intermittent stream is at the lower end of the UTP. Drainage from the UTP flows southwest within the unnamed intermittent stream drainage, and then east to its confluence with the intermittent irrigation raceway, approximately 0.5 mile downstream of the PPE.

The Mill building and Mill Pond areas drain via a shallow ditch for approximately 400 yards to its PPE in the irrigation raceway. From the PPE, the irrigation raceway flows toward the south-southeast for approximately 0.5 mile to its confluence with the unnamed intermittent stream. From there, the irrigation raceway flows approximately 8.5 miles to its end, at which point the return flow enters the Methow River. The 15-mile TDL begins at the PPEs into the intermittent stream and irrigation raceway, and continues to a point on the Methow River approximately 6 miles downstream of the apparent end of the irrigation raceway. The 15-mile TDL is illustrated in [Figure 7-4](#).

The Methow River's average annual flow is 1,344 cubic feet per second (cfs) measured at Twisp, Washington, 9 miles upstream of the confluence of Alder Creek and the Methow River (Wiggins 1998). The site is located outside the 500-year floodplain (FEMA 1981).

7.3.1 Targets

START-2 assumes that residents use the Methow River for drinking water; however, the locations of intakes are not known. The nearest possible intake in the Methow River to the most downstream PPE is approximately 8.75 miles.

The Methow River is known to provide habitat for the federal-listed threatened bull trout (*Salvelinus confluentus*) and the federal-listed endangered steelhead salmon (*Oncorhynchus mykiss*) and spring-run chinook salmon (*O. tshawytscha*) (FR 1997, 1998, and 1999b). The Methow River has been proposed as critical habitat for steelhead salmon (FR 1999a). The Methow River is documented as a critical migratory pathway for steelhead salmon, spring-run chinook salmon, and bull trout (WDFW 1999). The Methow River contains wintering habitat critical for the survival of steelhead salmon within the 15-mile TDL (Bartlett 1999).

Sport fishing is known to occur in the Methow River. Wetland frontage along the 15-mile TDL is 2.93 miles (USFWS 1987a, 1987b, 1987c).

Surface water and sediment samples were collected from the surface water TDL during the IA. Surface water and sediment sample locations are illustrated in [Figure 3-4](#). Collocated surface water/sediment samples were collected at the PPE of the ditch flowing eastward from the Mill Pond to the irrigation raceway (IR03). A sediment sample was collected from the unnamed intermittent stream near the Helen Krinke residence (HK01). The sample location is downstream of the UTP source area and upstream of the unnamed intermittent stream's confluence with the irrigation raceway. Collocated surface water/sediment samples were collected at the confluence of the unnamed intermittent stream and the irrigation raceway (IR02), and at a background location on the irrigation raceway (IR01).

7.3.2 Sample Results

Analytical results for target samples in the surface water pathway are presented in [Tables 7-6, 7-7a, 7-7b, and 7-7c](#). Each table also presents analytical results for corresponding background samples.

[Table 7-6](#) presents results for a surface water sample collected from the PPE in the irrigation raceway (IR03). The sample collected at location IR03 contained an elevated concentration of copper (1.8 µg/L). [Table 7-6](#) also presents results of a surface water sample collected at the confluence of the

unnamed intermittent stream and the irrigation raceway (IR02). No analytes were detected at elevated concentrations at location IR02.

Table 7-7a presents results of a sediment sample collected at IR03. No analytes were detected at elevated concentrations.

Table 7-7b presents results of sediment samples collected from the unnamed intermittent stream. The sample from location ML01, collected during the 2000 Alder Mine PA/SI, contained elevated concentrations of copper (364 mg/kg), lead (115 mg/kg), mercury (0.348 mg/kg), selenium (1.3 mg/kg), silver (7.28 mg/kg), and zinc (232 mg/kg). The sample from location HK01, collected near the Helen Krinke residence, contained elevated concentrations of antimony (2.6 JK mg/kg), arsenic (74.3 mg/kg), barium (10,800 mg/kg), copper (278 mg/kg), lead (222 mg/kg), mercury (2.2 JH mg/kg), selenium (2.8 mg/kg), silver (5.8 mg/kg), and zinc (867 mg/kg).

Table 7-7c presents results of a sediment sample collected at IR02. This sample contained copper (316 mg/kg) at an elevated concentration.

It should be noted that surface water may exhibit seasonal variation in concentrations of metals and other analytes.

7.4 AIR MIGRATION PATHWAY

No people live or work at the site. Approximately 1,569 people live within a 4-mile radius of the site. The downtown area of Twisp is located within 0.75 mile north of the site (**Figure 2-1**). The site is located approximately 1,500 feet from the Methow River, which is believed to be used for recreational boating and fishing. A total of 823 acres of wetlands are located within a 4-mile radius of the site (**Table 7-8**; USFWS 1987a, 1987b, 1987c). The 4-mile radius of the site is illustrated in **Figure 7-1**. Wind direction and speed are not known. It is expected that commercial silviculture, livestock production and grazing occur within the 4-mile air pathway TDL of the site.

Table 7-1

**GROUNDWATER DRINKING WATER POPULATION WITHIN A 4-MILE RADIUS
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

Distance (Miles)	Well Identification	Groundwater Wells	Population
0 - ¼	Domestic Wells	10	20.7
¼ - ½	Domestic Wells	19	39.3
	Town of Twisp #3 Municipal Well	1	500
½ - 1	Domestic Wells	13	26.9
	Town of Twisp #2 Municipal Well	1	500
1 - 2	Domestic Wells	68	140.8
2 - 3	Domestic Wells	100	207
3 - 4	Domestic Wells	101	209
TOTAL		313	1643.7

Table 7-2

**MUNICIPAL WELL INFORMATION
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

Identification	Well Depth (feet bgs)	Screen Depth (feet bgs)	Status
Town of Twisp #1	50	unknown	emergency use only
Town of Twisp #2	100	20 - 50	primary
Town of Twisp #3	83	50 - 100	primary
Town of Twisp #4	140	120 - 140	not currently used

Source: McConnell 2002.

Table 7-3

**MONITORING WELL AND TEMPORARY WELL POINT GROUNDWATER SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214219	02214177	02214178	02214179	02214180	02214181	02214182	02214183	02214184	02214185	02214238	EPA MCL	EPA Region 9 Tap Water PRGs	MTCA Method B
CLP Sample ID	MJOPH3	MJOPL7	NA	MJOPL8	NA	MJOPL9	MJOPM0	MJOPM1	MJOPM2	MJOPM3	MJOPK8			
Station ID	DW18	TP01	TP01	MW03	MW03	BOM BKG-21	BOM BKG-66	MW02	BOM M4-32	BOM M4-24	MW01			
Description	Harvey domestic well	Well point, Mill Pond	Well point, Mill Pond	MW03	MW03	BOM BKG-21	BOM BKG-66	MW02	BOM M4-32	BOM M4-24	MW01			
TAL Metals (µg/L)														
Aluminum	7.3 UJK	392000	NA	28.0 JK	NA	7.3 UJK	7.3 UJK	539	7.3 UJK	7.3 UJK	7.3 UJK	NA	36000	NA
Antimony	4.7 U	55.9 UJK	NA	105	NA	8.0 JB	4.7 U	33.6 JK	50.4 JB	35.4 JB	17.1 JB	6	15	6.4
Arsenic	5.2 U	9.2 JB	NA	3.8 JB	NA	723	322	75.0	35.8	2.8 U	4.8 JB	10	0.045 ^a	0.0583
Barium	16.1 JB (0.80 U SQL)	9.9 JK	NA	63.5 JB	NA	7.3 JK	7.7 JK	12.6 JB	21.2 JB	15.7 JB	37.6 JB	2000	2600	1120
Beryllium	0.10 U	5.0	NA	0.10 U	NA	0.10 U	0.10 U	0.62 JB	0.34 JB	0.22 JB	0.10 U	4	73	32
Cadmium	0.40 UJK	285	NA	0.40 UJK	NA	0.40 UJK	0.40 UJK	0.40 UJK	0.40 U	0.40 U	0.40 UJK	5	18	8
Calcium	48600	360000	NA	36900	NA	28900	40300	488000	460000	443000	104000	NA	NA	NA
Chromium	0.76 JB (0.60 U SQL)	275	NA	1.8 JB	NA	2.3 JB	0.60 U	12.9 JK	10.5	6.2 JB	1.8 JB	100	NA	48
Cobalt	0.66 JK	425	NA	1.5 JB	NA	1.4 JB	0.60 U	86.9	11.3 JB	7.4 JB	2.3 JB	NA	2200	NA
Copper	1.5 JK	174000	NA	4.4 JK	NA	2.2 UJK	0.90 UJK	0.90 UJK	4.4 JK	0.90 UJK	0.90 UJK	1300 ^b	1400	592
Iron	44.3 JK	1470000 JK	NA	50.1 JK	NA	229 JK	66.7 JK	279000 JK	448 JK	208 JK	17.3 UJK	NA	11000	NA
Lead	3.3	22.0	NA	2.1 U	NA	2.1 U	2.1 U	2.5 JB	2.1 U	2.1 U	2.1 U	15 ^b	NA	NA
Magnesium	11900	235000	NA	4190 JB	NA	16400	23700	220000	110000	128000	18100	NA	NA	NA
Manganese	0.10 UJK	5600 JK	NA	49.4 JK	NA	11.1 JK	82.0 JK	6690 JK	955 JK	574 JK	138 JK	NA	880	2240
Mercury	0.20 U	0.24 JH	NA	0.20 U	NA	0.52 UJK	0.34 JH	0.20 U	0.20 U	0.21 JH	0.20 U	2	11	4.8
Nickel	1.8 U	216	NA	1.8 U	NA	1.8 U	1.8 U	23.1 JB	2.3 JB	1.8 U	1.8 U	NA	730	NA
Potassium	716 JK	3520 JK	NA	4430 JK	NA	2840 JK	2600 JK	10400 JK	2320 JK	2850 JK	1560 JK	NA	NA	NA
Selenium	3.0 U	59.2	NA	3.0 U	NA	3.0 U	3.0 U	5.9	3.0 U	3.0 U	3.0 U	50	180	80
Sodium	5250	49700	NA	83000	NA	189000	171000	29300	35300	38500	65600	NA	NA	NA
Thallium	5.4 U	20.8 JK	NA	5.4 UJK	NA	5.4 UJK	5.4 UJK	5.4 UJK	5.4 UJK	5.4 UJK	5.4 UJK	2	2.4	NA
Vanadium	0.88 U	295	NA	0.80 UJK	NA	0.80 UJK	0.80 UJK	0.80 UJK	0.80 UJK	0.80 UJK	0.80 UJK	NA	260	112
Zinc	183 JK	38100 JK	NA	33.9 JK	NA	32.6 JK	29.0 JK	12800 JK	8.0 JK	5.4 JK	19.3 JK	NA	11000	4800
Water Quality Parameters (mg/L)														
Alkalinity, Total as CaCO ₃	130	NA	4 U	NA	160	230	240	100	350	350	160	NA	NA	NA
Bicarb. Alkalinity, HCO ₃	130	NA	4 U	NA	160	230	240	100	350	350	160	NA	NA	NA
Carb. Alkalinity, CO ₃	8 U	NA	4 U	NA	8 U	8 U	8 U	8 U	8 U	8 U	8 U	NA	NA	NA
Chloride	1 U	NA	50 U	NA	3	2	2	2	2	2	1	NA	NA	NA
Nitrate + Nitrite	3.7	NA	0.01 U	NA	0.17	0.02	0.09	0.01 U	NA	NA	0.01	NA	NA	NA
Nitrate as N	3.7	NA	0.5 U	NA	0.17	0.02	0.09	0.01 U	0.2 UJ	0.2 UJ	0.01	10	10	NA
Nitrite as N	0.005 U	NA	0.5 U	NA	0.005 U	0.005 U	0.005 U	0.005 U	0.1 UJ	0.1 UJ	0.005 U	1	1	NA
Sulfate (SO ₄)	48	NA	10000	NA	270	260	270	2500	1200	1200	300	NA	NA	NA
Total Dissolved Solids	200	NA	13000	NA	370	650	680	3900	2300	2200	620	NA	NA	NA

Note:

Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are elevated as defined in Section 5. Applied to TAL Metals only.

Highlight indicates exceedance of one or more regulatory benchmarks shown in the table.

Key:

^a

= Cancer endpoint.

^b

= Treatment technique based MCL.

B

= The reported concentration is between the instrument detection limit and the contract required detection limit.

CLP

= Contract Laboratory Program.

EPA

= United States Environmental Protection Agency.

H

= High bias.

ID

= Identification.

J

= The analyte was positively identified. The associated numerical value is an estimate.

K

= Unknown bias.

MCL

= Maximum Contaminant Level. The highest level of a contaminant that is allowed in drinking water.

mg/L

= milligrams per liter.

µg/L

= micrograms per liter.

MTCA

= Washington State Model Toxics Control Act.

NA

= Not applicable.

NSDWR

= National Safe Drinking Water Regulations. Non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.

PRG

= Preliminary Remediation Goal.

SQL

= Sample quantitation limit.

TAL

= Target Analyte List.

U

= The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 7-4

**DRINKING WATER WELL GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214219	02214201	02214202	02214203	02214204	02214205	02214206	02214207	02214208	02214209	02214210	02214211	02214212	EPA MCL	EPA Region 9 PRGs Tap Water	MTCA Method B
CLP Sample ID	MJOPH3	MJOPF3	MJOPF4	MJOPF5	MJOPF6	MJOPF7	MJOPF8	MJOPF9	MJOPG2	MJOPG3	MJOPG4	MJOPG5	MJOPG6			
Station ID	DW18	DW01	DW01	DW02	DW03	DW04	DW05	DW06	DW07	DW08	DW09	DW10	DW11			
Description	Harvey (Background)	White (first flush)	White	Strickland well	Strickland spring	F. Johnson	Sutherland	Simmons	J. Johnson	Krinke	Alexander	McKinney	Echelbarger			
TAL Metals (ug/L)																
Aluminum	7.3 UJK	7.3 UJK	7.3 UJK	7.3 U	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	377	7.3 UJK	NA	36000	NA
Antimony	4.7 U	4.7 UJK	4.7 UJK	13.0 JB	<u>4.7 JK</u>	4.7 UJK	4.7 UJK	4.7 UJK	4.7 UJK	<u>5.2 JK</u>	4.7 UJK	4.7 U	4.7 U	6	15	6.4
Arsenic	5.2 U	381	501	2.8 U	9.9 U	77.8	63.4	56.5	7.0 U	12.8 U	133	181	107	10	0.045 ^a	0.0583
Barium	16.1 JB (0.80 U SQL)	10.1 JB	11.2 JB	3.1 U	30.9 JB	35.4 JB	2.2 U	0.80 U	10 JB	24.8 JB	7.9 JB	0.80 U	15.8 JB	2000	2600	1120
Calcium	48600	59200	66000	490000	75500	41900	41700	29600	61400	306000	109000	53900	68100	NA	NA	NA
Cobalt	0.66 JK	0.60 UJK	0.60 UJK	4.0 U	0.60 UJK	0.60 UJK	0.60 UJK	0.60 UJK	0.60 UJK	2.3 JK	0.60 UJK	0.60 UJK	0.60 UJK	NA	2200	NA
Copper	1.5 JK	38.6	25.2	0.90 UJK	0.90 UJK	4.7 JK	10.3 JB	0.90 UJK	102	0.90 UJK	0.90 UJK	29.3	0.90 UJK	1300 ^b	1400	592
Iron	44.3 JK	875 JK	707 JK	50.0 UJK	17.3 UJK	53.9 JK	17.3 UJK	17.3 UJK	17.3 UJK	17.3 UJK	155 JK	101 JK	1490 JK	NA	11000	NA
Lead	3.3	5.0	3.6	2.1 U	2.1 U	3.5	4.0	2.1 U	2.1 U	2.1 U	2.1 U	4.7	2.1 U	15 ^b	NA	NA
Magnesium	11900	33500	37500	25200	14300	5100	6500	4100 JB	5470 UJK	87400	21400	9410	25900	NA	NA	NA
Manganese	0.10 UJK	25.8 JK	24.4 JK	291 JK	0.10 UJK	3.1 JK	0.10 UJK	16.4 JK	0.10 UJK	0.10 UJK	17.7 JK	0.10 UJK	69.6 JK	NA	880	2240
Potassium	716 JK	2300 JK	2520 JK	2300 JK	629 JK	300 JK	990 JK	91.2 JK	384 JK	4890 JK	1870 JK	546 JK	877 JK	NA	NA	NA
Selenium	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	11.2	3.0 U	3.0 U	3.0 JK	50	180	80
Sodium	5250	88600	97600	20900	8590	27000	6070	27600	3400 JB	23000	45300	5180	10700	NA	NA	NA
Zinc	183 JK	1200 JK	165 JK	313 UJK	11.4 JBK	24.4 JK	354 JK	71.9 JK	168 JK	1.1 UJK	136 JK	248 JK	10.8 JK	NA	11000	4800
Arsenic Speciation (ug/L)																
As (Inorganic)	NA	NA	370	NA	NA	62.7	NA	51.7	NA	NA	NA	NA	NA	NA	NA	NA
As (III)	NA	NA	318	NA	NA	0.952	NA	4.93	NA	NA	NA	NA	NA	NA	NA	NA
As (V) ^c	NA	NA	52	NA	NA	61.7	NA	46.8	NA	NA	NA	NA	NA	NA	NA	NA
Water Quality Parameters (mg/L)																
Alkalinity, Total as CaCO3	130	NA	250	160	240	140	100	92	170	320	240	180	240	NA	NA	NA
Bicarb. Alkalinity, HCO3	130	NA	250	160	240	140	100	92	170	320	240	180	240	NA	NA	NA
Carb. Alkalinity, CO3	8 U	NA	4 U	4 U	4 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	NA	NA	NA
Chloride	1 U	NA	2	1 U	1 U	1 U	2	10	1 U	2	1	1	2	NA	NA	NA
Hardness as CaCO3	160	NA	350	1900	430	180	150	100	190	1500	480	180	280	NA	NA	NA
Nitrate + Nitrite	3.7	NA	0.04	0.09	0.06	0.06	6.6	0.12	2.8	0.01 U	0.1	0.43	0.01 U	NA	NA	NA
Nitrate as N	3.7	NA	0.04	0.09	0.06	0.06	6.6	0.11	2.8	0.01 U	0.1	0.43	0.01 U	10	10	NA
Nitrite as N	0.005 U	NA	0.005 U	0.005 U	0.005	0.005 U	0.005 U	0.006	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	1	1	NA
Silica as SiO2	10	NA	23	21	19	19	25	17	12	29	27	14	20	NA	NA	NA
Sulfate	48	NA	230	1400	23	110	14	56	13	980	360	12	70	NA	NA	NA
Total Dissolved Solids	200	NA	640	2200	300	230	200	210	190	1700	600	210	350	NA	NA	NA
Total Organic Carbon	1.0 U	NA	1.0 U	1.0 U	1.0 U	1.0 U	7.6	1.3	1.4	2.1	1.0 U	1.0 U	1.0 U	NA	NA	NA
Total Suspended Solids	2 U	NA	4	3	2	3	3	2 U	2 U	2	3	9	5	NA	NA	NA

Note:

Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are elevated as defined in Section 5. Applied to TAL Metals only.

Highlight indicates exceedance of one or more regulatory benchmarks shown in the table.

Table 7-4 (CONTINUED)

**DRINKING WATER WELL GROUNDWATER SAMPLE ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214219	02214213	02214214	02214215	02214216	02214217	02214218	02214220	02214221	02214222	02214223	EPA MCL	EPA Region 9 PRGs Tap Water	MTCA Method B
CLP Sample ID	MJOPH3	MJOPG7	MJOPG8	MJOPG9	MJOPH0	MJOPH1	MJOPH2	MJOPH4	MJOPH5	MJOPH6	MJOPH7			
Station ID	DW18	DW12	DW13	DW14	DW15	DW16	DW17	DW19	DW16	DW12	DW20			
Description	Harvey (Background)	Russel	Town of Twisp #3	Port	Madison	D. Johnson	Kominak	Jolley	D. Johnson (first flush)	Russel (first flush)	Michaels			
TAL Metals (ug/L)														
Aluminum	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	7.3 UJK	<u>22.0 JK</u>	7.3 UJK	7.3 UJK	NA	36000	NA
Antimony	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	4.7 U	5.2 JB	4.7 U	5.0 JB	6.5 JB	6	15	6.4
Arsenic	5.2 U	14.3 U	2.8 U	<u>16.6</u>	2.8 U	12.1 U	2.8 U	<u>31.4</u>	8.9 JB	7.0 JB	<u>32.9</u>	10	0.045 ^a	0.0583
Barium	16.1 JB (0.80 U SQL)	19.5 JB	8.4 JB	5.5 U	7.1 JB	8.8 JB	15.2 JB	9.5 JB	<u>9.5 JK</u>	20.4 JB	19.5 JB	2000	2600	1120
Calcium	48600	84300	28400	46200	23400	38600	25000	107000	38400	91100	43400	NA	NA	NA
Cobalt	0.66 JK	0.60 UJK	0.60 UJK	0.60 UJK	0.70 JK	0.60 UJK	0.60 UJK	2.6 JK	0.60 U	0.70 JB	0.60 U	NA	2200	NA
Copper	1.5 JK	0.90 UJK	<u>101</u>	1.3 JK	1.1 JK	0.90 UJK	<u>9.3 JK</u>	0.90 UJK	<u>41.5</u>	<u>10.1 JK</u>	0.90 UJK	1300 ^b	1400	592
Iron	44.3 JK	190 JK	955 JK	17.3 U	17.3 UJK	17.3 UJK	17.3 UJK	17.3 UJK	100 JK	211 JK	163 JK	NA	11000	NA
Lead	3.3	2.1 U	6.4	2.1 U	2.1 U	2.1 U	2.1 U	2.1 U	5.0 U	3.8 U	2.1 U	15 ^b	NA	NA
Magnesium	11900	19900	4490 JB	6880	3590 JB	4410 JB	13400	37800	4420 JB	21600	27800	NA	NA	NA
Manganese	0.10 UJK	0.10 UJK	<u>11.6 JK</u>	0.10 UJK	0.10 JK	0.10 UJK	0.10 UJK	<u>11.3 JK</u>	<u>2.2 JK</u>	<u>5.0 JK</u>	<u>15.2 JK</u>	NA	880	2240
Potassium	716 JK	1580 JK	573 JK	796 JK	485 JK	751 JK	779 JK	2960 JK	808 JK	1810 JK	1230 JK	NA	NA	NA
Selenium	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	50	180	80
Sodium	5250	8350	2580 JB	3950 JB	2800 JB	3020 JB	35300	81000	3330 JB	9750	15300	NA	NA	NA
Zinc	183 JK	114 JK	1.1 UJK	1.2 UJK	11.9 JK	<u>636 JK</u>	1.1 UJK	328 JK	<u>3180 JK</u>	352 JK	90.5 JK	NA	11000	4800
Arsenic Speciation (ug/L)														
As (Inorganic)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
As (III)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
As (V) ^c	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Water Quality Parameters (mg/L)														
Alkalinity, Total as CaCO3	130	230	84	120	72	110	150	160	NA	NA	200	NA	NA	NA
Bicarb. Alkalinity, HCO3	130	230	84	120	72	110	150	160	NA	NA	200	NA	NA	NA
Carb. Alkalinity, CO3	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	NA	NA	8 U	NA	NA	NA
Chloride	1 U	1	1 U	3	1 U	1 U	1 U	1	NA	NA	1 U	NA	NA	NA
Hardness as CaCO3	160	320	96	150	140	140	200	470	NA	NA	230	NA	NA	NA
Nitrate + Nitrite	3.7	0.59	0.32	2.2	0.16	0.97	0.08	0.23	NA	NA	0.42	NA	NA	NA
Nitrate as N	3.7	0.58	0.32	2.2	0.16	0.97	0.08	0.23	NA	NA	0.42	10	10	NA
Nitrite as N	0.005 U	0.011	0.006	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	NA	NA	0.005 U	1	1	NA
Silica as SiO2	10	20	11	16	10	16	17	19	NA	NA	11	NA	NA	NA
Sulfate	48	120	9	19	7	12	61	460	NA	NA	36	NA	NA	NA
Total Dissolved Solids	200	380	100	180	90	150	240	800	NA	NA	280	NA	NA	NA
Total Organic Carbon	1.0 U	1.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NA	NA	1 U	NA	NA	NA
Total Suspended Solids	2 U	3	2 U	2 U	2 U	2 U	2 U	2 U	NA	NA	2	NA	NA	NA

Note: Bold type indicates sample concentration is above the detection limit.
Underline type indicates the sample results are elevated as defined in Section 5. Applied to TAL Metals only.
Highlight indicates exceedance of one or more regulatory benchmarks shown in the table.

Key:

a	= Cancer endpoint.
b	= Treatment technique based MCL.
c	= As (V) values are determined by subtracting As (III) from As (Organic) values.
B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
EPA	= United States Environmental Protection Agency
H	= High bias.
ID	= Identification.
J	= The analyte was positively identified. The associated numerical value is an estimate.
K	= Unknown bias.
MCL	= Maximum Contaminant Level. The highest level of a contaminant that is allowed in drinking water.
mg/L	= milligrams per liter.
ug/L	= micrograms per liter.
MTCA	= Washington State Model Toxics Control Act.
NA	= Not applicable.
NSDWR	= National Safe Drinking Water Regulations. Non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.
PRG	= Preliminary Remediation Goal.
SQL	= Sample quantitation limit.
TAL	= Target Analyte List.
U	= The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 7-5

**MINES AND PROSPECTS IN THE TWISP AREA
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

Mine or Prospect Name	Legal Description	Sulfide Minerals	Workings	Remarks
Alder Mine	NW 1/4 Sec. 36, T. 33 N, R. 21 E	Pyrite, sphalerite, galena, chalcopyrite, pyrrhotite	Over 4,000 feet of adits and drifts; open pit	Silicified dacite breccia host
Floyd-Rattlesnake	SE 1/4 Sec. 18, T. 33 N, R. 22 E	Pyrite, sphalerite, galena, chalcopyrite, arsenopyrite	Several 5 to 20 foot adits and pits	Dacite tuff lenses 1 to 5 feet thick with up to 25% sulfides, locally overlain by calcareous sedimentary rocks and interbedded with andesite tuffs
Spokane Mine	SW 1/4 Sec. 12, T. 33 N, R. 21 E	Pyrite, sphalerite, galena, chalcopyrite, arsenopyrite	Adits with 2,000 to 4,000 ton waste rock dump	Silicified dacite (?) breccia host
Twisp View	NW 1/4 Sec. 24, T. 33 N, R. 21 E	Pyrite, sphalerite, galena, chalcopyrite, arsenopyrite	Two pits (north and south), two shafts (pit shaft and ridge shaft), and two adits (main adit and lower adit)	Intensely crushed and chloritically altered Alder Creek Stock (quartz diorite)
	SE 1/4 Sec. 18, T. 33 N, R. 22 E	Pyrite	Small adit	Thin chert zone brecciated along northeast-trending fault
	NE 1/4 Sec. 18, T. 33 N, R. 22 E	Pyrite, chalcopyrite	40 to 60 foot inclined shaft	Andesite breccia altered along northwest-trending fault zone
	NE 1/4 Sec. 18, T. 33 N, R. 22 E	Pyrite	Small trench	Altered andesite breccia interbedded with sandstone, marble, and argillite
	NE 1/4 Sec. 13, T. 33 N, R. 21 E	Pyrite, sphalerite, galena	Several 15 to 60 foot adits	Up to 20% sulfide in silicified dacite in fault contact with Alder Creek Stock
	NE 1/4 Sec. 20, T. 33 N, R. 22 E	Pyrite, chalcopyrite	Small pit	Andesite breccia altered along northeast-trending fault
	NW 1/4 Sec. 25, T. 33 N, R. 21 E	Pyrite, chalcopyrite (?)	Several small adits (caved)	Altered rhyolite host (quartz-sericite phyllite) on strike with Alder Mine
	NW 1/4 Sec. 13, T. 33 N, R. 21 E	Pyrite, sphalerite	Small adit, caved	Silicified dacite host

Sources: Burnet (1976) and Forest Service (2001)

Table 7-6

**IRRIGATION RACEWAY SURFACE WATER SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY SITE
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214234	02214232	02214230
CLP Sample ID	MJ0PK4	MJ0PK2	MJ0PK0
Station ID	IR01	IR03	IR02
Sample Description	Background	Release	
TAL Metals (µg/L)			
Aluminum	92.6 JB	77.6 JB	11.2 JK
Barium	5.4 JK	8.7 JK	3.7 JK
Calcium	12400	11900	12000
Copper	0.90 UJK	<u>1.8 JK</u>	0.90 UJK
Iron	151 JK	129 JK	127 JK
Manganese	7.5 JK	6.5 JK	6.0 JK
Potassium	402 JK	377 JK	328 JK
Sodium	1110 JB	1140 JK	1010 JB
Zinc	24.0 JK	1.1 UJK	1.1 UJK
Water Quality Parameters (mg/L)			
Alkalinity, Total as CaCO3	38	44	42
Bicarb. Alkalinity, HCO3	38	44	42
Carb. Alkalinity, CO3	8 U	8 U	8 U
Chloride	1 U	1 U	1 U
Nitrate + Nitrite	0.05	0.03	0.02
Nitrate as N	0.05	0.03	0.02
Nitrite as N	0.005 U	0.005 U	0.005 U
Sulfate	4	4	4
Total Dissolved Solids	55	52	56

Note: Bold type indicates sample concentration is above the detection limit.
Underline type indicates the sample results are elevated as defined in Section 5.

Key:

- B = The reported concentration is between the instrument detection limit and the contract required detection limit.
- CLP = Contract Laboratory Program.
- EPA = United States Environmental Protection Agency.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical value is an estimate.
- K = Unknown bias.
- mg/L = Milligrams per liter.
- TAL = Target Analyte List.
- µg/L = Micrograms per liter.
- U = The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 7-7a

**IRRIGATION RACEWAY SEDIMENT SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214235	02214233
CLP Sample ID	MJ0PK5	MJ0PK3
Station ID	IR01	IR03
Sample Depth (inches bgs)	0 - 6	0 - 6
Description	Background	PPE
TAL Metals (mg/kg)		
Aluminum	14500	12900
Arsenic	16.8	14.1
Barium	110	99.0
Calcium	5890	7750
Chromium	19.9 JK	35.8 JK
Copper	30.2	33.2
Iron	25400	22100
Lead	5.0	6.1
Magnesium	7820	7450
Manganese	373	450
Nickel	14.7	27.9
Potassium	2000 JK	1090 JK
Vanadium	65.4	47.1
Zinc	71.9	87.6

Note: **Bold type** indicates sample concentration is above the detection limit.
Underline type indicates the sample results are elevated as defined in Section 5.

Key:

- bgs = below ground surface.
- CLP = Contract Laboratory Program.
- EPA = United States Environmental Protection Agency.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical value is an estimate.
- K = Unknown bias.
- mg/kg = milligrams per kilograms.
- PPE = Probable Point of Entry.
- TAL = Target Analyte List.

Table 7-7b

**UNNAMED INTERMITTENT STREAM SEDIMENT SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214240	02214241	00234357	02214229
CLP Sample ID	MJ0PM6	MJ0PM7	NA	MJ0PJ9
Station ID	US01	US02	ML01	HK01
Sample Depth (inches bgs)	0-6	0-6	0-6	0-6
Description	Background	Background	PPE	Release
TAL Metals (mg/kg)				
Aluminum	9400	8880	2060	2720
Antimony	1.2 U	1.1 U	4.5 UJL	<u>2.6 JK</u>
Arsenic	<u>31.3 JL</u>	<u>12.9 JL</u>	30.3	<u>74.3</u>
Barium	70.9	204	119	<u>10800</u>
Cadmium	<u>0.33 JK</u>	<u>0.84 JK</u>	0.41	<u>2.2 JK</u>
Calcium	10800	5900	541	3160
Chromium	6.0	2.2 JB (0.14 U SQL)	<u>2.64</u>	<u>8.0 JK</u>
Copper	<u>28.6 JK</u>	<u>36.4 JK</u>	<u>364</u>	278
Iron	12000	6750	167000	35400
Lead	7.1	4.8	<u>115</u>	<u>222</u>
Magnesium	3240	1180	1280	2500
Manganese	278	446	41.1	93.4
Mercury	0.12 U	0.12 U	<u>0.348</u>	<u>2.2 JH</u>
Potassium	<u>1180 JK</u>	<u>1130 JK</u>	3180	531 JK
Selenium	0.79 JB (0.77 U SQL)	0.68 U	<u>1.3</u>	<u>2.8</u>
Silver	0.26 U	0.23 U	<u>7.28</u>	<u>5.8</u>
Sodium	<u>379 JK</u>	<u>180 JK</u>	356	97.3 UJK
Vanadium	28.6	6.6 JB (0.18 U SQL)	<u>17.2</u>	<u>15.5</u>
Zinc	<u>67.6</u>	125	<u>232</u>	<u>867</u>

Note: Bold type indicates sample concentration is above the detection limit.
Underline type indicates the sample results are elevated as defined in Section 5.

Key:

- B = The reported concentration is between the instrument detection limit and the contract required detection limit.
- bgs = below ground surface.
- CLP = Contract Laboratory Program.
- EPA = United States Environmental Protection Agency.
- H = High bias.
- ID = Identification.
- J = The analyte was positively identified. The associated numerical value is an estimate.
- K = Unknown bias.
- L = Low bias.
- mg/kg = milligrams per kilograms.
- PPE = Probable Point of Entry.
- SQL = Sample quantitation limit.
- TAL = Target Analyte List.
- U = The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 7-7c

**UNNAMED INTERMITTENT STREAM AND IRRIGATION RACEWAY SEDIMENT SAMPLE
ANALYTICAL RESULTS SUMMARY
ALDER GOLD AND COPPER COMPANY
INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

EPA Sample ID	02214240	02214241	00234357	02214229	02214235	02214233	02214231
CLP Sample ID	MJ0PM6	MJ0PM7	NA	MJ0PJ9	MJ0PK5	MJ0PK3	MJ0PK1
Station ID	US01	US02	ML01	HK01	IR01	IR03	IR02
Sample Depth (inches bgs)	0-6	0-6	0-6	0 - 6	0 - 6	0 - 6	0-6
Description	Background	Background	Contribution	Contribution	Background	Contribution	Release
TAL Metals (mg/kg)							
Aluminum	9400	8880	2060	2720	14500	12900	7350
Antimony	1.2 U	1.1 U	4.5 UJL	2.6 JK	1.3 U	1.8 U	1.3 U
Arsenic	31.3 JL	12.9 JL	30.3	74.3	16.8	14.1	17.4 JL
Barium	70.9	204	119	10800	110	99	198
Cadmium	0.33 JK	0.84 JK	0.41	2.2 JK	0.11 UJK	0.15 UJK	0.29 JK
Calcium	10800	5900	541	3160	5890	7750	3680
Chromium	6.0	2.2 JB (0.14 U SQL)	2.64	8.0 JK	19.9 JK	35.8 JK	11.7
Copper	28.6 JK	36.4 JK	364	278	30.2	33.2	29.9 JK
Iron	12000	6750	167000	35400	25400	22100	13700
Lead	7.1	4.8	115	222	5.0	6.1	8.9
Magnesium	3240	1180	1280	2500	7820	7450	4370
Manganese	278	446	41.1	93.4	373	450	316
Mercury	0.12 U	0.12 U	0.348	2.2 JH	0.14 U	0.17 U	0.12 U
Nickel	6.3 JB (0.46 U SQL)	3.1 JB (0.42 U SQL)	1 U	1.1 JB (0.50 U SQL)	14.7	27.9	10.3 JB
Potassium	1180 JK	1130 JK	3180	531 JK	2000	1090 JK	845 JK
Selenium	0.79 JB (0.77 U SQL)	0.68 U	1.3	2.8	0.98 JB (0.82 SQL)	1.5 JB (1.1 U SQL)	0.80 U
Silver	0.26 U	0.23 U	7.28	5.8	0.27 U	0.38 U	0.27 U
Sodium	379 JK	180 JK	356	97.3 UJK	95.2 UJK	134 UJK	98.8 JK
Thallium	1.4 UJK	1.2 U	1.5 UJL	1.5 U	1.5 U	2 U	1.4 UJK
Vanadium	28.6	6.6 JB (0.18 U SQL)	17.2	15.5	65.4	47.1	29.5
Zinc	67.6	125	232	867	71.9	87.6	105

Note:

Bold type indicates sample concentration is above the detection limit.

Underline type indicates the sample results are elevated as defined in Section 5.

Key:

B	= The reported concentration is between the instrument detection limit and the contract required detection limit.
bgs	= below ground surface.
CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
H	= High bias.
ID	= Identification.
J	= The analyte was positively identified. The associated numerical value is an estimate.
K	= Unknown bias.
L	= Low bias.
mg/kg	= milligrams per kilograms.
SQL	= Sample quantitation limit.
TAL	= Target Analyte List.
U	= The analyte was not detected. The associated numerical values is the contract required detection limit.

Table 7-8

**POPULATION AND WETLANDS WITHIN A 4-MILE RADIUS
ALDER GOLD AND COPPER COMPANY INTEGRATED ASSESSMENT
TWISP, WASHINGTON**

Distance Ring (Miles)	Wetlands (Acreage)
On-site	0
0 - ¼	0
¼ - ½	0.9
½ - 1	39.8
1 - 2	229.6
2 - 3	289.1
3 - 4	263.5
TOTAL	822.9

8. REMOVAL ASSESSMENT DISCUSSION

The following sections describe the removal assessment of on-site surface soils ([Section 8.1](#)), subsurface soils ([Section 8.2](#)), and groundwater ([Section 8.3](#)).

8.1 ARARs

Soil analytical results are compared to regulatory cleanup levels (EPA Region 9 PRGs; MTCA Method B Unrestricted cleanup levels; and MTCA Method B Protection of Groundwater soil cleanup levels) and to MTCA Ecological Indicators. Groundwater analytical results are compared to EPA MCLs, EPA Region 9 Tap Water PRGs, and to MTCA Method B cleanup levels.

MTCA Method B cleanup levels are applicable to all media at all sites. Risk equations provided in MTCA are used to calculate the constituent concentrations that would result in no adverse human health effects due to acute or chronic toxicity or carcinogenicity. The calculated soil cleanup levels are based on exposure to contaminants via ingestion and dermal contact. The soil cleanup levels that are protective of contaminants leaching to groundwater were calculated using Ecology's calculation worksheet, MTCASGL10.XLS. EPA MCLs were used as the target groundwater cleanup level for all metals except for vanadium, for which an MCL has not been designated. The MTCA Method B groundwater cleanup level was used as the target groundwater cleanup level for vanadium. MTCA Method B cleanup levels for groundwater are based on exposure via ingestion and inhalation of vapor.

Although a terrestrial ecological evaluation has not been conducted for the site, it is assumed that the site would not be exempt from a simplified ecological evaluation due to its rural setting. Therefore, analytical results are compared to the more conservative terrestrial Ecological Indicator levels provided in MTCA Table 749-3. MTCA Table 749-3 provides screening values for plants, soil biota, and wildlife.

8.2 ON-SITE SURFACE SOIL

A total of five surface soil samples were collected for TAL metals analysis from on-site sources, including two tailings samples from the UTP, two tailings samples from the Mill Pond, and one soil sample from near the load-out area of the Mill building.

8.2.1 Tailings

Mill Pond tailings surface soil samples contained arsenic, barium, copper, iron, lead, mercury, selenium, and silver at concentrations exceeding one or more regulatory screening level. Mill Pond surface soil samples contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, thallium, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

UTP tailings surface soil samples contained arsenic, barium, and iron at concentrations exceeding one or more regulatory cleanup level. These samples contained aluminum, arsenic, barium, copper, lead, mercury, selenium, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

It should be noted that the background surface soil samples collected during the IA, as well as the 1986 Alder Mill SI (Ecology 1986) contained arsenic at a concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators. Is should also be noted that other surface soil samples collected during the IA from area mines and prospects contained arsenic at concentrations as high as 24,400 mg/kg, as discussed in [Section 6.4](#).

Tailings from the UTP have migrated downstream in the unnamed intermittent stream due to erosion, including a reported tailings impoundment failure in 1952, resulting in deposition of tailings within the unnamed intermittent stream drainage to the vicinity of the Krinke residence (see sediment sample HK01, discussed in [Section 7.3](#)), and reportedly as far as the irrigation raceway (Ecology 1986).

8.2.2 Surface Soil Near Mill Building

Surface soil collected from near the Mill building (MB02) contained antimony, arsenic, copper, iron, lead, mercury, and selenium at concentrations exceeding one or more regulatory cleanup level. This sample contained aluminum, antimony, arsenic, barium , copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

It should be noted that the background surface soil samples collected during the IA, as well as the 1986 Alder Mill SI (Ecology 1986) contained arsenic at a concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators. Is should also be noted that other surface soil samples collected during the IA from area mines and prospects contained arsenic at concentrations as high as 24,400 mg/kg, as discussed in [Section 6.4](#).

8.3 ON-SITE SUBSURFACE SOIL

A total of five subsurface soil samples were collected for TAL metals analysis from on-site sources, including three tailings samples from the UTP and two tailings samples from the Mill Pond. TAL analytical results of these source samples are presented in [Table 6-3](#).

Mill Pond tailings subsurface soil samples contained arsenic, barium, iron, lead, and mercury at concentrations exceeding one of more regulatory screening level. Mill Pond subsurface tailings samples contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

UTP tailings subsurface soil samples contained arsenic, barium, cadmium, copper, iron, and selenium at concentrations exceeding one of more regulatory screening level. UTP subsurface tailings samples contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

It should be noted that the background subsurface soil sample collected during the IA contained arsenic at a concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators.

Four subsurface soil samples from the tailings impoundments were collected for SPLP analysis. SPLP analytical results are summarized in [Table 6-4](#). SPLP leachates from both the UTP and Mill Pond tailings samples contained detectable concentrations of cadmium, copper, iron, magnesium, manganese, nickel, potassium, and zinc. SPLP leachate from Mill Pond tailings also contained detectable levels of aluminum, calcium, and cobalt.

8.4 MILL PROCESS MATERIAL SAMPLE

A sample of material located in the conditioner tank in the mill building contained arsenic (44.2 mg/kg), barium (57.8 mg/kg), cadmium (4,450 mg/kg), chromium (estimated 11.6 JK mg/kg), copper (13,200 mg/kg), lead (44.7 mg/kg), manganese (1,710 mg/kg), nickel (75.2 mg/kg), selenium (7.1 mg/kg), and zinc (173,000 mg/kg). This material is presently contained within the open tank; the material is accessible to the public.

8.5 GROUNDWATER

Groundwater analytical results for samples collected during the May 2002 IA field event are summarized below.

8.5.1 Monitoring Wells and Temporary Well Point

Groundwater samples were collected from a total of seven monitoring wells and one temporary well point installed in the immediate vicinity of, and upgradient and downgradient of the UTP and Mill Pond.

Analytical results of monitoring well and temporary well point groundwater samples are presented in [Table 7-3](#). Monitoring wells downgradient of the UTP (MW02, BOM-M4-24, and BOM M4-32) contained antimony, arsenic, iron, manganese, and zinc at concentrations exceeding one or more regulatory cleanup level. The monitoring well installed immediately downgradient of the Mill Pond (MW01) did not contain any analytes at concentrations greater than the regulatory cleanup levels.

The sample collected from TP01, installed within the Mill Pond tailings, contained aluminum, beryllium, cadmium, chromium, copper, iron, lead, manganese, selenium, thallium, vanadium, and zinc at concentrations exceeding one or more regulatory cleanup level. The well point was not installed in accordance with guidance for installation of monitoring wells, and was not developed prior to sampling; analytical results are provided for informational purposes.

The sample from the monitoring well immediately upgradient of the Mill Pond (MW03) contained antimony at a concentration exceeding all three regulatory cleanup levels. The monitoring wells upgradient of the UTP (BOM-BKG-21 and BOM BKG-66) contained arsenic at concentrations that exceed all three regulatory cleanup levels, and that are among the highest concentrations detected during the IA.

Based upon the evaluation of available data discussed in [Section 7.2](#), arsenic detected in the upgradient and downgradient monitoring wells is not readily attributable to the on-site sources. Several of the other metals detected in the MW02 (iron, manganese, and zinc) and BOM M4-32 (manganese) at concentrations exceeding regulatory benchmarks are possibly at least partly attributable to the UTP. The concentration of antimony in MW02 exceeding regulatory benchmarks could be partly attributable to the UTP.

8.5.2 Drinking Water Wells

Groundwater was sampled from a total of twenty drinking water wells, including nineteen domestic wells and one Town of Twisp municipal well, during the IA.

Analytical results are presented in [Table 7-4](#). Analytical results are compared to EPA MCLs, EPA Region 9 Tap Water PRGs, and to MTCA Method B cleanup levels. Sample results exceeding regulatory cleanup levels are shaded in [Table 7-4](#).

The only analyte exceeding groundwater regulatory cleanup levels in the drinking water wells is arsenic. Arsenic was detected at concentrations exceeding one or more regulatory cleanup level in ten wells. As discussed in [Section 7.2](#), the arsenic detected in these wells is not readily attributed to the on-site sources.

9. SUMMARY AND CONCLUSIONS

The Alder Mill site is a former ore processing facility that operated between 1949 and 1952. The mill processed copper, zinc, and gold ore mined from the Alder Mine. The mill utilized a conventional dual-circuit flotation system maintained at a pH of 10 or higher with lime. Features at the site include the mill building and two tailings impoundments (UTP and the Mill Pond). The UTP is approximately 650 feet long, 150 feet wide, an average of 12 feet deep, with a maximum observed thickness of 20 feet, and is estimated to contain 43,300 cubic yards of tailings. The Mill Pond is approximately 150 feet long, up to 50 feet wide, and up to 5 feet deep, and is estimated to contain approximately 1,333 cubic yards of tailings. In 1952, the UTP reportedly failed, resulting in the deposition of tailings down the length of the unnamed intermittent stream at least as far as its confluence with the irrigation raceway. The site is not fenced, and there is evidence of trespassing and vandalism at the site. The mill building structure is largely intact, although it has been vandalized. Equipment remaining in the mill building includes an ore bin, primary crusher, ball mill, flotation circuit(s), copper circuit conditioner tank, clarifier tank, concentrate storage, and a load-out area. Other features in the vicinity of the site include several mines and prospects that targeted the sulfide mineralization that exists within various bedrock units and mineralized fault zones.

The site has been the subject of numerous previous investigations. These investigations are summarized in [Section 2](#). Previous results are incorporated as appropriate in the IA report.

During the IA, potential sources of contamination (tailings and surface soils near the mill building) and receptors (surface soil, surface water, sediment, and area groundwater and drinking water wells) were investigated. In addition, soil samples from several off-site mineralized areas were collected to provide additional information about naturally-occurring soil conditions in the study area. Field work for the IA was conducted by the START-2 between May 20 and 24, 2002, and included installation of soil borings and monitoring wells, and collection of groundwater, surface soil, subsurface soil, surface water, and sediment samples. In addition, one sample of mill process material located in a conditioner tank within the mill building was collected. A total of 69 samples (33 groundwater samples, 13 subsurface soil samples, 13 surface soil samples, 3 surface water samples, 6 sediment samples, and 1 mill process material sample), including background but excluding QA samples (rinsate blanks), were

collected by the START-2 from on-site and off-site locations. The groundwater samples were collected from existing monitoring wells, monitoring wells installed during the IA, a temporary well point, and area domestic and municipal drinking water wells. Analytical results of one surface soil and one sediment sample collected during the Alder Mine PA/SI are incorporated into the IA as appropriate.

As part of the IA, analytical results of the IA and existing information, including sampling data and geological and hydrogeological data, were evaluated to determine whether previously documented arsenic groundwater contamination in the area is likely attributable to on-site sources.

9.1 SOURCES

9.1.1 Tailings

A total of ten TAL metals (antimony, arsenic, barium, copper, lead, mercury, selenium, silver, thallium, and zinc) were detected in the UTP or Mill Pond tailings surface soil samples at concentrations that are significant relative to the selected background samples. Mill Pond tailings surface soil samples contained arsenic, barium, copper, iron, lead, mercury, selenium, and silver at concentrations exceeding one of more regulatory screening level. Mill Pond surface soil samples also contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, thallium, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators. UTP tailings surface soil samples contained arsenic, barium, and iron at concentrations exceeding one or more regulatory cleanup level. These samples also contained arsenic, barium, copper, lead, mercury, selenium, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

A total of eight TAL metals (barium, cadmium, copper, lead, mercury, selenium, silver, and zinc) were detected in the UTP or Mill Pond tailings subsurface soil samples at concentrations that are significant relative to the selected background sample. Mill Pond tailings subsurface soil samples contained arsenic, barium, iron, lead, and mercury at concentrations exceeding one of more regulatory screening level. Mill Pond subsurface tailings samples also contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators. UTP tailings subsurface soil samples contained arsenic, barium, cadmium, copper, iron, and selenium at concentrations exceeding one of more regulatory screening level. UTP subsurface tailings samples contained aluminum, arsenic, barium, copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

It should be noted that the background surface and subsurface soil samples collected during the IA, as well as the 1986 Alder Mill SI (Ecology 1986) contained arsenic at a concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators. Is should also be noted that other surface

soil samples collected during the IA from area mines and prospects contained arsenic at concentrations as high as 24,400 mg/kg, as discussed in [Section 6.4](#).

Four subsurface soil samples from the tailings impoundments were collected for SPLP analysis. SPLP leachates from both the UTP and Mill Pond tailings samples contained detectable concentrations of cadmium, copper, iron, magnesium, manganese, nickel, potassium, and zinc. SPLP leachate from Mill Pond tailings also contained detectable levels of aluminum, calcium, and cobalt. Arsenic was not detected in the SPLP leachates.

Tailings from the UTP have migrated downstream in the unnamed intermittent stream due to erosion, including a reported impoundment failure in 1952, resulting in deposition of tailings within the unnamed intermittent stream drainage to at least as far as the irrigation raceway (Ecology 1986). The tailings were deposited within approximately 200 feet of the Krinke residence.

9.1.2 Surface Soil Near Mill Building

A total of eight TAL metals (antimony, arsenic, barium, copper, lead, mercury, selenium, and silver) were detected in surface soil sample collected from near the mill building at concentrations that are significant relative to the selected background samples. Antimony, arsenic, copper, iron, lead, mercury, and selenium were detected at concentrations exceeding one or more regulatory cleanup level. This sample contained aluminum, antimony, arsenic, barium, copper, lead, mercury, selenium, silver, vanadium, and zinc at concentrations exceeding the MTCA Ecological Indicators.

It should be noted that the background surface soil samples collected during the IA, as well as the 1986 Alder Mill SI (Ecology 1986) contained arsenic at a concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators. It should also be noted that other surface soil samples collected during the IA from area mines and prospects contained arsenic at concentrations as high as 24,400 mg/kg, as discussed in [Section 6.4](#).

9.1.3 Mill Process Material Sample

A sample of material located in the conditioner tank in the mill building contained detectable concentrations of arsenic (44.2 mg/kg), barium (57.8 mg/kg), cadmium (4,450 mg/kg), chromium (estimated 11.6 JK mg/kg), copper (13,200 mg/kg), lead (44.7 mg/kg), manganese (1,710 mg/kg), nickel (75.2 mg/kg), selenium (7.1 mg/kg), and zinc (173,000 mg/kg). The mill process material is located in an open tank accessible to the public.

9.1.4 Waste Rock and Native Rock Samples

Waste rock and native mineralized rock samples were collected from selected mines and prospects in the Twisp area to provide additional information on the mineralization that has locally resulted in relatively high metals concentrations in bedrock. A total of twelve TAL metals were detected at significant concentrations in the waste rock and vein material samples (antimony, arsenic, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, and zinc).

9.2 EXPOSURE PATHWAYS AND TARGETS

This section addresses IA results and results of previous investigations as they relate to the groundwater and surface water exposure pathways.

9.2.1 Groundwater Migration Pathway

A total of six analytes were detected at elevated concentrations in the monitoring wells installed downgradient of the UTP (antimony, arsenic, manganese, mercury, selenium, and zinc). Monitoring wells downgradient of the UTP contained antimony, arsenic, iron, manganese, and zinc at concentrations exceeding one or more regulatory cleanup level. Manganese was detected at an elevated concentration in the monitoring well installed downgradient of the Mill Pond; the groundwater sample from this well did not contain any analytes at concentrations greater than the regulatory cleanup levels. A total of twelve analytes were detected at elevated concentrations in the groundwater sample from the temporary well point installed in the Mill Pond (barium, beryllium, cadmium, copper, lead, manganese, mercury, nickel, selenium, thallium, vanadium, and zinc). This sample contained aluminum, beryllium, cadmium, chromium, copper, iron, lead, manganese, selenium, thallium, vanadium, and zinc at concentrations exceeding one or more regulatory cleanup level.

Four analytes were detected at elevated concentrations in groundwater samples collected from the monitoring wells upgradient of the UTP (arsenic, barium, manganese, and mercury). The samples from these upgradient monitoring wells contained arsenic at concentrations that exceed all three regulatory cleanup levels, and that are among the highest concentrations detected during the IA. Antimony and manganese were detected at elevated concentrations in the monitoring well installed upgradient of the Mill Pond. The concentration of antimony in this sample exceeds all three regulatory cleanup levels.

A total of seven analytes were detected at elevated concentrations in the drinking water wells (antimony, arsenic, barium, copper, manganese, selenium, and zinc). Arsenic was detected at concentrations exceeding one or more regulatory cleanup level in ten wells. No other analytes were detected at concentrations exceeding groundwater regulatory cleanup levels.

As discussed in [Section 7.2](#), the arsenic detected in these monitoring wells and drinking water wells is not readily attributed to the on-site sources. This conclusion is based upon evaluation of IA and other groundwater TAL metals analytical data; horizontal and vertical groundwater gradients; area geologic information; information on mining and exploratory activities; tailings SPLP analytical results; and evaluation of major anion and cation signatures of area groundwater.

Elevated concentrations of manganese and zinc detected in the several monitoring wells and drinking water wells could be partly attributed to on-site sources. Similarly, the elevated concentrations of antimony and selenium in the two wells downgradient of the UTP could be partly attributable to the UTP. As with arsenic, other contributing sources for these metals are possible.

9.2.2 Surface Water Migration Pathway

The surface water sample collected from the PPE in the irrigation raceway contained an elevated concentration of copper. No analytes were detected at elevated concentrations in the collocated sediment sample at this location. No analytes were detected at elevated concentrations in the surface water sample collected at the confluence of the unnamed intermittent stream and the irrigation raceway. The collocated sediment sample contained copper at an elevated concentration. The sediment sample collected during the 2000 Alder Mine PA/SI from immediately downstream of the lower end of the UTP in the unnamed intermittent stream location contained elevated concentrations of copper, lead, mercury, selenium, silver, and zinc. The sediment sample collected from the unnamed intermittent stream near the Krinke residence contained elevated concentrations of antimony, arsenic, barium, copper, lead, mercury, selenium, silver, and zinc.

It should be noted that surface water may exhibit significant seasonal variation in concentrations of metals and other analytes. Such variations are not accounted for in this IA.

9.3 CONCLUSIONS

IA results indicate significant concentrations of metals in on-site sources, including tailings within the Mill Pond and UTP, and surface soil near the mill building. Several metals were detected in the source samples at concentrations exceeding regulatory cleanup levels and MTCA Ecological Indicators. Tailings from the UTP have migrated down the intermittent stream from the UTP as a result of a reported tailings impoundment failure in 1952 (Ecology 1986), and possibly at other times.

Leaching of metals from tailings also has occurred, possibly resulting in elevated concentrations of some metals, including manganese and zinc, detected in several downgradient wells. Of particular importance to the IA is determining whether the arsenic detected in area wells is attributable to on-site sources. In order to address this question, the START-2 evaluated data gathered during the IA and

previous investigations, including soil and groundwater metals analytical results; horizontal and vertical groundwater gradients (and flow direction); background geologic information; information on mining and exploration history; tailings SPLP analytical results; and major anion and cation groundwater analytical results. Based upon evaluation of all of these data, it is concluded that the arsenic detected at elevated concentrations in area wells is not likely attributable to on-site sources.

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APPENDIX A
SAMPLE PLAN ALTERATION FORM

SAMPLE PLAN ALTERATION FORM

Project Name and Number: Alder Gold and Copper Company, TDD 02-01-0007

Material to be Sampled: Soil

Measurement Parameters: SPLP alkalinity, major anions, and total dissolved solids (TDS)

Standard Procedure for Field Collection & Laboratory Analysis (cite references): EPA SW-846 Methods 1312, 310.1 modified, 300.0, and 160.1

Reason for Analytical Variation: An alternate extraction fluid (deionized water) was used for SPLP extraction of anions, TDS, and alkalinity because sulfuric acid is used to adjust the pH of the standard Method 1312 extraction solution

Variation from Analytical Procedure:

Section 1.2.3.3 Potential Sources - the soil samples were also analyzed for SPLP alkalinity, SPLP major anions, and SPLP TDS

Section 2.1.1 (and Tables 2-1, 2-2, and 2-3) - The soil samples were also analyzed for SPLP alkalinity, SPLP major anions, and SPLP TDS

Special Equipment, Materials or Personnel Required: Not applicable

CONTACT	APPROVED SIGNATURE	DATE
Initiator:		
START Project Leader:		
EPA Task Monitor:		
EPA QA Officer:		

APPENDIX B
PHOTOGRAPHIC DOCUMENTATION

PHOTOGRAPH IDENTIFICATION SHEET

**Camera Type: Fuji Quicksnap Outdoor 35 mm Disposable Camera
(Rolls A, B, C, and E) and Kodak Max Flash Disposable Camera (Roll D)
Lens Type: NA**

TDD #: 02-01-0007

Site Name: Alder Gold and Copper Company

Photo No.	Date	Time	By	Dir.	Description
A-1	5/20/02	1120	JF	W	MW03 location with air rotary drill rig.
A-2	5/20/02	1130	JF	down	Subsurface soil sample 02214150 from MW03.
A-3	5/20/02	1555	JF	down	Subsurface soil sample 02214151 from MW04.
A-4	5/21/02	0730	JF	down	Subsurface soil sample 02214152 from SB04.
A-5	5/21/02	0742	JF	W	Drill rig at SB04 location.
A-6	5/21/02	0820	JF	down	Subsurface soil from SB04, 2.5 to 5 feet bgs.
A-7	5/21/02	0825	JF	down	Subsurface soil from SB04, 5 to 7.5 feet bgs
A-8	5/21/02	0840	JF	down	Subsurface soil from SB04, 7.5 to 10 feet bgs.
A-9	5/21/02	0850	JF	down	Subsurface soil sample 02214156 from SB04.
A-10	5/21/02	0855	JF	down	Subsurface soil from SB04 from 10 to 12.5 feet bgs.
A-11	5/21/02	1050	JF	down	Surface soil sample 02214158 from SB03.
A-12	5/21/02	1130	JF	down	Subsurface soil from SB03, 2.5 to 5 feet bgs.
A-13	5/21/02	1300	JF	NW	Drill rig at SB03 location.
A-14	5/22/02	1820	JF	E	Drill rig at MW02 location.
A-15	5/22/02	0805	JF	down	Surface soil sample 02214163 from SB02.
A-16	5/22/02	0840	JF	down	Subsurface soil sample 02214164 from SB02, 7.5 to 12.5 feet bgs.
A-17	5/22/02	0845	JF	down	Subsurface soil sample 02214165 from SB02, 7.5 to 12.5 feet bgs.
A-18	5/22/02	0915	JF	SE	Drill rig at SB02 location.
A-19	5/22/02	1035	JF	down	Surface soil sample 02214169 from SB01.
A-20	5/22/02	1600	JF	N	Development of well MW02.
A-21	5/23/02	1145	JF	down	Subsurface soil sample 02214176 from SB03.
A-22	5/23/02	1200	JF	down	Subsurface soil sample 02214175 from SB04.
B-1	5/20/02	1305	ML	down	Samples 02214201 and 02214202, collected at Tom White domestic well.
B-2	5/20/02	1310	ML	S	Tom White residence. Sample port at spigot in foreground.
B-3	-	-	-	-	Photo taken in error.
B-4	5/20/02	1515	ML	down	Sample 02214203, Keith Strickland well, at sample spigot, wood shed.
B-5	5/20/02	1516	ML	E	Sample 02214203, Keith Strickland well location. Strickland house in background, well head to left.
B-6	5/20/02	1527	ML	S	Strickland spring in hillside. Note plumbing trench running toward house in foreground.
B-7	5/20/02	1540	ML	SW	Sample 02214204, Strickland spring. Sample port at spigot.
B-8	5/21/02	1005	ML	down	Sample 02214205, Fran Johnson well, at sample spigot, side of house.
B-9	5/21/02	1105	MW	down	Sample 02214206, Ron Sutherland well.
B-10	5/21/02	1106	MW	NW	Sample location, 02214206.
B-11	5/21/02	1210	ML	down	Sample 02214207, Simmons well, at sample spigot.

PHOTOGRAPH IDENTIFICATION SHEET

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(Rolls A, B, C, and E) and Kodak Max Flash Disposable Camera (Roll D)
Lens Type: NA**

TDD #: 02-01-0007

Site Name: Alder Gold and Copper Company

Photo No.	Date	Time	By	Dir.	Description
B-12	5/21/02	1211	ML	N	Simmons residence and sample spigot.
B-13	5/21/02	1325	ML	down	Sample 02214208, Janice Johnson well, spigot below deck level.
B-14	5/21/025	1337	ML	W	Janice Johnson residence and wellhead (right).
B-15	5/21/02	1415	ML	down	Sample 02214209, well Helen Krinke well, sample location at spigot.
B-16	5/21/02	1416	ML	NW	Helen Krinke house.
B-17	5/21/02	1440	ML	S	Alexander well sample location. Wellhead in background.
B-18	5/21/02	1500	ML	down	Sample 02214210 at sample port, Alexander well.
B-19	5/21/02	1550	ML	down	Sample 02214211, Al McKinney well, at vault.
B-20	5/21/02	1551	ML	N	McKinney well (foreground) and sample spigot location (vault, background).
B-21	5/21/02	1635	ML	down	Sample 02214212, Echelbarger well, at sample spigot, side of house.
B-22	5/21/02	1636	ML	SE	Echelbarger well (foreground) and house with sample location.
B-23	5/21/02	1805	ML	down	Sample 02214213, Russell well, at spigot/wellhead.
B-24	5/21/02	1806	ML	E	Russell well and house.
B-25	5/22/02	0950	ML	SE	Sample 02214220 location, Jolley well.
B-26	5/22/02	1010	ML	down	Sample 02214220.
B-27	5/22/02	1130	ML	N	Sample 02214214 location, Town of Twisp well #3.
C-1	5/22/02	1135	ML	Down	Sample 02214214.
C-2	5/22/02	1245	ML	E	Sample 02214215 location, Ann Port community well, wellhouse.
C-3	5/22/02	1300	ML	Down	Sample 02214215.
C-4	5/22/02	1315	ML	W	Sample 02214216 location, Madison well.
C-5	5/22/02	1330	ML	DN	Sample 02214216.
C-6	5/22/02	1405	ML	SW	Sample 02214217 location, Dale Johnson well, wellhead and sample spigot.
C-7	5/22/02	1410	ML	Down	Sample 02214217.
C-8	5/22/02	1505	ML	W	Sample 02214218, Kominak well, residence in background.
C-9	5/22/02	1510	ML	Down	Sample 02214218.
C-10	5/22/02	1550	ML	E	Sample 02214219 location, Harvey well, residence in background.
C-11	5/22/02	1405	ML	Down	Sample 02214219.
C-12	5/22/02	1720	ML	E	Overview of mill area from 2,040 foot (estimated) knoll located northwest of mill. First of eight in panorama.
C-13	5/22/02	1720	ML	ESE	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Second of eight in panorama.
C-14	5/22/02	1720	ML	SSE	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Third of eight in panorama.
C-15	5/22/02	1720	ML	S	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Fourth of eight in panorama.

PHOTOGRAPH IDENTIFICATION SHEET

**Camera Type: Fuji Quicksnap Outdoor 35 mm Disposable Camera
(Rolls A, B, C, and E) and Kodak Max Flash Disposable Camera (Roll D)
Lens Type: NA**

TDD #: 02-01-0007

Site Name: Alder Gold and Copper Company

Photo No.	Date	Time	By	Dir.	Description
C-16	5/22/02	1720	ML	SSW	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Fifth of eight in panorama.
C-17	5/22/02	1720	ML	SW	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Sixth of eight in panorama.
C-18	5/22/02	1720	ML	SW	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Seventh of eight in panorama.
C-19	5/22/02	1720	ML	WSW	Overview of mill area from approximately 2,040 foot knoll located northwest of mill. Eighth of eight in panorama.
C-20	5/23/02	1150	ML	Down	Sample 02214224. Note: Sheet incorrectly states sample "02214225"
C-21	5/23/02	1155	ML	NW	Sample 02214224. Vein material, Twisp View Mine.
C-22	5/23/02	1315	ML	E	Shaft at Spokane Mine.
C-23	5/23/02	1320	ML	NE	Spokane Mine shaft (upper left) with pit (above shaft) and small waste rock piles (lower right).
C-24	5/23/02	1322	ML	NE	Spokane Mine adit (lower center) and pit/shaft area (upper right).
C-25	5/23/02	1325	ML	E	Spokane Mine waste dump at adit (out of photograph to the left). Kominak residence in the background.
C-26	5/23/02	1326	ML	Down	Sample 02214225. Waste rock from pile at adit, Spokane Mine.
C-27	5/23/02	1340	ML	N	Overview of Spokane Mine. Lower dumps (lower left), adit with collapsed wooden structures (adit just out of view, left center), and upper pits/shaft area (top center).
D-1	5/23/02	1415	ML	S	View of waste rock pile at location FR01 taken from waste rock pile located north of FR01, Floyd-Rattlesnake Mine.
D-2	5/23/02	1435	ML	S	Waste rock pile at location north of FR01.
D-3	5/23/02	1440	ML	W	Small adit and waste rock pile from FR01 location.
D-4	5/23/02	1442	ML	Down	Sample 02214226, collected at FR01.
D-5	5/23/02	1444	ML	S	Waste rock pile at FR02 location. Tom White residence in background
D-6	5/23/02	1445	ML	N	Waste rock pile at FR01 location from FR02 location.
D-7	5/23/02	1450	ML	Down	Sample 02214207.
D-8	5/23/02	1451	ML	S	Two small adits (approximately eight feet long to right, and fifteen feet long to left) at FR02 location, Floyd-Rattlesnake Mine.
D-9	5/23/02	1455	ML	N	Overview of FR02 and FR01 area.
D-10	5/23/02	1520	MW	down	Subsurface soil sample 02214228, TW01 location.
D-11	5/23/02	1521	MW	S	Location of sample 02214228 (bottom center), Tom White residence in background.
D-12	5/23/02	1540	ML	down	Sediment sample 02214229, at HK01 location near Krinke residence.
D-13	5/23/02	1630	MW	down	Samples 02214230 (surface water) and 02214231 (sediment) at IR02 sample location.
D-14	5/23/02	1750	ML	down	Samples 02214232 (surface water) and 02214233 (sediment), at IR03 location. Note: Photo not available due to camera malfunction.

PHOTOGRAPH IDENTIFICATION SHEET

**Camera Type: Fuji Quicksnap Outdoor 35 mm Disposable Camera
(Rolls A, B, C, and E) and Kodak Max Flash Disposable Camera (Roll D)
Lens Type: NA**

TDD #: 02-01-0007

Site Name: Alder Gold and Copper Company

Photo No.	Date	Time	By	Dir.	Description
D-15	5/23/02	1751	ML	N	IR03 sample location. Note: Photo not available due to camera malfunction.
E-1	5/23/02	1715	ML	E	Concentration tank in Mill building, sample 02214236 location. Note: Photo unavailable due to underexposure.
E-2	5/23/02	1725	ML	W	Location of surface soil sample 02214237 at MB02 location. Mill building in background.
E-3	5/23/02	1730	ML	down	Sample 02214236.
E-4	5/23/02	1732	ML	down	Sample 02214237.
E-5	5/24/02	1045	ML	down	Groundwater sample 02214238 at MW01 location. Note: sheet incorrectly indicates sample 02214237.
E-6	5/24/02	1135	ML	down	Groundwater sample 02214183 at MW01.
E-7	5/24/02	1140	ML	NW	MW02 location. Tailings impoundment dam in background.
E-8	5/24/02	1345	ML	N	View of portion of Floyd-Rattlesnake Mine area inspected on 5/23/02 (including locations FR02 and FR03), from hillside immediately above FR03 location.
E-9	5/24/02	1350	ML	N	Small pits near FR03 location, Floyd-Rattlesnake Mine area.
E-10	5/24/02	1415	ML	S	Adits at FR03 location. Fifteen foot adit (center) and eight foot spur (lower right). Note: Mineralized fault zone in wall above portal.
E-11	5/24/02	1420	ML	S	Small pit near FR03 location. Note: Mineralized zone and clipboard for scale.
E-12	5/24/02	1430	ML	down	Sample 02214239.
E-13	5/24/02	1450	ML	down	Sediment sample 02214240 at US01 location, dry streambed on unnamed intermittent stream.
E-14	5/24/02	1451	ML	S	US01 location, dry streambed.
E-15	5/24/02	1510	ML	E	Standing water and tailings at Upper Tailings Pond.
E-16	5/24/02	1525	ML	Down	Sediment sample 02214241 at location US02.
E-17	5/24/02	1526	ML	E	Sample 02214241 US02 location, on dry unnamed intermittent stream at location approximately 150 feet upstream of standing water pond at head of upper tailings pond.
E-18	5/24/02	1555	ML	S	Mill building with IDW drums and monitoring well MW03 (right).
E-19	5/24/02	1605	ML	S	Access road (foreground), monitoring well MW04 (left), Mill Pond (center) and mill building (right).

Key:

bgs = Below ground surface.
Dir. = Direction.
E = East.
ESE = East - southeast.
GPS = Global Positioning System.
IDW = Investigation-derived waste.
JF = Jeff Fowlow.
ML = Mark Longtine.
MW = Mark Woodke.
N = North.
NA = Not Applicable.

No. = Number.
NE = Northeast.
NW = Northwest.
S = South.
SE = Southeast.
SSE = South - southeast.
SSW = South - southwest.
SW = Southwest.
W = West.
WSW = West - southwest.

APPENDIX C
BOREHOLE LOGS

APPENDIX D
MONITORING WELL LOGS

APPENDIX E
GLOBAL POSITIONING SYSTEM DATA

APPENDIX F
DATA VALIDATION MEMORANDA AND ANALYTICAL RESULTS