Draft Final Work Plan for Remedial Investigation/Feasibility Study
Van Stone Mine
Stevens County, Washington

Prepared for
Washington State Department of Ecology
Toxics Cleanup Program

June 17, 2011
17330-31

HARTCROWSER

This page is intentionally left blank
for double-sided printing.

www.hartcrowser.com

HARTCROWSER

Draft Final Work Plan for Remedial Investigation/Feasibility Study Van Stone Mine Stevens County, Washington

Prepared for Washington State Department of Ecology Toxics Cleanup Program

June 17, 2011
17330-31

Prepared by
Hart Crowser, Inc.

Steve Hughes, LG, LHG
Senior Associate

Phil R. Cordell, GIT
Senior Staff

1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212
Fax 206.328.5581
Tel 206.324.9530

This page is intentionally left blank
for double-sided printing.

CONTENTS Page

CONTENTS (Continued)

Page

TABLES

FIGURES

DRAFT FINAL WORK PLAN FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY VAN STONE MINE

1.0 INTRODUCTION

The Van Stone Mine and Mill (Site) was a lead-zinc mine/mill located on the upper portion of Onion Creek near Northport, Washington. It is part of the Northport (Aladdin) mining district. Mining operations began in the 1930s. American Smelting and Refining Company (Asarco) initiated activities in 1951 and ceased operations in 1970. During those years, Asarco built and operated the 1000-ton-per-day floatation milling complex and mine infrastructure. After 1951, mining continued intermittently under various owners until being put on standby status in 1993 by Equinox Resources (Washington), Inc. (Equinox). The mine and surrounding features are shown on Figure 1.

The Washington State Department of Ecology (Ecology) added Van Stone Mine and Mill to its Confirmed and Suspected Contaminated Sites list on September 6, 2006. The Washington State Department of Ecology then completed a site hazard assessment (SHA) of the Van Stone Mine as required under the Model Toxics Control Act (MTCA). This site's hazard ranking, an estimation of the potential threat to human health and/or the environment relative to all other Washington state sites assessed at that time, was ranked as a 1 on a scale of 1 to 5 where 1 represents the highest relative risk and 5 the lowest. The results of the SHA were communicated by Ecology to Equinox in a February 7, 2007, letter. Ecology published the ranking of assessed/ranked sites, including the Van Stone Mine Site, in the February 21, 2007, Special Issue of the Site Register.

Ecology is exercising its cleanup authority on this Site under the MTCA, according to state law [RCW 70.105D]. Under a recent federal bankruptcy court-approved reorganization plan, the State of Washington has been awarded payment for environmental contamination caused by former Asarco sites in Washington, including the Van Stone Mine Site.

The current landowners of identified affected lands are:

1. Equinox Resources – Lower Tailings Pile, mill area, parts of the waste rock pile, and quarry lakes.
2. Vaagen Brothers – Upper Tailings Pile and a portion of the waste rock pile and West Pit Lake.

The named Potentially Liable Parties (PLPs) are:

1. Equinox Resources (Washington) Inc.
2. Sundown Holdings Ltd.
3. Vaagen Brothers Lumber Co. Inc.
4. Callahan Mining Corp.

Information used to develop this Work Plan was obtained from a December 15, 2010, review of Ecology's files for the Site, and a site visit conducted on April 27 and 28, 2011. During the document review, copies of various sources including federal, state, and local records, work conducted by Ecology & Environment, Inc., historical books and records, and title searches, site maps, state records, newspaper clippings, field data, and aerial photographs were obtained.

The historical reports, in PDF format, were reviewed to evaluate data collected and the results of laboratory analyses. Each document from Ecology was assigned a document control number (DCN). These documents are summarized in Appendix A. The site visit confirmed information obtained from the Ecology file review and current site conditions.

1.1 Site Overview

The Van Stone Mine Site is located in the Onion Creek watershed, 23 miles northeast of Colville, Washington in the Northport (Aladdin) mining district. The lead-zinc deposit covers about 1,400 acres in Sections 29, 30, and 33 of Township 38N, Range 40E. When mining at the Site stopped in 1993, the Department of Natural Resources (DNR) reported that approximately 328 acres of the area was "disturbed" (DCN #1020). The Site currently contains two open pit mines, overburden stockpiles, waste rock dumps, access and haul roads, and two tailings piles.

During mine operation, blasted rock was hauled by truck from the open pits to the rock house crusher plant, which then fed crushed rock on a conveyor to the mill. Waste rock was hauled by truck to waste rock dump areas near the open pits. The mill was a dual-circuit flotation system that produced 55 percent zinc concentrate and a 70 percent lead concentrate. The final ore concentrates were trucked off site for further processing.

Fine-grained tailings were initially conveyed to the Upper Tailings Pile and later to the Lower Tailings Pile through an 8-inch wood stave pipe. The wood stave pipe was replaced with a cement-asbestos pipe by Asarco. When mine operations restarted in the early 1990s, the cement-asbestos pipe was replaced with a black ABS continuous-weld pipe by Equinox to convey tailings from the thickener to the Lower Tailings Pile.

The Upper Tailings Pile was used until a berm failure in 1961. The Upper Tailings Pile currently covers about 9.5 acres and contains approximately 780,000 tons of tailings. After 1961, the Lower Tailings pile was constructed. It currently covers about 40 acres and contains approximately 1,820,000 tons of tailings.

The last period of mining operations at the Site was from 1991 to 1993, at which time operations ceased because of low zinc prices.

Equinox was issued surface mining reclamation permit #12667 on January 1, 1991, which covered reclamation on portions of the post-1971 waste rock dumps authorized by RCW 78.44 "Surface Mining Act." Since cessation of operations, Equinox has failed to meet the conditions stipulated in the reclamation permit. DNR issued a revised permit in 2001 and a DNR Notice of Corrective Action in 2000.

Post-mining reclamation has been underway since 1993, and most of the crushing and refining equipment has been removed from the Site. Sporadic reclamation activities have addressed small spills and dismantled the tailings pipeline that ran from the mill to the Lower Tailings Pile. Numerous structures still stand at the Site, but a complete list of Site features was not compiled following recent reclamation activities.

1.2 Purpose, Objectives and Scope of the RI/FS

Ecology is conducting this Remedial Investigation/Feasibility Study (RI/FS) to evaluate site cleanup requirements under applicable regulations. The RI/FS will comply with cleanup requirements administered by Ecology under the MTCA (WAC 173-3400-360 through 173-340-390).

The RI/FS will evaluate the potential environmental impacts from historical mining operations and the extent of ongoing releases of contaminants at the Site. Cleanup responses, presented as alternatives in the FS, will be evaluated to identify which response(s) are considered protective of human health and the environment.

The Sampling and Analysis Plan (SAP) in Appendix B addresses the data gaps identified during the review of historical site documents and discussions with Ecology. The varied history of mining at the Site makes it likely that data acquisition needed for completion of the RI/FS may require multiple phases of field work. Subsequent field work may include voluntary residential yard sampling or additional media sampling at the Site.

This RI/FS Work Plan is composed of several sections that address the components of the RI/FS study. Information that was gathered and evaluated to prepare for the RI/FS study follows:

Section 1 – Introduction. The introduction describes the Site setting and the purpose of the RI/FS.

Section 2 – Site Description. This section describes past mining operations, geology, and site characteristics. It discusses data usability, preliminary cleanup levels, and Applicable or Relevant and Appropriate Requirements (ARARs). It contains a preliminary conceptual site model, and identifies data gaps.

Section 3 – Remedial Investigation. This section outlines a Sampling and Analysis Plan (SAP) to collect additional environmental and geotechnical data to address data gaps and to evaluate the nature and extent of Site contamination and contaminant fate and transport. It discusses conducting a human health risk assessment and Terrestrial Ecological Evaluation (TEE), refining and finalizing the conceptual site model, and preparing the RI report.

Section 4 – Feasibility Study. This section evaluates the results of the RI to identify and screen for appropriate remedial technologies, and develops and describes cleanup action alternatives. It offers a detailed analysis of alternatives and compares alternatives to MTCA criteria.

Section 5 – Project Management and Project Scheduling. This section defines project team roles and responsibilities and outlines communication between the project team and Ecology. It outlines how issues will be tracked, working with the Ecology project manager to address and resolve issues and track project budgets. The RI/FS project manager will work internally with the Principal in Charge to establish that the quality assurance/quality control (QA/QC) on the project meets project quality standards and Ecology's requirements.

Completion of a RI/FS is, by nature, an iterative process. It is likely that, as new site information is obtained, the understanding of site conditions may be refined. Ecology may wish to add or modify the statement of work (SOW) based on the refined understanding of site conditions.

2.0 SITE DESCRIPTION, BACKGROUND, AND CONCEPTUAL SITE MODEL

The Onion Creek watershed is mostly undeveloped with the main resource designated as forest land (Figure 2). A limited number of residences are developed on private land parcels located along Onion Creek and its tributaries. Tribal Lands or Tribal cultural resource uses in the watershed were not identified in historical documents reviewed.

The watershed is fairly narrow and has a moderately steep topographic gradient, or about a 2,000-foot decrease in elevation from the open pits to the Lower Tailings Pile. The fairly steep elevation drop will likely have a controlling effect on the predominant wind direction, which is likely from east to west.

The Van Stone Mine is reached by traveling southeast on the Van Stone Mine Road from Stevens County Highway 9425 (Figure 1). About 0.5 miles southeast from the Highway 9425 turnoff, the first mine feature encountered is the Lower Tailings Pile, located adjacent to Van Stone Mine Road. Continuing about 2.7 miles southeast, the Van Stone open pits and waste rock piles mark the eastern extent of the mining operations.

The preliminary site boundary for the RI/FS encompasses the mine and surrounding area, which may be impacted by mining operations. The Site boundary currently does not include private residential properties or national forest land. However, site boundaries could change and include any public or private areas that may have been affected by mining activities once additional information is obtained.

For the RI/FS, the Site boundary is divided into five areas of interest (AOIs). Within the AOIs, impacted media may include surface water, groundwater, soil, and sediment. During the RI, the AOIs may be modified to better facilitate the evaluation of site conditions and the extent of contamination. The AOIs are described as:

- AOI-1: This AOI includes the geographic areas of the Site where open pits were developed, waste rock was dumped, ore rock was milled and processed, chemicals were stored, and facility and vehicle maintenance was performed.

- AOI-2: This AOI includes the area in which tailings conveyed from the Mill were deposited in a 27-acre Upper Tailings Pile. Tailings were deposited on the Upper Tailings Pile until 1961 when a tailings berm failed, releasing pond water and tailings in a westerly direction into Onion Creek. AOI-2 extends outward from the toe of the tailings pile in all directions to where tailings have been transported and deposited via erosion, wind, or berm failures. Between a Site visit on April 27 and 28, 2011, and a second Site visit on June 1, 2011, a portion of the Upper Tailings Pile failed releasing a mixture of pond water and tailings. This breach occurred at the same location as the 1961 breach. Brendan Dowling, the Ecology Project Manager, observed that substantial pond water had carried tailings downgradient and into Onion Creek.

- AOI-3: This AOI includes the Lower Tailings Pile and an adjacent water storage area. The area of the tailings pile is about 40 acres. The AOI includes soil outward from the toe of the tailings pile in all directions to where tailings have been transported and deposited via erosion, wind, or berm failures.

- AOI-4: This AOI includes the Tailings Conveyance Pipeline right-of-ways from the mill area to the Upper and Lower Tailings Piles. In addition, the AOI includes all roads that may have been used as part of mining operations to and from the mine/mill area to the tailings piles or pipeline right-of-ways. These roads would have likely been maintained during and after mining, and this maintenance could have involved the use of mine rock or tailings.

- AOI-5: This AOI includes Onion Creek and the Northeast and Southeast tributaries, and all other smaller tributaries to the Southeast Tributary that that flow past mine features. The AOI includes the floodplain of Onion Creek and tributaries where high precipitation events may have caused flooding and transport of site contaminants.

The following subsections present an overview of mining operations, the physical setting of the Site and surrounding area, and ecological resources.

Climate in the Onion Creek watershed varies from rain/snow to snow dominated (Equinox Closure and Reclamation Plan, DCN-1056). East of the Upper Tailings Pile, the precipitation zone is snow dominated, with about 30 inches of average annual precipitation. West of the Upper Tailings Pile or into the lower elevations of the watershed, the climate is rain/snow dominated, with about 25 inches of average annual precipitation. Records show that the Colville Airport Station, which is lower in elevation and likely to be warmer than the Van Stone Mine, has a maximum average temperature of 67.8 degrees Fahrenheit.

As part of a 1990 Tailings Disposal Design report, Equinox's consultant (Tailings Disposal Design Report 1990, DCN 1037) estimated precipitation for the Lower Tailings Pile disposal purposes as follows:

Month	Mean Precipitation Inches	100-Year Precipitation Inches
Jan	3.91	6.47
Feb	2.66	4.40
Mar	2.30	3.80
Apr	2.06	3.41
May	2.91	4.95
Jun	2.62	4.33
Jul	1.40	2.32
Aug	2.00	3.31
Sep	1.69	2.80
Oct	2.19	3.62
Nov	3.64	6.02
Dec	4.53	7.49
	Total 32.00	Total 52.93

Pan evaporation at the Site was estimated to be 37.59 inches per year based on records from the Spokane Station and the NOAA Atlas.

The design 24-hour precipitation, derived from isopluvial maps for Washington is as follows:

100 Year	3.5 inches
50 Year	2.9 inches
10 Year	2.4 inches
5 Year	2.2 inches
2 Year	1.8 inches

2.1 Mining Operations

The Van Stone Mine has a long history of development starting with discovery of zinc-lead-silver ore at the Site in 1920 by George Van Stone and Henry Maylor. Van Stone and Maylor started development of the Site and transferred ownership of the mine and facilities to various parties until 1993, when the mine was inactivated by the current owners. During the life of the mine, the periods of mine production, the workings developed, and the production quantity were:

- **Periods of production:** 1938–1942, 1952–1970, 1991–1993
- **Total workings developed:** Two open pits and several hundred feet of underground tunnels
- **Production Quantity:** 8.77 million tons combined ore and waste

2.1.1 Description of Mine Features

The Van Stone Mine is the largest open pit metal mine in Washington State. Mining operations and facilities are spread over a wide geographic area (Figure 1). Most mining activity took place in the eastern area of the Site. Mine features in the eastern area include mill building foundations and scattered intact structures, two open pits (now pit lakes), waste rock piles, a tailings thickener, an overburden stockpile, one tailings pile, and haul roads. The western area, topographically downgradient from the mill, contains a second tailings pile and water storage ponds. A pipeline alignment was developed and used to convey tailings from the mill to the western, or lower, tailings pond after the Upper Tailings Pile failed in 1961.

2.1.1.1 Eastern Area of Site

The eastern mine/mill area consists of a waste rock storage area, one tailings pile, two open pits, a seepage pond, buildings, and stained soil areas. Buildings and former buildings on the property include a processing plant, crushing plant, mill building, mill shop, warehouse, change house, assay office, garage, scale house, core storage, switch building, pit shop, a bunkhouse, and four residences. Equipment and former equipment at the Site includes a conveyor system, reagent and fuel storage areas, three very large water storage tanks, a fire system, wood stave tailings pipeline, power lines, and other shop and road equipment. Based on visual evidence of discarded material, it appears that wood stave pipes were used to convey tailings from the mill to both tailings piles. However, debris observed during the April 27 and 28, 2011, site visit indicates that open wood flumes may have been used to convey tailings to the Upper Tailings Pile, which is consistent with statements in the EPA Start II report (DCN-2002). Additional information about the use of pipelines and flumes to convey tailings will need to be collected and evaluated during the Remedial Investigation. The following subsection contains summary information about the mine site features.

2.1.1.2 Open Pits and Underground Workings

Two open pits were developed during mining operations at the Site. The largest open pit was initially mined by Asarco and later by Equinox. To be consistent with historical reports of the Site, the North Pit will be referred to as the North Pit and the West End Pit, even though it is one continuous feature. The second open pit is smaller and will be referred to as the South Pit. The West End Pit contains a pit lake which will be referred to as the West End Pit Lake. The South Pit contains a small shallow pit lake (which may be seasonal) and will be referred to as the South Pit Lake.

The North Pit high-wall excavation is 400 feet wide rim-to-rim and approximately 1,000 feet long. The pit walls show rock jointing which may indicate some structural weakness. Additional information will need to be obtained to evaluate pit wall stability.

The West End Pit is 700 feet long and 700 feet wide, including the pit walls. The West End Pit Lake is approximately 4.5 acres in area and 100 feet deep. Its static elevation is about 3,500 feet and contains an estimated 146 million gallons of water. It is dammed by a 30-foot-wide, rock-fill berm that allows water to seep into the adjacent unnamed tributary to the Southeast Tributary of Onion Creek (Beacon Hill 1999). During years of high snowfall, the spring runoff may create an overflow condition at the berm, (Lentz 2002). Lentz observed an estimated discharge over the berm of 20 gallons per minute (gpm) in May 2001 and estimated that drainage from the North Pit contributes 5 to 10 gpm to the West End Pit Lake each year.

A 1990 document produced by Equinox for their proposed Van Stone Mine project (DCN-1070) contains cross-sections of underground mine workings (tunnels) which were advanced into the middle dolomite unit of the Metaline limestone formation and extend approximately 75 feet below the current West End Pit Lake bottom, to elevation 3,325 feet. In addition, a SEPA Environmental Checklist prepared by Equinox (DCN 1059) stated that discharge from the mine during previous underground exploration was approximately 3 to 5 gallons per minute. Given the low estimate of seepage in the underground workings, fracture flow within the Metaline formation (a limestone-dolomite rock typically having a low permeability) is generally assumed to be low. However, higher groundwater flows may occur along faults mapped in the vicinity of the mine.

In 1990, Equinox prepared a document describing the startup of the mine activity and made reference to historical records indicating that underground workings were relatively dry with an estimated groundwater infiltration rate of 3 to 5 gallons per minute (DCN-1070, Appendix A). If this estimate is accurate, it may indicate that the potential for pit lake water (including the flooded underground mine workings) migrating downgradient through bedrock fractures to down-gradient is low. It does not, however, take into account fault zones in the vicinity of the North Pit. Domestic wells located south of the Lower Tailings Pile have variable yields, but in general indicate a wide range of variability in well yields near the site (Table 2).

The South Pit is smaller and located about 1,000 feet south of the West End Pit. The open pit has narrow openings at both ends and the maximum elevation difference from pit floor to pit rim is about 180 feet. Historical photographs of the pit walls do not indicate the structural instability as is evident in photographs of the North Pit. A small, shallow pit lake is present in the center of the pit floor. The pit lake is likely seasonal, resulting from spring snowmelt, seasonal precipitation and limited discharge from pit wall seepage.

2.1.1.3 Mill Facility

The mill facility has undergone modifications including demolition of portions of the mill buildings in recent years. Before finalizing the SAP in this Work Plan, a site visit was made to catalog and observe current conditions. We confirmed that most of the original equipment, as described in the EPA 2002 START contract, were removed.

> "The buildings on site include the process plant, crushing plant, mill building, mill shop, warehouse, change house, assay office, garage, scale house, core storage, switch building, pit shop, conveyor system, reagent and fuel storage areas, bunk house, and four residences. Other miscellaneous items include a 20 million gallon water tank, return water tank, power feeders, pump power line, T-6 tractor, car spotter, tailings pipe line, tailings flume, tailings dam, 60 million gallon water tank, 200 million gallon water tank, fire mains and hydrants, domestic water main, two pipe lines, three dams.
>
> Six areas of stained soil were noted in the mill area. These areas are depicted on Figure 6 in Appendix B. The first area was near a liquid propane tank south of the mill building. The second area was near elevated transformers adjacent to the mill building. At this location the soil was stained orange and green. The third area was near an aboveground storage tank (AST) with secondary containment near the entrance to the mine/mill. The containment area was filled with water and smelled of diesel. No sheen was noted. The secondary containment had been breached. The fourth area was on a concrete pad with staged transformers and stained soil south of the liquid propane tank. The fifth area was near staged 55-gallon drums surrounded by stained soil west of the mine/mill buildings and south of the Roundup Powder Company abandoned building. The sixth area was near another AST area surrounded by stained soil located east of the shed and staged 55-gallon drums."

2.1.1.4 Waste Rock Pile

Trucks hauled waste rock generated during mining from the North Pit to the waste rock storage area (Figure 1). The trucks dumped the waste rock from the edge of the open-pit haul road into the waste rock area. This method of dumping allowed the surface area of the waste rock dump to be expanded and extend the dumping area on the hillside. The waste rock pile covers about 50 acres. The eastern toe of the waste rock storage area is located less than 100 feet from the Southeast Tributary of Onion Creek. Slopes on the north side of the haul road consist, in part, of colluvial overburden. Currently, there are no estimates of the volume of overburden or the depth of the overburden pile.

2.1.1.5 Upper and Lower Tailings Piles

Mill tailings were discharged at two widely separated sites: Asarco (1952–1970) initiated use of the Upper Tailings Pile in 1952 and the Lower Tailings Pile in 1961. Equinox (1990–1993) replaced the original wood stave pipe with ABS pipe and discharged to the Lower Tailings Pile. The tailings at both locations are of the same composition as the dolomitic limestone host rock, ground to a minus 200 mesh (Huttl, 1953, Equinox, Notice of Construction DCN 1032). Based on review of historical documents, it does not appear that substantial efforts have been made by the current owners to permanently stabilize the tailings piles.

The Upper Tailings Pile covers about 9.5 acres (about 780,000 tons of tailings) and is located west of the West End Pit. After the Upper Tailings Pile pond dam failed in 1961, use of the Upper Tailings Pile stopped. Based on the April 27 and 28, 2011, site visit, there were two ponds observed on the Upper Tailings Pile. The pond liners present in these areas were in poor condition and did not appear competent to hold water without significant leakage. At the location where the 1961 Upper Tailings Pile failure occurred, seepage and continued erosion of tailings was observed about three feet below the top of the tailings pile. Overall, the slopes on the tailings pile appeared steep and eroded, likely caused by seasonal precipitation.

The Lower Tailings Pile covers approximately 37 acres (about 1,820,000 tons of tailings). An outfall channel in the northeast corner of the east basin allows meltwater collecting in the pond to escape. The channel bed is lined with fabric and some rock. The outfall invert, at elevation 2,698 feet above sea level (asl), was 4 feet above the pool height in October 2002. Both basins contain stands of bullrushes and grass covering about 10 percent of the total surface. Eight-inch cement-asbestos pipe and wood stave pipe from the Asarco era lie on the surface in various places. As part of the 1990 construction and renewed operation of the mine, Equinox replaced the wood stave tailings pipe with ABS pipe for conveyance of tailings to the Lower Tailings Pile (DNR Inactive Mines Report, DCN-2001). Stacks of black ABS flexible tailings line and 6-inch steel water-return line from the Equinox operations are also located at numerous points around the mill facility.

During the RI, locations along the tailings pipeline corridor where ABS pipe has been stockpiled or discarded will be inventoried and the condition of the pipe will be documented in photos. The information will be used to help identify if and where piping problems may have resulted in uncontrolled releases of tailings along the transmission corridor.

According to caretaker Randy Miller (written communication, 2003) all of the tailings produced by Equinox between 1991 and 1993 were discharged to the Lower Tailings Pile. The height of the Lower Tailings Pile pond berm varies from 30 feet at the northeast corner to 90 and 100 feet, respectively, on the south and west extremities. Two lifts are present, separated by a 30-foot-wide bench. The edges of the berm are rilled with holes, cracks, and gullies and water is piping in places. Piping may indicate that subsurface water is eroding soil, a condition that could result in failure of a berm or dam. A chain-link fence is intact on parts of the perimeter, but has collapsed at other points where the berm has slumped.

Equinox constructed an approximately 1-acre wastewater detention pond near the southeast corner of the Lower Tailings Pile. Randy Miller stated that it was never put in use. However, in submittals to restart operations in the 1990s, Equinox asserted that return of the waste water to the mill circuit would decrease the need for makeup water from the creek by 50 percent. Based on review of the historical documents, it is unclear whether the detention pond was used by Equinox. Currently, it is fenced and contains a small amount of standing water and thick algae. Sediment in the pond should be collected and analyzed for contaminant levels.

The tailings flume/line to the Lower Tailings Pile crosses the mine access road and continues cross-country on various easements and rights-of-way in a circuitous route north of the road (Figure 1).

2.1.1.6 Drums and Stains at the Mill

During the site inspection by EPA in 2002 (EPA START), their consultants observed six areas of stained soil usually associated with liquid propane or other petroleum storage tanks. When the Washington Department of Natural Resources (DNR) visited the Site in 2005 (Information Circular 100), they identified drums and tanks on the Site. If the contents were known, they were recorded and the estimated volumes noted in Appendix C of the DNR report. Appendix C identifies copper sulfate in various forms and at different locations on the Site, and storage of ammonium acetate, as well as several drums of solvents and acids.

2.1.2 Site Ownership, Legal description, and History

The Van Stone Mine site is located in Stevens County, Washington, approximately 23 Miles northeast of Colville off the Van Stone Road. The property is very large, covering several quarter sections in three townships and smaller portions of a fourth township. Mine properties are divided among 15 parcels, portions of which are owned by either Equinox or the Vaagen Brothers (Stevens County Assessor's web site).

The ownership portions of the Site are described as:

Equinox Resources

- Lower Tailings Pile
- Mill area
- Portions of waste rock pile
- Pit lakes

Vaagen Brothers Lumber Company Inc. (Vaagen Brothers)

- Upper Tailings Pile
- A portion of the waste rock piles
- West End Pit Lake

The specific location of the mine by Township and Range, and land parcels occupied is:

- Township 38 North, Range 40 East, Sections 28, 29, 30, 31, 32, and 33
- Latitude: 48° 45' 38" Longitude: 117° 45' 24"
- Ecology Facility Site ID Number: 5418085
- Parcel ID Numbers: 5037700, 5038401, 5039320, 5039302, 5041401, 5038410, 5038800, 5039550, 5041500, 5041600, 5041700, 5041750, 5041800, 5042150, 0433400

Additional information that provides some parcel descriptions and ownership information is available from vesting deeds (EPA, September 2003, DCN 1055).

2.1.2.1 Chronology of Historical Operations

The chronological history of Site activity including mine development, milling operations, and ownership changes was documented in the EPA Preliminary Potentially Responsible Party Search (EPA, September 2003, DCN 1055).

Portions of the search for historical operations and ownership changes are presented below. The information is presented as reported by EPA.

1920 - Ore body is discovered by George Van Stone and Henry Maylor.

1926 - Under an unrecorded property lease, Hecla Mining conducted limited exploration and delineation of the ore body. The Van Stone Mining Company subsequently signed a lease with an option to purchase a portion of the property.

1938 - Willow Creek Mines of Nevada purchased the property and retained ownership until 1942. During that time, they developed limited underground workings, mined the ore body, and shipped a small quantity of ore.

1944 - The Van Stone Mining Co. (or Van Stone Lead Silver Mining Co.) releases their option to purchase the property.

1945 - According to one source, US Bureau of Mines conducted diamond drilling at the Site. This information could not be confirmed with the Department of Interior.

1947 - On April 18, 1947, American Smelting & Refining Company (Asarco) received the following Water Right Permits:

- Water Right Permit 7398 for 0.40 cubic feet per second for mining, milling, and general camp use from the Southeast Fork of Onion Creek.
- Water Right Permit 5073 for 0.20 cubic feet per second for mining, milling, and general camp use from the Southeast Fork of Onion Creek.
- Water Right Permit 7397 for 0.20 cubic feet per second for mining, milling, and general camp use from the Northeast Fork of Onion Greek.
- Water Permit 7399 for 0.45 cubic feet per second for mining, milling, and general camp use from the Middle East Fork of Onion Creek.

1950 - Asarco Inc. bought the land and claims along with approximately 1,200 adjoining acres from Ernest Lotz and Louis Menegas.

1952 - Asarco Inc. operated the open-pit zinc mine and the mill 24 hours a day, 7 days a week under a government contract for the Defense Material Procurement Agency. Terms of the government contract are not known, but may have been extended for several years. P.A. Lewis was the general superintendent of the mine. They built a 1,000-ton concentrator at the mill. Isbell Construction of Reno, Nevada, conducted the stripping and mining operations for Asarco. Ore was trucked to Marble, Washington, where the zinc was shipped to Anaconda Copper Company's Black Eagle, Montana, smelter, and the lead was sent to Asarco's smelter in East Helena, Montana. On June 24, Asarco received the Water Right Permit No. 2531 for 75 gallons per minute, or 10 acre feet per year (Northeast Quarter 114 of Northeast Third, 113 Section 30).

1955 - The mill reported having sufficient ore on hand for processing to last several years. Superintendents at the mine during the 1950s and 1960s were Nolan Probst and Walter Barlow. The General Manager was Norman Visnes.

1957 - The mine was shut down due to low metal prices.

1961 - The west end of the Upper Tailings Pile pond failed, releasing a significant amount of water into Onion Creek, flooding the Clugstone Creek county road. A new tailings pond was constructed in the Northwest Quarter of Section 29 and the Northeast Quarter of Section 30. The mill discharge pipe was extended and routed around the upper pond and across country approximately 2 miles to the new tailings pond. Richard LeCaire, a former employee of the mine and a fisheries biologist for the Colville Confederated Tribes, indicated, "...it was not uncommon for the tailings slurry pipe to break and go unnoticed for an 8-hour shift." (The mine produced about 1,000 tons per 24-hour shift).

1965-66 - Asarco Inc. was producing at the mine during these years. In 1966, production was 820 tons of zinc per month.

I967 - Operations were shut down in May.

1969 - The mine was opened for part of the year by Asarco, Inc. under mine manager Al Kingman. A newspaper article (source not identified) indicated that 6,137 tons of zinc and 968 tons of lead were mined in 1970, according to the Asarco, Inc. annual report.

1970 - In April, Asarco, Inc. discovered a new ore body in the western extension of the North Pit. However, the open-pit operation was closed in the following winter. Herb Buffan worked as a contract miner for Asarco Inc. He became the powder foreman and then the pit foreman.

1971 - Department of Natural Resources research indicated that Asarco sold the property to Sumerian Mining Co. of Spokane (aka Atlas Mine and Mill Supply, aka Washington Resources LLC). Nandor Szombathy was president of Atlas Mine and Mill Supply. (While the title search did not confirm this purchase, a sale was identified in 1991 by this company to Equinox Resources [Washington] Inc.) On June 18, Callahan Mining Corporation of New York acquired the mill and mine property with mineral rights on 1,224 acres of property. Herb Buffan became general foreman at the mine/mill.

1975 - Callahan Mining Company with partners, US Borax and Chemical Corporation and British Newfoundland Exploration Ltd., began underground drifting (tunneling along a vein of ore) and diamond drilling at the mine. They drove a drift into the pit wall to explore the ore body on the west end of the North pit, along with some drilling.

1989 - The property was for sale by Callahan.

1990 - Callahan Mining Corporation and Equinox Resources Ltd. conducted feasibility studies to determine if the mine/mill could be reopened. On July 5, Equinox Resources (Wash.) Inc. purchased the mill and mine from Callahan Mining Corporation, Pacific Coast Mines, Inc., and Sharondale Corporation. On the same date, Equinox Resources (Wash.) Inc. signed a Deed of Trust with Ticor Title, which stated that Cominco Ltd. was the beneficiary of the Deed of Trust. The purpose of the Deed of Trust was to secure an agreement where $506,250 was loaned to Equinox with the agreement that further funds could be loaned in the future by Cominco Ltd.

1991- Equinox reactivated the open pit mine and concentrator, filing a preliminary Reclamation and Closure Plan with DNR before reopening the operation. They were issued permit No. 12667 on January 1. On April 5, Atlas Mine and Mill Supply and Nandor Szombathy quitclaimed the property to Equinox Resources (Wash.), Inc. An article in an April edition of the Statesman-Examiner indicated that ore would be shipped to Trail, British Columbia for processing. In August, Equinox received two promissory notes and secured them with a Security Agreement. One was from Equinox Resources Ltd. for $430,000 and the second was from Biscay Ltd. for $181,000. The Security Agreement contained provisions that specific earlier deeds and agreements would be paid before this agreement was satisfied. These included security agreements with Cominco Ltd. and Cominco American Ltd.

The Equinox Resources Ltd. 1990 Annual Report indicated that concentrates would be smelted at Cominco's Trail Smelter at an annual rate of 34,000 tons of zinc concentrate and 5,400 tons of lead concentrate. The mine was shut down in October and reopened in August 1992.

1992 - The mine reopened in June or August (according to differing reports). Ore would be shipped to Cominco in Trail, BC for processing. Ross Beaty was the contact at Equinox Resources (Wash.) Inc. In June 1992, Cominco reconvened the earlier Deed of Trust back to Equinox Resources Inc.

1993 - In January, the operation closed down due to low zinc prices. The surface mine reclamation permit covers part of post-1991 rock dumps and was bonded for $95,000. The tailings and mill site were partially bonded by the Department of Ecology for $245,000.

1998 - In June, Washington State Department of Ecology's Dam Safety Office (DSO) documented the failure of the Lower Tailings Pile pond membrane liner. The liner failure allowed seepage that threatened the stability of the dike around the pond, which was constructed of tailings material. In December, Ecology issued a State Waste Discharge Permit No. 5287 to reduce the level of water in the tailings pond to 2 feet below the failure point in the liner. The water from the pond was applied to nearby fields using a sprinkler. This permit expired on June 30, 2003. The permit also required final closure of the tailings pond.

2003 - Mano River Resources, Inc., parent company of Equinox Resources (Wash.) Inc., had the property for sale. Equinox failed to meet the requirements of their reclamation permit.

2.1.2.2 Land Use, Zoning, and Property Boundaries

A number of parcels are zoned single family residential near Onion Creek and north of the lower tailings pond. The remainder of the surrounding land is primarily designated forest land. Parcel numbers and locations are shown on Figure 2 and parcel information for properties adjacent to the Site is presented in Table 1.

Forest lands are the most extensive resource category designated on the Stevens County Future Land Use Map and comprise 42 percent of the county's total land area. Forest land designation includes privately owned, Department of Natural Resources, and the US Forest Service lands. Under RCW 84.33085 the definition of forest land is:

"Forest land" is synonymous with "designated forest land" and means any parcel of land that is twenty or more acres or multiple parcels of land that are contiguous and total twenty or more acres that is or are devoted primarily to growing and harvesting timber. Designated forest land means the land only and does not include a residential homesite. The term includes land used for incidental uses that are compatible with the growing and harvesting of timber but no more than ten percent of the land may be used for such incidental uses. It also includes the land on which appurtenances necessary for the production, preparation, or sale of the timber products exist in conjunction with land producing these products.[1]

Except for residential parcels shown on Figure 2, future land use outside of the existing mine development appears limited to some residential development and forest lands. During the RI, land use activities will be updated as more information is gained from surveys of the local residents.

2.1.3 Surface Topography, Surface and Subsurface Structures, Utility Lines, and Other Pertinent Features

The Site is located east of Onion Creek. The topography is characterized by ridges and valleys incised by tributaries to Onion Creek.

2.1.4 Site Reconnaissance

On April 27 and April 28, 2011, Hart Crowser staff and the Washington State Department of Ecology Project Manager visited the Van Stone Mine site to observe current conditions. The following summarizes the conditions observed during the site visit.

2.1.4.1 Site Facilities and Open Pits

Historical documents indicated that the majority of the milling and support equipment had been removed from the Site. This was confirmed by the Site visit as summarized by the following general observations.

Crushing, grinding, and milling equipment had been removed from the Site. Concrete foundations and walls were left in place. In several areas, water from snowmelt was draining across the concrete foundations. The melt water appeared clear but sampling and testing will be required to determine water quality.

Offices and storage building were present and did contain miscellaneous small supplies. Some of these buildings appear to have electrical service but were locked and could not be inspected. Two core shacks that were observed

---

[1] The definition of forest lands excerpted from the Revised Code of Washington, RCW 84.033.035: Definitions.

contained large volumes of full core boxes. Five large storage tanks along with 12, 55-gallon drums were located in front of a building that appeared to have been used for equipment maintenance. The large tanks appeared to be empty, but the contents of the 55-gallon drums were unknown.

The thickening unit and associated equipment had been removed from the Site. The area was graded and several small trees planted as part of Site restoration. A graded area was used for storing miscellaneous material including piping, toilets, and small machinery parts.

The North Pit and West Pit Lake was observed from the west pit wall. The pit walls are steep and the loose material on pit high walls makes physical access on the pit benches dangerous. The earthen dam containing discharge from the West Pit Lake has only sparse vegetation. An unlined drainage ditch allows discharge from the pit lake. The drainage ditch appeared to be undercutting the exit point on the dam at the time of our observations in the Spring of 2011. The pit lake level was estimated to be about 4 feet below the top of the earthen dam. The South Pit was not accessible because of snow cover.

Waste rock was as shown on historical maps. The waste rock covers a considerable area around the open pit and varies in size from gravelly material to boulders.

Overall, the conditions observed reflected historical documents reviewed before the Site visit.

2.1.5 Site Geology and Ore Mineralization

The Van Stone Mine is located near the contact of the Cambrian age Metaline Limestone and the Spirit pluton, a granite unit of Mesozoic age. Unconsolidated glacial sediments consisting of till, outwash, and lacustrine soils overlie approximately 50 percent of the mine and surrounding area. Bedrock includes folded, faulted Paleozoic sedimentary and metasedimentary rock on side slopes and ridges of foothills, and Mesozoic granitic rock on foot slopes and side slopes of foothills.

The Metaline Limestone is the principal host for lead-zinc mineralization in northeastern Washington. Yates and others (1964) placed the Van Stone mineralization in the Middle Unit, which is principally dolomite.

The limestone is described as a hard, crystalline dolomitic limestone with sizeable open and healed fractures. Brecciated dolomite containing steaks, pods, and elongated tubular masses of sphalerite and galena distinguish the high-grade from the low grade-grade ore, where the sulfide mineralization is found in small steaks and lenticels. The mineralization was discontinuous and created a problem for the small-scale mining operation (Mills, 1977).

The open pits at the Site are located in an area where soils are of variable thickness overlying Paleozoic metasedimentary rocks. A small amount of glacial overburden was removed to expose the ore deposits, but most of the overburden consisted of dolmitic limestone. The Spirit granite is not exposed at the tailings piles; a weathered zone of residual soils and/or colluvial material and glacial outwash cover the granite in these areas.

2.1.6 Hydrology and Hydrogeology

Climate in the Onion Creek watershed is transitional between maritime and continental with mean annual precipitation ranging from 15 to 35 inches per year. The Van Stone Mine is located in the headwater sub-basin, where annual rainfall averages 30 inches per year. The 24-hour precipitation in the headwater sub-basin ranges from 1.8 inches over a 2-year return period to 3.1 inches over a 100-year return period (Boise Cascade Corporation 1997).

The Onion Creek watershed has a catchment area of 47,360 acres, drains in a northwesterly direction and discharges to the Columbia River near the community of Onion Creek on Highway 25. The elevation of the watershed ranges from 5,775 feet above sea level (asl) in the headwaters to 1,290 feet asl at the confluence with the Columbia River. Flood frequency analyses for each of the Onion Creek sub-basins (Boise Cascade Corp. 1997) indicates that the 2-, 25-, 50-, and 100-year return flood flows in Onion Creek immediately below the Van Stone Lower Tailings Pile range from 87 cubic feet per second (cfs), 206 cfs, 234 cfs, and 262 cfs, respectively.

There are no public water supplies in the watershed. However, the EPA Start II report (DCN-1047) indicates that there are approximately nine residences using surface water from Onion Creek as a source of drinking water within the 15-mile target distance limit and west of County 9475. Within the general area of the Site, there are 20 wells listed in Ecology's water supply database (Table 2). The Onion Creek School obtains its potable water supply from a well. One spring reportedly exists on the east side of Onion Creek near the Schoolhouse.

2.1.6.1 Creeks

The Onion Creek watershed is characterized by steep topography and a series of ridges and valleys. Onion Creek has been categorized by Ecology as a Class AA (extraordinary) surface water body.

The primary Onion Creek stream channel is located west of the Lower Tailings Pile and generally trends in a north-south, to northwest-southeast direction (Figure 1). As shown on Figure 1, a schoolhouse is located about 3,000 feet northwest of the Lower Tailings Pile on the north side of Onion Creek. About 1,500 feet upstream from the schoolhouse, Onion Creek is joined by a tributary, referred to as the Northeast (NE) Tributary. The northeast tributary trends in an east-west direction. The Lower Tailings Pile is located on the south side of and adjacent to the northeast tributary.

About 6,000 feet upstream of the schoolhouse, a second tributary, referred to as the Southeast Tributary, joins Onion Creek. The tributary trends generally in an east-west direction and the Upper Tailings Pile, open pits and mine buildings are located on the south side of the tributary. Two smaller tributaries branch off of the Southeast Tributary and bound the Upper Tailings Pile, mine building, and open pits. A third unnamed tributary is located between the West End Pit and the Upper Tailings Pile.

2.1.6.2 Hydrogeology

Groundwater in the Van Stone Mine area appears generally discontinuous, occurring generally along the soil/bedrock contact or in fractured zones of metamorphic and granitic rocks. The discontinuous nature of groundwater at the Site is observed in many of the borings. Limited Equinox data on monitoring wells indicate that monitoring well W-2, located just south of the Lower Tailings Pile, was dry when completed in December 1989 (Equinox Resources, DCN 2017). The well did not intercept water at the soil/bedrock contact or in bedrock fractures. Monitoring well W-1, located just north of the Lower Tailings Pile, intercepted shallow groundwater and was sampled. A review of the driller's logs from the Equinox report indicated that W-1 intercepted granite at a depth of 50 feet and W-2 at a depth of 14 feet.

In addition to the monitoring wells, the Equinox report presents logs of several geotechnical borings that were advanced on and around the Lower Tailings Pile. A review of the geotechnical borings shows that west of the Lower Tailings Pile pond the alluvial material is deeper than on the south side of the Lower Tailings Pile. Groundwater was encountered in the geotechnical boring west and south of the Lower Tailings Pile. This information may indicate an area of the Site where there is a thickening of the alluvial material below and west of the Lower Tailings Pile. The presence of groundwater in the alluvium could be a potential pathway for COC migration and will need to be evaluated in this area of the Site.

2.1.6.3 Domestic Water Supply Wells

Ecology's well database identifies 20 wells within a 1-mile radius of the Site, 18 of which are identified as domestic wells. Locations from Ecology are shown on Figure 1 and Table 2 provides detailed information on the wells.

Wells in the vicinity of the Site are screened in the continental glacial drift, weathered granite, or fractured granite that underlies much of the Site and surrounding area. Drilling logs indicate continental glacial drift depths ranging from 1 to 83 feet below ground surface (bgs), weathered granite from 1 to 100 feet bgs, and granite between 8 and 600 feet bgs. Deep wells set in the granite rely on fracture flow. Pumping rates for wells screened within the unweathered granite are estimated at 1.5 to 30 gpm. Pumping rates in wells completed in the glacial drift and weathered granite were estimated to be between 2 and 5 gpm.

2.1.7 Ecological Resources

The following subsections summarize ecological resources on the Site from historical reports. This information, along with past and current land use activities will be updated as more information is obtained from surveys of the local residents.

2.1.7.1 Forest Cover, Vegetation, and Wildlife

Lower elevation forest cover consists mostly of western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and some Englemann spruce (*Picea engelmannii*). Riparian vegetation consists of small to medium mixed conifer stands ranging from sparse to dense growths. Canopy closure generally ranges from 90 to 100 percent. Higher elevation forest cover consists of Douglas fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), western larch (*Larix occidentalis*), lodgepole pine (*Pinus contorta*), and Englemann spruce (*Picea engelmannii*). Deciduous species include trembling aspen (*Populus tremuloides*), paper birch (*Betula papyrifera* var. *commutata*), and sitka alder (*Alnus sinuata*). About 1.8 linear miles of wetland frontage along Onion Creek support sparse fir, larch, willows, and grass.

Deer, elk, and bear have been observed on the Site, as well as lark sparrows feeding on seeds. Breeding pairs of mallards, goldeneyes, buffleheads, and hooded mergansers were noted during past investigations of the Lower Tailings Pile pond area. Bald eagle habitat has been observed on the Columbia River/Lake Roosevelt within a 15-mile radius of Van Stone Mine on various dates, according to the Washington State Department of Fish and Wildlife.

2.1.7.2 Fish

The falls near the mouth of Onion Creek form a migration barrier to fish entering the upper portion of the watershed from the Columbia River. Salmonid species that have been observed in small numbers in the lower mile of Onion Creek below the falls include adfluvial kokanee (*Oncorhynchus nerka*), bull trout (*Salvelinus confluentus*), and cutthroat trout (*Oncorhynchus clarkii*). Bull trout do not occur above the falls.

Other than the falls at the mouth of Onion Creek, there are no other physical barriers to fish migration. Brook trout and rainbow trout use the entire network of tributaries above the falls throughout all life stages and do not segregate into specific areas (Boise Cascade Corp. 1997, DCN 2006). There are two potential road barriers (culverts) on the northeast and southeast tributaries of Onion Creek located:

- Below the Lower Tailings Pile where the northeast tributary crosses under the main Onion Creek road, and

- About a mile southeast of the Lower Tailings Pile on Onion Creek Road at the intersection with a logging road.

However, neither of these culverts has been confirmed to preclude fish from the creeks adjacent to mine site areas (Boise Cascade Corp. 1997).

The northeast tributary of Onion Creek in the mine site area is categorized as a confirmed fish-bearing Type 3 Stream for the majority of its length, although fish have not been confirmed in the upper reaches of the northeast and southeast tributaries.

2.1.7.3 Pit Lakes

In the West End Pit Lake, a considerable growth of aquatic plants in the gently sloping littoral area near the lakeshore was observed (Lentz 2002). Lentz also reported that the plant had been identified as *Veronica anagallis-aquatica* and stated that it is, "ubiquitous around the entire shoreline, even occupying steep rocky slopes of the lakebed." A species of Rana frog has also been spotted in the West End Pit Lake (verbal communication with Brendan Dowling, Washington State Department of Ecology, 2011). A diverse benthic macroinvertebrate group identified by Marc Hayes (DNR Information Circular 100, 2005, DCN 2001) included caddisflies, segmented worms, stoneflies, and true bugs (Homoptera).

In 2001, Rodney Lentz conducted a study of limnology and geochemistry of two pit lakes, including the West End Pit Lake at the Van Stone Mine. While water quality was fair and the West End Pit Lake supported a macroinvertebrate community, Mr. Lentz did not identify the presence of a fish population. If a fish population is present in the pit lake, it is likely a planted species given that the migration of fish from the Onion Creek system is blocked by a very steep topographic gradient from the pit lake dam discharge point to the creek.

In the South Pit Lake, no plant or aquatic life has been reported.

2.1.7.4 Tailings Piles and Waste Rock Piles

Grasses and lodgepole pine seedlings are reported near the Upper Tailings Pile pond, small cottonwoods to 3 feet tall are common, and inland cedar saplings are present but sparse. In addition, both basins contained stands of bullrushes and grass covering about 10 percent of the total surface. Although there is very little standing or open water or wetland habitat in the area, the Van Stone property provides habitat for a large number of paserines, some waterfowl, upland game birds such as grouse, owls, and representatives of the raptor family (hawks, eagles). Many of the species that frequent the area are migratory or transitory (Equinox, Reclamation and Closure Plan, 1999, DCN-2094). Breeding pairs of mallards, goldeneyes, buffleheads, and hooded mergansers on the impounded water surface in both ponds on the Lower Tailings Pile were observed by DNR in their study (DRN, 2005, DCN-2001).

The waste rock dumps are reported to be mostly barren of vegetation with only an occasional shrub or tree observed.

2.2 Summary of Releases and Remedial Actions at the Site

A West End Pit Lake was constructed using a mixture of rock blasting debris mixed with local soil. In addition, two prominent tailings piles with associated tailings ponds were constructed on the Site, the Upper Tailings Pile, and the Lower Tailings Pile. The following sections summarize the problems identified with each of the structures.

2.2.1 West End Pit (Pit Lake Dam)

The tailings dam at the West End Pit, located immediately downstream of the West End Pit Lake, was likely constructed as a temporary road. The road functions as a dam by blocking the discharge from the West End Pit Lake into an unnamed tributary to the Southeast Tributary of Onion Creek. During years of high snowfall, spring runoff may create an overflow condition at the dam. The

West End Pit Lake is within Ecology's Dam Safety Office (DSO) jurisdictional threshold of 10 acre-feet. Based on Ecology's June 11, 2010 inspection, the DSO issued a letter, Notice of Correction Docket #7904, informing Equinox that the tailings dam is now regulated and must comply with state dam safety rules and regulations (DCN-1002). The DSO classified the dam as a Significant Downstream Hazard, Hazard Class 2. To date, there have not been documented corrective actions.

2.2.2 Upper Tailings Pile (West and East Basins)

In April 1961, the tailings dam at the western end of the west basin of the Upper Tailings Pile failed, sending water down an unnamed tributary into the Southeast Tributary, and then into Onion Creek which flooded downstream past the Onion Creek schoolhouse (DNR Information Circular 100, 2005, DCN 2001). The flood widened Onion Creek by 20 to 30 feet and created a debris dam that plugged a culvert at the county road and eventually failed. Little evidence of erosion or rilling downslope from the breech was reported. The channel supports a vigorous stand of pine and fir.

Soon after the dam failure, tailings disposal in the Upper Tailings Pile was abandoned by Asarco in favor of a larger 40-acre site located in sections 29 and 30, approximately 2 miles to the northwest. The new disposal area was known as the Lower Tailings Pile. Currently, some revegetation has taken place on the Upper Tailings Pile west basin.

Between an Ecology Site Visit on April 28-28, 2011 and a second Ecology Site visit on June 1, 2011, a portion of the Upper Tailings Pile failed releasing a mixture of pond water and tailings. This breach occurred at the same location of the 1961 breach. Brendan Dowling, the Ecology Project Manager observed that substantial pond water had carried tailings downgradient and into Onion Creek.

2.2.3 Lower Tailings Pile (Pond Dam)

The Upper Tailings Pile failure in 1961 resulted in construction of the larger Lower Tailings Pile. After 1961, tailings were conveyed to the Lower Tailings Pile through a wood stave pipe extension from the Upper Tailings Pile (DNR Information Circular 100, 2005, DCN 2001). In 1991, as part of a Phase II remedial action, Equinox installed a 30-millimeter PVC geomembrane liner in the east and west basins on the Lower Tailings Pile. Between 1991 and 1993, Equinox conducted routine quality control inspections of the basins and the liner system.

In early 1995, snowmelt runoff caused a Lower Tailings Pile embankment breach at Discharge No. 1. This resulted in considerable erosion and transport of tailings into the northeast tributary of Onion Creek. Equinox temporarily stabilized the embankment by placing approximately 1,500 cubic yards of rock-fill from nearby mine waste dumps. Surface water runoff also occurred at Discharge No. 2 causing erosion of the embankment. Later in 1995, Equinox conducted a more comprehensive inspection of the Lower Tailings Pile to evaluate the erosion of the tailings dam, inspect the PVC geomembrane liner, and determine additional actions needed to minimize erosion of the embankment and transport of tailings to Onion Creek.

The Dam Safety Office inspected the Lower Tailings Pile on March 25, 2008, and identified deficiencies with the east basin. The principal deficiency was determined to be the failure of the PVC geomembrane liner. Deficiencies included sections with complete absence of PVC liner and sections of exposed PVC liner with cracks and apparent wind damage. At that time, the DSO determined that the deficiencies could lead to two possible failure modes on the Lower Tailings Pile, which included piping failures or severe erosion and overtopping of the dam. Based on the available historical documents reviewed, final remedial corrective actions have not been undertaken to address the deficiencies.

2.2.4 Upgrade of Tailings Conveyance Piping from 1991-1993 Mining Operations

In 1991, Equinox installed an 8-inch ABS tailings discharge line from the Upper Tailings Pile to the Lower Tailings Pile to convey tailings slurry from milling operations to the Lower Tailings Pile. This line can be observed emerging from the forest near the south end of the berm separating the two basins on the Upper Tailings Pile. To date, there have not been documented failures or corrective actions to the 8-inch ABS tailings discharge line.

2.3 Data Usability, Preliminary Cleanup Levels, and Potential ARARs

The initial evaluation of historical chemical and physical site data and potential Applicable, or Relevant and Appropriate Requirements (ARARs) are presented in this section.

2.3.1 Review of Historical Reports and Data Usability

Historical reports in PDF format were obtained during a review of Ecology files on December 15, 2010, and were reviewed to evaluate data collected and the results of laboratory analyses. Each document from Ecology was assigned a document control number (DCN). When an Ecology PDF contained multiple documents, the documents were separated and assigned individual DCN numbers. The DCN numbering facilitated clear references to the documents during work on the project. Table 3 lists the documents reviewed, assigns DCNs, and summarizes the laboratory data included in each of the documents. These documents are further summarized in Appendix A.

Based on the review of historical reports, most of the laboratory data was found to be of limited use for the Van Stone RI/FS. Table 3 summarizes historical reports reviewed in preparation of the work plan and identifies which reports contain laboratory data and for each report, the types of analytical data included. Table 8 presents summary statistics of the historic data compiled in Tables 9 through 13, which present the historic analytical data for groundwater, surface water, sediment, and soil. All historic data provided by Ecology is included with the exception of surface water data collected by Equinox in the early 1990s. This data was not included because 1) much of the data were below detection limits, which were typically higher in older data, and 2) the sampling points were a limited number of surface water locations. Including this data would not add additional information useful in developing the work plan.

Data usability is typically lower when using older data sets. The length of time since data collection typically results in:

- Limited availability of laboratory QA;
- Detection limits too high for comparison to current cleanup levels; and
- Difficulty correcting errors observed in the data sets, especially surface water data.

As shown on Table 8, at many sample locations in Onion Creek the frequency of detection (a concentration reported above the laboratory detection limit) is low but the number of reported values exceeding the lowest potential ARAR for a COC is high. For example, in Table 8, sample 1SW shows that the results for three of 21 sample analyses for arsenic were above the detection limit. However, because the reported detection limit is greater than the lowest potential ARAR, the number of sample results for arsenic exceeding the lowest potential ARAR arsenic concentration is 17. Given the high detection limit, it would be difficult to assume that the sample does not exceed the lowest potential ARAR concentration.

A portion of the historical data determined usable was compiled and compared to the lowest potential ARARs. The exceedances of the lowest potential ARAR for arsenic (surface water only), cadmium, lead, and zinc are presented for soil, surface water and sediment on Figures 3, 4, and 5, respectively. These three metals were used because lead and zinc are the economic metals mined while cadmium and arsenic while not considered of economic value may be concentrated in wastes such as tailings during the milling process. These four metals were used in the work plan as preliminary indicator metals for Site contamination to help guide RI sampling areas.

The high detection levels are a major concern in using the data. Overall, as shown in Tables 8 through 13, much of the data are marginal in use for evaluating Site risks. In limited cases, such as the sediment data where non-detects are less an issue, there are a very limited number of sampling locations. For the work plan, the lowest potential ARAR concentration is used for comparison to COCs. ARARs will be refined during the RI, which may allow some additional use of the historic data.

2.3.2 Chemicals of Concern (COCs) and Preliminary Cleanup Levels

As defined in WAC 173-340-700, a "cleanup level" is the concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions. Establishing cleanup levels may also take into account background concentrations in cases where the natural background is greater than the concentration of the hazardous substance. Ecology's approach to establishing cleanup levels typically involves three steps for each constituent of concern: (1) establishing terrestrial ecological risk-based levels; (2) establishing human health risk-based levels; and (3) establishing background levels.

Groundwater and surface water cleanup levels are based on estimates of highest beneficial use and the reasonable maximum exposure expected to occur under current and potential future site use conditions [WAC 173-340-720]. The location of groundwater wells and use of groundwater as a source of residential drinking water in the watershed is the likely highest beneficial use and represents the reasonable maximum exposure. Cleanup levels for surface water are established by the classification and highest beneficial use of surface water in accordance with chapter 173-201A WAC.

In preparing this RI/FS Work Plan, preliminary cleanup levels were compiled from multiple sources. The preliminary cleanup levels for groundwater, surface water, sediment, and soil are presented on Tables 4, 5, 6, and 7, respectively. Currently, there are no promulgated cleanup levels for sediment. Table 6 presents sediment values based on various sources, but cleanup levels will be evaluated and selected based on information provided by the Terrestrial Ecological Evaluation (TEE). For screening purposes in the work plan, only the lowest ARAR value was used. While these are the most conservative numbers, their use is appropriate to develop potential areas of the Site with potential data gaps.

2.3.3 Summary of Potential Applicable or Relevant and Appropriate Requirements (ARARs)

Potential Applicable or Relevant and Appropriate Requirements (ARARs) include water quality standards, waste disposal standards, air quality standards, and mined land reclamation standards. Other federal or state advisories, criteria, or guidance may be identified for a particular release or removal action on the Site. For the Van Stone Mine RI/FS, Ecology has indicated that future use of the Site will be considered unrestricted land use and MTCA Method B will be used to establish cleanup levels protective of human health and the environment.

The state is exercising its independent cleanup authority for this Site under the Model Toxics Control Act (MTCA) [RCW 70.105D]. MTCA sets forth various ways to determine the numeric values for ARARs (i.e., cleanup levels) for surface water, groundwater, and soil. This includes using tables with cleanup standards for sites that have few hazardous substances and meet specified criteria in Washington Administrative Code (WAC) 173-340-704, and methods for addressing multiple contaminants and pathways for sites that meet other specified criteria [WAC 173-340-705, -706, and -708].

ARARs are typically selected following identification of remedial action objectives. This section presents ARARs and other guidance identified for consideration in the RI/FS for the Van Stone Mine.

ARARs fall into three broad categories, based on the manner in which they are applied: chemical-, action-, and location-specific. Cleanup levels are based on the most stringent potential ARAR, where more than one potential ARAR exists. In general, only the substantive requirements of an ARAR need to be implemented at the Site.

- Chemical-specific ARARs regulate the release to, or presence in the environment of materials with certain chemical or physical characteristics, or containing specified chemical compounds. The requirements are usually either health- or risk-based numerical values or methodologies that establish the acceptable amount or concentration of a chemical that may remain in or be discharged to the environment.

- Action-specific ARARs set performance, design, or similar controls or restrictions on particular kinds of activities related to the management of hazardous substances, pollutants, or contaminants. The ARARs are activated by the particular remedial action that is selected for implementation, and indicate how or to what level the alternative must achieve the requirements.

- Location-specific ARARs are restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. They relate to the geographic or physical position of the Site. Remedial actions may be restricted or precluded depending on the location or characteristics of the Site and the requirements that apply to it. Location-specific ARARs may apply to actions in natural or manmade features. Examples of natural site features include wetlands and floodplains. An example of a manmade feature is an archaeological site.

Table 14 presents the potential ARARs identified for the Van Stone Mine Site. This list will be evaluated and refined as the RI/FS develops and more information is available for the Site.

2.4 Conceptual Site Model

A preliminary conceptual site model was developed to provide an initial understanding of potential site contamination and help formulate an approach to conducting the Remedial Investigation (Figure 6). The preliminary CSM and preliminary cleanup levels provide guidance for identifying the data gaps that are addressed in the Sampling and Analysis Plan (SAP) (Appendix B).

2.4.1 Conceptual Site Model

The conceptual site model (CSM) for the RI/FS was developed to convey: (1) a summary of the sources of contamination; (2) mechanisms of contaminant release; (3) pathways of contaminant release and transport; and (4) ways in which humans and ecological resources in the basin are exposed to contaminants. The CSM was developed to provide a structure for assembling information about the watershed and Site from a variety of sources and helping to identify data gaps that would be addressed during field work.

The following are potential source types, release mechanisms, and affected media that were identified as potentially important to the investigation of the Site.

Primary Source Types:

- Mine workings - Open pits, adits and associated underground drifts (tunnels) and leaching of metals to groundwater and surface water.

- Waste rock - Rock derived from mining activities (not considered ore, but may be mineralized).
- Tailings piles and tailings pond dam failures.
- Conveyance piping to the tailings ponds.
- Discarded fractions of processed ore containing residual metals.
- Concentrates and other process wastes such as ore concentrates, unprocessed ore, and other wastes related to mining.
- Artificial fill - Mining wastes intentionally placed as fill (e.g. roadways and structures).
- Mill buildings - Wastes generated from milling operations, laboratory processes, storage of petroleum or other products, and supporting infrastructure such as electrical transformers.

Affected media:

- Groundwater
- Surface water
- Sediment
- Alluvium (soils and other materials that have been transported by water to their present location, and usually are not covered by water)
- Upland soil, including wind-blown areas

Exposure routes are the pathways and processes by which humans and living natural resources (receptors) might be exposed to metals from mining waste. The approach that will be used to evaluate risks to receptors is described in the Human Health Risk Assessment and the Ecological Risk Assessment portions of this Work Plan.

2.5 Data Gaps Analysis

Based on the review of historical documents, limited background, chemical, and geotechnical data are available for use in the RI/FS. Our review of historical documents indicates several source areas where migration of contaminants could potentially occur. The data gaps analysis focused on four types of data: (1) background, (2) source areas, documented releases in source areas, and the need to obtain environmental data, and (3) historical geotechnical data, and (4) additional information needed to evaluate cleanup alternatives.

Table 1 and Table 10 in Appendix B summarize sampling locations, analysis and assumptions for environmental and geotechnical sampling, respectively.

2.5.1 Background

Establishing site-specific background for contaminants of concern (COCs) in groundwater, surface water, sediment, and soil is necessary to: (1) evaluate the extent of site contamination, (2) identify whether cleanup levels developed under MTCA may be below background, and (3) establish cleanup levels for protection of human and ecological receptors.

The background concentrations of contaminants of concern (COCs) at the Site generally fall into the following two categories:

Naturally Occurring - These are defined as concentrations of COCs present as a result of geochemical processes that have not been influenced by human activity. Naturally occurring organic and inorganic background COCs in soil, sediment, surface water and groundwater are attributable to the natural geological and hydrogeological characteristics of the area. At this Site, background concentrations of COCs may be variable due to the emplacement and enrichment of the lead-zinc ore body.

Anthropogenic – Concentrations of COCs associated with synthetic or natural substances that have been released to the environment as a result of human activities, but are not related to specific activities conducted at the mine site. Sources of anthropogenic background can include agricultural runoff, septic systems, agricultural and residential application of pesticides, air pollution, industrial discharges, landfills, and urban pollution (lead and PAHs from automobiles and combustion process). Anthropogenic background COC concentrations are typically widely distributed in the environment due to human activities, not related to site sources or releases, and attributable to past and present legal applications or sources.

Background concentration information is derived on a site-specific basis using samples from nearby "background" locations. The basic principle in identifying background sampling locations is to find areas that resemble as closely as possible soil, sediment, surface water and groundwater conditions at the site had a discharge or release not occurred. The selection of background sampling locations is a matter of professional judgment.

The background sampling areas must be clearly unaffected by releases from the subject site. In selecting background sample locations, the following issues were considered:

- Natural concentrations of inorganics can vary with soil type. When determining natural background, the soil type for the site and background locations should be the same, if possible.

- Both natural and anthropogenic constituent concentrations can vary with soil depth. Consequently, background samples should be taken from the same soil horizon(s) as the site soil samples.

- Concentrations from background studies published in the literature may be difficult to use as the basis of comparison with site concentrations. Published background studies may be of value in determining whether a site-specific background data set lies within the range of observations by others. If not, the validity of the site-specific background data set may need to be evaluated.

- In measuring chemical concentrations in background samples, the same analytical methods used for site samples will be used.

- The background data set will be examined carefully for the presence of outliers, i.e., data that may not in fact represent background conditions. Formal outlier tests as well as professional judgment can be used in evaluating the background data set.

2.5.2 Background Sample Size

For each media of concern, a sample size of ten or more background samples is required to establish a natural site-specific background (WAC 173-340-709). Based on watershed topography, habitat, and geology, fifteen background samples for each media of concern was considered sufficient to distinguish statistical differences between concentrations of COCs on the Site and site-specific background. While the primary mine features vary substantially from the eastern to the western portions of the Site, the topography, habitat, and geology were considered sufficiently similar to warrant establishing one suite of background concentrations for each media of concern. Background samples of soil, sediment, and surface water are co-located where possible and easily accessible for sampling.

2.5.3 Rationale for Background Sample Locations

The following bullets summarize the rationale for selecting the fifteen specific background sample locations shown on Figure 7.

- Areas in which evidence of manmade sources such as roads (i.e. dust, and vehicle exhaust), telephone and power line right-of-ways, dump sites, and home sites were avoided.

- A review of available historical site data indicated where data were collected in areas of historical mining operations and not appropriate for use as background data.

- Mining impacts have occurred in two sub-watersheds of the Onion Creek watershed. Based on topography, habitat, and geology, it is unlikely that background in the two sub-watersheds is different. Both areas are mostly covered by continental glacial drift, the material likely impacted by historical mining. The 15 background sample locations for each media span the two sub-watersheds and mostly sample the drift material. Each location is upstream and upslope of the mining areas, have similar characteristics, but are sufficiently distant from mining activity to not be affected or contaminated by materials and activities in the Van Stone Mine area or manmade sources.

- One background sample will be co-located with the historical surface water sample, SW-7. This sample is located within an area of exposed bedded dolomite of the Metaline formation, the same host rock in the open pits.

- Two upstream surface water sample locations, SW-7 and SW-8, present usable background data. While the data are usable, it is preferable to collect the entire set of samples at the same time and under the same field conditions. Two background sample locations will be located near the historical surface water samples, SW-7 and SW-8, to facilitate a comparison of historical surface water concentrations.

- Locations for stream sediment sampling that are similar in morphology and depositional environment to those on the Site.

Table 1 in Appendix A presents the laboratory analysis that we recommend for the background sample collection.

2.5.4 Environmental Data Gaps Analysis

The historical environmental site data reviewed for the work plan is summarized in Table 3. Appendix A presents a summary of the environmental data from the historical reports reviewed. Information obtained from report review and data analysis is summarized in Tables 8 through 13. Figures 3, 4, and 5 present a subset of data and exceedances of the lowest ARAR value in soil, surface water, and sediment for arsenic, cadmium, lead, and zinc. These COCs are believed to be a good first indicator of Site contamination. Overall, historic data collection focused on evaluating contaminant levels in the tailings piles. This is of limited use in the RI for determining the nature and extent of site contamination. While surface water and sediment data have fewer non-detects, in many cases the sampling locations are not well documented, which creates data gap in these media.

2.5.5 Exceedances of COCs in Soil

As shown on Figure 3, there are significant concentrations of lead and zinc in the North Pit Waste Rock Pile, mill stained soil areas, and Lower Tailings Pile. The data shows the highest exceedances in the waste rock. The Lower Tailings Pile is lower in COC exceedances, likely the result of refinement of the milling process.

Overall, the data are limited and not of sufficient quantity or quality to identify the nature and extent of Site contamination.

2.5.5.1 Soil Data Needs

To evaluate the nature and extent of Site contamination, soil data will be collected from the tailings piles, waste rock piles, haul roads, mill building area, and stream banks along Onion Creek and the tributaries draining the site features. The areas in which soil data will be collected, the analysis to be performed, the estimated number of soil samples, and sampling assumptions are presented in Tables 9 and 10. Sample collection will be a combination of spot sampling based on visual observations and sample transverses, which are first evaluated using, field X-Ray Fluorescence (XRF) readings to establish a likely extent of contamination and guide and limit sampling locations. Calibration of the XRF will include chemical data from selected Site samples prior to extensive field use of the instrument.

Based on further discussions with local residents, there is a potential that additional sampling of residential yards, gardens, and driveways may be conducted as part of the RI.

2.5.6 Dust Conditions

Currently, there is little information on Site dust hazards and the Air exposure pathway. As part of the RI, a wind station and air sampler will be used to evaluate dust conditions at the Lower Tailings Pile. Based on the XRF screening of dirt roads on the site, air sampling may need to be extended to roadways.

Evaluation of this concern and the need for air sampling will start with an analysis of the maximum COC concentrations from XRF data and sieve analysis conducted on selected road samples. This information will be used to estimate a worst-case condition potential for air transport of particulates. The information will be discussed with Ecology along with recommendations for any additional air sampling.

2.5.7 Exceedances of COCs in Surface Water

As shown on Figure 4, significant exceedances of screening levels for lead in surface water are present in the northeast and southeast tributaries to Onion Creek and in Onion Creek. The lead exceedances are reported as dissolved fraction in parts per billion (ppb) with a corresponding screening level of 2.52 ppb. The very low screening level is based on protection of aquatic life. While the concentrations of arsenic, cadmium, and zinc in surface water also exceed the screening levels, most of the exceedances are low.

The limited surface water sampling data available are not adequate to evaluate Site impacts from the identified source areas. Another concern with contaminant sources is whether seepage or leaching of metals is resulting in contaminants entering surface water under differing seasonal conditions. Two such conditions would be:

- Oxidation of source materials during winter months when precipitation in the form of snow does not tend to infiltrate the subsurface. Then, in early spring, a combination of snowmelt and rain creates a "first flush' as combination of surface water runoff and groundwater infiltration which can increase release and transport of hazardous substances from source materials. This condition may result in increased contaminant loading to groundwater and surface water.

- And, stream base flow is likely to occur in the late fall. If groundwater transports hazardous substances from source areas (and surface water transport from depositional areas along the streams affected by the 1961 dam failure), contaminant loads in surface water may increase under base flow conditions relative to other times of the year.

2.5.7.1 Surface Water Data Needs

To evaluate the nature and extent of COCs in surface water, a minimum of two sampling events are recommended. The first event should be in late winter or early spring when a first flush of Site materials is likely to occur. Timing of the first flush will be evaluated based on groundwater elevation changes versus changes in surface water flows.

The second event should be in late fall or early winter, when base flow conditions occur in the streams. If groundwater is a transport mechanism for COCs, then under base flow conditions, COC concentrations in surface water may increase.

A synoptic sampling methodology is recommended for both surface water-sampling events. Synoptic sampling provides a spatially detailed description of the water quality in a stream and is accomplished by sampling numerous sites in a relatively short time. Synoptic samples are typically collected in a progressively upstream order to prevent potential contamination of sampling sites. It is recommended that surface water samples be collected at eight stream locations on the Site. It is also recommended that, at each of the sampling locations, streambanks be sampled to evaluate potential tailings deposition from past releases from the Upper and Lower Tailings Piles. Actual transect locations should be identified during the initial site visit.

Pit lake sampling is recommended to evaluate current water quality. In addition to water quality sampling, it is recommended that the pit lakes be investigated to confirm bottom depths, potential connections to underground workings, sources of pit lake recharge, seepage from pit walls, potential recharge of groundwater, and visual evidence of seepage from the pit lakes.

The areas where surface water data collection is recommended, the analysis to be performed, the estimated number of surface water samples to collect, and assumptions are presented in Tables 9 and 10.

2.5.8 Groundwater Data Needs

Historical groundwater information at the Site is limited to data collected from three monitoring wells installed by Equinox. The monitoring wells were installed to evaluate groundwater downgradient from the Lower Tailings Pile. The data on the wells is not applicable to establishing background concentrations of COCs in groundwater. Consequently, groundwater quality and background are data gaps.

A good first step in establishing current groundwater quality would be to select six local residential wells that are completed in either the shallow unconfined alluvium or deeper wells completed in bedrock. Groundwater collected from these wells would be a good first step in establishing groundwater quality and he need for further groundwater evaluations. Sampling of the wells will need to be discussed with local residents. Sampling of domestic wells would be part of a voluntary program on the part of the well owners.

2.5.9 Exceedances of COCs in Sediment

As shown on Figure 5, there are limited data on sediment conditions at the Site. Exceedances of screening levels in the table on Figure 5 show that, except for the sampling location at the West End Pit Lake Dam and on the Lower Tailings Pile East Pond, the exceedances are low (a 1X factor). While sediment cleanup levels are not promulgated in Washington state, there are insufficient historical data to evaluate sediment impacts at the Site.

In addition, historical data does not address Site impacts on the fish or benthic community in Onion Creek and its tributaries. The potential fro such impacts will be further evaluated based on the surface water and sediment data collected during the initial phase of the RI. If the data indicate that COC concentrations exceed effect thresholds for the fishery or benthic community, a second phase of RI sampling may be necessary to evaluate exposure pathways further.

2.5.9.1 Sediment Data Needs

Given the 1961 failure of the Upper Tailings Pile dam, and the releases from the Lower Tailings Pile, sediment data will be needed to evaluate impacts to the stream system. Areas of the stream channels that need to be characterized include the unnamed tributary adjacent to the West End Pit Lake, the northeast and southeast tributaries to Onion Creek and Onion Creek downstream past the schoolhouse. The recommended sediment sample collection, laboratory analysis, and the estimated number of sediment samples and sampling assumptions are presented in Tables 9 and 10.

2.5.10 Historical Geotechnical Data and Data Needs

Section 2 of the Work Plan describes mining history at the Site and multiple releases of hazardous substances during the course of mining activity. The section also provided a summary of current Site conditions and discussed several site features such as the tailings piles, ponds, and waste rock piles, which are likely unstable and potential continuing sources to release of hazardous substances. The two open pits on the Site have pit lakes and unstable side wall conditions. In addition, the 1961 release of water and tailings from the Upper Tailings Pile transported hazardous substances down the Southeast Tributary and Onion Creek for over 2 miles downstream from the source. The tailings piles and waste rock piles will likely require consolidation and stabilization to prevent future failures or stop current releases. Pit conditions will need to be addressed and stream conditions addressed if hazardous substances are found to exceed cleanup levels.

The following sections summarize available geotechnical data by significant site features, and identify data gaps that we recommend closing. Information on the geotechnically significant features and data gaps may be modified following an initial Site visit.

2.5.11 Lower Tailings Pile

The Lower Tailings Pile was built in two main stages that are of geotechnical significance.

Asarco Inc. constructed the first stage of the Lower Tailings Pile pond in 1961, and tailings were disposed of in this pond during milling operations through an unknown date in the 1970s. The first stage Lower Tailings Pile that existed at the suspension of milling operations in the 1970s is hereafter referred to as the 1970s Lower Tailings Pile.

Equinox Resources Ltd. reactivated the mine and mill in 1991. In preparation for impounding additional tailings, Equinox built an additional tailings pond on top of the west end of the 1970s Lower Tailings Pile in the Fall 1990 (DCN 1023 and 1024). They later built an additional tailings pond on top of the east end of the 1970s Lower Tailings Pile in the Summer of 1991 (DCN 1025). The disposal of the additional tailings by Equinox will be referred to collectively as the Lower Tailings Pile and the West and East Ponds.

2.5.11.1 1970s Lower Tailings Pile

In 1974, the US Department of Interior – Bureau of Mines published a study on the seepage analysis of tailings slimes zone (DCN 1014). The geotechnical data provided in this study consisted of index properties (i.e., moisture content, unit weight, specific gravity, void ratio, saturation, and grain size), hydraulic conductivities, consolidation properties, and limited strength test data (direct shear) from explorations performed in 1970 and 1971. All test data in the 1974 Bureau of Mines study are for tailings slimes at the interior of the 1970s Lower Tailings Pile.

In late 1989, Klohn Leonoff Consultants performed geotechnical investigations on the 1970s Lower Tailings Pile and in native soil near the toe of the 1970s Lower Tailings Pile. In late 1990, Klohn Leonoff provided a design report for construction of the 1990s Lower Tailings Pile (DCN 1037). The 1989 geotechnical investigations of the 1970s Lower Tailings Pile included:

- Ten Cone Penetration Test (CPT) soundings with porewater pressure measurements (i.e., piezocone) distributed throughout the interior and near the perimeter/crest.

- Two borings near the perimeter/crest and one boring at the mid-interior. Shelby Tube samples of tailings were occasionally collected.

- Four geotechnical borings completed through native soil near the toe of the Lower Tailings Pile.

- All 1989 geotechnical borings generally included Standard Penetration Tests (SPT) performed at approximately 5-foot intervals. All borings were completed with piezometers generally screened within native soils below the tailings and at or near the bedrock contact.

- Laboratory analyses performed for the 1990 Klohn Leonoff Tailings Disposal Design Report (DCN 1037) included two strength tests (direct shear) performed on tailings, Shelby Tube samples, two interface shear strength tests (direct shear) performed for a tailings and pvc liner interface, and nine grain size analyses of tailings. Additionally, five moisture contents and two Atterberg limits tests were performed on native soils samples adjacent to or below the 1970s Lower Tailings Pile.

In 1999, Ecology's Dam Safety Office (DSO) reviewed the Klohn Leonoff 1989 CPT soundings and geotechnical borings and concluded that the 1970s Lower Tailings Pile was effectively drained (DCN 1004). The interpretation of this conclusion was that the 1970s Lower Tailings Pile was not susceptible to liquefaction. However, it appears the materials provided for DSO review did not include the CPT continuous pore pressure information but instead included data tables that called out groundwater at the bottom of every CPT sounding, which, DSO noted in their review appeared to be a relic of the data logging. Hart Crowser's review of the CPT continuous pore pressure plots provided in the 1990 Klohn Leonoff Tailings Disposal Design Report (DCN 1037) indicates layers of saturated tailings existed within the majority of CPT soundings through the 1970s Lower Tailings Pile at the time of the December 1989 CPT soundings. Additionally, the December 1989 CPT soundings indicate a potential continuously saturated tailings zone (i.e., groundwater) within the 1970s Lower Tailings Pile. The depth to this saturated zone ranges from about 10 feet at the interior (CPT C9) to 20 to 25 feet at the mid-interior (CPT C14).

2.5.11.2 1990s Lower Tailings Pile

No geotechnical explorations data for the 1990s Lower Tailings Pile were found during the historical document review. Limited information is available on the construction of the 1990s Lower Tailings Pile West pond (DCN 1023 and 1024) and the 1990s Lower Tailings Pile East pond (DCN 1025). No information regarding the 1990s Lower Tailings Pile operations and potential additional construction of the 1990s Lower Tailings Pile via the proposed upstream tailings construction method was discovered in the historical document review.

In fall 1990, Equinox produced a letter report about construction of the 1990s Lower Tailings Pile West pond (DCN 1023), which indicated:

- The starter dike was constructed by borrowing tailings and material from the outer perimeter of the 1970s Lower Tailings Pile upstream construction dike while maintaining the 45-foot setback from the crest as recommended by Klohn Leonoff in the design report (DCN 1037).

- The starter dike was traffic compacted in 6-inch lifts and bladed and bulldozed to level and further compact every 2 feet.

- The front dike (i.e., western edge) was constructed to 10 feet tall with a final crest elevation of 2700 feet, and the back dike (i.e., eastern edge) was constructed 20 feet tall with a final crest elevation of 2,710 feet.

- A seepage collection system was installed. The details of the seepage collection system are unclear, as an as-built plan view of the starter dam and seepage collection system was missing from the historical documents reviewed. However, the letter (DCN 1037) appears to indicate 4-inch perforated pipe extends into the tailings, and the seepage collection lines were connected to create a ring around the interior of the starter dike.

- A construction quality assurance (CQA) report produced by Vector Engineering, Inc. (DCN 1024) for the 30 mil PVC liner installation. The report states that the liner was installed in accordance with plan specifications and industry standards (ASTM D3083 [Shear] and ASTM D413 Peal). The CQA report mentions the seepage recovery drains, but this element of construction was not documented in the Vector Engineering, Inc report.

- In addition to the 1990s Lower Tailings Pile west pond, a smaller lined seepage collection pond was constructed south of the Lower Tailings Pile. Construction of the pond embankments was accomplished using coarse tailings and the same construction methods as the 1990s Lower Tailings Pile West pond. Six inches of compacted tailings were also placed below the entire interior pond footprint as a protection layer between the native ground and PVC liner, which was also overlain by a hypalon liner.

The only documentation of the summer 1991 construction of the 1990s Lower Tailings Pile East pond found during the historical document review was a CQA report provided by Vector Engineering, Inc. (DCN 1025). Vector Engineering, Inc.'s CQA report (DCN 1025) discussed the 30 mil PVC liner installation and indicates the liner was installed in accordance with the permitted design drawings, technical and project specifications, and accepted industry standards. An as-built liner drawing was provided, but no dimensions or elevations were indicated. No mention of a seepage collection system is made in the CQA report.

Information in Vector Engineering, Inc.'s CQA report (DCN 1025) indicates the overall 1990s Lower Tailings Pile did not follow the Klohn Leonoff layout recommendations in the design report (DCN 1037) but were a variation on the design layout. However, no plan view construction as-built drawings for the 1990s Lower Tailings Pile were found during historical document review, with the exception of the liner as-built for the 1990s Lower Tailings Pile East pond mentioned previously.

2.5.11.3 DSO Correspondence Regarding the Lower Tailings Pile

Correspondence between DSO and Equinox throughout the 1990s was included in the historical document review. The correspondence documents DSO inspections of the Lower Tailings Pile and DSO's concerns regarding:

- Erosion issues of the Lower Tailings Pile overall,
- Condition of the liner(s) and seepage in the 1990s Lower Tailings Pile,
- Water contained in the 1990s Lower Tailings Pile, and
- Saturated tailings within the 1990s Lower Tailings Pile.

The DSO letter to the File for Record on January 18, 2008, (DCN 1005) provides the most recent summary of the issues for the Lower Tailings Pile. The geotechnically significant issues are continued erosion problems, the need to evaluate the global structural stability of the Lower Tailings Pile as part of reclamation. The letter also notes that while boring results indicated that tailings below the liner are unsaturated, any impounded materials above the liner must be considered saturated and liquefiable and that, until remediation sufficiently progresses and reduces the total volume of stored water below 10 acre-feet, the Lower Tailings Pile will remain within DSO's regulatory purview.

2.5.11.4 Lower Basin Geotechnical Data Needs

To assess options for reclaiming the Lower Tailings Pile as part of the RI/FS, the following geotechnical information is needed:

- **Assessment of tailings saturation/groundwater levels.** As noted in the DSO correspondence, the tailings above the liner of the 1990s Lower Tailings Pile must be assumed to be saturated above the liner. Construction documentation indicates a seepage collection system was installed for at least part of the 1990s Lower Tailings Piles; however, the efficacy of this system is unknown. Additionally, the current condition of the 1970s Lower Tailings Pile below the liner is not known, and DSO has identified issues with the liner during their inspections. An assessment of the tailings saturation is necessary to assess the potential for liquefaction and potential Lower Tailings Pile instability and release of tailings and impounded water.

- **Geotechnical explorations of the 1990s Lower Tailings Pile.** Currently, no geotechnical explorations or *in situ* test data are available for the 1990s Lower Tailings Pile. Geotechnical explorations and *in situ* testing (e.g., SPT, CPT) are necessary to assess the stratigraphy and variability of tailings in the 1990s Lower Tailings Pile, as well as the liquefaction potential.

- **Tailings strength test data.** No laboratory strength test data are currently available for the tailings in the 1990s Lower Tailings Pile. Strength properties of the tailings are necessary to perform stability analyses for reclamation options. Currently very limited laboratory data are available regarding the strength of the tailings in the 1970s Lower Tailings Pile, particularly given the changes in tailings material from the perimeter to the interior and given the method of tailings deposition and dam construction. Additionally, the available strength data are based on testing methods that are less reliable than the current standard of practice.

2.5.12 Upper Tailings Pile

Currently no geotechnical data are available for the Upper Tailings Pile. However, the Upper Tailings Pile dam is known to have experienced an embankment failure in 1961.

Based on review of Site photographs and aerial photographs, it appears that a lined backup tailings pond, referenced in Ecology correspondence from fall 1992 (DCN 1052), was constructed in the east basin on the Upper Tailings Pile. However, no documentation of the design, construction, or operation of the backup tailings pond was found during historical document review. According to site and aerial photographs, it appears the backup tailings pond may be impounding water at least seasonally.

2.5.12.1 Upper Tailings Pile Geotechnical Data Needs

To assess options for remediating the Upper Tailings Pile as part of the RI/FS, the geotechnical information needed is similar to those of the Lower Tailings Pile:

- **Assess tailings saturation/groundwater levels.** This assessment is necessary to assess the potential for liquefaction and potential Upper Tailings Pile instability and release of tailings and impounded water.

- **Geotechnical explorations of the Upper Tailings Pile.** Currently no geotechnical explorations or *in situ* test data are available for the Upper Tailings Pile. Geotechnical explorations and *in situ* testing (e.g., SPT, CPT) are necessary to assess the stratigraphy and variability of tailings in the Upper Tailings Pile, as well as the liquefaction potential.

- **Tailings strength data.** Currently no laboratory strength test data are available for the tailings in the Upper Tailings Pile. Strength properties of the tailings are necessary to perform stability analyses for reclamation options.

2.5.13 West End Pit and West End Pit Lake Dam

Currently no geotechnical data are available for the West End Pit and Pit Lake Dam.

2.5.13.1 DSO Correspondence Regarding the West End Pit Lake Dam

DSO correspondence to Equinox on August 2, 2010, (DCN 1002) indicated the West End Pit Lake Dam was probably originally constructed as a temporary road that inadvertently functions as a dam. Based on DSO inspection, it appears the dam was probably constructed of a mixture of rock-blasting debris and local soils; however, the composition and integrity of the dam is unknown. DSO required corrective actions include a dam breach analysis, a geotechnical evaluation of the structural integrity of the embankment and seepage conditions, an emergency action plan (if necessary based on dam breach analysis), a site survey and as-built drawings for the dam and reservoir area, and an operations and maintenance plan.

2.5.13.2 West End Pit Lake Dam Geotechnical Data Needs

The DSO required corrective actions for physical hazards on private land that would generally be outside of the scope of the current RI/FS, if there were no risks of hazardous substance exposure. However, tasks related to mitigating the dam safety hazards at the Site could be incorporated into the scope of RI/FS activities (at Ecology's request) since dam safety must be addressed to prevent future tailings releases.

To assess options for stabilizing the West End Pit Lake and Pit Lake Dam as part of the RI/FS, the following geotechnical information would be needed:

- **Assess groundwater levels and seepage conditions of the Pit Lake Dam.** This assessment is needed to evaluate the structural integrity of the Pit Lake Dam.

- **Geotechnical explorations of the Upper Tailings Pile.** Geotechnical explorations and *in situ* testing (e.g., SPT, CPT) are necessary to assess the stratigraphy and variability of soils in the Pit Lake Dam, as well as the liquefaction potential.

- **Pit Lake Dam strength data.** These data are necessary to evaluate the structural integrity of the Pit Lake Dam. If the soils encountered are not suitable for relatively undisturbed sampling (i.e., Shelby Tubes) and standard laboratory testing, then empirical correlations may be used based on *in situ* testing.

- **Assessment of West End Pit wall structural stability.** This assessment is necessary in combination with an evaluation of the Pit Lake Dam to assess the risk of a failure and potential impacts of a wave created by such a failure on the stability of the Pit Lake Dam.

2.5.14 Waste Rock Piles

Currently no geotechnical data are available for the Waste Rock Piles at the Site.

2.5.14.1 Waste Rock Piles Geotechnical Data Needs

- **Assessment of groundwater levels.** Potential groundwater levels within the waste rock piles may affect long-term stability.

- **Geotechnical explorations of the Waste Rock Piles.** Geotechnical explorations (e.g., test pits, borings, geologic mapping) are necessary to assess the stratigraphy and variability of waste rock in the Waste Rock Piles, as well as estimate appropriate strength data for assessing long-term stability of these generally coarse materials.

3.0 REMEDIAL INVESTIGATION APPROACH

The purpose of the RI is to collect data necessary to characterize the Site adequately for the purpose of developing and evaluating cleanup action alternatives (WAC 173-340-360 through 173-340-390). Site characterization may be integrated with development and evaluation of alternatives in the FS. This approach is used when efficiencies in data collection are achieved or a phased approach to data collection is warranted.

3.1 Field Data Acquisition and Analysis

We recommend the RI be implemented in several steps, which may be conducted stepwise or in parallel. The recommended RI work includes:

- Detailed Site mapping to confirm Site conditions such as the location and size of tailings piles, waste rock piles, drums, or other hazardous materials on the Site; tailings pile failures and apparent impacts on streams, vegetation, and wildlife. This information will be used to refine the maps prepared for this Work Plan. As part of this effort, we will work with Ecology to address potential residential concerns and identify domestic wells that will be sampled as a preliminary screening of groundwater quality.

- A recommended Sampling and Analysis Plan (SAP) is presented in Appendix B. The SAP addresses identified data gaps and additional environmental and geotechnical information that needs to be collected at the Site. Data analysis is needed to characterize the distribution of hazardous substances. Source areas of hazardous substances on the Site need to be characterized to provide location, quantity, areal and vertical extent, and concentrations within the sources and areas of continuing releases.

  As part of the SAP, the field team should profile source areas on the Site with *in situ* testing to limit the number of soil samples that need to be collected and analyzed. This may be done using a portable X-Ray Fluorescence (XRF) instrument. Sources of contamination may be screened by XRF to locate likely contamination boundaries. Sample collection could then be concentrated in regions where contaminants are below or near cleanup levels and laboratory data will confirm the extent of contamination outward from a source area.

The size of the Site and varied history of operations may best be addressed with a phased approach to data acquisition. The initial SAP addresses collecting environmental data on groundwater, surface water, and soil at the Site, and geotechnical information on tailings and waste rock piles.

- A Human Health Risk Assessment should be conducted. Timing of the assessment will depend on SAP implementation and obtaining laboratory results and validation of the results.

- A Terrestrial Ecological Evaluation (TEE) should be conducted. Timing of the assessment will depend on SAP implementation and obtaining laboratory results and validation of the results. Evaluation of aquatic receptors may best be addressed in a phased approach where COC concentrations in sediments are first evaluated and used to guide evaluation of aquatic receptors.

- Surface water and groundwater should be characterized to evaluate likely contaminant transport at the Site. Surface water needs to include erosion of tailings and impacted soil. The impacted surface water drainage from the 1961 tailings dam breach will be a major focus of this work, along with the tailings releases from the north and west areas of the Lower Tailings Pile.

- Geotechnical characteristics of the tailings piles should be determined to enable an assessment of the potential for future releases due to instability of the tailings piles.

- Groundwater should be evaluated to determine potential contaminant migration from abandoned underground workings, pit lakes, and stream recharge.

- A Remedial Investigation report should be prepared that identifies and characterizes site conditions, land features, surface water drainages, areas of potential erosion, and areas of sediment transport. The nature and extent of contamination should include the areal and/or vertical extent of Site contamination in soil, sediment, surface water, and groundwater sufficient to guide the Feasibility Study in development and evaluation of cleanup alternatives. The Human Health Risk Assessment and TEE will be included as Appendices to the RI or as stand-alone documents, depending on Ecology's planned distribution of the documents.

The following two subsections describe the approach to conducting Human Health and Ecological Risk Assessments. The risk assessments are key to identifying impacts to human health and ecological receptors and risk levels that will need to be addressed during development of cleanup alternatives. Risk assessment approaches can substantially vary in methods used and how risks are calculated. Details are provided in the following section to document the proposed approach to evaluating Site risks.

3.2 Human Health and Ecological Risk Assessments

A Baseline Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) will be prepared to assess potential hazards and risks to human and ecological receptors from exposure to mine waste and contaminated media at the Van Stone Mine in Stevens County, Washington in accordance with MTCA (WAC 173-340, Ecology 2007).

3.2.1 Selecting Contaminants of Concern

This section describes how the analytical data will be compiled and used to select Contaminants of Concern (COCs). COCs are chemicals that are present in the environment at levels that may place humans or ecological receptors at risk of adverse health effects that may partially or wholly originate from site-related sources.

3.2.1.1 Data Tabulation and Review

Analytical results collected during the RI will be tabulated and reviewed to ensure suitability for use in the HHRA/ERA. The risk assessments will use background and chemical data from samples of the following environmental media collected during the RI to estimate exposures:

- Waste rock and tailings piles;
- Surface and subsurface soil and dust;
- Surface water from Onion Creek and its tributaries;
- Surface water from tailings ponds and pit lakes;
- Sediment from Onion Creek and its tributaries; and
- Groundwater.

Data usability will be evaluated based on the data qualifiers. Data qualifiers are applied by the laboratory and describe the reliability of particular data. Estimated values (J) will be used as-is and rejected values (R) will be assumed unusable for risk assessment purposes. When both an original sample and field QA sample are collected from the same sample location, the higher of the two results will be used in the data summary and risk assessments.

The maximum detected concentration, mean concentration, and 95 percent upper confidence limit (UCL) of the mean concentration, will be determined for the COCs in all media (Ecology 1992, 2007).

Previously accepted risk assessment procedures recommended that chemicals that are below the detection limit (sample data flagged as "U" be assigned one-half the detection limit. However, current guidelines no longer recommend this approach. Instead, non-detected chemicals will be evaluated using the latest version of the EPA's ProUCL software to quantify exposures (EPA 2010). Chemicals where all samples within a medium are qualified as below detection will not be evaluated for that medium. For samples with less than six detected values of a contaminant, the maximum detected value for that contaminant will be used as the exposure concentration.

3.2.1.2 Initial Screening

To identify COCs at the Site, a stepwise selection process described by WAC guidance (Ecology 2007) will be used. Contaminants that do not meet these screening steps will be assumed to present negligible risks to human health and ecological receptors and will be screened out of the risk assessment process. The screening process consists of three steps: (1) determining the frequency of detection, (2) comparing to background concentrations, and (3) for HHRA, comparing to established criteria for potential toxicity for exposure pathways identified as complete in the CSM. Essential nutrients will also be screened out unless they are present at concentrations that may pose a potential risk to receptors.

- **Identification of Detected Chemicals.** For a given medium, chemicals that are detected in less than five percent of the samples will be eliminated from further evaluation.

- **Comparison to Site Background Concentrations.** Some chemicals have a wide range of occurrence in soil and water. Detecting these chemicals at the Site does not necessarily indicate that they were introduced by site releases. WAC 173-340-709, "Methods for Defining Background Concentrations," recommends that lognormal 90th percentile background values be used to compare site data to background results when alternative statistical methods are not employed (Ecology 2007).

  Maximum concentrations of chemical will be compared to area background concentrations established during the RI. Constituents with maximum concentrations less than their respective 90th percentile background value will be eliminated from further risk evaluation. However, should a COC's background concentration exceed its health-based cleanup levels, the COC will not be eliminated from further evaluation without significant explanation and discussion. Any inorganic chemicals that do not have background values will be carried forward to the next step of the screening identification process.

- **Screening for Human Health.** Maximum concentrations of the remaining compounds found in soil and sediment will be compared to MTCA Method B Cleanup Levels for unrestricted land use. Maximum concentrations found in groundwater will be compared to Method B cleanup levels and State and Federal drinking water criteria. Maximum concentrations found in surface water will be compared to the lower of the Method B cleanup levels and State and Federal surface and drinking water quality criteria for human health. Chemical with maximum concentrations exceeding these criteria will be retained as COCs for human health. Compounds without screening criteria will be retained as COCs for a qualitative evaluation.

- **Screening for Ecological Health.** After screening the data for detection frequency and background level exceedances described above, the resulting data set will constitute the COCs for the ERA without further screening. The COCs undergo ecological risk evaluation described in Section 3.3.

3.2.2 Human Health Risk Assessment (HHRA) Approach

An HHRA will be prepared to assess potential hazards and risks to human receptors from exposure to mine waste and contaminated media at the Site. The HHRA will incorporate analytical data and other information gathered during the RI and site-specific exposure factors based on the anticipated receptors and future land uses. The HHRA will be prepared in general accordance with state and federal regulations and guidelines (Ecology 2007 and EPA 1989) and consists of the following steps:

Step 1 – Exposure Assessment;
Step 2 – Toxicity Assessment;
Step 3 – Risk Characterization;
Step 4 – Uncertainty Analysis; and
Step 5 – Summary of Human Health Risks.

3.2.3 Step 1-Exposure Assessment

The first step of the HHRA will be to develop an exposure assessment of the Site. This involves preparing a conceptual site model, identifying the potentially exposed populations at the Site, determining the potentially complete exposure pathways at the Site, estimating Exposure Point Concentrations (EPCs), and developing a set of exposure factors and assumptions for use in the risk calculations. Each of these tasks is described in the following sections.

3.2.3.1 Prepare a Human Health Conceptual Site Model

A preliminary human health CSM has been prepared for the Site to provide a framework for assessing risk by identifying the following:

- The environmental setting and contaminants known or suspected to exist at the Site;
- Contaminant fate and transport mechanisms that might exist at the Site;
- Mechanisms of toxicity associated with contaminants and potential receptors;
- Complete exposure pathways that might exist at the Site; and
- Potential exposed populations.

The Preliminary CSM will be refined based on information collected during the RI and should be representative of current and likely future conditions at the Site.

3.2.3.2 Identify Potentially Exposed Populations

The following primary exposed human populations are anticipated to use the Site:

- Adult and child residents; and
- Adult and child trespassers.

3.2.3.3 Identify Complete Exposure Pathways

Based on the anticipated potentially exposed populations described above, the exposure pathways to be considered in the HHRA include:

- Incidental ingestion of surface and subsurface soil, waste rock, and tailings;
- Incidental ingestion of sediment in Onion Creek;
- Ingestion of impacted groundwater;
- Ingestion of impacted surface water;
- Inhalation of mine waste particulates;
- Dermal contact with surface water in Onion Creek, tailings ponds, and pit lakes; and
- Ingestion of impacted biota such as homegrown produce and fish.

3.2.3.4 Estimate Exposure Point Concentrations

EPCs for each COC identified in the initial screening will be developed to quantify exposures to humans at the Site. The EPC is a statistically derived value that represents the concentrations for chronic exposures, i.e., concentrations to which a receptor may be exposed over a long time as the individual randomly moves over the Site. The EPCs will be determined for each exposure unit as the 95 UCL of the mean concentration for each medium using the PRoUCL software. ProUCL incorporates detected values and undetected values by assigning values based on the distribution of detected values. ProUCL uses this substituted data set to determine the overall data distribution and recommends a 95 UCL appropriate to that distribution. When the data set consists of less than six detections, the maximum concentration will be used as the EPC.

3.2.4 Step 2-Toxicity Assessment

The second step of the HHRA is to assess the toxicological properties of the COCs identified in the exposure assessment. Toxicological values are used in the risk calculations and in developing cleanup levels. The COC toxicological properties are evaluated to determine the types and severity of potential health hazards associated each COC.

In accordance with Ecology guidance (Ecology 2007), EPA's online Integrated Risk Information System (IRIS) (EPA 2011) will be used to identify toxicity criteria for the Site COCs. IF toxicity criteria are not available in IRIS, additional toxicological sources will be used, such as those contained in EPA's Regional Screening Levels for Chemical Contaminants at Superfund Sites (EPA 2011).

The purpose of the toxicity information is to identify the potential adverse health effects of exposure to contaminants and to estimate the likelihood that these adverse health effects may occur based on the extent of exposure. Two general types of health effects are evaluated: carcinogenic effects and adverse non-carcinogenic health effects. This distinction is made because the EPA generally assumes that a dose threshold exists for non-carcinogens and that compensatory biological processes prevent the expression of adverse health effects if humans are exposed to chemical doses below the threshold. No such threshold is generally is assumed for carcinogens. Instead, it generally is assumed that a finite probability of developing cancer is associated with any exposure to a carcinogen. As a result, carcinogens and non-carcinogens have separate toxicity criteria, called slope factors and reference doses, respectively. In general, the toxicological effects of a compound are the dominant health effects of the chemical, as determined by the EPA.

Reference dose values will be used to evaluate non-carcinogenic health effects, and cancer potency factors will be used to evaluate carcinogenic health risks. Reference doses and slope factors are contained in the CLARC database and used in calculating cleanup levels. In cases where both reference doses and cancer potency factors are available for a COC, both non-carcinogenic and carcinogenic health effects will be evaluated. For those COCs for which toxicity criteria are not available, a similar chemical may be identified and its toxicity value may be used as a surrogate for the chemical without data. If no surrogate chemical data are available to conduct a quantitative risk estimate, a qualitative evaluation of the risk will be presented.

3.2.5 Step 3-Risk Characterization

WAC 173-340 mandates that site cleanups protect the state's citizens and the environment. Ecology has established cleanup standards and requirements for hazardous waste sites to implement this statutory mandate. These precalculated cleanup levels are available in the online Cleanup Levels & Risk Calculations (CLARC) database for a large number of chemicals and exposure pathways. Ecology integrates toxicological criteria, exposure factors, such as exposure duration and frequency, and soil and drinking water ingestion rates, and target risk levels in calculating cleanup levels.

For unrestricted land-use (Method B), the target risk levels for estimated excess cancer risk is less than or equal to one in one million (1×10^{-6}) for a known or suspected carcinogens, or less than one in one hundred thousand (1×10^{-5}) for multiple hazardous substances or pathways. Target risk levels for non-carcinogens are: (1) a hazard index of less than one for individual chemicals, and (2) a hazard quotient less than one for multiple hazardous substances or pathways.

3.2.5.1 Comparison to Method B Cleanup Levels

The unrestricted land-use (Method B) cleanup levels for soil, surface water, and groundwater are presented in the CLARC database. Cleanup levels for soils are developed assuming that ingestion and dermal contact (for petroleum contamination only) are the dominant routes of exposure. Surface water cleanup levels consider fish consumption as the dominant exposure route and groundwater cleanup levels are based on ingestion. Exposure factors used to develop cleanup levels are considered representative of reasonable maximum exposure under unrestricted land-use conditions and the cleanup levels are considered protective of the expected exposure scenarios at the Site.

In order to calculate cancer and non-cancer risks for Site receptors the EPCs for COCs identified in **Step 1- Exposure Assessment** will be compared to Method B cleanup levels and resulting risks will be calculated as follows:

- Cancer Risk=(EPC/Method B Cleanup Level for Carcinogens) x (1×10^{-6})
- Non-cancer Risk=EPC/Method B Cleanup Level for Non-carcinogens

Comparison to Method B cleanup levels will be used to assess risks associated with the following pathways: (1) Incidental ingestion of surface and subsurface soil, waste rock, and tailings; (2) Incidental ingestion of sediment in Onion Creek; (3) Ingestion of impacted groundwater; and (4) Ingestion of fish. Should the risk assessment process described above indicate that a COC poses unacceptable risks to site receptors, a more thorough investigation of risks using site-specific exposure information may be completed. For example, if water quality data indicate unacceptable risks associated with fish consumption, fish tissue data may b collected for additional evaluation of risk.

For the pathways not assessed by comparison to the Method B cleanup level, (e.g., ingestion of impacted surface water, inhalation of particulates, dermal contact with surface water, and ingestion of impacted biota), risk may be quantified using site-specific exposure factors.

3.2.5.2 Lead Risk Assessment

WAC 340-173 provides Method A soil (based on preventing unacceptable blood lead levels) and groundwater cleanup levels (based on State and Federal drinking water quality) for unrestricted land use for lead (Ecology 2007). However, no Method B cleanup levels are calculated for lead. Lead EPCs will be compared to Method A soil cleanup levels and State and Federal drinking water criteria to determine if site concentrations may pose an unacceptable risk to human receptors. Risks associated with exposure to lead will be addressed qualitatively in the uncertainty discussion.

Further, the EPA has no consensus reference dose (RfD) for lead because of the difficulty of identifying a threshold level for adverse health effects needed to establish an RfD. As a result, lead health risk assessment involves measuring and modeling blood lead levels for relatively short-term exposures and relating those to national criteria. Currently, the EPA has established the following lead health criteria with respect to children; no child in an identifiable population should have a greater than 5 percent probability of a blood lead level of 10 mg/dL or greater.

Pharmacokinetic models have been developed to predict blood lead levels resulting from different lead intake scenarios. Those are the Integrated Exposure Uptake Biokinetic Model (IEUBK) for predicting childhood blood-lead levels and the Adult Lead Model (ALM) for assessing adult exposures (EPA 1994, EPA 1996b).

The EPA recommends that soil lead levels less than 400 mg/kg are generally safe for residential use. Above that level, the EPA suggests collecting data and modeling blood-lead levels with the IEUBK model. The IEUBK integrates site-specific soil and house dust lead concentrations with default water, food, and air lead concentrations to calculate individual probabilities of blood lead exceedances for a hypothetical child population living at the Site.

If lead concentrations in site media exceed the EPA soil and drinking water criteria, associated risk may be estimated using the IEUBK and ALM models, as appropriate.

3.2.5.3 Contaminants of Concern

Cleanup levels shall be defined for a COC with an EPC that is greater than the corresponding screening level. If a constituent does not have established toxicity levels and, therefore, no established cleanup levels, and a surrogate risk-based cleanup level could not be identified, then that contaminant will be considered a qualitative COC and will be discussed in the uncertainty analysis.

3.2.5.4 Adjustment for Total Risk and Hazard Index

WAC 173-340 requires the evaluation of cumulative risk to account for exposure to multiple hazardous substances and/or exposure resulting from more than one exposure pathway when Method B levels are used (Ecology 2007). Should the hazard index exceed 1, or should the total cancer risk exceed one in one hundred thousand (1×10^{-5}), cleanup levels will be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. These adjustments shall be made in accordance with the procedures in WAC 173-340-708(s).

3.2.6 Step 4-Uncertainty Analysis

The estimates of exposure, non-carcinogenic hazard, and carcinogenic risk presented in the HHRA are subject to varying degrees of uncertainty from a variety of sources, including site data, exposure assessment, and risk characterization. These uncertainties and their potential influence on results of the HHRA will be discussed.

3.2.7 Step 5-Summary of Potential Human Health Risks

The conclusions of the HHRA will include summaries of the risk characterization results, qualitative evaluation of chemicals for which no toxicity information is available, and calculation of risk-based clean-up levels, if applicable. Recommendations for additional assessment of risk to human receptors will be provided, if deemed necessary to understand the potential for health risks that may result from human exposure to COCs at the Site.

3.2.8 Ecological Risk Assessment Approach

The approach to conducting the Baseline Ecological Risk Assessment (ERA) for the Site described below is based on MTCA requirements (Ecology 2007 and 2011) and environmental and waste characteristics of the Site. The ERA will be consistent with Ecology guidance on TEE.

3.2.9 Terrestrial Ecological Evaluation Exclusion

The approach to performing the TEE was determined through evaluation of existing site data and pertinent Ecology regulations, WAC 173-340-7490. An exclusion from performing a TEE is not considered possible at the Site because ecological receptors and potentially complete exposure pathways exist within the Site. Because the Site is located adjacent to US Forest Service land and on property that contains at least 10 acres of native vegetation within 500 feet of the Site, the Site meets the requirements to undergo a site-specific evaluation, according to Ecology (2011) guidelines for TEE. The following presents details on the selection and procedures for performing a site-specific evaluation for the TEE.

3.2.9.1 Characteristics of the Site

The mine reclamation and closure plan report (Beacon Hill Consultants 2002) provides a summary of the Site characteristics that impact whether a TEE can be excluded. The Site is located in the upper Onion Creek watershed, a typical montane habitat of northeastern Washington. According to the Land Status Map in the closure plan report, US Forest Service property is located on the south boundary of the Site. Conifer forests and associated wildlife characterize the general region in which the Site is located.

3.2.9.2 Ecology Guidance for TEE

MTCA (WAC 173-340-7490(2) provides criteria for determining whether the Site can be excluded from a site-specific TEE, based on characteristics of the Site.

This first step of the TEE determines whether the Site has the potential to pose a risk to wildlife or plants, or affect the soil biota at the Site. Certain site circumstances provide an exclusion from any further ecological evaluation at the Site because the contaminants either have no pathway to harm plants or animals (e.g., they are under buildings or deep in the ground); or there is no habitat where plants or animals live near the contamination; or finally, the contamination does not occur at concentrations higher than are found naturally in the area.

As described in Section 1.3.2.1, the Site contains habitat where plants or animals can live near the contaminated soil, and the contamination appears to be elevated above concentrations naturally occurring in soils. As such, the Site does not qualify for an exclusion from a TEE.

Based on the site characteristics, the Site is located adjacent to US Forest Service land on property that contains at least 10 acres of native vegetation within 500 feet of the Site. Thus, in accordance with WAC 173-340-7491, the Site must undergo a site-specific evaluation (Ecology 2007 and 2011).

According to Ecology (2011), the site-specific TEE is intended to facilitate selection of a cleanup action by developing information needed to evaluate cleanup action alternatives in the feasibility study. There are two elements in planning a site-specific ecological evaluation. Both must be done in consultation with, and approved by Ecology. The two elements of the site-specific evaluation are: (1) problem formulation; and (2) selecting methods to address issues identified during problem formulation.

After reviewing information developed in the problem formulation step, Ecology may, at its discretion, determine that continuation of the site-specific evaluation is not required for either of the following reasons:

- The cleanup action plan developed for the protection of human health will eliminate exposure pathways of concern to all soil contamination; or

- A simplified evaluation may be conducted because it will adequately identify and address any existing or potential threats to ecological receptors.

The approaches to performing the problem formulation step and the selection of the appropriate TEE methods at the Site are discussed below. The problem formulation establishes the goals and scope of the site-specific assessment. It identifies issues to be addressed, specifically: (1) the identity and distribution of the COCs; (2) exposure pathways; (3) terrestrial ecological receptors of concern; and (4) a toxicological assessment. The purpose of employing the site-specific

TEE method is to ensure that the goals of the ecological evaluation are fulfilled, which are: (1) determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment; (2) characterizing existing or potential threats to terrestrial plants or animals exposed to hazardous substances in soil, and (3) establishing site-specific cleanup standards for the protection of terrestrial plants and animals (WAC 173-340-7489(1)(a)).

3.2.9.3 Problem Formulation

According to guidance on conducting a TEE under MTCA, the scope of the ERA will be defined through a problem formulation step, during which the physical characteristics (i.e., ecosystem components) of the Site will be described, including the important ecological habitats, plants, and wildlife that exist there, including rare, threatened, and endangered species. This information will allow development of the Conceptual Ecological Exposure Model, presenting the assessment communities and receptors of concern (ROCs), ecological exposure media of concern, and exposure pathways to be assessed within the risk-based screening. Finally, assessment endpoints and measures will be defined that describe the primary ecological concerns at the Site and link the risk-based screening results to risk management decisions.

Identification of habitat and ROCs will be based on searches of the Washington Department of Fish and Wildlife Priority Habitat and Species Database and the Washington Department of Natural Resources Natural Heritage Program Database for the Site vicinity. Due to the numerous species that may inhabit a given site, individual ROCs will be identified that correspond to receptor groups that are defined primarily by the predominant exposure routes. The receptor groups of concern at the Site are likely to include the following:

- Terrestrial plants exposed to COCs in soil, waste rock, and tailings;
- Terrestrial invertebrates exposed to COCs in soil, waste rock, and tailings;
- Terrestrial birds exposed to COCs soil, waste rock, tailings, surface water, and sediment;
- Terrestrial mammals exposed to COCs in soil, waste rock, tailings, surface water, and sediment;
- Aquatic life exposed to COCs in surface water and sediment;
- Benthic (sediment-dwelling) invertebrates exposed to COCs in sediment and surface water; and
- Fish-eating wildlife exposed (via the food chain) to COCs in sediment.

After identification of ROCs, their exposure pathways, and exposure media, assessment endpoints are identified. The assessment endpoints are descriptions of the environmental characteristics of concern at the Site (EPA 1998), and generally represent ecological aspects that should be assessed in order to assure protection of the environment and allow informed site-specific risk management decisions. Assessment endpoints typically consist of protecting the survival and reproduction of species and communities. Measurement endpoints (i.e., the means for measuring the survival and reproduction endpoints) will be listed and typically consist of the EPCs and environmental media standards and criteria used to estimate the potential for risks.

3.2.9.4 Site-Specific TEE Methods

Of the site-specific methods for TEE described in Ecology guidance, we recommend the method of comparison of exposure concentrations with ecological criteria under "Literature Survey" will be used, and will be supplemented with additional ecological criteria as needed, using the method described under "Wildlife Exposure Model." Methods described under "Soil Bioassays" or "Site-Specific Field Studies" are not anticipated.

3.2.10 Approach to Evaluating Risks Associated with Surface Water and Sediment Exposures

Ecological risks associated with surface water and sediment at the Site will be evaluated following Washington state guidelines and established practices for performing ERAs at mining sites. The specific approach and methods for evaluating risks from exposures of ecological receptors to surface water and sediment contamination for the Site are presented in following sections.

3.2.11 Risk-Based Screening

The COCs remaining following the initial screening procedures described above will be incorporated into the ERA. EPCs for each COC in each medium will be calculated and compared to risk-based screening criteria.

3.2.11.1 Ecological Exposure Point Concentrations

Ecological EPCs for each COC will be developed for each medium for quantifying exposures to wildlife receptors that may use the Site. The EPCs are conservative estimates of the environmental concentration to which ecological receptors are exposed at the Site. For this ERA, the EPCs will be based on the 95 UCL for each constituent in soil. The 95 UCL of the mean concentration for each medium will be determined using EPA ProUCL software. When the data set consists of less than six detections, the maximum concentration will be used as the EPC.

3.2.11.2 Ecological Risk-Based Comparative Concentrations

The following ecological screening criteria will be used for comparison with the EPCs in the respective environmental medium:

- Surface water – Washington state water quality standards (Ecology 2003).
- Soil, tailings, and waste rock soil – Ecology risk-based screening concentrations for surface soil in Table 749-3. For chemicals missing values in Table 749-3, Tables 749-4 and 749-5 will be used in the Wildlife Exposure Model method to develop appropriate values; Where MTCA does not have an accepted value in Table 749-3, the EPA Eco-SSL values will be considered followed by the Oak Ridge National Laboratory (ORNL) values and ODEQ guidance, in a tiered approach.
- Sediment – As per Ecology recommendations, the freshwater sediment quality guidelines in Ingersoll et al. (2000), or other sources acceptable to Ecology will be used, since freshwater criteria are not available in MTCA.

For COCs without corresponding ecological criteria, the lowest available alternative ecological criteria will be selected from other peer-reviewed sources, such as Oak Ridge National Laboratory documents (Jones et al. 1997, Sample et al. 1996, and Suter and Tsao 1996) or ecological soil screening levels developed by EPA (EPA 2008). For sediment, ODEQ (2001) risk-based Screening Level Values (SLVs) or NOAA values will be considered. If no ecological criteria are available for a COC, criteria from other COCs may be used as surrogate values (based on similarity in chemical structure), where appropriate. The ecological criteria will be tabulated and cited.

3.2.11.3 Risk-Based Screening Procedure

The risk-based screening step eliminates from further consideration COCs that are not detected at the Site above ecological screening criteria. Cleanup levels shall be developed for COCs that exceed a screening criterion (i.e., a risk ratio greater than 1.0).

In addition to the above evaluation using detected chemicals at the Site, for undetected chemicals, the maximum detection limit will be compared to the respective screening criteria to assess that the analytical methods were sensitive enough to detect a potential impact.

3.2.12 Ecological Risk Characterization

The risk characterization section will present the predicted ecological risks and discuss associated uncertainties. Hazard quotients will be prepared for plants, soil invertebrates, and wildlife. However, for the ERA, no species-specific toxicity quotients or indices will be calculated. Therefore, the risk characterization will be a description of why particular COCs were selected in order to focus any further assessment or remediation on the COCs of most concern at the Site. In addition, the uncertainties associated with the ERA process will be presented and discussed with regard to the potential to result in over- or underestimation of the actual ecological risks.

3.2.13 Ecological Risk Assessment Conclusions

The results of the ERA will be summarized. Recommendations for additional assessment of risk to ecological receptors will be provided, if deemed necessary to understand the potential for risks that may result from exposure to COCs at the Site. Conditions for additional risk assessment could be data gaps that were not obvious before conducting the remedial investigation or the need for more Site-specific contaminant toxicity and/or exposure information to better refine risks. Additional assessment tools for evaluating sediment can consist of a stream macroinvertebrate analysis. The analysis is useful if the ERA concludes that sediment and water data suggest a possible risk to macroinvertebrates; the macroinvertebrate analysis would confirm or refute the risk conclusions using on-site biological data.

4.0 FEASIBILITY STUDY APPROACH

The following summary of the FS approach is based on WAC 173-340-350(8) procedures for conducting a feasibility study.

4.1 Cleanup Standards for Site Hazardous Substances and Media

Preliminary cleanup levels for hazardous substances at the Site have been established during RI scoping based on available information and are presented in Section 3.11.2 of this Work Plan. Preliminary cleanup levels will be refined during the RI, if necessary, based on evaluation of the background data collected, chemical site data collected, aquatic and terrestrial environments, fisheries, mammals, and input from local residents on current/future land use and site access. Cleanup standards include both cleanup levels and points of compliance for Site hazardous substances and media.

4.2 Site Exceedances of Hazardous Substance Cleanup Standards

Based on the Site information available at the time of preparing this Work Plan (as summarized in previous sections), concentrations of hazardous substances exceed preliminary cleanup levels, and cleanup action alternatives will need to be developed and analyzed in the FS to address these exceedances.

Site exceedances of hazardous substance cleanup levels at the standard or conditional points of compliance for media and exposure pathways will be assessed in the FS. The assessment will be based on the nature and extent of contamination determined during the RI. Remedial action objectives and cleanup action alternatives will be developed to address hazardous substance exceedances.

4.3 Identification and Initial Screening of Technologies

Cleanup action objectives will be developed and general response actions identified to address exceedances of hazardous substance concentrations identified in the FS. Cleanup action components and available technologies will be identified in the FS, and a preliminary screening will be performed to eliminate technologies that are not technically possible to implement at the Site. Cleanup action alternatives will be developed from the cleanup action components that survive the initial technology screening.

An initial screening of alternatives to reduce the number of alternatives carried forward in detailed evaluation may be appropriate for this Site [WAC 173-340-350(8) (b)]. The following cleanup action alternatives or components may be eliminated from the FS:

1. Alternatives that, based on a preliminary analysis, Ecology determines clearly do not meet the minimum requirements specified in WAC 173-340-360, so that a more detailed analysis is unnecessary. This includes those alternatives for which a disproportionate cost analysis shows that the costs are clearly disproportionate under WAC 173-340-360(3)(e); and

2. Alternatives or components not technically possible.

Ecology shall make the final determination of which alternatives must be evaluated in the FS.

4.4 Development and Description of Cleanup Action Alternatives

Cleanup action alternatives will be developed in accordance with WAC 173-340-350(8) (c) (i). These alternatives shall address Site exceedances of hazardous substance concentrations that exceed levels of protection for human health and aquatic and terrestrial ecological receptors [WAC 173-340-350(8)(c)(i)(A)].

A reasonable number of alternatives will be developed and evaluated [WAC 173-340-350(8)(c)(i)(B)]. Alternatives will address Ecology's preferred cleanup strategies: reuse or recycle the hazardous substances, destroy or detoxify the hazardous substances, immobilize or solidify the hazardous substances, and/or provide for on-site or off-site disposal [WAC 173-340-350(8)(c)(i)(C)].

The feasibility study will include at least one permanent cleanup action alternative [WAC 173-340-200]. This alternative will serve as a baseline against which the other alternatives will be evaluated to assess whether the cleanup action selected is permanent to the maximum extent practicable. The evaluation of alternatives will address MTCA exceptions including as model remedy selection, technical feasibility, or disproportionate costs of an alternative as described in WAC 173-340-350(8)(c)(ii)(B).

4.4.1 Ecology Expectations for Cleanup Action Alternatives

Ecology has the following expectations, which will be considered in the development of cleanup action alternatives for the Site [WAC 173-340-370]:

- Emphasize use of treatment technologies where possible;
- Minimize the need for long-term management of contaminated materials;
- Use engineering controls, such as containment, where treatment is impracticable;
- Limit the effects of precipitation and surface water run-on/runoff to on-site containment of contaminated materials;
- Consolidate hazardous substances left on-site to the maximum extent practicable;
- Prevent or minimize releases to surface water via surface runoff and groundwater discharges in excess of cleanup levels;
- Conduct appropriate monitoring to evaluate that the natural attenuation process is taking place and that human health and the environment are protected; and
- Evaluate that selected cleanup actions will not result in a significantly greater overall threat to human health and the environment than other alternatives.

4.5 Detailed Analysis of Alternatives

After the initial screening of alternatives, a detailed analysis of the remaining alternatives will be conducted [WAC 173-340-360(2)]. The analysis will include addressing threshold requirements, other requirements, and action-specific requirements. In this process, each alternative will be evaluated to assess whether an alternative provides for a reasonable restoration time frame [WAC 173-340-360(4)]. The alternatives that satisfy the minimum MTCA requirements will then be carried forward into a comparative analysis, which is discussed in the following section.

4.5.1 Threshold Requirements

Initially, alternatives carried forward will be evaluated to asses how each alternative satisfies MTCA threshold requirements. These requirements include protection of human health and the environment, compliance with cleanup standards, compliance with applicable state and federal laws, and compliance with future monitoring [WAC 173-340-360(2)(a)].

4.5.2 Other Requirements

Alternatives that meet the threshold requirements will then be analyzed to evaluate which alternative best uses permanent solutions to the maximum extent practicable, provides for a reasonable restoration time frame, and considers public concerns [WAC 173-340-360(2)(b)].

4.5.3 Action-Specific Requirements

In addition to other requirements, the alternatives will be evaluated to asses whether the alternatives satisfy action-specific requirements. The action-specific requirements include cleanup of groundwater, cleanup of soil at current or potential future residential areas, cleanup of soil at schools and child care centers, use of institutional controls, control of present and future releases and migration, reliance on dilution and dispersion, and remediation levels [WAC 173-340-360(2)(c) through (h)].

4.5.4 Reasonable Restoration Time Frame

Following the detailed analysis, alternatives will then be evaluated to assess how the cleanup actions provide for a reasonable restoration time frame. Factors that will be evaluated include: human health and ecological Site risks, achieving shorter restoration times, current and potential future use of the Site and surrounding areas, availability of alternative water supplies, effectiveness and reliability of institutional controls, the ability to control and monitor migration of hazardous substances, toxicity of the hazardous substances, and potential natural attenuation [WAC 173-340-360(4)(b)].

If a cleanup action selected has a greater degree of long-term effectiveness than on-site or off-site disposal, isolation, or containment options, a longer restoration time frame for the Site to achieve cleanup levels at a point of compliance may be acceptable. Extending the restoration time frame will not be used as a substitute for active remedial measures, when such actions are practicable.

4.6 Comparative Analysis of Alternatives

A comparative analysis will be conducted on the alternatives carried forward from the detailed analysis and reasonable restoration time frame analysis [WAC 173-340-360(2) and (3)]. To evaluate which alternatives use permanent solutions to the maximum extent practicable, the comparative analysis will use a disproportionate cost analysis to compare the costs and benefits of permanent cleanup action alternatives [WAC 173-340-360(3)(e)].

4.6.1 Disproportionate Cost Analysis [WAC 173-340-360(3)(e)]

A cost-benefit analysis will be used to evaluate disproportionate costs. The first step will be to identify, under each alternative, the incremental cost of the cleanup actions and the benefits realized by those actions. This information will then be used to compare alternatives and identify which alternatives are disproportionately high in cleanup action costs verses the benefits realized by those cleanup actions.

This information will be used as a basis for recommending which cleanup actions would be cost effective and be permanent to the maximum extent practicable. To evaluate whether a cleanup action is permanent to the maximum extent practicable, the following criteria will be used in disproportionate cost analysis.

- **Protectiveness.** Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.
- **Permanence.** The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.
- **Cost.** The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency

oversight costs that are cost recoverable. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Cost estimates for treatment technologies shall describe pretreatment, analytical, labor, and waste management costs. The design life of the cleanup action shall be estimated and the cost of replacement or repair of major elements shall be included in the cost estimate.

- **Effectiveness over the long term.** Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.
- **Management of short-term risks.** The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.
- **Technical and administrative implementability.** Ability to be implemented including consideration of whether the alternative is technically possible, availability of necessary off-site facilities, services and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with existing facility operations and other current or potential remedial actions.
- **Consideration of public concerns.** Whether the community has concerns about the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the Site.

5.0 PROJECT ORGANIZATION AND SCHEDULE

Prior to implementation of the RI/FS Work Plan, an organization chart will be submitted to Ecology that identifies key project personnel and their roles and responsibilities on the project. The chart will describe the responsibilities and lines of authority and communication for key positions including quality assurance and quality control.

The Project Manager duties will consist of assuring technical quality, establishing schedule and budget, selecting project team members and subcontractors, providing technical oversight, and providing overall production and review of project deliverables. The Project Manager will be responsible for adhering to budgets and schedules and communicating and resolving issues that surface during project execution with the Ecology Project Manager. This approach will facilitate efficient production of project work, allow for an independent quality review, and permit resolution of any QA issues before submittal of work products.

A Principal in Charge will be identified for the project and will work with the Project Manager to obtain project resources, meet overall quality objectives for the project, and fulfill contractual and administrative requirements of the project.

The final reports for the RI/FS will include a:

- Remedial Investigation;
- Human Health Risk Assessment;
- Terrestrial Ecological Evaluation; and
- Feasibility Study.

The Project Manager will work with Ecology to establish whether combining any of the individual reports into a single report will better facilitate use and dissemination of the information. During implementation of the RI/FS, it may be necessary to convey interim findings. If requested by Ecology, Technical Memoranda will be prepared and submitted to Ecology for review and comment on the findings.

Each report will be submitted as a draft for Ecology review and comment. Comments received will be addressed and the final reports submitted to Ecology. During the tasking of the RI/FS work, the Project Manager will work with Ecology to identify the number of hard or electronic copies of each report that need to be submitted.

5.1.1 Field Coordinator

The field coordinator is responsible for the daily management of activities in the field.

Quality Assurance (QA) Leader

A quality assurance/quality control (QA/QC) leader will be assigned to the project. This person will be responsible for tracking and checking the project's overall QA/QC. The project QA leader is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. Specific responsibilities of the QA leader are discussed in the SAP.

5.1.2 Data Management

Data collected during the RI/FS will be input to Ecology's EIM database. The approach to data management and input to Ecology's database is discussed further in the SAP.

5.1.3 Project Schedule

Based on authorization to proceed with the RI/FS, a project schedule will be submitted to Ecology. The schedule will identify timing of planned field activity, results of laboratory analysis, and general deliverable dates for the RI/FS documents.

6.0 REFERENCES

See Table 3 for DCN numbers and additional references.

Beacon Hill Consultants (1988) Ltd., 1999, Equinox Resources (Wash.) Inc., Van Stone Mine, Washington State, USA; Reclamation and closure plan: Beacon Hill Consultants (1988) Ltd. [under contract to] Mano River Resources Inc., 1 v.

Beacon Hill Consultants. 2002. Equinox Resources (WASH.) Inc. Van Stone Mine, Washington State, USA. Reclamation and Closure Plan. Prepared for Mano River Resources Inc. (formerly Zicor Mining Inc.)

Boise Cascade Corporation, March 1997, Onion Creek Watershed Analysis, Kettle Falls, Washington.

Ecology. 1992. Statistical Guidance for Ecology Site Managers

Ecology. 2007. Model Toxics Control Act. Washington Administrative Code (WAC) 173-340.

Ecology. 2011. http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/TEEHome.htm. Site accessed February 2011.

EPA. 1989. Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (HHEM) (Part A, Baseline Risk Assessment). Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002.

EPA. 1994. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. Office of Emergency and Remedial Response. EPA/540/R-93/081.

EPA. 1996a. Soil Screening Guidance: User's Guide. Publication 9355.4-23. United States Office of Solid Waste Response, US Environmental Protection Agency, Washington, DC. July.

EPA. 1996b. Recommendations of the technical review workgroup for lead for an interim approach to assessing risks associated with adult exposure to lead in soil. Technical Review Work Group on Lead.

EPA. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002-F. Risk Assessment Forum, US Environmental Protection Agency, Washington, DC.

EPA. 2000. Bioaccumulation testing and interpretation for the purpose of sediment quality assessment: status and needs. EPA-823-R-00-001. Bioaccumulation Analysis Workgroup, US Environmental Protection Agency, Washington, DC.

EPA. 2008. Ecological Soil Screening Levels. U.S. Environmental Protection Agency. http://www.epa.gov/ecotox/ecossl/index.html.

EPA. 2010. ProUCL Version 4.00.05 User Guide (Draft). EPA/600/R-07/041. Available from: http://www.epa.gov/esd/tsc/TSC_form.htm

EPA. 2011. Integrated Risk Information System (IRIS). U.S. Environmental Protection Agency. http://www.epa.gov/IRIS/.

EPA. 2011. Regional Screening Levels for Chemical Contaminants at Superfund Sites.

EPA. 1992. Dermal *Exposure Assessment: Principles and Applications,* Interim Report. Office of Health and Environmental Assessment. 600/8-91-011B

Ingersoll, C., D. MacDonald, N. Wang, J. Crane, L. Field, P. Haverland, N. Kemble, R. Lindskoog, C. Severn, and D. Smorong. 2000. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. Prepared by U.S. Geological Survey for U.S. Environmental Protection Agency Great Lakes National Program Office (GLNPO). Chicago. EPA 905/R-00/007. http://www.cerc.usgs.gov/pubs/center/pdfDocs/91126.pdf

Jones, D.S, G.W. Suter, and R.N. Hull. 1997. Toxicological Benchmarks for Screening Contaminants of Concern for Effects on Sediment-Associated Biota: 1997 Revision. ES/ER/TM-95/R4. Prepared for the US Department of Energy by Lockheed Martin Energy Systems. Oak Ridge National Laboratory, TN.

Lentz, R. T., 2002, Physical limnology and geochemistry of two circum-neutral pH mine pit lakes in NE Washington: American Society for Surface Mining and Reclamation, 2002 National Meeting, paper, 17 p.

Mills, J. W., 1977, Zinc and lead ore deposits in carbonate rocks, Stevens County, Washington: Washington Division of Geology and Earth Resources Bulletin 70, 171 p.

Neitzel, T. W., 1972, Geology of the Van Stone mine, Stevens County, Washington: Washington State University Master of Science thesis, 47 p.

Oregon Department of Environmental Quality (ODEQ). 2001. Guidance for Ecological Risk Assessment: Level II Screening. Final. Oregon Department of Environmental Quality, Waste Management and Cleanup Division, Portland, OR.

ODEQ. 2007. Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment. Final. Oregon Department of Environmental Quality, Environmental Cleanup Program, Portland, OR. Updated April 3.

Sample, B.E., D.M. Opresko, and G.W. Suter. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. ES/ER/TM-86/R3. Prepared for the US Department of Energy by Lockheed Martin Energy Systems. Health Sciences Research Division, Oak Ridge National Laboratory, TN.

Smith, Kathleen S., C.A. Ramsey, and P.L. Hageman, 2000. Sampling Strategy for the Rapid Screening of Mine-Waste Dumps on Abandoned Mine Lands. US Department of the Interior, US Geological Survey. Denver, Colorado.

Suter, G.W., and C.L. Tsao. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Prepared for US Department of Energy. Oak Ridge National Laboratory, TN. June.

United States Environmental Protection Agency (EPA). 1989. Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual (HHEM) (Part A, Baseline Risk Assessment). Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002. NTIS PB90-155581.

Washington State Department of Ecology (Ecology). 2003. Water Quality Standards. Washington State Department of Ecology. http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A.

Yates, R. G.; Becraft, G. E.; Campbell, A. B.; Pearson, R. C., 1964, Tectonic framework of northeastern Washington, northern Idaho, and northwestern Montana [abstract]: American Institute of Mining, Metallurgical, and Petroleum Engineers; Canadian Institute of Mining and Metallurgy Joint Meeting, [1 p.].

J:\Jobs\1733031\Work Plan\Draft Final Van Stone Work Plan.doc

Table 1 - Parcel Information in the Vicinity of the Van Stone Mine

Parcel	Owner Name	Address	Land Type
433400	Vaagen Bros. Lumber Co. Inc.	567 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5032900	Diana L Walker et al.	464 Douglas Falls Rd., Colville WA, 99114	Resource - Designated Forest Land
5033800	William M. Swartz	2025 B Lotze Creek Rd., Colville WA 99114	Residential - Single Family
5033900	North Country Properties LLC.	2501 N. Linder Rd., Eagle, ID 83616	Resource - Designated Forest Land
5034100	Brad R. Allison	1269 Arcadia Blvd, Bullhead City, AZ 86442-6959	Resource - Designated Forest Land
5034200	North Country Properties LLC.	2500 N. Linder Rd., Eagle, ID 83616	Resource - Designated Forest Land
5037100	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5037200	Stimson Washington Inc	7600 N. Mineral Dr. #400, Suite 400, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5037500	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5037690	Stimson Washington Inc	7601 N. Mineral Dr. #400, Suite 400, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5037695	Olen R. Burris	2057 Lotze Creek Rd., Lot D, Colville, WA 99114	Residential - Single Family
5037700	Equinox Resources (Wash) Inc.	PO Box 32, Colville, WA 99114	Undeveloped - Land
5038000	William M. Swartz	2025 B Lotze Creek Rd., Colville WA 99114	Resource - Designated Forest Land
5038100	Keith D. Ringer	1436 Peterson Swamp Rd., Colville, WA 99114	Resource - Designated Forest Land
5038200	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5038200	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5038401	Equinox Resources (Wash) Inc.	PO Box 32, Colville, WA 99116	Undeveloped - Land
5038410	Vaagen Bros. Lumber Co. Inc.	566 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5038450	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5038600	Edward C. Darrah	2131 Lotze Creek Rd., Colville, WA 99114	Residential - Single Family
5038650	George Mattozzi	2157 Lotze Creek Rd., Colville, WA 99114	Undeveloped - Land
5038700	Onion Creek Eighty Acres LLC.	298 S. Main St. #304, Colville, WA 98114	Resource - Designated Forest Land
5038800	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5038900	Earle W. Olson	20321 22nd Ave. E., Spanaway, WA 98387	Residential - Single Family
5039000	Jason A. Jones	2117 Lotze Creek Rd., Colville, WA 99114	Residential - Single Family
5039101	Daniel L. Hildahl	2125 Lotze Creek Rd., Colville, WA 99114	Undeveloped - Land
5039201	Daniel L. Hildahl	2125 Lotze Creek Rd., Colville, WA 99114	Residential - Single Family
5039302	Equinox Resources (Wash) Inc.	PO Box 32, Colville, WA 99115	Undeveloped - Land
5039320	Equinox Resources (Wash) Inc.	PO Box 32, Colville, WA 99114	Undeveloped - Land
5039400	Diana L Walker et al.	464 Douglas Falls Rd., Colville WA, 99114	Resource - Designated Forest Land
5039500	Chopot Lands LLC	PO Box 206 Colville, WA, 99114	Resource - Designated Forest Land
5039550	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5040000	Frank D. Age	PO Box 1415, Eugene, OR 97441	Residential - Single Family
5040235	Frank D. Age	PO Box 1415, Eugene, OR 97440	Residential - All Other
5041075	Stephen M. Lambert	PO Box 4122, Bremerton, WA 98312	Undedeveloped - Timber Land
5041100	Stimson Washington Inc	7602 N. Mineral Dr. #400, Suite 400, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5041200	Onion Creek Eighty Acres LLC.	298 S. Main St. #304, Colville, WA 98114	Resource - Designated Forest Land
5041300	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5041401	Equinox Resources (Wash) Inc.	PO Box 32, Colville, WA 99114	Resource - Designated Forest Land
5041500	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5041600	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5041700	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5041750	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5041800	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5042000	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
5042150	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Undeveloped - Land
5037900	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5037850	Gallatin Northeast Washington, Land and Timber LLC.	687 W. Canville Ave. #101, Coeur d'Alene, ID 83815	Resource - Designated Forest Land

Table 1 - Parcel Information in the Vicinity of the Van Stone Mine

5037650	Stimson Washington Inc	7600 N. Mineral Dr. #400, Suite 400, Coeur d'Alene, ID 83815	Resource - Designated Forest Land
433400	Vaagen Bros. Lumber Co. Inc.	565 W. 5th Ave., Colville, WA 99114	Resource - Designated Forest Land
5041725	Ron J Matney	Julie A Matney, 790 S Main St., Colville, WA 99114	Resource - Designated Forest Land
5032950	Onion Creek School Distict	Onion Creek School Distict	School District
5033100	North Country Properties LLC.	2500 N. Linder Rd., Eagle, ID 83616	Residential - Single Family
5033200	North Country Properties LLC.	2500 N. Linder Rd., Eagle, ID 83616	Undeveloped - Land
5039420	Chopot Lands LLC	PO Box 206 Colville, WA, 99114	Resource - Designated Forest Land
5032700	Diana L Walker et al.	464 Douglas Falls Rd., Colville WA, 99114	Resource - Designated Forest Land
5032620	William H Martin	1976 Onion Creek Rd., Colville WA, 99114	Residential - Single Family
5040200	Stacy E Henricks	2132 Lotz Creek Rd., Colville WA, 99114	Resource - Designated Forest Land
5039700	Frank D. Age	PO Box 1415, Eugene, OR 97440	Resource - Designated Forest Land

Table 2 - Summary of Water Wells in the in the Vicinity of the Van Stone Mine

Map ID	Well Log ID	Section	Owner	Well Address	Owner Address	Depth (ft)	Use
W-1	WL-1	28	Jack McCotter	695 Rocky Lake Rd., #A, Colville, WA 99114	Same as well	660	Domestic
W-2	WL-2	31	Jerry Bonetto	Not available	PO Box 68, Colville, WA 99114	38	Domestic
W-3	WL-3	31	Alan Cates	Not available	Rte. 2, Box 307 A, Colville, WA 99114	30	Domestic
W-4	WL-4	29	Jim Haager	Not available	Rte. 2, Colville, WA, 99114	20	Domestic
W-5	WL-5-Jones1	29	Frank Jones	2117 Lotze Creek Rd., Colville, WA 98114	20315 22nd Ave. E., Spanaway, WA 98387	100	Domestic
W-5	WL-5-Jones2	29	Frank Jones	2118 Lotze Creek Rd., Colville, WA 98114	20316 22nd Ave. E., Spanaway, WA 98387	600	Domestic
W-5	WL-5-Garceau	29	L. Garceau	Not available		240	Domestic
W-6	WL-6	20	Jerry Carmen	Not available	PO Box 232, Vaughn, WA 98394	480	Domestic
W-7	WL-7	20	Bill Allison	Not available	Rte 2, Box 31CA, Colville, WA 99114	263	Domestic
W-8	WL-8	19	Jacob Ralph	1994 Clugston-Onion Creek Rd., Colville, WA 99114	PO Box 499, Chewelah, WA 99109	200	Domestic
W-9	WL-9	19	Schwab, Otto & Diedre	1991 Clugston-Onion Creek Rd., Colville, WA 99114	Same as well	120	Domestic
W-10	WL-10	18	Dan Wilcox	Not available	Rte. 1, Box 670, Evans, WA 99126	100	Domestic
W-11	WL-11	13	Doug & Sharon Sundheim	Not available	2335 Alm Rd., #18, Chewelah, WA 99109	400	Domestic
W-12	WL-12	24	Channing M. Day Jr	Not available	Rte 2, Box 250, Colville, WA 99116	280	Domestic
W-13	WL-13	30	American Smelting and Refining Co.	Not available	Not available	21	Not available
W-14	WL-14	30	Equinox Resources Ltd		625 Howell St. Vancouver, BC	23	Monitoring Well
W-15	WL-15	30	Paul Lotze	Not available	Not available	120	Domestic
W-16	WL-16	NE1/4NE1/4S25T38NR39E	Jerry L. Slater	Not available	1880 Clugston- Onion Creek Rd., Colville, WA 99114	200	Domestic
W-17	WL-17	N1/2SW1/4SE1/4S24T38NR39E	Leoward Gordon	Not available	Rte. 2, Box 285 Colville, WA	280	Domestic
W-18	WL-18	NW1/4SE1/4S24T38NR39E	Tony Nickerson	Not available	1923 Clugston-Onion Creek Rd., Colville, WA 99114	120	Domestic
W-19	WL-19	SW1/4NE1/4S24T38NR39E	STATE OF WASH. FORD FISH HATCHERY	Not available	Not available	40	Other
WL-20	WL-20	NE1/4SE1/4S19T38NR40E	2006 Lotze	Onion Creek School	2006 Lotze Creek Rd., Colville, WA 99114	135	Non-tansient/Non-community[1]

1: A Group A Public Water System serves 25 or more people per day for 60 or more days /year. The system is defined as Noncommunity when it does not serve 15 or more year-round service connections or 25 or more non-residents/day for 60 or more days/year. The system is Nontransient when it serves 25 or more of the same people/day for 180 or more days/year.

This page is intentionally left blank
for double-sided printing.

						General Chemistry																		Biological			Mics.			Dissolved Metals																																
Reviewed by	**Document Control Number**	**Report Date**	**File Name / Investigation Event**	**Investigation Description**	**Exploration Type Nomenclature**	Temperature	pH	Hardness ($CaCO_3$)	Specific Conductivity	Dissolved Oxygen	Alkalinity	ORP	Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	Total Suspended Solids (TSS)	Turbidity	Sulfate	Sulfide	Nitrite & Nitrate	Chloride	Cyanide	Ammonia Nitrogen	Fluoride	Fecal Coliform	Total Coliform	Bichem O2 Demand	Oil	SVOCs	Pesticides/PCBs	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silicon (Si)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfur (S)	Tin (Sn)	Titanium (Ti)	Thallium (Tl)	Vanadium (Va)	Yttrium (Y)	Zinc (Zn)
CFR	**DCN-1000**	**NA**	**tcp 2.5 map pages**	Van Stone site figures from various years.	None																																																									
CFR	**DCN-1001**	**2010**	**Creek Sampling 11.22.10**	Sampling Data from 10/24/2010 DOE creek sampling of surface water for tributaries. Locations provided in GIS shape file provided by DOE.	**Surface Water (11 Onion Creek samples and Lab certs):** 61VSCS-01 through 61VSCS-11	x	x	x	x	x																										x				x				x		x																				x
CFR	**DCN-1002**	**2010**	**Notice of Correction 8.2.2010**	Notice of Correction Docket #7904. Letter informing Equinox that tailings pile dam is now regulated and needs to be in compliance of all rules and regulations.	None																																																									
ERD	**DCN-1003**	**2010**	**Parcel Search 7.19.2010**		None																																																									
ERD	**DCN-1004**	**1989**	**Lower Tailings Investigation 1990**	Miscellaneous documents include correspondence and maps with exploration locations, boring logs, and CPT data.	Boring Logs and CPT Data 10 Cones and 3 Borings (DH89-6, DH89-3, DH89-1)	x	x	x	x		x		x		x		x		x	x			x							x		x	x			x	x	x		x	x	x		x	x	x	x	x		x	x		x	x					x			x
CFR	**DCN-1005**	**2008**	**Periodic Inspection Report - Van Stone Tailing Dam 1.18.2008**	Periodic Inspection Report (1/18/2008). Includes inspection findings, downstream hazard assessment, and required remedial work.	None																																																									
ERD	**DCN-1006**	**1999**	**Re Reclamation Plan for the Van Stone Mine**	Correspondence	None																																																									
ERD	**DCN-1007**	**1995**	**Re Van Stone Mine Tailings Dam Inspection 10.16.1995**	Correspondence, includes Lower Tailings Pond drawings.	None																																																									
ERD	**DCN-1008**	**1999**	**SEPA Lead Agency & Determination of Nonsignificance 10.1999**	Correspondence memorandum, includes one Equinox monitoring well log.	None																																																									
CFR	**DCN-1009**	**2007**	**Soil and Surface Water Sample Tables 2005-2006**	2005-2006 Sampling Data, Data Tables (11/1/2007).	**Sediment (4 samples, Table X):** 1) VS Upstream, 2) VS Pit, 3) VS Downstream of Pit, and 4) VS Downstream of Tailings.																									x	x	x		x		x		x		x	x	x			x	x		x			x		x						x			x
					Surface Water (4 Pond samples, Table X): 1) VS Upstream, 2) VS Pit, 3) VS Downstream of Pit, and 4) VS Downstream of Tailings.	x	x	x	x				x		x	x	x													x		x				x				x	x	x				x																x
ERD	**DCN-1010**	**1998**	**Tailings Dam Inspection Correspondence 1993-1998**	Correspondence, includes Lower Tailings Pond drawings and photographs.	None																																																									
ERD	**DCN-1011**	**1999**	**Van Stone Reclamation Plan 6.22.1999**	Includes: Standard Reclamation Plan and completed Environmental Checklist, Determination of Nonsignificance																																																											
ERD	**DCN-1012**	**1991**	**Water Quality Summary Reports 1991-1992**	1991-1992 Surface water and groundwater sampling data.	**Surface Water:** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x					x	x	x								x
					Groundwater: 1GW and 2GW	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x					x	x	x								x
ERD	**DCN-1013**	**NA**	**Summary of Mineable Reserves**	Summary of mineable reserves.	None																																																									
ERD	**DCN-1014**	**1974**	**Seepage Environmental Analysis of Slime Zone Tailing Pond**	A research paper covering the seepage of the slime zone through the lower tailings dam and; limited environmental analysis of metal concentrations within the pond, dam, and seeps. Data included Shelby Tube, Consolidation, and Permeability Data (within the slime zone).	**Shelby Tubes (11 total):** 13-1, 13-2, 13-3, 31-4, 13-5, 13-6, 13-7, 21-8, 21-9, 21-10, and 21-11																															x	x			x	x	x		x	x					x			x	x								x
					Tailings Samples (2): 13 and 21																															x	x			x	x	x		x	x					x			x	x								x
					Mics. Samples: sediment, seeps, soils, tailings (surface and core)																																					x																				x
					Well Points: WP-X1 and WP-X2; **Piezometers:** CH1 through CH7																																																									
ERD	**DCN-1015**	**1990**	**Lower Tailings Water Quality Data 1990-1996**	Summary of groundwater quality data.	**Groundwater Sampling:** 1GW and 2GW	x	x		x	x			x	x	x	x	x		x	x											x	x				x	x				x	x		x	x	x		x					x	x	x								x
ERD	**DCN-1016**	**2005**	**Revised Final Reclamation Plan 7.2005**	Reclamation Plan Report, with one drawing.	None																																																									
CFR	**DCN-1017**	**2007**	**Site Hazard Assessment Worksheet**	Site Hazard Assessment Worksheet Summary Score Sheet (2/21/2007) summarizes 2002 E&E study data and Scores Site (RANKING - 1).	None																																																									
ERD	**DCN-1018**	**2005**	**Water Quality Data 2005-2006**	Field measurements, general chemistry and metals for four surface water sites.	**Surface Water Samples:** VS upstream, VS pit, VS, Downstream of Pit, VS Downstream of Tailings	x	x	x	x				x		x	x	x													x			x			x				x	x	x				x																x
CFR	**DCN-1019**	**2007**	**Water Well Data**	Compiled water well data and area water well information.	None																																																									
CFR	**DCN-1020**	**2003**	**Report on Certain Aspects of the Van Stone Mine**	Report sent from DNR to EPA. Includes: 1. Secretary of State records, chronology, officers and addresses of previous owners. 2. Site and land status maps. 3. Clippings and annual reports archived in DGER mine files. 4. DGER field data (surface water and soil analyses, and hazardous materials inventory). 5. Digital on-site photos from October 2002, and aerial photos from 1972, 1990 and 2000.	**Surface Water Samples (5 Pond & Onion Creek samples, Table 1 to 3):** 1) N. Lake, 2) S. Lake, 3) O. Creek Drainage, 4) E. Basin Lower Tailings Pond, and 5) West Basin Lower Tailings Pond.	x	x	x	x																											x						x																				x
					Soil Samples (4 Tailings & Waste Rock Samples, Table 5): 1) Soil sample 25 feet south of red door at mill, green copper oxide, 2) Lower tailings grab sample, 3) Upper tailings grab sample, 4) Concentrate spillage at West Pb-Zn bins grab.																															x				x		x																				x
					Soil Samples (3 Tailings & Background Samples, Table 1, Appendix B): 1) Van Stone Fresh Tailings, 2) Van Stone Old Tailings, and 3) Van Stone Native.		x										x	x												x			x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x				x									x
CFR	**DCN-1021**	**1996**	**Waste Discharge Permit Application**	Wastewater Discharge Permit application (May 21, 1996): Detailed information on geology, hydrology, and soils in the watershed. Also includes locations of residences along Onion Creek and Tailings Management Plan.	**Grab Surface Water Sample:** Pit Water		x		x				x																			x					x					x		x		x								x								x
CFR	**DCN-1022**	**1991**	**Waste Discharge Permit**	Waste Discharge Permit (5/31/91) includes sampling location coordinates (latitude/longitude) for surface water locations SW-1 to SW-8, and groundwater wells W-1 and W-2.	None																																																										
ERD	**DCN-1023**	**1991**	**Tailings Dam Construction 1996**	Re: Van Stone Mine (2/26/1991), Details tailings dam construction and seepage collection dam construction.	None																																																											
ERD	**DCN-1024**	**1990**	**Const Quality Assurance Final Report Phase 1**	Tailings Pile liner construction details, construction quality insurance final report, Van Stone Tailings Impoundment Phase 1	None																																																											
ERD	**DCN-1025**	**1991**	**Const Quality Assurance Final Report Phase 2**	Tailings Pile liner construction details, construction quality insurance final report, Van Stone Tailings Impoundment Phase 2	None																																																											

Table 3 - Van Stone Mine - Summary of Historical Reports and Laboratory Data

Reviewed by	Document Control Number	Report Date	File Name / Investigation Event	Investigation Description	Exploration Type Nomenclature	General Chemistry																		Biological			Mics.			Dissolved Metals																																
						Temperature	pH	Hardness ($CaCO_3$)	Specific Conductivity	Dissolved Oxygen	Alkalinity	ORP	Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	Total Suspended Solids (TSS)	Turbidity	Sulfate	Sulfide	Nitrite & Nitrate	Chloride	Cyanide	Ammonia Nitrogen	Fluoride	Fecal Coliform	Total Coliform	Bichem O2 Demand	Oil	SVOCs	Pesticides/PCBs	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silicon (Si)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfur (S)	Tin (Sn)	Titanium (Ti)	Thallium (Tl)	Vanadium (Va)	Yttrium (Y)	Zinc (Zn)
CFR	DCN-1026	2004	**Groundwater Sampling 9.2004**	Results from September 19, 2004 sampling event.	**Surface Water Samples (3 Pond samples, Table X):** 1) East Tailings TPOND1, 2) West Tailings TPOND2, and 3) Reclaim Pond RPOND.		x	x	x		x		x		x	x	x		x	x											x	x		x		x		x		x	x	x				x		x		x	x		x	x					x			x
ERD	DCN-1027	2007	**Site Hazard Assessment Worksheet with correspondence 2.20.2007**	Site Hazard Assessment Worksheet Summary Score Sheet (2/21/2007), summarizes 2002 E&E study data and Scores Site (RANKING - 1) plus correspondence between DOE and EQ.	None																																																						
ERD	DCN-1028	1990	**Tailings Impoundment Liner system -Phase II**	Grab surface water samples.	**Surface Water (6 total):** North Pit Ponded Water, Upstream Control, Just above old pond, just below old pond, just above new pond, just below new pond																											x				x		x				x				x																x
CFR	DCN-1029	1996	**Trace Element Geochemistry of Onion Creek Near Van Stone**	Research Paper on trace element geochemistry of Onion Creek near the Van Stone lead-zinc mine. (Missing even pages of document 1/13, DOE notified.)	**Groundwater (2 groundwater samples, Table 2):** W18 and W19.	x	x		x		x						x		x											x	x	x	x			x	x	x		x	x	x		x	x		x	x		x	x			x	x					x		x
					Surface Water (23 surface water samples, Table 2): W1-4, missing W5, W6-24.	x	x		x		x						x		x											x	x	x	x			x	x	x		x	x	x		x	x		x	x		x	x			x	x					x		x
					Sediment (18 sediment samples, Table 3): Sed1 through Sed18.																								x	x	x	x			x	x	x		x	x	x		x	x		x	x		x	x			x	x					x		x
CFR	DCN-1030	2007	**Van Stone Mine Cleanup Report 5.7.2010**	Van Stone Mine Cleanup Report (May 7, 2007), report to DOE from Equinox detailing cleanup efforts in 2006, including removal of a Kay Ray nuclear gauge.	None																																																				
ERD	DCN-1031	2010	**Van Stone mine Synopsis Nov 2010 - BD at Ecology**		None																																																				
ERD	DCN-1032	1990	**Notice of Construction 11.9.1990**	Details 6-year mining plan. Includes maps w/ existing and proposed workings, geology info, process info, climate and hydraulic data, and info on plants and wildlife.	None																																																				
ERD	DCN-1033		**Van Stone Tailings Deficiencies Letter 4.27.1998**	Site inspection deficiencies and photographs.	None																																																				
ERD	DCN-1034	2006	**Hazardous Compliance Pages**	Correspondence and cleanup report by Equinox for 2006.	None																																																				
ERD	DCN-1035	1986	**Site Inspection Report 1986**	Site Inspection Report (Michael Spencer DOE, 3/1986). Discussion of surface water sampling results lead (5.96 mg/l) in lower tailings pile indicating dangerous waste. Includes general site information.	**Surface Water (6 total):** North Pit Ponded Water, Upstream Control, Just above old pond, just below old pond, just above new pond, just below new pond																											x				x		x				x				x																x
CFR	DCN-1036	2004	**DNR Inactive and Abandoned Mines**	Comprehensive report giving detailed general information of the status of the mine. Good report to obtain section summaries from.	**Surface Water (5 Pond & Onion Creek samples, Table 6)**: 1) West End pit lake, 2) South pit lake, 3) Middle East Fork Onion Creek, 4) Lower tailings pond east basin, and 5) Lower tailings pond west basin.	x	x	x	x																											x						x																				x
			INACTIVE AND ABANDONED MINE LANDS—Van Stone mine, Northport Mining District, Stevens County, Washington (DNR 12/2004).		**Soil (4 tailing & waste rock samples, Table 3):** 1) soil sample 25 feet south of red door at mill, green copper oxide, 2) Lower tailings grab sample, 3) Upper tailings grab sample, and 4) concentrate spillage at west Pb-Zn bins, grab sample.																														x				x		x																				x
ERD	DCN-1037	1990	**Tailings Disposal Design Report 1990**	Geotechnical recommendations and site history. Includes geotechnical and water quality data in report, dated January 8, 1990.	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x								x	x	x	x			x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
					Boring exploration and monitoring well logs, tailings descriptions, and cone penatometer data w/ graphs, water level data																																																				
ERD	DCN-1038	NA	**Fact Sheet for Discharge Permit**	General site information and water quality data presented to DOE.	**Grab Surface Water Samples:** Tailings Pond area	x	x		x				x				x		x	x											x	x				x	x				x	x		x	x	x		x				x		x								x
					Groundwater Samples: GW1 and GW2	x	x		x				x	x	x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-1039	1990	**Water Quality Data Report 1990**	Complete dataset referenced in "Tailings Design Report" and "Van Stone Mine Project" reports. Note this report is duplicated in various other reports.	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CFR	DCN-1040	2009	**DW Inspection Report 7.8.2009**	Dangerous Waste Inspection Compliance Inspection at Van Stone Mine on May 12, 2009. Compliance Inspection - Copper Sulfate Container (DW) identified on-site.	None																																																				
CFR	DCN-1041	2002	**Upper Columbia River PAsSIs**	Summarizes sampling event and general site information. Best source for soil sampling. Twelve waste rock samples (VSWP01SS through VSWP12SS), twenty-one tailings samples (VSTP01SS through VSTP21SS,) seven surface soil samples (VSSS01SS through VSSS07SS), five sediment and one surface water sample.	**Soil (38 samples including waste rock, tailings, & surface soil, Table 6-6):** 12 waste rock samples (VSWP01SS through VSWP12SS); 21 tailings samples (VSTP01SS through VSTP21SS); and 7 surface soil samples (VSSS01SS through VSSS07SS) from areas of stained soil.																						x		x	x	x	x	x		x	x	x	x	x	x	x		x	x	x		x		x	x		x	x					x	x		x
			Preliminary Assessments and Site Inspections Report Upper Columbia River Mines and Mills Stevens County, Washington (START-2 October 2002).		**Sediment (5 samples, Table 6-7):** VSMW01SD, VSPP01SD through VSPP04SD.																							x	x		x	x			x	x	x	x	x	x	x		x	x			x		x										x		x
					Surface water (1 sample, Table X): VSMW01SW **MISSING DATA**																																																							
					WESTON Appendix H: 1 surface water sample collected from Onion Creek (TS099); 3 Mine and mill-specific background surface soil samples (US007, US008, and US009); and 3 sediment samples were collected from an Unnamed tributary to Onion Creek and Van Stone Mine/Mill (US005, US006, US010). **MISSING DATA**																																																							

						General Chemistry																		Biological			Mics.			Dissolved Metals																																
Reviewed by	**Document Control Number**	**Report Date**	**File Name / Investigation Event**	**Investigation Description**	**Exploration Type Nomenclature**	Temperature	pH	Hardness ($CaCO_3$)	Specific Conductivity	Dissolved Oxygen	Alkalinity	ORP	Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	Total Suspended Solids (TSS)	Turbidity	Sulfate	Sulfide	Nitrite & Nitrate	Chloride	Cyanide	Ammonia Nitrogen	Fluoride	Fecal Coliform	Total Coliform	Bichem O2 Demand	Oil	SVOCs	Pesticides/PCBs	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silicon (Si)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfur (S)	Tin (Sn)	Titanium (Ti)	Thallium (Tl)	Vanadium (Va)	Yttrium (Y)	Zinc (Zn)
CFR	DCN-1042	2002	**Physical Limology and Geochemistry of Two Circum-Neutral pH Mine Pit Lakes in NE Washington**	Physical Limology and Geochemistry of Two Circum-Neutral pH Mine Pit Lakes in NE Washington; Research Paper - Limnological and water chemistry data.	**Grab Surface Water Sample:** Average Pit Lake (Note: Total Metals and general chemistry are monthly averages during the study)		x		x				x		x		x		x	x											x	x				x	x			x	x	x		x	x	x		x					x	x								x
ERD	DCN-1043	2006	**Letter summarizing START-2 Report**	Correspondence between DOE and Equinox Resources.	None																																																							
ERD	DCN-1044	2006	**Site Hazard Assessment Correspondence 9.18.2006 (6 pages)**	Correspondence between DOE and Equinox Resources, pre- site hazard assessment.	None																																																									
ERD	DCN-1045	2007	**Site Hazard Assessment Correspondence 2.4.2007**	Correspondence between DOE and Equinox Resources, post- site hazard assessment.	None																																																									
ERD	DCN-1046	2006	**Site Hazard Assessment Correspondence 9.18.2006 (2 pages)**	Correspondence between DOE and Equinox Resources, pre- site hazard assessment.	None																																																									
ERD	DCN-1047	2002	**START-2 Pages**	Extracted pages from DCN-1041	Waste rock samples, surface soil samples, and sediment samples, refer to DCN-2002.																															x				x		x				x																x
ERD	DCN-1048	1991	**Dam Correspondence**	Correspondence between DOE and Equinox Resources.	None																																																									
CFR	DCN-1049	1995	**Environmental Sampling Request Correspondence by EPA**	Correspondence between EPA and Equinox Resources.	None																																																									
ERD	DCN-1050	2005	**Letter 10.18.2005 Water Quality Sampling**	Summary of surface water and sediment quality data, note duplicate data from DCN-1009.	**Sediment (4 samples, Table X):** 1) VS Upstream, 2) VS Pit, 3) VS Downstream of Pit, and 4) VS Downstream of Tailings.																									x	x	x		x		x		x		x	x	x			x	x		x			x		x						x			x
					Surface Water (4 Pond samples, Table X): 1) VS Upstream, 2) VS Pit, 3) VS Downstream of Pit, and 4) VS Downstream of Tailings.	x	x	x	x				x		x	x	x													x		x				x				x	x	x				x																x
ERD	DCN-1051	2004	**Correspondence with Subject 9.19.2004 Sampling**	Results from September 19, 2004 sampling event, note duplicate data from DCN-1026.	**Surface Water Samples (3 Pond samples, Table X):** 1) East Tailings TPOND1, 2) West Tailings TPOND2, and 3) Reclaim Pond RPOND.		x	x	x		x		x		x	x	x		x	x											x	x		x		x		x		x	x	x				x		x			x		x						x			x
ERD	DCN-1052	1990	**Dam Maintenance Plan and Associated Dam Issues**	Correspondences from 1990 to 1995.	None																																																								
ERD	DCN-1053	1999	**Dam Safety Office Comments Summary**	Correspondence summarizes the July 1999 Reclamation and Closure Plan.	None																																																								
ERD	DCN-1054	1995	**Pan America Sale of Equinox Holdings**	News release of share holdings.	None																																																							
ERD	DCN-1055	2003	**Preliminary Potential Responsible Party Search**	Report by EPA dated September 30, 2003. Includes detailed site history and owner information.	None																																																								
ERD	DCN-1056	1999	**Reclamation and Closure Plan**	Reclamation and Closure Plan (Beacon Hill Consultants July, 1999) includes Onion Creek watershed analysis with watershed figures from Boise Cascade Corp. 1997 report.	**Soil Samples (3 Tailings & Background Samples, Table 1, Appendix B):** 1) Van Stone Fresh Tailings, 2) Van Stone Old Tailings, and 3) Van Stone Native.		x										x	x												x			x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x				x								x
CFR	DCN-1057	1999	**Reclamation and Closure Plan with hand written notes**	Reclamation and Closure Plan (Beacon Hill Consultants July, 1999) includes Onion Creek watershed analysis with watershed figures from Boise Cascade Corp. 1997 report. Note had hand written notes, duplicate of DCN-1056	**Soil Samples (3 Tailings & Background Samples, Table 1, Appendix B):** 1) Van Stone Fresh Tailings, 2) Van Stone Old Tailings, and 3) Van Stone Native.		x										x	x												x			x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x				x								x
PRC	DCN-1058	NA	**Pit Details and Maps from unknown document**	Pit construction and proposed reclamation details, maps, and photos. Figures detail proposed pit excavation and mine shafts. Photos are of pit lakes.	None																																																									
ERD	DCN-1059	2005	**Revised Final Reclamation Plan Figures**	Figures for Reclamation Plan.	None																																																									
ERD	DCN-1060	1990	**SEPA Environmental Checklist Rpt**	Van Stone Mine Project (Equinox Resources, 1/9/1990) includes: 1) Environmental Checklist, 2) Waste Discharge Permit Application Form, 3) Geotechnical and Water Quality Report (1/8/1990) (duplicate of DCN-1039)	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
					Groundwater Sample: GW1			x	x	x				x	x	x	x	x	x	x	x		x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
					Electric Piezocone Testing and 11 Boring logs (DH89-1, DH89-2, DH89-3, DH89-5, DH89-6, DH89-7A, DH89-7B, DH89-8A, DH89-8B, DH89-8C W1, and W2)																																																									
ERD	DCN-1061	2004	**Surface Mine Inspection Report**	Surface Mine Inspection Report Completed for Van Stone (notes).	None																																																								
ERD	DCN-1062	1993	**Tailings and Dam Safety Issues**		None																																																								
ERD	DCN-1063	1998	**Tailings Pond Water Level lowering via irrigation**	Correspondences regarding lowering water level.	None																																																								
PRC	DCN-1064	1996	**Waste Discharge Permit Article**	Local 1996 newspaper article on application for renewal on Van Stone mine waste discharge permit.	None																																																								
ERD	DCN-1065	NA	**Historical photos**	Photographs	None																																																								
PRC	DCN-1066	1977	**Zinc and Lead Ore Deposits in Carbonate Rocks, Stevens County, WA**	DNR detailed geologic description.	None																																																								
PRC	DCN-1067	1990	**Geotech and water quality data report 1990**	Re: Van Stone Mine Geotechnical and water quality data report	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x	x			x	x	x	x	x	x	x	x	x		x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CFR	DCN-1068	1990	**Van Stone Mine Map 1**	Open Pit General Arrangement	None																																																								
CFR	DCN-1069	1990	**Van Stone Mine Map 2**	Proposed 2720' Tailings Impoundment	None																																																								
CFR	DCN-1070	1990	**Van Stone Mine Map 3**	Test Hole Location Plan	None																																																								
CFR	DCN-1071	1990	**Van Stone Mine Map 4**	Proposed 2750' Tailings Impoundment	None																																																								
CFR	DCN-1072	1990	**Van Stone Mine Map 5**	Details and Sections	None																																																								
CFR	DCN-1073	1990	**Van Stone Mine Map 6**	Stability Sections	None																																																								
CFR	DCN-1074	1990	**Van Stone Mine Map 7**	Seepage Recovery System	None																																																								
ERD	DCN-2000	5-1990	**wqdr 5.16.1990 w.labs**	Water Quality Data Report and Analysis by Equinox	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x	x			x	x	x	x	x	x	x		x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ERD	DCN-2001	7-1990	**wqdr 7.4.1990 w.labs**	Water Quality Data Report and Analysis by Equinox	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x	x			x	x	x	x	x	x	x		x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ERD	DCN-2002	2-1991	**wqdr 2.28.1991 w.labs**	Water Quality Data Report and Analysis by Equinox	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

						General Chemistry																		Biological			Mics.			Dissolved Metals																																
Reviewed by	**Document Control Number**	**Report Date**	**File Name / Investigation Event**	**Investigation Description**	**Exploration Type Nomenclature**	Temperature	pH	Hardness ($CaCO_3$)	Specific Conductivity	Dissolved Oxygen	Alkalinity	ORP	Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	Total Suspended Solids (TSS)	Turbidity	Sulfate	Sulfide	Nitrite & Nitrate	Chloride	Cyanide	Ammonia Nitrogen	Fluoride	Fecal Coliform	Total Coliform	Bichem O2 Demand	Oil	SVOCs	Pesticides/PCBs	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silicon (Si)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfur (S)	Tin (Sn)	Titanium (Ti)	Thallium (Tl)	Vanadium (Va)	Yttrium (Y)	Zinc (Zn)
ERD	DCN-2003	3-1991	wqdr 5.28.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x		x	x			x		x	x	x		x	x	x											x				x	x				x	x		x	x	x		x				x	x	x			x					x
ERD	DCN-2004	4-1991	wqdr 4.18.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x		x				x		x		x		x	x	x											x				x	x				x	x		x	x	x		x						x			x					x
ERD	DCN-2005	7-1991	wqdr 7.3.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (6 total):** 1SW, 2SW, 3SW, 4SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x		x				x		x		x		x	x	x											x				x	x				x	x		x	x	x		x						x			x					x
ERD	DCN-2006	8-1991	wqdr 8.3.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (6 total):** 1SW, 2SW, 3SW, 4SW, 6SW, and 7SW; **Groundwater Sample:** GW1	x	x		x				x	x	x		x		x	x	x											x				x	x				x	x		x	x	x		x				x		x			x					x
ERD	DCN-2007	8-1991	wqdr 8.23.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2008	9-1991	wqdr 9.30.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2009	10-1991	wqdr 10.21.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2010	12-1991	WQ sum table 12.15.1991 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2011	5-1992	wqdr 5.11.1992 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2012	8-1992	WQ sum table 8.10.1992 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2013	10-1992	WQ sum table 10.2.1992 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2014	10-1992	WQ sum table 10.23.1992 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2015	11-1992	WQ sum table 11.23.1992 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2016	1-1993	WQ sum table 1.6.1993 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2017	5-1993	WQ sum table 3.19.1993 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2018	8-1993	WQ sum table 5.17.1993 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW1	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2019	8-1994	WQ sum table 8.19.1993 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW1	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x									x
ERD	DCN-2020	11-1994	WQ sum table 8.19.1994 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW1	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x									x
ERD	DCN-2021	3-1995	WQ sum table 11.24.1994 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x									x
ERD	DCN-2022	6-1995	WQ sum table 1st Qtr 1995 w.labs	Water Quality Data Report and Analysis by Equinox	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2	x	x		x	x			x		x	x	x		x	x											x	x				x	x				x	x		x	x	x		x				x	x									x
ERD	DCN-2023	8-1995	WQ sum table 2nd Qtr 1995 w.labs	AmTest Data Package for samples received on 7/26/95	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2024	11-1995	WQ labs 8.25.1995	AmTest Data Package for samples received on 10/18/1995	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2025	2-1996	WQ labs 11.2.1995	AmTest Data Package for samples received on 1/17/1996	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Samples:** GW1 and GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2026	5-1996	WQ labs 2.2.1996	AmTest Data Package for samples received on 4/17/1996	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 8SW; **Groundwater Sample:** GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2027	11-1996	WQ labs 4.1996	AmTest Data Package for samples received on 10/23/1996	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 8SW; **Groundwater Sample:** GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2028	8-1996	WQ labs 11.5.1996	AmTest Data Package for samples received on 7/24/1996	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2					x			x		x	x	x		x	x		x									x	x				x	x				x	x		x	x	x		x				x	x	x								x
ERD	DCN-2029	2-1997	WQ labs 7.1996	AmTest Data Package for samples collected on 1/22/1997	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2					x			x		x	x	x		x	x	x	x									x	x				x	x				x	x		x	x	x		x				x	x	x								x

Reviewed by	Document Control Number	Report Date	File Name / Investigation Event	Investigation Description	Exploration Type Nomenclature
ERD	**DCN-2030**	**5-1997**	**WQ labs 1.22.1997**	AmTest Data Package for samples collected on 4/28/1997	**Surface Water (4 total):** 4SW, 5SW, 6SW, and 8SW
ERD	**DCN-2031**	**8-1997**	**WQ labs 5.9.1997**	AmTest Data Package for samples collected on 7/23/1997	**Surface Water (7 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2032**	**11-1997**	**WQ labs 8.11.1997**	AmTest Data Package for samples collected on 10/28/1997	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2033**	**2-1998**	**WQ labs 11.14.1997**	AmTest Data Package for samples collected on 1/26/1998	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2034**	**8-1998**	**WQ labs 3.2.1998**	AmTest Data Package for samples collected on 7/23/1998	**Surface Water (6 total):** 1SW, 2SW, 4SW, 5SW, 6SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2035**	**11-1998**	**WQ labs 7.1998**	AmTest Data Package for samples collected on 10/21/1998	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2036**	**11-1998**	**WQ labs 10.1998**	AmTest Data Package for samples collected on 10/21/1998	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2037**	**5-1998**	**WQ labs 4.1998**	AmTest Data Package for samples collected on 4/28/1998	**Surface Water (8 total):** 1SW, 2SW, 3SW, 4SW, 5SW, 6SW, 7SW, and 8SW; **Groundwater Sample:** GW2
ERD	**DCN-2038**	**NA**	**cp 2.1.2 1990-91 water qual rpts no labs**	Compilation Water Quality Data Report includes reports: DCN-2000, DCN-2001, DNC-2002, DCN-2003, DCN-2004, DCN-2005, DCN-2006, DCN-2007, DCN-2008, DCN-2009, DCN-2010 **(Refer to the above referenced DCN documents)**	Lab Analyses
ERD	**DCN-2039**	**NA**	**tcp 2.1.2 1992 water qual rpts no labs)**	Compilation Water Quality Data Report includes reports: DCN-2011 to DCN-2015 **(Refer to the above referenced DCN documents)**	Lab Analyses
ERD	**DCN-2040**	**NA**	**cp 2.1.2 1993-94 water qual rpts no labs**	Compilation Water Quality Data Report includes reports: DCN-2016, DCN-2018, DCN-2019, DCN-2020, DCN-2021. Does not include report dated 3/19/93 (DCN-2017, presented) **(Refer to the above referenced DCN documents)**	Lab Analyses

General Chemistry

Document Control Number	Temperature	pH	Hardness ($CaCO_3$)	Specific Conductivity	Dissolved Oxygen	Alkalinity	ORP	Total Dissolved Solids (TDS)	Total Organic Carbon (TOC)	Total Suspended Solids (TSS)	Turbidity	Sulfate	Sulfide	Nitrite & Nitrate	Chloride	Cyanide	Ammonia Nitrogen	Fluoride
DCN-2030					x			x		x	x	x		x	x		x	
DCN-2031					x			x		x	x	x		x	x		x	
DCN-2032					x			x		x	x	x		x	x		x	
DCN-2033					x			x		x	x	x		x	x		x	
DCN-2034					x			x		x	x	x		x	x		x	
DCN-2035					x			x		x	x	x		x	x		x	
DCN-2036					x			x		x	x	x		x	x		x	
DCN-2037					x			x		x	x	x		x	x		x	
DCN-2038																		
DCN-2039																		
DCN-2040	x	x		x	x			x		x	x	x		x	x			

Biological / Mics.

Document Control Number	Fecal Coliform	Total Coliform	Bichem O2 Demand	Oil	SVOCs	Pesticides/PCBs
DCN-2030						
DCN-2031						
DCN-2032						
DCN-2033						
DCN-2034						
DCN-2035						
DCN-2036						
DCN-2037						
DCN-2038						
DCN-2039						
DCN-2040						

Dissolved Metals

Document Control Number	Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Lithium (Li)	Magnesium (Mg)	Manganese (Mn)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silicon (Si)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Sulfur (S)	Tin (Sn)	Titanium (Ti)	Thallium (Tl)	Vanadium (Va)	Yttrium (Y)	Zinc (Zn)
DCN-2030		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2031		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2032		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2033		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2034		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2035		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2036		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2037		x	x				x	x				x	x		x	x	x		x				x	x	x								x
DCN-2038																																	
DCN-2039																																	
DCN-2040		x	x				x	x				x	x		x	x	x		x				x	x	x								x

Notes:

Document includes relevant environmental data (green)

Document includes relevant geotechnical data (blue)

Document provides relevant summary documentation about the Site (orange)

**** MISSING 1997 BOISE CASCADE CORP. REPORT

All files PDF files are located in J:\Projects\Van Stone Mine\Van Stone Document Library\Documents by DCN

Some duplication of historical reports and analytical data may occur in this summary.

This page is intentionally left blank for double-sided printing.

Table 4 - Preliminary Screening Levels for Groundwater

Constituents of Concern	Lowest Potential Groundwater ARAR (a)	State of Washington			Federal	
		State MCLs (b)	MTCA Method A (c)	MTCA Method B (d)	Federal MCLGs (e)	Federal MCLs (f)
Total Metals in ug/L						
Aluminum (Al)	16,000	--	--	16,000 (i)	--	--
Antimony (Sb)	6	6	--	6.4	6	6
Arsenic (As)	0.058	10	5	0.058	0 at tap	10
Barium (Ba)	2,000	2,000	--	3,200	2,000	2,000
Beryllium (Be)	4	4	--	32	4	4
Cadmium (Cd)	5	5	5	16	5	5
Chromium (Cr)	100/50 (h)	100	100/50 (h)	24,000/48 (j)	100	100
Copper (Cu)	640	1,300	--	640	1,300	--
Iron (Fe)	300 (g)	300 (g)	--	11,200	--	--
Lead (Pb)	15	15	15	--	0 at tap	--
Manganese (Mn)	50 (g)	50 (g)	--	2,240	--	--
Mercury (Hg, inorganic)	2	2	2	--	2	2
Nickel (Ni)	100	100	--	320	--	--
Selenium (Se)	50	50	--	80	50	50
Silver (Ag)	80	100 (g)	--	80	--	--
Thallium (Th)	0.5	2	--	--	0.5	2
Vanadium (Va)	1.12	--	--	1.12	--	--
Zinc (Zn)	4,800	5,000 (g)	--	4,800	--	--

Notes:

(a) Shaded cells identify lowest potential chemical-specific ARAR.

(b) WAC 246-290-310. State of Washington MCLs.

(c) WAC 173-340-900, Table 720-1. MTCA Method A.

(d) WAC 173-340-720. MTCA Method B Groundwater cleanup levels. For carcinogenic constituents, the value presented is the lower of the non-carcinogenic and carcinogenic level calculated using Equations 720-1 and 720-2. Information from CLARC 3.1 was used unless otherwise noted.

(e) Maximum Contaminant Level Goals (MCLGs) for non-carcinogens. Non-zero MCLGs are potentially relevant and appropriate. 40 CFR 141.50 and 141.51 and Drinking Water Standards and Health Advisories Office.

(f) Maximum Contaminant Levels (MCLs). 40 CFR 141.62 and Drinking Water Standards and Health Advisories, Office of Water, US EPA, EPA 822-B-00-001, Summer 2000.

(g) Secondary State of Washington MCLs, per 246-290-310 WAC.

(h) Adjusted MCL/MTCA Method A value of 50 µg/L based on total value for chromium III and chromium VI. If only chromium III is present, an MCL of 100 µg/L may be used.

(i) Reference dose and/or cancer potency factor from EPA Region 9 Preliminary Remediation Goals table, October 2004.

(j) 24,000 µg/L (Chromium III), 48 µg/L (Chromium VI).

-- Not established or not applicable.

This page is intentionally left blank
for double-sided printing.

Table 5 - Preliminary Screening Levels for Surface Water

Constituents of Concern	Lowest Potential Surface Water ARAR (a)	State of Washington			Federal							
		Water Quality Standards for Surface Waters (b)		MTCA Method B Cleanup Levels [WAC 173-340-730] (c)	National Recommended Water Quality Criteria [Section 304 of the Clean Water Act] (d)				National Toxics Rule Criteria [40 CFR 131.36(b)(1)] (e)			
		Protection of Aquatic Organisms		Protection of Human Health	Protection of Aquatic Organisms		Protection of Human Health		Protection of Aquatic Organisms		Protection of Human Health	
		Acute	Chronic	Fish Ingestion	Acute	Chronic	Consumption of Water and Organism	Consumption of Organism Only	Acute	Chronic	Consumption of Water and Organism	Consumption of Organism Only
Total Metals in µg/L												
Aluminum (Al)	87	--	--	--	750	87	--	--	--	--	--	--
Antimony (Sb)	1000	--	--	1000	--	--	--	--	--	--	--	--
Arsenic (As)	0.018	--	--	0.098	--	--	0.018	0.14	--	--	0.018	0.14
Barium (Ba)	1000	--	--	--	--	--	1,000	--	--	--	--	--
Beryllium (Be)	270	--	--	270	--	--	--	--	--	--	--	--
Cadmium (Cd)	41	--	--	41	--	--	--	--	--	--	--	--
Chromium (Cr)	243,055(Cr^{III})/ 486(Cr^{VI})	--	--	240,000(Cr^{III})/ 490(Cr^{VI})	--	--	--	--	--	--	--	--
Copper (Cu)	1300	--	--	2,900	--	--	1,300	--	--	--	--	--
Iron (Fe)	300 (f)	--	--	--	--	1,000	300 (f)	--	--	--	--	--
Lead (Pb)	--	--	--	--	--	--	--	--	--	--	--	--
Manganese (Mn)	50	--	--	--	--	--	50	100	--	--	--	--
Mercury (Hg, inorganic)	0.012	--	0.012	--	--	--	--	--	--	0.012	0.14	0.15
Nickel (Ni)	610	--	--	1,100	--	--	610	4,600	--	--	610	4,600
Selenium (Se)	5	20	5.0	2,700	--	5	170	4,200	20	5	--	--
Silver (Ag)	26000	--	--	26,000	--	--	--	--	--	--	--	--
Thallium (Th)	0.24	--	--	--	--	--	0.24	0.47	--	--	1.7	6.3
Vanadium (Va)	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (Zn)	7400	--	--	17,000	--	--	7,400	26,000	--	--	--	--
Dissolved Metals in µg/L												
Aluminum (Al)	--	--	--	--	--	--	--	--	--	--	--	--
Antimony (Sb)	14	--	--	1000	--	--	--	--	--	--	14	4300
Arsenic (As)	0.018	360	190	0.098	340	150	0.018	0.14	360	190	0.018	0.14
Barium (Ba)	1000	--	--	--	--	--	1,000	--	--	--	--	--
Beryllium (Be)	270	--	--	270	--	--	--	--	--	--	--	--
Cadmium (Cd)	0.2	3.7	1.03	41	2	0.2	--	--	3.7	1.03	--	--
Chromium III (Cr III)	74	549	178	240,000	570	74	--	--	549	178	--	--
Chromium VI (Cr VI)	10	15	10	490	16	11	--	--	15	10	--	--
Copper (Cu)	9	17	11	2,900	13.4	9	1,300	--	17	11	--	--
Iron (Fe)	300 (f)	--	--	--	--	1,000	300 (f)	--	--	--	--	--
Lead (Pb)	2.52	65.0	2.52	--	65.0	2.52	--	--	65.0	2.52	--	--
Manganese (Mn)	50	--	--	--	--	--	50	100	--	--	--	--
Mercury (Hg, inorganic)	0.14	2.1	--	--	1.4	0.77			2.1	--	0.14	0.15
Nickel (Ni)	52	1415	157	1,100	468	52	610	4,600	1415	157	610	4,600
Selenium (Se)	5	--	--	2,600	--	5	170	4,200	--	--	--	--
Silver (Ag)	3.2	3.4	--	26,000	3.2	--	--	--	3.4	--	--	--
Thallium (Th)	0.24	--	--	--	--	--	0.24	0.47	--	--	1.7	6.3
Vanadium (Va)	--	--	--	--	--	--	--	--	--	--	--	--
Zinc (Zn)	105	114	105	17,000	117	118	7,400	26,000	114	105	--	--

Notes:

Drinking water criteria shown in the table should also be considered if surface water is classified as a current or future potential domestic water supply under Chapter 173-201A WAC.

Underlined values are hardness dependant, hardness in historical data from Onion Creek ranged from 50 to 200 mg/L. Hardness dependant criteria were adjusted based on the applicable Washington surface water standard of 100 mg/L (WAC 173-201A, Standards for aquatic life in surface water, chronic level maximums at 100 mg/L hadrness) (DCN-2001).

(a) Shaded cells identify lowest potential chemical-specific ARAR.

(b) Chapter 173-201A WAC. Water Quality Standards for Surface Waters of the State of Washington (last update November 20, 2006).

(c) Chapter 173-340-730 WAC. MTCA Method B surface water cleanup levels. For carcinogenic constituents, the value presented is the lower of the non-carcinogenic and carcinogenic level calculated using Equations 730-1 and 730-2 and information from CLARC 3.1, unless otherwise noted.

(d) Water quality criteria published under Section 304 of the Clean Water Act. EPA, National Recommended Water Quality Criteria, 2006.

(e) National Toxics Rule. 40 CFR 131.26(b)(1).

(f) Secondary State of Washington MCLs, per 246-290-310 WAC.

-- Not established or not applicable.

This page is intentionally left blank for double-sided printing.

Table 6 - Preliminary Screening Levels for Sediment

Constituents of Concern (mg/kg)	Lowest Potential Sediment ARAR (a)	State of Washington				Federal			
		Potential Freshwater Sediment Quality Values (b)		Northwest Regional Sediment Evaluation Framework (d)		NOAA Screening Quick Reference Tables (SQuiRTs) (f)		MacDonald (g)	
		LAET (c)	2LAET (c)	SL1 (e)	SL2 (e)	Threshold Effects Level	Probable Effects Level	TELs	PELs
Aluminum (Al)	--	--	--	--	--	--	--	--	--
Antimony (Sb)	0.6	0.6	1.9	--	--	--	--	--	--
Arsenic (As)	5.9	31.4	50.9	20	51	5.9	17	5.9	17
Barium (Ba)	--	--	--	--	--	--	--	--	--
Beryllium (Be)	0.46	0.46	--	--	--	--	--	--	--
Cadmium (Cd)	0.596	2.39	2.9	1.1	1.5	0.596	3.53	0.596	3.53
Chromium (Cr)	37.3	95	133	95	100	37.3	90	37.3	90
Copper (Cu)	35.7	619	829	80	830	35.7	197	35.7	197
Iron (Fe)	--	--	--	--	--	--	--	--	--
Lead (Pb)	35	335	431	340	430	35	91.3	35	91.3
Manganese (Mn)	--	--	--	--	--	--	--	--	--
Mercury (Hg, inorganic)	0.174	0.8	3.04	0.28	0.75	0.174	0.486	0.174	0.486
Nickel (Ni)	18	53.1	113	60	70	18	35.9	18	35.9
Selenium (Se)	--	--	--	--	--	--	--	--	--
Silver (Ag)	0.545	0.545	3.5	2	2.5	--	--	--	--
Thallium (Th)	--	--	--	--	--	--	--	--	--
Vanadium (Va)	--	--	--	--	--	--	--	--	--
Zinc (Zn)	123	683	1,080	130	400	123	315	123	315

Notes:

Currently, the State of Washington does not have promulgated cleanup levels for freshwater sediments.

(a) Shaded cells identify lowest potential chemical-specific ARAR.

(b) Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSLs) as listed for Floating Percentile Approach example presented in Avocet (2003). Example uses mid-point of sensitivity options above 85% and individual polycyclic aromatic hydrocarbons (PAHs) (rather than summed). Example assumes 15% false negatives, approximately 25% false positives, and better than 80% overall accuracy. SQS represents no adverse effects screening level. CSL represents assumed screening level above which cleanup may be required. Avocet (2003) recommends development of SQVs using the Floating Percentile Approach.

(c) Lowest Apparent Effects Threshold (LAET) and 2LAET as listed in Avocet (2003). Avocet (2003) does not recommend using the AET approach for establishing SQS and CSL standards because of relatively low statistical sensitivity. However, Avocet (2003) indicates that this approach may be appropriate for establishing maximum contaminant concentrations for dredging programs, and as hot spot and early action levels for cleanup programs.

(d) US Army Corps of Engineers et al. 2006.

(e) Interim freshwater sediment quality guidelines. Lower screening level (SL1) corresponds to a concentration below which adverse effects to benthic organisms would not be expected. Upper screening level (SL2) corresponds to a concentration at which minor adverse effects may be observed in the more sensitive groups of benthic organisms.

(f) Screening Quick Reference Tables (SQuiRTs) from http://response.restoration.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf.

(g) Ingersoll, C., D. MacDonald, N. Wang, J. Crane, L. Field, P. Haverland, N. Kemble, R. Lindskoog, C. Severn, and D. Smorong. 2000. Prediction of sediment toxicity using consensus-based freshwater sediment quality guidelines. Prepared by U.S. Geological Survey for U.S. Environmental Protection Agency Great Lakes National Program Office (GLNPO). Chicago. EPA 905/R-00/007. http://www.cerc.usgs.gov/pubs/center/pdfDocs/91126.pdf

-- Not established or not applicable.

This page is intentionally left blank
for double-sided printing.

Table 7 - Preliminary Screening Levels for Waste Rock, Soil, and Tailings

Constituents of Concern (mg/kg)	Lowest Potential Soil ARAR (a)	State of Washington								Federal			
		Ecology-Reported Natural Background (b)	MTCA Method A Soil Cleanup Levels (c)	MTCA Method B Soil Cleanup Levels		Ecological Indicator Screening Criteria			Ecological Soil Screening Levels (Eco-SSL) (g)			
				Soil Ingestion (d)	Groundwater Protection (e)	Protection of Plants (f)	Protection of Soil (f)	Protection of Wildlife (f)	Plants	Soil Invertebrates	Avian Wildlife	Mammalian Wildlife
Aluminum (Al)	50	37,200	--	80000	--	50	--	--	--	--	--	--
Antimony (Sb)	0.27	--	--	32	5.42 (j)	5	--	--	--	78	--	0.27
Arsenic (As)	0.67	7	20	0.67	5.84 (j)	-- / 10 (h)	-- / 60 (h)	7 / 132 (h)	18	--	43	46
Barium (Ba)	102	--	--	16,000	1650 (j)	500	--	102	--	330	--	2000
Beryllium (Be)	1.4	1.4	--	160	63 (j)	10	--	--	--	40	--	21
Cadmium (Cd)	0.36	1	2	80	0.69 (j)	4	20	14	32	140	0.77	0.36
Chromium III (Cr III)	26	42 (i)	2,000	120,000	2000 (j)	42 (i)	42 (i)	67 (i)	--	--	26	34
Chromium VI (Cr VI)	19		19	240	19.2 (j)				--	--	--	130
Cobalt (Co)	13	--	--	--	--	20	--	--	13	--	120	230
Copper (Cu)	28	36	--	3,200	577 (j)	100	50	217	70	80	28	49
Iron (Fe)	91.2	43,100	--	56,000	91.2 (j)	--	--	--	--	--	--	--
Lead (Pb)	11	17	250	--	--	50	500	118	120	1700	11	56
Manganese (Mn)	220	1,100	--	11,200	522 (j)	1,100	--	1,500	220	450	4300	4000
Mercury (Hg, inorganic)	0.07	0.07	2	--	2.09 (j)	0.3	0.1	5.5	--	--	--	--
Nickel (Ni)	30	38	--	1,600	130 (j)	30	200	980	38	280	210	130
Selenium (Se)	0.3	--	--	400	5.2 (j)	1	70	0.3	0.52	4.1	1.2	0.63
Silver (Ag)	2	--	--	400	13.6 (j)	2	--	--	560	--	4.2	14
Thallium (Th)	1	--	--	--	--	1	--	--	--	--	--	--
Vanadium (Va)	2	--	--	5.6	22.4 (j)	2	--	--	--	--	7.8	280
Zinc (Zn)	46	86	--	24,000	6220 (j)	86	200	360	160	120	46	79

Notes:
(a) Shaded cells identify lowest potential chemical-specific ARAR.
(b) Data from Natural Background Soil Metals Concentrations in Washington State, (Ecology 1994).
(c) WAC 173-340-740(2), WAC 173-340-900 (Table 740-1). Model Toxics Control Act (MTCA) Method A.
(d) WAC 173-340-740(3). MTCA Method B Unrestricted land use soil cleanup standards. For carcinogenic constituents, the value presented is the lower of the non-carcinogenic and carcinogenic level calculated using Equations 740-1 and 740-2 for ingestion only. Equations 740-4 and 740-5 for ingestion and dermal contact. Information from CLARC 3.1 was used
(e) WAC 173-340-740(3)(b)(iii)(A); MTCA Method B unrestricted land use soil cleanup standards, groundwater protection. Values calculated using the MTCA three-phase partitioning model
(f) MTCA 173-340-900 (Table 749-3).
(g) EPA Ecological Soil Screening Levels (ECO-SSL) are found at http://www.epa.gov/ecotox/ecossl/.
(h) Based on Arsenic III / Arsenic V.
(i) Based on total Chromium.
(j) Based on drinking water MCL.
-- Not established or not applicable.

This page is intentionally left blank for double-sided printing.

Table 8. Summary Statistics of Historical Analytical Data

	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
Groundwater Data Statistics										
Lowest Potential Groundwater ARAR (see Table 4)	0.000058	0.005	0.05	0.64	0.015	0.002	0.1	0.08	4.8	mg/L*
Summary Statistics - Groundwater Well - GW-1										
Frequency of Detection	15/28	12/27	4/4	1/4	23/28	2/29	3/28	5/22	27/28	
Number of Excedences of Lowest Potential Groundwater ARAR	24	1	2	0	19	5	0	0	0	
Maximum Detection	0.008	0.0083	0.071	0.008	0.16	0.0012	0.01	0.02	0.78	mg/L
Minimum Detection	0.001	0.0003	0.046	0.008	0.006	0.0004	0.01	0.01	0.072	mg/L
Mean Detection	0.002	0.0028	0.057	0.008	0.065	0.0008	0.01	0.02	0.282	mg/L
Summary Statistics - Groundwater Well - GW-2										
Frequency of Detection	17/18	16/18	--	--	16/17	0/18	9/18	0/18	18/18	
Number of Excedences of Lowest Potential Groundwater ARAR	18	2	--	--	13	1	0	0	0	
Maximum Detection	0.029	0.00961	--	--	0.39	--	0.08	--	0.91	mg/L
Minimum Detection	0.001	0.0007	--	--	0.002	--	0.01	--	0.046	mg/L
Mean Detection	0.005	0.0027	--	--	0.074	--	0.03	--	0.294	mg/L
Summary Statistics - Unknown Groundwater Wells										
Frequency of Detection	2/2	2/2	2/2	2/2	2/2	--	2/2	--	2/2	
Number of Excedences of Lowest Potential Groundwater ARAR	2	0	0	0	0	--	0	--	0	
Maximum Detection	0.0092	0.00003	0.0006	0.0132	0.0012	--	0.0016	--	0.215	mg/L
Minimum Detection	0.00049	0.00002	0.00021	0.001	0.00095	--	0.0011	--	0.0905	mg/L
Mean Detection	0.00485	0.000025	0.00041	0.0071	0.00108	--	0.0014	--	0.1528	mg/L
Surface Water Data Statistics										
Lowest Potential Surface Water ARAR (see Table 5)	0.000018	0.0002	0.074	0.009	0.00252	0.00014	0.052	0.0032	0.105	mg/L*
Summary Statistics - Surface Water - North and South Pit Area										
Frequency of Detection	9/9	9/12	0/1	6/7	10/12	2/8	1/1	--	12/12	
Number of Excedences of Lowest Potential Surface Water ARAR	9	4	0	0	4	1	0	1	4	
Maximum Detection	0.033	0.0006	--	0.0008	0.018	0.00006	0.01	--	0.6	mg/L
Minimum Detection	0.00018	0.00019	--	0.0002	0.0001	0.000003	0.01	--	0.0149	mg/L
Mean Detection	0.00546	0.00015	--	0.0005	0.0027	0.000032	0.01	--	0.1206	mg/L
Summary Statistics - Surface Water - Upper Tailings Pile Area										
Frequency of Detection	14/15	15/15	5/11	13/13	13/15	2/4	9/9	--	15/15	
Number of Exceedances of Lowest Potential Surface Water ARAR	15	10	0	0	7	0	0	--	7	
Maximum Detection	0.0041	0.0016	0.0016	0.0017	0.0861	0.00012	0.0019	--	0.434	mg/L
Minimum Detection	0.00044	0.00001	0.00021	0.0004	0.000057	0.000003	0.00073	--	0.0085	mg/L
Mean Detection	0.00189	0.00041	0.00111	0.0007	0.012977	0.000061	0.00120	--	0.1320	mg/L
Summary Statistics - Surface Water - Lower Tailings Pile Area										
Frequency of Detection	18/19	13/21	10/15	17/17	19/21	2/5	13/13	0/3	18/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	15	7	0	0	11	0	0	0	5	
Maximum Detection	0.0045	0.0014	0.0026	0.0059	0.254	0.00012	0.00462	--	0.324	mg/L
Minimum Detection	0.00026	0.00001	0.00018	0.0005	0.000072	0.00006	0.00062	--	0.0013	mg/L
Mean Detection	0.00210	0.00041	0.00110	0.0013	0.058654	0.00009	0.00162	--	0.0896	mg/L
Summary Statistics - Surface Water -1SW										
Frequency of Detection	3/21	9/21	3/4	0/4	15/21	1/21	2/21	1/16	21/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	12	17	0	13	5	
Maximum Detection	0.001	0.2	0.025	--	0.068	0.0003	0.02	0.01	0.15	mg/L
Minimum Detection	0.001	0.0002	0.013	--	0.002	0.0003	0.01	0.01	0.018	mg/L

Table 8. Summary Statistics of Historical Analytical Data

	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
Mean Detection	0.001	0.0228	0.020	--	0.010	0.0003	0.02	0.01	0.075	mg/L
Summary Statistics - Surface Water -2SW										
Frequency of Detection	12/21	7/21	3/4	0/4	14/21	1/21	2/21	8/21	21/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	11	17	0	6	2	
Maximum Detection	0.004	0.053	0.024	--	0.03	0.0003	0.02	0.004	0.167	mg/L
Minimum Detection	0.001	0.0002	0.011	--	0.0002	0.0003	0.02	0.001	0.003	mg/L
Mean Detection	0.002	0.0081	0.018	--	0.0071	0.0003	0.02	0.002	0.041	mg/L
Summary Statistics - Surface Water -3SW										
Frequency of Detection	16/21	5/21	2/4	3/4	15/21	0/21	1/21	0/16	19/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	13	0	0	12	17	0	12	1	
Maximum Detection	0.005	0.091	0.016	0.006	0.012	--	0.01	--	0.13	mg/L
Minimum Detection	0.001	0.0002	0.016	0.003	0.001	--	0.01	--	0.007	mg/L
Mean Detection	0.002	0.0185	0.016	0.004	0.005	--	0.01	--	0.034	mg/L
Summary Statistics - Surface Water - 4SW										
Frequency of Detection	1/21	6/21	2/4	3/4	15/21	2/21	0/21	1/16	20/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	13	0	0	11	17	0	13	2	
Maximum Detection	0.002	0.0006	0.025	0.003	0.023	0.0004	--	0.01	0.18	mg/L
Minimum Detection	0.002	0.0002	0.007	0.003	0.002	0.0004	--	0.01	0.018	mg/L
Mean Detection	0.002	0.0004	0.017	0.003	0.007	0.0004	--	0.01	0.066	mg/L
Summary Statistics - Surface Water -5SW										
Frequency of Detection	1/15	2/15	3/4	2/4	7/15	1/15	0/15	0/15	13/15	
Number of Exceedances of Lowest Potential Surface Water ARAR	11	9	0	0	4	11	0	11	1	
Maximum Detection	0.003	0.057	0.019	0.006	0.011	0.012	--	--	0.12	mg/L
Minimum Detection	0.003	0.0002	0.007	0.004	0.001	0.012	--	--	0.002	mg/L
Mean Detection	0.003	0.0286	0.014	0.005	0.004	0.012	--	--	0.026	mg/L
Summary Statistics - Surface Water - 6SW										
Frequency of Detection	4/21	11/21	4/4	0/4	17/21	0/21	1/21	1/16	20/21	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	15	17	1	13	10	
Maximum Detection	0.001	0.307	0.026	--	0.1	--	6.1	0.01	0.31	mg/L
Minimum Detection	0.001	0.0002	0.007	--	0.002	--	6.1	0.01	0.015	mg/L
Mean Detection	0.001	0.0289	0.017	--	0.016	--	6.1	0.01	0.112	mg/L
Summary Statistics - Surface Water - 7SW										
Frequency of Detection	1/18	6/18	0/1	0/1	13/18	2/18	1/18	0/13	14/18	
Number of Exceedances of Lowest Potential Surface Water ARAR	17	12	0	0	11	17	0	12	0	
Maximum Detection	0.001	0.61	--	--	0.011	0.0017	0.02	--	0.08	mg/L
Minimum Detection	0.001	0.0002	--	--	0.002	0.0009	0.02	--	0.002	mg/L
Mean Detection	0.001	0.1020	--	--	0.005	0.0013	0.02	--	0.031	mg/L
Summary Statistics - Surface Water - 8SW										
Frequency of Detection	1/11	2/11	--	--	7/11	1/11	0/11	0/11	10/11	
Number of Exceedances of Lowest Potential Surface Water ARAR	11	10	--	--	4	11	0	11	0	
Maximum Detection	0.001	0.07	--	--	0.12	0.0012	--	--	0.046	mg/L
Minimum Detection	0.001	0.0004	--	--	0.001	0.0012	--	--	0.002	mg/L
Mean Detection	0.001	0.0352	--	--	0.020	0.0012	--	--	0.022	mg/L
Summary Statistics - Surface Water - Along Onion Creek Tributaries										
Frequency of Detection	3/3	1/3	2/3	2/2	2/2	1/1	2/2	--	2/3	
Number of Exceedances of Lowest Potential Surface Water ARAR	3	0	0	0	0	0	0	--	0	

Table 8. Summary Statistics of Historical Analytical Data

	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
Maximum Detection	0.003	0.00001	0.00024	0.0003	0.00015	0.00006	0.0006	--	0.0007	mg/L
Minimum Detection	0.00012	0.00001	0.00012	0.0002	0.00013	0.00006	0.00052	--	0.0006	mg/L
Mean Detection	0.00112	0.00001	0.00018	0.0002	0.00014	0.00006	0.00056	--	0.0007	mg/L
Sediment Data Statistics										
Lowest Potential Sediment ARAR (see Table 6)	5.9	0.596	37.3	35.7	35	0.174 0	18	0.545	123	mg/kg
Summary Statistics - Sediment - North and South Pit Area										
Frequency of Detection	4/5	5/5	5/5	5/5	5/5	1/2	5/5	0/3	5/5	
Number of Excedences of Lowest Potential Sediment ARAR	1	5	0	0	5	0	0	0	5	
Maximum Detection	13.8	16.9	3.9	6.6	847	0.123	6.4	--	4270	mg/kg
Minimum Detection	2.3	0.92	2.0	1.65	39.8	0.123	2.2 JB	--	314	mg/kg
Mean Detection	5.8	6.42	2.5	2.86	225.7	0.123	3.3	--	1832	mg/kg
Summary Statistics - Sediment - Upper Tailings Pile Area										
Frequency of Detection	4/4	4/4	4/4	4/4	4/4	1/1	4/4	0/1	4/4	
Number of Excedences of Lowest Potential Sediment ARAR	0	4	0	0	4	0	0	0	4	
Maximum Detection	3.41	15.8	3.6	25.3	645	0.013	4.3	--	3900	mg/kg
Minimum Detection	2.0	2.64	3.2	2.03	77.2	0.013	2.31	--	700	mg/kg
Mean Detection	2.50	9.81	3.4	9.66	275.3	0.013	3.45	--	2520	mg/kg
Summary Statistics - Sediment - Lower Tailings Pile Area										
Frequency of Detection	11/13	12/13	13/13	13/13	13/13	--	13/13	--	13/13	
Number of Excedences of Lowest Potential Sediment ARAR	1	9	0	3	8	--	0	--	7	
Maximum Detection	9.2	14.2	12.5	257	3850	--	8.9	--	4100	mg/kg
Minimum Detection	0.11	0.11	0.98	0.25	2.2	--	1 JB	--	2.9	mg/kg
Mean Detection	2.59	4.88	3.52	37.49	852.8	--	3.7	--	1228.0	mg/kg
Summary Statistics - Sediment - Along Onion Creek										
Frequency of Detection	4/4	4/4	4/4	4/4	4/4	--	4/4	--	4/4	
Number of Excedences of Lowest Potential Sediment ARAR	0	4	0	0	3	--	0	--	3	
Maximum Detection	2.3	7.8	4.2	9.5	242	--	4.8	--	2000	mg/kg
Minimum Detection	1.4	0.73	3.1	5.7	18.4	--	3.3	--	71	mg/kg
Mean Detection	1.9	4.61	3.7	8.2	120.4	--	4.2	--	1190	mg/kg
Soil Data Statistics										
Lowest Potential Soil ARAR (see Table 7)	0.67	0.36	19	28	11	0.07	30	2	46	mg/kg
Upper Tailings Pile (only one soil sample collected in area)										
Upper tailings grab sample	--	16.4	--	--	485	--	--	--	5070	mg/kg
Summary Statistics - Lower Tailings Pile										
Frequency of Detection	9/19	19/20	19/19	19/19	20/20	7/19	19/19	12/19	20/20	
Number of Excedences of Lowest Potential Soil ARAR	19	18	0	2	19	4	0	0	20	
Maximum Detection	15.1	14.3	12.9	76.2 JL	4710	0.17	17.1	0.56 JB	5870	mg/kg
Minimum Detection	0.96 JB	0.36 JB	1.3 JB	3 JB	10.7	0.06 JB	1.6 JB	0.22 JB	106	mg/kg
Mean Detection	5.37	4.22	5.0	19.3	384.8	0.09	6.1	0.42	1493	mg/kg
Summary Statistics - Unknown Soil Samples										
Frequency of Detection	--	6/6	6/6	6/6	6/6	--	6/6	--	6/6	
Number of Excedences of Lowest Potential Soil ARAR	--	0	0	0	0	--	0	--	0	
Maximum Detection	--	0.041	0.0213	0.0401	13.8	--	0.0283	--	9.3	mg/kg
Minimum Detection	--	0.00348	0.013	0.0236	0.44	--	0.0105	--	0.1	mg/kg
Mean Detection	--	0.02089	0.018	0.0320	5.0	--	0.0165	--	4.9	mg/kg

Table 8. Summary Statistics of Historical Analytical Data

	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
Summary Statistics - Soil (Waste Rock)										
Frequency of Detection	10/12	12/12	12/12	12/12	12/12	10/12	12/12	11/12	12/12	
Number of Excedences of Lowest Potential Soil ARAR	12	12	0	0	11	10	0	1	12	
Maximum Detection	43.8	234	7.1	12.5	76500	1.5	13.7	4.4	68000	mg/kg
Minimum Detection	5.2	5.5	0.46 JB	1.9 JB	7.4	0.08 JB	2.1 JB	0.25 JB	3450	mg/kg
Mean Detection	17.0	52.2	2.02	6.0	8552.8	0.56	5.6	1.02	17498	mg/kg
Summary Statistics - Soil (Stained Soil)										
Frequency of Detection	6/7	8/8	7/7	8/8	8/8	5/7	7/7	7/7	8/8	
Number of Excedences of Lowest Potential Soil ARAR	7	8	0	5	8	5	0	3	8	
Maximum Detection	42.9	940	5.1	18400	181000	6	10.7	27.1	431000	mg/kg
Minimum Detection	9.7	1.9	1.2 JB	5 JB	114	0.15	2.5 JB	0.22 JB	812	mg/kg
Mean Detection	20.5	321.2	3.4	2422	42941	2.03	5.3	5.74	105543	mg/kg

Table 9 - Summary of Historical Analytical Data for Groundwater

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
		Lowest Potential Groundwater ARAR (see Table 4)			0.000058	0.005	0.05	0.64	0.015	0.002	0.1	0.08	4.8	mg/L*
Groundwater Well - GW-1														
1GW	DCN-1039	Equinox	Lower Tailings Pile	1/24/1989	ND	ND	0.071	ND	ND	ND	ND	0.02	0.244	mg/L
1GW	DCN-1039	Equinox	Lower Tailings Pile	3/14/1989	ND	ND	0.065	ND	ND	ND	ND	ND	0.09	mg/L
1GW	DCN-1039	Equinox	Lower Tailings Pile	4/4/1989	ND	ND	0.046	ND	0.02	ND	ND	0.01	0.185	mg/L
GW1	DCN-1037/1039/1059	Equinox	Lower Tailings Pile	12/8/1989	ND	0.005	0.047	0.008	0.06	ND	0.01	0.02	0.543	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	1/24/1990	0.03 U	0.002 U	--	--	0.02 U	0.0002 U	0.01 U	0.02	0.244	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	3/14/1990	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.09	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	4/4/1990	0.03 U	0.002 U	--	--	0.02	0.01 U	0.01 U	0.01	0.185	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	5/10/1990	0.03 U	0.002 U	--	--	0.03	0.01 U	0.01 U	0.01 U	0.163	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	6/4/1990	0.03 U	0.002 U	--	--	0.03	0.01 U	0.01 U	0.01 U	0.143	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	9/9/1990	0.001	0.0014	--	--	0.006	0.0012	0.01 U	--	0.072	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	11/30/1990	0.003	0.0083	--	--	0.011	0.0002 U	0.01 U	--	0.31	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	2/28/1991	0.001 U	0.0003	--	--	0.012	0.0002 U	0.01 U	--	0.002 U	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	3/28/1991	0.001 U	0.0012	--	--	0.014	0.0002 U	0.01 U	--	0.084	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	4/18/1991	0.001	0.0021	--	--	0.071	0.0002 U	0.01 U	--	0.18	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	5/16/1991	0.001	0.003	--	--	0.057	0.0002 U	0.01 U	--	0.368	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	6/13/1991	0.002	0.0022	--	--	0.072	0.0002 U	0.01 U	0.01 U	0.31	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	7/17/1991	--	--	--	--	--	0.01 U	--	--	--	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	8/29/1991	0.001 U	0.0022	--	--	0.006	0.0002 U	0.01 U	0.01 U	0.16	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	9/24/1991	0.002	0.0005 U	--	--	0.12	0.0004	0.01	0.01 U	0.5	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	10/22/1991	0.001 U	0.0016	--	--	0.076	0.0002 U	0.01 U	0.01 U	0.2	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	11/12/1991	0.001	--	--	--	0.16	0.0002 U	0.01 U	0.01 U	0.16	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	3/19/1992	0.002	0.005	--	--	0.16	0.0002 U	0.01	0.01 U	0.78	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	6/12/1992	0.001	0.002 U	--	--	0.096	0.0002 U	0.01 U	0.01 U	0.42	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	8/27/1992	0.001	0.002 U	--	--	0.008	0.0002 U	0.01 U	0.01 U	0.39	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	9/24/1992	0.003	0.002 U	--	--	0.13	0.0002 U	0.01 U	0.01 U	0.48	mg/L
1GW	DCN-1012/1038	Equinox	Lower Tailings Pile	10/29/1992	0.003	0.002 U	--	--	0.13	0.0002 U	0.01 U	0.01 U	0.38	mg/L
1GW	DCN-1015/1038	Equinox	Lower Tailings Pile	4/15/1993	0.002	0.0008	--	--	0.071	0.0002 U	0.01 U	0.01 U	0.17	mg/L
1GW	DCN-1015/1038	Equinox	Lower Tailings Pile	7/29/1993	0.008	0.0029	--	--	0.14	0.0002 U	0.01 U	0.01 U	0.38	mg/L
GW-1	DCN-1038	Equinox	Lower Tailings Pile	10/17/1993	0.002	0.00002 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.38	mg/L
Summary Statistics - Groundwater Well - GW-1														
				Frequency of Detection	15/28	12/27	4/4	1/4	23/28	2/29	3/28	5/22	27/28	
				Number of Excedences of Lowest Potential Groundwater ARAR	24	1	2	0	19	5	0	0	0	
				Maximum Detection	0.008	0.0083	0.071	0.008	0.16	0.0012	0.01	0.02	0.78	mg/L
				Minimum Detection	0.001	0.0003	0.046	0.008	0.006	0.0004	0.01	0.01	0.072	mg/L
				Mean Detection	0.0022	0.0028	0.057	0.008	0.065	0.0008	0.01	0.02	0.282	mg/L
Groundwater Well - GW-2														
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	7/17/1991	0.0026	0.005	--	--	0.08	0.01 U	0.01 U	0.01 U	0.32	mg/L
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	8/29/1991	0.002	0.0007	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.046	mg/L
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	9/24/1991	0.004	0.0005 U	--	--	0.074	0.0002 U	0.01 U	0.01 U	0.31	mg/L
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	10/22/1991	0.003	0.0011	--	--	0.049	0.0002 U	0.01 U	0.01 U	0.11	mg/L
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	11/12/1991	0.003	0.00287	--	--	0.11	0.0002 U	0.01 U	0.02 U	0.39	mg/L
2GW	DCN-1012/1038	Equinox	Lower Tailings Pile	6/12/1992	0.001	0.003	--	--	0.011	0.0002 U	0.01 U	0.01 U	0.51	mg/L
2GW	DCN-1015/1038	Equinox	Lower Tailings Pile	Oct-94	0.029	0.00961	--	--	--	0.0002 U	0.08	0.01 U	0.91	mg/L
2GW	DCN-1015/1038	Equinox	Lower Tailings Pile	Jan-95	0.016	0.00425	--	--	0.39	0.0002 U	0.06	0.01 U	0.45	mg/L
2GW	DCN-1015/1038	Equinox	Lower Tailings Pile	4/12/1995	0.005	0.001	--	--	0.087	0.0002 U	0.03	0.01 U	0.16	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	10/17/1995	0.007	0.00002 U	--	--	0.001 U	0.0002 U	0.03	0.01 U	0.44	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	1/16/1996	0.001 U	0.003	--	--	0.155	0.0002 U	0.03	0.01 U	0.51	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	4/16/1996	0.004	0.0013	--	--	0.067	0.0002 U	0.01	0.01 U	0.2	mg/L

Table 9 - Summary of Historical Analytical Data for Groundwater

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
Lowest Potential Groundwater ARAR (see Table 4)					**0.000058**	**0.005**	**0.05**	**0.64**	**0.015**	**0.002**	**0.1**	**0.08**	**4.8**	**mg/L***
GW-2	DCN-1038	Equinox	Lower Tailings Pile	7/23/1996	0.002	0.0016	--	--	0.029	0.0002 U	0.01	0.01 U	0.14	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	10/22/1996	0.004	0.0056	--	--	0.039	0.0002 U	0.02	0.01 U	0.18	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	4/28/1997	0.002	0.0015	--	--	0.022	0.0002 U	0.01 U	0.01 U	0.098	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	7/23/1997	0.002	0.00072	--	--	0.038	0.0002 U	0.01 U	0.01 U	0.28	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	10/28/1997	0.002	0.0014	--	--	0.016	0.0002 U	0.01 U	0.01 U	0.18	mg/L
GW-2	DCN-1038	Equinox	Lower Tailings Pile	7/22/1998	0.002	0.00089	--	--	0.01	0.0002 U	0.01	0.01 U	0.061	mg/L
Summary Statistics - Groundwater Well - GW-2														
Frequency of Detection					17/18	16/18	--	--	16/17	0/18	9/18	0/18	18/18	
Number of Excedences of Lowest Potential Groundwater ARAR					18	2	--	--	13	1	0	0	0	
Maximum Detection					0.029	0.00961	--	--	0.39	--	0.08	--	0.91	mg/L
Minimum Detection					0.001	0.0007	--	--	0.002	--	0.01	--	0.046	mg/L
Mean Detection					0.005	0.0027	--	--	0.074	--	0.03	--	0.294	mg/L
Groundwater Well - Unknown Groundwater Wells														
W18	DCN-1029	University	Lower Tailings Pile	1992	0.00049	0.00002	0.0006	0.001	0.00095	--	0.0011	--	0.215	mg/L*
W19	DCN-1029	University	Lower Tailings Pile	1992	0.0092	0.00003	0.00021	0.0132	0.0012	--	0.0016	--	0.0905	mg/L*
Summary Statistics - Unknown Groundwater Wells														
Frequency of Detection					2/2	2/2	2/2	2/2	2/2	--	2/2	--	2/2	
Number of Excedences of Lowest Potential Groundwater ARAR					2	0	0	0	0	--	0	--	0	
Maximum Detection					0.0092	0.00003	0.0006	0.0132	0.0012	--	0.0016	--	0.215	mg/L
Minimum Detection					0.00049	0.00002	0.00021	0.001	0.00095	--	0.0011	--	0.0905	mg/L
Mean Detection					0.00485	0.000025	0.00041	0.007	0.00108	--	0.0014	--	0.1528	mg/L

Notes:

U = The analyte was not detected above the laboratory detection limit.

DCN = Document Control Number.

mg/L = milligrams per litter.

* = Converted from ug/L to mg/L.

Laboratory analysis assumed to be dissolved fraction

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
				Lowest Potential Surface Water ARAR (see Table 5)	**0.000018**	**0.0002**	**0.074**	**0.009**	**0.00252**	**0.00014**	**0.052**	**0.0032**	**0.105**	**mg/L***
North and South Pit Area														
North pit ponded water	DCN-1035	Ecology	Unknown	10/16/1985	0.008	0.0006	0.0001 U	--	0.002	0.00006	--	--	0.216	mg/L
Average pit lake chemistry	DCN-1042	University	Van Stone Area	NA	0.033	0.00019	--	0.002 U	0.005	0.002 U	0.01	0.01 U	0.11	mg/L
West end of the North Pit Lake	DCN-1020/2001	DNR	West End of North Pit Lake	Oct-02	--	0.005 U	--	--	0.01 U	--	--	--	0.1	mg/L*
South Pit Lake	DCN-1020/2001	DNR	South Pit Lake	Oct-02	--	0.005 U	--	--	0.018	--	--	--	0.6	mg/L*
Onion Creek Drainage bypassing South Pit	DCN-1020/2001	DNR	Onion Creek Drainage bypassing South Pit	Oct-02	--	0.005 U	--	--	0.01 U	--	--	--	0.015	mg/L*
VS Upstream (Low Flow)	DCN-1009/1018/1050	Ecology	South Pit Area	10/18/2005	0.00043	0.00005	--	0.00018	0.0001	0.00005 U	--	--	0.0149	mg/L*
VS Pit (Low Flow)	DCN-1009/1018/1050	Ecology	North Pit Pond	10/18/2005	0.00261	0.00011	--	0.00062	0.0002	0.00005 U	--	--	0.0785	mg/L*
VS Downstream of Pit (Low Flow)	DCN-1009/1018/1050	Ecology	Onion Creek below Open Pits	10/18/2005	0.00068	0.00013	--	0.00	0.0002	0.00005 U	--	--	0.122	mg/L*
VS Upstream (High Flow)	DCN-1009/1018/1050	Ecology	South Pit Area	6/14/2006	0.00034	0.00006	--	0.00026	0.0002	0.000002 U	--	--	0.0207	mg/L*
VS Pit (High Flow)	DCN-1009/1018/1050	Ecology	North Pit Pond	6/14/2006	0.00321	0.00006	--	0.00044	0.0003	0.000002 U	--	--	0.0632	mg/L*
VS Downstream of Pit (High Flow)	DCN-1009/1018/1050	Ecology	Onion Creek below Open Pits	6/14/2006	0.00018	0.00006	--	0.00082	0.0002	0.0000032	--	--	0.0258	mg/L*
61VSCS-05	DCN-1001	Ecology	Onion Creek below Open Pits	10/24/2010	0.00065	0.000109	--	0.00045	0.0005	--	--	--	0.0811	mg/L*
Summary Statistics - Surface Water - North and South Pit Area														
				Frequency of Detection	9/9	9/12	0/1	6/7	10/12	2/8	1/1	--	12/12	
				Number of Excedences of Lowest Potential Surface Water ARAR	9	4	0	0	4	1	0	1	4	
				Maximum Detection	0.033	0.0006	--	0.00082	0.018	0.00006	0.01	--	0.6	mg/L
				Minimum Detection	0.00018	0.00019	--	0.00018	0.0001	0.0000032	0.01	--	0.0149	mg/L
				Mean Detection	0.00546	0.0002	--	0.0005	0.0027	0.00003	0.01	--	0.1206	mg/L
Upper Tailings Pile Area														
Just above old pond	DCN-1035	Ecology	Unknown	10/16/1985	0.001	0.0004	0.0001 U	--	0.001 U	0.00006 U	--	--	0.177	mg/L
Just below old pond	DCN-1035	Ecology	Unknown	10/16/1985	0.001 U	0.0003	0.0001 U	--	0.001 U	0.00012	--	--	0.148	mg/L
W1	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0034	0.00055	0.0015	0.0017	0.0458	--	0.0019	--	0.108	mg/L*
W2	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0041	0.0013	0.0014	0.0012	0.0861	--	0.0017	--	0.328	mg/L*
W3	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0035	0.0016	0.0016	0.00079	0.0131	--	0.0015	--	0.434	mg/L*
W21	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0013	0.00001	0.0002	0.00096	0.00024	--	0.00079	--	0.0085	mg/L*
W11	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.002	0.00042	0.0009	0.00041	0.0032	--	0.0014	--	0.163	mg/L*
W12	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0022	0.00036	ND	0.00039	0.0018	--	0.0012	--	0.127	mg/L*
W13	DCN-1029	University	Near abandoned tailings pond (TP1) & mine downgradient	1992	0.0024	0.00027	ND	0.00041	0.0048	--	0.00076	--	0.0732	mg/L*
W14	DCN-1029	University	Onion Creek Tributary	1992	0.0033	0.00028	ND	0.00041	0.0084	--	0.00073	--	0.0704	mg/L*
W15	DCN-1029	University	Onion Creek Tributary	1992	0.00088	0.0003	ND	0.00052	0.004	--	0.00081	--	0.0664	mg/L*
VS downstream of Tailings (Low Flow)	DCN-1009/1018/1050	Ecology	Onion Creek below Upper Tailings Pile	10/18/2005	0.00067	0.00011	--	0.00039	0.000057	0.00005 U	--	--	0.0803	mg/L*
VS downstream of Tailings (High Flow)	DCN-1009/1018/1050	Ecology	Onion Creek below Upper Tailings Pile	6/14/2006	0.00044	0.00011	--	0.00052	0.00028	0.0000026	--	--	0.0513	mg/L*
61VSCS-06	DCN-1001	Ecology	Onion Creek below Upper Tailings Pile	10/24/2010	0.00062	0.000105	--	0.00043	0.000491	--	--	--	0.0756	mg/L*
61VSCS-07	DCN-1001	Ecology	Onion Creek below Upper Tailings Pile and Open Pits	10/24/2010	0.00061	0.0000990	--	0.00044	0.000432	--	--	--	0.0698	mg/L*
Summary Statistics - Surface Water - Upper Tailings Pile Area														
				Frequency of Detection	14/15	15/15	5/11	13/13	13/15	2/4	9/9	--	15/15	
				Number of Exceedances of Lowest Potential Surface Water ARAR	15	10	0	0	7	0	0	--	7	
				Maximum Detection	0.0041	0.0016	0.0016	0.0017	0.0861	0.00012	0.0019	--	0.434	mg/L
				Minimum Detection	0.00044	0.00001	0.00021	0.00039	0.000057	0.000003	0.00073	--	0.0085	mg/L
				Mean Detection	0.00189	0.00041	0.00111	0.00066	0.012977	0.000061	0.00120	--	0.1320	mg/L
Lower Tailings Pile Area														
Just above new pond	DCN-1035	Ecology	Unknown	10/16/1985	0.001 U	0.0002 U	0.0001 U	--	0.001 U	0.00012	--	--	0.001 U	mg/L
Just below new pond	DCN-1035	Ecology	Unknown	10/16/1985	0.001	0.0003	0.0001 U	--	0.001 U	0.00006	--	--	0.006	mg/L
W4	DCN-1029	University	Near tailings pond (TP2)	1992	0.0026	0.00057	0.0026	0.00095	0.0691	--	0.0011	--	0.0897	mg/L*
W6	DCN-1029	University	Near tailings pond (TP2)	1992	0.0024	0.00053	0.0024	0.00075	0.065	--	0.0011	--	0.0854	mg/L*
W7	DCN-1029	University	Near tailings pond (TP2)	1992	0.0045	0.00051	0.0023	0.00068	0.0668	--	0.0011	--	0.0821	mg/L*
W8	DCN-1029	University	Near tailings pond (TP2)	1992	0.0033	0.0014	0.00089	0.0013	0.254	--	0.0018	--	0.324	mg/L*
W9	DCN-1029	University	Near tailings pond (TP2)	1992	0.0043	0.0008	0.00076	0.00079	0.0384	--	0.0017	--	0.103	mg/L*
W10	DCN-1029	University	Near tailings pond (TP2)	1992	0.0016	0.00079	0.00059	0.00059	0.178	--	0.0016	--	0.313	mg/L*
W20	DCN-1029	University	Near the new tailings pond (TP2) downgradient	1992	0.0019	0.00007	0.00018	0.00052	0.0036	--	0.0009	--	0.0284	mg/L*
W22	DCN-1029	University	Near the new tailings pond (TP2) downgradient	1992	0.0019	0.00001	0.00027	0.00067	0.00016	--	0.00062	--	0.0013	mg/L*
W23	DCN-1029	University	Near the new tailings pond (TP2) downgradient	1992	0.0029	0.00001	0.00027	0.00062	0.00017	--	0.00063	--	0.0014	mg/L*
W24	DCN-1029	University	Near the new tailings pond (TP2) downgradient	1992	0.0	0.0003	0.00073	0.0059	0.0043	--	0.0014	--	0.107	mg/L*
East basin lower tailings pond	DCN-1020/2001	DNR	East basin Lower Tailings Pile	Oct-02	--	0.005 U	--	--	0.207	--	--	--	0.271	mg/L*
West Basin lower tailings pond	DCN-1020/2001	DNR	West Basin Lower Tailings Pile	Oct-02	--	0.005 U	--	--	0.172	--	--	--	0.131	mg/L*

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
				Lowest Potential Surface Water ARAR (see Table 5)	**0.000018**	**0.0002**	**0.074**	**0.009**	**0.00252**	**0.00014**	**0.052**	**0.0032**	**0.105**	**mg/L***
TPOND1	DCN-1026/1051	Ecology	East basin Lower Tailings Pile	9/15/2004	0.0008	0.0001 U	0.0005 U	0.00295	0.0376	0.00005 U	0.00462	0.0001 U	0.021	mg/L*
TPOND2	DCN-1026/1051	Ecology	West Basin Lower Tailings Pile	9/15/2004	0.00178	0.0001 U	0.0005 U	0.00171	0.00634	0.00005 U	0.00254	0.0001 U	0.0063	mg/L*
RPOND	DCN-1026/1051	Ecology	Reclaim Pond near Lower Tailings Pile	9/15/2004	0.00026	0.0001 U	0.0005 U	0.00087	0.00035	0.00005 U	0.00199	0.0001 U	0.005 U	mg/L*
61VSCS-08	DCN-1001	Ecology	Lower Tailings Pile	10/24/2010	0.00049	0.000058	--	0.00061	0.000275	--	--	--	0.03	mg/L*
61VSCS-09	DCN-1001	Ecology	Onion Creek below Lower Tailings Pile	10/24/2010	0.00151	0.000022	--	0.00262	0.0109	--	--	--	0.008	mg/L*
61VSCS-10	DCN-1001	Ecology	Onion Creek below Onion Creek School	10/24/2010	0.00207	0.00002 U	--	0.00069	0.000072	--	--	--	0.0046	mg/L*
61VSCS-11	DCN-1001	Ecology	Reclaim Pond near Lower Tailings Pile	10/24/2010	0.00044	0.0001 U	--	0.00066	0.00035	--	--	--	0.005 U	mg/L*
Summary Statistics - Surface Water - Lower Tailings Pile Area														
				Frequency of Detection	18/19	13/21	10/15	17/17	19/21	2/5	13/13	0/3	18/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	15	7	0	0	11	0	0	0	5	
				Maximum Detection	0.0045	0.0014	0.0026	0.0059	0.254	0.00012	0.00462	--	0.324	mg/L
				Minimum Detection	0.00026	0.00001	0.00018	0.00052	0.000072	0.00006	0.00062	--	0.0013	mg/L
				Mean Detection	0.00210	0.00041	0.00110	0.00135	0.0586535	0.00009	0.00162	--	0.0896	mg/L
Surface Water Monitoring														
1SW	DCN-1039	Equinox	West Fork Onion Creek	1/24/1989	ND	ND	0.025	ND	ND	ND	ND	0.01	0.080	mg/L
1SW	DCN-1039	Equinox	West Fork Onion Creek	3/14/1989	ND	ND	0.022	ND	ND	ND	ND	ND	0.062	mg/L
1SW	DCN-1039	Equinox	West Fork Onion Creek	4/4/1989	ND	ND	ND	ND	ND	ND	ND	ND	0.135	mg/L
1SW	DCN-1037/1039/1059	Equinox	Below Lower and Upper Tailings Pile	12/8/1989	ND	ND	0.013	ND	ND	ND	ND	ND	0.053	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	1/24/1991	0.001 U	0.0002	--	--	0.011	0.0003	0.01 U	--	0.091	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	2/28/1991	0.001 U	0.002	--	--	0.006	0.0002 U	0.01 U	--	0.109	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	3/28/1991	0.001 U	0.0004	--	--	0.005	0.0002 U	0.01 U	--	0.116	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	4/18/1991	0.001 U	0.0006	--	--	0.01	0.0002 U	0.02	--	0.12	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	5/16/1991	0.001	0.0004	--	--	0.01	0.0002 U	0.01 U	--	0.092	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	6/13/1991	0.001 U	0.0006	--	--	0.068	0.0002 U	0.01	0.01 U	0.15	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02	0.01 U	0.01 U	0.01 U	0.057	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	8/29/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.018	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1991	0.001	0.0005 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.033	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	10/22/1991	0.001 U	0.0005 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.029	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	11/12/1991	0.001 U	0.2	--	--	0.006	0.0002 U	0.01 U	0.01 U	0.05	mg/L
1SW	DCN-1012	Equinox	Equinox	3/19/1992	0.001 U	0.0004	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.056	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	6/12/1992	0.001 U	0.002 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.067	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	8/27/1992	0.001	0.002 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.047	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1992	0.001 U	0.002 U	--	--	0	0.0002 U	0.01 U	0.01 U	0.06	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	10/29/1992	0.001 U	0.002 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.078	mg/L
1SW	DCN-1012	Equinox	West Fork Onion Creek	11/30/1992	0.001 U	0.0002	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.064	mg/L
Summary Statistics - Surface Water -1SW														
				Frequency of Detection	3/21	9/21	3/4	0/4	15/21	1/21	2/21	1/16	21/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	12	17	0	13	5	
				Maximum Detection	0.001	0.2	0.025	--	0.068	0.0003	0.02	0.01	0.150	mg/L
				Minimum Detection	0.001	0.0002	0.013	--	0.002	0.0003	0.01	0.01	0.018	mg/L
				Mean Detection	0.001	0.0228	0.020	--	0.01	0.0003	0.015	0.01	0.075	mg/L
2SW	DCN-1039	Equinox	Unnamed Creek	1/24/1989	ND	ND	0.024	ND	ND	ND	ND	ND	0.012	mg/L
2SW	DCN-1039	Equinox	Unnamed Creek	3/14/1989	ND	ND	0.019	ND	ND	ND	ND	ND	0.029	mg/L
2SW	DCN-1039	Equinox	Unnamed Creek	4/4/1989	ND	ND	ND	ND	ND	ND	ND	ND	0.048	mg/L
2SW	DCN-1037/1039/1059	Equinox	Below Lower Tailings Pile	12/8/1989	ND	ND	0.011	ND	ND	ND	ND	ND	0.010	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	1/24/1991	0.004	0.0012	--	--	0.03	0.0002 U	0.01 U	0.004	0.167	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	2/28/1991	0.002	0.0007	--	--	0.015	0.0002 U	0.02	0.002	0.13	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	3/28/1991	0.001 U	0.0002	--	--	0.006	0.0002 U	0.01 U	0.001 U	0.033	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	4/18/1991	0.002	0.0003	--	--	0.006	0.0002 U	0.02	0.002	0.07	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	5/16/1991	0.001	0.0002 U	--	--	0.007	0.0002 U	0.01 U	0.001	0.002 U	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	6/13/1991	0.001 U	0.0005 U	--	--	0.005	0.0002 U	0.01 U	0.001 U	0.01	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.03 U	0.055	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	8/29/1991	0.002	0.0005 U	--	--	0.0002	0.0002 U	0.01 U	0.002	0.003	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	9/24/1991	0.002	0.0005 U	--	--	0.002	0.0003	0.01 U	0.002	0.004	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	10/22/1991	0.002	0.0005 U	--	--	0.004	0.0002 U	0.01 U	0.002	0.006	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	11/12/1991	0.002	0.053	--	--	0.001 U	0.0002 U	0.01 U	0.002	0.005	mg/L

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
				Lowest Potential Surface Water ARAR (see Table 5)	**0.000018**	**0.0002**	**0.074**	**0.009**	**0.00252**	**0.00014**	**0.052**	**0.0032**	**0.105**	**mg/L***
2SW	DCN-1012	Equinox	Unnamed Creek	3/19/1992	0.001 U	0.0009	--	--	0.001 U	0.002 U	0.01 U	0.001 U	0.028	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	6/12/1992	0.001 U	0.002 U	--	--	0.004	0.0002 U	0.01 U	0.001 U	0.024	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	8/27/1992	0.003	0.002 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.015	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	9/24/1992	0.003	0.002 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.045	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	10/29/1992	0.002	0.002 U	--	--	0.006	0.0002 U	0.01 U	0.01 U	0.035	mg/L
2SW	DCN-1012	Equinox	Unnamed Creek	11/30/1992	0.002	0.0005	--	--	0.012	0.0002 U	0.01 U	0.01 U	0.1	mg/L
Summary Statistics - Surface Water -2SW														
				Frequency of Detection	12/21	7/21	3/4	0/4	14/21	1/21	2/21	8/21	21/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	11	17	0	6	2	
				Maximum Detection	0.004	0.053	0.024	--	0.03	0.0003	0.02	0.004	0.167	mg/L
				Minimum Detection	0.001	0.0002	0.011	--	0.0002	0.0003	0.02	0.001	0.003	mg/L
				Mean Detection	0.002	0.0081	0.018	--	0.0071	0.0003	0.02	0.002	0.041	mg/L
3SW	DCN-1039	Equinox	Unnamed Creek	1/24/1989	ND	ND	0.016	0.003	ND	ND	ND	ND	0.008	mg/L
3SW	DCN-1039	Equinox	Unnamed Creek	3/14/1989	ND	ND	0.016	0.006	ND	ND	ND	ND	0.011	mg/L
3SW	DCN-1039	Equinox	Unnamed Creek	4/4/1989	ND	ND	ND	0.004	ND	ND	ND	ND	0.058	mg/L
3SW	DCN-1037/1039/1059	Equinox	Below Lower Tailings Pile	12/8/1989	ND	ND	ND	ND	ND	ND	ND	ND	0.007	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	1/24/1991	0.002	0.0002 U	--	--	0.005	0.0002 U	0.01 U	--	0.033	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	2/28/1991	0.002	0.0002 U	--	--	0.003	0.0002 U	0.01 U	--	0.002 U	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	3/28/1991	0.002	0.0002	--	--	0.008	0.0002 U	0.01 U	--	0.064	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	4/18/1991	0.001	0.0004	--	--	0.009	0.0002 U	0.01	--	0.07	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	5/16/1991	0.002	0.0003	--	--	0.007	0.0002 U	0.01 U	--	0.092	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	6/13/1991	0.001	0.0005 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.032	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.012	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	8/29/1991	0.002	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.015	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	9/24/1991	0.002	0.0005 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.002 U	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	10/22/1991	0.003	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.002 U	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	11/12/1991	0.002	0.091	--	--	0.007	0.0002 U	0.01 U	0.01 U	0.012	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	3/19/1992	0.002	0	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.012	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	6/12/1992	0.005	0.002 U	--	--	0.005	0.0002 U	0.01 U	0.01 U	0.02	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	8/27/1992	0.004	0.002 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.011	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	9/24/1992	0.003	0.002 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.007	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	10/29/1992	0.001	0.002 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.009	mg/L
3SW	DCN-1012	Equinox	Unnamed Creek	11/30/1992	0.003	0.0004	--	--	0.012	0.0002 U	0.01 U	0.01 U	0.13	mg/L
Summary Statistics - Surface Water -3SW														
				Frequency of Detection	16/21	5/21	2/4	3/4	15/21	0/21	1/21	0/16	19/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	13	0	0	12	17	0	12	1	
				Maximum Detection	0.005	0.091	0.016	0.006	0.012	--	0.01	--	0.130	mg/L
				Minimum Detection	0.001	0.0002	0.016	0.003	0.001	--	0.01	--	0.007	mg/L
				Mean Detection	0.002	0.0185	0.016	0.004	0.0048	--	0.01	--	0.0335	mg/L
4SW	DCN-1039	Equinox	West Fork Onion Creek	1/24/1989	ND	ND	0.025	0.003	ND	ND	ND	0.01	0.090	mg/L
4SW	DCN-1039	Equinox	West Fork Onion Creek	3/14/1989	ND	ND	0.022	0.003	ND	ND	ND	ND	0.044	mg/L
4SW	DCN-1039	Equinox	West Fork Onion Creek	4/4/1989	ND	ND	0.007	0.003	ND	ND	ND	ND	0.163	mg/L
4SW	DCN-1037/1039/1059	Equinox	Onion Creek below Upper Tailings Pile and Open Pits	12/8/1989	ND	ND	0.012	ND	ND	ND	ND	ND	0.053	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	1/24/1991	0.001 U	0.0002	--	--	0.006	0.0004	0.01 U	--	0.079	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	2/28/1991	0.001 U	0.0002 U	--	--	0.002	0.0002 U	0.01 U	--	0.002 U	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	3/28/1991	0.001 U	0.0002	--	--	0.003	0.0004	0.01 U	--	0.047	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	4/18/1991	0.001 U	0.0006	--	--	0.014	0.0002 U	0.01 U	--	0.18	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	5/16/1991	0.001 U	0.0002	--	--	0.008	0.0002 U	0.01 U	--	0.032	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	6/13/1991	0.001 U	0.0005 U	--	--	0.023	0.0002 U	0.01 U	0.01 U	0.057	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.039	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	8/29/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.032	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.018	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	10/22/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.02	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	11/12/1991	0.001 U	0.001 U	--	--	0.01	0.0002 U	0.01 U	0.01 U	0.063	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	3/19/1992	0.001 U	0.0006	--	--	0.014	0.0002 U	0.01 U	0.01 U	0.059	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	6/12/1992	0.001 U	0.002 U	--	--	0.007	0.0002 U	0.01 U	0.01 U	0.087	mg/L

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
				Lowest Potential Surface Water ARAR (see Table 5)	0.000018	0.0002	0.074	0.009	0.00252	0.00014	0.052	0.0032	0.105	mg/L*
4SW	DCN-1012	Equinox	West Fork Onion Creek	8/27/1992	0.002	0.002 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.056	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1992	0.001 U	0.002 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.059	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	10/29/1992	0.001 U	0.002 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.078	mg/L
4SW	DCN-1012	Equinox	West Fork Onion Creek	11/30/1992	0.001 U	0.0003	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.072	mg/L
Summary Statistics - Surface Water - 4SW														
				Frequency of Detection	1/21	6/21	2/4	3/4	15/21	2/21	0/21	1/16	20/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	13	0	0	11	17	0	13	2	
				Maximum Detection	0.002	0.0006	0.025	0.003	0.023	0.0004	--	0.01	0.18	mg/L
				Minimum Detection	0.002	0.0002	0.007	0.003	0.002	0.0004	--	0.01	0.018	mg/L
				Mean Detection	0.002	0.0004	0.017	0.003	0.0065	0.0004	--	0.01	0.066	mg/L
5SW	DCN-1039	Equinox	East Fork Onion Creek	1/24/1989	ND	ND	0.019	0.004	ND	ND	ND	ND	0.013	mg/L
5SW	DCN-1039	Equinox	East Fork Onion Creek	3/14/1989	ND	ND	0.017	0.006	ND	ND	ND	ND	0.010	mg/L
5SW	DCN-1039	Equinox	East Fork Onion Creek	4/4/1989	ND	ND	ND	ND	ND	ND	ND	ND	0.040	mg/L
5SW	DCN-1037/1039/1059	Equinox	Onion Creek below Upper Tailings Pile and Open Pits	12/8/1989	ND	ND	0.007	ND	ND	ND	ND	ND	0.057	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.015	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	8/29/1991	0.001 U	0.0005 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.01	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	9/24/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.002 U	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	10/22/1991	0.001 U	0.0005 U	--	--	0.011	0.0002 U	0.01 U	0.01 U	0.002 U	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	11/12/1991	0.001 U	0.057	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.002	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	3/19/1992	0.001 U	0.0002 U	--	--	0.001 U	0.002 U	0.01 U	0.01 U	0.017	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	6/12/1992	0.001 U	0.002 U	--	--	0.006	0.0002 U	0.01 U	0.01 U	0.12	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	8/27/1992	0.003	0.002 U	--	--	0.002	0.012	0.01 U	0.01 U	0.007	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	9/24/1992	0.001 U	0.002 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.007	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	10/29/1992	0.001 U	0.002 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.03	mg/L
5SW	DCN-1012	Equinox	East Fork Onion Creek	11/30/1992	0.001 U	0.0002	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.01	mg/L
Summary Statistics - Surface Water -5SW														
				Frequency of Detection	1/15	2/15	3/4	2/4	7/15	1/15	0/15	0/15	13/15	
				Number of Exceedances of Lowest Potential Surface Water ARAR	11	9	0	0	4	11	0	11	1	
				Maximum Detection	0.003	0.057	0.019	0.006	0.011	0.012	--	--	0.12	mg/L
				Minimum Detection	0.003	0.0002	0.007	0.004	0.001	0.012	--	--	0.002	mg/L
				Mean Detection	0.003	0.0286	0.014	0.005	0.004	0.012	--	--	0.026	mg/L
6SW	DCN-1039	Equinox	West Fork Onion Creek	1/24/1989	ND	ND	0.026	ND	ND	ND	6.1	0.01	0.144	mg/L
6SW	DCN-1039	Equinox	West Fork Onion Creek	3/14/1989	ND	ND	0.02	ND	ND	ND	ND	ND	0.094	mg/L
6SW	DCN-1039	Equinox	West Fork Onion Creek	4/4/1989	ND	ND	0.007	ND	0.02	ND	ND	ND	0.170	mg/L
6SW	DCN-1037/1039/1059	Equinox	Onion Creek below Upper Tailings Pile and Open Pits	12/8/1989	ND	ND	0.013	ND	ND	ND	ND	ND	0.019	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	1/24/1991	0.001 U	0.0003	--	--	0.006	0.0002 U	0.01 U	--	0.128	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	2/28/1991	0.001 U	0.0002	--	--	0.005	0.0002 U	0.01 U	--	0.002 U	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	3/28/1991	0.001 U	0.0005	--	--	0.005	0.0002 U	0.01 U	--	0.173	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	4/18/1991	0.001 U	0.0003	--	--	0.015	0.0002 U	0.01 U	--	0.11	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	5/16/1991	0.001 U	0.0002 U	--	--	0.003	0.0002 U	0.01 U	--	0.038	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	6/13/1991	0.001	0.0009	--	--	0.1	0.0002 U	0.01 U	0.01 U	0.21	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	7/17/1991	0.03 U	0.002 U	--	--	0.08	0.01 U	0.01 U	0.01 U	0.31	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	8/29/1991	0.001 U	0.0006	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.12	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1991	0.001 U	0.0005 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.05	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	10/22/1991	0.001 U	0.0005 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.052	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	11/12/1991	0.001 U	0.307	--	--	0.009	0.0002 U	0.01 U	0.01 U	0.078	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	3/19/1992	0.001 U	0.0005	--	--	0.005	0.0002 U	0.01 U	0.01 U	0.092	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	6/12/1992	0.001 U	0.004	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.015	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	8/27/1992	0.001	0.003	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.081	mg/L

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
				Lowest Potential Surface Water ARAR (see Table 5)	**0.000018**	**0.0002**	**0.074**	**0.009**	**0.00252**	**0.00014**	**0.052**	**0.0032**	**0.105**	**mg/L***
6SW	DCN-1012	Equinox	West Fork Onion Creek	9/24/1992	0.001	0.002 U	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.095	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	10/29/1992	0.001 U	0.002 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.11	mg/L
6SW	DCN-1012	Equinox	West Fork Onion Creek	11/30/1992	0.001	0.0009	--	--	0.004	0.0002 U	0.01 U	0.01 U	0.15	mg/L
Summary Statistics - Surface Water - 6SW														
				Frequency of Detection	4/21	11/21	4/4	0/4	17/21	0/21	1/21	1/16	20/21	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	15	0	0	15	17	1	13	10	
				Maximum Detection	0.001	0.307	0.026	--	0.1	--	6.1	0.01	0.31	mg/L
				Minimum Detection	0.001	0.0002	0.007	--	0.002	--	6.1	0.01	0.015	mg/L
				Mean Detection	0.001	0.0289	0.017	--	0.016	--	6.1	0.01	0.112	mg/L
7SW	DCN-1037/1039/1059	Equinox	Onion Creek above the South Pit	12/8/1989	ND	ND	ND	ND	ND	ND	ND	ND	0.010	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	1/24/1991	0.001 U	0.0002 U	--	--	0.007	0.0002 U	0.02	--	0.018	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	2/28/1991	0.001 U	0.0002 U	--	--	0.002	0.0002 U	0.01 U	--	0.002 U	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	3/28/1991	0.001 U	0.0003	--	--	0.007	0.0002 U	0.01 U	--	0.08	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	4/18/1991	0.001 U	0.0004	--	--	0.011	0.0002 U	0.01 U	--	0.07	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	5/16/1991	0.001 U	0.0002 U	--	--	0.007	0.0002 U	0.01 U	--	0.002 U	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	6/13/1991	0.001 U	0.0005 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.002 U	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.03	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	8/29/1991	0.001 U	0.0005 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.017	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	9/24/1991	0.001 U	0.0008	--	--	0.001 U	0.0017	0.01 U	0.01 U	0.002 U	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	10/22/1991	0.001 U	0.0005 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.002	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	11/12/1991	0.001 U	0.61	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.003	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	3/19/1992	0.001 U	0.0002	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.026	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	6/12/1992	0.001 U	0.002 U	--	--	0.003	0.0002 U	0.01 U	0.01 U	0.043	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	8/27/1992	0.001 U	0.002 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.008	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	9/24/1992	0.001	0.02 U	--	--	0.006	0.0002 U	0.01 U	0.01 U	0.069	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	10/29/1992	0.001 U	0.002 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.021	mg/L
7SW	DCN-1012	Equinox	Middle Fork Onion Creek	11/30/1992	0.001 U	0.0002	--	--	0.002	0.0009	0.01 U	0.01 U	0.03	mg/L
Summary Statistics - Surface Water - 7SW														
				Frequency of Detection	1/18	6/18	0/1	0/1	13/18	2/18	1/18	0/13	14/18	
				Number of Exceedances of Lowest Potential Surface Water ARAR	17	12	0	0	11	17	0	12	0	
				Maximum Detection	0.001	0.61	--	--	0.011	0.0017	0.02	--	0.08	mg/L
				Minimum Detection	0.001	0.0002	--	--	0.002	0.0009	0.02	--	0.002	mg/L
				Mean Detection	0.001	0.1020	--	--	0.005	0.0013	0.0	--	0.031	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	7/17/1991	0.03 U	0.002 U	--	--	0.02 U	0.01 U	0.01 U	0.01 U	0.022	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	8/29/1991	0.001	0.0005 U	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.013	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	9/24/1991	0.001 U	0.0005 U	--	--	0.002	0.0012	0.01 U	0.01 U	0.002 U	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	10/22/1991	0.001 U	0.0005 U	--	--	0.007	0.0002 U	0.01 U	0.01 U	0.01	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	11/12/1991	0.001 U	0.07	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.002	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	3/19/1992	0.001 U	--	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.031	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	6/12/1992	0.001 U	0.002 U	--	--	0.002	0.0002 U	0.01 U	0.01 U	0.013	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	8/27/1992	0.001 U	0.002 U	--	--	0.12	0.0002 U	0.01 U	0.01 U	0.046	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	9/24/1992	0.001 U	0.002 U	--	--	0.001	0.0002 U	0.01 U	0.01 U	0.029	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	10/29/1992	0.001 U	0.002 U	--	--	0.007	0.0002 U	0.01 U	0.01 U	0.025	mg/L
8SW	DCN-1012	Equinox	Creek Near Mine House	11/30/1992	0.001 U	0.0004	--	--	0.001 U	0.0002 U	0.01 U	0.01 U	0.031	mg/L
Summary Statistics - Surface Water - 8SW														
				Frequency of Detection	1/11	2/11	--	--	7/11	1/11	0/11	0/11	10/11	
				Number of Exceedances of Lowest Potential Surface Water ARAR	11	10	--	--	4	11	0	11	0	
				Maximum Detection	0.001	0.07	--	--	0.12	0.0012	--	--	0.046	mg/L
				Minimum Detection	0.001	0.0004	--	--	0.001	0.0012	--	--	0.002	mg/L
				Mean Detection	0.001	0.0352	--	--	0.02	0.0012	--	--	0.022	mg/L

Table 10 - Summary of Historical Analytical Data for Surface Water

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd**	Cr**	Cu**	Pb**	Hg	Ni**	Ag**	Zn**	Units
Lowest Potential Surface Water ARAR (see Table 5)					0.000018	0.0002	0.074	0.009	0.00252	0.00014	0.052	0.0032	0.105	mg/L*
Surface Water Along Onion Creek														
Upstream Control	DCN-1035	Ecology	Unknown	10/16/1985	0.003	0.0002 U	0.0001 U	--	0.001 U	0.00006	--	--	0.001 U	mg/L
W16	DCN-1029	University	Background Surface Water	1992	0.00024	0.00001	0.00012	0.00025	0.00015	--	0.00052	--	0.0007	mg/L*
W17	DCN-1029	University	Background Surface Water	1992	0.00012	ND	0.00024	0.00022	0.00013	--	0.0006	--	0.0006	mg/L*
Summary Statistics - Surface Water - Along Onion Creek Tributaries														
Frequency of Detection					3/3	1/3	2/3	2/2	2/2	1/1	2/2	--	2/3	
Number of Exceedances of Lowest Potential Surface Water ARAR					3	0	0	0	0	0	0	--	0	
Maximum Detection					0.003	0.00001	0.00024	0.00025	0.00015	0.00006	0.0006	--	0.0007	mg/L
Minimum Detection					0.00012	0.00001	0.00012	0.00022	0.00013	0.00006	0.00052	--	0.0006	mg/L
Mean Detection					0.00112	0.00001	0.00018	0.00024	0.00014	0.00006	0.00056	--	0.00065	mg/L

Notes:

J = Analytical results qualified as estimated when the analyte is positively identified as either present or absent based on QC data.

B = The detected concentration is below the method detection limit/CRDL, but is above the instrument detection limit.

H = The numerical result is likely biased high; above the actual concentration.

L = The numerical result is likely biased low; below the actual concentration.

K = The bias of the numerical value is unknown.

Q = The detected concentration is below the method reporting limit/CRQL, but is above the method detection limit.

U = The analyte was not detected above the laboratory detection limit.

DCN = Document Control Number.

mg/L = milligrams per litter.

* = Converted from ug/L to mg/L.

** = Hardness-dependent criteria.

Concentrations reported are assumed dissolved fraction

Table 11. Summary of Historical Analytical Data for Sediment within Onion Creek and Tributaries

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
			Lowest Potential Sediment ARAR (see Table 6)		5.9	0.596	37.3	35.7	35	0.174	18	0.545	123	mg/kg
North and South Pit Area														
VS Upstream	DCN-1009/1050	Ecology	South Pit Area	10/18/2005	3.05	0.92	2	1.65	67.4	0.005 U	2.53	0.1 U	314	mg/kg
VS Downstream of Pit	DCN-1009/1050	Ecology	Onion Creek below Open Pits	10/18/2005	2.3	1.17	2.4	1.66	39.8	0.123	2.34	0.1 U	378	mg/kg
1254363 (VSMW01SD)	DCN-2002	EPA	North Pit Pond Area	6/2001 to 9/2001	3.2 U	1.2 JB	2.4 JB	2.1 JB	50.4	--	2.2 JB	--	526	mg/kg
1254361 (VSPP03SD)	DCN-2002	EPA	North Pit Pond Area	6/2001 to 9/2001	13.8	11.9	2 JB	2.3 JB	124	--	2.9 JB	--	3670	mg/kg
Sed1	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	3.9	16.9	3.9	6.6	847	--	6.4	--	4270	mg/kg
Summary Statistics - Sediment - North and South Pit Area														
				Frequency of Detection	4/5	5/5	5/5	5/5	5/5	1/2	5/5	0/3	5/5	
				Number of Excedences of Lowest Potential Sediment ARAR	1	5	0	0	5	0	0	0	5	
				Maximum Detection	13.8	16.9	3.9	6.6	847	0.123	6.4	--	4270	mg/kg
				Minimum Detection	2.3	0.92	2	1.65	39.8	0.123	2.2 JB	--	314	mg/kg
				Mean Detection	5.8	6.42	2.5	2.86	225.7	0.123	3.27	--	1832	mg/kg
Upper Tailings Pile Area														
VS downstream of Tailings	DCN-1009/1050	Ecology	Onion Creek below Upper Tailings Pile	10/18/2005	3.41	2.64	3.2	2.03	77.2	0.013	2.31	0.1 U	700	mg/kg
Sed 9	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	2.1	14	3.6	5.9	167	--	3.9	--	3600	mg/kg
Sed10	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	2.5	15.8	3.4	5.4	212	--	3.3	--	3900	mg/kg
Sed11	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	2	6.8	3.5	25.3	645	--	4.3	--	1880	mg/kg
Summary Statistics - Sediment - Upper Tailings Pile Area														
				Frequency of Detection	4/4	4/4	4/4	4/4	4/4	1/1	4/4	0/1	4/4	
				Number of Excedences of Lowest Potential Sediment ARAR	0	4	0	0	4	0	0	0	4	
				Maximum Detection	3.41	15.8	3.6	25.3	645	0.013	4.3	--	3900	mg/kg
				Minimum Detection	2	2.64	3.2	2.03	77.2	0.013	2.31	--	700	mg/kg
				Mean Detection	2.5	9.81	3.4	9.66	275.3	0.013	3.45	--	2520	mg/kg
Lower Tailings Pile Area														
(VSPP01SD)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	9.2	6	1.5 JB	23 JL	466	--	1.7 JB	--	1960	mg/kg
(VSPP02SD)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	2.1 U	0.07 U	1.7 JB	1.5 JB	2.2	--	1 JB	--	13	mg/kg
1254364 (VSPP04SD)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	1.4 U	0.17 JB	2.9 JB	3.3 JB	8.1	--	2.6 JB	--	112	mg/kg
Sed 2	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	0.28	4.2	1.9	2.9	375	--	1.8	--	1000	mg/kg
Sed 3	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	0.84	0.11	2.3	0.46	2.9	--	1.8	--	2.9	mg/kg
Sed 4	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	0.31	1.3	0.98	0.34	217	--	3	--	95.9	mg/kg
Sed 5	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	4.4	13.8	6.1	257	3850	--	6.6	--	4100	mg/kg
Sed 6	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	1.5	13.5	2.7	78.5	2910	--	4.8	--	3900	mg/kg
Sed 7	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	0.11	0.13	1.1	0.25	2.8	--	2.2	--	7.6	mg/kg
Sed 8	DCN-1029	University	Sediments from new tailings pond (TP2)	1992	3.7	14.2	3.2	95.4	3070	--	4.9	--	3440	mg/kg
Sed15	DCN-1029	University	Sediments near new tailings pond (TP2)	1992	2.8	0.83	12.5	9.3	37.2	--	8.9	--	141	mg/kg
Sed16	DCN-1029	University	Sediments near new tailings pond (TP2)	1992	2.3	3.6	3.6	7.3	130	--	3.8	--	1150	mg/kg
Sed18	DCN-1029	University	Sediments near new tailings pond (TP2)	1992	3.0	0.73	5.3	8.1	15.2	--	5.4	--	41.4	mg/kg
Summary Statistics - Sediment - Lower Tailings Pile Area														
				Frequency of Detection	11/13	12/13	13/13	13/13	13/13	--	13/13	--	13/13	
				Number of Excedences of Lowest Potential Sediment ARAR	1	9	0	3	8	--	0	--	7	
				Maximum Detection	9.2	14.2	12.5	257	3850	--	8.9	--	4100	mg/kg
				Minimum Detection	0.11	0.11	0.98	0.25	2.2	--	1 JB	--	2.9	mg/kg
				Mean Detection	2.59	4.88	3.52	37.49	852.8	--	3.7	--	1228	mg/kg
Along Onion Creek														
Sed12	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	1.7	3.9	3.1	5.7	62.3	--	4.1	--	1050	mg/kg
Sed13	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	2	7.8	3.2	9.5	242	--	3.3	--	2000	mg/kg
Sed14	DCN-1029	University	Sediments near mine and abandoned tailings pond (TP1)	1992	1.4	6	4.2	8.9	159	--	4.8	--	1640	mg/kg
Sed17	DCN-1029	University	Background Sediment	1992	2.3	0.73	4.2	8.5	18.4	--	4.6	--	71	mg/kg
Summary Statistics - Sediment - Along Onion Creek														
				Frequency of Detection	4/4	4/4	4/4	4/4	4/4	--	4/4	--	4/4	
				Number of Excedences of Lowest Potential Sediment ARAR	0	4	0	0	3	--	0	--	3	
				Maximum Detection	2.3	7.8	4.2	9.5	242	--	4.8	--	2000	mg/kg
				Minimum Detection	1.4	0.73	3.1	5.7	18.4	--	3.3	--	71	mg/kg
				Mean Detection	1.9	4.61	3.7	8.2	120.4	--	4.2	--	1190	mg/kg

Notes:

J = Analytical results qualified as estimated when the analyte is positively identified as either present or absent based on QC data.

B = The detected concentration is below the method detection limit/CRDL, but is above the instrument detection limit.

U = The analyte was not detected above the laboratory detection limit.

DCN = Document Control Number.

mg/kg = milligrams per kilogram.

Table 12. Summary of Historical Analytical Data for Soil (Tailings Pile)

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
				Lowest Potential Soil ARAR (see Table 7)	**0.67**	**0.36**	**19**	**28**	**11**	**0.07**	**30**	**2**	**46**	**mg/kg**
Upper Tailings Pile														
Upper tailings grab sample	DCN-1020/2001	DNR	Upper Tailings Pile	Oct-02	--	16.4	--	--	485	--	--	--	5070	mg/kg
Lower Tailings Pile														
1254312 (VSTP21SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	4.2 U	8.6	8.7	76.2 JL	4710	0.09 JB	2.6 JB	0.36 JB	2430	mg/kg
1254315 (VSTP01SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	15.1	7.3	3.0	27.4 JL	283	0.07 JB	4.8 JB	0.32 JB	2770	mg/kg
1254316 (VSTP02SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	6.8	1.9	12.9	26.9 JL	81.7	0.06 U	17.1	0.51 JB	813	mg/kg
1254317 (VSTP03SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	5.7 U	2.4	10.1	23.1 JL	74.3	0.06 U	13.6	0.51 JB	907	mg/kg
1254318 (VSTP04SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	8.4	7.6	1.8 JB	23.4 JL	257	0.09 JB	3.4 JB	0.22 JB	2920	mg/kg
1254319 (VSTP05SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	6.3 U	3.2	6.8	22.6 JL	119	0.06 U	10.5	0.40 JB	1100	mg/kg
1254320 (VSTP06SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	4.5 U	1.0 JB	7.5	11.1 JL	35.9	0.06 U	11.5	0.5 JB	150	mg/kg
1254321 (VSTP07SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	5.2 U	3.0	6.3	18.1 JL	109	0.06 U	9.6	0.47 JB	1100	mg/kg
1254322 (VSTP08SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	4.2 U	1.5	7.1	14.1 JL	51.2	0.06 U	10.0	0.48 JB	565	mg/kg
1254323 (VSTP09SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	4.8 U	0.59 JB	6.8	10.4 JL	18.8	0.06 U	9.1 JB	0.56 JB	121	mg/kg
1254331 (VSTP10SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	3.3 U	4.9	2.4	25.3 JL	167	0.07 JB	2.4 JB	0.26 JB	2100	mg/kg
1254332 (VSTP11SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	3.0 U	5.2	3.7	23.6 JL	143	0.06 JB	4.3 JB	0.46 JB	2610	mg/kg
1254333 (VSTP12SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	0.96 JB	0.67 JB	2.5	5.4	32.7	0.05 U	2.4 JB	0.14 U	341	mg/kg
1254334 (VSTP13SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	2.6	5.2	1.9 JB	11.2	87.3	0.08 JB	1.9 JB	0.23 U	2260	mg/kg
1254335 (VSTP14SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	0.96 JB	0.24 U	2.0 JB	3.0 JB	10.7	0.05 U	1.6 JB	0.10 U	106	mg/kg
1254336 (VSTP15SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	1.2 JB	0.36 JB	2.9	3.6 JB	16.3	0.05 U	2.6 JB	0.13 U	171	mg/kg
1254337 (VSTP16SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	9.6	14.3	1.3 JB	28.7	270	0.17	2.5 JB	0.29 U	5870	mg/kg
1254338 (VSTP17SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	2.7	0.86 JB	3.9	5.9	25.2	0.05 U	2.9 JB	0.28 U	432	mg/kg
1254339 (VSTP18SS)	DCN-2002	EPA	Lower Tailings Pile	6/2001 to 9/2001	1.0 U	0.74 JB	2.7	5.9	33.8	0.05 U	2.5 JB	0.23 U	312	mg/kg
Lower tailings grab sample	DCN-1020/2001	DNR	Lower Tailings Pile	Oct-02	--	10.8	--	--	1170	--	--	--	2790	mg/kg
Summary Statistics - Lower Tailings Pile														
				Frequency of Detection	9/19	19/20	19/19	19/19	20/20	7/19	19/19	12/19	20/20	
				Number of Excedences of Lowest Potential Soil ARAR	19	18	0	2	19	4	0	0	20	
				Maximum Detection	15.1	14.3	12.9	76.2 JL	4710	0.17	17.1	0.56 JB	5870	mg/kg
				Minimum Detection	0.96 JB	0.36 JB	1.3 JB	3.0 JB	10.7	0.06 JB	1.6 JB	0.22 JB	106	mg/kg
				Mean Detection	5.37	4.22	5.0	19.3	384.8	0.09	6.1	0.42	1493	mg/kg
Unknown														
Van Stone Fresh Tailings	DCN-1020	DNR	Unknown	Oct-02	--	0.041	0.0213	0.0401	13.8	--	0.0105	--	9.3	mg/kg*
Van Stone Old Tailings	DCN-1020	DNR	Unknown	Oct-02	--	0.0182	0.013	0.0322	0.44	--	0.0107	--	5.3	mg/kg*
Van Stone Native	DCN-1020	DNR	Unknown	Oct-02	--	0.00348	0.0211	0.0236	0.822	--	0.0283	--	0.1	mg/kg*
Van Stone Fresh Tailings	DCN-1056	Equinox	Unknown	NA	--	0.041	0.0213	0.0401	13.8	--	0.0105	--	9.3	mg/kg*
Van Stone Old Tailings	DCN-1056	Equinox	Unknown	NA	--	0.0182	0.013	0.0322	0.44	--	0.0107	--	5.3	mg/kg*
Van Stone Native	DCN-1056	Equinox	Unknown	NA	--	0.00348	0.0211	0.0236	0.822	--	0.0283	--	0.1	mg/kg*
Summary Statistics - Unknown Soil Samples														
				Frequency of Detection	--	6/6	6/6	6/6	6/6	--	6/6	--	6/6	
				Number of Excedences of Lowest Potential Soil ARAR	--	0	0	0	0	--	0	--	0	
				Maximum Detection	--	0.041	0.0213	0.0401	13.8	--	0.0283	--	9.3	mg/kg
				Minimum Detection	--	0.0035	0.013	0.0236	0.44	--	0.0105	--	0.1	mg/kg
				Mean Detection	--	0.0209	0.018	0.0320	5.02	--	0.0165	--	4.9	mg/kg

Notes:

J = Analytical results qualified as estimated when the analyte is positively identified as either present or absent based on QC data.

B = The detected concentration is below the method detection limit/CRDL, but is above the instrument detection limit.

L = The numerical result is likely biased low; below the actual concentration.

U = The analyte was not detected above the laboratory detection limit.

DCN = Document Control Number.

mg/kg = milligrams per kilogram.

* = Converted from ug/g to mg/kg.

Table 13. Summary of Historical Analytical Data for Soil (Waste Rock and Stained Soil)

Sample ID	DCN #	Collected by	Area	Sample Date	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Units
			Lowest Potential Soil ARAR (see Table 7)		**0.62**	**0.36**	**19**	**28**	**11**	**0.07**	**30**	**2**	**46**	**mg/kg**
Soil (Waste Rock in North Pit Area)														
1254196 (VSWP01SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	42.3	41.4	7.1	12.5	1830	1.3 JL	13.7	0.94 JB	20600 JK	mg/kg
1254197 (VSWP02SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	5.4	15.4	2.4	4.9 JB	286	0.08 JB	4.5 JB	0.44 JB	15000 JK	mg/kg
1254198 (VSWP03SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	17.5	10.5	1.7 JB	7.3	204	0.32 JL	3.8 JB	0.53 JB	5920 JK	mg/kg
1254199 (VSWP04SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	43.8	38.8	1.7 JB	6.2 JL	2080	1.5	3.8 JB	0.83 JB	10800	mg/kg
1254200 (VSWP05SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	3.7 U	69.7	1.0 JB	1.9 JB	12100	0.38	2.3 JB	0.88 JB	19500	mg/kg
1254201 (VSWP06SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	14.9	124	0.87 JB	7.8 JL	6090	0.84	3.8 JB	1.9 JB	45800	mg/kg
1254202 (VSWP07SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	5.9	234	0.46 JB	2.5 JB	76500	0.29	2.1 JB	4.4	68000	mg/kg
1254203 (VSWP08SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	12.7	33.7	1.1 JB	5.4 JL	359	0.26	5.6 JB	0.5 JB	5960	mg/kg
1254204 (VSWP09SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	11.6	27.9	2.1 JB	4.3 JB	47.4	0.05 U	7.1 JB	0.17 U	3660	mg/kg
1254205 (VSWP10SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	5.2	10.1	3.6	4.8 JB	1610	0.52	3.8 JB	0.25 JB	3450	mg/kg
1254206 (VSWP11SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	4.3 U	5.5	1.3 JB	8.5 JL	7.4	0.05 U	5.9 JB	0.28 JB	4950	mg/kg
1254207 (VSWP12SS)	DCN-2002	EPA	North Pit Waste Rock	6/2001 to 9/2001	10.8	15.0	0.86 JB	5.7	1520	0.08 JB	10.7	0.27 JB	6340 JK	mg/kg
Summary Statistics - Soil (Waste Rock)														
				Frequency of Detection	10/12	12/12	12/12	12/12	12/12	10/12	12/12	11/12	12/12	
				Number of Excedences of Lowest Potential Soil ARAR	12	12	0	0	11	10	0	1	12	
				Maximum Detection	43.8	234	7.1	12.5	76500	1.5	13.7	4.4	68000	mg/kg
				Minimum Detection	5.2	5.5	0.46 JB	1.9 JB	7.4	0.08 JB	2.1 JB	0.25 JB	3450	mg/kg
				Mean Detection	17.0	52.2	2.02	6.0	8552.8	0.56	5.6	1.02	17498	mg/kg
Soil (Stained Soil in Mill Area)														
1254324 (VSSS01SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	16.5	702	2.2 JB	202	10900	3.2	5.1 JB	3.3	189000	mg/kg
1254325 (VSSS02SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	9.7	36.6	3.7	461 JL	11000	0.21	4.8 JB	1.9 JB	12000	mg/kg
1254326 (VSSS03SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	2.2 U	1.9	3.7	5.0 JB	114	0.05 U	2.5 JB	0.22 JB	812	mg/kg
1254327 (VSSS04SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	23.6	510	1.2 JB	73.1 JL	181000	0.05 U	6 JB	27.1	164000	mg/kg
1254328 (VSSS05SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	42.9	940	5.1	218 JL	14700	6	10.7	6.8	431000	mg/kg
1254329 (VSSS06SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	11.3	24.7	3	7.6 JL	1040	0.15	4.4 JB	0.41 JB	5770	mg/kg
1254330 (VSSS07SS)	DCN-2002	EPA	Mill Area	6/2001 to 9/2001	19	8.2	4.7	10.8 JL	771	0.6	3.5 JB	0.44 JB	3560	mg/kg
Soil sample 25 ft south of red door at mill, green copper oxide	DCN-1020/2001	DNR	Mill Area	Oct-02	--	--	--	18400	--	--	--	--	--	mg/kg
Zn bins grab	DCN-1020/2001	DNR	Mill Area	Oct-02	--	346	--	--	124000	--	--	--	38200	mg/kg
Summary Statistics - Soil (Stained Soil)														
				Frequency of Detection	6/7	8/8	7/7	8/8	8/8	5/7	7/7	7/7	8/8	
				Number of Excedences of Lowest Potential Soil ARAR	7	8	0	5	8	5	0	3	8	
				Maximum Detection	42.9	940	5.1	18400	181000	6	10.7	27.1	431000	mg/kg
				Minimum Detection	9.7	1.9	1.2 JB	5.0 JB	114	0.15	2.5 JB	0.22 JB	812	mg/kg
				Mean Detection	20.5	321.2	3.4	2422.2	42941	2.03	5.3	5.74	105543	mg/kg

Notes:

J = Analytical results qualified as estimated when the analyte is positively identified as either present or absent based on QC data.

B = The detected concentration is below the method detection limit/CRDL, but is above the instrument detection limit.

L = The numerical result is likely biased low; below the actual concentration.

K = The bias of the numerical value is unknown.

U = The analyte was not detected above the laboratory detection limit.

DCN = Document Control Number.

mg/kg = milligrams per kilogram.

Authority	Medium	Requirement	Status	Synopsis of Requirement
Chemical-Specific ARARs				
Federal Regulatory Requirement	Surface Water	National Recommended Water Quality Criteria [Federal Water Pollution Control Act (Clean Water Act) 33 USC § 1314(a), Section 304(a)].	Applicable	The 1999 NWQC criteria are applicable to protection of aquatic life at the Site [WAC 173-340-730(3)(b)(i)(B)] as these were the NWQC criteria available when the MTCA regulations were last updated. Even if not applicable, the 1999 criteria are relevant and appropriate for protection of aquatic life under MTCA [WAC 173-340-710(4)]. The 2006 NWQC and subsequent NWQC (such as the 2007 copper criterion) are relevant and appropriate for protection of aquatic life under MTCA [WAC 173-340-710(4)].
Federal Regulatory Requirement	Surface Water	National Recommended Water Quality Criteria [Federal Water Pollution Control Act (Clean Water Act) 33 USC § 1314(a), Section 304(a)].	Relevant and Appropriate	National Recommended Water Quality Criteria (NWQC) is guidance established by the EPA for evaluating toxics effects on human health and aquatic organisms. The 2004 NWQC and the 2007 copper criterion are relevant and appropriate for protection of aquatic life at the Site under CERCLA [Section 121(d)(2)].
Federal Regulatory Requirement	Surface Water	National Toxics Rule (NTR) [40 CFR Part 131].	Applicable	The National Toxics Rule (NTR) established numeric water quality standards for protection of human health and aquatic organisms for states that did not fully comply with Section 303(c)(2)(C) of the Clean Water Act (CWA). The State of Washington is required to comply with certain standards in the NTR [40 CFR § 131.36(d)(14)]. MTCA identifies the NTR as an ARAR [WAC 173-340-730(3)(b)(i)(C)]. The NTR standards mandated for Washington are applicable for the Site.
State Regulatory Requirement	Surface Water	Washington State Water Quality Standards for Surface Water [RCW 90.48; Chapter 173-201A WAC].	Applicable	Washington State has established aquatic life criteria for hazardous substances in freshwater. These provisions and standards in Chapter 173-201A WAC are applicable for the Site, including the antidegradation policy (Section 300) and the narrative criteria (Section 260).
Federal Regulatory Requirement	Surface Water and Groundwater	Maximum Contaminant Levels (MCLs)) and National Maximum Contaminant Level Goals (MCLGs) [40 CFR Part 141].	Applicable	Surface water and groundwater at the Site are potentially potable under MTCA [Chapter 173-340 WAC]. Under the Safe Drinking Water Act [SDWA; 42 USC § 300 et seq.], EPA establishes health goals based on risk and sets legal limits—maximum contaminant levels (MCLs)—to help ensure consistent quality of the water supply. EPA has also established health-based MCL goals (MCLGs) for public water systems.
State Regulatory Requirement	Surface Water and Groundwater	Washington State Drinking Water Standards [RCW 119A; Chapter 246-290 WAC].	Applicable	Washington State has established health-based MCLs to protect consumers using public water supplies. MTCA identifies state MCLs as being directly applicable to potential surface water and groundwater sources of drinking water at the Site.
State Regulatory Requirement	Surface Water, Groundwater, Soil	Washington State Model Toxics Control Act [RCW 70.105D; Chapter 173-340 WAC].	Applicable	The Model Toxics Control Act (MTCA) is directly applicable to the surface water, groundwater, and soil at the Site. MTCA surface water cleanup standards are generally based on the highest beneficial use and reasonable maximum exposure expected under current and potential future site uses. MTCA has provisions for soil cleanup that are based on protection of human health and terrestrial ecological receptors, as well as groundwater and/or surface water resources.

Table 14 – Potential Applicable, and Relevant or Appropriate Requirements (ARARs)

Authority	Medium	Requirement	Status	Synopsis of Requirement
State Regulatory Requirement	Surface Water	Washington State Model Toxics Control Act, Surface Water Cleanup Standards [Residential Soils, WAC 173-340-730]	Potentially Relevant and Appropriate	Establishes surface water cleanup criteria based on estimates of highest beneficial use and reasonable maximum exposure for current and future users.
State Regulatory Requirement	Soil	Washington State Model Toxics Control Act, Soil Cleanup Standards [Residential Soils, WAC 173-340-740]	Potentially Relevant and Appropriate	Establishes soil cleanup levels for current and potential site use conditions.
State Regulatory Requirement	Soil	Washington State Model Toxics Control Act, Soil Cleanup Standards [Industrial Soils, WAC 173-340-745]	Potentially Relevant and Appropriate	Establishes soil cleanup levels where industrial site use represents reasonable maximum exposure.
State Regulatory Requirement	Air	Washington State Model Toxics Control Act, Air Quality Standards [Residential Soils, WAC 173-340-750]	Potentially Relevant and Appropriate	Establishes cleanup standards to protect air quality based on current and future site uses.
State Regulatory Requirement		Washington State Model Toxics Control Act, Human Health Risk Assessment [WAC 173-340-708]	Potentially Relevant and Appropriate	Defines the risk assessment framework to establish cleanup levels, and remediation levels using a quantitative risk assessment.
State Regulatory Requirement	Plants and Animals	Washington State Model Toxics Control Act, Terrestrial Ecological Evaluation Procedures [WAC 173-340-7490]	Potentially Relevant and Appropriate	Establishes site specific cleanup standards for protection of terrestrial plants and animals. Does not include ecological receptors in sediment, surface water, or wetlands.
State Regulatory Requirement	Plants and Animals	Washington State Model Toxics Control Act, Simplified Terrestrial Ecological Evaluation Procedures [WAC 173-340-7492]	Potentially Relevant and Appropriate	Outlines the process for evaluating sites which do not have a substantial potential for posing a threat of significant adverse effects to terrestrial receptors.
State Regulatory Requirement	Biological Organisms	Persistent, Bioaccumulative Toxins Rule [WAC 173-333].	Applicable	Establishes criteria to identify persistent, Bioaccumulative toxins that pose human health or environmental threats, defines chemical action plans preparation, and defines the processes the Washington State Department of Ecology (Ecology) will use to coordinate the implementation with the Department of Health and other agencies.
Federal Regulatory Requirement	Soil and water	Preliminary Remediation Goals (PRGs) for soil and water [US Environmental Protection Agency (EPA) Region 9]	Applicable	PRGs are tools for evaluating the cleaning up contaminated sites. They are risk-based concentrations that are intended to assist risk assessors and others in initial screening-level evaluations of environmental measurements. The PRGs contained in the Region 9 PRG Table are generic; they are calculated without site specific information. However, they may be re-calculated using site specific data. PRGs are EPA guidelines, not legally enforceable standards.
Federal Regulatory Requirement	Surface Water and Groundwater	National Secondary Drinking Water Regulations [40 CFR Part 143]	Applicable	Establishes secondary MCLs for aesthetic standards for pubic water systems.

Authority	Medium	Requirement	Status	Synopsis of Requirement
Action-Specific ARARs				
Federal Regulatory Requirement	Surface Water	Federal Water Pollution Control Act--National Pollution Discharge Elimination System [Clean Water Act; 33 USC § 1342, Section 402].	Applicable	The NPDES regulations establish requirements for point source discharges and stormwater runoff. In particular for the Site, these regulations are applicable for any point source discharge of contaminated water (e.g., discharge following treatment of groundwater), stormwater runoff at the Site, and management of stormwater runoff during construction where the remedial construction site involves 1 acre or more.
Federal Regulatory Requirement	Surface Water	Federal Water Pollution Control Act--Water Quality Certification [Clean Water Act; 33 USC § 1341, Section 401].	Applicable	Section 401 of the CWA provides that applicants for a license or permit to conduct any activity, including, but not limited to, the construction or operation of facilities, which may result in discharges into the navigable waters, shall obtain certification from the state that discharges will comply with applicable water quality standards. While no formal certification will be required for the Site, substantive requirements will be applicable to remedial actions that require substantive compliance with federal permit equivalency (e.g., National Pollution Discharge Elimination System (NPDES), Section 404).
State Regulatory Requirement	Surface Water	Water Quality Standards for Surface Waters of the State of Washington-- Mixing Zones [RCW 90.48; WAC 173-201A-400].	Applicable	In Washington State, mixing zones and the associated effluent limits are established for point sources in discharge permits, general permits, or orders. Mixing zones do not apply to discharges directly from the groundwater to surface water per WAC 173-340-730(6)(b). Prior to a mixing zone being authorized for a point source discharge, the discharger must fully apply AKART. This regulation is applicable where the Site remedial action involves compliance with the substantive requirements of a discharge permit (i.e., NPDES).
State Regulatory Requirement	Surface Water	Water Quality Standards for Surface Waters of the State of Washington--Short-Term Modifications [RCW 90.48; WAC 173-201A-410].	Applicable	State water quality criteria can be modified for a specific water body on a short-term basis (e.g., actual periods of non-attainment are generally limited to hours or days rather than weeks or months). The modification may be necessary to accommodate essential activities, respond to emergencies, or to otherwise protect the public interest, even though such activities may result in a temporary reduction of water quality conditions. Substantive provisions of this regulation are applicable where the selected remedy involves activities near or in streams and wetlands. Such activities could impact water quality and result in the exceedances of the water quality criteria.
State Regulatory Requirement	Surface Water and Groundwater	Water Code and Regulation of Public Ground Waters of Washington State - Surface Water and Groundwater Withdrawal [RCW 90—90.03 and 90.44].	Applicable	These laws specify the criteria and procedures for appropriating surface water and groundwater for beneficial use. Any use of surface water and groundwater (except for certain uses of less than 5,000 gallons per day of groundwater) requires a water right permit or certificate. Substantive compliance with these laws is applicable to the Site under MTCA, since remedial actions involve withdrawal and/or diversion of surface water or groundwater that would otherwise require a state water rights permit or certificate.
State Regulatory Requirement	Surface Water, Groundwater, Soil	Washington Model Toxics Control Act [RCW 70.105D; Chapter 173-340 WAC].	Applicable	MTCA establishes administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances are located.

Authority	Medium	Requirement	Status	Synopsis of Requirement
State Regulatory Requirement	Surface Water and Sediment	Hydraulic Code [RCW 77.55; Chapter 220-110 WAC].	Applicable	The Hydraulic Code requires that any construction activity that uses, diverts, obstructs, or changes the bed or flow of state waters must be done under the terms of a Hydraulics Project Approval permit issued by Washington State Department of Fish and Wildlife (WSDFW). Depending on the selected remedial action, substantive provisions of the Hydraulic Code are applicable at the Site.
State Regulatory Requirement	Sediment	Washington State Sediment Management Standards [Chapter 173-204 WAC].	Relevant and Appropriate	The intended purposes of the sediment management standards are relevant and appropriate to clean up of sediments at the Site.
Federal Regulatory Requirement	Surface Water	Dam Safety Chapter 173-175 WAC.	Applicable	This regulation provides for the comprehensive regulation and supervision of dams in order to reasonably secure safety to life and property and is applicable to the tailings piles (i.e., former tailings impoundments) at the Site.
State Regulatory Requirement	Aquatic Lands	Aquatic Lands Management - Washington State [RCW 79.90; Chapter 332-30 WAC].	Relevant and Appropriate	The Aquatic Lands Management law develops criteria for managing state-owned aquatic lands. Aquatic lands are to be managed to promote uses and protect resources as specified in the regulations. While not directly applicable to the Site, the criteria in the Aquatic Lands Management are relevant and appropriate to remedial actions involving Onion Creek and associated Onion Creek tributaries under MTCA.
Federal Regulatory Requirement	Sediment	Federal Water Pollution Control Act--Discharge of Dredge and Fill Materials [Clean Water Act; 33 USC § 1344, Section 404].	Applicable	Section 404 of the CWA establishes programs to regulate the discharge of dredged and fill materials into the waters of the United States, including wetlands. The substantive provisions of this requirement are applicable to remedial actions involving dredging, filling, diversion, and/or construction in streams or wetlands at the Site.
Federal Regulatory Requirement	Solid Waste	Resource Conservation and Recovery Act [42 USC § 6901 et seq.], Subtitle C - Hazardous Waste Management [40 CFR Parts 260 to 279].	Applicable to New Landfills.	Subtitle C hazardous waste regulations specify hazardous waste identification, management, and disposal requirements. These regulations are applicable for generation, management, and disposal of hazardous waste. Where Washington has an authorized state hazardous waste program (RCW 70.105; Chapter 173-303 WAC), it applies in lieu of the federal program.
Federal Regulatory Requirement	Solid Waste	Resource Conservation and Recovery Act [42 USC § 6901 et seq.], Subtitle D - Managing Municipal and Solid Waste [40 CFR Parts 257 and 258].	Relevant and Appropriate to Existing Landfills.	Subtitle D of RCRA establishes a framework for management of non-hazardous solid waste. These regulations establish guidelines and criteria from which states develop solid waste regulations. Subtitle D is relevant and appropriate to existing solid waste disposal and management at the Site.
State Regulatory Requirement	Solid Waste	Washington State Solid Waste Handling Standards [RCW 70.95; Chapter 173-350 WAC].	Applicable	Washington State Solid Waste Handling Standards apply to facilities and activities that manage solid waste. The regulations set minimum functional performance standards for proper handling and disposal of solid waste, describe responsibilities of various entities, and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure.
State Regulatory Requirement	Hazardous Waste	Washington State Hazardous Waste Management Act and Dangerous Waste Regulations [RCW 70.105; Chapter 173-303 WAC].	Relevant and Appropriate	Washington State Dangerous Waste regulations govern the handling and disposition of dangerous waste, including identification, accumulation, storage, transport, treatment, and disposal. Washington State has not adopted an exemption for certain mining wastes (such as the Bevill Amendment) from regulation under RCRA Subtitle C. The Dangerous Waste regulations are applicable to generating, handling, and managing dangerous waste at the Site, and relevant and appropriate even if dangerous wastes are not managed during remediation. In particular, the subsection regarding point of compliance [WAC 173-303-645(6)] is relevant and appropriate to any waste management areas established at this Site.

Authority	Medium	Requirement	Status	Synopsis of Requirement
State Regulatory Requirement	Air	Maximum Environmental Noise Levels - Washington State [RCW 70.107; Chapter 173-60 WAC].	Applicable	The Maximum Environmental Noise Levels regulations of Washington State establish maximum noise levels permissible in identified environments, and provide use standards relating to the reception of noise within these environments. These regulations are applicable depending on the remedial activities selected for the Site.
Federal Regulatory Requirement	Air	Clean Air Act [42 USC § 7401 et. seq.; 40 CFR Part 50].	Applicable	The federal Clean Air Act creates a national framework designed to protect ambient air quality by limiting air emissions. These regulations are applicable to construction activities at the Site.
State Regulatory Requirement	Air	Washington Clean Air Act and Implementing Regulations [WAC 173-400-040(8)].	Relevant and Appropriate	This regulation is relevant and appropriate to remedial actions at the Site. It requires the owner or operator of a source of fugitive dust to take reasonable precautions to prevent fugitive dust from becoming airborne and to maintain and operate the source to minimize emissions.
State Regulatory Requirement	Air	General Regulations for Air Pollution Sources - Washington State [RCW 70.94; Chapter 173-400 WAC].	Applicable	These regulations provide for the systematic control of air pollution from air contaminant sources and for the proper development of the state's natural resources. The purpose of the regulations is to establish technically feasible and reasonably attainable standards, and to establish rules generally applicable to the control and/or prevention of the emission of air contaminants. Depending on the remedial action selected, these regulations are applicable to the Site (e.g., generation of fugitive dust during remediation of soil and tailings, or emissions from equipment).
Federal Regulatory Requirement	Air	National Emissions Standards for Hazardous Air Pollutants (NESHAP) - Asbestos, 40 CFR Part 61, Subpart M.	Applicable	Demolition or removal of any asbestos-containing materials in the former Mill Building must comply with NESHAP requirements.
State Regulatory Requirement	Groundwater	Regulation and Licensing of Well Contractors and Operators [RCW 18.104; Chapter 173-162 WAC].	Applicable	These regulations establish procedures for the examination, licensing, and regulation of well contractors and operators. "Well" means water wells, resources protection wells, instrumentation wells, dewatering wells, and geotechnical soil borings. These requirements are applicable to contractors who install and/or decommission wells and borings at the Site.
State Regulatory Requirement	Groundwater	Minimum Standards for Construction and Maintenance of Water Wells [RCW 18.104; Chapter 173-160 WAC].	Applicable	Washington State has developed minimum standards for constructing water and monitoring wells, and for the decommissioning of wells. These standards are applicable to wells constructed at the Site for water withdrawal or monitoring, and for decommissioning of Site wells.
State Regulatory Requirement	Treatment Facilities	Submission of Plans and Reports for Construction of Wastewater Treatment Facilities in Washington State [RCW 90.48; Chapter 173-240 WAC].	Applicable	Under this law, regulations were established requiring submission of wastewater treatment system design plans, specifications, and reports to Ecology for review and approval. The regulations also include provisions for Ecology review and approval of proposed methods for operation and maintenance, and for construction modifications. Substantive aspects of these requirements are applicable to the Site under MTCA, since the remedial action involves construction of a wastewater treatment system.

Authority	Medium	Requirement	Status	Synopsis of Requirement
Location-Specific ARARs				
Federal Regulatory Requirement	Surface Water	Clean Water Act (CWA), Section 401 and 404 [33 USC 1344, 40 CFR Part 230, 33 CFR §§ 320-330].	Relevant and Appropriate	The CWA restricts discharge of dredged or fill material into surface waters, including wetlands. If wetlands are disturbed as part of the cleanup action, the disturbance should comply with the substantive requirements of the US Army Corps of Engineers Nationwide Permit 38.
Federal Regulatory Requirement	Historic Buildings	National Historic Preservation Act [16 USC § 470].	Applicable	The National Historic Preservation Act (NHPA) requires federal agencies to take into account the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP) or as a National Historic Landmark. Depending on the remedial actions selected for the Site and, in particular, determination of the need for demolition of the abandoned mill building, NHPA requirements are applicable and will need to be addressed during remedial design.
Federal Regulatory Requirement	Historic Buildings	Historic Site, Buildings, Objects, and Antiquities Act [16 USC §§ 461 - 467].	Applicable	The Historic Site, Buildings, Objects, and Antiquities Act require preservation of historic sites, buildings, and objects of national significance. This Act is applicable where components of the Site listed or eligible for listing on the Historic Site, Buildings, Objects and Antiquities Federal Register will be impacted by remedial actions.
Federal Regulatory Requirement	Archaeological Resources	Archaeological and Historic Preservation Act [16 USC § 469].	Applicable	The Archaeological and Historic Preservation Act (AHPA) provides for the preservation of archaeological and historic data that might be destroyed through alteration of terrain due to a federal construction project or a federally licensed program or activity. This Act is applicable to the Site where remedial activities would cause loss or adverse impacts to significant scientific, prehistoric, historic, or archaeological data.
Federal Regulatory Requirement	Archaeological Resources	Archaeological Resources Protection Act [16 USC § 470].	Applicable	The Archaeological Resources Protection Act prescribes the steps that must be taken by investigators to preserve archaeological resources. This Act is applicable to the Site where remedial activities would cause loss or adverse impacts to significant scientific, prehistoric, historic, or archaeological data.
Federal Regulatory Requirement	Native American Burial Grounds	Native American Graves Protection and Reparation Act [25 USC § 3001 et seq].	Applicable	The Native American Graves Protection and Reparation Act protect the remains, funerary objects, and cultural artifacts of Native Americans. The requirements of this Act must be followed when graves are discovered or ground-disturbing activities encounter Native American burial sites. This Act is applicable to the Site where remedial actions involve disturbance/alteration of the ground and/or site terrain.
Federal Regulatory Requirement	Stream and Sediment	Fish and Wildlife Conservation Act [16 USC §§ 2901 - 2911].	Applicable	The purpose of the Fish and Wildlife Conservation Act is to promote conservation of non-game fish and wildlife through assistance to states and use of federal authority. The requirements of this Act are applicable to Site remedial activities, including action in Onion Creek and associated Onion Creek Tributaries involving stream diversion, dredging, and/or channel altering activities.

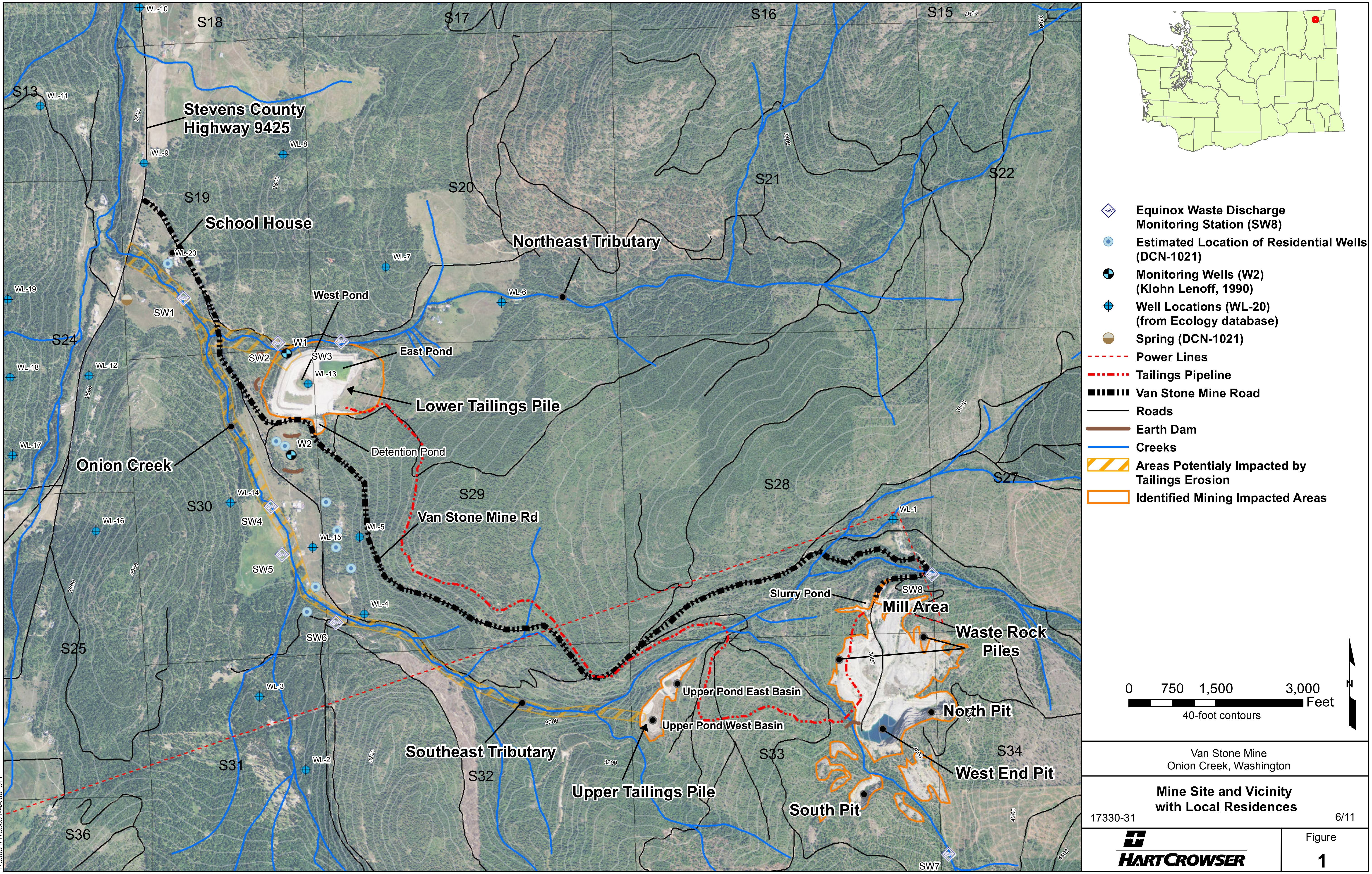
Authority	Medium	Requirement	Status	Synopsis of Requirement
Federal Regulatory Requirement	Stream and Sediment	Fish and Wildlife Coordination Act [16 USC §§ 661-667].	Applicable	The Fish and Wildlife Coordination Act provides that when the waters or channel of a body of water are modified by a federal entity, the department or agency must first consult with the U.S. Fish and Wildlife Service (USFWS) and with the head of the agency exercising administration over the wildlife resources of the state (WSDFW), with a view to the conservation of wildlife resources. The requirements of this Act are applicable to the Site where the implementation of remedial activities involves impacts to water or stream channels.
Federal Regulatory Requirement	Aquatic	Endangered Species Act [16 U.S.C. §§ 1531 - 1544].	Applicable	The Endangered Species Act (ESA) protects species of fish, wildlife, and plants that are listed as threatened or endangered with extinction. It also protects designated critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species, including consultation with resource agencies. Consistent with ESA Section 7, if any federally designated threatened or endangered species are identified in the vicinity of remediation work, and the action may affect such species and/or their habitat, the Agencies will consult with USFWS to ensure that remedial actions are conducted in a manner to avoid adverse habitat modification and jeopardy to the continued existence of such species.
Federal Regulatory Requirement	Wilderness Areas	Wilderness Act [16 USC §§ 1131 - 1136].	Applicable	The Wilderness Act established the National Wilderness Preservation System, which is to be comprised of federal land designated by Congress as wilderness areas, and administered to leave the land unimpaired for future use as a wilderness. The requirements within the Act are applicable for assessing Site remedial alternatives.
State Regulatory Requirement	Surface Water	Washington State Shoreline Management Act [RCW 90.58].	Applicable	The purpose of the Shoreline Management Act is to prevent inherent harm in the uncoordinated and piecemeal development of the state's shorelines. It applies to all marine waters; streams with a mean annual flow greater than 20 cfs; water areas larger than 20 acres; plus shorelands 200 feet landward from the edge of the aforementioned waters; and associated wetlands, river deltas, and floodplains. Local governments adopt shoreline master programs based on state guidelines but tailored to specific needs.
Federal Regulatory Requirement	Wetlands	Executive Order 11990 - Protection of Wetlands.	Applicable	Executive Order 11990 requires that potential impacts to wetlands be considered, and as practical, destruction, loss, or degradation of wetlands be avoided. EPA promulgated regulations to implement this Executive Order under 40 CFR Part 6. The requirements of this Order are applicable to remedial activities that take place within Onion Creek and associated Onion Creek tributaries and Site wetlands.
Federal Regulatory Requirement	Floodplains	Executive Order 11988 - Protection of Floodplains.	Applicable	Executive Order 11988 requires evaluation of the potential effects of actions that take place in a floodplain to avoid, to the extent possible, adverse impacts. EPA promulgated regulations to implement this Executive Order under 40 CFR Part 6. The requirements of this Order are applicable to remedial activities that take place within the 100-year floodplain of Onion Creek and associated Onion Creek tributaries.
Federal Regulatory Requirement	Native American	The American Indian Religious Freedom Act [AIRFA; 42 USC § 1996].	Applicable	This Act mandates federal agencies to protect the right of Indian Tribes to exercise their traditional religions. It is applicable to land-disturbing activities implemented during remedial action if places and physical paraphernalia needed for religious practice are affected. This Act is applicable to the Site if traditional cultural properties, archaeological resources, or historic sites important to the practice of American Indian religions are present.

Table 14 – Potential Applicable, and Relevant or Appropriate Requirements (ARARs)

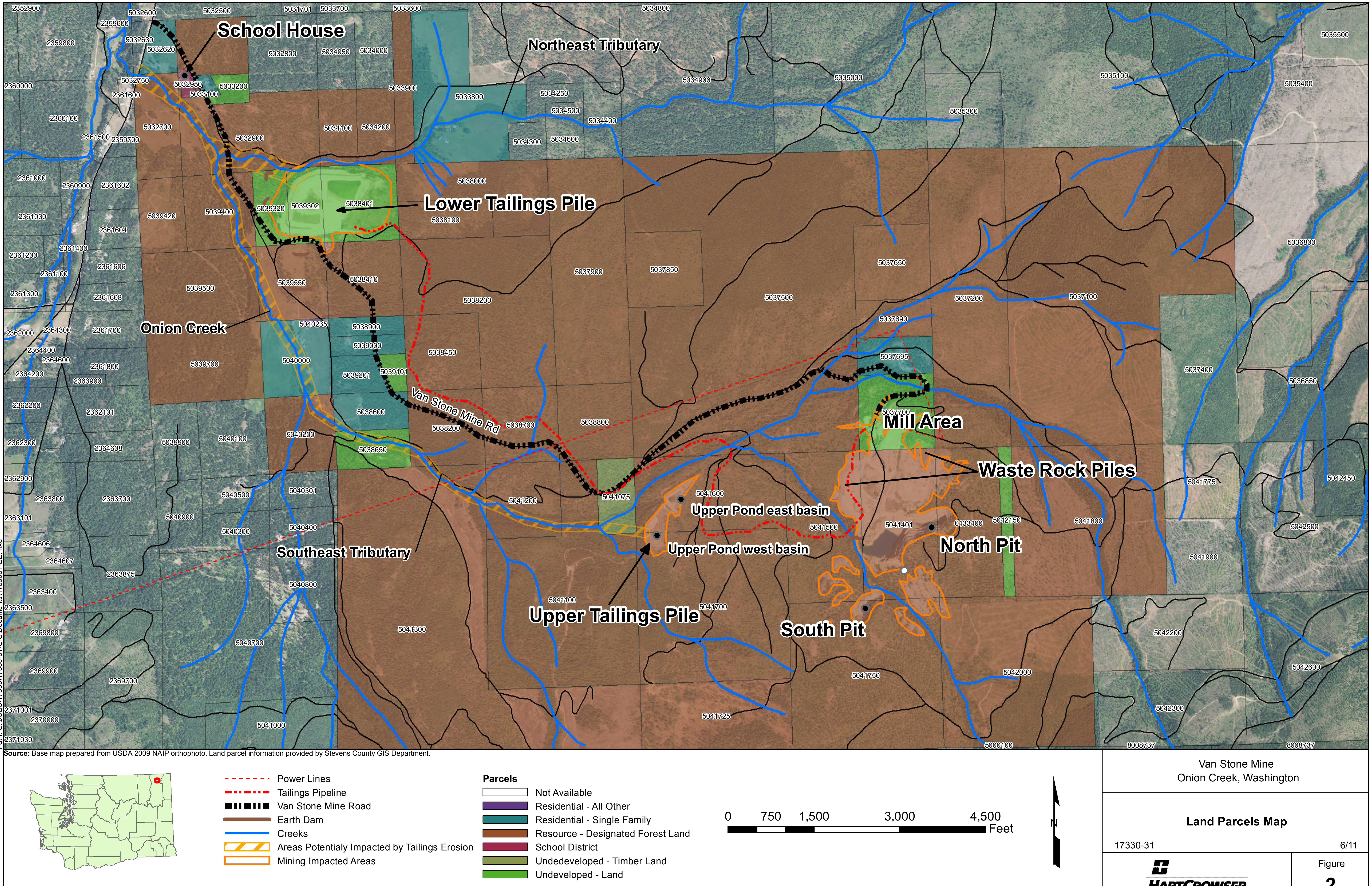
Authority	Medium	Requirement	Status	Synopsis of Requirement
Federal Regulatory Requirement	Avian	Migratory Bird Treaty Act (MBTA), 16 USC § 703 et seq.	Relevant and Appropriate	The MBTA makes it unlawful to "hunt, take, capture, kill" or take various other actions adversely affecting a broad range of migratory birds, including tundra swans, hawks, falcons, songbirds, without prior approval by the USFWS. (See 50 CFR 10.13 for the list of birds protected under the MBTA.) Under the MBTA, permits may be issued for take (e.g., for research) or killing of migratory birds (e.g., hunting licenses). The mortality of migratory birds due to ingestion of contaminated sediment is not a permitted take under the MBTA. The MBTA and its implementing regulations are relevant and appropriate for protecting migratory bird species identified. The selected response action will be carried out in a manner that avoids the taking or killing of protected migratory bird species, including individual birds or their nests or eggs.
Federal Regulatory Requirement	Roads	Roadless Area Conservation Rule 2001 [66 Fed. Reg. 3244, January 12, 2001].	Applicable	This rule limits road construction, reconstruction, and timber harvest in inventoried roadless areas because they have the greatest likelihood of altering and fragmenting landscapes, resulting in immediate, long-term loss of roadless area values and characteristics. This rule is applicable to permanent roads and temporary construction roads in the vicinity of the Site.
Federal Regulatory Requirement	Bald Eagle	Bald Eagle Protection Act [16 USC § 668 et seq].	Potentially Relevant and Appropriate	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.
Federal Regulatory Requirement	Cultural Environment	Protection and Enhancement of the Cultural Environment [Executive Order No. 11593].	Potentially Relevant and Appropriate	Requires federal agencies to nominate historic properties to the National Register of Historic Places and to treat properties as if on the list.
Federal Regulatory Requirement	Hazardous and Solid Waste	Hazardous and Solid Waste Regulations [40 CFR Part 264.18]	Potentially Relevant and Appropriate	Location standards and restrictions for hazardous waste treatment, storage, and disposal (TSD) facilities.

Authority	Medium	Requirement	Status	Synopsis of Requirement
Other Guidance for Consideration				
State Regulatory Requirement	Sustainability	Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management.	Other Guidance for Consideration	This order establishes a policy that Federal agencies conduct their activities in an environmentally sound and sustainable manner.
State Regulatory Requirement	Greenhouse Gas Emissions	Superfund Green Remediation Strategy, Office of Superfund Remediation and Technology Innovation, August 2009.	Other Guidance for Consideration	This sets out the plans of the Superfund Remedial Program to reduce greenhouse gas (GHG) emissions and other negative environmental impacts that might occur during remediation of a hazardous waste site.
State Regulatory Requirement	Cleanup Footprint	Incorporating Sustainable Practices into Remediation of Contaminated Sites, April, 2008, EPA 542-R-08-002.	Other Guidance for Consideration	This outlines the principles of green remediation and describes opportunities to reduce the footprint of cleanup activities throughout the life of a project.
State Regulatory Requirement	Cleanup Footprint	EPA's Principles for Greener Cleanups, August 27, 2009.	Other Guidance for Consideration	This sets forth the goal to evaluate cleanup actions comprehensively to ensure protection of human health and the environment and to reduce the environmental footprint of cleanup activities, to the maximum extent possible.
State Regulatory Requirement	Greenhouse Gas Emissions	Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, October 5, 2009.	Other Guidance for Consideration	This requires federal agencies to make reductions in greenhouse gas emissions a priority for federal agencies. The EO states that the federal government must lead by example in increasing energy efficiency, reducing greenhouse gas emissions, etc.
State Regulatory Requirement	Energy Conservation	EPA Region 10's Clean and Green Policy, August 13, 2009. EPA Region 10's Clean and Green Policy applies to all Superfund cleanups including those performed by Potentially Responsible Parties (PRPs).	Other Guidance for Consideration	The Policy encourages cleanup practices that, among other things, employ 100% use of renewable energy, and energy conservation and efficiency approaches including EnergyStar equipment; and use of cleaner fuels and diesel emissions controls.
State Regulatory Requirement	Groundwater	Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration, OSWER Directive 9283.	Other Guidance for Consideration	This Directive provides a compilation of some key existing EPA groundwater policies to assist EPA Regions in making groundwater restoration decisions pursuant to CERCLA and the NCP.
State Regulatory Requirement	Sediment	Numeric Values for Freshwater Sediment Quality.	Other Guidance for Consideration	Neither the federal government nor Washington State has current promulgated freshwater sediment standards. However, this is an area that is the subject of active scientific evaluations by EPA and Ecology, as well as other agencies (e.g., US Army Corps of Engineers et al. 2006). The results of the ongoing interagency cooperative assessment provide information that is helpful in establishing protective cleanup levels. For the Site, sediment cleanup levels that are relevant and appropriate are based on state freshwater sediment quality values, the Sediment Evaluation Framework for the Pacific Northwest screening levels (US Army Corps of Engineers et al. 2006), and scientific literature, as discussed in the SFS.

This page is intentionally left blank
for double-sided printing.


S18
S17
S16
S15
S13
Stevens County Highway 9425
S19
S20
S21
S22
School House
Northeast Tributary
West Pond
East Pond
SW1
SW2
SW3
W1
S24
Lower Tailings Pile
Detention Pond
W2
Onion Creek
S29
S28
S27
S30
SW4
SW5
SW6
Van Stone Mine Rd
Slurry Pond
SW8
Mill Area
Waste Rock Piles
S25
Upper Pond East Basin
Upper Pond West Basin
North Pit
West End Pit
Southeast Tributary
S31
S32
S33
S34
Upper Tailings Pile
South Pit
S36
SW7
WL-1
WL-2
WL-3
WL-4
WL-5
WL-6
WL-7
WL-8
WL-9
WL-10
WL-11
WL-12
WL-13
WL-14
WL-15
WL-16
WL-17
WL-18
WL-19
WL-20
Equinox Waste Discharge Monitoring Station (SW8)
Estimated Location of Residential Wells (DCN-1021)
Monitoring Wells (W2) (Klohn Lenoff, 1990)
Well Locations (WL-20) (from Ecology database)
Spring (DCN-1021)
Power Lines
Tailings Pipeline
Van Stone Mine Road
Roads
Earth Dam
Creeks
Areas Potentialy Impacted by Tailings Erosion
Identified Mining Impacted Areas
0 750 1,500 3,000 Feet
40-foot contours
N
Van Stone Mine
Onion Creek, Washington
Mine Site and Vicinity with Local Residences
17330-31
6/11
HARTCROWSER
Figure 1
173303/1733031-AA 061311

This page is intentionally left blank for double-sided printing.



Source: Base map prepared from USDA 2009 NAIP orthophoto. Land parcel information provided by Stevens County GIS Department.

Van Stone Mine
Onion Creek, Washington

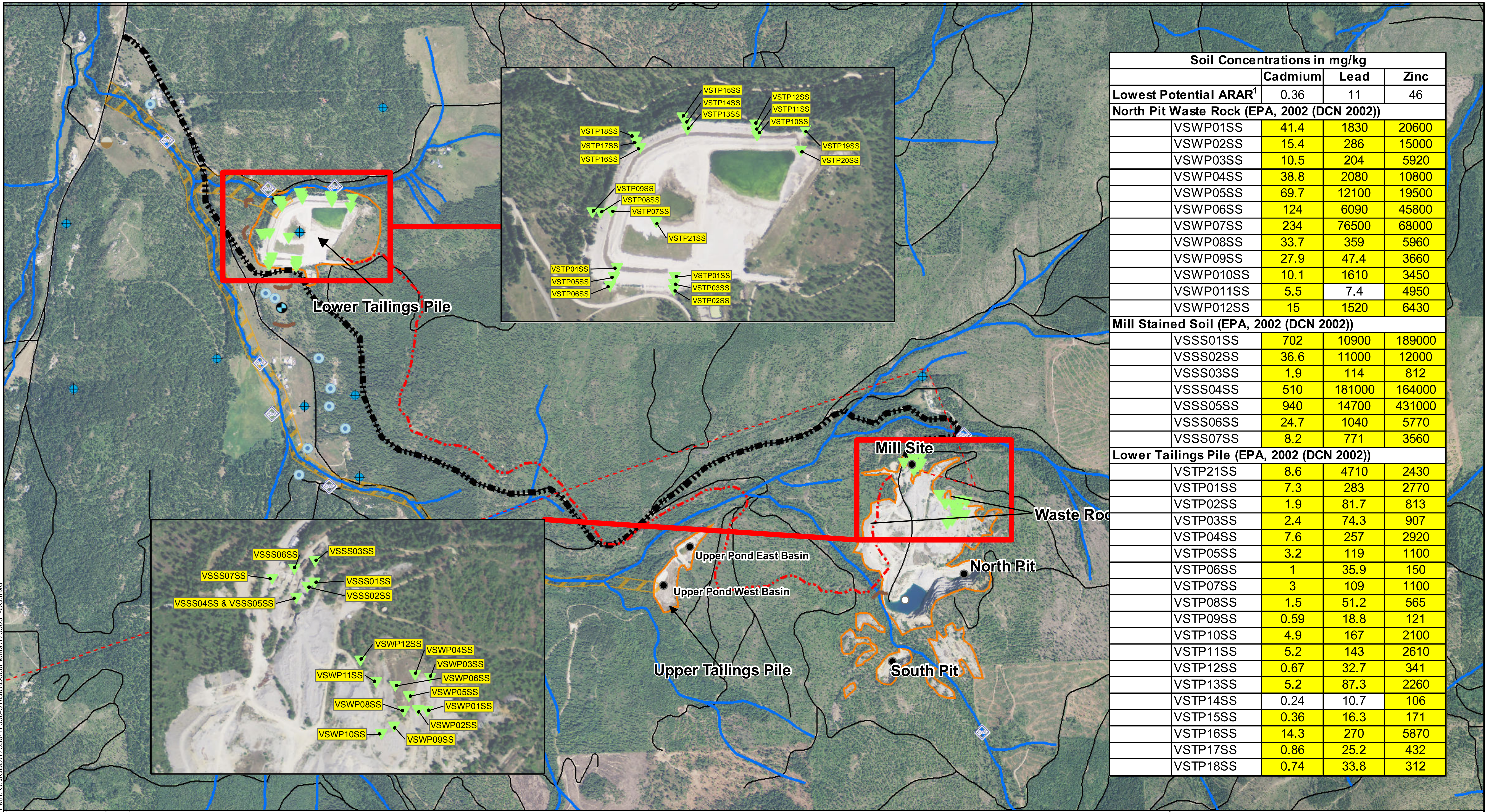
Land Parcels Map

17330-31 6/11

HARTCROWSER

Figure
2

This page is intentionally left blank for double-sided printing.



Soil Concentrations in mg/kg				
		Cadmium	Lead	Zinc
Lowest Potential ARAR[1]		0.36	11	46
North Pit Waste Rock (EPA, 2002 (DCN 2002))				
	VSWP01SS	41.4	1830	20600
	VSWP02SS	15.4	286	15000
	VSWP03SS	10.5	204	5920
	VSWP04SS	38.8	2080	10800
	VSWP05SS	69.7	12100	19500
	VSWP06SS	124	6090	45800
	VSWP07SS	234	76500	68000
	VSWP08SS	33.7	359	5960
	VSWP09SS	27.9	47.4	3660
	VSWP010SS	10.1	1610	3450
	VSWP011SS	5.5	7.4	4950
	VSWP012SS	15	1520	6430
Mill Stained Soil (EPA, 2002 (DCN 2002))				
	VSSS01SS	702	10900	189000
	VSSS02SS	36.6	11000	12000
	VSSS03SS	1.9	114	812
	VSSS04SS	510	181000	164000
	VSSS05SS	940	14700	431000
	VSSS06SS	24.7	1040	5770
	VSSS07SS	8.2	771	3560
Lower Tailings Pile (EPA, 2002 (DCN 2002))				
	VSTP21SS	8.6	4710	2430
	VSTP01SS	7.3	283	2770
	VSTP02SS	1.9	81.7	813
	VSTP03SS	2.4	74.3	907
	VSTP04SS	7.6	257	2920
	VSTP05SS	3.2	119	1100
	VSTP06SS	1	35.9	150
	VSTP07SS	3	109	1100
	VSTP08SS	1.5	51.2	565
	VSTP09SS	0.59	18.8	121
	VSTP10SS	4.9	167	2100
	VSTP11SS	5.2	143	2610
	VSTP12SS	0.67	32.7	341
	VSTP13SS	5.2	87.3	2260
	VSTP14SS	0.24	10.7	106
	VSTP15SS	0.36	16.3	171
	VSTP16SS	14.3	270	5870
	VSTP17SS	0.86	25.2	432
	VSTP18SS	0.74	33.8	312

Path: G:\JOBS\17330\17330-31\GIS\Documents\1733031-CC.mxd

Source: Base map prepared from USDA 2009 NAIP orthophoto.

- Surface Soil Sample (EPA, 2002)
- Equinox Waste Discharge Monitoring Station (SW8)
- Estimated Location of Residential Wells (DCN 1021)
- Well Locations (WL-20) (from Ecology Database)
- Monitoring Wells (W2) (Klohn Lenoff, 1990)
- Spring (DCN-1021)
- Power Lines
- Tailings Pipeline
- Van Stone Mine Road
- Earth Dam
- Creeks
- Areas Potentialy Impacted by Tailings Erosion
- Mining Impacted Areas

0 750 1,500 3,000 4,500 Feet

N

Notes:
[1] Values used for comparison are the lowest potential ARAR concentrations listed in Table 7 of the workplan. Where the ARAR is exceeded, shaded yellow.

Van Stone Mine
Onion Creek, Washington

Soil Metals Concentrations

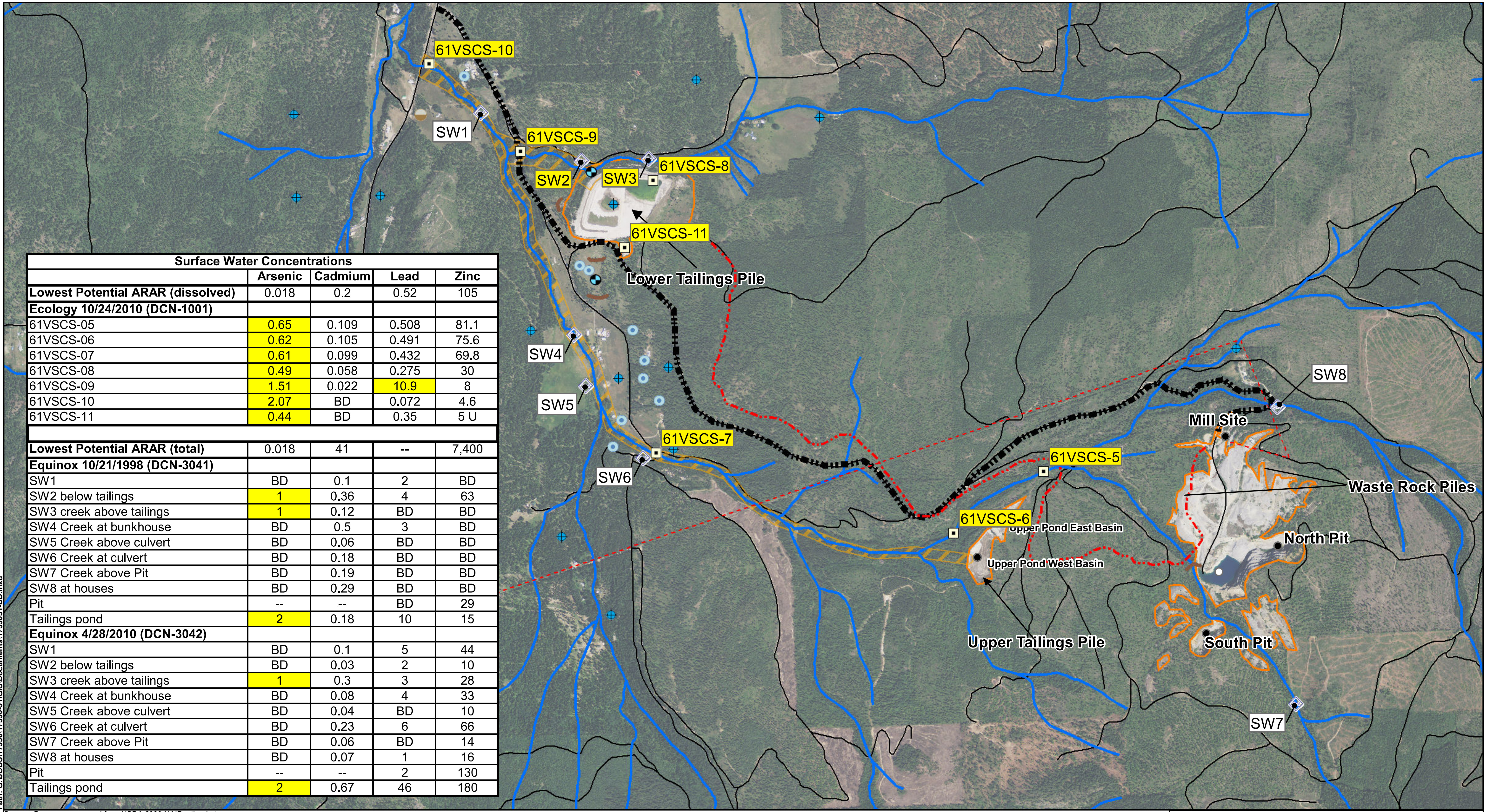
17330-31 6/11

HARTCROWSER

Figure
3

This page is intentionally left blank for double-sided printing.

Surface Water Concentrations				
	Arsenic	Cadmium	Lead	Zinc
Lowest Potential ARAR (dissolved)	0.018	0.2	0.52	105
Ecology 10/24/2010 (DCN-1001)				
61VSCS-05	0.65	0.109	0.508	81.1
61VSCS-06	0.62	0.105	0.491	75.6
61VSCS-07	0.61	0.099	0.432	69.8
61VSCS-08	0.49	0.058	0.275	30
61VSCS-09	1.51	0.022	10.9	8
61VSCS-10	2.07	BD	0.072	4.6
61VSCS-11	0.44	BD	0.35	5 U
Lowest Potential ARAR (total)	0.018	41	--	7,400
Equinox 10/21/1998 (DCN-3041)				
SW1	BD	0.1	2	BD
SW2 below tailings	1	0.36	4	63
SW3 creek above tailings	1	0.12	BD	BD
SW4 Creek at bunkhouse	BD	0.5	3	BD
SW5 Creek above culvert	BD	0.06	BD	BD
SW6 Creek at culvert	BD	0.18	BD	BD
SW7 Creek above Pit	BD	0.19	BD	BD
SW8 at houses	BD	0.29	BD	BD
Pit	--	--	BD	29
Tailings pond	2	0.18	10	15
Equinox 4/28/2010 (DCN-3042)				
SW1	BD	0.1	5	44
SW2 below tailings	BD	0.03	2	10
SW3 creek above tailings	1	0.3	3	28
SW4 Creek at bunkhouse	BD	0.08	4	33
SW5 Creek above culvert	BD	0.04	BD	10
SW6 Creek at culvert	BD	0.23	6	66
SW7 Creek above Pit	BD	0.06	BD	14
SW8 at houses	BD	0.07	1	16
Pit	--	--	2	130
Tailings pond	2	0.67	46	180



Path: G:\JOBS\17330\17330-31\GIS\Documents\1733031-DD.mxd

Source: Base map prepared from USDA 2009 NAIP orthophoto.

Surface Water Samples (Ecology, 2010)
Equinox Waste Discharge Monitoring Station (SW8)
Estimated Location of Residential Wells (DCN 1021)
Well Locations (WL-20) (from Ecology Database)
Monitoring Wells (W2) (Klohn Lenoff, 1990)
Spring (DCN-1021)

Power Lines
Tailings Pipeline
Van Stone Mine Road
Earth Dam
Creeks
Areas Potentialy Impacted by Tailings Erosion
Mining Impacted Areas

0 1,500 3,000 4,500 Feet

N

Notes:
[1] Values used for comparison are the lowest potential ARAR concentrations listed in Table 5 of the work plan. Where the ARAR is exceeded, shaded yellow.
Concentrations are dissolved and total in ug/L.

Van Stone Mine
Onion Creek, Washington

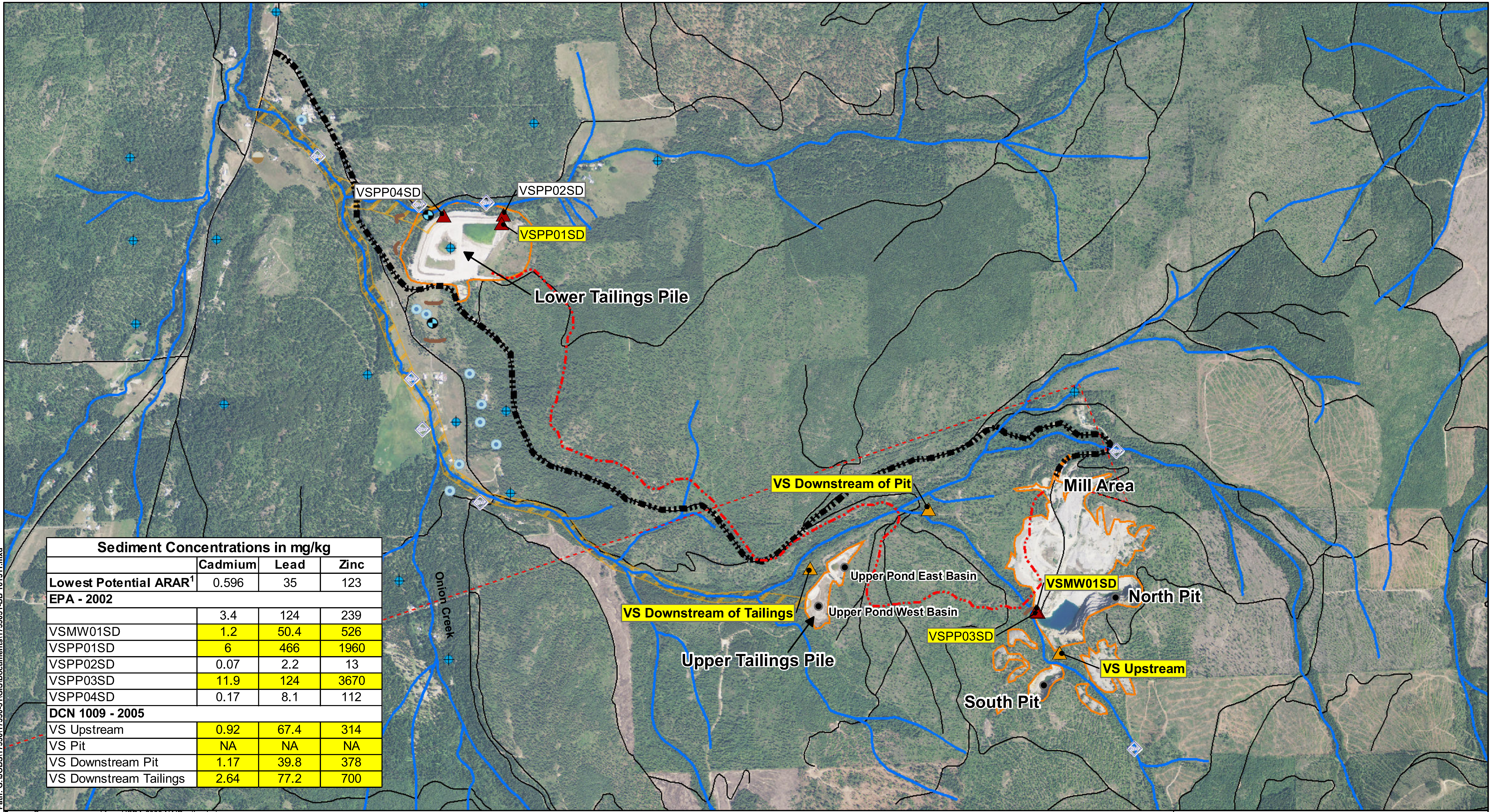
Surface Water Concentrations

17330-31 6/11

HARTCROWSER

Figure
4

This page is intentionally left blank for double-sided printing.

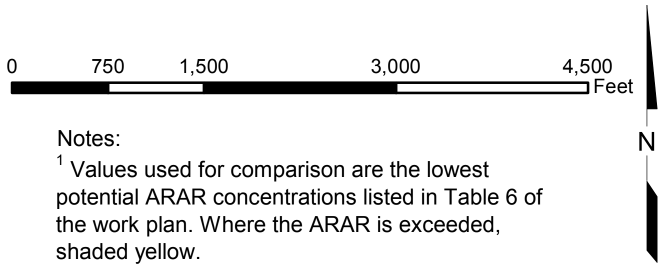


Sediment Concentrations in mg/kg			
	Cadmium	Lead	Zinc
Lowest Potential ARAR[1]	0.596	35	123
EPA - 2002			
	3.4	124	239
VSMW01SD	1.2	50.4	526
VSPP01SD	6	466	1960
VSPP02SD	0.07	2.2	13
VSPP03SD	11.9	124	3670
VSPP04SD	0.17	8.1	112
DCN 1009 - 2005			
VS Upstream	0.92	67.4	314
VS Pit	NA	NA	NA
VS Downstream Pit	1.17	39.8	378
VS Downstream Tailings	2.64	77.2	700

Path: G:\JOBS\17330\17330-31\GIS\Documents\1733031-BB 161311.mxd

Source: Base map prepared from USDA 2009 NAIP orthophoto.

Sediment samples (DCN 1009)
Sediment Samples (EPA, 2002)
Equinox Waste Discharge Monitoring Station (SW8)
Monitoring Wells (W2) (Klohn Lenoff, 1990)
Estimated Location of Residential Wells (DCN 1021)
Well Locations (WL-20) (from Ecology database)
Spring (DCN 1021)
Power Lines
Tailings Pipeline
Van Stone Mine Road
Earth Dam
Creeks
Areas Potentialy Impacted by Tailings Erosion
Mining Impacted Areas
Roads



Notes:
[1] Values used for comparison are the lowest potential ARAR concentrations listed in Table 6 of the work plan. Where the ARAR is exceeded, shaded yellow.

Van Stone Mine
Onion Creek, Washington

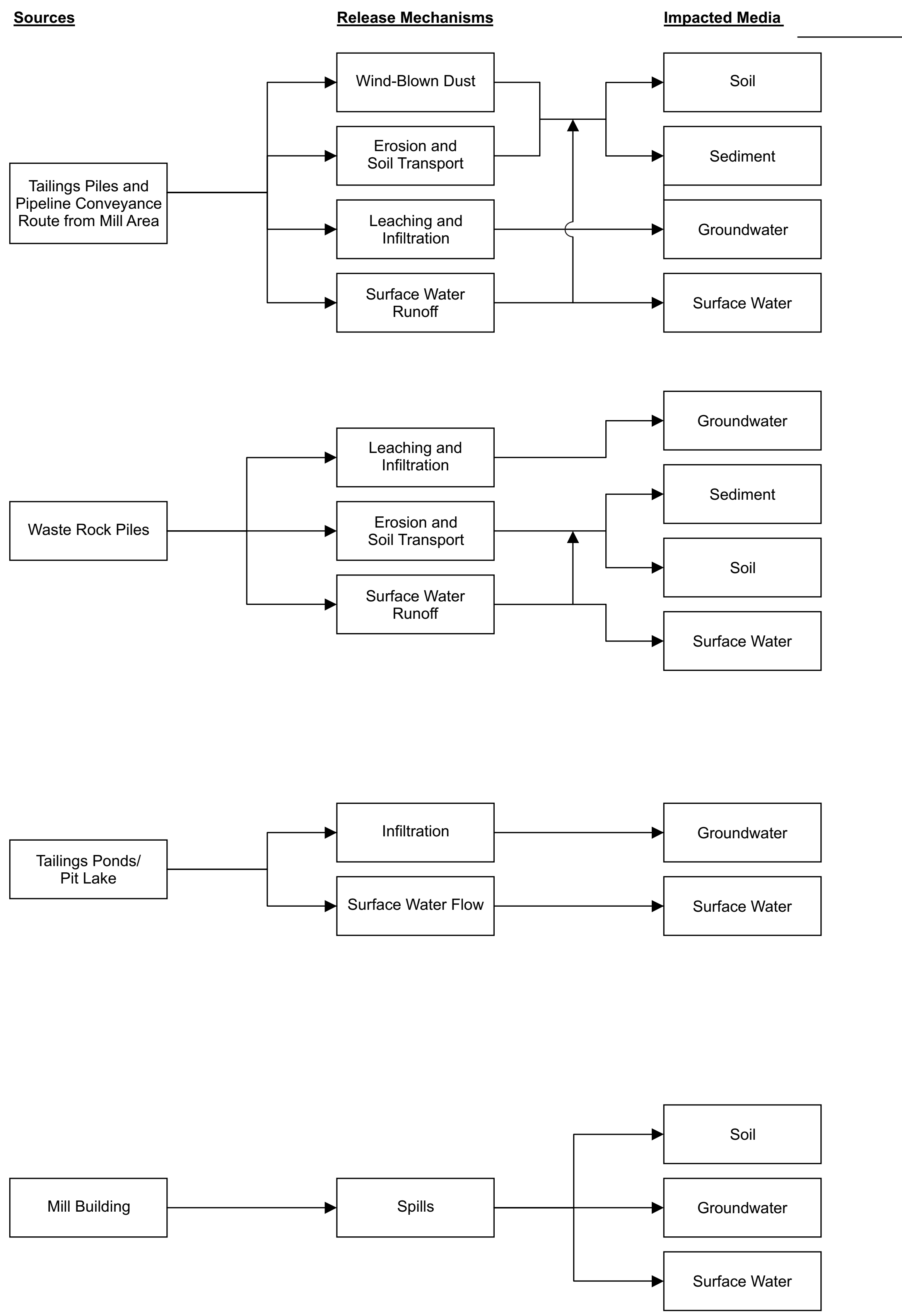
Sediment Metals Concentrations

17330-31 6/11

HARTCROWSER

Figure
5

Preliminary Conceptual Site Model
Van Stone Mine, Onion Creek, Washington



Impacted Media	Route	Adult Resident Child Resident	Tresspasser	Terrestrial Biota	Aquatic Biota
Soil	Inhalation	●	◐	●	
	Dermal Contact	◐	◐	●	
	Ingestion	●	◐	●	
Groundwater	Inhalation	●	◐		
	Dermal Contact	●	◐		
	Ingestion	●	◐		
Surface Water	Inhalation	●	◐		
	Dermal Contact	●	◐	◐	●
	Ingestion	●	●	◐	●
Sediment	Inhalation				
	Dermal Contact	◐	◐	◐	●
	Ingestion	◐	◐	◐	●
Biota*	Inhalation				
	Dermal Contact				
	Ingestion	●	●	●	●

Legend

● Complete Pathway

◐ Incomplete Pathway

*Biota (e.g., homegrown vegetables, insects, fish, plants) may be considered a secondary source that accumulate constituents of concern from impacted soil, sediment, surface water, and groundwater and may be consumed by humans or ecological receptors. Independent of being a secondary source, terrestrial and aquatic biota are also receptors.

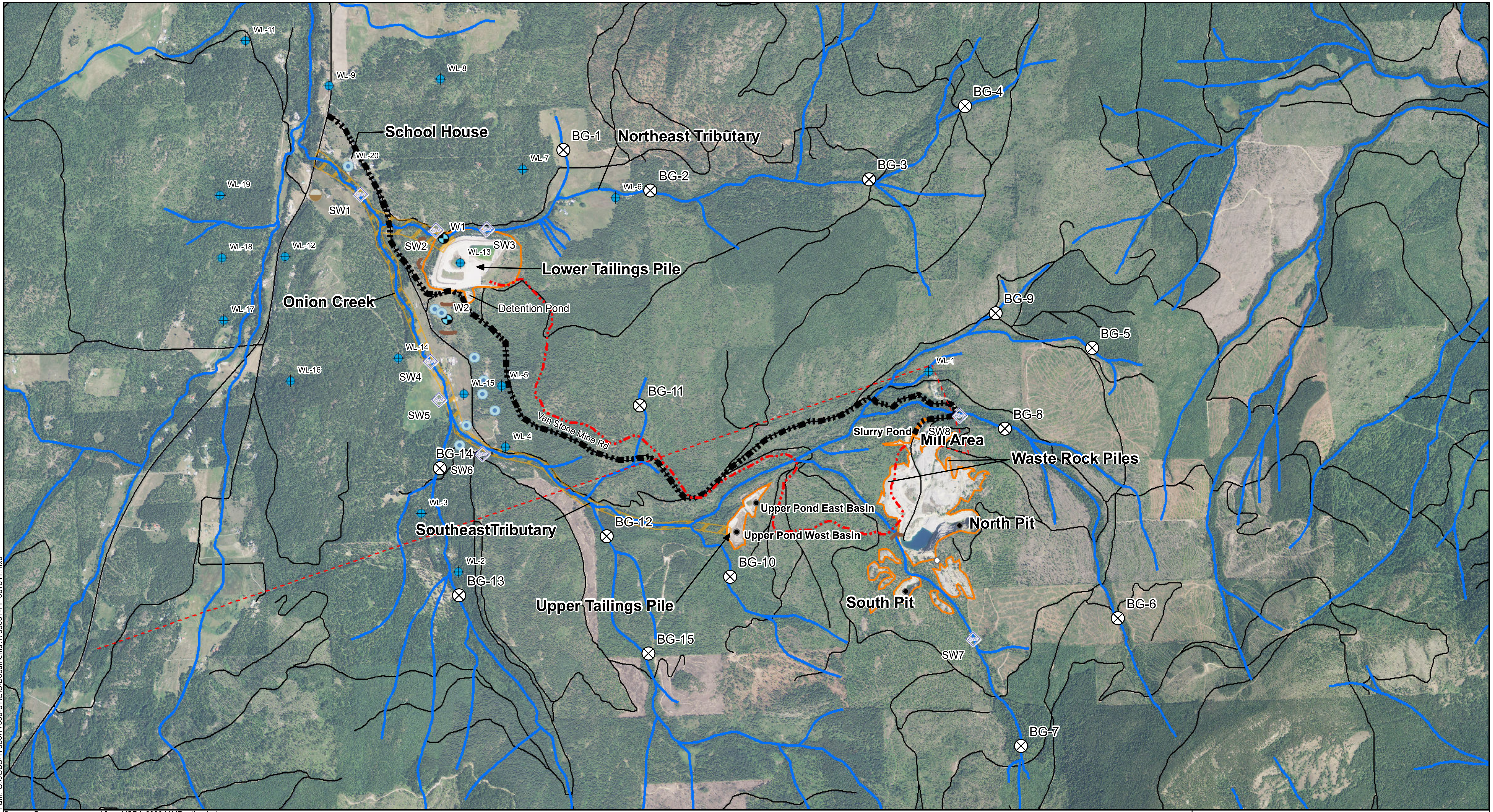
JAB 06/17/11 1733031-AA.cdr

HARTCROWSER

17330-31 *6/11*

Figure 6

This page is intentionally left blank for double-sided printing.



Path: G:\JOBS\17330\17330-31\GIS\Documents\1733031-FF 061311.mxd

Source: Base map prepared from USDA 2009 NAIP orthophoto.

Equinox Waste Discharge Monitoring Station (SW8)
Estimated Location of Residential Wells (DCN 1021)
Monitoring Wells (W2) (Klohn Lenoff, 1990)
Well Locations (WL-20) (from Ecology database)
Spring (DCN-1021)

Power Lines
Tailings Pipeline
Van Stone Mine Road
Earth Dam
Creeks
Areas Potentialy Impacted by Tailings Erosion
Mining Impacted Areas
Roads

Proposed Background Sample Locations (BG-15) (Surface Soil, Sediment, and Surface Water)
Note: Background samples are generally co-located and easily accessible for sampling.

0 2,000 4,000 6,000 Feet

N

Van Stone Mine
Onion Creek, Washington

Proposed Background Sampling Locations

17330-31 6/11

HARTCROWSER

Figure
7

This page is intentionally left blank for double-sided printing.

APPENDIX A
SUMMARY OF HISTORICAL DOCUMENT REVIEW – JUNE 7, 2011 MEMORANDUM

HARTCROWSER

www.hartcrowser.com

MEMORANDUM

DATE: June 7, 2011

TO: Project Folder

FROM: Colleen Rust/Emily Duncanson/Phil Cordell

RE: **Van Stone Document Review**
17330-31

CC: **Steve Hughes**

This memorandum summarizes the documents most relevant to the Work Plan for the Van Stone Mine site (the Site). See below for document summaries of the following documents:

1. DCN-1000 - tcp 2.5 map pages
2. DCN-1001 - Creek Sampling 11.22.2010 f
3. DCN-1002 - Notice of correction 8.2.2010
4. DCN-1003 - Parcel Search 7.19.2010
5. DCN-1004 - Lower Tailings Investigation 1990
6. DCN-1005 - Periodic Inspection Report - Van Stone Tailing Dam 1.18.2008
7. DCN-1006 – Re Reclamation Plan for the Van Stone Mine
8. DCN-1007 – Re Van Stone Mine Tailings Dam Inspection 10.16.95
9. DCN-1008 - SEPA Lead Agency & Determination of Nonsignificance
10. DCN-1009 - Soil and Surface Water Sample Tables 2005-2006
11. DCN-1010 – Tailings Dam Inspection Correspondence 1993-1998
12. DCN-1011 – Van Stone Reclamation Plan 6.22.1999
13. DCN-1012 - Water Quality Summary Reports 1991-1992
14. DCN-1013 - Summary of Mineable Reserves
15. DCN-1014 - Seepage Environmental Analysis of Slime Zone Tailing Pond
16. DCN-1015 – Lower Tailings Water Quality Data 1990-1996
17. DCN-1016 – Revised Final Reclamation Plan
18. DCN-1017 - Site Hazard Assessment Worksheet
19. DCN-1018 – Water Quality Data 2005-2006
20. DCN-1019 - Water Well Data
21. DCN-1020 - Report on Certain Aspects of the Van Stone Mine
22. DCN-1021 - Waste Discharge Permit Application

1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212
Fax 206.328.5581
Tel 206.324.9530

23. DCN-1022 - Waste Discharge Permit
24. DCN-1023 - Tailings Dam Construction 1996
25. DCN-1024 - Construction Quality Assurance Final Report Phase1
26. DCN-1025 - Construction Quality Assurance Final Report Phase2
27. DCN-1026 - GW Sampling 9.2004
28. DCN-1027 – Site Hazard Worksheet with Correspondence 2.20.2007
29. DCN-1028 – Tailings Impoundment Liner System- Phase II
30. DCN-1029 - Trace element geochemistry of Onion Creek near Van Stone
31. DCN-1030 - Van Stone Mine Cleanup Report 5.7.2010
32. DCN-1031 - Van Stone Mine Synopsis Nov 2010 - BD at Ecology
33. DCN-1032 - Notice of Construction 11.9.1990
34. DCN-1033 – Van Stone Tailings Dam Deficiencies Letter 4.27.1998
35. DCN-1034 – Hazardous Compliance Pages
36. DCN-1035 - Site Inspection Report 1986
37. DCN-1036 - DNR Inactive and Abandoned Mines
38. DCN-1037 - Tailings Disposal Design Report 1990
39. DCN-1038 – Fact Sheet for Discharge Permit
40. DCN-1039 - Water Quality Data Report 1990
41. DCN-1040 – DW Inspection Report 7.8.2009
42. DNC-1041 - Upper Columbia River PAsSIs
43. DCN-1042 – Physical Limnology and Geochemistry of Two Circum-Neutral pH Mine Pit Lakes
44. DCN-1043 – Letter summarizing START-2 Report
45. DCN-1044 – Site Hazard Correspondence 9.18.2006 (6 Pages)
46. DCN-1045 - Site Hazard Correspondence 2.4.2007
47. DCN-1046 - Site Hazard Correspondence 9.18.2006 (2 Pages)
48. DCN-1047 – START-2 Pages
49. DCN-1048 – Dam Correspondence
50. DCN-1049 – Environmental Sampling Request Correspondence by EPA
51. DCN-1050 - Letter 10.18.2005 Water Quality Sampling
52. DCN-1051 - Correspondence with Subject 9.19.2004 Sampling
53. DCN-1052 - Dam Maintenance Plan and Associated Dam Issues
54. DCN-1053 - Dam Safety Office Comments Summary
55. DCN-1054 - Pan America Sale of Equinox Holdings
56. DCN-1055 - Preliminary Potential Responsible Party Search
57. DCN-1056 - Reclamation and Closure Plan
58. DCN-1057 - Reclamation and Closure Plan with hand written notes
59. DCN-1058 - Pit Details and Maps from unknown document
60. DCN-1059 - Revised Final Reclamation Plan Figures

61. DCN-1060 - SEPA Environmental Checklist Report
62. DCN-1061 - Surface Mine Inspection Report
63. DCN-1062 - Tailings Dam Safety Issues
64. DCN-1063 - Tailings Pond Water Level lowering via irrigation
65. DCN-1064 - Waste Discharge Permit Article
66. DCN-1065 – Historical Site photos
67. DCN-1066 - Zinc and Lead Ore Deposits Stevens County, WA
68. DCN-1067 – Geotech and Water Quality Data Report 1990
69. DCN-1068 - Van Stone Mine Map 1
70. DCN-1069 - Van Stone Mine Map 2
71. DCN-1070 - Van Stone Mine Map 3
72. DCN-1071 - Van Stone Mine Map 4
73. DCN-1072 - Van Stone Mine Map 5
74. DCN-1073 - Van Stone Mine Map 6
75. DCN-1074 - Van Stone Mine Map 7

DCN-1000 - tcp 2.5 map pages.pdf

Document includes miscellaneous maps of the Van Stone Mine Site from various reports.

DCN-1001 - Creek Sampling 11.22.2010

The Washington State Department of Ecology (Ecology) creek sampling data from October 23, 2010, surface water sampling of tributaries. Locations provided in GIS shape file provided by Ecology. The following information was included in the document:

Eleven surface water samples, 61VSCS-01 through 61VSCS-11, were collected; two samples were placed on hold. Nine samples were analyzed, but sample data was included for only seven samples. Data was not summarized in tables.

Surface water samples were analyzed for dissolved metals (As, Cd, Cu, Pb, and Zn) by EPA Method 200.8 and hardness by Standard Method 2340B. Field notes include field parameters, temperature, pH, conductivity, and dissolved oxygen. Seven surface water samples, 61VSCS-05 through 61VSCS-11, were analyzed for Zn, Pb, Cu, Cd, and As. Ten surface water samples, 61VSCS-01 through 61VSCS-10, were analyzed for hardness.

The report includes laboratory certificates, laboratory QA, field notes with field parameters, GPS location name, and sample location description.

Summary of suitability of existing data: Water samples were filtered, results reported dissolved metals. The data was acceptable with minor qualification. Data were not formatted in a table.

Eleven surface water samples were collected around the site; the majority of the samples were collected from creeks at or below mine locations along tributaries.

DCN-1002 - Notice of correction 8.2.2010

Notice of Correction Docket No.7904. Letter from Washington State Department of Ecology's Dam Safety Officer (DSO) informing Equinox that tailings pile dam is now regulated and needs to be in compliance with all dam safety rules and regulations.

General Information

- The pit lake dam is under the jurisdiction of DSO. At the dam crest, it is estimated that the pit lake can store about 50 acre-feet of water. The dam impounds a volume that exceeds Ecology's jurisdictional threshold of 10 acre-feet. No analytical data were collected.

- The Van Stone Pit Lake Dam is at Longitude 117°45′43″W and Latitude 48°45′35″N, in Stevens County, Washington.

- The dam was probably built with a mixture of rock-blasting debris mixed with local soil. The dam is about 100 feet long, 15 feet wide, and the highest part of the dam is about 15 feet above natural grade.

DCN-1003 Parcel Search 7.19.2010

Summary information on Parcel Numbers: 5039302, 5038401, 5039320, and 5041401. The information includes: parcel summary, taxable value, property characteristics, tax summary, assessment summary, valuation history, sales history, and building/land details.

DCN-1004 Lower Tailings Investigation 1990

This report includes a series of partial documents including maps with exploration locations, boring logs, and CPT data. The information includes some site photographs taken during investigation activities.

Maps

- Proposed Site Investigation Map: includes location water level monitoring, electric cone sounding, and completion for groundwater sampling.
- Test Hole Location Plan
- Site Location and Vicinity Map
- Surface Water Sample Site Location Plan

Data

- Test Hole Log sample data and description of materials for Hole Nos. DH89-6, DH89-1, DH89-3
- Electric Cone Data for Van Stone Mine C1-C6, C8-C10, C14

General Information

- Brief review of document "Equinox Resources, (Wash) Inc. Van Stone Mine Reclamation & Closure Plan."
- Review of geotechnical data from mid to late December 1999, Cone Penetration Testing & Hollow Stem Auger Borings.

DCN-1005 - Periodic Inspection Report - Van Stone Tailing Dam 1.18.2008

Periodic Inspection Report, by the DSO. Includes inspection findings, downstream hazard assessment, and required remedial work.

General Information

This report provides background information, field inspection findings, downstream hazard assessment, emergency preparedness, photos of the dam, and dam details including reservoir size and conclusions.

DCN-1006 Reclamation Plan for the Van Stone Mine

This is correspondence between Hallam Knight Piesold Ltd. and Beacon Hill Consultants on July 19, 1999, in response to comments on the draft Van Stone Reclamation Plan. The comment responses were addressed in the final report titled "Equinox Resources (Wash) Inc., Van Stone Mine, Washington State, USA, Reclamation and Closure Plan." Correspondence also includes additional notes on the points raised on the draft report.

DCN-1007 Re Van Stone Mine Tailings Dam Inspection 10.16.1995

Correspondence between Knight Piesold Ltd. (Consulting Engineers) and Zicor Mining, Inc.
The document is in response to a site inspection on October 10, 1995, which was to evaluate the erosion of the tailings dam and to inspect on-site materials which could be used for mitigation purposes. Knight Piesold Ltd. included comments on erosion control measures already implemented and gives recommendations on additional control measures required to prevent further erosion of the dam.

The document includes drawings of "Tailings Impoundment No. 2 General Arrangement," "Tailings impoundment No. 2 typical embankment cross section," "Tailings impoundment No. 2 Recommended Berm Cross Section," "Tailings Impoundment No. 2 Berm- Swale Layout," "Tailings Impoundment No. 2 Catch Basin/Channel Configuration," "Tailings Impoundment No. 2 Catch Basin/Channel Details," and "Tailings impoundment No. 2 Catch Basin/Channel Cross Sections."

DCN-1008 SEPA Lead Agency & Determination of Nonsignificance 10.1999

This is a memorandum from Washington State Department of Natural Resources (DNR) to various parties on October 12, 1999, stating that DNR is the lead agency for Determination of Nonsignificance on revision of a mining claim plan. The memorandum requests comments on an "Environmental Checklist and Determination of Nonsignificance," and includes a filled out "Environmental Checklist" form completed by Equinox on June 9,1999.

DCN-1009 - Soil and Surface Water Sample Tables 2005-2006

The document includes water quality sampling conducted on October 18, 2005, with summary tables. Four surface water samples were collected from the following areas:

1. VS Upstream,
2. VS Pit,
3. VS Downstream of Pit, and
4. VS Downstream of Tailings.

Four sediment samples were also collected. (May be co-located, unknown.)

1. VS Upstream,
2. VS Pit,
3. VS Downstream of Pit, and
4. VS Downstream of Tailings.

Surface water analysis of low-flow surface water samples, including dissolved metals (As, Cd, Cr, Cu, Pb, and Zn) and total metals (Al, Fe, and Hg). Field measurements and general chemistry for low and high flow of temperature, pH, conductivity, and hardness, TDS, TSS, turbidity sulfate.

Sediment Analysis of sediment samples for metals (Al, Sb, Be, Cd, Cr, Cu, Fe, Mn, Ni, Ag, Zn, As, Pb, Hg, Se, Tl). Report materials included summary tables, but no laboratory reports.

A summary of suitability of existing data stating that surface water and sediment data were acceptable with minor qualification; data are presented in summary tables. Limited sample coverage and surface water and sediment samples may be co-located. No sample location information other than the sample name.

DCN-1010 Tailings Dam Inspection Correspondence 1993-1998

Correspondence form Ecology to Equinox on April 27, 1998, regarding deficiencies with the North Dike and remedial program in response to a site inspection. The correspondence includes photos of the site dated March 25, 1998. The materials included:

- DCN-1007 Re Van Stone Mine Tailings Dam Inspection 10.16.1995
- April 27, 1994, File for Record by Ecology titled "Van Stone Mines Site Meeting File No.:ST61-608."
  - A meeting was held on site on April 22, 1994, to review the modifications that were made to the facility in February and March 1994.
  - The document outlines the site inspection and the participants' comments on the site modifications.
- December 1, 1993, file for record by Ecology titled "Van Stone Mines Tailing Impoundment Inspection."
  - A tour of the project site on November 10, 1993, is discussed and the geotechnical issues posed by the steep embankment side slopes are examined.

DCN-1011 Van Stone Reclamation Plan 6.22.1999

The document includes a completed DNR "Standard Reclamation Plan," a completed "Environmental Checklist," and a completed "Determination of Nonsignificance." Appendix A includes a technical project description of mining activities.

DCN-1012 Water Quality Summary Reports 1991-1992

- Summary of water quality data from 1991-1992

- Samples: 1SW through 8SW, 1GW and 2GW

DCN-1013 Summary of Mineable Reserves

This document includes portions of a report with tables summarizing mineable reserves, open-pit mineable reserves by section, and an open pit operation schedule.

DCN-1014 Seepage-Environmental Analysis of Slime Zone of a Tailings Pond

This research paper by Spokane Mining Research Center includes:

- General geology
- Van Stone field investigation
- Laboratory data
- Environmental field and laboratory investigation
- Stream sediment analysis
- Results and conclusions of sediment analysis
- Water quality of receiving streams
- Finite-element analysis
- Environmental design criteria
- Conclusions
- Appendix A – Analysis of tailings from Shelby tubes 13 and 21
- Appendix B – Computer model output data
- Illustrations
- Tables

General Information

- A Bureau of Mines study was designed to identify the influences of the slime zone in preventing dissolved and suspended solids from seeping outside the tailings pond.
- A finite-element method was used to determine the rate of discharge of subsurface water from the Van Stone tailings pond.
- Output from a numerical model defined critical seepage zones and revealed that proper pond design and maintenance can reduce pond seepage losses.
- Minimization of seepage requires the pond level water to be above the slime zone.

DCN-1015 Lower Tailings Water Quality Data 1990-1996

This document is a data table summarizing water quality data for 1SW, 2GW, for the years 1990 through 1996.

DCN-1016 Revised Final Reclamation Plan

The document is a Final Reclamation Plan from Cunningham Engineers including a background and plan discussion. It includes maps titled “Plan View of Tailings Reclamation Area,” and “Cross Section of Tailings Reclamation-Flat Slope Detail.”

DCN-1017 - Site Hazard Assessment Worksheet

Summary score sheets dated February 20, 2007, summarize the E & E study data from 2002.

Worksheets 1 through 6

- Overall ranking = 1
- SW/Human Health = 38.3; Air/HH=14.8, GW/HH=40.8, SW/Envir=67.8, Air/Envir=60.9
- Human and Environmental Toxicity values for Cd, Cu, Pb, Hg, and Zn.
- Migration Potential (precipitation, terrain slope, flood plains, etc.)

DCN-1018 Water Quality Data 2005-2006

Water quality data collected from October 18, 2005 to June 14, 2006 is presented in this document. Analyses conducted include field measurements, general chemistry, and metals concentrations.

Samples were collected at the following locations:

- VS upstream
- VS Pit
- VS downstream of pit
- VS Downstream of Tailings

DCN-1019 - Water Well Data

The document presents compiled water well information in the area and includes the Onion Creek School District's water well information and estimated evapotranspiration data for Stevens County.

DCN-1020 - Report on Certain Aspects of the Van Stone Mine

This report was sent from DNR to US Environmental Protection Agency (EPA). It includes the following sections:

- Secretary of State records, chronology, officers and addresses of previous owners.
- Site and land status maps.
- Clippings and annual reports archived in the Division of Geology and Earth Resources (DGER) mine files.
- DGER field data, including surface water and soil analyses, and hazardous materials inventory.
- Digital on-site photos from October 2002 and from aerial photos 1972, 1990, and 2000.

The text below describes the DGER field data taken in October 2002.

Samples described in the report include

Table 3: Five surface water samples collected at the Site;

1. North Pit,
2. South Pit,
3. Onion Creek bypass,
4. East basin lower tailings, and
5. West basin lower tailings.

Table 5: Four soil samples of tailings and dumps at the Site; digital photos were taken of a few soil samples.

1. Soil sample 25 feet south of red door at mill, green copper oxide,
2. Lower tailings grab sample,
3. Upper tailings grab sample, and
4. Concentrate spillage at west Pb-Zn bins grab samples.

Appendix B, Table 1: Two samples of tailings and one sample of native (background) soil.

1. Van Stone Fresh Tailings,
2. Van Stone Old Tailings, and
3. Van Stone Native.

Analyses performed on the samples include:

Table 3: Surface water samples: hardness, Cd, Pb, Zn

Table 5: Soil samples; Cd, Cu, Pb, Zn

Appendix B, Table 1: Soil samples; pH, P, K, O.M., No3-N, NH4-M, SO4-S, B, E.O., grain size, texture (USDS1950), Ca, Mg, K, Na, Zn, Mn, Cu, Fe, P, B, Pb, Al, Cr, Cd, Ba, Ni, Co, Be, and Mo.

Report Materials: See text above, Tables 3 through 6, Appendix B Table 1. A few samples have digital photos of the sample locations, no GPS coordinates.

Summary of suitability of existing data: The data summarized in the tables come from other Equinox Resources Inc. reports. The data is limited in areal extent and is primarily centered on tailings pile and pit areas, with one background soil sample called Van Stone Native. It is unclear where these samples were located and the purpose for the sampling.

General Information

- Several breeding pairs of Mallard ducks and three female Hooded Mergansers were observed on the lower tailings pond east basin.

- The North Pit Lake is approximately 700 feet x 350 feet wide x 100 ft deep. The extreme west end of the lake appears to be dammed by undisturbed rock in the haul road, or a minor amount of shot rock. Little if any infiltration to Onion Creek was occurring at the time of the DGER field investigation. The lake level is elevation 3,510 feet.

- The South pit lake is approximately 130 feet long x 50 feet wide x 2 feet deep. It does not appear to overflow. The lake level is elevation 3,600 feet. The northern-most branch of Onion Creek bypasses both pit lakes.

DCN-1021 Waste Discharge Permit Application

This wastewater discharge permit application dated May 21, 1996, includes detailed information on geology, hydrology, and soils in the watershed. Also includes locations of residences along Onion Creek and a tailings management plan. This document includes:

- Renewal application with some site background information
- Production schematics (Attachment B-2)
- Treatment and disposal description/flow schematic (Attachment C-2)
- USGS topographical map showing plant/facility location (Attachment H-3)
  - There are no drilled wells or other sources of drinking water within a one-mile radius around the old tailings dam.
  - Residence locations along Onion Creek (L1, L2, etc.)

- Soil survey map of Van Stone area (Attachment H-5)
- Local geology and hydrology (Attachment H-6)
- Tailings management (Attachment F-7)

DCN-1022 Waste Discharge Permit

This waste discharge permit is dated May 31, 1991. The document includes locations and coordinates (lat/long) of surface water sampling locations SW-1 to SW-8, and groundwater wells W-1 and W-2.

DCN-1023 Tailings Dam Construction 1996

This document Includes:

- A description of tailings dam construction including site preparation, dam construction, and completion; and
- A description of seepage collection dam construction including site preparation, dam construction, and drawings (which are described but not included).

This document does not include much environmental information beyond the dam construction area.

DCN-1024 Const Quality Assurance Final Report Phase 1

General Information

The report summarizes the construction quality assurance (CQA) services provided by Vector Engineering, Inc. during construction of the liner system for the Phase I tailings impoundment at the Van Stone Mine. It includes the following information:

- The liner system consisted of a sand base subgrade, PVC, and Hypalon geomembrane liners, and seepage recovery drains.
- Construction of the tailings pond, free water collection pond, and the recovery drains began October 4, 1990 and was performed by D.H. Blattner & Sons Construction under the direct supervision of Bob Funderhide.

DCN-1025 Const Quality Assurance Final Report Phase 2

General Information

The report summarizes the quality control services provided by Vector Engineering, Inc. during the construction of the liner system for the Phase II tailings impoundment at the Van Stone Mine.

- Construction components of the liner system consisted of a sand base subgrade and 30 mil PVC geomembrane liner.
- Construction of the Phase II tailings pond began earlier in the spring and was performed by D.H. Blattner & Sons Construction.
- The report includes a liner deployment map.

DCN-1026 - GW Sampling 9.2004

This document includes surface water sampling data collected during a September 19, 2004, sampling event. The samples were collected from the tailings and reclaim ponds for permitting requirements at the Site.

Surface Water samples: Three pond surface water sample locations are shown on Figure 1, no GPS coordinates are given.

1. East Tailings TPOND1,
2. West Tailings TPOND2, and
3. Reclaim Pond RPOND.

Surface Water Analysis included NO2/NO3, chloride, sulfate, total alkalinity, TDS, TSS, conductivity, turbidity, pH, potassium, sodium, and hardness Metals including Sb, As, Be, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Se, Ag, Tl, and Zn.

Report Materials include a cover letter, analytical results in a table, and Figure 1 showing locations of samples at the Mine Site (tailings and reclaim ponds). No GPS coordinates of samples are included.

The surface water data was acceptable with minor qualification; data is presented in a summary table. No laboratory certificates were attached. Limited surface water samples were collected at three specific locations within the East Tailings, West Tailings, and Reclaim Ponds for point of compliance (i.e. permitting requirements).

DCN-1027 Site Hazard Worksheet with correspondence 2.20.2007

The document contains the same material as DCN-1017 but also includes correspondence between Ecology and Equinox regarding the site hazard assessment.

DCN-1028 Tailings Impoundment Liner system – Phase III

This report includes DCN-1023 through DCN-1025. See those report summaries for details.

DCN-1029 - Trace element geochemistry of Onion Creek near Van Stone

Trace Element Geochemistry of Onion Creek near Van Stone Lead-Zinc Mine. This document is a research paper on trace element geochemistry of the mine. Even-numbered pages of the document are missing.

Surface water, and groundwater samples, W1 through W24 were collected (missing data from W5). Twenty-three water samples were analyzed. The water samples were collected along Onion Creek and tailings ponds at Van Stone Mine. See Figure 1 for locations; no GPS coordinates were included.

- Two background surface water samples, W16 and W17, were collected.
- Nine surface water samples were collected near the abandoned tailings pond (TP-1) and mine downgradient (W1 though W3, W11 through W15, and W21).
- Four surface water samples were collected near the new tailings pond (TP-2) and including downgradient at W20 and W22 through W24

- Six surface water samples were collected near the new tailings pond (TP-2); W4 and W6 through W10.
- Two groundwater samples were collected from W18 and W19.

Eighteen sediment samples were collected and analyzed. The sediment samples were collected along Onion Creek and tailings ponds at Van Stone Mine. See Figure 1 for locations, no GPS coordinates were included.

- One background sediment sample Sed17, was collected.
- Seven sediment samples were collected near the mine and abandoned tailings pond (TP-1): Sed1, and Sed9 through Sed14.
- Three sediment samples were collected near tailings pond (TP-2): Sed15, Sed16, Sed 18.
- Seven sediment samples were collected from tailings pond (TP-2): Sed2 through Sed8.

Water (Groundwater and Surface Water) Analysis:

Table 2 - Groundwater and Surface water samples were analyzed for temperature, pH, conductivity, Al, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sr, V, Zn, Alkalinity, SO4, Cl, and NO3. Water samples were digested and analyzed by EPA Method SW 846 USEPA, 1982).

Sediment Analysis:

Table 3 - Sediment samples were analyzed for Al, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Sb, Se, Sr, V, and Zn. Sediment samples were digested and analyzed by EPA Method SW 846 USEPA, 1982).

Tables 2 and 3 summarize water and sediment results. The report includes an introduction, site background, sample collection and chemical analysis, results and dissection of model, summary data tables, and references.

The analytical methods used may pose a problem, i.e. the detection limits (unknown in the tables) may be greater than the 2011 screening levels. It does not appear that the majority of the water and sediment samples were co-located. This study provides groundwater samples from two unidentified wells with no reported sampling depth.

DCN-1030 - Van Stone Mine Cleanup Report 5.7.2010

This report to Ecology from Equinox details cleanup efforts during 2006 including removal of a Kay Ray nuclear gauge; a removal certificate is provided. This report is a general summary of the cleanup efforts, including materials removed from the site such as the mill building, crusher building, and 97 percent of the mill equipment.

DCN-1031 Van Stone Mine Synopsis Nov 2010 – BD at Ecology

This document about the site includes a brief site history, information, and clear photos.

DCN-1032 Notice of Construction 11.9.1990

This report details a 6-year mining plan with maps of existing and proposed workings, geology, mill process information, climate and hydrolic data, and information on plants and wildlife.

Maps include:

1. Property Location Map
2. Property Land Status Map
3. Geologic map of the southern part of the Kootenay Arc
4. Geologic map, showing approximate position of Van Stone mine pits
5. Longitudinal Section Proposed Development

DCN-1033 Van Stone Tailings Deficiencies Letter 4.27.1998

This document is the same as the first correspondence included in DCN-1010 dated April 27, 1998. It includes concerns and recommendations regarding waste issues at the site.

DCN-1034 Hazardous Compliance Pages

Correspondence dated July 8, 2009, regarding a hazardous waste compliance inspection on May 12, 2009. The inspection report included. The report includes DCN-1030.

DCN-1035 Site Inspection Report 1986

This report was prepared by Michael J. Spencer, Washington State Department of Ecology, and includes a Preliminary Assessment/Site Inspection Section for the Hazardous Waste Cleanup Program. The report includes the following information:

- Site Owner/Operator
- Site History and Background

- Environmental Setting (Climate, Geology/Hydrology, Topography and Drainage, and Groundwater and Surface Water Uses
- Methods
- Analytical Parameters (QA/QC)
- Results and Discussion
- Conclusions and Recommendations
- Figures and Tables
  - Appendix A: Sample Analysis Results/Correspondence/Historical Data
  - Appendix B: EPA Site Inspection Report Form
  - Appendix C: Photographic Documentation
  - Appendix D: Site Sampling Plan
  - Appendix E: Site Safety Plan

Water Samples – Analyzed for Dissolved Priority Pollutant Metals

1. Sample NCT033 taken at the mill water supply dam on the middle fork of Onion Creek, upstream of the north and south pits. This is the same upstream control site used by Ecology Eastern Regional Office in their 1976 water quality survey.
2. Sample NCT034 was collected from the ponded water at the south end of the North Pit, just along the edge.
3. Sample NCT035 was collected from the drop box in the middle of the house supply, where the east fork of the Onion Creek was ponded by a small dam structure
4. Sample NCT037 was taken from an old tailings pond (pile), along an eight-foot-deep fissure toward the southwest edge.
5. Sample NCT036 taken from the main stem of Onion Creek.
6. Sample NCT038 collected from the middle fork of Onion Creek, downstream about a quarter mile from the old tailings pile.
7. Sample NCT039 was taken just upstream in a small tributary to Onion Creek passing close by the north face of the new tailings pond (pile).
8. Sample NCT041 was taken downstream (west) of the new tailings pile in a tributary to Onion Creek (described in NCT039).

Sediment – Analyzed for EP Toxicity Metals

Sample NCT040 was taken from just under the surface from the central area of the new tailings pond (pile).

General Information

The environmental setting section may be helpful with some additional background/location information. Results of the analyses of the Onion Creek water samples show that there was no off-site migration of heavy metals from tailings ponds, at the time of sampling.

DCN-1036 - DNR Inactive and Abandoned Mines

General Information

- No mining has occurred at the Site since Equinox closed it 1993.
- Additional summary data, see excerpts in Section 5.0 of the FS-WP
- Description of openings (North and South pits), structures (mill building, crusher plant, shops, etc.), materials (piping, mill reagents, solvents, fuels, etc.)
- Van Stone Mine has a water right to 75 gpm from the NE¼ NE¼ sec. 30.

Four soil samples were taken at the following locations:

1. Soil sample 25 feet south of red door at mill, green copper oxide,
2. Lower tailings grab sample,
3. Upper tailings grab sample, and
4. Concentrate spillage at west Pb-Zn bins, grab sample.

Five surface water samples (four pond, one Onion Creek) were taken at the following locations:

1. West End pit lake,
2. South pit lake,
3. Middle East Fork Onion Creek,
4. Lower tailings pond east basin, and
5. Lower tailings pond west basin.

Analysis

Soil - Table 3 - Cd, Cu, Pb, and Zn. Analysis by EPA Method 6010, inductively coupled plasma.

Surface Water - Table 5 - Flow, conductivity, pH, bed color (natural, black poly lining, etc.), temperature, elevation, hardness, Cd, Pb, and Zn. Analysis by EPA Method 6010, inductively coupled plasma.

Summary report materials include Tables 3 and 5, Appendix B Water quality standards for hardness-dependent metals, and Appendix C Consumable and hazardous materials list for the site. Most recent soil and surface water data, though the extent of samples (4-Soil and 5-SW) is limited.

DCN-1037 Tailings Disposal Design Report 1990

This document includes a tailings disposal design report and a geotechnical and water quality data report. The Tailings Disposal Design Report includes:

- Background and information on previous and proposed mining operations
- Geotechnical investigations including site investigation description and data and laboratory testing program details and data
- Outlines site conditions including foundations, existing tailings, seismicity, liquefaction, climatic and hydrologic data
- Tailings production
- Impoundment concept
- Liner system
- Tailings water control
- Stability evaluation
- Spillway and Diversion
- Construction considerations

Geotechnical and Water Quality Data Report (1990) by Klohn Leonoff, Inc

The Geotechnical and Water Quality Data Report (1990) by Klohn Leonoff, Inc. is organized as follows:

- Introduction
- Geotechnical Investigation (Electric Piezocone Testing and Geotechnical Drilling and Sampling)
- Water Quality Investigation (Surface and Ground Sampling)
  - Surface Water Samples
  - SW-1 West Fork Onion Creek – downstream of confluence of unnamed stream west of Van Stone mine tailings impoundment area.
  - SW-2 Unnamed stream – immediately northwest and downstream of Van Stone mine tailings impoundment
  - SW-3 Unnamed stream – north of Van Stone mine tailings impoundment
  - SW-4 West Fork Onion Creek – upstream of confluence of drainage swale, south of Van Stone tailings impoundment secondary holding dams
  - SW-5 West Fork Onion Creek – upstream of confluence of East Fork Onion Creek

- SW-6 East Fork Onion Creek – downstream of Lotze Road culvert
- SW-7 Middle Fork Onion Creek – upstream of Van Stone mine (background sample for drainage basin)

■ Site Characterization includes general geology and geotechnical, surface water, and groundwater conditions.

■ Electric piezocone test logs (Appendix I)
  - ConTec Report: Electric Piezocone Testing at Van Stone Mine Tailings Impoundment (Dec 5-10, 1989)
  - Geotechnical test hole and monitoring well logs data (Appendix II)
  - Water level monitoring data (Appendix III)
  - Water quality laboratory test results (Appendix IV)
  - Photographs (Appendix V)

Notes on Geotechnical and Water Quality Data Report

The purpose of the geotechnical investigation was to determine ground conditions within the existing tailings basin, in the foundation below the tailings, and in the area immediately downstream of the tailings dike. The purpose of the water quality investigation was to assess baseline surface and ground water quality conditions at the site. Water was encountered in most of the drill holes, near the contact with bedrock. Surface water samples analyzed for metals using Plasma Spectrographic Analysis – EPA Method 200.7

DCN-1038 Fact Sheet for Discharge Permit

General Information

■ It is a companion document to the draft State Washington Discharge Permit No. ST-5287.

■ It includes a thorough background section with a history of the site, facility, and groundwater.

■ A wastewater characterization of the concentration of pollutants (water chemistry and metals) is reported in a table.

■ A table of water chemistry and metal concentration results from groundwater wells GW1 and GW2 is included.

Figures in the Report

■ Surface water sample site location plan map

■ Groundwater monitoring well location map

DCN-1039 Water Quality Data Report 1990

This report summarizes field activities and laboratory data collected for the Van Stone project March 12-13, and April 3-4, 1990. It includes Water Quality Data and Water Chemistry Data and Amtest Laboratory Original Data. It also includes surface water sample site location plan map and test hole location plan.

DCN-1040 DW Inspection Report 5.7.2010

The document is included in DCN-1034. The document is correspondence regarding dangerous waste inspection compliance inspection at Van Stone Mine on May 12, 2009. Compliance Inspection Finding - Copper Sulfate Container (DW) Identified on-site.

DCN-1041 - Upper Columbia River PAsSIs

Preliminary Assessments and Site Inspections Report - Upper Columbia River Mines and Mills Stevens County, Washington (START-2 October 2002). The report summarizes a sampling event and general site information. Data included the following:

- Twelve waste rock samples (VSWP01SS through VSWP12SS) were collected from the waste rock pile.
- Twenty-one tailings samples (VSTP01SS through VSTP21SS) were collected from two tailings piles. Samples VSTP01SS through VSTP09SS and VSTP21SS were collected from the tailings pile located near the entrance to the mine/mill. Samples VSTP10SS through VSTP20SS were collected from the old tailings pile located on the eastern portion of the mine/mill.
- Seven surface soil samples (VSSS01SS through VSSS07SS) were collected from stained soil areas around the mine/mill property.
- One co-located surface water and sediment sample (VSMW01SW and VSMW01SD) was collected from the mine pit water.
- One sediment sample (VSPP01SD) was collected at PPE 1 from the confluence of the tailings pile and the pond located near the entrance of the mine/mill.
- One sediment sample (VSPP02SD) was collected at PPE 2 from the potential overland flow from the tailings pile to the unnamed creek located near the entrance of the mine/mill.
- One sediment sample (VSPP03SD) was collected at PPE 3 from the northwest corner of the mine pit water area.
- One sediment sample (VSPP04SD) was collected from PPE 4 near the southwest portion of the old tailings pile at the confluence with an unnamed creek.

Soil Analysis (waste rock, tailings, surface soil)

Table 6-6 – Thirty-eight surface soil samples for TAL metals analyses: twelve waste rock samples (VSWP01SS through VSWP12SS); twenty-one tailings samples (VSTP01SS through VSTP21SS); and seven surface soil samples (VSSS01SS through VSSS07SS) from areas of stained soil. Seven surface soil samples also were analyzed for pesticide/PCBs and SVOCs. NOTE: Table 6-6 does NOT include pesticide/PCBs data.

Sediment Analysis

Table 6-7 - Five sediment samples for TAL metals analyses, three sediment samples were also analyzed for pesticide/PCBs.

Surface Water Analysis

Missing data for the one surface water sample; only know of one result from the text. The analyte of concern in the surface water sample collected from the mine pit water (VSMW01SW) was zinc at an estimated concentration of 112 g/L.

WESTON Samples (Appendix H of DCN-1041): Missing Appendix H

- One surface water sample collected from Onion Creek associated with Van Stone Mine/Mill (TS099; Appendix H).
- Three Mine and mill-specific background surface soil samples collected for the Van Stone Mine/Mill (US007, US008, and US009; Appendix H).
- Three sediment samples were collected from an Unnamed tributary to Onion Creek and Van Stone Mine/Mill (US005, US006, US010)

The report included a background summary with historical information, mine and mill descriptions with measurements. NOTE: Missing surface water data for sample VSMW01SW, missing pesticide/PCBs data for 7 surface soil samples, missing Appendix H of the WESTON report.

Summary of suitability of existing data

See Figure 6-13 and 6-14, samples provide a good coverage of data at the site. This data set is likely the most comprehensive data for Van Stone.

DCN-1042 Physical Limnology and Geochemistry of Two Circum-Neutral pH Mine Pit Lakes in NE Washington

This research paper is about limnological and water chemistry data. One surface water sample was collected from a mine pit at Van Stone Mine at the following location:

Lat 48° 45′ 37″
Long 117° 45′ 30″
Elevation: 1050 meters
Pit Configuration: Side hill, daylights to the west
Slope Aspect: West
Area: 19,150 m^2
Volume: 311,500 m^3
Max Depth: 31 feet
Mean Depth (Vol/Area): 16 feet
Relative Depth (Werzel, 2001): 10%

The surface water sample was analyzed for: temperature, pH, specific conductivity, DO, ORP, TSS, TDS, sulfate, Nitrite + Nitrate, chloride, total metals Sb, As, Cd, Ca, Cu, Fe, Pb, Mg, Mn, Hg, Ag, Na, and Zn, dissolved Ni (only one).

According to the paper, temperature, pH, specific conductivity, DO, and ORP were measured monthly during the period of the study. This is a scientific paper with summary data tables; it does not include the monthly data for temperature, pH, specific conductivity, DO, and ORP. Only one surface water sample is studied, so this document offers very limited data.

DCN-1043 Letter summarizing START-2 Report

Correspondence between Sandra Teccani from Ecology's Toxics Cleanup Program to Jack McCotter at Equinox on September 1, 2006. The report includes a map of Van Stone Mine and Mill Samples.

DCN-1044 Site Hazard Assessment Correspondence 9.18.2006 (6 Pages)

This document is an e-mail correspondence on February 13, 2007, from Patrick J. Hallinan of Ecology and Michael Spencer of Ecology. The e-mail transmits two attached documents: (1) a letter from Michael Spencer from Ecology to Jack McCotter of Equinox dated September 18, 2006, titled "Site Hazard Assessment - Van Stone Mine. Ecology Facility Site ID: 5418085, and (2) a letter from Robert Jomphe of Equinox to Sandra Traccani, Hydrogeologist (unknown company), dated October 19, 2006.

The letter from Spencer to McCotter notifies Equinox that Ecology will conduct a Site Hazard Assessment of Van Stone Mine. The letter from Jomphe to Traccani notifies Traccani that Equinox will continue site cleanup in 2007.

DCN-1045 Site Hazard Assessment Correspondence 2.4.2007

Correspondence dated February 4, 2007, between Ecology and Equinox regarding a post site hazard assessment. The letter indicates a site hazard ranking of 1, where 1 represents the highest relative risk. The document also includes an e-mail between Robert Rafarth and Michael Spencer of Ecology discussing a file titled "Van Stone WQ data.xls."

DCN-1046 Site Hazard Assessment Correspondence 9.18.2006 (2 Pages)

It is correspondence between Ecology and Equinox Resources regarding how Ecology will conduct a site hazard assessment, dated September 18, 2006.

DCN-1047 START-2 pages

This document contains historical information about Van Stone Mine/Mill. It discusses a START-2 visit and visual inspection of the property and surrounding area, and description of mine/mill features. The document discusses the collection of 21 tailings samples (VSP01SS through VSTP21SS) from two tailings piles, as well as:

- Twelve waste rock samples (VSWPOISS through VSWP12SS) were collected from the waste rock pile. The samples were collected within the overland surface water drainage routes identified by the START-2.
- Samples VSTPOlSS through VSTP09SS and'VSTP21SS were collected from the tailings pile located near the entrance to the mine/mill. Samples VSTPlOSS through VSTP20SS were collected from the old tailings pile located on the eastern portion of the mine/mill.
- One sediment sample (VSPPOlSD) was collected at PPE 1 from the confluence of the tailings pile and the pond located near the entrance of the mine/mill.
- One sediment sample (VSPP02SD) was collected at PPE 2 from the potential overland flow from the tailings pile to the unnamed creek located near the entrance of the mine/mill.
- One sediment sample (VSPP03SD) was collected at PPE 3 from the northwest corner of the mine pit water area.
- One sediment sample (VSPP04SD) was collected from PPE 4 near the southwest portion of the old tailings pile at the confluence with an unnamed creek.
- The START-2 collected 38 surface soil samples for TAL metals analyses: twelve waste rock samples (VSWPOlSS through VSWP12SS); twenty-one tailings samples (VSTPOISS through

VSTP21SS); and seven surface soil samples (VSSSOISS through VSSS07SS) from areas of stained soil. Seven surface soil samples also were analyzed for pesticides, PCBs and SVOCs

- This document includes two sample location maps. It does not include raw data. Data is discussed, but not presented in any tables or figures.

DCN-1048 Dam Correspondence

This document is correspondence between Ecology and Equinox on September 20, 1990, regarding "Notice of Determination of Nonsignificance." The document includes:

- Dam safety invoice dated August 14, 2007, and

- Other e-mails confirming dates of site inspections and meetings.

DCN-1049 Environmental Sampling Request Correspondence by EPA

The document included two letters:

- Correspondence from Coeur d'Alene Mines Corp to SAIC regarding their files on the Van Stone Mine property and Callahan and the other owners of the Van Stone Mine who sold it to Equinox Resources (Washington), Inc. in April, 1990. Coeur d'Alene Mines Corporation acquired Callahan on December 31, 1991.

- Correspondence from the President of Equinox to EPA regarding a request for sampling in Onion Creek.

DCN-1050 Letter 10.18.2005

The letter presents water quality sampling results collected Oct. 18, 2005 for locations: VS Upstream, VS Pit, VS Downstream of Pit, and VS Downstream of Tailings. Sample collection included water and sediment samples.

DCN-1051 Correspondence with Subject 9.19.2004 Sampling

This correspondence from Pat Hallinan at Ecology to Jack McCotter of Equinox discusses the following:

- Sample results from the tailings and reclaim water ponds on September 19, 2004
- Results sent on November 18, 2004

- Sample locations: East Tailings (TPOND1), West Tailings (TPOND2), and Reclaim Pond (RPOND)
- Includes sample map

DCN-1052 Dam Maintenance Plan and Associated Dam Issues

This document is a press release regarding the sale of Van Stone Mine. Attached to the press release are documents including:

- Correspondence on January 18, 1994-Re: Van Stone Tailings Dam File No. ST61-608from Equinox to Ecology regarding buttressing the northeast section of exterior dike that retains the current live pond on February 15, 1994.
- Telephone record regarding call from Equinox to Ecology.
- Correspondence dated December 8, 1993 from Ecology to Equinox where Ecology proposes a phased approach to resolving the various dam safety concerns with the tailings impoundment.
- Correspondence dated September 25, 1992, regarding the enclosure of Determination of Nonsignificance for the construction of the back-up tailings impoundment (actual document is not included).
- Memorandum dated July 30, 1990, which summarizes discussions with Klohn Leonoff on the current scheme to raise the abandoned tailings impoundment for the Van Stone project.

DCN-1053 Dam Safety Office Comments Summary

Correspondence summarizing comments from the DSO on the July 1999 Reclamation and Closure Plan submitted by Equinox.

DCN-1054 Pan America Sale of Equinox Holdings

News release regarding the sale of Equinox shares.

DCN-1055 Preliminary Potential Responsible Party Search

This is a preliminary potentially liability party search conducted by Grechen Schmidt of EPA, dated September 30, 2003. The outline of this document is as follows:

- Introduction
  - Scope of work
  - Site Background
  - Investigation Conducted

- Site location and operation
- Site Description
- Site Legal Description
- Site History
- Chronology of Historical Operations
- Environmental Investigations Conducted
  - EPA Investigation
  - Department of Natural Resources Investigation
  - Equinox Resources (Wash.) Inc
- Title Search Results
  - - Easements on property:
  - - Right of Way on property
  - - Recorded Leases
- References
- Appendix A: Footnotes
- Appendix B: Title Documents
- Appendix C: Maps and Photographs

Note: Appendices are not included in the PDF.

DCN-1056 Reclamation and Closure Plan

Information about the site and reclamation related-information includes:

- Introduction
- Reclamation plan objective
- Project Access and setting
- Land use and capability objectives
- Reclamation research program
- Reclamation Units
- Reclamation and closure strategy
- Reclamation methodology
- Reclamation monitoring, facilities, and staff
- Reclamation capital cost estimate
- Tables
  - Table 1. Suggested seed mixes for reclamation test plots
  - Table 2. Reclamation Units and area of disturbance
  - Table 3. Conceptual Reclamation and closure schedule for closure without additional mining or following additional mining

- Table 4. Preliminary Soil (Overburden) budget
- Maps
  - Project road access map
  - Onion creek watershed and subcatchment boundaries
  - Land status map
  - Precipitation zones and sub-basins
  - Landform map
  - Final Soil Erosion potential
  - Current land use and vegetation cover
  - Riparian vegetation condition
  - Target and estimated canopy closure
  - Potential culvert fish barriers
  - Channel segments/fish distribution
  - Existing mine site and area of disturbance
  - Closure of existing mine site and resloping of waste rock dump
  - Closure of re-opened operations
  - Revegetation plan of existing mine site
  - Revegetation plan of re-opened operations

DCN-1057 - Reclamation and Closure Plan with hand written notes

Revised Reclamation and Closure Plan (Beacon Hill Consultants July, 1999) for the Van Stone Mine. The objective of the plan is to provide a systematic approach to decommissioning the Van Stone Mine and retuning all disturbed lands associated with mine operations (post-1971) to a Mixed Land Use capability.

The report contains background descriptions. It summarizes the Boise Cascade Corporation Onion Creek Watershed Analysis, 1997 and 1998. It also includes information on:

- Topography, Geology, Soils, Climate, Hydrology, Vegetation, Fisheries, Land Use, and Watershed processes.

- Dimensions and details of Van Stone Mine features.

- Area of disturbance Table 2.

DCN-1058 Pit Details and Maps from unknown document

Figures titled “Cross Section of Tailings Reclamation – Flat Slope Details” and “Plan View of Tailings Reclamation Area.”

DCN-1059 Revised Final Reclamation Plan Figures

Figures for Reclamation Plan.

DCN-1060 SEPA Environmental Checklist Report

This document is a January 9, 1990 Environmental Checklist sent from Equinox to Ecology. Environmental information used in this report includes:

- Historical mine records and communications between previous mine owners and government agencies
- Two phase program conducted by Jones & Stokes Associates
- Current testing of all potential and current discharge (effluent) streams
- Surface and groundwater study and initial sampling by Klohn Leonoff Inc
- Tailings disposal, seismic stability, and dam safety aspects by Klohn Leonoff Inc

General Information

- Appendix A :
  - Technical Project Description included in, which describes the planned mine activities
  - Maps/Schematics: Geologic map of the southern part of the Kootenay Arc, Geologic map, showing approximate position of Van Stone mine pits, Longitudinal Section & Proposed Development, Mine Section N350, Flow Diagram of Lead-Zinc Flotation, Schematic Flowsheet of Liquid Wastes, General Site Layout, Van Stone Process (Schematic)
  - Report also includes Industrial/Commercial Waste Discharge Permit Application Form Filled out for Equinox
  - “Notice of Construction Declaring Intent to Construct, Install, or Establish a New Air Contaminant Source”
  - PSD Applicability Form (Completed)
  - Appendix B – Geotechnical and Water Quality Data Report (Jan 1990). This document is described in DCN-1037

DCN-1061 Surface Mine Inspection Report

The document is a completed "Surface Mine Inspection Report" dated Nov. 7, 2000, which includes handwritten notes regarding a site visit and a drawing of tailings impoundment.

DCN-1062 Tailings Dam Safety Issues

- Correspondence from Beacon Hill Consultants in response to letter dated April 27, 1998 regarding a March 28 inspection of the tailings dam and the integrity of the north dike.
- Correspondence dated March 23, 1998 from Ecology to Equinox requesting permission to conduct annual inspection of inactive metal mines project
- Correspondence dated July 9, 1997 from Ecology to Zicor Mining Corporation which updates the status of the dam safety issues associated with the tailings impoundment and comments on the proposed scope of work necessary for closure of the tailings impoundment element of the project.
- Ecology File for record dated April 27, 1994 regarding April 22, 1994 meeting attended to review the modifications made to the facility in February and March 1994
- Correspondence dated December 8, 1993 from Ecology to Equinox presenting engineering concerns following a November 8 inspection of the tailings impoundment and outlines a program to redress the situation.
- Ecology File for record dated December 1, 1993 regarding a November 10, 1993 tour of the site to look at geotechnical issues posed by steep embankment side slopes.
- Correspondence dated June 11, 1997 DNR to Ecology documenting a revised reclamation plan being sent.
- Correspondence June 5, 1998 from Ecology to Beacon Hill Consultants Ltd. responding to a conceptual scheme to address the hazard posed by the deteriorated geomembrane liner in the free water pond.
- Correspondence dated September 6, 1996 from DNR to Beacon Hill Consulting Ltd. reporting some conditions that were observed and are out of compliance.

DCN-1063 Tailings Pond Water Level Lowering via irrigation

Correspondence discussing the need to lower water levels in the Lower Tailings Pile pond. It consists of e-mails, letters, and call records from 1998. The correspondence includes design plans for irrigation and description of a plan from USDA Soil Conservation Service.

DCN-1064 Waste Discharge Permit Article

This document is a 1996 local newspaper article notifying the public about renewal of a waste discharge permit.

DCN-1065 Historical site photos

Three pages of historical photos (no date included) of various aspects of the site.

DCN-1066 - Zinc and Lead Ore Deposits Stevens County, WA

Detailed Geology of the Van Stone Mine from 1977 by Joseph W. Mills.

DCN-1067 - Geotech and Water Quality Data Report 1990

Van Stone Mine Project comprehensive report dated January 8, 1990, with proposed mine workings figures. Geotechnical and water quality data report attached. Also, includes select water samples and geotechnical discussions.

Mine Water samples: Two mine water samples were collected in 1980 and 1989

SW-1 through SW-7 surface water samples and analysis: These samples were analyzed for temperature, pH, specific conductivity, turbidty, TSS, TDS, DO, chemical oxygen demand, TOC, cyanide, ammonia nitrogen, hardness, gross alpha, sulfide, total coliform, fecal coliform, biochemical oxygen demand, Hg, and Fluoride.

Mine Water Analysis: From table on page 38 or 141: pH, Zn, Pb, Cd, Oil, Hg, Flow, TSS, and Conductivity.

The report included an environmental checklist for the site, and the following information:

- Historical mine records and communications between previous mine owners and government agencies,
- Two-phase program conducted by Jones & Stokes Associates,
- Current testing of all potential and current discharge (effluent) streams,
- Surface and groundwater study and initial sampling by Klohn Leonoff Inc. (Appendix B). Note: This is the original report associated with monitoring wells W-1 and W-2 and surface water sampling at SW-1 through SW-8.
    - Appendix I - Electric Piezocone Test Logs (Conetec report)

- Appendix II - Geotechnical Test Hole and Monitoring Well Logs
- Appendix III - Water Level Monitoring Data
- Appendix IV - Water Quality laboratory Test Results
- Appendix V - Photographs

■ Tailings disposal, seismic stability and dam safety aspects by Klohn Leonoff Inc.

DCN-1068 - Van Stone Mine Map 1

Map: Open Pit General Arrangement

DCN-1069 - Van Stone Mine Map 2

Map: Proposed 2720' Tailings Impoundment

DCN-1070 - Van Stone Mine Map 3

Map: Test Hole Location Plan

DCN-1071 - Van Stone Mine Map 4

Map: Proposed 2750' Tailings Impoundment

DCN-1072 - Van Stone Mine Map 5

Map: Details and Sections

DCN-1073 - Van Stone Mine Map 6

Map: Stability Sections

DCN-1074 - Van Stone Mine Map 7

Map: Seepage Recovery System

APPENDIX B
SAMPLING AND ANALYSIS PLAN

This page is intentionally left blank
for double-sided printing.

Draft Final
Sampling and Analysis Plan/
Quality Assurance Project Plan
Van Stone Mine
Stevens County, Washington

Prepared for
Washington State
Department of Ecology
Toxics Cleanup Program

June 17, 2011
17330-31

HARTCROWSER

This page is intentionally left blank
for double-sided printing.

CONTENTS Page

CONTENTS (Continued) Page

TABLES

FIGURES

SAMPLING AND ANALYSIS PLAN/
QUALITY ASSURANCE PROJECT PLAN
VAN STONE MINE

1.0 INTRODUCTION

This combined Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) describes the recommended general sampling locations, field sampling procedures, laboratory analytical methods, data evaluation procedures, and quality control criteria to support the Washington State Department of Ecology (Ecology) in performing a Remedial Investigation/Feasibility Study (RI/FS) at the Van Stone Mine site.

A schedule for implementing the SAP will be prepared and submitted to Ecology, and then finalized based on Ecology's authorization to proceed with the work.

1.1 Background

The Van Stone Mine was the largest open pit metal mine in Washington. Mining operations and facilities on the Site are spread over a wide geographic area (Figure B-1). The eastern area of the Site is where most of the mining activity took place. Buildings on the eastern area of the property had included a processing plant, crushing plant, mill building, mill shop, warehouse, change house, assay office, garage, scale house, core storage, switch building, pit shop, a bunk house and four residences. The mill buildings and mill equipment were removed by Equinox in 2006 (Van Stone Mine Cleanup Report, DCN-1030). Mine features in the eastern area now include mill building foundations and scattered intact, associated structures; two open pits (with pit lakes); waste rock piles, overburden stockpile, one tailings pond, and haul roads.

The western area, topographically downgradient from the mill, contains a second tailings pile, and water storage pond. A pipeline was used to convey tailings from the milling operations to the western or, lower tailings pond after the failure of the Upper Tailings Pile in 1961.

The eastern mine/mill area consists of a waste rock storage area, one tailings pile, two open pits, a seepage pond, buildings and stained soil areas. Section 2 of the Van Stone RI/FS work plan contains a complete discussion of the site description, ownership, mining history and site contaminant issues.

2.0 SAMPLING OBJECTIVES, AND FIELD TEAM

The purpose of conducting an RI/FS is to evaluate the potential environmental impacts from historical mining operations and the extent of potential ongoing releases of contaminants at the Site. The SAP addresses data gaps that were identified during review of historic Site documents.

2.1 Sampling Objectives

The scope of work described in the SAP is designed to aid in evaluating if there are impacts to human health and the environment from historical mining and milling activities at the site. The objectives of the SAP are to:

1. Establish background concentrations for Contaminants of Concern (COCs) in groundwater, surface water, soil, and sediment (media of concern);
2. Provide data to refine the preliminary Conceptual Site Model by media;
3. Collect environmental data to fill data gaps and facilitate identifying the extent of site contamination, and the range of Contaminants of Concern (COCs) concentrations exceeding background and screening levels;
4. Collect environmental data by media, sufficient to conduct the Human Health Risk Assessment and TEE; and
5. Collect geotechnical data to address data gaps identified for tailings piles and waste rock pile stability, pond capacity and liner(s) integrity, pit lake configurations, open pit high wall stability, and additional information on the extent and conditions of underground workings.

Analytical results will be compared as follows:

1. **Sediment:** Results will be compared to the Threshold Effect Concentrations (TEC) or Probable Effect Concentrations (PECs)
2. **Soils:** Concentrations will be compared to Model Toxics Control Act (MTCA) Method B unrestricted land use direct contact criteria.
3. **Surface Water:** Chemical concentrations will be compared to Washington State surface water quality criteria, the Clean Water Act, and the National Toxics Rule
4. **Groundwater:** Results will be compared to drinking water maximum contaminant levels (MCLs) and Model Toxics Control Act (MTCA) Method A and Method B unrestricted use criteria.

Geotechnical information will be collected to assess risk of tailings pile instability that could result in releases to the environment, and to determine stable slope configurations that can be used during the feasibility study (FS) to assess alternatives for capping the tailings to comply with ARARs. The remedial investigation (RI) also will include geotechnical data collection and stability evaluation of the embankment that acts as a dam at the west end of the pit lake, and a parametric assessment of stability of the pit wall slopes for the North and South Pits.

Chemical analysis will be performed by a laboratory accredited by the State of Washington. The laboratory and laboratory project manager will be identified before implementation of the SAP.

A quality assurance data validation review will be performed on all analytical sample results. Validated data will be entered into Ecology's Environmental Information Management (EIM) system. Sampling results and laboratory data will be compiled and evaluated. Sampling locations, procedures, analytical methods, and evaluation of results are discussed in subsequent sections of this SAP/QAPP.

Geotechnical data collection will include:

1. Cone penetrometer soundings, including measurements of pore pressure dissipation to assess gradation, consistency, and hydraulic conductivity of the tailings piles.

2. Mud rotary borings to collect samples using a split spoon sampler (including Standard Penetration Tests, orSPTs), and undisturbed, Shelby tube samples of tailings.

3. A mud rotary or sonic boring with SPTs to collect samples and assess consistency or density of the fill in the pit lake embankment.

4. Vibrating wire piezometers (VWPs) will be installed in selected borings to enable measurement of groundwater pore pressure in the tailings and pit lake embankment.

5. Samples of the tailings and embankment material will be classified, and moisture content measured, since the moisture content is an index to other engineering properties. Gradation will also be determined for selected representative samples of the tailings (using a hydrometer and/or mechanical sieving depending on the sample gradation range).

6. Consolidated, undrained triaxial strength tests will be accomplished on undisturbed samples of the tailings.

7. A Proctor compaction test will be accomplished to determine the moisture-density relationship of compacted tailings, for use in the FS.

The field classification of samples of tailings and other soil samples will be independently reviewed in the laboratory, and geotechnical test quality assurance procedures will be accomplished in accordance with procedures published by the American Society for Testing and Materials (ASTM) or other applicable reference standards.

2.2 Field Team

Key staff members and their project functions shall be identified in the schedule submitted to Ecology based on an authorization to proceed. The following identifies the core team for the RI:

Ecology

- Brendan Dowling, Ecology Project Manager

Hart Crowser

- Mike Bailey, Engineer, Principal in Charge
- Steven Hughes, Project Manager
- Roger McGinnis, Project Chemist
- Colleen Rust, Field Team Leader
- Phil Cordell, Field Team, GIS
- Megan Higgins, EIT, Geotechnical Engineer
- Anne Conrad, Data QA/QC\
- Emily Duncanson, Data Validation

Another, senior geotechnical engineer will also be involved at the time work is accomplished.

3.0 SAMPLE COLLECTION

This section presents the areas of the Site where field environmental and geotechnical data will be collected, and describes the sample/data collection methods.

3.1 Sampling Locations

Physical sampling locations will be identified based on observations of site conditions and sampling access made during the initial site visit. Maps in the work plan will be updated to reflect the specific locations.

3.2 Environmental Data Collection

Based on a review of historical site documents, environmental soil samples, sediment surface water samples, and groundwater samples will need to be collected. Table B-1 presents the investigation areas for environmental sampling by matrix and site feature.

A first task of the SAP will be to implement background sampling. During the initial site visit, each proposed background sampling location will be evaluated for access, mine disturbance, or potential contamination. If changes are required in sampling locations, they will be discussed with Ecology and reviewed in the work plan and SAP.

In addition to sample collection, the site will be mapped to refine or confirm Site features. Mapping will include:

1. The size, areal extent, miscellaneous debris, and ongoing erosion of sources of site contamination.
2. The condition of Onion Creek and its tributaries that intersect the site. This will include refinement of the understanding of impacts from tailings pile failures, including: areas of deposition, stream channel geomorphology, impacts to the riparian zones, impacts to road crossings, and visual evidence of tailings transport downstream from the tailings piles.
3. The condition of access and haul roads and the potential for waste rock historically used in road maintenance.
4. Open pit conditions, including geology, faulting and shear zones, seeps, and access points to underground workings.
5. Discussions with residents and the condition of domestic wells and potential access to collecting water samples.
6. The mine buildings and surrounding areas will be inventoried to confirm that chemicals and other materials stored on site as documented during a site

visit by the Department of Natural Resources (DNR) in 2005 have been removed.

3.3 Geotechnical Data Collection

Proposed geotechnical explorations for this project include geologic reconnaissance, borings, and cone penetrometer soundings. Table B-10 summarizes where data will be collected and the type of data that will be collected.

Exploration logs will be prepared in the field to facilitate interpretation of the drilling observations, sampling, and testing data. The logs will indicate the depth where the soils change. Note that the change may be gradual. In the field, samples collected will be classified as noted on the field exploration logs.

A preliminary geologic reconnaissance will be accomplished to select cPT and boring locations. The following generally describes the type of data that will be collected:

1. Monitoring wells and VWP will be used to collect groundwater samples, and to determine long-term groundwater levels.
2. Standard Penetration Test (SPT) data will be collected to provide an approximate measure of soil density and consistency of the tailings piles, and for sample collection.
3. Relatively undisturbed (Shelby tube) samples will be collected for classification and testing in fine-grained soils (e.g., tailings slime).
4. Cone penetrometer data will be collected and used to evaluate the tailings and subgrade soil on the site.

CPT data will automatically be recorded as the cone probes advance. The locations of data collection points will be based on visual observations made at the time of the initial site visit. These will be shown on updated maps in the work plan.

3.4 Field Sampling Methods

During field work, actual sample locations will be documented in the field using a GPS and may be adjusted to target visual observations made at the time of sampling.

The locations of explorations and sampling points will be determined based on GPS measurements referenced to Washington State Plane, South Zone, NAD83

HARN coordinates and elevations will be based on NAVD88 and interpreted from elevations shown on existing maps and Site surveys.

When collecting surface water and groundwater samples, if low-level mercury analysis will be performed, sampling protocol will follow the EPA guidance for implementation and use of EPA Method 1631 for the determination of low-Level mercury.

The following sections describe the sampling methods that will be used for collection of environmental and geotechnical samples/data.

3.4.1 Geologic Reconnaissance, Background Soils, Surface Soil, Tailings, Waste Rock, or Stained Area Sampling

Sample collection and field observations will be performed in a consistent manner by field personnel at all sampling locations to ensure that data are representative. Surface samples collected should be representative of the targeted 0- to 6-inch-depth profile, or if visual observations such as color or soil types indicate that a shallower depth interval is warranted, the sampling interval will be reduced and documented in the field log. Care should be taken to collect all size fractions and avoid loss of fine material. Excess soil will be collected so that material can be archived for future additional analysis.

3.4.1.1 Geologic Reconnaissance

Geologic reconnaissance will be accomplished for the purposes of collecting information on slopes of the tailings piles and pit lake embankment that will subsequently be used for stability analyses. Geologic reconnaissance will also be accomplished to observe bedrock conditions that will be used for pit wall stability assessment.

Prior to locating CPT or borings on the tailings, a two person crew (typically one geologist and one geotechnical engineers) will walk the perimeter of the tialings piles and observe slope conditions, including, average slope inclination, height, presence or absence of benches, presence or absence of instability or significant erosion, presence of any seeps, etc. The perimeter of each tailings pile will be divided into reaches of about 500 feet in length (250 feet in the area where the 1961 and 2011 instability has occurred). Within each reach, the team will select one section that appears to present the least stable combination of slope and height, and measure slope inclination and height (including bench widths and heights) using a clinometer or Brunton compass. These data will later be used to develop cross-sections for stability analysis.

A similar reconnaissance and slope measurements will be accomplished on the pit lake embankment, also for the purpose of documenting slope conditions and collecting data that will be used to develop cross section(s) for stability analysis.

Finally, geologic reconnaissance will be accomplished to assess the degree of fractures and fracture surface condition (irregularity, weathering or alteration, infilling, and openness) of bedrock adjacent to the pit slopes. Fracture observations will be collected along a transect lien, typically 50 feet in length, at four to eight representative locations. These observations will be limited to areas that are safe to access, and observations will be extrapolated to areas that are not accessible. Outcrop samples will be tested with a Schmidt Hammer, or hand samples will be collected for strength testing using a point load apparatus, to obtain estimates of surficial rock strength.

3.4.1.2 Background Soil and Waste Rock Composite Sample Collection

Samples will be collected from five-point sampling locations and combined into one composite background sample. The collection of discrete subsamples at each of the five points will follow the procedure in Section 3.4.1.2. The sampling grid layout will be established as follows:

1. Using GPS to locate the background sampling point.

2. The on the ground GPS location will establish the center sampling point of the five-point square sampling grid.

3. From the center sampling point, measure out 10 feet in a north direction. From that location, measure 10 feet in both east and west directions to establish two corner sampling locations. Repeat this procedure starting at the center sampling point and measuring 10 feet south. Then measure 10 feet in both east and west directions to establish the remaining two corners of the sampling square.

4. Follow the discrete sample collection procedure described in Section 3.4.1.2 for collection of samples at each of the five subsample locations.

5. Combine the five subsamples in one composite background sample.

Composite waste rock samples will be collected following a procedure described in "Sampling Strategy for the Rapid Screening Assessment of Mine-Waste Dumps on Abandoned Mine Lands" (Smith et. al., 1997). This procedure involves collecting 30 subsamples within a targeted waste rock sample collection area, which are then combined into one composite sample for laboratory analysis. Subsample locations are randomized for each composite sample area. If, during field sampling, a sub-sample location is dominated by large waste rock, the location is adjusted to obtain sufficient material to pass through a No. 10 mesh (2mm) sieve. Sufficient sub-sample material will be collected and archived to allow for subsequent XRF screening, if needed.

3.4.1.3 Discrete Sample Procedure

The sample location and site conditions will be recorded in field books and on field sampling forms. Plastic sheeting will be used to stockpile groundcover and excavated soil. Materials placed on plastic sheeting will be used to backfill and re-cover sampling locations.

An area of approximately 8 inches by 8 inches will need to be uncovered. The actual area may vary by site depending on how rocky the soil is and how much vegetation is present. Sample collection should then proceed as follows:

1. Remove the surface layer of grass, leaves, or twigs at each sample point using a clean spade, shovel, or trowel. The groundcover should only be removed to the point where soil is exposed, being careful not to disturb the soil below. An effort should be made to collect soil adhering to roots by shaking or brushing it into the collection bowl.
2. If the sampling point does not contain vegetation, then any rocks or pebbles can be brushed aside by the sampler(s) using a gloved hand.
3. Put on a clean pair of nitrile gloves.
4. Excavate soil to a depth of 3 inches with a clean spade, spoon, bulb planter, or trowel. Use a ruler to measure the depth accurately.
5. Place spoonfuls of soil into a clean 16-ounce sample container for chemistry analysis, continuing until the container is full. Take care to ensure that the soil placed in the jar is representative of the grain size and vertical distribution in the sample.
6. Once containers are full, wipe the rims using a clean paper towel, and then screw the lids on tightly.
7. Label the sample jars with the date, time, and sample identification and placed in a ziplock bag.
8. Place the labeled sample containers into an iced cooler.

3.4.1.4 Transect Sampling

Sample collection below the toe of waste rock piles and tailings piles will be done by sampling outward from the toe of the pile along transects as described below:

1. The field sampling lead will locate sampling transects at the current toe, or base, of each mine feature as shown on SAP Figures B-3 through B-5. They will visually review field conditions and, if necessary, adjust the transect location to best fit the conditions observed.

2. From the starting point of each transect, the field team will measure off a distance outward from the mine feature of about 500 feet. This distance will be the starting point for XRF screening. The purpose of the XRF screening is to identify the likely extent of detectable COCs in soil on along a transect.

3. If COCs are detected at 500 foot mark, an additional 250 feet will be measured outward and the XRF screening repeated. This procedure will be repeated until COCs in soil are not detected.

4. When XRF screening indicates that COCs are below detection, the field team will identify this location as the first discrete sample location. The field team will then calculate 5 equidistant sample locations starting at the non-detect XRF location and ending within 20 feet of the toe of the mine feature.

5. The field team will then collect a discrete soil sample from each of the 5 sampling locations. Except for field determination by XRF of the non-detect location on a transect, samples will be taken to a sheltered staging area for XRF screening and selection of transect samples for laboratory analysis.

3.4.2 XRF Screening Procedure

Soil samples will be field screened for selected metals using EPA Method 6200, Field Portable XRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. The purpose of the XRF screening is to help guide samples collection for laboratory analysis.

3.4.2.1 Instrument Calibration

While the instrument is factory calibrated, an internal, self-calibration check must be performed whenever the instrument is turned on or instrument parameters are reset. In addition, the calibration check is to be performed once per hour or if ambient temperature changes by more than 10°F since the previous calibration check. Detailed procedures for the instrument self-calibration check are in the User’s Guide.

An NIST-traceable calibration check sample must be analyzed after every instrument internal self-calibration check according to the following procedure.

1. Turn the instrument on and allow it to warm up for 15 minutes.

2. Choose the “Bulk Sample” mode from the Setup screen.

3. Choose “Calibrate and Test” from the Main Menu. In about 1 minute, the instrument will finish the internal self-calibration and display “ready to test.”

4. Place an NIST “high” prepared soil sample in the testing platform and perform a 5-minute measurement. At the end of the test verify that results for each metal listed below are within the acceptance range.If results are not within manufacturer’s recommended ranges, the instrument internal self-calibration must be performed and check samples reanalyzed. If, upon reanalysis, check sample results are still outside the acceptance range, contact the instrument manufacturer technical service for diagnostic help.

5. Place the silicon dioxide blank sample in the test stand and perform a one minute test. Do not touch the surface of the blank or you may introduce contamination. All elements should be reported as “less than limit of detection.” If the instrument meets the acceptance criteria in step 4 above but reports a detected element in the silica blank, it is likely that the instrument window is contaminated. Gently wipe the window with a Q-tip which has been moistened with distilled water and wipe dry with a Kimwipe. Repeat the blank measurement. Detailed procedures for the calibration check analysis are presented in the User’s Guide.

3.4.2.2 XRF Sample Preparation

Soil samples will be sieved prior to sample analysis to remove larger particles such as gravel and to ensure samples are relatively homogeneous. The following procedures are to be used for preparing all soil samples for lead XRF analysis.

1. Collect a 25- to 50-gram soil sample.

2. Sieve through a #10 mesh (2mm) sieve. Examine larger, retained particles. Discard gravel, sticks, vegetation, etc.

3. Mix the resulting sample, place in a XRF sample cup or small plastic bag, and analyze. If the sample is selected for confirmation laboratory analysis, submit an aliquot to the analytical laboratory.

3.4.2.3 XRF Sample Analysis

The following procedure is to be used for analysis of soil.

1. Turn the instrument on and allow it to warm up for 15 minutes.

2. Choose the "Bulk Sample" mode from the Setup screen.

3. Perform the instrument self-calibration check and control sample calibration as described in the previous section.

4. Fill a small plastic bag or an XRF sample cup with a 1/4-mil Mylar film window as described in the User's Guide. Label the outside of the cup using a marking pen.

5. Place the sample cup on the bulk testing platform and attach the XRF spectrometer.

6. Squeeze the instrument shutter release and press the instrument down to depress the shutter release plunger. The plunger must be fully depressed or the window will not be completely open and readings will be inaccurate. The back of the instrument must be flush with the test guard. **Caution! Do not put your hand on the end plate of the instrument or lift it off the test guard when the shutter is open.**

7. Observe the instrument readings to decide when the desired confidence level (95 percent) has been achieved (typically 0.5 - 1 minute). Record the result.

8. Lift the instrument. The plunger will back out of the bottom, closing the shutter. If not, push the plunger closed and call the instrument manufacturer.

9. The next sample is ready for testing.

10. A calibration check sample analysis must be performed after every 10 samples or once per hour, whichever is more frequent. A calibration check sample analysis is also performed after the last sample is analyzed. If calibration acceptance criteria are not met, all samples analyzed since the last valid calibration must be reanalyzed.

11. At the end of each day, all sample results and spectra are to be downloaded to a computer using manufacturer supplied software.

3.4.3 Groundwater Sampling Procedures

Each monitoring or residential well will have a permanent mark scribed at the top of the casing to identify the point used for measuring the depth to groundwater. This mark will be noted in the field log and used as the measuring point for future groundwater measurements.

3.4.3.1 Monitoring Wells

At each monitoring well to be sampled, field personnel will record well conditions, and depth to water using a Solinst or equivalent interface probe. The probe will be cleaned between measurements to prevent well cross-contamination. Groundwater samples will be collected from monitoring wells using low-flow sampling techniques to minimize suspended solids in the samples. The wells will be purged and sampled with a peristaltic pump. Clean sample tubing will be used for each well and disposed of after use.

The field parameters of pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxygen redox potential meters will be measured and recorded periodically during the purging of the well. Once the field parameters remained stable between measurements, the groundwater sample will be collected. The final stabilized readings measured just before sampling will be recorded on a Groundwater Sampling Data form. Samples to be analyzed for dissolved metals will be filtered using a clean 0.45 µm in-line filter, and placed in sample containers with preservative.

3.4.3.2 Domestic Wells

Before collecting groundwater samples from residential wells, each well will be purged and monitored (as described for monitoring wells) until field parameters are stable. The final stabilized readings measured just before sampling will be recorded on a Groundwater Sampling Data form. Once the field parameters remained stable between measurements, the groundwater sample will be collected from a discharge point nearest to the well head. Any conveyance tubing between the well head and sample collection point will be note in the field log. Samples to be analyzed for dissolved metals will be filtered using a clean 0.45 µm in-line filter, and placed in sample containers with preservative.

3.4.4 Surface Water Sampling

Surface water samples will be collected from Onion Creek and its tributaries. Samples collected for dissolved chemical analysis will be field filtered using a hand-operated pump with a disposable in-line 0.45-micron filter cartridge and dedicated, disposable tubing. Samples will be collected from the filter outlet directly into pre-preserved sample containers obtained from the laboratory. A minimum of 25 mL of sample water will be flushed through the sampling tubing and filter before samples are collected.

Sample containers, preservation, and holding times are presented in Table B-2.

3.4.5 Stream Sediment Sampling

A McNeil sampler will be used to collect stream sediment samples. The McNeil Core Sampler consists of a stainless steel cylinder that defines the portion of the streambed to be sampled and an attached basin that is used to store the collected sediment and trap the suspended fines. The sampler is worked into the channel substrate, and the encased sediment core is dug out by hand and deposited in a built-in basin. When all sediment has been removed to the level of the lip of the core tube, a cap is placed over the tube to prevent water and the collected sediments from escaping when the tube is lifted out of the water. Those suspended sediments in the tube below the cap are lost, but this loss is generally an insignificant percentage of the total sample.

The analytical laboratory will use a series of sieves to sieve the wet sediment sample and determine the particle size distribution, percent fines, or geometric mean diameter of the distribution. The sieving process will provide data that allows estimating the percent of the bulk sample passing the <2mm size. The laboratory will further process the sample to obtain the <2mm fraction which the laboratory will analyze.

Based on the results of the sediment sieving and sediment chemical analysis, additional sediment bioassays may be required. If so, a supplement to the SAP will be written to address procedures in the Sediment Management Standards.

3.4.6 Dust Sampling

Under dry summer conditions, strong winds may be a transport mechanism for tailings. A semi-portable weather station will be used at the lower tailings pile to develop weather data over a 3-week period. The type of weather data that will be obtained includes wind direction and velocity, air temperature, precipitation, and humidity. If the data collected indicates that wind strength and duration is sufficient to result in erosion of the tailings, a high volume air sampler may be needed to further evaluate the erosion and transport of tailings.

3.4.7 Collection of Samples During Drilling

Drilling will typically be accomplished by mud rotary or sonic drilling methods. Cutting, including drill mud, will be spread on the tailings piles in areas that are protected from erosion.

3.4.7.1 Standard Penetration Test (SPT) Procedures

The SPT (in general accordance with ASTM D 1586) will be used to obtain disturbed samples. This test uses a standard 2-inch outside diameter split-spoon sampler. Using a 140-pound autohammer, free-falling 30 inches, and the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts and the percent of disturbed sample will be noted on the field book and plotted on the boring logs at their respective sample depths.

Soil samples will be recovered from the split-barrel sampler, field classified, and placed into water-tight jars. They will then be taken to Hart Crowser's laboratory for further testing.

In the Event of Hard Driving

Occasionally very dense materials preclude driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as follows:

1. **Penetration less than 6 inches.** The log indicates the total number of blows over the number of inches of penetration.

2. **Penetration greater than 6 inches.** The blow count noted on the log is the sum of the total number of blows completed after the first 6 inches of penetration. This sum is expressed over the number of inches driven that exceed the first 6 inches. The number of blows needed to drive the first 6 inches is not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6-inch increment for SPT) for 3 inches would be recorded as 80/9.

3.4.7.2 Shelby Tubes

To obtain a relatively undisturbed sample for classification and testing in fine-grained soils (e.g., tailings slime), a 3-inch-diameter thin-walled steel (Shelby) tube sampler will pushed hydraulically below the bottom of the drill hole (as generally described in ASTM D 1587). The tubes will be sealed in the field and taken to our laboratory for extrusion and classification.

3.4.8 Cone Penetrometer Probes

The seismic piezocone is arranged to measure the following parameters, which are used for the soil classification:

- Tip resistance, Qc in tsf (resistance to soil penetration developed at the cone tip);
- Friction resistance, Fs in tsf (resistance to soil penetration developed along the friction sleeve); and
- Pore water pressure behind the cone tip, U_{bt} in psi.

Two of the probes may also be accomplished with apparatus that enables measurement of a shear wave profile as the probe is advanced, in order to estimate site-specific seismic response. The CPT system is mounted on a tracked vehicle, which provides the necessary reaction for the applied loads.

The electric piezocone penetrometer test procedure involves hydraulically pushing a series of cylindrical rods into the soil at a constant rate of 2 centimeters per second or other rate selected by the CPT operator and subsequently monitoring soil and pore fluid response near the conical tip. The cylindrical rod at the bottom of the drill string houses the pressure transducer and load cells which, during probing, measure the parameters indicated above. To be useful, the results must be used with engineering judgment in conjunction with other tests, preferably the SPT procedure, which allows soil sample collection for direct comparison purposes. Tests will be performed in general accordance with procedures outlined in ASTM D 3441, Standard Method for Deep, Quasi-Static, Cone and Friction-Cone Penetration Tests of Soil.

The classification method used to develop an interpreted soil profile is based on normalized parameters provided by the piezocone, as there is no soil samples collected with a penetrometer system of this type.

The relationship between the cone tip resistance and friction ratio, which has been normalized for soil overburden stresses, can be established to predict soil behavior (Jeffries and Davies, 1991 and 1993). The Cone Penetrometer will not be equipped with analytical instrumentation such as an XRF unit.

3.4.9 Monitoring Well Installation

A hollow stem auger (HAS) drill will be used to drill the monitoring well borings. Two-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter 0.020-inch machine-slotted screen will be used for the well casings and screens. The well screen and casing riser will be lowered down through the open hole. A No.

10/20 silica sand will be placed in the annular space from the base of the boring to approximately 2 to 3 feet above the top of the well screen by allowing the sand pack to settle through the revert. Screen slots and sand pack sizing will be consistent with the screen and sand pack used by Equinox in monitoring wells MW 1 and MW2 installed adjacent to the Lower Tailings Pile (DCN-1059). The monitoring wells will be installed in accordance with Washington State Department of Ecology regulations (WAC 173-160).

Well seals will be constructed by placing bentonite chips in the annular space on top of the filter sand to within 3-feet of ground surface. The remaining annular space was backfilled with concrete to complete the surface seal. For security, the monitoring wells will be completed with locking stick-up steel monuments set in concrete. The monitoring well construction details will be illustrated on the boring logs.

Well development will start with pumping the well to remove drilling fluids. Then chlorine will be injected into the screened section and a surge block used to manually bring the chlorine in contact with remaining revert mud. Depending on the well yield, the well will be purged of about 100 gallons of water. The field parameters of pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxygen redox potential meters will be measured and recorded periodically during the development of the well. Once the field parameters have stabilized with values within +/- 10% between measurements the well will be considered sufficiently developed for sampling. Depending on the field schedule, water sampling may be postponed until the end of field work.

3.5 Equipment Decontamination Procedures

For collection of surface water and groundwater, all samples will be collected directly in precleaned sampling jars obtained from the project laboratory.

For all soil, sediment, surface water and groundwater sampling precleaned equipment will be used. All reusable or nondedicated field equipment (e.g., sampling spoons, mixing bowls, spade/shovel, split spoons, water meters) will be decontaminated prior to reuse. Equipment will be cleaned in the following manner:

- Nitrile gloves (or equivalent) must be worn during decontamination.
- Excess soil/sediment will be removed using paper towels or by dry brushing.
- Rinse with potable water, collecting rinse water in one of the decontamination buckets.

- Wash with a spray bottle containing Liquinox™ or equivalent non-phosphate detergent and water and clean with the stiff-bristle brush until all evidence of soil/sediment or other material has been removed.
- Rinse with deionized or distilled water three times, ensuring that all soap from the previous step has been removed.
- If necessary, place the equipment on a piece of aluminum foil to air dry.
- A trash bag will be provided to contain waste paper towels, aluminum foil, and used nitrile gloves.

3.6 Disposal of Investigation-Derived Waste

3.6.1 Disposal of Incidental Trash

Incidental trash generated during this investigation (including discarded nitrile gloves, aluminum foil, paper towels, and disposable equipment) will be placed in plastic trash bags and disposed of as solid waste.

3.6.2 Soil Cuttings

Soil cuttings will be generated on and adjacent to tailings piles. After drilling on the tailings piles the cuttings and residual drill mud will be spread and left on the tailings pile in areas protected from erosion. During drilling of monitoring wells adjacent to tailings piles, the drill cuttings will be placed on plastic sheeting. Following completion of the monitoring well the cuttings will be placed on the tailings pile such that wind or precipitation will not cause erosion or transport of the material.

3.6.3 Decontamination Water Disposal

Soap and water decontamination solutions will be poured onto the ground.

3.7 Sample Containers and Labels

Sample container requirements vary according to analyte. Precleaned sample containers will be obtained from the analytical laboratory. Sample containers shall be cleaned following the requirements described in Specifications and Guidance for Contaminant-Free Sample Containers (EPA 1992a, OSWER Directive 92.0-05a). Required sample containers, preservatives, and holding times are summarized in Table B-3.

3.8 Field Documentation

Field notes will be maintained during sampling and processing operations. The following will be included in the field notes:

- Site name and location;
- Date and time of entry;
- Names of the field sampler collecting and logging the samples;
- Weather conditions;
- Date, time, and identification of each sample, including number of jars and tests requested;
- Documentation of photographs;
- Details of sample collection, including GPS coordinates; actual sampling point locations will be recorded on a sketch map;
- Any deviation from the approved SAP; and
- General observations.

3.9 Sample handling procedures

3.9.1 Sample Preservation and Holding Times

Samples will be preserved according to the requirements of the specific analytical methods to be employed, and all samples will be extracted and analyzed within method-specified holding times. Required sample containers, preservatives, and holding times are summarized in Table B-2.

3.9.2 Chain of Custody Procedures

Chain of custody forms will be used to document the collection, custody, and transfer of samples from their initial collection location to the laboratory, and their ultimate use and disposal. Entries for each sample will be made on the custody form after each sample is collected.

Sample custody procedures will be followed to provide a documented record that can be used to follow possession and handling of a sample from collection through analysis. A sample is considered to be in custody if it meets at least one of the following conditions:

- The sample is in someone's physical possession or view;
- The sample is secured to prevent tampering (i.e., custody seals); and/or
- The sample is locked or secured in an area restricted to authorized personnel.

A chain of custody form will be completed in the field as samples are packaged. At a minimum, the information on the custody form shall include the sample number, date and time of sample collection, sampler, analysis, and number of containers. Two copies of the custody form will be placed in the cooler prior to sealing for delivery to the laboratory with the respective samples. The other copy will be retained and placed in the project files after review by the Project Chemist. Custody seals will be placed on each cooler or package containing samples so the package cannot be opened without breaking the seals.

3.9.3 Delivery of Samples to Analytical Laboratory

After sample containers have been filled, they will be packed on ice in coolers. The coolers will be transferred to Analytical Resources Inc. (ARI) in Tukwila, WA, for chemical analysis. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24;
- Individual sample containers will be packed to prevent breakage;
- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler, and the Hart Crowser office name and address) to enable positive identification;
- A sealed envelope containing custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler;
- Signed and dated custody seals will be placed on all coolers prior to shipping;
- Samples will either be shipped by overnight courier or will be hand delivered to the laboratory by Hart Crowser personnel; and

- Upon transfer of sample possession to the testing laboratories, the custody form will be signed by the persons transferring custody of the coolers. Upon receipt of samples at the laboratory, the shipping container custody seal will be broken and the laboratory sample-receiving custodian will compare samples to information on the chain of custody form and record the condition of the samples received.

4.0 LABORATORY ANALYTICAL METHODS

Table B-1 identifies background samples and samples by media that will be collected within the Areas of Interest (AOIs) on the Site and the types of analyses that will be conducted by the laboratory. Samples will be analyzed according to EPA methods as described in Update III to Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846 (EPA 1986) as summarized in Tables B-3 and B-4. Laboratory methods, practical quantitation limits (PQL; reporting limits) and method detection limits are also presented in Tables B-3 and B-4 along with the individual analytes requested for the different tests.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The quality of analytical data generated is assessed by the frequency and type of internal QC checks developed for analysis type. The quality of laboratory measurements will be assessed by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, surrogate compound recoveries, instrument calibrations, performance evaluation samples, interference checks, etc., as specified in the analytical methods to be used. The following general procedures will be followed for all laboratory analyses:

- Laboratory blank measurements at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;

- Matrix spike (MS) analysis to assess accuracy at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;

- Matrix spike duplicate or laboratory duplicate to assess precision at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;

- Surrogate or labeled compound spikes in each sample for organics analysis to assess accuracy; and

- Laboratory control sample analysis or a certified reference material (CRM), if appropriate CRM is available, with each analytical batch to assess accuracy in the absence of any matrix effect at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix. Acceptance criteria for the CRM results (based on the 95% confidence interval) must be provided by the laboratory. If results fall outside the acceptance range, the laboratory may be required to re-extract and reanalyze the associated samples.

Laboratory quality control procedures, criteria, and corrective action are summarized in Tables B-4 through B-9 for the various analyses.

5.1 Data Quality Indicators

The overall quality assurance objectives for field sampling, field measurements, and laboratory analysis are to produce data of known and appropriate quality. The procedures and quality control checks specified herein will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. This section defines the objectives for accuracy and precision for measurement data. These goals are primarily expressed in terms of acceptance criteria for the quality control checks performed.

The quality of analytical data generated is controlled by the frequency and type of internal quality control checks developed for analysis type. Laboratory results will be evaluated by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, interference checks, etc., as specified in the analytical methods to be used.

5.1.1 Precision

Precision is the degree of reproducibility or agreement between independent or repeated measurements. Analytical variability will be expressed as the relative percent difference (RPD) between laboratory replicates and between matrix spike and matrix spike duplicate analyses. RPD will be used to measure precision for this investigation and is defined as follows:

$$RPD = \frac{(D_1 - D_2)}{(D_1 + D_2)/2} \times 100$$

Where,

D_1 = Sample value
D_2 = Duplicate sample value

Field duplicate samples will not be collected since the project objective is to evaluate chemical concentrations (and natural variability) across the entire state rather than at individual sampling locations. In addition, composite samples will be collected at each site and MIS sampling procedures will be employed by the laboratory to minimize sampling variability.

5.1.2 Accuracy

Accuracy is the agreement between a measured value and its true or accepted value. While it is not possible to determine absolute accuracy for environmental samples, the analysis of standards and spiked samples provides an indirect assessment of accuracy.

Laboratory accuracy will be assessed as the percent recovery of matrix spikes, matrix spike duplicates, surrogate spiked compounds (for organic analyses), and laboratory control samples. Accuracy will be defined as the percentage recoverable from the true value and is defined as follows:

$$\%Recovery = \frac{(SSR\text{-}SR)}{SA} \times 100$$

Where,

SSR = spiked sample result
SR = sample results (not applicable for surrogate recovery)
SA = amount of spike added

5.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care will be taken in the design of the sampling program to ensure sample locations are selected properly, sufficient numbers of samples are collected to accurately reflect conditions at the site, and samples are representative of sampling locations. A sufficient volume of sample will be collected at each sampling point to minimize bias or errors associated with sample particle size and heterogeneity.

5.1.4 Completeness

Completeness is the percentage of measurements made that are judged to be valid. Completeness will be calculated separately for each analytical group, e.g., metals or PAHs. Results must also contain all quality control check analyses required to verify the precision and accuracy of results to be considered complete. Data qualified as estimated during the validation process will be considered complete. Nonvalid measurements will be results that are rejected during the validation review or samples for which no analytical results were obtained. Completeness will be calculated for each analysis using the following equation:

$$\text{Completeness} = \frac{\text{valid data points obtained}}{\text{total data points planned}} \times 100$$

The target goal for completeness is a minimum of 95 percent. Completeness will be monitored on an on-going basis so that archived sample extracts can be reanalyzed, if required, without remobilization.

5.1.5 Comparability

Comparability is the degree to which data from separate data sets may be compared. For instance, sample data may be compared to data from background locations, to established criteria or guidance, or to data from earlier sampling events. There has been little consistency among historical studies used to estimate background chemical concentrations. For example, intervals defined as surface soil have varied often ranging from one inch to six or more inches in depth. In addition, analytical methods have not been consistent across studies.

As discussed in Section 6.0, sample collection will be performed in a consistent manner by field personnel at all sampling locations to ensure all data collected as part of this study are comparable. Comparability is attained by careful adherence to standardized sampling and analytical procedures, based on rigorous documentation of sample locations (including depth, time, and date).

The use of standardized methods to collect and analyze samples, along with instruments calibrated against National Institute for Standards and Technology (NIST) and US EPA traceable standards will also ensure comparability, particularly for comparison of data collected from this study (within-study comparability).

Comparability also depends on other data quality characteristics. Only when data are judged to be representative of the environmental conditions, and when precision and accuracy are known, can data sets be compared with confidence.

5.2 Data Quality Assurance Review

A project chemist at Hart Crowser will perform an independent data quality review of the chemical analytical results provided by ARI. This report will assess the adequacy of the reported detection limits in achieving the project screening levels for soil; the precision, accuracy, representativeness, and completeness of the data; and the usability of the analytical data for project objectives. Exceedances of analytical control limits will be summarized and evaluated.

A data evaluation review will be performed on all results using QC summary sheet results provided by the laboratory for each data package. The data evaluation review is based on the Quality Control Requirements previously described and follows the format of the EPA National Functional Guidelines for Inorganic (EPA 2010) Superfund Data Review, and EPA National Functional Guidelines for Organic (EPA 2008) Superfund Data Review modified to include specific criteria of individual analytical methods. Raw data (instrument tuning, calibrations, instrument printouts, bench sheets, and laboratory worksheets) will be available for review if any problems or discrepancies are discovered during the routine evaluation. The following is an outline of the data evaluation review format:

- Verify that sample numbers and analyses match the chain of custody request;
- Verify sample preservation and holding times;
- Verify that instrument tuning, calibration, and performance criteria were achieved;
- Verify that laboratory blanks were performed at the proper frequency and that no analytes were present in the blanks;
- Verify that laboratory duplicates, matrix spikes, surrogate compounds, and laboratory control samples were run at the proper frequency and that control limits were met; and
- Verify that required detection limits have been achieved.

Data qualifier flags, beyond any applied by the laboratory, will be added to sample results that fall outside the QC acceptance criteria. An explanation of data qualifiers to be applied during the review is provided below:

U The compound was analyzed for but was not detected. The associated numerical value is the sample reporting limit.

J The associated numerical value is an estimated quantity because QC criteria were slightly exceeded.

UJ The compound was analyzed for, but not detected. The associated numerical value is an estimated reporting limit because QC criteria were not met.

T The associated numerical value is an estimated quantity because reported concentrations were less than the practical quantitation limit (lowest calibration standard).

R Data are not usable because of significant exceedance of QC criteria. The analyte may or may not be present; resampling and/or reanalysis are necessary for verification.

6.0 DATA ANALYSIS AND REPORTING

6.1 Evaluation of Chemistry Data

Analytical results will be compared to:

- Sediment results will be compared to preliminary Washington State Freshwater Sediment Management Standards (SMS) criteria and apparent effects thresholds (AETs).
- Soil concentrations will be compared to Model Toxics Control Act (MTCA) Method A and Method B unrestricted land use direct contact criteria.
- Surface water chemical concentrations will be compared to Washing State surface water quality criteria.
- Groundwater results will be compared to drinking water maximum contaminant levels (MCLs) and Model Toxics Control Act (MTCA) Method A and Method B unrestricted use criteria.

6.2 Laboratory Reports

The laboratory data reports will consist of complete data packages that will contain complete documentation and all raw data to allow independent data reduction and verification of analytical results from laboratory bench sheets, and instrument raw data outputs. Each laboratory data report will include the following:

- Case narrative identifying the laboratory analytical batch number, matrix and number of samples included, analyses performed and analytical methods used, and description of any problems or exceedance of QC criteria and corrective action taken. The laboratory manager or their designee must sign the narrative.

- Copy of chain of custody forms for all samples included in the analytical batch.

- Tabulated sample analytical results with units, data qualifiers, percent solids, sample weight or volume, dilution factor, laboratory batch and sample number, Hart Crowser sample number, and dates sampled, received, extracted, and analyzed all clearly specified.

- All calibration, quality control, and sample raw data including quantitation reports and other instrument output data.

- Blank summary results indicating samples associated with each blank.

- MS/MSD result summaries with calculated percent recovery and relative percent differences.

- Surrogate compound recoveries, when applicable, with percent recoveries.

- Laboratory control sample results, when applicable, with calculated percent recovery.

- Performance evaluation or certified reference material sample results, if applicable, with acceptance limits.

- Electronically formatted data deliverable (CD) results will be uploaded into Ecology's EIM data management system.

7.0 HART CROWSER REPORTS

Hart Crowser will prepare a draft report summarizing sampling procedures and laboratory testing results. The report will include a map(s) with sampling locations, tabulated analytical testing data, and laboratory analytical documentation. The report will also include an assessment of sediment recontamination potential. A final report will be completed following discussions with Ecology.

8.0 REFERENCES

EPA 1986. Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846, 3rd Update.

EPA 1992a. Specifications and Guidance for Contaminant-Free Sample Containers. OSWER Directive 92.0-05A.

EPA 2008. US EPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Data Review. EPA-540-R-08-01, June 2008.

EPA 2010. US EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review. EPA-540-R-10-011, January 2010.

Smith, K. S. et. al. 1997. Sampling strategy for the Rapid Screening of Mine-Waste Dumps on Abandoned Mine Lands. US Geologic Survey Solid Phase sampling Workshop.

J:\Jobs\1733031\Work Plan\Appendix B - SAP\Draft Final\Draft Final Appendix B - SAP.doc

Table B-1 - Sample Analysis by Matrix and Site Feature

Area of Interest (AOIs) / Description of Samples Collected	Media Sampled	Number of Discrete Samples	Number of Composite Samples[3]	Total Metals[1]	Dissolved Metals[1]	Dissolved Mercury	Total Mercury	PCBs	NWTPH-Dx	VOCs	PAHs	TOC	TSS	TDS	Alkalinity	Hardness	XRF Screening Locations[2]	pH	Temperature	Specific conductance	Eh	Turbidity	Dissolved Oxygen
				Laboratory Analysis													Field Measurements						
Background Samples (Figure B-2)																							
Creek surface water samples	Surface Water	15			X	X	X						X	X	X	X		X	X	X	X	X	X
Creek sediment samples (co-located with surface water samples)	Sediment	15		X			X					X											
Groundwater samples (6 residential wells)	Groundwater	6		X			X						X	X	X	X		X	X	X	X	X	X
Soil samples	Soil		15	X			X										15						
Background Samples:		**36**	**15**													**XRF Screening Samples:**	**15**						
AOI-1 Open Pits, Waste Rock, and Mill Facility (Figure B-1)																							
Soil samples collected from five transects (3 chemical samples & 4 XRF readings per transect)	Soil	15		X			X										20						
Soil samples collected from erosional areas below tailings pile (limited to 2 erosional areas)	Soil	6		X			X										12						
Composite Soil Samples of Waste Rock	Soil		9	X			X										120						
Stained soil areas near mill	Soil	10		X			X	X	X	X	X						10						
North and South Pit seepage samples (one per pit)	Surface water	2			X	X	X						X	X	X	X		X	X	X	X	X	X
West End Pit Lake discharge:	Surface water	1			X	X	X						X	X	X	X		X	X	X	X	X	X
AOI-1 Samples:		**34**	**9**													**XRF Screening Samples:**	**162**						
AOI-2 Upper Tailings Pile (Figure B-1)																							
Soil samples collected from five transects (3 chemical samples & 4 XRF readings per transect)	Soil	15		X			X										20						
Soil samples collected from erosional areas below tailings pile (limited to 6 samples)	Soil	6		X			X										12						
Soil Samples collected from 2011 Tailings Pile Breach with XRF Screening	Soil	10		X			X										30						
Groundwater monitoring well samples (2 wells installed during RI)	Groundwater	2		X			X						X	X	X	X		X	X	X	X	X	X
AOI-2 Samples:		**33**														**XRF Screening Samples:**	**62**						
AOI-3 Lower Tailings Pile (Figure B-1)																							
Soil samples collected from five transects (3 chemical samples & 4 XRF readings per transect)	Soil	15		X			X										20						
Soil samples collected from erosional areas below tailings pile (limited to10 samples)	Soil	10		X			X										20						
Groundwater monitoring well samples (2 Equinox wells W1 & W2 and 3 wells installed during RI)	Groundwater	5		X			X						X	X	X	X		X	X	X	X	X	X
AOI-3 Samples:		**30**														**XRF Screening Samples:**	**40**						
AOI-4 Tailings Pipeline Area and Facility Roads																							
Sampling of potential pipeline releases (limited to 10 samples)identified using XRF screening	Soil	10		X			X										30						
Dirt roads will be observed and screened using XRF - 5 samples collected for laboratory analysis	Soil	5		X			X										30						
AOI-4 Samples:		**15**														**XRF Screening Samples:**	**60**						
AOI-5 Onion Creek and Tributaries																							
Onion Creek - Surface water samples	Surface Water	14			X	X	X								X	X		X	X	X	X	X	X
Onion Creek - Sediment samples (co-located with surface water sample)	Sediment	14		X			X					X											
Northeast Tributary - Surface water samples	Surface Water	2			X	X	X								X	X		X	X	X	X	X	X
Northeast Tributary - Sediment samples (co-located with surface water samples)	Sediment	2		X			X					X											
Southeast Tributary - Surface water locations sampled	Surface Water	2			X	X	X								X	X		X	X	X	X	X	X
Southeast Tributary - Sediment samples (co-located with surface water samples)	Sediment	2		X			X					X											
Tributary below West Pit Lake Dam - Surface water samples	Surface Water	1			X	X	X								X	X		X	X	X	X	X	X
Tributary below West Pit Lake Dam - Sediment samples (co-located with surface water sample)	Sediment	2		X			X					X											
AOI-5 Samples:		**39**														**XRF Screening Samples:**	**0**						
Total number of background samples (discrete and composite):		**51**																					
Total number of discrete environmental samples:		**151**																					
Total number of composite environmental samples:		***9***																					
Total number of samples for laboratory analysis:		***211***														**Total Number of XRF Screening Samples:**	**339**						

Notes:

1. Priority Pollutant Metals include Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Thallium, and Zinc.
2. XRF Screening: This field screening method will be used to help delineate the extent of metal impacts and locations for chemical sample collection.
3. Each composite sample will consist of 30 subsamples of waste rock piles and 5 samples of soil background samples collected and screeened <2mm.

This page is intentionally left blank for double-sided printing.

Table B-2 – Sample Containers, Preservation, and Holding Times

Sample Type	Sample Container	Sample Preservation Technique	Maximum Holding Time
Total solids	Included in metals or organics container	Cool, < 6°C Freeze, -18°C	14 days 6 months
Diesel and heavy oil range petroleum hydrocarbons	Soil - One 4-oz wide mouth glass jar	Cool to < 6°C	14 days
Metals (except mercury)	Soil - One 4-oz wide mouth glass jar Water (dissolved) – 500-mL HDPE Water (total) – One 500-mL HDPE	Cool, < 6°C Freeze, -18°C Field filter; HNO3 to pH < 2; Cool, < 6°C HNO3 to pH < 2; Cool, < 6°C	6 months 1 year 6 months 6 months
Mercury	Soil - Included in metals container Water (dissolved) – 500-mL Teflon Water (total) – One 500-mL HDPE	Freeze, -18°C Field filter (0.45 micron filter); HC1 to pH < 2; Cool, < 6°C HNO3 to pH < 2; Cool, < 6°C	28 days 28 days 28 days
Semivolatile organic compounds (SVOCs) - after extraction	Soil - One 16-oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C Cool, < 6°C	14 days 1 year 40 days
PCBs - after extraction	Soil - One 8-oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 1 year 40 days

Table B-3 - Soil and Freshwater Sediment Sample Preparation, Analytical Methods, and Quantitation Limits

	Preparation Method	Analysis Method	Pratical Quantitation Limits[a]	Soil MTCA Method B Criteria	Freshwater Sediment Screening Numbers[b]
CONVENTIONALS:					
Total Solids in %	–	PSEP	0.10%		
Total Organic Carbon in %	–	EPA 9060/Ecology (a)	0.0		
Petroleum Hydrocarbons			**mg/kg (dry weight)**		
Diesel and heavy oil range hydrocarbons	NWTPH-Dx	NWTPH-Dx	5.0		
METALS			**mg/kg (dry weight)**	**mg/kg (dry weight)**	**mg/kg (dry weight)**
Antimony	EPA 3050B	EPA 6010B	5.0	32.0	0.6[c]
Arsenic	EPA 3050B	EPA 6010B	5.0	0.7	33[b]
Beryllium	EPA 3050B	EPA 6010B	0.1	160.0	0.46[c]
Cadmium	EPA 3050B	EPA 6010B	0.2	80	4.98[b]
Chromium	EPA 3050B	EPA 6010B	0.5	240	111[b]
Copper	EPA 3050B	EPA 6010B	0.2	2960	149[b]
Lead	EPA 3050B	EPA 6010B	2.0	254(A)	128[b]
Mercury	EPA 7471A	EPA 7471A	0.05	24	1.06[b]
Nickel	EPA 3050B	EPA 6010B	1	1600	48.6[b]
Selenium	EPA 3050B	EPA 6010B	5	400	
Silver	EPA 3050B	EPA 6010B	0.3	400	0.545[c]
Thallium	EPA 3050B	EPA 6010B	5	5.6	
Zinc	EPA 3050B	EPA 6010B	0.6	24000.0	459b
Polycyclic Aromatic Hydrocarbons (PAHs)			**ug/kg (dry weight)**	**ug/kg (dry weight)**	**ug/kg (dry weight)**
2-Methylnaphthalene	EPA 3540C	EPA 8270D	20	3,200	
Acenaphthene	EPA 3540C	EPA 8270D	20	4,800	
Acenaphthylene	EPA 3540C	EPA 8270D	20	-	
Anthracene	EPA 3540C	EPA 8270D	20	24,000	845[b]
Benzo(a)anthracene	EPA 3540C	EPA 8270D	20	137	1050[b]
Benzo(a)pyrene	EPA 3540C	EPA 8270D	20	137	1450[b]
Benzo(b)fluoranthene	EPA 3540C	EPA 8270D	20	137	
Benzo(g,h,i)perylene	EPA 3540C	EPA 8270D	20	-	
Benzo(k)fluoranthene	EPA 3540C	EPA 8270D	20	137	
Benzofluoranthenes (b,k, j)	EPA 3540C	EPA 8270D	20	137	
Chrysene	EPA 3540C	EPA 8270D	20	137	1290[b]
Dibenzo(a,h)anthracene	EPA 3540C	EPA 8270D	20	-	
Fluoranthene	EPA 3540C	EPA 8270D	20	3,200	2230[b]
Fluorene	EPA 3540C	EPA 8270D	20	3,200	536[b]
Indeno(1,2,3-c,d)pyrene	EPA 3540C	EPA 8270D	20	137	
Naphthalene	EPA 3540C	EPA 8270D	20	1600	561[b]
Phenanthrene	EPA 3540C	EPA 8270D	20	-	1170[b]
Pyrene	EPA 3540C	EPA 8270D	20	2,400	1520[b]
PCBs			**ug/kg (dry weight)**		
Aroclor 1016	EPA 3540C	EPA 8082	4		
Aroclor 1221	EPA 3540C	EPA 8082	4		
Aroclor 1232	EPA 3540C	EPA 8082	4		
Aroclor 1242	EPA 3540C	EPA 8082	4		
Aroclor 1248	EPA 3540C	EPA 8082	4		
Aroclor 1254	EPA 3540C	EPA 8082	4		
Aroclor 1260	EPA 3540C	EPA 8082	4		
Aroclor 1262	EPA 3540C	EPA 8082	4		
Aroclor 1268	EPA 3540C	EPA 8082	4		
Total PCBs	EPA 3540C	EPA 8082	4	500	676[b]

a - default reporting limits may apply depending upon extraction methods
b - Based on the Consensus-Based Probable Effect Concentrations (PECs) presented in Table 3 of the "Development and Evaluation of Consensus-Based 2000 Sediment Water Guidelines for Freshwater Ecosystems," January, 2000
c - Values are Lowest Apparent EFFECTS Threshold as listed in Avocet, 2003

Table B-4 - Surface Water and Groundwater Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	Surface Water Screening Level	Groundwater Screening Level
CONVENTIONALS:					
Hardness	–	PSEP	0.0		
Petroleum Hydrocarbons			**mg/L**		
Diesel and heavy oil range hydrocarbons	NWTPH-Dx	NWTPH-Dx	5.0		
METALS			**ug/L**	**Dissolved Constituents ug/L**	**Dissolved Constituents ug/L**
Antimony	EPA 3050B	EPA 6020	0.2	14.0	6
Arsenic	EPA 3050B	EPA 6020	0.2	0.0	0.058
Beryllium	EPA 3050B	EPA 6020	0.2	273.0	4
Cadmium	EPA 3050B	EPA 6020	0.2	0.04	5
Chromium	EPA 3050B	EPA 6020	0.5	10	50
Copper	EPA 3050B	EPA 6020	0.5	1	592
Lead	EPA 3050B	EPA 6020	1.0	0.2	15
Mercury	EPA 7471A	EPA 7471A	0.1	0.14	2
Nickel	EPA 3050B	EPA 6020	0.5	6.3	100
Selenium	EPA 3050B	EPA 6020	0.5	5	50
Silver	EPA 3050B	EPA 6020	0.2	0.04	80
Thallium	EPA 3050B	EPA 6020	0.2	0.24	0.5
Zinc	EPA 3050B	EPA 6020	4.0	13.0	4,800

a - default reporting limits may apply depending on extraction methods

Table B-5 – Quality Control Procedures for Conventional Parameters

	Suggested Control Limits						
Analyte	**Initial Calibration**	**Continuing Calibration**	**Calibration Blanks**	**Laboratory Control Samples**	**Matrix Spikes**	**Laboratory Replicates**	**Method Blank**
Total solids	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20 % RSD	Not applicable

Table B-6 – Quality Control Procedures, Criteria, and Corrective Actions for TPH-Dx Analysis

Hydrocarbons NWTPH-Dx			
Laboratory Quality Control			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 20 or fewer samples	All analytes < reporting limit	Re-extract and reanalyze associated samples unless concentrations are > 5 x blank level
Initial calibration	4-point external calibration prior to analysis of samples	%RSD < 25%	Recalibrate instrument
Continuing calibration	Every 10 samples with mid-range standard	% Difference < 20% of initial calibration	Recalibrate instrument and re-analyze affected samples
System monitoring compounds (surrogates)	o-Terphenyl; Every lab and field sample	50 – 150% recovery	Evaluate data for useability
Laboratory duplicates	1 per batch of every 10 or fewer samples	None specified	Evaluate data for useability
Retention time windows	All samples and continuing calibration checks	±0.06 relative retention time units (sample and standard)	Reanalyze affected samples

Table B-7 - Quality Control Procedures for Metals Analysis

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Daily	Correlation coefficient ≥0.995	Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples
Initial Calibration Verification	Immediately after initial calibration	90 to 110 % recovery for ICP-AES, ICP-MS, and GFAA (80 to 120 % for mercury), or performance-based intralaboratory control limits, whichever is lower	Laboratory to resolve discrepancy prior to sample analysis
Continuing Calibration Verification	After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample	90 to 110 % recovery for ICP-AES and GFAA, 85 to 115 % for ICP-MS (80 to 120 % for mercury)	Laboratory to recalibrate and reanalyze affected samples
Initial and Continuing Calibration Blanks	Immediately after initial calibration, then 10 percent of samples or every 2 hours, whichever is more frequent, and after the last sample	Analyte concentration < PQL	Laboratory to recalibrate and reanalyze affected samples
ICP Interelement Interference Check Samples	At the beginning and end of each analytical sequence or twice per 8 hour shift, whichever is more frequent	80 to 120 percent of the true value	Laboratory to correct problem, recalibrate, and reanalyze affected samples
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples
Detection Limits	Not applicable	See Table 4 & 5	Laboratory must initiate corrective actions and contact the QA/QC coordinator and/or the project manager immediately
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent	Analyte concentration ≤ PQL	Laboratory to redigest and reanalyze samples with analyte concentrations < 10 times the highest method blank
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent	Soil - RPD ≤ 35 % applied when the analyte concentration is > PQL Water - RPD ≤ 25 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted

Table B-7 - Quality Control Procedures for Metals Analysis

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent	75 to 125 % recovery applied when the sample concentration is < 4 times the spiked concentration for a particular analyte	Laboratory may be able to correct or minimize problem; or qualify and accept data
Laboratory Control Samples, Certified or Standard Reference Material	Overall frequency of 5 percent of field samples	80 to 20 % recovery, or performance based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table B-8 – Quality Control Procedures for Semivolatile Organic Analysis

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Instrument Tuning	Prior to initial calibration and every 12 hours	See Method 8270d: Sections 11.3.1 and 11.4.1 and Table 3	Retune and recalibrate instrument
Initial Calibration	See Method 8270d: Sections 11.3	< 20% relative percent difference	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours	See Method 8270d: Sections 11.4 < 20% percent difference	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Table 4	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Performance based intralaboratory control limits	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.

Table B-8 – Quality Control Procedures for Semivolatile Organic Analysis

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Surrogate Spikes	Added to every organics sample as specified in analytical protocol	Performance based intralaboratory control limits	Follow corrective actions specified in Method 8270.
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table B-9 – Quality Control Procedures for PCB Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	See Method 8082, Section 11.4	See Method 8082, Section 11.4	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours or every 20 samples See Method 8082, Section 11.6.2	± 20 % difference See Method 8082, Section 11.6.2	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Table 4	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Compound- and matrix-specific RPD ≤ 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.
Surrogate Spikes	Added to every organics sample as specified in analytical protocol; See Method 8082, Section 7.10	Tetrachloro-m-xykene recovery - 30 to 150% Decachlorobiphenyl recovery - 30 to 150%	Re-extract and reanalyze sample unless interferences are present

Table B-9 – Quality Control Procedures for PCB Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

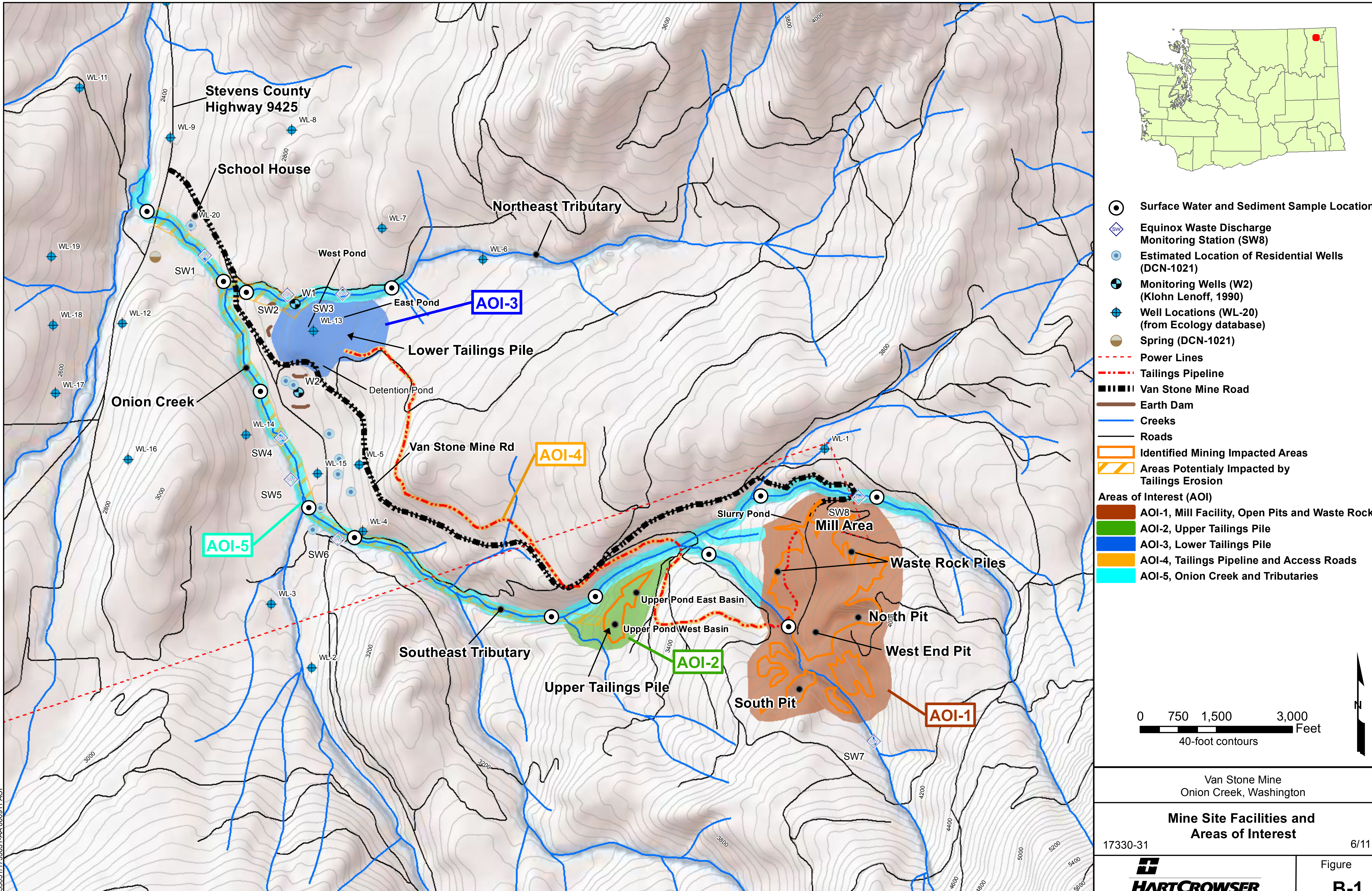
Table B-10 - Geotechnical Data Collection and Sample Analyses

	Upper Tailings Pile	Lower Tailings Pile	Pit Lake Embankment	Pit Wall Outcrops
Geologic Reconaissance	X	X	X	X
CPT Soundings	6	6		
Mud Rotary Borings	2	2		
Mud Rotary or Sonic Boring			1	
Vibrating Wire Piezometers (Note1)	1 to 3	1 to 3	1	
Laboratory Tests				
Visual Classification (all samples)	X	X	X	
Moisture Content (all samples)	X	X	X	
CU Triaxial (3 confining pressures)	2	2		
Proctor Compaction (Note 2)				
Rock Strength by PLS and/or Schmidt Hammer (Note 3)				X

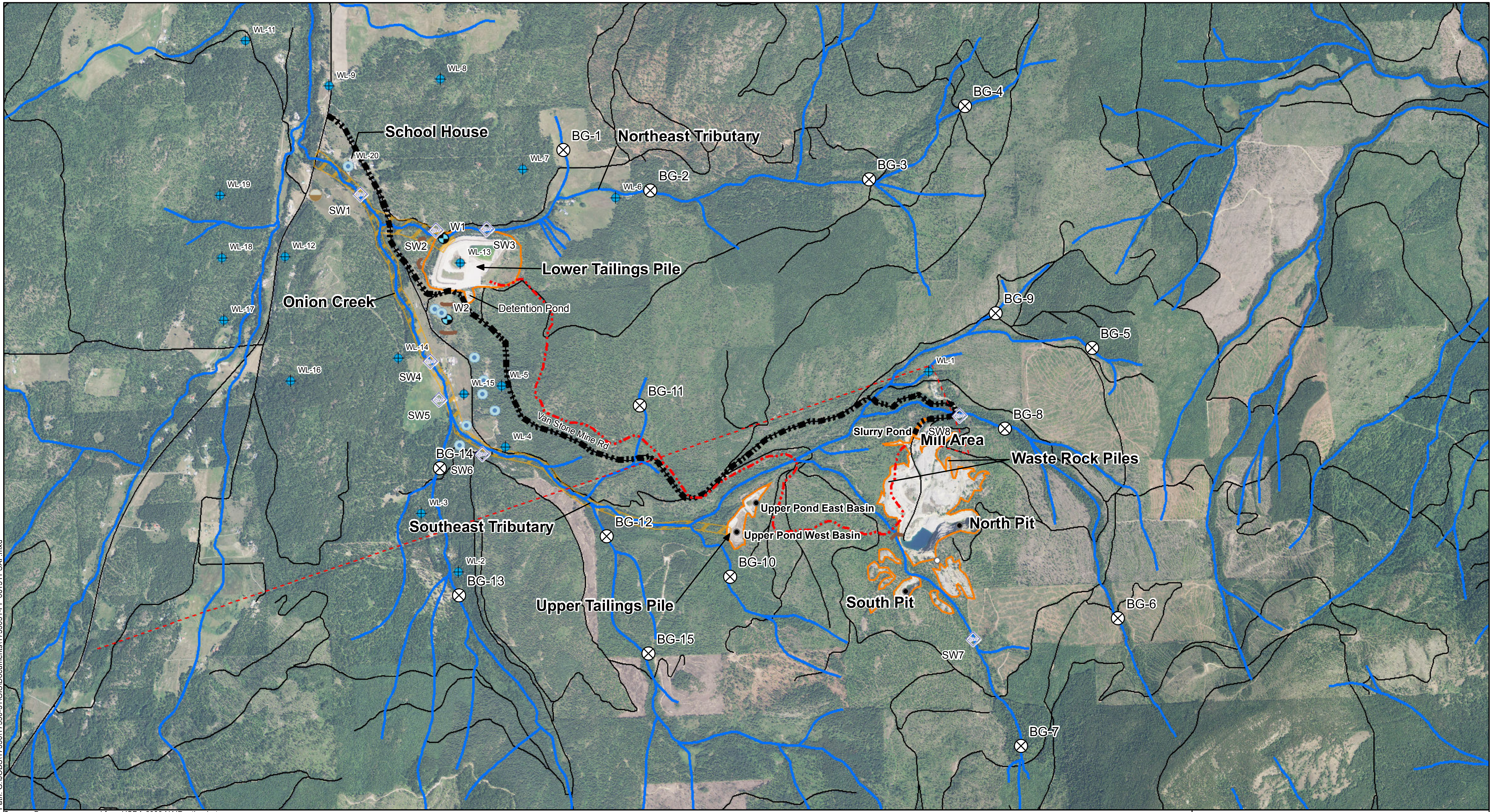
Note 1. VWP locations will be determined based on observation of sample moisture content at the time of drilling, and/or dissipation testing from the cPTs.

Note 2. A grab sample will be collected from one or the other tailings pile for a single Proctor Compaction Test.

Note 3. Typically 8 to 10 Schmidt Hammer measurements or 4 to 5 PLS grab samples will be obtained at each of 4 to 8 outcorps sampled.


Stevens County Highway 9425
School House
Northeast Tributary
West Pond
East Pond
AOI-3
Lower Tailings Pile
Detention Pond
Onion Creek
Van Stone Mine Rd
AOI-4
AOI-5
Slurry Pond
Mill Area
Waste Rock Piles
Upper Pond East Basin
Upper Pond West Basin
North Pit
West End Pit
Southeast Tributary
AOI-2
Upper Tailings Pile
South Pit
AOI-1
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
W1
W2
WL-1
WL-2
WL-3
WL-4
WL-5
WL-6
WL-7
WL-8
WL-9
WL-11
WL-12
WL-13
WL-14
WL-15
WL-16
WL-17
WL-18
WL-19
WL-20
Surface Water and Sediment Sample Locations
Equinox Waste Discharge Monitoring Station (SW8)
Estimated Location of Residential Wells (DCN-1021)
Monitoring Wells (W2) (Klohn Lenoff, 1990)
Well Locations (WL-20) (from Ecology database)
Spring (DCN-1021)
Power Lines
Tailings Pipeline
Van Stone Mine Road
Earth Dam
Creeks
Roads
Identified Mining Impacted Areas
Areas Potentially Impacted by Tailings Erosion
Areas of Interest (AOI)
AOI-1, Mill Facility, Open Pits and Waste Rock
AOI-2, Upper Tailings Pile
AOI-3, Lower Tailings Pile
AOI-4, Tailings Pipeline and Access Roads
AOI-5, Onion Creek and Tributaries
0 750 1,500 3,000
Feet
40-foot contours
N
Van Stone Mine
Onion Creek, Washington
Mine Site Facilities and Areas of Interest
17330-31
6/11
HARTCROWSER
Figure
B-1
1733031/1733031-AA 060911 AOI

This page is intentionally left blank for double-sided printing.



Path: G:\JOBS\17330\17330-31\GIS\Documents\1733031-FF 061311 SAP.mxd

Source: Base map prepared from USDA 2009 NAIP orthophoto.

Equinox Waste Discharge Monitoring Station (SW8)

Estimated Location of Residential Wells (DCN 1021)

Monitoring Wells (W2) (Klohn Lenoff, 1990)

Well Locations (WL-20) (from Ecology database)

Spring (DCN-1021)

Power Lines

Tailings Pipeline

Van Stone Mine Road

Earth Dam

Creeks

Areas Potentialy Impacted by Tailings Erosion

Mining Impacted Areas

Roads

Proposed Background Sample Locations (BG-15) (Surface Soil, Sediment, and Surface Water)
Note: Background samples are generally co-located and easily accessible for sampling.

0 2,000 4,000 6,000 Feet

N

Van Stone Mine
Onion Creek, WA

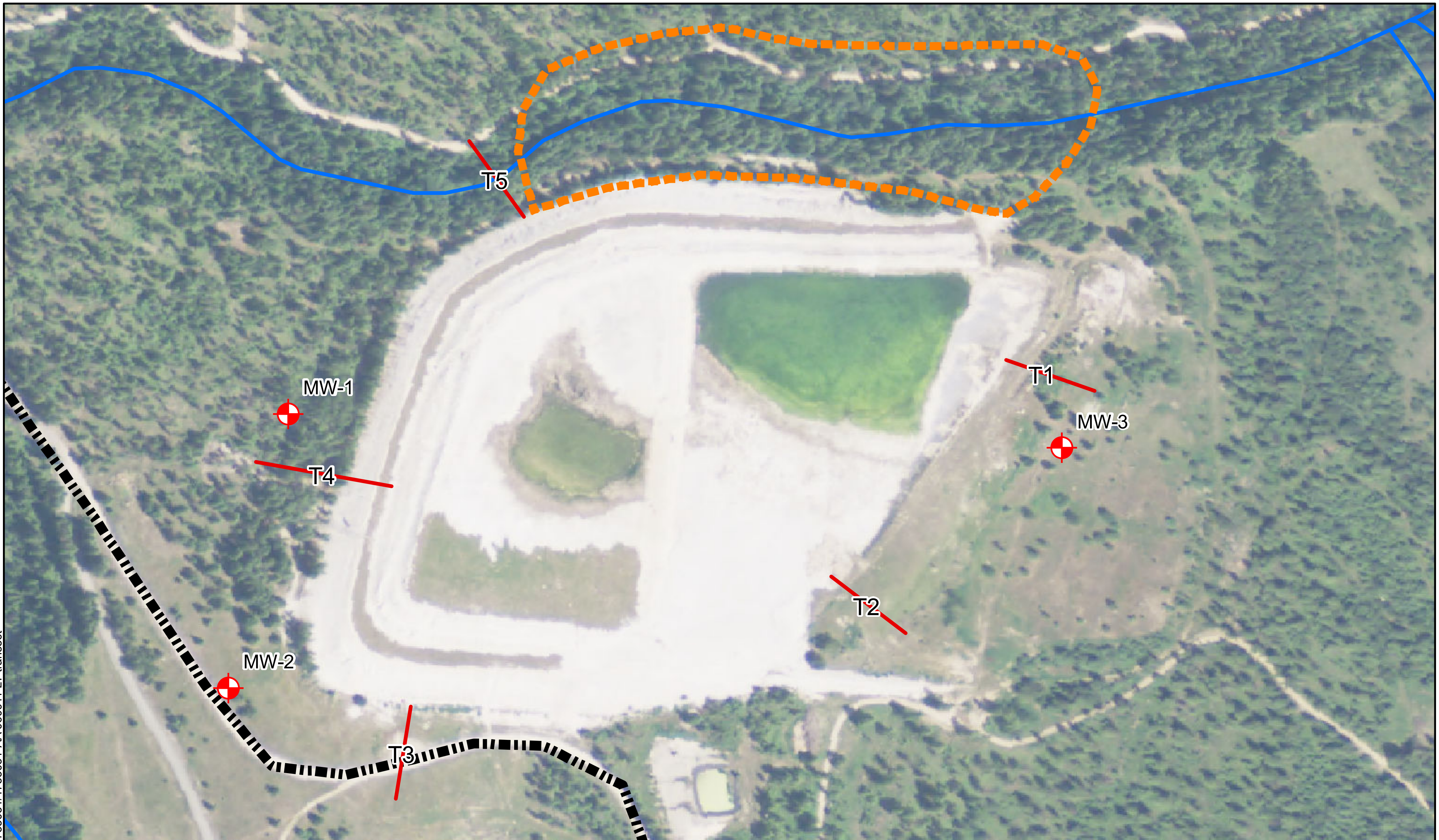
Proposed Background Sampling Locations

17330-31 6/11

HARTCROWSER

Figure
B-2

This page is intentionally left blank for double-sided printing.



1733031/1733031-AA 060911 LT transect

Source: Base map prepared from USDA 2009 NAIP orthophoto.

MW-3 - Proposed monitoring well location

T5 - Proposed transects

Areas of potential tailings erosion

Van Stone Mine Road

Creeks

0 150 300 600 Feet

N

Van Stone Mine
Onion Creek, Washington

Lower Tailings Pile
Sample Collection Locations

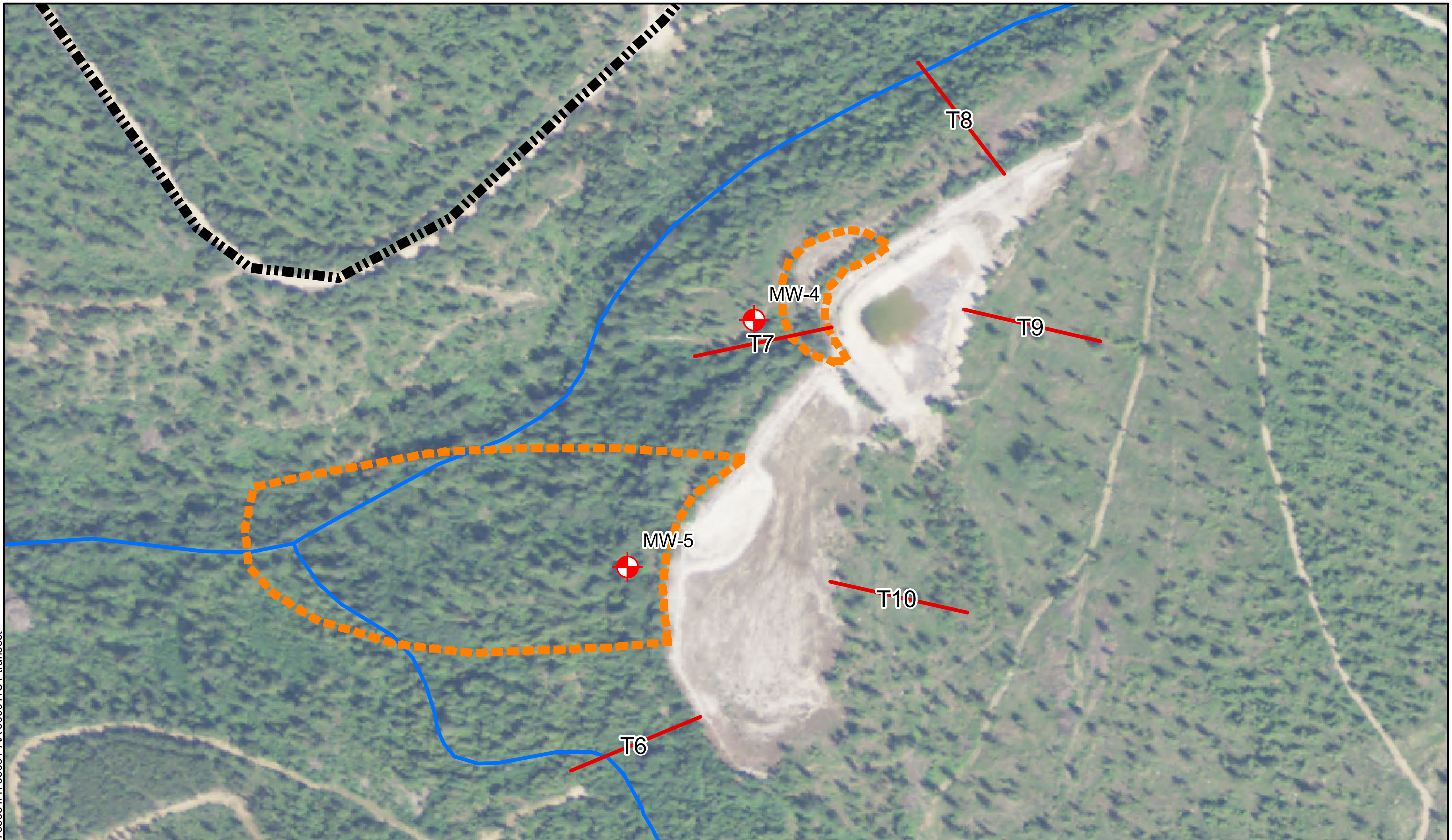
17330-31 6/11

HARTCROWSER

Figure

B-3

This page is intentionally left blank
for double-sided printing.



1733031/1733031-AA 060911UT transect

Source: Base map prepared from USDA 2009 NAIP orthophoto.

MW-5 - Proposed monitoring well location

T5 - Proposed transects

Areas of potential tailings erosion

Van Stone Mine Road

Creeks

0 150 300 600 Feet

N

Van Stone Mine
Onion Creek, Washington

Upper Tailings Pile
Sample Collection Locations

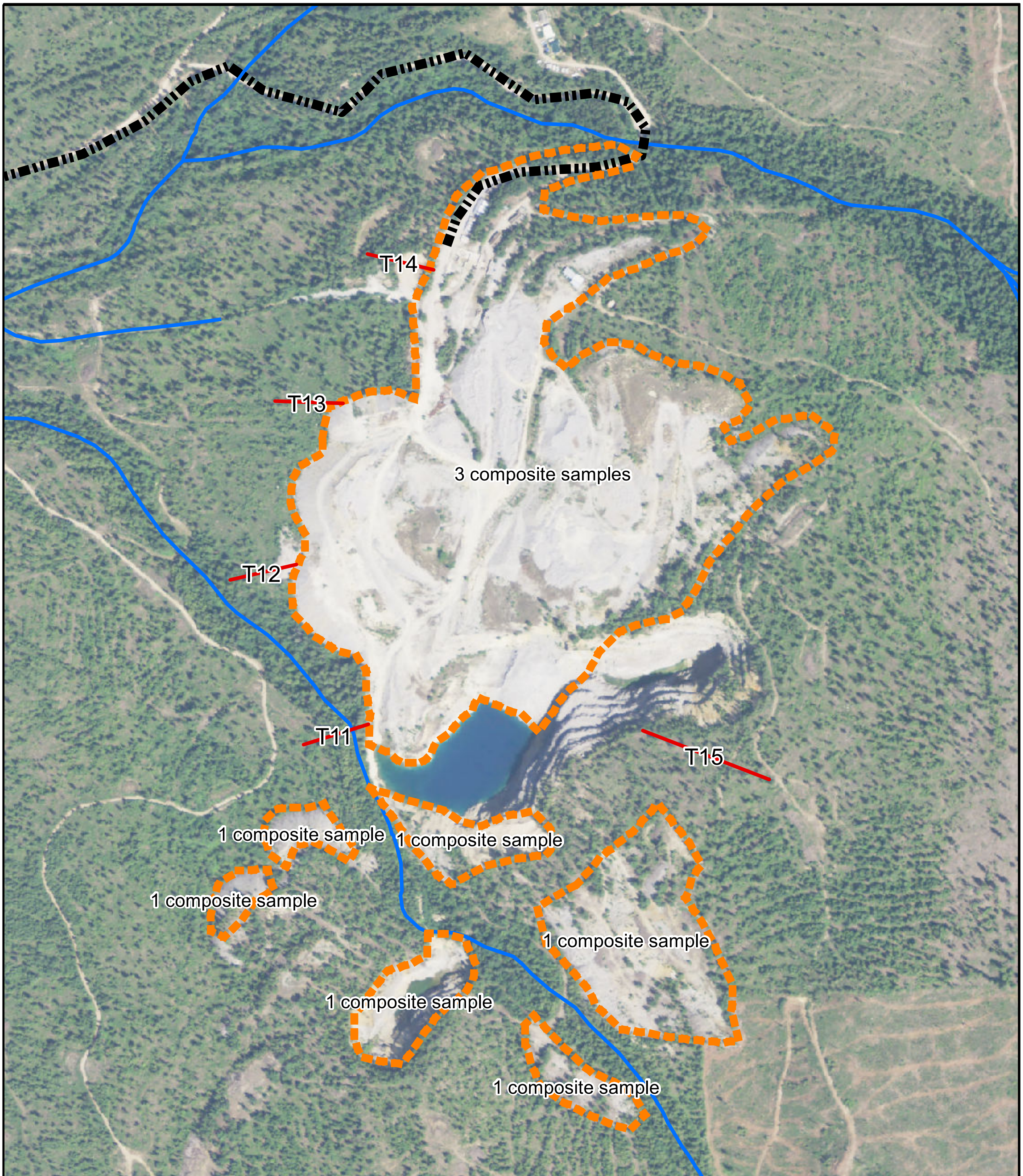
17330-31 6/11

HARTCROWSER

Figure

B-4

This page is intentionally left blank
for double-sided printing.



1733031/1733031-AA 060911 MM transect

Source: Base map prepared from USDA 2009 NAIP orthophoto.

T5 - Proposed transects
Composite sample locations
Van Stone Mine Road
Creeks

0 300 600 1,200 Feet

Van Stone Mine
Onion Creek, Washington

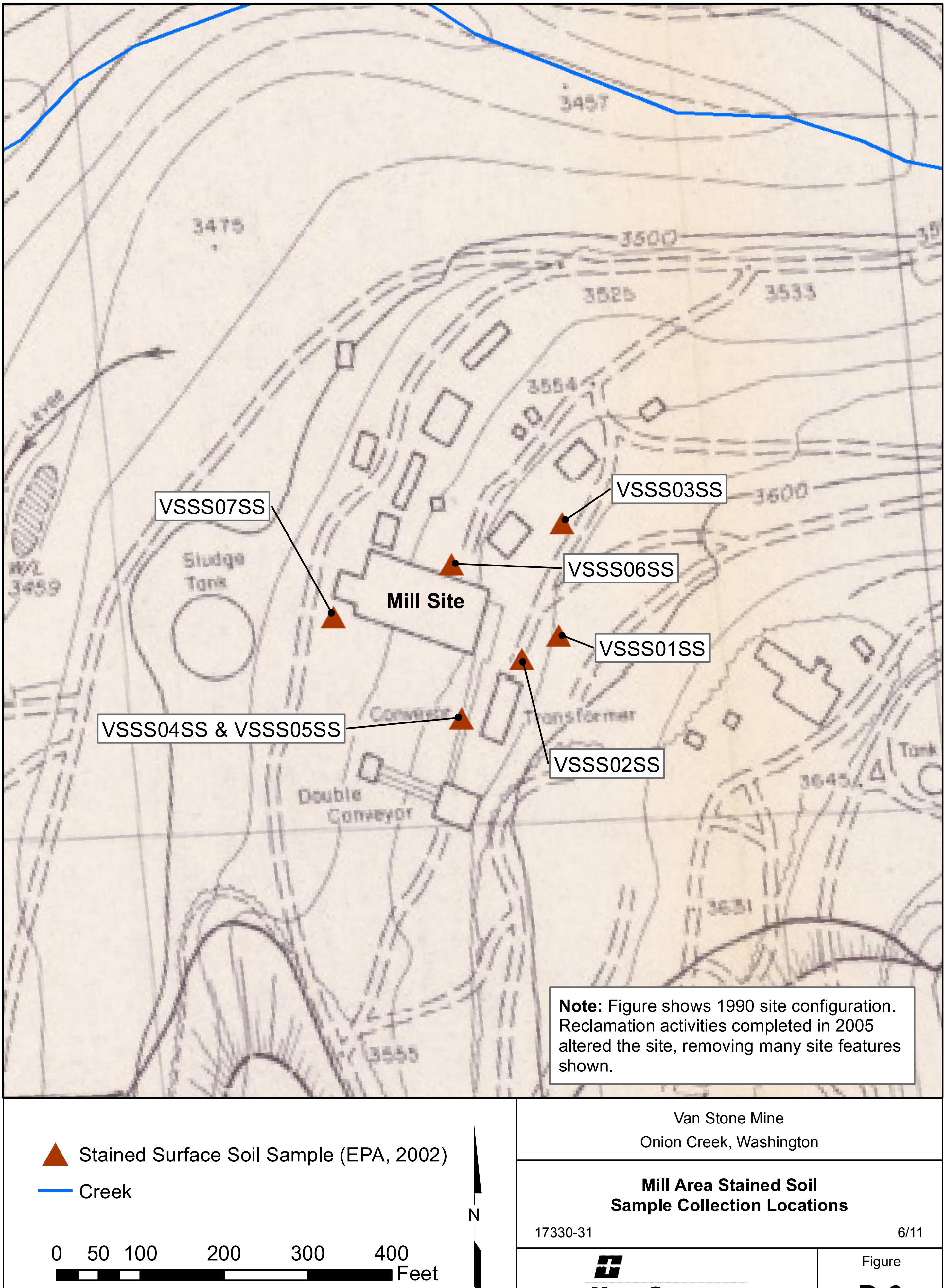
Mill Site and Open Pit Sample Collection Locations

17330-31 6/11

HARTCROWSER

Figure **B-5**

This page is intentionally left blank
for double-sided printing.



Source: Equinox Resources August 1990 figure.

1733031/1733031-GG

Van Stone Mine
Onion Creek, Washington

Mill Area Stained Soil Sample Collection Locations

17330-31 6/11

HARTCROWSER

Figure **B-6**

This page is intentionally left blank
for double-sided printing.