Draft Engineering Evaluation / Cost Analysis

Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington
TDD: 12-02-0006

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July 2013

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List of Abbreviations

Abbreviation	Definition
°F	degrees Fahrenheit
%	percent
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
Ca:Mg	Calcium to magnesium
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Converse	Converse Davis Dixon Associates, Inc.
COPC	contaminants of potential concern
CPF	cancer potency factor
Corps	United States Army Corps of Engineers
DI	deionized
E & E	Ecology and Environment, Inc.
EE/CA	Engineering Evaluation / Cost Analysis
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
ESU	Evolutionarily Significant Unit
f/cc	fibers per cubic centimeter
GWL	Great Western Lumber Company
IA	integrated assessment
IRIS	Integrated Risk Information System
KWL	Kerr Wood Leidal Associates, Limited
µm	micrometers
MCL	maximum contaminant level
MFL	millions of fibers per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mi^2	square miles
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OSHA	Occupational Safety and Health Administration
PCME	phase-contrast microscopy equivalent
PEL	permissible exposure limit

List of Abbreviations and Acronyms (cont.)

PLM	polarized light microscopy
PSE	Pacific Surveying and Engineering, Inc.
RAO	removal action objective
s/cc	structures per cubic centimeter
SARA	Superfund Amendments and Reauthorization Act
SCSMAP	Swift Creek Sediment Management Action Plan
SCS	Soil Conservation Service
Site	Sumas Mountain Asbestos (aka Swift Creek) Site
SPLP	Synthetic Precipitation Leaching Procedure
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TBC	to-be-considered
TDD	Technical Direction Document
TEM	transmission electron microscopy
WDOE	Washington State Department of Ecology
WDFW	Washington State Department of Fish and Wildlife
WDOH	Washington State Department of Health
WRCC	Western Regional Climate Center
yd^3	cubic yards

Executive Summary

This Engineering Evaluation / Cost Analysis (EE/CA) was prepared for the Sumas Mountain Asbestos (aka Swift Creek) Site (site) in Whatcom County, approximately 12 miles northeast of Bellingham, Washington. Swift Creek flows west from Sumas Mountain and enters the Sumas River near the towns of Everson and Nooksack, Washington. Swift Creek originates in a landslide area on Sumas Mountain, and the geological landslide material includes naturally occurring asbestos. Every year, an estimated 150,000 cubic yards (yd^3) of sediment containing naturally occurring asbestos is transported from the landslide through the surface water downstream. Dredged sediments near Swift Creek were tested and shown to contain on average approximately 1.6% asbestos, including chrysotile and a small amount of actinolite. Flood deposits in and adjacent to Swift Creek and the Sumas River have been found to contain as much as 26.75% asbestos. This EE/CA has been prepared to evaluate removal action alternatives to reduce the risks to human health and the environment from the naturally occurring asbestos.

CERCLA Section 104(a)(3) limits EPA from taking a removal or remedial action in response to a release or threat of release of a naturally occurring substance from a location where it is naturally found. In 2008, consistent with this limitation, EPA undertook a removal action to stabilize piles of material that had been dredged from Swift Creek. EPA is considering additional actions within its authorities to address material from Swift Creek that has been or is predicted to be released through human activity. EPA is coordinating with local, state, and federal government agencies on a plan to use the available authorities of each to intercept this material and contain it safely, in order to reduce asbestos deposition in areas where exposure would be unavoidable.

The excessive sediment in Swift Creek is caused by the large, complex landslide in the upper watershed of Sumas Mountain. The exposed slide material contains naturally occurring elevated levels of asbestos, nickel, cobalt, chromium, and magnesium. The sediment is characterized by elevated pH, a lack of certain plant nutrients, and a calcium-magnesium imbalance harmful to soil productivity. Swift Creek downstream of the landslide has no resident fish. The movement of sediment downstream in Swift Creek contributes to water quality problems and deposition of sediments in the Sumas River.

Until recently, the Swift Creek channel was maintained by routine dredging. The dredged material was stockpiled on the banks of Swift Creek, predominantly between Goodwin Road and the confluence with Sumas River. Much of the dredged material was removed from the banks of Swift Creek for a variety of uses. The practice of removing dredged material from the banks of Swift Creek for public use is now prohibited due to human health concerns about the asbestos in Swift Creek sediments.

During an EPA investigation in 2009, concentrations of chrysotile asbestos as high as approximately 26.75% were found in bank sediment and upland soil samples at locations along the Sumas River all the way to the Canadian border. These results showed that asbestos concentrations are potentially higher in materials deposited during flood events.

Conclusions identified in risk evaluations performed by EPA and Washington State Department of Health for the site are as follows:

- Exposures to asbestos can occur through incidental or routine contact with bank materials along Swift Creek and Sumas River. Direct contact with soil and sediments containing asbestos can result in a release of fibers into the breathing zone and fibers being inhaled into the lungs. The effects of asbestos exposure often occur 10 to 40 years after exposure.

- For activities and areas assessed, cancer risk estimates for some exposure scenarios are above the high end of EPA's acceptable risk range of $1x10^{-6}$ (i.e., one in one million) to $1x10^{-4}$ (i.e., one in ten thousand).

- While inhalation is the primary route of concern for asbestos health risks, asbestos has been found in Swift Creek and Sumas River at levels unsuitable for drinking.

- Residents and farm workers are advised to avoid contact with sediments from Swift Creek or the Sumas River downstream of the Swift Creek confluence, avoid tracking sediments into homes or businesses, and to assume that sediments and flood deposits contain asbestos.

- To date, epidemiological analysis of available cancer data for the Swift Creek and Sumas River region does not indicate a statistically significant increase in the rates of lung and bronchial cancer or mesothelioma relative to other populations in Washington.

The objectives for the proposed removal actions evaluated in this EE/CA are to protect human health and the environment by minimizing human and ecological receptor contact with asbestos-containing sediments and to comply with applicable or relevant and appropriate requirements to the extent practicable. Specific removal action objectives include reducing the potential for exposure by restricting access and/or containing the sediments in a secure repository.

The alternatives developed to achieve the removal action objectives are described and evaluated in this report. The alternatives include acquiring potentially impacted properties and effecting institutional controls and access restrictions in the Swift Creek flood plain, to allow for the storage and natural deposition of asbestos-containing sediments; annual dredging of Swift Creek and transporting the sediments to a dedicated repository; and the installation of sediment basins and other sediment collection systems to reduce the downstream movement of asbestos, accompanied with final placement in a repository. Because of the limitations in EPA's response authority under CERCLA, elements of the work required under each of the alternatives would need to be performed by another entity, if at all.

The removal action alternatives were analyzed individually and also compared against each other using the criteria of effectiveness, implementability, and cost. The estimated implementation costs for the removal action alternatives are $3,100,000 for institutional controls and access restrictions; $15,690,000 for annual dredging of Swift Creek and construction of a repository; and $43,690,000 for installing upstream sediment collection systems and repository construction. Note that these cost estimates do not include land acquisition costs. For cost-estimating purposes in this EE/CA, the active alternatives are assumed to have a defined performance period of 10 years, while the landslide is expected to continue eroding beyond this time period; therefore, EPA and other involved agencies recognize that this is an interim solution.

Based on the alternative evaluation, Alternative A4 (Sediment Basins, Setback Levees, and In-Stream Sediment Traps) is the recommended removal action alternative for the Sumas Mountain

Asbestos (aka Swift Creek) Site. Although Alternative A4 is the most expensive alternative, it is technically and administratively implementable, and it is considered to be the most effective at meeting the site-specific RAOs. Alternative A4 removes both suspended and bedload sediment and the associated asbestos contamination before it enters the more populated areas of Swift Creek and the downstream Sumas River. Additionally, the sediment basins and other control structures remove the asbestos-contaminated sediment automatically and continuously, without requiring annual dredging. And, while Alternative A4 is the most expensive alternative, the per-unit cost of asbestos-contaminated sediment addressed is similar to Alternative A3, and the additional costs are considered reasonable given the additional protection to human health provided.

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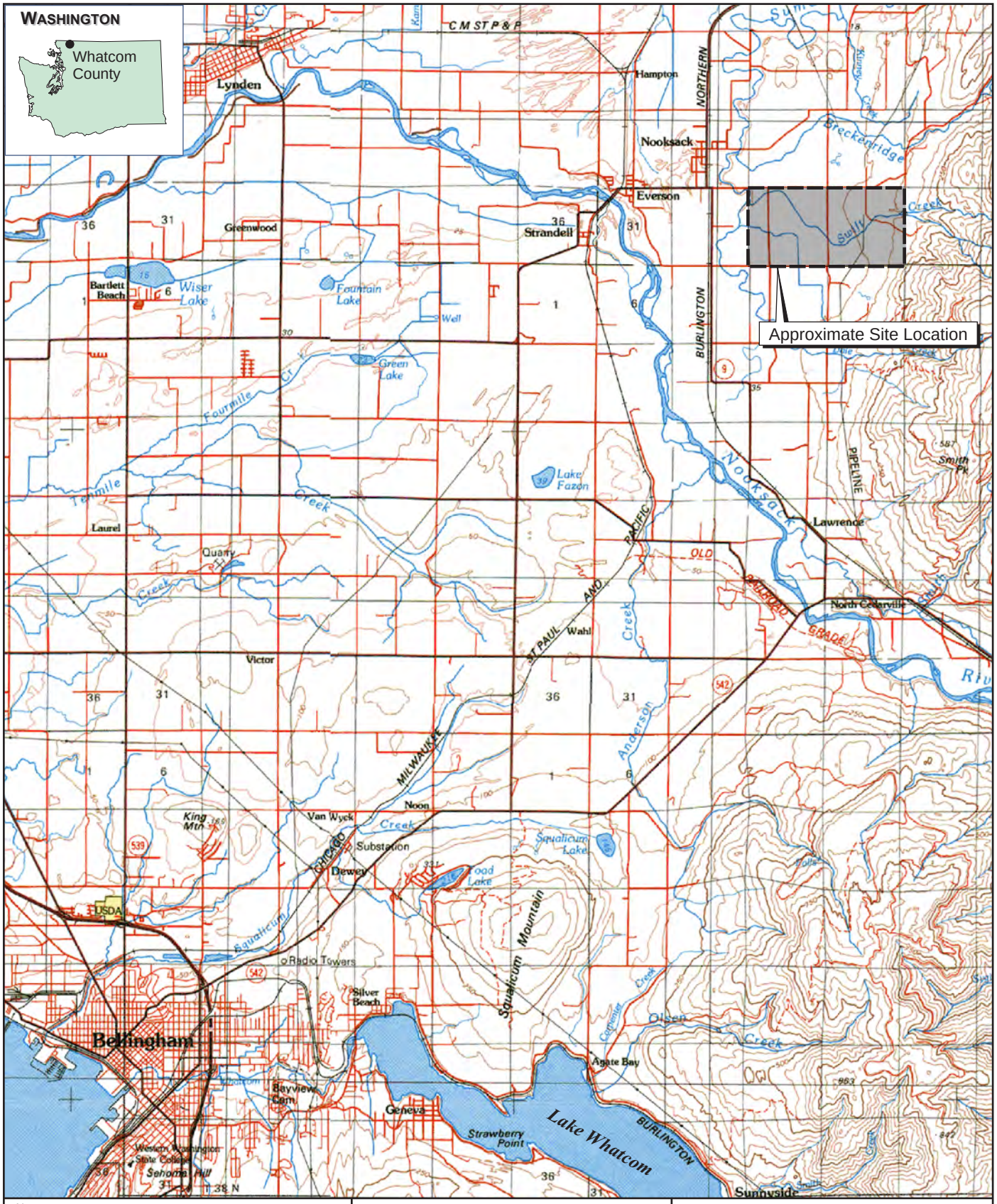
1 Introduction

This Engineering Evaluation / Cost Analysis (EE/CA) was prepared for the Sumas Mountain Asbestos (aka Swift Creek) Site (site) in Whatcom County, approximately 12 miles northeast of Bellingham, Washington. Ecology and Environment, Inc. (E & E) prepared this EE/CA for the United States Environmental Protection Agency (EPA) under Superfund Technical Assessment and Response Team (START)-3 contract EP-S7-06-02, Technical Direction Document (TDD) 12-02-0006.

Swift Creek flows west from Sumas Mountain and enters the Sumas River near the towns of Everson and Nooksack, Washington (see Figure 1-1). Several forks of Swift Creek converge below a landslide area on Sumas Mountain. The geological landslide material includes naturally occurring asbestos, and every year, an estimated 150,000 cubic yards (yd^3) of sediment containing naturally occurring asbestos (including chrysotile and a small amount of actinolite) is transported from the landslide through the surface water downstream. The sediment can contain more than 1% asbestos, and samples of dredge material contain on average approximately 1.6% asbestos. Particle size sorting in the creek and during flooding appears to lead to higher localized concentrations, and asbestos concentrations up to approximately 26.75% were measured in 2009 flood deposits. This EE/CA has been prepared to evaluate removal action alternatives to reduce the risks to human health and the environment from the sediment containing the naturally occurring asbestos.

Whatcom County has been developing a comprehensive management plan for the site and released the Draft Swift Creek Sediment Management Action Plan (SCSMAP) and the SCSMAP Phase 1 Implementation Plan in December 2012 (Whatcom County 2012a, b). The SCSMAP identified and prioritized problems within the watershed and proposed several strategies to deal with these problems, including development of debris deflection, setback levees, and in-stream sediment traps; further exploration of sediment basins for trapping suspended sediment; maintenance and repair, including annual maintenance, channel conveyance, and large-scale maintenance and repair; and possible slide stabilization in the form of a toe buttress. In February 2013, Whatcom County published for public comment a draft Environmental Impact Statement (EIS) to evaluate the potential environmental impacts of their SCSMAP and Phase 1 Implementation Plan.

This EE/CA evaluates several removal action alternatives, including actions described in the SCSMAP and EIS. Any removal action selected based on this EE/CA will be conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. Specifically, any EPA-conducted removal action at this site must comply with the limitations in CERCLA, including Section 104(a)(3). Because of the limitations in EPA's response authority under CERCLA, elements of the work required under each of the alternatives would need to be performed by another entity, if at all. This EE/CA was prepared in accordance with and in a manner consistent with the National Contingency Plan (NCP) and the EPA document *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993).



SUMAS MOUNTAIN ASBESTOS
(aka SWIFT CREEK) SITE
Whatcom County, Washington

Figure 1-1
Site Location Map

ecology and environment, inc.
Global Environmental Specialists

Source: Maptech, Inc. 2001.

2 Site Characterization

This section provides general site information including the location and physical description, site operations and ownership history, and surrounding land uses. The physical description of the site includes information pertaining to topography and hydrology, regional geology and soils, meteorology, and sensitive ecosystems. Previous investigations and removal actions are summarized, and pertinent information related to the source, nature, and extent of contamination is presented. Finally, a streamlined risk evaluation is presented, which evaluates the actual or potential threat to human health and the environment posed by site contamination.

2.1 Site Description and History

The site extends from the landslide on Sumas Mountain to the Sumas River (approximately 4 miles); however, most flood control management and dredging activities by Whatcom County have occurred at the section of Swift Creek located between Goodwin and Oat Coles Roads at approximately Latitude 48° 55’ 8.526” North and Longitude 122° 18’ 13.914” West within Section 33, Township 40 North, Range 4 East in Whatcom County, Washington (Figure 2-1). Additional sediment management activities have been performed by Great Western Lumber Company (GWL) to the east of Goodwin Road.

Extreme sedimentation occurs in Swift Creek below Goodwin Road as a result of historic landslide activity on Sumas Mountain, located in the upper watershed of Swift Creek. The landslide is located approximately 1.7 miles upstream from Goodwin Road near the headwaters of Swift Creek. Goodwin Road is located approximately 1.4 miles upstream of the confluence of Swift Creek with the Sumas River. Oat Coles Road is located approximately 1,900 feet upstream of the confluence of Swift Creek with the Sumas River.

The sediments contain naturally occurring asbestos and metals (including nickel, cobalt, chromium, and magnesium). An estimated 150,000 yd^3 of sediment is transported into Swift Creek annually. Sediment deposition occurs in the lower gradient region of the watershed. Stream channel dredging has been performed frequently to reduce the flooding hazard in the area and protect county infrastructure. Dredged materials have been placed on the banks of Swift Creek. (WDOE 2005)

2.1.1 Site Ownership History

There are multiple adjacent privately owned residential/agricultural properties located along the banks of Swift Creek downstream from Goodwin Road to the confluence with Sumas River. GWL owns or manages property upstream of the dredged area of Swift Creek, from the east side of Goodwin Road to the base of the landslide. Whatcom County acquired one residential property at the corner of Oat Coles Road and South Pass Road and currently uses it for Swift Creek maintenance activities.

2.1.2 Site Operations and Waste Characteristics

Historically, the Swift Creek drainage has been plagued by landslide problems. The reactivation of the ancient landslide appears to have occurred in the 1940s. The landslide encompasses approximately 225 acres and extends from the steep, unvegetated toe at an elevation of 1,000 feet up to an elevation of approximately 2,600 feet. (WDOE 1977)

The excessive sediment in Swift Creek is caused by the large, complex landslide in the upper watershed of Sumas Mountain. The exposed slide material contains naturally occurring elevated levels of asbestos, nickel, cobalt, chromium, and magnesium. The sediment has an elevated pH, lacks certain plant nutrients, and has a calcium-magnesium imbalance harmful to soil productivity. Vegetative growth is inhibited in the slide material, and Swift Creek downstream of the landslide has no resident fish. The movement of sediment downstream in Swift Creek contributes to water quality problems in the Sumas River. (WDOE 2005)

Sedimentation along the lower reaches of the Swift Creek alluvial fan has been a significant management problem since the 1950s. Figure 2-2 indicates the areas along Swift Creek and the Sumas River downstream of the Swift Creek confluence that are prone to flooding. To prevent flooding, the Swift Creek channel was maintained by dredging, and the dredged material was stockpiled on the banks of Swift Creek predominantly between Oat Coles and Goodwin Roads. In past years, stockpiled dredge material was removed from the banks of Swift Creek by the public, including local business and residents, for a variety of uses. The practice of removing dredged material from the banks of Swift Creek for public use was later discontinued in 2007 due to human health concerns about the asbestos in Swift Creek sediments. Additional dredge material was added to the stockpile in 2005 and now piles of this material remain along the banks of the creek (KWL 2008). In 2007 and 2008, EPA performed a removal action at the site to stabilize these dredge piles along the banks of Swift Creek between Oat Coles and Goodwin Roads (E & E 2008a, 2008b).

Existing records indicate the following volumes of dredged sediments removed from Swift Creek to the west of Goodwin Road by the US Army Corps of Engineers (Corps) and Whatcom County (KWL 2008, PSE 2010):

- 1971 – 70,000 yd^3
- 1978 – unknown volume
- 1980 – 30,000 yd^3
- 1985 – 37,500 yd^3
- 1990 – 37,500 yd^3
- 1995 – 16,700 yd^3
- 1998 – 50,000 yd^3
- 1999 to 2002 – 58,430 yd^3
- 2005 – 75,000 to 100,000 yd^3
- 2006 – 70,000 yd^3
- 2008 – 20,000 yd^3

In addition to these sediment removal activities, GWL performed sediment dredging activities east of Goodwin Road. From 1994 through 2004, they removed a total of 91,105 yd^3, for an average annual volume of 8,282 yd^3. GWL performed additional dredging from 2005 to 2007, although the records are incomplete. GWL ceased sediment dredging after 2007 (KWL 2008).

In 2005, the EPA became aware of the potential asbestos contamination in the fill material and recommended to the Corps and Whatcom County that no dredged material from Swift Creek be removed from the site. To prevent the removal of material from the site, Whatcom County installed gates at Goodwin and Oat Coles Roads to restrict access and placed warning signs to notify the public that Swift Creek sediments contain asbestos and that removing material from the site is prohibited. In 2006 and 2008, Whatcom County dredged a portion of Swift Creek. EPA performed a removal action to stabilize the dredge piles in 2007 and 2008.

Sediment management activities have been occurring at Swift Creek since at least the 1950s. Whatcom County and other agencies agreed that the issues presented by Swift Creek required a comprehensive management plan and in 2011 Whatcom County initiated EIS scoping. In December 2012 Whatcom County issued a Draft SCSMAP and a Phase 1 Implementation Plan (Whatcom County 2012a, b). To meet challenges related to Swift Creek flooding, potential health risks, and potential for creek avulsion, Whatcom County identified strategies appropriate for implementation under the SCSMAP. The SCSMAP identified and prioritized problems within the watershed and proposed several strategies to deal with these problems, including development of debris deflection, setback levees, and in-stream sediment traps; further exploration of sediment basins for trapping suspended sediment, maintenance and repair, including annual maintenance, channel conveyance, and large-scale maintenance and repair; and slide stabilization in the form of a toe buttress. In February 2013, Whatcom County published a draft EIS for public comment.

2.2 Physical Characteristics of the Site

2.2.1 Topography and Hydrology

The Swift Creek watershed has a total area of approximately 2.7 square miles (mi^2). Swift Creek is a tributary of the Sumas River, which flows north to the Fraser River, in British Columbia, Canada. The upper Swift Creek drainage system includes two forks located on the slopes of Sumas Mountain. The north fork is also known as Goldmine Creek, and has a drainage area of 1.1 mi^2. The south fork has a watershed of 1.0 mi^2. A third smaller tributary of 0.6 mi^2 drains to Swift Creek from the south, downstream of the fan apex. The landslide that provides the source of the asbestos-containing sediment is located within Swift Creek's south fork. (KWL 2008)

The watershed elevation ranges from approximately 3,400 feet at the top of Sumas Mountain down to 80 feet at the confluence with the Sumas River. The north fork of Swift Creek originates at an elevation of approximately 3,350 feet and has an average gradient of 25 percent (%) over a distance of approximately 2.25 miles down to the confluence with the south fork. The south fork of Swift Creek originates at an elevation of approximately 2,700 feet and drops to an elevation of 400 feet down to the alluvial fan apex over a distance of approximately 1.9 miles. (KWL 2008)

2.2.2 Geology and Hydrogeology

A comprehensive geotechnical study on the geology of the site may be found in the Swift Creek Tributaries and the Sumas River Watershed report by Converse Davis Dixon Associates for the United States Soil Conservation Service (Converse 1976). A brief summary is included below.

Springs and groundwater seeps originate upslope of the slide mass. Springs also occur in the Swift Creek landslide debris. Springs originating in the slide debris, and particularly in the lower

end, are milky white and contain suspended rock flour and clay. Surface runoff eventually channelizes along the northern and southern boundaries of the slide (Converse 1976).

2.2.3 Soils

The Swift Creek landslide is a large, active deep-seated landslide approximately 1,300 feet wide by 4,600 feet long and is located within the south fork portion of the upper watershed. The landslide was likely a post-glacial, dormant landslide that resumed active sliding before 1940. The overall slide movement is a combination of mechanisms including earthflow, deep-seated rotational slumps, block glide, debris flows and smaller surficial creep and slumps. Tension cracks in the landslide provide easy access for water to infiltrate into the landslide mass. The infiltration increases pore water pressure along shear surfaces, which in turn reduces shear strength and accelerates landslide movement. (KWL 2008)

The landslide toe is at an elevation of approximately 880 feet, is inclined at 30 degrees, and is devoid of vegetation. The exposed toe soil is generally saturated even during relatively dry weather and has a high percentage of fines (predominantly sand and silt with some clay). Large conglomerate blocks overlie the highly weathered serpentinite at this location. (KWL 2008)

Bedrock units in the area of the Swift Creek landslide include meta-sedimentary greywacke that has been thrust over younger serpentinite. The serpentinite is in turn overlain by massive Tertiary continental conglomerates that dip to the west. Alluvium, glacial deposits and slide debris mantle the conglomerates. The metamorphic serpentinite originates from basic intrusive rocks: fine-grained, green peridotite, and dunite. In the periphery and the landslide mass, the bedrock is strongly serpentinized. The serpentinite contains natural chrysotile asbestos and trace metals (including nickel, chromium, magnesium, and cobalt) in relatively high levels. (KWL 2008)

2.2.4 Meteorology

The climate of the Swift Creek area is typical of the Puget Sound area of Washington. The closest point of recorded weather data is the Clearbrook station (451484), located about 5 miles west of Swift Creek. The winters are wet and generally mild, with an average annual precipitation of about 47 inches (WRCC 2013). The 1976 geotechnical report by Converse and Associates references the map of mean annual precipitation published by the Soil Conservation Service, indicating that the average precipitation ranges from 50 inches in the lower reaches of Swift Creek to above 70 inches of precipitation in the upper reaches. The Clearbrook weather station experiences about 16 inches of snowfall between November and March (WRCC 2013).

According to WRCC data collected from the Clearbrook weather station from 1903 to 2012, the average maximum temperatures recorded for the summer months (June through August) ranges from 70.3 to 75.9 degrees Fahrenheit (°F), and the average maximum temperatures recorded for the winter months (December through February) ranges from 41.2 to 46.5 °F. The average minimum temperatures recorded for the summer months range from 47.4 to 49.0 °F, and the average minimum temperatures recorded for the winter months range from 30.2 to 32.3 °F. July and August are the driest months, with averages of 1.47 and 1.76 inches of precipitation, respectively. (WRCC 2013)

2.2.5 Sensitive Ecosystems

One federal- and/or state-listed endangered or threatened species occurs in the vicinity of the site (Zawistoski 2013):

- Steelhead Trout (no Evolutionarily Significant Unit [ESU]) (Oncorhynchus mykiss).

Additionally, the following is listed as a Species of Concern:

- Coho Salmon, Puget Sound/Strait of Georgia ESU (Oncorhynchus kisutch).

The Washington State Department of Fish and Wildlife (WDFW) has a geographic information systems layer (phsregion_ svnonsensitive) that depicts priority habitats, which are “unique or significant value to many fish or wildlife species” and "priority species are those fish and wildlife species requiring special efforts to ensure their perpetuation because of low numbers, sensitivity to habitat alteration, tendency to form vulnerable aggregations, or because they are of commercial, recreational, or tribal importance.” For this WDFW layer, a Sumas River Riparian zone is called out along with a Sumas River Wetland zone, which provides excellent wildlife habitat and protects water quality.

The Whatcom County fish and wildlife habitat map folio (Whatcom County 1994) indicates the presence of coho salmon, steelhead trout, and cutthroat trout habitat along the alluvial fan reaches of Swift Creek and its north fork. As a result of the landslide, the south fork of Swift Creek no longer contains habitat suitable for the long-term survival of fish. At present, only 0.25 to 0.50 mile of stream habitat in the north fork is believed to support fish. Cutthroat trout have been observed in this reach by WDFW staff. (KWL 2008)

While the EE/CA alternatives are focused on areas along Swift Creek itself, several species of salmon use Sumas River to reach tributaries for spawning, and in particular salmon habitat on Breckenridge Creek and wetland areas north of South Pass Road could be adversely affected by Swift Creek flooding or avulsion.

2.3 Surrounding Land Uses

The site includes the portion of Swift Creek that extends from the landslide area on the east to the confluence with the Sumas River on the west. The area of Swift Creek upgradient from the alluvial fan is forested. Once Swift Creek reaches the alluvial fan, it passes through an area of mixed residential and agricultural land use in the area between Goodwin and Oat Coles Roads. The property owned or managed by GWL is located on the east side of Goodwin Road, immediately upstream of the primary dredged area of Swift Creek. Other properties east of Goodwin Road, including residential properties near South Pass Road and commercial property south of GWL, could be affected by flooding, debris flows or creek avulsion.

2.4 Previous Investigations and Removal Actions

The following paragraphs briefly summarize previous selected environmental investigations and other related investigations that have been conducted at the site. Studies at Swift Creek began in the 1960s and have continued to date.

- United States Soil Conservation Service (SCS) 1964. The initial study was completed in June 1964 and consisted of an overview reconnaissance by SCS personnel. The study included an analysis of historic aerial photographs, grain-size analysis, and settling velocities of fine-grained sediment from the landslide. It was concluded that stabilization of the landslide was not practical and that priority should be given to the construction of levees to keep Swift Creek within its channel. (Converse 1976)

- United States Soil Conservation Service 1965. A second study was completed to estimate average sediment loads transported from the landslide to the alluvial fan and to the Sumas River. The average annual sediment load of Swift Creek was estimated at approximately 123,000 yd^3. (Converse 1976)

- United States Army Corps of Engineers 1971. The Corps investigated possible management alternatives for sedimentation on the Swift Creek fan. Several alternatives were considered, and construction of a large debris basin on the upper alluvial fan was selected as the preferred option. A cost analysis for the debris basin versus the estimated average flood damage concluded that federal funding for construction of a debris basin was not economically justified based on property impacts, although this study did not consider the asbestos in the sediment. (Converse 1976)

- United States Soil Conservation Service 1976. Phase I of the project involved a geological investigation, including a description of the regional and site geology; a detailed analysis of the landslide including its geometry and causes, mechanisms, and rates of movement; a seismic survey in the vicinity of the slide to evaluate subsurface characteristics and determine depths to bedrock, test pit explorations (16 pits to a maximum depth of 21.5 feet) on the upper fan to determine subsurface conditions in the potential debris basin area; and laboratory testing of representative samples from the test pits. Phase II (geologic and engineering analyses) included a preliminary evaluation of the feasibility of stabilizing the landslide along with an analysis of potential sedimentation basin on the upper alluvial fan. The selected alternative for landslide stabilization was an earth buttress constructed at the toe of the landslide. A construction cost estimate was not provided for this option as it was obvious that a buttress of this size would be on the order of several times more than the cost of a debris basin on the upper fan. The next considered alternative was construction of a single sedimentation basin; however, an appropriate location of sufficient volume was not apparent within the immediate vicinity of the site. (Converse 1976)

- Environment Canada 1980 and 1981. Two studies performed in 1980 and 1981 included a literature review on asbestos in receiving water, comparing water quality findings in Western Canada with those reported elsewhere, and collecting water samples. See Section 2.5.3 for a discussion of the findings of these studies. (Schreier 1980 and 1981)

- Environment Canada 1986 and 1987. In 1986, Hans Schreier, a University of British Columbia professor, investigated the potential of using earthworms and organic matter to modify the asbestos-contaminated soils to convert them into productive plant medium (no recommendations were made based on the results of this study), and in 1987 he

investigated the potential impact on fish populations in the Sumas River approximately 10 miles downstream of Swift Creek (no evidence was found that the asbestos rich waters adversely affected the small fish in the study). In 1987, a water quality study investigated the downstream dilution of asbestos and trace metals in the sediments and stream water of the Sumas River. The investigation concluded that the Swift Creek landslide influences the water and sediment quality of at least a 9.9 mile reach of the Sumas River. See Section 2.5.1 for a discussion of the findings of the 1987 study. (Schreier 1986 and 1987b)

- Whatcom County 1990. The Port of Bellingham was considering accepting excavated sediment to use at a fill site but wanted to determine if there was a potential environmental liability with the sediment. The consultant performing the study determined that the materials might be considered for use as fill with appropriate handling measures and guidelines. (Landau 1990)

- Northwest Air Pollution Authority (now known as Northwest Clean Air Agency) 1991. This study investigated the impacts of a farmer cultivating a field at Swift Creek that contained asbestos-rich sediments. During a flood in 1975, approximately 9.9 acres were inundated with up to 16 inches of fine sediment. The study concluded that there was no apparent need for mitigation of an airborne asbestos health hazard at Swift Creek by regulatory agencies, but suggested worker health and safety precautions should be taken to reduce exposure. (Blake 1991)

- Whatcom County 1995 and 1998. In 1995, an emergency sediment removal was conducted that placed excavated material on berms on Swift Creek, but this sediment removal was subject to two constraints by the Corps. First, Whatcom County needed to pursue a long-term management plan for Swift Creek, and second, the excavated sediment could not leave the site. Sediment removal was required again in 1998 and was proposed to be disposed of off site, and this was agreed to by the Corps after clearance was provided from the Whatcom County Health Department. (KWL 2008)

- Whatcom County 1998. This geotechnical engineering services study, including a stream management plan for Swift Creek, investigated three alternatives to minimize aggradation on the alluvial fan:
    - Annual removal of gravel near the bridges at Goodwin and Oat Coles Road;
    - Dredging the channel from the fan apex to the Sumas River, removing the levees downstream of Goodwin Road, and widening the channel to act as a sediment trap; and
    - Dredging the channel and removing the stockpiled material between Goodwin and Oat Coles Roads, constructing four sediment traps on the upper fan, and relocating the confluence of the north and south forks of Swift Creek approximately 1,300 feet downstream.

  However, none of the three alternatives were selected as a preferred option. (GeoEngineers 1998)

- Whatcom County 2004. Soil quality tests were conducted to compare the natural background concentrations of metals in Washington soils with those at Swift Creek. The calcium to magnesium (Ca:Mg) ratio of 0.02 was outside of limits for plant growth (optimally 3.0), and the nickel concentrations were significantly higher than state background levels. (KWL 2008)

- Washington State Department of Health (WDOH) 2005. A health consultation was prepared to determine health risks due to asbestos in Swift Creek sediments. The consultation concluded that the current knowledge of asbestos content in Swift Creek sediments was insufficient for determining human health risks and appropriate end use of dredged sediments. (WDOH 2006)

- EPA 2006. At the request of the Whatcom County Health Department and Whatcom County Public Works, EPA conducted reconnaissance sampling in April 2006, an integrated assessment (IA) in May 2006, and activity-based sampling in August 2006. Sampling and analysis in April and May confirmed that sediment and the dredged material contained chrysotile asbestos and a very small amount of actinolite asbestos. To further investigate the potential health risks for visitors to the Sumas Mountain site, activity-based sampling was performed in August 2006 on piles of dredged material deposited along Swift Creek between Goodwin and Oat Coles Roads. EPA evaluated three scenarios that are typically performed at the site, including loading/hauling dredged material, raking/spreading dredged material, and recreation (walking, biking, and jogging). See Sections 2.5.1 and 2.5.2 for a discussion of these field activities. As a result of these studies, the EPA recommended that dredged materials no longer be removed from the site as movement and use of the material may lead to health and legal liabilities. (EPA 2007a)

- EPA 2007. In March 2007, a basic design and cost estimate for a repository was prepared. EPA returned to the site in November 2007 to regrade the stockpiled materials along Swift Creek to prevent erosion and further releases of asbestos from the stockpiles and to prepare the surface for dust suppressant application. Dust suppressant was then applied on the stockpiles to minimize the levels of asbestos released through wind-blown dispersion. (E & E 2007)

- Washington State Department of Ecology (WDOE), May 2008. WDOE contracted with Hart Crowser, Inc. to conduct a planning level cost estimate for selected sediment management options.

- EPA July 2008. EPA collected additional samples to determine the levels of asbestos in residential soils on Swift Creek properties where dredged materials may have been used for fill. See Section 2.5.1 for a discussion of the findings of this fieldwork. (EPA 2009)

- EPA September 2008. EPA returned to the site to re-stabilize the dredge piles. (E & E 2008)

- EPA 2009. In early 2009, flooding occurred in much of western Washington, including the Sumas River. EPA was concerned that flood events may have deposited sediments containing asbestos along the banks. In February 2009, EPA staff visited the site with county and state officials to identify locations where January floods had deposited material onto uplands. In May 2009, surface water, soil and sediment samples were collected and were analyzed for asbestos by transmission electron microscopy (TEM) and/or polarized light microscopy (PLM) and selected metals by inductively coupled plasma-argon emission spectroscopy (ICP-AES). See Sections 2.5.1 and 2.5.3 for a discussion of the findings of this study. (EPA 2009)

- EPA 2010. In August 2010, EPA conducted activity-based sampling at three locations along the Sumas River downstream from Swift Creek where floods had deposited material in 2009. The selected locations were in close proximity to areas with flood deposits to determine the potential risks to individuals who live near or work in these areas or have regular access to flood deposits. Activities that were simulated included excavating and moving sediment deposits, spreading sediment deposits on a farm, yard work (including raking and mowing), and walking around properties (EPA 2011b). Analytical results showed that asbestos was detected in 18 of the 19 personal air samples, with phase-contrast microscopy equivalent (PCME) concentrations ranging from 0.0019 asbestos structures per cubic centimeter (s/cc) to 2.3 s/cc. The highest levels were associated with samples collected during loading/raking/spreading sediment deposits in a barn-type structure. Stationary sample concentrations were generally 10 times lower than personal sampler concentrations. (EPA 2011a).

- EPA 2012. In 2012, EPA performed field sampling activities at the site to support this EE/CA. A summary of the results is provided below, and more details about the sampling activities and results are included in Appendix A.

  In July 2012, EPA performed a site sampling event to characterize potential impacts to area groundwater from the asbestos- and metals-containing sediments. The results of asbestos analyses performed on groundwater samples from the GWL property were higher than expected, which was believed to be caused by the lack of monitoring well development and difficulties in collecting samples under low-flow conditions. EPA developed these wells in September 2012 and then collected additional groundwater samples in October 2012. Additionally, Whatcom County also collected its own groundwater samples for asbestos and metals analyses from these monitoring wells in October 2012.

  The groundwater asbestos results indicate that asbestos fibers could be locally mobilized under groundwater flow conditions induced by pumping and sampling. However, it is likely that the asbestos detected in groundwater samples originated near the wellbore, and it is concluded that long-distance migration of asbestos in groundwater is unlikely.

  The metals results indicate that aluminum, iron, and manganese were present in groundwater and surface water samples at concentrations that exceeded secondary MCLs. However, no metals were detected at concentrations that exceeded any primary MCL.

The results also indicated that, with the exception of calcium, the metals present in the sediment and dredge material exhibited low potential for leaching. In particular, the three metals that exceeded secondary MCLs in groundwater and surface water (aluminum, iron, and manganese) exhibited very low leachability in the site sediment and dredge material samples.

- In early 2012, the Agency for Toxic Substances and Disease Registry (ATSDR) deployed air sampling equipment at two locations and is completing a yearlong study. Air samples are collected on a schedule intended to capture a range of conditions, including seasonal weather and human activity. EPA provided soil sampling support. The report for this work has not been issued as of February 2013.

2.5 Source, Nature and Extent of Contamination

The source, nature and extent of contamination were characterized during the field events that are summarized in Section 2.4. Previous investigations indicated that asbestos has been present in Swift Creek since at least 1976 (Converse 1976), and since it is naturally present in the geology, it is likely to have been present since the slide was reactivated. It has also been reported that various metals, including nickel, cobalt, chromium, and magnesium, are present in naturally occurring elevated levels in the landslide and are therefore likely present in Swift Creek (WDOE 2005).

Asbestos is a hazardous substance under CERCLA, and when it has been released or may be released due to human activities, it can be addressed under CERCLA authorities. Clearly, the local geology is the primary source of asbestos at the site, with asbestos moving through the environment through natural processes such as entrained in air or carried by water. However, human activities (such as dredging and plowing) have also caused and will likely continue to cause further releases of asbestos at the site, giving rise to areas that may be addressed through CERCLA response actions.

2.5.1 Soil, Sediment, and Dredge Material

During an EPA investigation performed in 2006, the concentration of asbestos in the dredged materials, measured by PLM, ranged from 0.1% to 4.4%, with an average concentration of 1.6%. Workers collecting the samples wore personal monitors to determine their level of exposure to airborne asbestos fibers; those results are summarized in Section 2.5.2.

From EPA's investigation in July 2008, concentrations of asbestos in residential soils near Swift Creek where dredged materials may have been used for fill ranged from 0.25% to 6.5%; asbestos was not detected at a background location (EPA 2009). Soil samples also were analyzed for metals to determine whether the calcium to magnesium ratio in soils near the site can be used as a marker for asbestos contamination. While the Ca:Mg ratios were different compared to the Ca:Mg ratios at the background location, a clear correlation could not be discerned from this data. Earlier studies by Dr. Hans Schreier at University of British Columbia indicated that metals or metals ratios may be useful as indicators of asbestos contamination (Schreier 1987a).

During an EPA investigation in 2009, concentrations of chrysotile asbestos as high as approximately 26.75% were found in samples of bank sediment and upland soil impacted by

deposited sediments at locations along the Sumas River all the way to the Canadian border. These results showed that asbestos concentrations in the sediment from the slide has the potential to concentrate during flood events (EPA 2009).

During the 2012 EPA field event, four sediment samples, including one field duplicate, were collected. One sample was collected from the landslide, one sample was collected from Swift Creek near Goodwin Road, and two samples (including the field duplicate) were collected from dredged materials on Whatcom County's property at the corner of Oat Coles and South Pass Roads. These samples were analyzed for Target Analyte List (TAL), Synthetic Precipitation Leaching Procedure (SPLP), and deionized (DI) water leach metals. The results indicated that while several metals, including chromium, cobalt, magnesium, and nickel were present in the sediment and dredge material samples above natural background levels, the leachable concentrations of these metals were relatively low. See the discussion of the results in Appendix A for additional details.

2.5.2 Airborne Exposure to Sediment/Dredge Material

During the 2006 EPA dredge material sampling investigation (Section 2.5.1), workers collecting the samples wore personal monitors which revealed airborne concentrations of asbestos ranging from 0.0094 PCME fibers per cubic centimeter of air (f/cc) to 0.055 PCME f/cc (E & E 2006). A PCME fiber is defined as a fiber with an aspect ratio (length:width) greater than 3:1, and is longer than 5 micrometers (µm) in length, and has a diameter between 0.2 and 3.0 µm. The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for asbestos is 0.1 f/cc on an eight-hour time weighted average (Title 29 of the Code of Federal Regulations [CFR] Part 1926.1101(c)(1)).

The results of the EPA 2006 activity-based sampling indicated that there were elevated levels of exposure to asbestos fibers for all three activities evaluated. Concentrations of PCME fibers ranged from not detected to 0.21 f/cc. The average concentrations of PCME fibers were 0.078 f/cc for loading/hauling dredged material, 0.018 f/cc for raking/spreading dredged material, and 0.029 f/cc for walking/biking on the dredged piles. A risk evaluation using these data indicated that typical activities conducted on site may lead to an increased level of long-term risk of asbestos-related cancers resulting from regular exposures to dredged materials from the site (EPA 2007a).

In order to evaluate potential risks associated with exposures to flood-deposited materials containing asbestos, EPA conducted activity-based sampling in August 2010 (EPA 2011a). Activities that were simulated included excavating and moving sediment deposits, spreading sediment deposits on a farm, yard work (including raking and mowing), and walking around properties (EPA 2011b). Analytical results showed that asbestos was detected in 18 of the 19 personal air samples, with PCME concentrations ranging from 0.0019 to 2.3 s/cc. The highest levels were associated with samples collected during loading/raking/spreading sediment deposits. Stationary sample concentrations were generally 10 times lower than personal sampler concentrations. Dredging activities were not simulated by EPA, but previous occupational monitoring (WSHA 2005) indicated that use of wet methods can meet OSHA standards.

2.5.3 Surface Water

In Environment Canada's 1980 and 1981 studies, asbestos fibers were detected between 10^7 and 10^{13} fibers per liter (between 10 and 10,000,000 million fibers per liter [MFL]) with the highest concentrations found in the creek immediately below the landslide, and it was noted that asbestos fiber concentrations in Swift Creek were well above normal and were attributed to the influence of serpentine bedrock in the area (Schreier 1980 and 1981).

The 1987 Schreier study found that asbestos fiber concentrations in the Sumas River were substantial, high asbestos and nickel concentrations were positively correlated with the discharge, and decreasing downstream concentrations were observed for asbestos, chromium, nickel, and manganese in streamwater (Schreier 1987b).

In the 2009 EPA investigation, surface water samples collected at the same time as the sediment and soil samples (see Section 2.5.1) revealed asbestos concentrations from about 63 to 879 MFL along downstream stretches of the Sumas River; concentrations within Swift Creek were between 1,200 and 1,500 MFL. These results showed that asbestos from the slide has the potential to concentrate during flood events (EPA 2009). EPA also conducted surface water sampling in 2010 during the dry season, and the asbestos concentrations were much lower (EPA 2011a).

In the July 2012 EPA field sampling event, two surface water samples collected from Swift Creek indicated three total metals (aluminum, iron, and manganese) with results exceeding the EPA secondary MCLs, although the dissolved concentrations of these metals were below the respective secondary MCL. No metal was detected above any primary MCL. Additional details are included in Appendix A.

2.5.4 Groundwater

In 2012, EPA collected groundwater samples from the site in July and October 2012, and the results are summarized in Appendix A. The results indicated that asbestos was detected in some of the samples and indicated that asbestos fibers could be locally mobilized under groundwater flow conditions induced by pumping and sampling, although long-distance migration of asbestos in groundwater is unlikely. Additionally, three metals (aluminum, iron, and manganese) were present in some of the groundwater samples with results exceeding secondary MCLs. No metal was detected above any primary MCL.

2.6 Streamlined Risk Evaluation

EPA's document *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993) requires a streamlined risk evaluation to assist in determining whether a removal action is justified and to identify the potential current and future exposures that should be prevented. In a streamlined risk evaluation, the contaminants of potential concern (COPCs) for which actions may be taken are identified by defining potential exposure pathways and receptors, and comparing contaminant concentrations to published screening levels. Screening levels are conservative risk-based concentrations or applicable state and federal standards consistent with the pathways and receptors identified.

This section presents a summary of human health and risk evaluations that have been conducted to date at the site during previous investigations. Additional risk assessment specifically for this EE/CA was not performed because adequate information about potential health risks is available in previous reports, as summarized in this section. In addition, data gaps in the exposure pathway assessment of the site have been characterized in previous reports.

The risk evaluation for an EE/CA is intended to be streamlined and focused on the specific problem that the EE/CA for the site is addressing, which is to identify the scope of the removal action for the site. In an EE/CA risk evaluation, the contaminants of potential concern for which actions may be taken are identified by defining potential exposure pathways and receptors, and comparing analyte concentrations to screening levels. These steps, in addition to preparing a more comprehensive risk assessment for asbestos, have been performed by EPA in previous human health evaluations. The results from these assessments will be relied upon for this EE/CA.

An overview of analytical results, potential exposure pathways evaluated, and risk estimates are provided in this section. In addition, summaries of three health consultations conducted by WDOH during the years between 2005 and 2010 are described. Based on review of these previous evaluations, conclusions about the site and data gaps related to human health are outlined.

Previous reports containing human health evaluations at the Sumas Mountain site include:

- 2006 WDOH *Health Consultation*;
- 2007b EPA *Summary Report of EPA Activities*;
- 2008 WDOH *Health Consultation*;
- 2009 EPA *Soil, Sediment, and Surface Water Sampling*;
- 2010 WDOH *Asbestos Cluster Investigation*; and
- 2011b EPA *Risk Evaluation for Activity-Based Sampling Results*.

Previous EPA Site Investigations

In April, May, and August 2006, EPA initiated field investigations of dredged sediments at the Swift Creek Asbestos Site (between Goodwin Road and Oat Coles Road) to characterize the mineral composition of sediments and dredge piles, verify and estimate the amount of naturally occurring asbestos, and perform activity-based sampling to assess potential health risks associated with dredged material. These investigations were prompted, in part, by a 2006 WDOH Health Consultation indicating that additional characterization of Swift Creek and portions of Sumas River was necessary to determine potential health risks (WDOH 2006).

The April and May 2006 investigations confirmed that asbestos was present in dredged sediments and air samples (EPA 2007a). The PLM concentrations of asbestos in bulk samples collected from the dredged material ranged from 0.1 to 4.4 %, with an overall concentration of 1.7 %. Analysis of dredged sediments also indicated that levels of certain metals (chromium, nickel, and vanadium) were elevated compared to health-based concentrations and natural background (EPA 2007a). Based on these results, EPA performed activity-based sampling in August 2006 in which EPA field staff wore air monitoring equipment and simulated activities that were expected to occur at the site and that would disturb dredged material. These activities represented exposure scenarios that had been observed or were known to occur at the site. The

activities simulated included loading/hauling dredged material, raking/spreading dredged material, and recreation (i.e., walking, jogging, and biking). In addition, EPA placed stationary air samplers around the site to provide data about potential exposure levels to nearby bystanders who may be adjacent to or downwind of site activities. Asbestos fibers were detected in 16 out of 18 personal air samples at PCME concentrations ranging from 0.0028 to 0.21 s/cc, with the highest average concentration (0.078 s/cc) associated with loading/hauling. The average concentrations for the raking/spreading and recreation scenarios were 0.018 s/cc and 0.029 s/cc, respectively. Analysis indicated that chrysotile was the most prevalent asbestos fiber type, with detections found in all personal and stationary air samples. A small number of amphibole fibers were also detected in some of the samples, but the percentage was very low.

EPA expanded the sampling of the Swift Creek and Sumas River region in 2008 and 2009 (EPA 2009). This sampling was prompted by WDOH (2008) indicating that EPA's investigations had been limited to a relatively small area and the limited number of scenarios covered by the activity-based sampling may not reflect all potential exposures. The 2008 sampling event focused on characterizing asbestos levels in residential soils on four Swift Creek properties where dredged materials may have been used for fill. In May 2009, EPA collected surface water, bank sediment, and upland soil samples to characterize properties impacted by 2009 flood events, which deposited sediments containing asbestos along the creek and river banks. Asbestos concentrations reported for the residential properties sampled in 2008 ranged from 0.25 to 6.5%. This range is similar to the range reported for the dredged materials sampled in 2006, except the maximum is slightly higher than reported for 2006 (4.4%). The 2009 sample analyses indicated asbestos concentrations ranging from about 1.75% to 21.75% along Swift Creek in creek bank sediments and from 2.75 to 26.75% in upland soils with flood deposits. Along Sumas River, asbestos concentrations displayed similar ranges (7.25 to 22.75% in bank sediments and 0.25 to 26.75% in upland soils) (EPA 2009). These concentrations were much higher than those observed during the 2006 and 2008 investigations. Similar to previous sample results, chrysotile fibers were the predominant form of asbestos found in samples, while only a small percentage of amphibole fibers were identified.

EPA conducted activity-based sampling in August 2010 at three locations along the Sumas River downstream from Swift Creek where floods had deposited material in 2009. Activities performed during the sampling including simulated excavating, moving, and mowing. Analytical results showed that asbestos was detected in 18 of the 19 personal air samples, with PCME concentrations ranging from 0.0019 to 2.3 s/cc. The highest levels were associated with samples collected during loading/raking/spreading sediment deposits under dry conditions, particularly in barn-type structures. (EPA 2011a)

Previous EPA Human Health Risk Evaluations

EPA classifies asbestos as a known human carcinogen via inhalation. The diseases that are linked to airborne asbestos exposure most frequently include asbestosis, pleural changes, lung cancer, and mesothelioma. Cancer risks from asbestos exposure increase with the concentration of fibers in the air, the frequency and duration of exposure, and the time since first exposure (EPA 2012).

Asbestos occurs in two forms: serpentine and amphibole. Chrysotile, the predominant form of asbestos found at the site, belongs to the serpentine family. Chrysotile fibers are curved and flexible. Amphiboles are long, thin, brittle, needle-like fibers. Some evidence indicates that amphibole fibers have a higher toxicity than chrysotile because of their shape. The longer thinner fibers can reach the lower airways and become embedded in the lung tissue for a lifetime, thus causing disease (WDOH 2006).

Potential cancer risks associated with asbestos exposure are estimated by combining an inhalation cancer potency factor (CPF) with quantitative information about exposure. The CPF, described in EPA's Integrated Risk Information System (IRIS) (EPA 2012), is based on the occurrence of lung cancer and mesothelioma in people exposed to asbestos at their jobs. While chrysotile asbestos may present lower toxicity than amphibole asbestos, the CPF does not differentiate between the two types of fibers.

Cancer risks are expressed as the incremental probability of an individual developing cancer over a lifetime as the result of exposure to carcinogenic chemicals. This increment is in addition to the background cancer risk experienced by all individuals in the course of daily life. Risks are typically expressed in scientific notations. For example, the notation $1x10^{-6}$ is the same as 0.000001, or 1/1,000,000, or one in one million.

EPA typically uses a $1x10^{-6}$ (one in one million) to $1x10^{-4}$ (one in ten thousand) risk range to make decisions about the need to take action at a site. Specifically, EPA generally considers cancer risks less than $1x10^{-6}$ acceptable, while cancer risks greater than one in ten thousand, or $1x10^{-4}$, usually require some level of response. The lower bound of this range, $1x10^{-6}$, is typically considered the point of departure where EPA begins to consider remedial options. However, the use of $1x10^{-4}$ as a benchmark is consistent with other asbestos sites (EPA 2007 and 2011b). In addition, the State of Washington cleanup regulations use a $1x10^{-6}$ (one in one million) acceptable cancer risk for recreational, residential, and commercial land uses.

Using the data collected in August 2006, EPA performed a risk evaluation assuming the activities or exposure scenarios described in the previous section, plus additional scenarios that would have similar exposure levels. The additional scenarios included farming, gardening, child playing in soil, and cross-country team training. The results of the risk evaluation indicated that for all scenarios, risk levels exceeded the lower bound of EPA's acceptable excess lifetime cancer risk range (i.e., $1x10^{-6}$ or a one in one million likelihood of developing cancer from exposure). However in most cases, risks were less than the upper bound of EPA's acceptable risk range ($1x10^{-4}$ or one in ten thousand). Three scenarios, including dredging/hauling, farming, and gardening, corresponded to risk estimates exceeding $1x10^{-4}$ (EPA 2007a). EPA cautioned that individuals in the community could have multiple routes of exposure. If so, these risks would be additive and the total risk could be higher than calculated in the report.

While EPA did not perform a quantitative risk evaluation as part of the 2008 and 2009 site investigations described in the previous section, EPA did make some conclusions about potential human health exposures related to asbestos along the creek and river (EPA 2009). First, the sample results demonstrated that flooding contributed to distribution of asbestos-containing sediments beyond the river banks. As a result, exposures to asbestos via incidental and routine

contact with bank materials continued to be a concern. Furthermore, exposures to asbestos in flood-impacted media may be higher than previously estimated in 2006 because of higher concentrations found in the 2009 samples. Direct contact with soil and sediments could result in releases of asbestos fibers to air, where inhalation could occur. Secondly, the presence of asbestos in Swift Creek and Sumas River surface water makes it unsuitable for drinking, and use of the water for irrigation could spread the asbestos further from the creek and river. Finally, given the potential health risks associated with exposure to asbestos, EPA outlined several precautions that property owners along the Sumas River should follow (EPA 2009).

Due to ongoing concerns with elevated asbestos concentrations in flood-deposited materials, EPA prepared a risk evaluation using the sample results from the 2010 activity-based field investigation described in the previous section. As noted above, sample results demonstrated that asbestos fibers in flood deposits were released into the breathing zone when outdoor activities were conducted (EPA 2011a, b). For several of the exposure scenarios, risk estimates were within EPA's acceptable risk range ($1x10^{-6}$ to $1x10^{-4}$). However, risks generally exceeded the acceptable range for activities related to gardening, farm soil work, and child play in an animal shed and fields. Risk estimates ranged from $2x10^{-4}$ to $1x10^{-2}$ (EPA 2011b), with the higher risk estimates associated with asbestos exposure during routine child play and daily farming.

The findings of the EPA (2011b) risk evaluation are consistent with previous studies. Asbestos is present in dredged and flood-deposited materials, and exposure to these materials may present human health risks. Precautions for limiting potential exposures outlined in EPA (2009) were re-iterated in the 2011 risk evaluation.

EPA provides a caveat that the exposure levels estimated in the evaluations (EPA 2007a and 2011b) include only those that correspond to intermittent activities. Individuals may be exposed to asbestos from dredged and flood-deposited materials in ways and from sources that are not addressed in the risk evaluations. Residents and farmers in impacted areas may experience more than one type of exposure, resulting in potentially additive risks. Actual exposures and risks estimated in both evaluations may be higher or lower than those estimated.

EPA has not assessed asbestos in interior residential settings; however, EPA performed soil sampling and activity-based sampling in several residential yards in 2010, and sampling has occurred in other areas with asbestos-containing soil or flood deposits where animals, vehicles, and workers could track asbestos indoors.

WDOH Health Consultations

WDOH prepared three separate health consultations for the site between 2006 and 2010 (WDOH 2006, 2008, and 2010). In 2006, WDOH qualitatively summarized potential human health effects related to naturally occurring asbestos at the site based on environmental and toxicological data available at the time. Based on this evaluation, WDOH made recommendations for further actions, including additional characterization of sediments and surface water, and activity-based sampling for risk assessment purposes (WDOH 2006).

A follow-up health consultation was prepared in 2008 to present an epidemiological review of health outcome data in the Swift Creek area, identify remaining data gaps, and outline an action

plan to fill data gaps (WDOH 2008). The WDOH reviewed lung cancer and mesothelioma data for the area surrounding Swift Creek compiled in the Washington State Cancer Registry. A comparison of cancer data for the Swift Creek community with data for Whatcom County and Washington State revealed no significant differences in lung and bronchus cancer rates. No mesothelioma cases for the study area were identified in the cancer registry from 1992 to 2004.

In response to the new data generated from EPA's 2009 field investigation, WDOH conducted a follow-up epidemiological analysis of cancer data in 2010 (WDOH 2010). Two additional years of data compared to the previous review and an expanded study area encompassing the Swift Creek drainage and the Sumas River region were included in the study. Consistent with the 2008 review, the results of this study revealed no evidence of elevated asbestos-related disease rates in the Swift Creek and Sumas River region. WDOH noted that the study conclusions are qualified due to the long disease latency period, small number of mesothelioma cases, and population migration. (WDOH 2010)

Conclusions and Data Gaps

Conclusions identified in risk evaluations of the Sumas Mountain Asbestos (aka Swift Creek) Site are as follows:

- Risk assessment of the site indicates that exposures to asbestos can occur through incidental or routine contact with bank materials along Swift Creek and Sumas River. Direct contact with soil and sediments containing asbestos can result in release of fibers into the breathing zone and fibers being inhaled into the lungs.

- For activities and areas assessed, cancer risk estimates for some exposure scenarios are above the high end of EPA's acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$.

- While inhalation is the primary route of concern for asbestos health risks, the presence of asbestos in Swift Creek and Sumas River water makes it unsuitable for drinking.

- Due to potential health risks identified by EPA and WDOH, residents and farm workers should avoid contact with sediments from Swift Creek or the Sumas River in areas downstream of the slide area; avoid tracking sediments into homes or businesses; and assume that flood deposits contain asbestos. Several health advisories have been released by the government agencies and are available online at: http://www.co.whatcom.wa.us/health/environmental/solidwaste/asbestos_swift_creek.jsp.

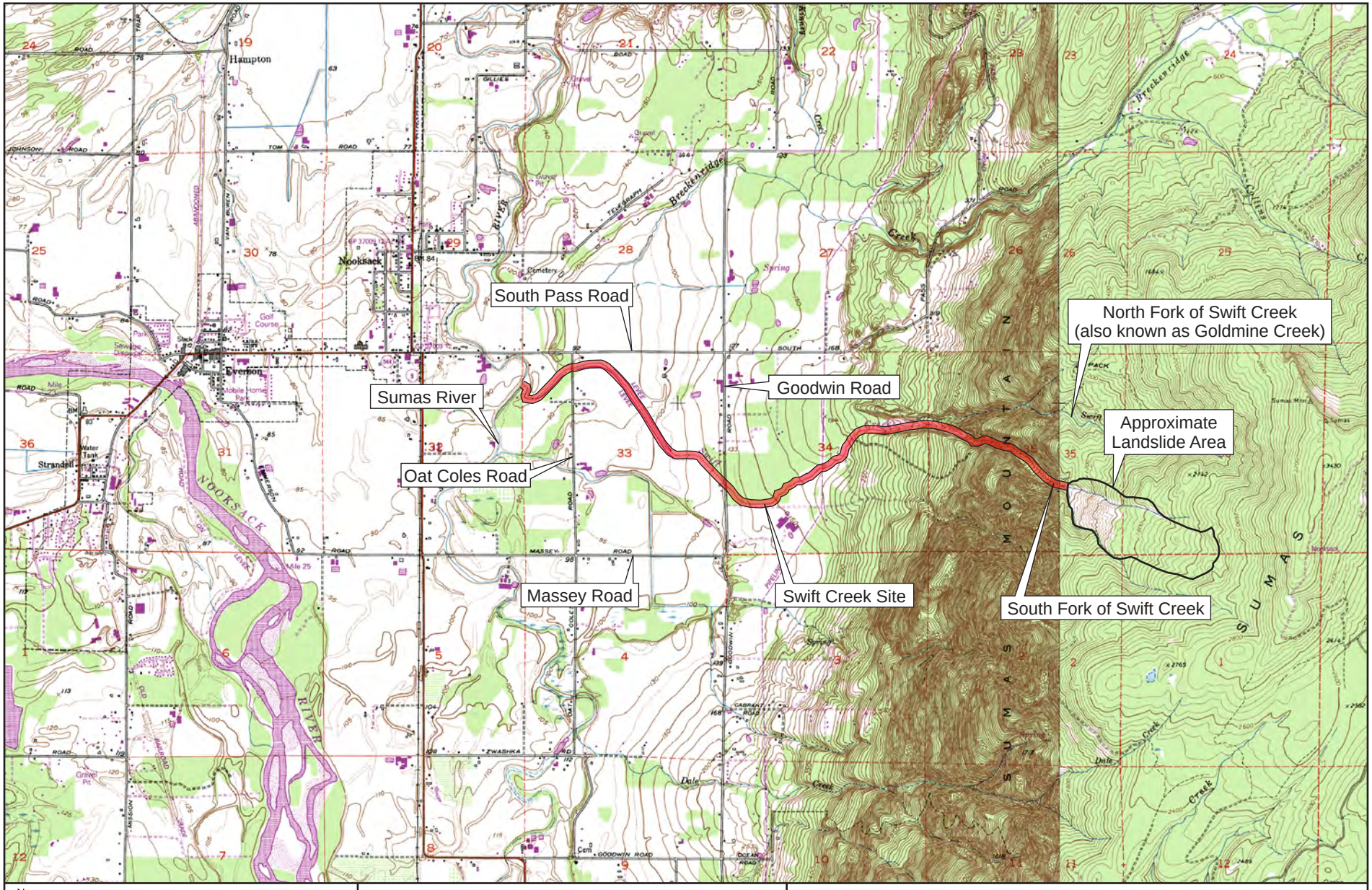
- Epidemiological analysis of available cancer data for the Swift Creek and Sumas River region does not indicate a statistically significant increase in the rates of lung and bronchial cancer or mesothelioma relative to other populations in Washington.

A full evaluation of risks would require characterization of the extent of asbestos in areas throughout the floodplain and development of a reasonable maximum exposure scenario, considering a range of worker exposure pathways, environmental conditions, and potential residential exposures. Human health risk data gaps that remain include:

- Worker and residential risks associated with asbestos-containing sediments taken off site.

- Worker and residential risks associated with indoor air where asbestos-containing sediments have flooded, been tracked, or otherwise brought indoors.
- Risks associated with irrigation use of water from Swift Creek or Sumas River.

Despite an incomplete picture of the current extent of asbestos and the potential exposure pathways, risk evaluations to date warrant action to control sources of this material. EPA response actions, though subject to CERCLA limitations, can be supplemented by actions of other parties to intercept the material to reduce flooding and take other actions to limit releases of Swift Creek material in the environment.



N

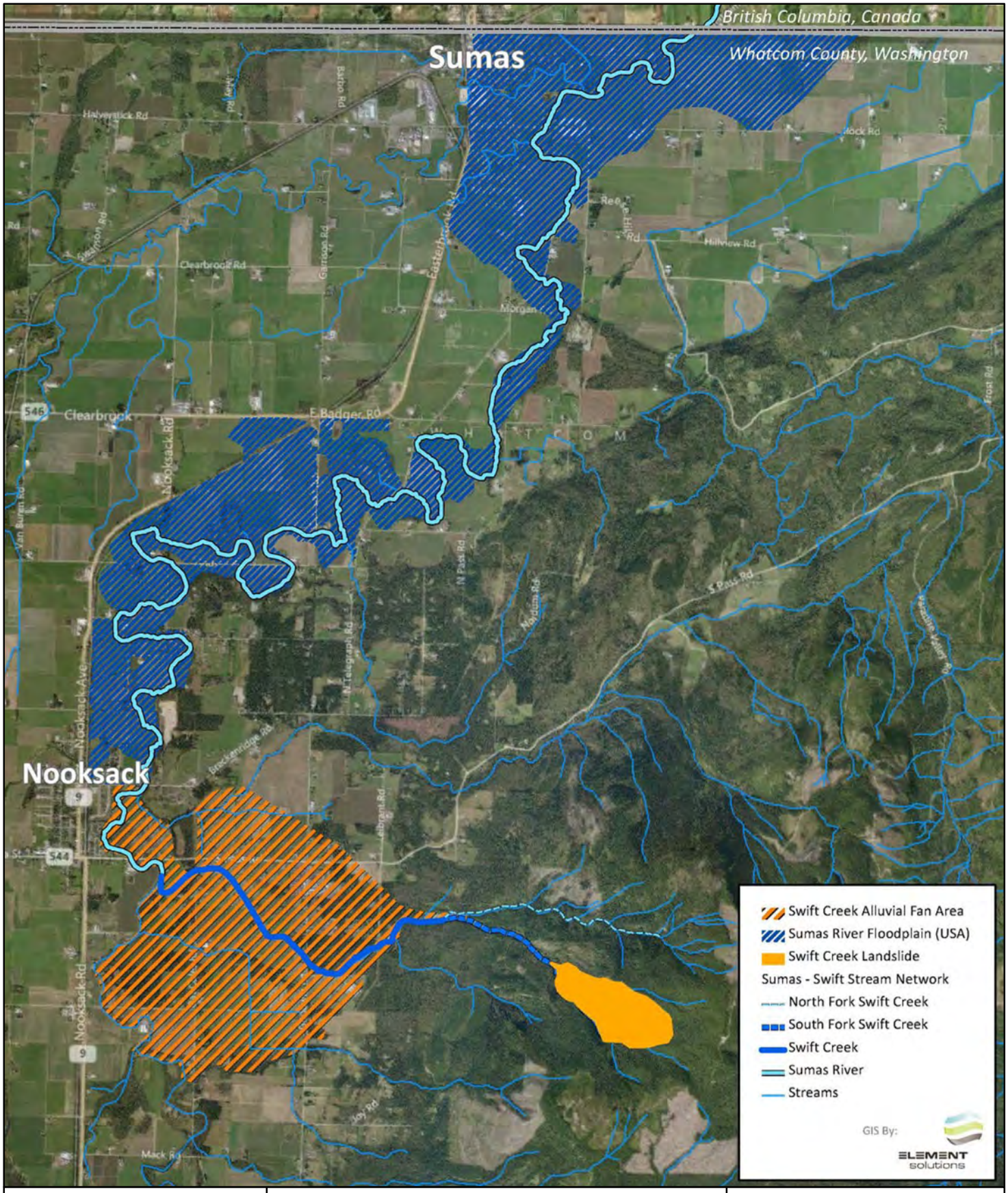
0 1,818 3,636 7,272 Feet

SUMAS MOUNTAIN ASBESTOS
(aka SWIFT CREEK) SITE
Whatcom County, Washington

Figure 2-1
Site Layout Map

ecology and environment, inc.
Global Environmental Specialists

Source: Maptech, Inc. 2001.



N

0 2,500 5,000

Approximate Scale in Feet

SUMAS MOUNTAIN ASBESTOS
(aka SWIFT CREEK) SITE
Whatcom County, Washington

Figure 2-2
Swift Creek Alluvial Fan and Sumas River Floodplain

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Source: Whatcom County 2013.

3 Removal Action Objectives

According to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), where the EPA determines there is a threat to public health, welfare, or the environment, a removal action may be taken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances.

This section describes the statutory considerations for removal actions, the objectives of the proposed removal action at the site, the scope of the removal action, compliance with potential applicable or relevant and appropriate requirements (ARARs), and the general schedule for removal activities.

3.1 Statutory Considerations on Removal Actions

Consistent with CERCLA Section 104(C)(1), Section 300.415(b)(5) of the NCP stipulates that cost and duration of a removal action be limited to $2 million and 12 months for EPA-financed removal actions. Cost and implementation time exemptions may be granted if the EPA determines that the removal action is necessary to mitigate an immediate risk to human health, welfare, or the environment or that the removal action is otherwise appropriate and consistent with an anticipated long-term remedial action. EPA funds expended to conduct an EE/CA are CERCLA Section 104(b)(1) monies and are not counted toward the $2 million statutory limit for removal actions.

3.2 Determination of Removal Action Scope and Objectives

3.2.1 Removal Action Scope

The goals of the removal action are to protect human health and the environment by addressing the risks identified in the streamlined risk evaluation, comply with ARARs to the extent practicable, and limit the number of restrictions needed for future use of the site.

The scope corresponds to the following removal factors identified in the NCP:

- 40 C.F.R. § 300.415(b)(2)(i) which identifies “actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;”
- 40 C.F.R. § 300.415(b)(2)(iv) which identifies “high levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate;” and
- 40 C.F.R. § 300.415(b)(2)(v) which identifies “weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.”

3.2.2 Removal Action Objectives

To achieve the above goals, the following removal action objectives (RAOs) have been developed:

1. Reduce human exposure to asbestos (through inhalation or ingestion) in and released from site sediments; and

2. Reduce potential migration of asbestos from Swift Creek to the Sumas River and nearby residential and agricultural property.

These objectives will be achieved while working within the statutory limits and attaining potential ARARs to the extent practicable. In addition to the releases of asbestos at the site, it should also be noted that several metals (including nickel, cobalt, chromium, and magnesium) are also present at the site at concentrations that may warrant additional investigation. Asbestos and each of these metals are also specifically listed at CERCLA hazardous substances (see NCP at 40 CFR Table 302.4). However, given the widespread distribution of asbestos and the significance of human health risks it poses, this EE/CA focuses on addressing the asbestos contamination. The alternatives evaluated herein focus on controlling the source and thus reducing exposure to both.

In addition, while the EE/CA focuses on reducing risks to human health, the proposed alternative may help address some potential ecological concerns. For example, Swift Creek avulsion could deposit sediment on ecologically valuable wetlands north of South Pass road and could affect Breckenridge Creek fish habitat.

3.3 Applicable or Relevant and Appropriate Requirements

Potential ARARs have been screened to aid in technology and alternative evaluation. For the removal action, on-site actions are to comply with the substantive requirements of any identified ARARs, to the extent practicable considering the exigencies of the situation. Off-site actions must comply with all applicable requirements such as permit applications.

ARARs are divided into the following categories:

- **Chemical-specific requirements** are health- or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants.
- **Action-specific requirements** are controls or restrictions on particular types of activities, such as hazardous waste management or wastewater treatment.
- **Location-specific requirements** are restrictions on activities that are based on the characteristics of a site or its immediate environment.

Additionally, to-be-considered (TBC) materials are advisories, criteria, guidance or policy documents, and proposed standards that are not legally binding, but that may provide useful information or recommended procedures relevant to a cleanup action. The potential chemical-, location-, and action-specific ARARs and TBC materials for the EE/CA are summarized in Appendix C.

3.4 Determination of Removal Schedule

The removal action may be initiated within two to six months following issuance of this EE/CA and selection of a removal action, depending on appropriate construction weather conditions, available funding, design requirements, and other determinations. The time required to implement the removal action will depend on the alternative selected, the participation of other parties, and other factors. EPA expects to implement certain elements of the alternatives

described herein where appropriate, subject to available funding and CERCLA limitations on EPA response actions. In order for EPA actions to be effective, a comprehensive approach will be needed, with elements outside of the CERCLA limitations, such as flood control efforts, anticipated to be completed by other parties.

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4 Removal Action Alternatives

4.1 Identification of Removal Action Alternatives

Based on the analysis of the nature and extent of contamination and results of the streamlined risk evaluation, removal action alternatives were identified to meet the RAOs presented in Section 3.2. Once the removal action alternatives were developed, each alternative was analyzed against the criteria specified in the EPA document *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (EPA 1993).

Using site-specific data and the RAOs, the following removal action alternatives were developed for the site:

Alternative A1 – No Action

Alternative A2 – Institutional Controls and Access Restrictions

Alternative A3 – Annual Dredging and Hauling

Alternative A4 – Sediment Basins, Setback Levees, and In-Stream Sediment Traps

All of the alternatives but No Action are interim actions. The alternatives differ significantly in terms of the level of risk reduction they offer, as they provide varying degrees of sediment capture and containment. The alternatives impact a range of land areas, with No Action potentially affecting the largest area. Additionally, it should be noted that the selected removal alternative will have to take into account the seismic conditions of the Swift Creek area and incorporate the appropriate considerations into the final design, implementation, and operations.

4.2 Description of Removal Action Alternatives

4.2.1 Alternative A1: No Action

Under this alternative, no action would be taken to address asbestos-containing sediment in the Swift Creek alluvial fan or flood plain area (see Figure 4-1). As stated in the SCSMAP (Whatcom County 2012a), an estimated average of 150,000 yd^3 of asbestos-containing sediment is transported into Swift Creek annually. The unchecked deposition of sediment would continue unabatedly to reduce the Swift Creek channel capacity, making the stream channel area prone to flooding. Flooding would cause asbestos-laden sediments, along with previously dredged materials on the banks, to be carried to and deposited on residential and agricultural properties in the Swift Creek flood plain area. The channel is already choked with sediment, and the stream channel could shift to an alternate path in the flood plain or upstream on the alluvial fan, potentially affecting large areas with asbestos-laden flood deposits. In addition, during flood events, material carried from Sumas Mountain and the Swift Creek area would likely be mobilized (or remobilized from dredge piles) to downstream areas and deposited adjacent to Sumas River. Unavoidably, materials deposited on actively farmed lands, residential yards, commercial facilities, roads, and within homes or other structures, will be disturbed, potentially leading to exposure to airborne asbestos.

4.2.2 Alternative A2: Institutional Controls and Access Restrictions

For this alternative, asbestos-containing sediment would be allowed to build up and be deposited in the Swift Creek flood plain area as in the No Action alternative. However, this alternative would include institutional and access controls to manage the Swift Creek flood plain.

Institutional controls are administrative and/or legal controls (e.g., deed restrictions or permits) intended to minimize the potential for human exposure to contamination and/or protect the integrity of a removal action by limiting land or resource use. Institutional controls do not actively address contamination and do not include man-made physical changes to the site, but attempt to meet the RAOs by reducing the potential for exposure to contamination. Access restrictions are physical controls (e.g., fencing or warning signs) put in place to minimize human and ecological receptor exposure to contamination and/or protect the integrity of a removal action by limiting direct contact with particular areas of concern. Like institutional controls, access controls do not actively address contamination, and attempt to meet the RAOs by reducing the potential for exposure to contamination. Institutional controls and access controls are often used together, and may be used in conjunction with an active technology.

For this alternative, property or property rights that could be affected as a result of allowing Swift Creek to fill, flood, and find a new path would be acquired from the current property owners. Access would be limited to these areas through the use of warning signs and/or fencing.

In order to determine which properties might be affected property, FEMA 100-year flood zone maps were used in conjunction with the known alluvial fan area and areas of potential asbestos-containing sediment release from flooding in Swift Creek (Whatcom County 2009) to determine the areas that would potentially be affected by continuous, unabated deposition of asbestos-containing sediment (see Figure 4-2). For purposes of this EE/CA and to yield a conservative estimate, it was assumed that all properties that intersect these areas would be acquired or placed under deed restrictions, approximately 2,600 acres. This alternative does not include properties that could be affected by flooding along the Sumas River.

4.2.3 Alternative A3: Annual Dredging and Hauling

Alternative A3 addresses asbestos-containing sediments in the Swift Creek channel by performing annual dredging to prevent sediment build-up and reduce the potential for flooding and over-topping of the creek banks (see Figure 4-3). Consistent with previous practices, a finite amount of dredged material would be used for maintenance and repair of the berm walls along Swift Creek. This alternative assumes that a nearby county-owned property, currently used for storage of materials from recent limited dredging, would be used as a temporary staging area. Dredged sediment would then be hauled to and placed in a nearby permanent repository.

This alternative involves constructing a permanent repository in which asbestos-containing sediments would be placed so as to contain the material and limit human exposure to the asbestos. The repository location would ideally be in close proximity to the sediment dredging area to reduce transportation costs. An unused gravel pit or quarry, if close by, would be advantageous for this purpose because it would reduce site preparation costs and would minimize the potential for disturbance of undeveloped/unimpacted land. Once the repository

reaches capacity, it would be closed in accordance with appropriate federal, state and local requirements.

Implementation of this alternative would require obtaining a suitable repository site with capacity for ten years of an estimated 50,000 cubic yards a year, located within proximity to the Swift Creek sediment removal location. While hauling and placing the material, dust emissions would need to be minimized with water/surfactant application, and runoff would need to be controlled. Requirements for a repository include a barrier fence and warning signs. Site closure would require at a minimum a 6-inch layer of compacted soil cover with vegetation, a property deed notice, and maintenance of the final cover. While regulations require a minimum 6-inch compacted cover, note that a thicker cover of compacted soil may be required above the asbestos-laden sediment to allow for the growth of vegetation. For the purpose of developing this alternative, it has been assumed that the repository would have a life expectancy of 10 years. It should be noted that dredging would only periodically remove bedload sediments. Asbestos-containing sediments will continue to be carried from Sumas Mountain and suspended loads would not be reduced. When full, the repository would be closed and a new disposal location would have to be placed into operation. A replacement repository is not covered in the cost estimate for this alternative.

For cost estimating purposes, it was assumed that an average of 50,000 yd^3 of asbestos-containing bedload sediment would be deposited and then dredged from the lower reaches of Swift Creek each year, and this quantity would be placed in one 15-acre repository on an annual basis for 10 years (A3 repository option). It was also assumed that the total thickness of material at repository locations would not exceed 20 feet, and the side slopes would not exceed 1 vertical to 2 horizontal. It should be noted that this option is more cost effective for a repository with adequate size to accommodate multiple years of sediment removal than for multiple repositories that could only contain a single year's volume.

4.2.4 Alternative A4: Sediment Basins, Setback Levees, and In-Stream Sediment Traps

For Alternative A4, sediment basins, setback levees, and in-stream sediment traps would be constructed on the upper Swift Creek alluvial fan (east of Goodwin Road) to capture and manage bedload and suspended load sediment (estimated at 150,000 yd^3 each year) and control the downstream migration of sediment (see Figure 4-4). Under this alternative, asbestos-laden sediments would be captured prior to entering the downstream portion of Swift Creek. This would minimize channel siltation and associated maintenance costs, and would also reduce the likelihood of flooding or avulsion due to low channel capacity. Also included in this alternative is the one-time removal of approximately 200,000 cubic yards of material from the dredged material berms and accumulated channel deposits in and next to Swift Creek. This material would be hauled to and placed in a nearby permanent repository.

This alternative is conceptually similar to the alternative that is outlined by Whatcom County Public works in their SCSMAP and the SCSMAP Phase 1 Implementation Plan (Whatcom County 2012a, b). Conceptual design drawings for the sediment basins and other features from the Whatcom County Phase 1 Implementation Plan are included in Appendix D.

Setback levees would provide areas for contained sediment deposition along Swift Creek. Two setback levees would be constructed under this alternative. One would serve as a debris deflection levee and be constructed on the Swift Creek right bank within the Goodwin Reach (the section of Swift Creek from the canyon mouth to Goodwin Road). The other setback levee would be constructed on the right bank within the Oat Coles Reach (the section of Swift Creek from Goodwin Road to its confluence with the Sumas River). In-stream sediment traps would be constructed on the Canyon Reach (the section of Swift Creek from the alluvial fan apex to the canyon mouth) of Swift Creek to trap bedload sediment. This would reduce overall requirements for sediment management actions further downstream in Swift Creek, but would require periodic removal of trapped sediment.

In addition to the setback levees and in-stream sediment traps, sediment basins would also be constructed to trap large quantities of sediment (both bedload and suspended), and prevent them from entering Sumas River. According to the SCSMAP Phase 1 Implementation Plan developed by Whatcom County (2012b), suspended sediment in Swift Creek characteristically has very rapid settling rates.

Sediment that is recovered from the basins, setback levees, and in-stream traps would be hauled to and placed in a nearby permanent repository in a manner that would isolate and encapsulate the material. Implementation of this alternative would require obtaining a suitable repository site with capacity for ten years of an estimated 150,000 cubic yards of material per year, located within proximity to the Swift Creek sediment removal location. While hauling and placing the material, dust emissions would need to be minimized with water/surfactant application and runoff would need to be controlled. Requirements for a repository include a barrier fence and warning signs. Site closure would require at a minimum a 6-inch layer of compacted soil cover with vegetation, a property deed notice, and maintenance of the final cover. While regulations require a minimum 6-inch compacted cover, note that a thicker cover of compacted soil may be required to allow for the growth of vegetation. For the purpose of developing this alternative, it has been assumed that the repository constructed under this alternative would have a life expectancy of 10 years. It should be noted that the collection of asbestos-containing sediments will be an on-going process. At the end of ten years, the repository constructed under this alternative will be full, and a new disposal location will have to be placed into operation if this approach to addressing Swift Creek sediments is to be maintained.

The conceptual design proposed by Whatcom County in their SCSMAP Phase 1 Implementation Plan specifies that the sediment basins would have an approximate sediment storage capacity of 1,963,000 yd^3. For purposes of this EE/CA, it was assumed that the sediment basins would be full after 10 years and the sediment would then be removed. Based on an estimated Swift Creek sediment (both bedload and suspended) loading rate of 150,000 yd^3 per year (Whatcom County 2012b), a total of 1,500,000 yd^3 of sediment is projected to be removed from the sediment basins, setback levees, and in-stream sediment traps in a 10-year period. For cost estimating purposes, it was assumed that sediment removed from the sediment basins, setback levees, and in-stream sediment traps would be placed in a repository with a volume of 1,500,000 yd^3 (A4 repository option). It was also assumed that the total thickness of material at the repository location would not exceed 20 feet, and the side slopes would not exceed 1 vertical to 2 horizontal.

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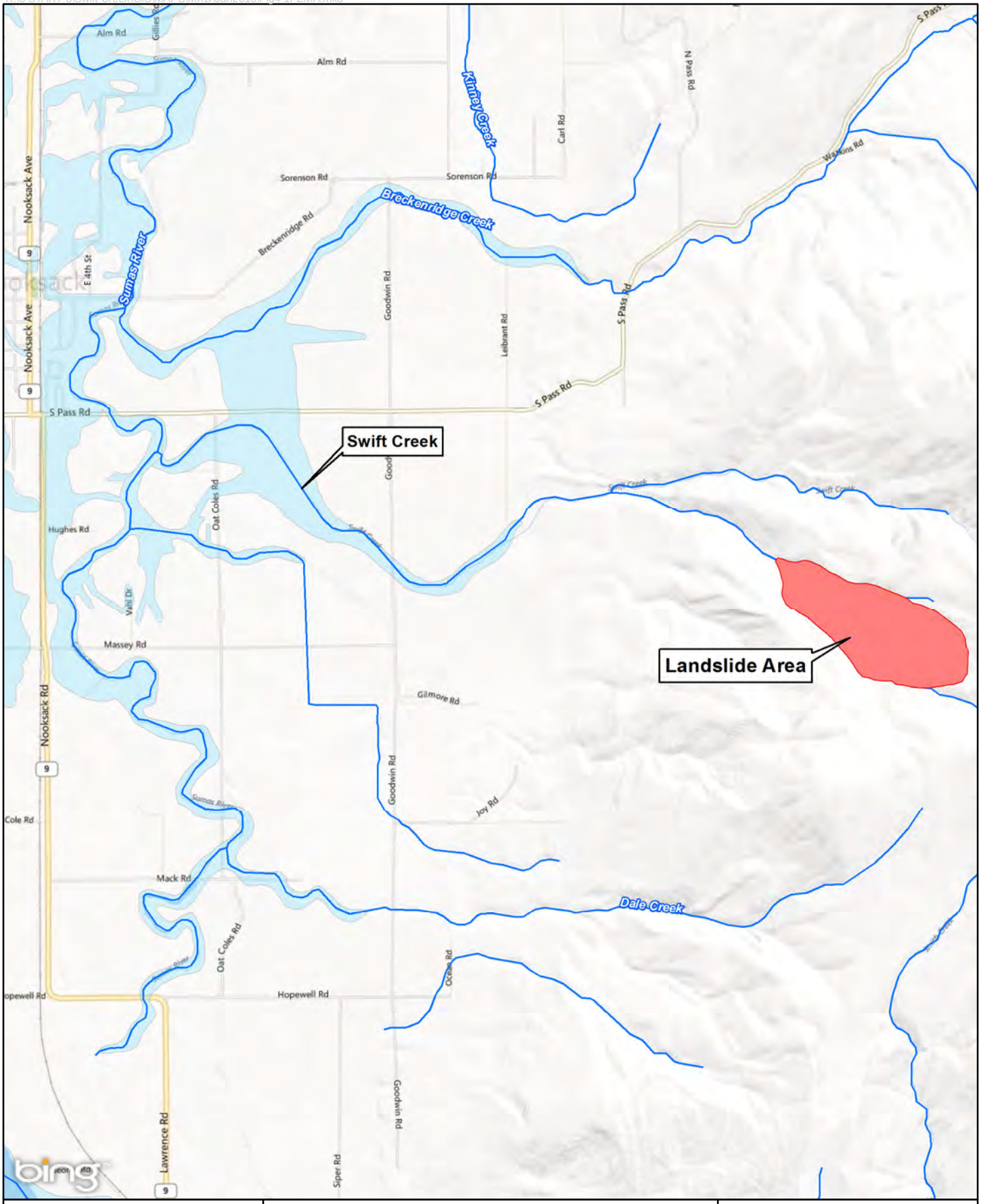

N

0 1,000 2,000 4,000 Feet

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 4-1
Alternative A1
No Action

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FEMA Flood Zone

Landslide Area

Sources: Whatcom County 2012, FEMA 2012, NAVTEQ 2010, Microsoft 2013

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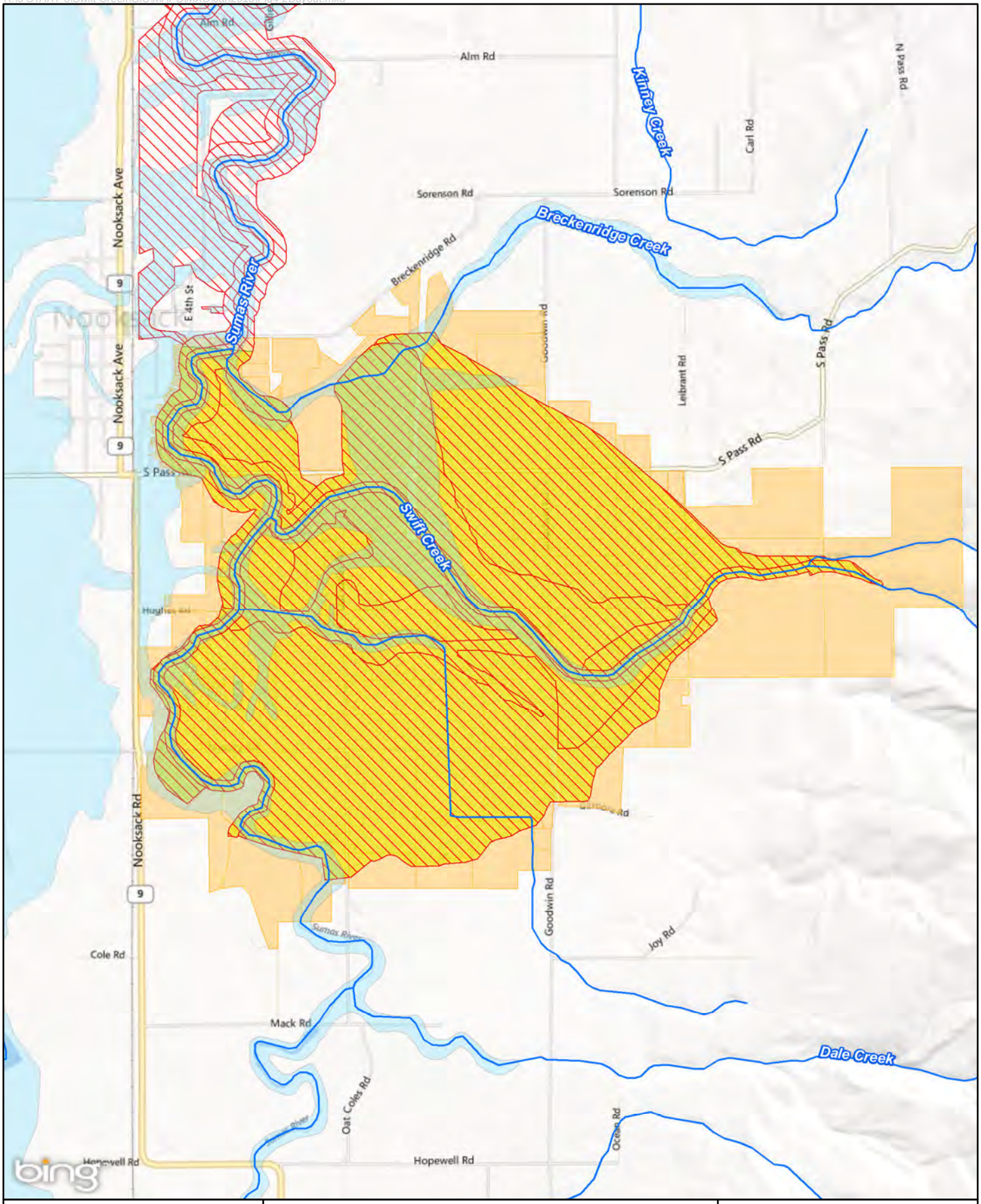

N

0 1,000 2,000 4,000 Feet

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 4-2
Alternative A2 Institutional Controls and Access Restrictions

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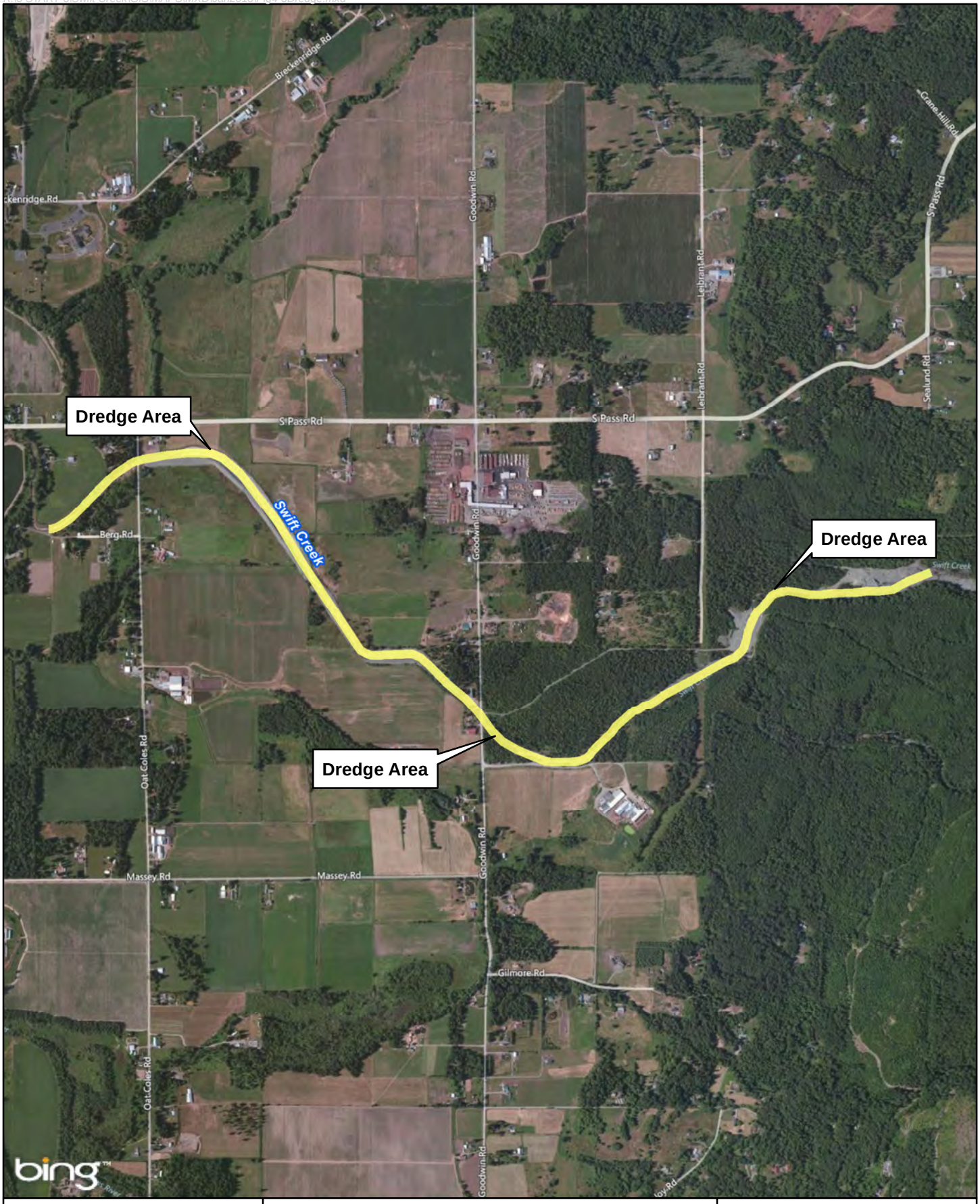
Alluvial Fan
FEMA Flood Zone
NOA Contamination Area
Proposed Properties with Institutional Controls and Access Restrictions

Sources: Whatcom County 2012, FEMA 2012, NAVTEQ 2010, Microsoft 2013

R:\3 START 3\Swift Creek\GIS\MAPS\MXD\Jan2013\Fig4-3Dredge.mxd



N

0 500 1,000 2,000 Feet

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 4-3
Alternative A3
Annual Dredging and Hauling

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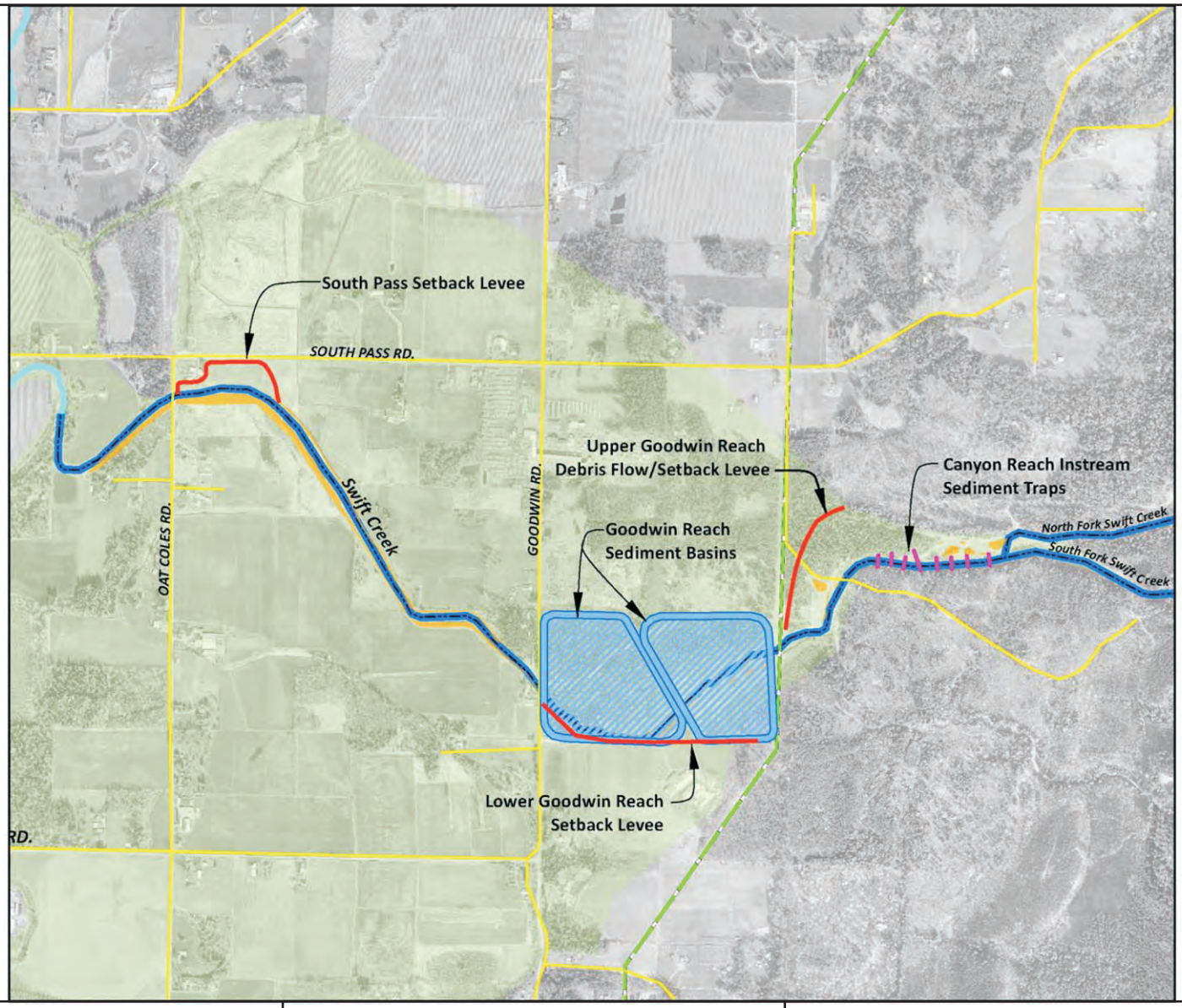
Dredge Area

Sources: 2010 DigitalGlobe USGS, 2013 Microsoft, 2010 NAVTEQ



N

0 500 1,000 2,000 Feet

SUMAS MOUNTAIN ASBESTOS
(aka SWIFT CREEK) SITE
Whatcom County, Washington

Figure 4-4
Alternative A4
Sediment Basins, Setback Levees, and In-Stream Sediment Traps

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Source: Whatcom County Public Works Department, 2012.

5 Analysis of Removal Action Alternatives

This section presents both the individual and comparative analyses of the removal action alternatives based on the short- and long-term effectiveness of each alternative relative to reducing the potential for asbestos exposure and providing protection of public health and the environment. EPA's three broad criteria—effectiveness, implementability, and cost—are used to evaluate each alternative against the scope of the removal action, and these criteria are described below.

Effectiveness

Effectiveness includes several evaluation factors, which are defined below.

Overall Protection of Human Health and the Environment: Assesses the ability of the alternative to be protective of human health under present and future land use conditions.

Compliance with ARARs: Identifies whether implementation of the alternative would comply with all chemical-specific, action-specific, and location-specific ARARs and TBC requirements.

Long-term Effectiveness: Addresses the magnitude of residual risk remaining at the conclusion of removal activities; that is, addresses the adequacy and reliability of controls established by a removal action alternative to maintain reliable protection of human health and the environment over time.

Reduction of Toxicity, Mobility, and Volume through Treatment: Identifies whether or not implementation of the alternative would reduce contaminant toxicity, mobility (e.g., preventing contaminant migration soil from reaching human receptors), or actual volume of the hazardous substances.

Short-term Effectiveness: This criterion addresses the effects of an alternative during the construction and implementation phase until the removal objectives are met. This criterion includes the time with which the removal action achieves protectiveness and potential to create adverse impacts on human health and the environment during construction and implementation.

Implementability

Implementability is evaluated in accordance with the criteria defined below.

Technical Feasibility: Evaluates construction and operational considerations, as well as demonstrated performance/useful life.

Administrative Feasibility: Evaluates activities such as statutory limits, permitting requirements, easements/rights of ways, and impact on adjoining property.

Availability of Service and Materials: Considers the availability of qualified contractors to handle site preparation, design, equipment, personnel, services and materials, excavation, disposal capacity, and transportation in time to maintain the removal schedule, as well as the availability of disposal facilities that can accept asbestos-related wastes.

State Acceptance: Considers whether the state is likely to concur with the proposed alternatives.

Community Acceptance: Considers level of stakeholder acceptance of the proposed alternatives.

It should be noted that the previous two implementability criteria (state and community acceptance) are used to modify the selection of an alternative. Therefore, these two criteria are not used in the current evaluations with the exception of Alternative 1. Only the No Action alternative uses these two criteria, which are based upon anticipated acceptance given the current conditions at the site. A public comment period will be used to gauge actual State and community acceptance and the evaluations will be modified based upon actual responses.

Cost

Summaries of the removal action alternative costs (except for the No Action alternative, which has no associated costs) are provided in Tables 5-1 through 5-3, and assumptions and references for the cost estimates are included in the Appendix E. Each removal action alternative was evaluated to determine its project cost, and the cost estimates contain the capital cost and annual operational and maintenance costs. The cost estimate for each component of the proposed alternatives is based on assumptions provided in this section and in Appendix E.

To the extent possible for Alternative A4 (Sediment Basins), the cost estimate presented in this EE/CA relies on cost estimates and other information provided in the Whatcom County SCSMAP Phase I Implementation Plan (Whatcom County 2012b). For specific structures (i.e., the South Pass Road Setback Levee, the Upper Goodwin Reach Debris Flow Deflection/Setback Levee, and the Canyon Reach In-Stream Sediment Trap Structures), the cost estimates were verified and then incorporated herein. In the SCSMAP Phase I Implementation Plan, the cost estimate for the sediment basins was based on a 1976 estimate (Converse 1976), with the value adjusted for inflation. In this EE/CA, the costs for the sediment basin were re-calculated using current costs, relying on elements from the 1976 cost estimate as well as new assumptions outlined herein.

Because of uncertainties and variations, including the amount of asbestos-containing sediment expected to be carried down Swift Creek and the quantity that would be transported to repositories, actual cleanup costs may be expected to range by an approximate factor of -20%/ +50%.

The present worth should be calculated for alternatives that will last longer than 12 months (EPA 1993). Under this EE/CA, removal action alternatives A3 and A4 will require more than 12 months of operation; therefore, present worth is required for those alternatives.

5.1 Individual Analysis of Alternatives

The individual analysis of alternatives is intended to provide the relevant information required to select a removal alternative. The evaluation of alternatives was conducted using EPA's evaluation criteria, which are listed in the guidance for conducting an EE/CA (EPA 1993).

5.1.1 Alternative A1 – No Action

As required under the NCP, the No Action alternative was included and evaluated to provide a baseline to which other alternatives can be compared. Under this alternative, no action would be

taken to prevent asbestos-containing sediment from being deposited in the Swift Creek or Sumas River flood plain.

Effectiveness
This alternative does not address asbestos-containing sediment and does not meet the RAOs. Risks to human health and the environment would likely increase as material from Sumas Mountain is deposited in more areas where releases caused by human activities would result in more exposure to asbestos.

Overall Protection of Human Health and the Environment: For Alternative A1, no action will be implemented to reduce potential exposure to asbestos-laden sediments. Therefore, this alternative provides for no active protection of human health and the environment. As a consequence of No Action, Swift Creek may be expected to continue to fill, creating an increased likelihood of flooding and human exposures to asbestos.

Compliance with ARARs: ARARs would not apply as no response action would be taken.

Long-Term Effectiveness and Permanence: Under Alternative A1, asbestos-laden sediments would continue to migrate and accumulate in an unabated manner. Therefore, this alternative offers no long-term effectiveness or permanence.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative provides no reduction of toxicity, mobility, or volume through treatment because no action will be implemented.

Short-Term Effectiveness: Short-term effectiveness is used to evaluate risks to workers and the community from an alternative during activities such as construction, truck traffic, and air emissions. Implementation of the No Action alternative does not pose such short-term risks.

Implementability
This alternative is technically implementable since there is no action to implement.

Cost
There is no cost associated with the No Action alternative.

5.1.2 Alternative A2 – Institutional Controls and Access Restrictions

In this alternative, asbestos-containing sediment would be allowed to be deposited by floods on properties in the Swift Creek flood plain. Access to affected areas would be limited by acquiring properties or property rights and implementing institutional and access controls to reduce potential exposure.

Effectiveness
This alternative does not remove the asbestos-containing sediment. By allowing Sumas Mountain material to be deposited on the Swift Creek alluvial fan and flood plain, this alternative could naturally reduce (but not eliminate) downstream transport to the Sumas River. Institutional and access controls could reduce exposure to residential receptors in the Swift Creek area. Restricting farming, livestock, and residential land use in areas affected by flood deposits could thus reduce the potential human exposure to asbestos, but it would not prevent all animal access, and asbestos would continue to be deposited on existing soil. At the same time, with a potentially larger affected area, it could be harder than it is currently to keep people from

accessing areas with asbestos. Vegetation would be minimal, particularly in areas of active creek meandering, and uncontrolled deposition would expose flood deposits to drying and wind erosion. Therefore, this alternative does not meet the RAOs. Existing and future risks to human health and the environment would remain unchanged or increase.

Overall Protection of Human Health and the Environment: Under this alternative, institutional controls will be implemented to address potential exposure pathways and limit human exposure to the asbestos-containing sediment in the Swift Creek floodplain. Since the asbestos-laden sediments will move downstream in smaller volumes, and residential and commercial use of Swift Creek areas affected by flood deposits would be restricted, this alternative does offer some protection to human health. However, as noted above, restricting human and animal access to a large area could be difficult, and the area would have little vegetation and would be subject to drying and wind erosion. It would reduce but not prevent flooding impacts from affecting the more populous Sumas River floodplain.

Compliance with ARARs: This alternative does not comply with all ARARs or TBCs associated with the site. In particular, this alternative appears likely to be inconsistent with the State of Washington rules regarding fugitive dust. WAC 173-400-040(9), in part, requires the owner or operator of a source or activity that generates fugitive dust to take reasonable precaution to prevent that fugitive dust from becoming airborne. WAC 173-400-040(9) may be applicable or relevant and appropriate for this alternative as it may result in a large surface area covered by fine dust left when asbestos-containing sediment is deposited and dries out. Without an owner or operator identified and committed to take reasonable precautions to prevent fugitive dust from this area, this alternative may be inconsistent with this ARAR. In addition, this alternative may also be inconsistent with State of Washington rules regarding soil contamination, including WAC 173-340-740(6), which provides that "cleanup actions shall not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup action for all or a portion of the site." For the Sumas Mountain Site, it may be hard to show that it is not "technically possible" to implement a "more permanent action" for at least a "portion" of the Site. Therefore, the Institutional Controls and Access Restrictions alternative appears to be inconsistent with substantive requirements of WAC 173-340-440(6).

Long-Term Effectiveness and Permanence: This alternative would allow for uncontrolled sediment deposition in the Swift Creek floodplain. If affected properties are acquired or restricted in use, limited long-term protectiveness may be achieved. The overall effectiveness of this alternative would depend on the number of properties that can be acquired or otherwise restricted, with the maximum effectiveness obtained only if all of the affected properties are so acquired or restricted.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative provides no reduction of toxicity or volume through treatment. There would be some reduction in mobility by allowing sediments to settle on surrounding shoreline properties.

Short-Term Effectiveness: Short-term effectiveness is used to evaluate risks to workers and the community from an alternative during activities such as construction, truck traffic, and air emissions. Given that physical activities associated with this alternative are limited, including posting signs and fencing, the short-term risks are minimal.

Implementability
This alternative is technically implementable. Fencing and signage to restrict access to the area are readily available. Alternative A2 would be administratively challenging, however. EPA is not authorized by statute to acquire or own property in order to effectuate a removal action (see CERCLA Section 104(j)(i)), so another entity would need to accept ownership or property titles or rights to enforce land use restrictions. This could require the coordination of multiple parties to create and fund a trust or limited liability corporation, for example. Additionally, owners may not want to sell, transfer, or otherwise restrict use of their properties.

Cost
The total estimated cost associated with Alternative A2 is $3,100,000. This cost does not included land acquisition costs; under this alternative it is assumed that the institutional controls and access restrictions can be implemented without property transfer. Indirect capital costs, including administration and legal fees, were estimated based on the market value price of the affected area. A summary of the major cost items is presented in Table 5-1. Future costs were not calculated but would mainly involve fence maintenance. Additional details of this cost estimate are presented in Appendix E.

5.1.3 Alternative A3 – Annual Dredging and Hauling
This alternative involves the annual dredging of deposited asbestos-containing sediment from the Swift Creek channel. Dredged sediments would be hauled to a nearby repository for permanent disposition.

Effectiveness
By dredging asbestos-laden sediments and placing them into a dedicated repository, Alternative A3 will help prevent further accumulation of asbestos in the immediate area. However, since asbestos-containing sediment that is not removed annually (estimated at approximately two-thirds of the total suspended and bedload sediment) will continue down Swift Creek to the Sumas River, this alternative won't address aggradation, flooding and associated sediment deposition in populated areas of the floodplain. Thus, this alternative does not address downstream exposure pathways.

Overall Protection of Human Health and the Environment: This alternative would reduce the overall accumulation of asbestos within the Swift Creek channel and flood plain area, but asbestos material will still be present and some will continue to move downstream to the Sumas River. Therefore, this alternative does offer some protection of human health and the environment, but doesn't completely eliminate exposure pathways.

Compliance with ARARs: This alternative can be implemented such that most of the ARARs and TBCs could be met. For example, dredging activities under this alternative could be implemented in a manner intended to meet substantive requirements of Clean Water Act Section 404. The disposal option associated with this alternative may diverge from general requirements for asbestos disposal at an approved landfill. Coordination with the Northwest Clean Air Agency, WDOE, Whatcom County Health Department, and other agencies may be required to ensure compliance with substantive requirements identified as ARARs. Additional protective measures and requirements beyond those assumed for estimating the cost of this option could be required, adding to the overall costs.

Long-Term Effectiveness and Permanence: Under this alternative, asbestos-containing sediments would be dredged annually and placed into a dedicated repository. This alternative

does offer a long-term effective and permanent solution for the dredged asbestos-laden sediments and would reduce the volume of downstream transport. However, some asbestos-containing sediment will continue to move downstream to the Sumas River and periodically be deposited on its flood plain. Therefore, Alternative A3 offers limited long-term effectiveness and permanence. If dredging is not continued after 10 years, issues of flooding and asbestos exposure will likely recur.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative does not reduce the toxicity or volume through treatment. Mobility would be reduced by placing the asbestos-containing sediment into a dedicated repository, although the creek channel dredging will increase stream velocity and the mobility of asbestos-containing sediments not removed from the channel.

Short-Term Effectiveness: There are short-term risks associated with this alternative. As stated above, asbestos may become airborne or spread to other areas during dredging, hauling, and disposal operations. Appropriate wet methods, dust and sediment control, personnel protection, and air monitoring protocols need to be designed and implemented to ensure worker and community protection. Additionally, truck traffic hazards and road impacts will be associated with the hauling of sediments to the repository.

Implementability

Dredging and hauling technologies and controls are straightforward and proven. Equipment, trained operators, and supplies are readily available. Therefore, the alternative is technically implementable. Administratively, substantive requirements of dredging permits would have to be met, and a repository location will need to be identified. An entity will be needed to hold title to and operate the repository. A permit may be needed or, if located on site, compliance with the substantive requirements of a permit. Public acceptance of a repository off site may be challenging.

Cost

The capital cost for Alternative A3 was estimated to be $217,000. This cost does not include land acquisition costs for a repository. The annual cost (termed post-removal site control, PRSC) was estimated to be $1,860,000. Assuming a 10-year operational life and an inflation rate of 3.5%, the total present worth of Alternative A3 is $15,690,000. A summary of major cost components is provided in Table 5-2. Additional cost information is provided in Appendix E.

5.1.4 Alternative A4 – Sediment Basins, Setback Levees, and In-Stream Sediment Traps

In this alternative, sediment basins, setback levees, and in-stream sediment traps would be constructed on the upper Swift Creek alluvial fan (east of Goodwin Road) to capture and manage bedload and suspended load sediment and reduce the amount of asbestos-laden sediment migrating downstream. Once the sediment basins and other features reach capacity, the asbestos-containing sediment would need to be hauled to a nearby repository for permanent disposition. To address the risk of asbestos-laden sediment deposition due to current conditions in Swift Creek, this alternative would also include the removal of approximately 200,000 cubic yards of material in berms built from dredge spoils and clogging the Swift Creek channel. This material would be hauled to and placed in the nearby permanent repository.

Effectiveness
Alternative A4 can provide an effective removal alternative to address the RAOs established for the site, by capturing and removing asbestos-containing sediment that would otherwise move downstream into the residential areas along both Swift Creek and Sumas River. The sediment traps would intercept larger materials, while the sediment basins would greatly reduce both bedload and suspended sediments moving through the system.

Overall Protection of Human Health and the Environment: Because this alternative involves upstream collection, removal, and subsequent placement of asbestos-laden sediments into a dedicated repository, it will provide a reduction in asbestos exposure, providing protection of human health and the environment.

Compliance with ARARs: This alternative could be implemented in such a way as to be compliant with the ARARs and TBCs. For example, as with A3, ARARs for A4 could include substantive requirements of Clean Water Act Section 404 for work to remove sediments from sediment traps constructed within Swift Creek. ARARs would also include controls for fugitive dust from facilities constructed to contain dredged materials. Engineering features would be designed to meet substantive requirements of State rules including those for dam safety and disposal of contaminated materials, to the extent practicable. The disposal option associated with this alternative may diverge from general requirements for asbestos disposal at an approved landfill. Coordination with the Northwest Clean Air Agency, WDOE, Whatcom County Health Department, and other agencies may be required to ensure compliance with substantive requirements identified as ARARs. Additional protective measures and requirements beyond those assumed for estimating the cost of this option could be required, adding to the overall costs.

Long-Term Effectiveness and Permanence: Under this alternative, asbestos-containing sediments would be intercepted up-stream of the populated areas of Swift Creek and annually placed into a dedicated repository. For as long as there is storage capacity and operating funds, continuous removal of sediments and containment in a repository may offer an effective interim solution for the asbestos-laden sediments.

Reduction of Toxicity, Mobility, or Volume through Treatment: This alternative would not reduce the toxicity or volume of asbestos-containing sediment through treatment. Mobility would be reduced by placing the asbestos-containing sediment into a dedicated repository.

Short-Term Effectiveness: The short term risks associated with Alternative A4 include traffic impacts from hauling the material from the sediment traps and basins to a staging area and then to the repository. Use of an on-site repository would avoid traffic hazards on public roads. Construction and maintenance, including removal or consolidation of sediments, would need to be performed in accordance with applicable federal and state regulations to protect workers and the community.

Implementability
Sediment basins and the technology associated with them are considered effective and proven. Equipment, trained operators, and supplies are readily available. Therefore, the alternative is technically implementable. Administratively, this alternative can be implemented provided that a suitable location for the repository can be identified and acquired, the permits needed to operate it can be obtained (or substantive requirements met, for an on-site repository), and an entity is

willing to hold title. Depending upon the final location of the repository, public acceptance may be difficult to obtain.

Cost

The total capital cost for Alternative A4 was estimated to be $13,250,000. This cost does not include land acquisition costs for a repository. The annual PRSC cost was estimated to be $3,660,000. Assuming a 10-year operational life and an inflation rate of 3.5%, the total present worth of Alternative A4 is $43,690,000. A summary of major cost components is provided in Table 5-3. Additional cost information is provided in Appendix E

For the sediment basin, the SCSMAP Implementation Plan (Whatcom County 2012b) provided a cost estimate of approximately $14 million for a similar conceptual basin-type design with a 3-year lifespan. This cost was derived from a 1976 estimate (Converse 1976), after adjusting for inflation (KWL 2008). Based on this, the SCSMAP stated that a cost "range of $4 million to $20 million may be applicable given 'best to fair scenario' conditions" (Whatcom County 2012b). The total capital cost of approximately $13 million estimated in this EE/CA for construction of the sediment basins and other control structures is similar to the $14 million estimated in the SCSMAP. However, the SCSMAP doesn't directly address costs associated with annual maintenance beyond a 3-year lifespan or final disposition of the sediments, while the costs in this EE/CA include the construction of a repository and annual maintenance to move 150,000 yd^3 of sediment to the repository for a 10-year period. Therefore, the estimated costs associated with annual maintenance and final disposal over a 10-year period explain the majority of the differences in the cost estimates between this EE/CA and the Whatcom County SCSMAP.

5.2 Comparative Analysis of Alternatives

In the previous section, the removal action alternatives were individually analyzed using EPA's three broad criteria of effectiveness, implementability, and cost. In this section, the alternatives are compared to each other using the same broad criteria. The comparative analysis is intended to provide the relevant information required to select a removal alternative.

5.2.1 Effectiveness

With the exception of Alternative A1 (No Action), the three action alternatives provide varying degrees of effectiveness. Alternative A2 (Institutional Controls and Access Restrictions) is slightly more effective than the No Action alternative in that institutional controls will be relied on to reduce potential human exposure in areas affected by Swift Creek floods. Of the two remaining alternatives, Alternative A4 (Sediment Basins) will be the most effective alternative. While both A3 (Annual Dredging) and A4 include dedicated repositories to provide long-term storage of the asbestos-containing sediments, A4 collects the asbestos-laden sediment upstream of the populated areas of Swift Creek and Sumas River and does so continuously. Annual dredging would only address those sediments that become deposited in the Swift Creek channel each year and would not address material that moves downstream or becomes deposited on the floodplain. Therefore, Alternative A4 is the most effective alternative in regards to meeting the site-specific RAOs.

Protection of Human Health and the Environment: Alternative A4 potentially provides the most protection of human health and the environment because it intercepts both bedload and suspended load sediments and minimizes the amount of asbestos-laden sediment entering more populated downstream communities. While both A4 and A3 include dedicated repositories (differing in size) for asbestos-containing sediments, A4 manages the material upstream, away

from the more populated downstream areas, while the annual dredging operations in A3 would occur near populated areas.

Alternative A2 relies solely on institutional controls and access restrictions to reduce the potential asbestos exposure. This provides far less protection than Alternatives A4 and A3. While the No Action Alternative (A1) provides the least protection, the difference between Alternatives A1 and A2 is not considered significant.

Compliance with ARARs: Ultimately, meeting the requirements of the ARARs is dependent upon the design and implementation of the alternative. While the No Action alternative (A1) does not trigger ARARs, Alternatives A2, A3, and A4 can. It is probable that A4 can be designed to meet the ARARs, because a series of dedicated collection systems will be designed and implemented; whereas, for Alternative A3 compliance with the ARARs will be more difficult due to its reliance on the existing natural sedimentation process. Finally, Alternative A2 uses only land use restrictions, fencing, and signs to minimize exposure to asbestos-containing sediments. This will likely not meet state ARARs associated with fugitive dust and soil contamination.

Long-Term Effectiveness and Permanence: No alternative provides a permanent solution to the landslide and the ongoing erosion of asbestos-containing sediment into the stream. For the assumed 10-year duration evaluated in this EE/CA, Alternatives A3 (Annual Dredging) and A4 (Sediment Basins) offer similar levels of long-term effectiveness and permanence for asbestos-containing sediment placed in a repository. Under Alternative A4 the sediment is continuously intercepted upstream and away from more populated areas. Under Alternative A3, sediment removal from the channel would occur annually, but during most times of the year, bedload and suspended sediment (potentially 2/3 of the total volume) would continue downstream. For this reason, Alternative A4 is more protective.

Alternative A1, the No Action alternative, provides neither long-term effectiveness nor permanence. Alternative A2 provides limited long-term effectiveness for residents in the Swift Creek floodplain, provided the institutional controls and access restrictions remain effective. If Alternative A4 sediment interception is maintained, the alternative should continue to function beyond the 10-year period, while if annual dredging (Alternative A3) stops, the issues of aggradation and exposure to flood deposits returns to current levels.

Reduction of Toxicity, Mobility, or Volume through Treatment: None of the proposed alternatives provides for reduction of toxicity or volume through treatment.

With the exception of Alternative A1, which also provides for no reduction in mobility, the three action alternatives do provide varying degrees in mobility reduction. While Alternative A2 (Institutional Controls and Access Restrictions) does provide some reduction in mobility by allowing sediments to settle on surrounding shoreline properties, it does not provide for the same degree of reduction that Alternatives A3 (Annual Dredging) and A4 (Sediment Basins) provide. While both Alternatives A3 and A4 collect and place asbestos material into a dedicated repository, the dredging associated with A3 will increase stream velocity and resulting mobility of asbestos-containing sediments that are not removed from the channel. Therefore, Alternative A4 provides a greater reduction in mobility.

Short-Term Effectiveness: Alternative A1 does not in itself pose short term risks, because no actions are undertaken. Of the three action alternatives, Alternative A2 (Institutional Controls

and Access Restrictions) has fewer adverse effects in the short-term than Alternatives A3 (Annual Dredging) and A4 (Sediment Basins).

5.2.2 Implementability

While all of the removal alternatives are technically implementable and the materials, labor and equipment are also readily available, Alternative A2 (Institutional Controls and Access Restrictions) is considered to be the most technically implementable of the three action alternatives. As stated previously, there is no heavy construction activities associated with A2, and erecting fences and posting warning signs are the main construction items associated with this alternative. However, from an administrative standpoint, Alternative A2 may be difficult to implement because of the need for an entity to own the land and the need for individual property owners and the local community to agree to property transfers or use restrictions. Alternative A3 (Annual Dredging) is considered to be the most implementable overall. Unlike Alternative A4 (Sediment Basins), Alternative A3 involves excavation and dredging on an annual basis and does not require the construction and operation of a sediment collection system. Administratively, both Alternative A3 and A4 require siting, land acquisition, permitting (or meeting any substantive requirements of any permits) and ownership/management of a repository. Due to statutory limits in CERCLA Sec. 104(a)(3), parts of Alternatives A2, A3, and A4 may be beyond EPA's authority to implement.

While technically and administratively implementable, Alternative A1, No Action, will result in uncontrolled asbestos deposition in the floodplain, and the resulting impact to human health in the long term, while not fully understood, would be greater.

5.2.3 Cost

Alternative A1 (No Action) has the lowest cost ($0). Of the three action alternatives over the 10-year costing period assumed for this EE/CA, Alternative A2 (Institutional Controls and Access Restrictions) is the least expensive alternative ($3,100,000), followed by Alternative A3 (Annual Dredging) ($15,690,000). The most expensive alternative is Alternative A4 (Sediment Basins), which has a total cost of $43,690,000.

Table 5-1
Cost Estimate, Alternative A2
Institutional Controls and Access Restrictions
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs				
Item Description	**Quantity**	**Unit**	**Cost/Unit**	**Cost**
Land Acquisition Costs	2,600	acre		Not Included
Subtotal Direct Capital Costs (rounded to nearest $10,000)				***$0***
Indirect Capital Costs				
Administration	3.5%			$1,411,000
Legal Fees and License/Permit Costs	3.5%			$1,411,000
Subtotal Indirect Capital Costs (rounded to nearest $10,000)				***$2,820,000***
Subtotal Capital Costs				$2,820,000
Contingency Allowance (10%)				$282,000
Total Cost, Not Including Land Acquisition (rounded to nearest $10,000)				**$3,100,000**

Assumptions:

Costs to acquire property are not included.

Indirect capital costs are based on the market value price ($40,310,465) of the potentially affected area (approximately 2,600 acres).

Table 5-2
Cost Estimate, Alternative A3
Annual Dredging and Hauling for 10 years
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs					
Item Description	**Quantity**	**Unit**	**Cost/Unit**		**Cost**
Land Acquisition Cost for Repository (A3 Repository Option)	15	acre			Not Included
Silt Fence, polypropylene	3,500	l.f.	$0.83		$2,905
Erosion Control Hay Bales, staked	2,500	l.f.	$10.55		$26,375
Chain Link Fence (6' high) for Repository	4,000	l.f.	$19.25		$77,000
Total Direct Capital Costs (Rounded to Nearest $1,000)					*$106,000*
Indirect Capital Costs					
Engineering and Design	7%				$23,940
Administration	5%				$17,100
Legal Fees and License/Permit Costs	5%				$17,100
3rd Party Construction Oversight	5%				$17,100
Total Indirect Capital Costs (Rounded to Nearest $1,000)					*$75,000*
Total Capital Costs					
Subtotal Capital Costs					*$181,000*
Contingency Allowance	20%				*$36,200*
Total Capital Cost (Rounded to Nearest $1,000)					***$217,000***
Annual Direct PRSC Costs					
Item Description	**Quantity**	**Unit**	**Cost/Unit**	**Annual Cost**	**10-Year Cost**
Field Overhead and Oversight	2	month	$16,760	$33,520	
Air Monitoring Instrument Rental	2	month	$3,405.00	$6,810	
Mobilization and Demobilization	1	l.s.	$1,614	$1,614	
Dredging of Asbestos-Containing Sediment from Creek Channel	50,000	c.y.	$4.14	$207,000	
Material Hauling (from dredging location to staging area)	50,000	c.y.	$5.30	$265,000	
Load Asbestos-Containing Sediment from Dump Location: front end loader, 3 c.y. bucket	50,000	c.y.	$4.14	$207,000	
Transportation of Asbestos-Containing Sediment (from staging area to repository)	50,000	c.y.	$6.40	$320,000	
Spread Dumped Material at Repository: dozer, no compaction	50,000	c.y.	$2.26	$113,000	
Compaction of Dumped Material in Repository: riding, vibrating roller, 12" lifts, 2 passes	50,000	c.y.	$0.26	$13,000	
Finish Grading of Repository: slopes, steep	75,000	s.y.	$0.25	$18,750	
Water Truck: soil wetting	50,000	c.y.	$2.38	$119,000	
Purchase and Transport of Topsoil for Repository Cover	12,500	c.y.	$7.00	$87,500	
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	12,500	c.y.	$2.26	$28,250	
Seeding for Repository Cover	15	acre	$1,250.00	$18,750	
Total Annual Direct PRSC Costs (Rounded to Nearest $1,000)				*$1,439,000*	
Annual Indirect PRSC Costs					
Administration	5%			$71,950.00	
Insurance, Taxes, Licenses	3%			$43,170.00	
Total Annual Indirect PRSC Costs (Rounded to Nearest $1,000)				*$115,000*	
Total Annual PRSC Costs					
Subtotal Annual PRSC Costs				*$1,554,000*	
Contingency Allowance	20%			$310,800	
Total Annual PRSC Cost, with Discount Rate (Rounded to Nearest $10,000)				***$1,860,000***	***$15,470,000***
Total Cost					
Total Cost, Not Including Land Acquisition (Rounded to Nearest $10,000)					**$15,690,000**

Assumptions:
Costs to acquire property are not included.
Indirect Capital Costs are based in part on estimated land value for repository.
Does not include sediment that is already placed in berms along Swift Creek.
Sediment quantity estimate of 50,000 c.y. for annual PRSC assumes bedload sediment deposited on the lower reach of Swift Creek.
100 truckloads (20 cy capacity)/day were assumed to estimate duration of dredging and hauling to repository activities.
Transportation assumes the repository is 5 miles away from the staging/loading area (i.e., 10 miles round trip).
Maintenance costs of the repository cover layer are not included.
10-year cost projection assumes a discount rate of 3.5% per year.
In accordance with NESHAP, a cover soil layer of 6 inches was assumed.

Key:
c.y. = cubic yard
l.f. = linear foot
l.s. = lump sum
NESHAP = National Emission Standards for Hazardous Air Pollutants
PRSC = post-removal site control
s.y. = square yard

Table 5-3
Cost Estimate, Alternative A4
Sediment Basins, Setback Levees, and In-Stream Sediment Traps
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs					
Item Description	**Quantity**	**Unit**	**Cost/Unit**		**Cost**
Direct Capital Costs					
Sediment Basin					
Field Overhead and Oversight	8	month	17,960.00		$145,186
Air Monitoring Instrument Rental	8	month	$3,405.00		$27,526
Mobilization and Demobilization	1	l.s.	4,304.00		$4,304
Land Acquisition Cost for Sediment Basin	80	acre	15,750.00		Not Included
Land Acquisition Cost for Repository (A4 Repository Option)	50	acre	15,750.00		Not Included
Clearing and Grubbing	80	acre	1,650.00		$132,000
Stripping	242,500	c.y.	0.93		$225,525
Embankment	1,157,500	c.y.	0.96		$1,111,200
Waste Excavation	150,000	c.y.	4.14		$621,000
Filter Blanket	162,500	s.y.	2.33		$378,625
Slope Protection	95,000	s.y.	2.33		$221,350
Channel Excavation	27,500	c.y.	4.14		$113,850
Drop Inlet Control Structures					
Concrete (including structure excavation)	360	c.y.	485.00		$174,600
Pre-stress conc. Pipe.	180	l.f.	241.00		$43,380
Slide Gates	4	each	20,230.00		$80,920
Training Dike					
Clearing	2	acre	1,650.00		$3,300
Stripping	2,000	acre	0.93		$1,860
Embankment	11,000	c.y.	0.96		$10,560
Slope Protection	1,000	s.y.	2.33		$2,330
Excavation of Asbestos-Containing Sediment in Berms along Swift Creek	200,000	c.y.	4.14		$828,000
Transportation of Asbestos-Containing Sediment (from berm location to repository)	200,000	c.y.	6.40		$1,280,000
Spread Dumped Material at Repository: dozer, no compaction	200,000	c.y.	2.26		$452,000
Compaction of Dumped Material in Repository: riding, vibrating roller, 12" lifts, 2 passes	200,000	c.y.	0.26		$52,000
Water Truck: soil wetting	200,000	c.y.	2.38		$476,000
Purchase and Transport of Topsoil for Repository Cover	50,000	c.y.	7.00		$350,000
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	50,000	c.y.	$2.26		$113,000
Seeding for Repository Cover	50	acre	$1,250.00		$62,500
Access Road for Sediment Basins	4,000	l.f.	14.75		$59,000
Channel Restoration	50,000	c.y.	4.14		$207,000
South Pass Road Setback Levee (1)	1	l.s.	159,957.00		$159,957
Upper Goodwin Reach Debris Flow Deflection/Setback Levee (1)	1	l.s.	534,879.00		$534,879
Canyon Reach Instream Sediment Trap Structures (1)	1	l.s.	565,956.00		$565,956
Silt Fence, polypropylene	8,000	l.f.	0.83		$6,640
Erosion Control Hay Bales, staked	6,000	l.f.	10.55		$63,300
Chain Link Fence (6' high) for Sediment Basins and Repository	17,000	l.f.	19.25		$327,250
Total Direct Capital Costs (Rounded to Nearest $1,000)					*$8,835,000*
Indirect Capital Costs					
Engineering and Design	10%				$883,500
Administration	5%				$441,750
Legal Fees and License/Permit Costs	5%				$441,750
3rd Party Construction Oversight	5%				$441,750
Total Indirect Capital Costs (Rounded to Nearest $1,000)					*$2,209,000*
Total Capital Costs					
Subtotal Capital Costs					*$11,044,000*
Contingency Allowance	20%				*$2,208,800*
Total Capital Cost (Rounded to Nearest $10,000)					***$13,250,000***
Annual Direct PRSC Costs					
Description	**Quantity**	**Unit**	**Cost/Unit**	**Annual Cost**	**10-Year Cost**
Field Overhead and Oversight	4	month	17,960.00	$68,248	
Mobilization and Demobilization	1	l.s.	2,690.00	$2,690	
Excavation of Asbestos-Containing Sediment from Sediment Basins	150,000	c.y.	4.14	$621,000	
Transportation of Asbestos-Containing Sediment (from sediment basins to repository)	150,000	c.y.	6.40	$960,000	
Spread Dumped Material: dozer, no compaction	150,000	c.y.	2.26	$339,000	
Compaction: riding, vibrating roller, 12" lifts, 2 passes	150,000	c.y.	0.26	$39,000	
Water Truck: soil wetting	150,000	c.y.	2.38	$357,000	
Purchase and Transport of Topsoil for Repository Cover	40,500	c.y.	7.00	$283,500	
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	40,500	c.y.	$2.26	$91,530	
Seeding for Repository Cover	50	acre	$1,250.00	$62,500	
Total Annual Direct PRSC Costs (Rounded to Nearest $1,000)				*$2,824,000*	
Annual Indirect PRSC Costs					
Administration	5%			$141,200.00	
Insurance, Taxes, Licenses	3%			$84,720.00	
Total Annual Indirect PRSC Costs (Rounded to Nearest $1,000)				*$226,000*	
Total Annual PRSC Costs					
Subtotal Annual PRSC Costs				*$3,050,000*	
Contingency Allowance	20%			$610,000	
Total Annual PRSC Cost, with Discount Rate (Rounded to Nearest $10,000)				***$3,660,000***	***$30,440,000***
Total Cost					
Total Cost, Not Including Land Acquisition (Rounded to Nearest $10,000)					**$43,690,000**

Note: (1). The costs for these items are from the Whatcom County Swift Creek Sediment Management Action Plan (SCSMAP).

Assumptions:
Costs to acquire property are not included.
Indirect Capital Costs are based in part on estimated land value for repository.
Assumes two sediment basins to be constructed with the total storage capacity presented in the SCSMAP.
Sediment quantity estimate of 150,000 c.y. for annual PRSC assumes total of bedload and suspended sediment released to Swift Creek.
A factor of 2.5 was applied to sediment basin quantities to account for the SCSMAP sediment storage capacity of 1,963,000 cubic yards.
The 1976 Converse cost estimate was based on a sediment storage capacity of 771,173 cubic yards.
A 10-year lifespan was assumed for the sediment basin. 150,000 cy/yr @ 10 yrs = 1,500,000 cubic yards.
100 truckloads (20 cy capacity)/day were assumed to estimate duration of dredging and hauling for repository activities.
Transportation assumes the repository is 5 miles away from the staging/loading area (i.e., 10 miles round trip).
Maintenance costs of the repository cover layer are not included.
10-year cost projection assumes a discount rate of 3.5% per year.
In accordance with NESHAP, a cover soil layer of 6 inches was assumed.

Key:
c.y. = cubic yard
l.f. = linear foot
l.s. = lump sum
NESHAP = National Emission Standards for Hazardous Air Pollutants
PRSC = post-removal site control
SCSMAP = (Whatcom County) Swift Creek Sediment Management Action Plan, 2012
s.y. = square yard

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6 Recommended Removal Action Alternative

Based on the alternative evaluation conducted in Section 5, Alternative A4 (Sediment Basins, Setback Levees, and In-Stream Sediment Traps) is the recommended removal action alternative for the Sumas Mountain Asbestos (aka Swift Creek) Site.

Although Alternative A4 is the most expensive alternative, it is technically and administratively implementable, and it is considered to be the most effective at meeting the site-specific RAOs. While both alternatives A3 and A4 involve the removal of asbestos-contaminated sediment from the site followed by final disposition in a dedicated repository for long-term storage, Alternative A4 removes both suspended and bedload sediment and the associated asbestos contamination before it enters the more populated areas of Swift Creek and the downstream Sumas River. Additionally, the sediment basins and other control structures remove the asbestos-contaminated sediment automatically and continuously, without requiring annual dredging. While readily implementable, Alternative A3 (Annual Dredging) is not considered as effective at meeting the site-specific RAOs because it only addresses the bedload sediments deposited in the lower reaches of Swift Creek each year, and A3 does not address the remaining asbestos-laden suspended sediment, perhaps two thirds of the total volume. This sediment will continue downstream where it may increase flood risks and may be deposited on farms, residences, and towns in the flood plain of Sumas River.

Alternative A4 is nearly three times more expensive than Alternative A3. However, Alternative A4 addresses both bedload and suspended sediments (estimated to be 150,000 yd^3 per year for planning purposes) upstream and away from populated areas, while Alternative A3 would only capture the bedload sediment deposited along the Swift Creek channel (estimated at approximately 50,000 yd^3 annually), with additional suspended sediments continuing to be transported downstream to the Sumas River. Because Alternative A4 is intended to address approximately three times as much asbestos-contaminated sediment, the costs are actually similar per unit of contaminated sediment. Because Alternative A4 will address both bedload and suspended sediments and because it does so upstream and further away from populated areas, the additional costs are considered reasonable for the additional protection of human health provided. Additionally, with periodic maintenance, the sediment basins and other sediment collection structures could conceivably be used beyond the 10-year performance period used for this EE/CA, which could provide additional cost benefit in the future.

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7 References

Blake, D.L., 1991, Swift Creek Asbestos Health Risk Analysis, Northwest Air Pollution Authority, Mount Vernon, Washington.

Converse Davis Dixon Associates, Inc. (Converse), 1976, Final Geotechnical Report for Swift Creek Tributaries, Sumas River Watershed, prepared for the United States Soil Conservation Service.

Ecology and Environment, Inc. (E & E), September 24, 2012a, *Sampling Plan Alteration Form, Swift Creek / Sumas Mountain Asbestos Site, Whatcom County, Washington*, TDD 12-02-0006.

———, August 1, 2012b, *Site-Specific Sampling Plan, Swift Creek / Sumas Mountain Asbestos Site, Whatcom County, Washington*, TDD 12-02-0006.

———, April 2008, *Swift Creek Asbestos Site Time-Critical Removal Action Report*, TDD 07-08-0011.

———, March 2007, *Swift Creek Repository Basic Design and Cost Estimate*, TDD 06-12-0025.

———, November 2006, *Swift Creek Integrated Assessment, Final Report, Everson, Washington*, TDD 06-06-0020.

GeoEngineers, Inc., 1998, Geotechnical Engineering Services, Stream Management Plan for Swift Creek, Whatcom County, Washington.

Kerr Wood Leidal Associates, Limited (KWL), January 2008, Swift Creek Background and Management Alternatives, for Whatcom County Flood Control Zone District.

Landau and Associates, Inc. (Landau), 1990, Swift Creek Investigation Report, Whatcom County, Washington, prepared for the Whatcom County Engineering Department, Bellingham, Washington.

Pacific Surveying and Engineering, Inc. (PSE), April 27, 2010, Technical Memorandum, Sumas Mountain Naturally-Occurring Asbestos Interim Alternatives Analysis.

Schreier, H., Omueti, J.A., and Lavkulich, L.M. 1987a, Weathering processes of asbestos-rich serpentinitic sediments. Soil Science Society of America Journal 51(4): 993-999.

Schreier, H., Northcote, T.J., and Hall, K., 1987b, Trace metals in fish exposed to asbestos rich sediments, Water, Air and Soil Pollution 35:275-291.

Schreier, H. and Timmenga, H.J., 1986, Earthworm response to asbestos-rich serpentinitic sediments, Soil Biology and Biochemistry 18(1): 85-89.

Schreier, H. and Taylor, J., 1981, Variations and mechanisms of asbestos fibre distribution in stream water, Environment Canada Inland Waters Directorate, Technical Bulletin No. 118.

———, 1980, Asbestos fibres in receiving waters, Environment Canada Inland Waters Directorate, Technical Bulletin No. 117.

United States Environmental Protection Agency (EPA), 2012, Integrated Risk Information System. Online: http://www.epa.gov/IRIS/.

_____, April 2011a, Environmental Monitoring for Asbestos: Sumas Mountain Asbestos Site Selected Residential Properties.

_____, March 2011b, Memorandum to E. Hale from J. Wroble. Risk Evaluation for Activity Based Sampling Results, Sumas Mountain Asbestos Site, Whatcom County, WA, Revision 1.1.

_____, October 2009, Soil, Sediment and Surface Water Sampling Sumas Mountain Naturally Occurring Asbestos Site, Whatcom County, WA.

_____, February 8, 2007a, Memorandum from J. Wroble to D. Baker-Kircher, Risk Evaluation for Activity-Based Sampling Results, Swift Creek Site, Whatcom County, Washington.

_____, February 2007b, Summary Report of EPA Activities, Swift Creek Asbestos Site, Whatcom County, WA.

———, August 1993, *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, EPA 540-R-93-057.

United States Department of Agriculture (USDA), January 2013, Custom Soil Resource Report for Whatcom County Area, Washington.

———, May 1992, *Soil Survey Whatcom County, Washington*.

Washington State Department of Ecology (WDOE), June 24, 2005, In the Matter of Granting a Water Quality Certification to Whatcom County Public Works, Order #2453.

_____, February 11, 1977, Letter from Darrel Anderson, *Sumas River, Swift Creek, Drainage Asbestos Fibre Source Investigation*.

Washington State Department of Health (WDOH), February 2010. Sumas Mountain/Swift Creek Asbestos Cluster Investigation.

———, February 2008, Health Consultation, Evaluation of Health Statistics and Public Health Data Gaps Related to Exposure to Naturally Occurring Asbestos from Swift Creek, Swift Creek Sediment Asbestos Site, Everson, Whatcom County, WA.

———, March 2006, Health Consultation, Swift Creek Sediment Asbestos, Whatcom County, WA.

Whatcom County Public Works (Whatcom County), December 2012a, Draft Swift Creek Sediment Management Action Plan (SCSMAP).

_____, December 2012b, Swift Creek Sediment Management Action Plan (SCSMAP), Phase 1 Implementation Plan.

———, July 8, 2009, Swift Creek Naturally Occurring Asbestos (NOA), Draft areas of potential NOA release, by flooding of either Swift Creek or the Sumas River.

———, 1994, Fish and Wildlife Habitats of Whatcom County: a Map Folio of Fish and Wildlife Habitat.

Western Regional Climate Center (WRCC), January 7, 2013, Period of Record Monthly Climate Summary, Clearbrook, Washington (451484), http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wa1484.

Zawistoski (Zawistoski, Mark), February 4, 2013, GIS Analyst, memorandum regarding GIS Analysis of Human and Environmental Targets, to Steve Hall, Project Manager.

A Summary of EPA 2012 Sampling Events

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Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Appendix A
Summary of EPA 2012 Sampling Events

In 2012, the United States Environmental Protection Agency (EPA) directed Ecology and Environment, Inc. (E & E), under Superfund Technical Assessment and Response Team (START)-3 contract EP-S7-06-02, Technical Direction Document 12-02-0006, to perform field sampling activities at the Sumas Mountain Asbestos (aka Swift Creek) Site (site) to support an engineering evaluation / cost analysis (EE/CA). The following sections summarize the sampling methods and results for these sampling events.

July 2012 Sampling Event

In July 2012, EPA performed a site sampling event to characterize potential impacts to area groundwater from the asbestos- and metals-containing sediments. The sampling event included the collection of surface water, sediment, and groundwater samples for the analysis of metals and/or asbestos. Specifically, the following samples were collected from the site:

- Groundwater samples from 10 area wells:
    - Four monitoring wells installed by Whatcom County Public Works in 2010 on Great Western Lumber (GWL) property east of Goodwin Road, which is the proposed location of a sediment basin(s) (PMW-01 through PMW-04),
    - Three monitoring wells installed by the Whatcom County Health Department in 2009 on area road right-of-ways (ROW) (HMW-01 through HMW-03), and
    - Three area domestic wells;
- Surface water samples from two locations in Swift Creek; and
- Sediment and dredge material samples from two locations in Swift Creek and a dredge pile located on a Whatcom County-owned property near Swift Creek and Oat Coles Road.

The groundwater and surface water samples were analyzed for the following parameters:

- Total target analyte list (TAL) metals;
- Dissolved TAL metals; and
- Asbestos in water (monitoring wells PMW-01 through PMW-04, only).

The sediment and dredge material samples were analyzed for the following parameters:

- Total TAL metals;
- Synthetic Precipitate Leaching Procedure (SPLP) TAL metals;
- Deionized (DI) water leach metals (performed as a modification to the SPLP extraction using DI water as the leaching fluid); and
- Geotechnical parameters (soil classification, moisture content, Atterberg limits, and grain size distribution).

Samples were collected and analyzed in accordance with the Site-Specific Sampling Plan (SSSP) (E & E 2012b), and the sample locations are indicated on Figure 1. Table 1 summarizes the sample collection information and analyses, and Table 2 summarizes the available information for the seven site monitoring wells. Information about the groundwater sampling, including sampling methods and water quality parameters collected during monitoring well purging and sampling, is included in Table 3.

EPA analytical results were validated by a START chemist. The validation memoranda and analytical results are included in Appendix B. Tables 4 through 11 present a summary of the results of the analytical testing performed on the July 2012 samples. Discussions of the results are presented below.

September 2012 Well Development

During the July 2012 sampling event, the asbestos in water analyses were only performed on the four GWL monitoring wells (PMW-01 through PMW-04) to establish a baseline level of asbestos concentration for the proposed sediment basin location. START had intended to collect groundwater samples from the monitoring wells using a low-flow sampling technique. However, the water in some of the wells was too deep to use the available low-flow sampling equipment. Therefore, it was necessary to sample some of the wells with bailers.

The asbestos concentrations in the July 2012 groundwater samples from these four monitoring wells were higher than expected. After researching available installation information for the monitoring wells, it could not be determined whether the wells had been developed following their installation. It was concluded that the unexpectedly high groundwater asbestos results may be attributed to the presence of asbestos in near-wellbore soils disturbed during groundwater sampling. To better evaluate the source of the asbestos in the groundwater samples, EPA decided to develop the four GWL monitoring wells (PMW-01 through PMW-04) and subsequently re-sample the wells using a low-flow technique.

EPA completed the well development in September 2012, and the results of water quality parameters recorded during well development are included in Table 3.

October 2012 Sampling Event

In October 2012, EPA returned to the site to re-sample the GWL monitoring wells (PMW-01 through PMW-04) and sample ROW monitoring wells (HMW-01 through HMW-03) using a low-flow sampling technique. The groundwater samples were analyzed for the following parameters:

- Total TAL metals,
- Dissolved TAL metals,
- Asbestos in water, and
- Total suspended solids (TSS).

The samples were collected and analyzed in accordance with the SSSP (E & E 2012b) and Sample Plan Alteration Form (E & E 2012a). The sample collection locations are indicated on Figure 2. Sample collection details, monitoring well information, and monitoring well collection

data are recorded in Tables 1 through 3, respectively. Data validation memoranda and analytical results are included in Appendix B, and the results are summarized in Tables 12 through 15.

Whatcom County also conducted its own sampling event at the site in October 2012 and collected groundwater samples from the site monitoring wells for total TAL metals, dissolved TAL metals, and asbestos in water. The results for Whatcom County's samples are included in Tables 16-18.

Asbestos Results

Table 12 presents the results of the asbestos analyses performed on EPA's October 2012 groundwater samples. The October 2012 sample locations and asbestos results are also indicated on Figure 3.

Results are presented for two asbestos fiber size ranges: asbestos fibers longer than 0.5 microns, and asbestos fibers longer than 10 microns. For fibers longer than 0.5 microns, the results ranged from non-detect to 890 million fibers per liter (MFL) and were generally much lower than the results for the July 2012 samples (Table 4). Chrysotile was the only type of asbestos fiber detected.

For the longer asbestos fibers, the results were also lower than for the July 2012 samples, with only two samples containing detectable levels of asbestos fibers longer than 10 microns. The two samples with asbestos detections were both on the GWL property: PMW-01 had a concentration of 0.39 MFL, and PMW-04 had a concentration of 0.19 MFL. The other GWL wells and all three of the monitoring wells located on the area ROW (HMW-01 through HMW-03) were non-detect for asbestos fibers longer than 10 microns. The federal maximum contaminant level (MCL) for asbestos is 7 MFL for fibers longer than 10 microns (i.e., the asbestos MCL only applies to fibers longer than 10 microns). Results for all of the October 2012 samples were less than the MCL.

The results for the two fiber size ranges (longer than 0.5 micron and longer than 10 microns) indicate that the asbestos fibers present in the groundwater samples are generally short (i.e., less than 10 microns).

The detection of asbestos in the samples collected in July and October 2012 does indicate that it is possible for asbestos to be locally mobilized under groundwater flow conditions induced by pumping and sampling. However, the results of groundwater samples collected by EPA and Whatcom County in October 2012 collectively indicate that significant migration of asbestos in groundwater does not likely occur under natural aquifer flow conditions. This is based on the finding that use of a low-flow sampling technique resulted in either non-detect or very low concentrations of asbestos in at least one sample collected by either EPA or Whatcom County from all but one of the wells (PMW-02). The presence of asbestos in those low-flow samples from October 2012 is likely attributable to disturbance of near-wellbore geologic materials as a result of sampling.

Metals Results

Surface Water

EPA collected two surface water samples from Swift Creek in July 2012, and the total and dissolved metals results are summarized in Table 5. The results were compared to the federal MCLs and the Washington State ambient water quality criteria. Three total metals (aluminum, iron, and manganese) were detected in at least one sample at concentrations exceeding their respective secondary MCLs, although the dissolved concentrations of these metals were below the secondary MCL. There were no exceedences of any of the primary MCLs or ambient water quality criteria in either the total or dissolved metals results.

Groundwater

In 2012, EPA collected groundwater samples from the site in July and October, and the results are summarized in Tables 6 and 7 (July 2012) and Table 13 and 14 (October 2012). Key metals results and sample locations from October 2012 are indicated on Figure 4.

In both the July and October 2012 groundwater results, and similar to the July 2012 surface water results, three total metals (aluminum, iron, and manganese) were present in some of the groundwater samples at concentrations that exceeded secondary MCLs. Additionally, for the dissolved metals results, iron and manganese were detected in some samples at concentrations exceeding secondary MCLs, while aluminum levels were below its secondary MCL. There were no exceedences of any of the primary MCLs in either the total or dissolved metals groundwater samples.

The total and dissolved groundwater results were also compared to EPA's Regional Screening Levels (RSL) for tapwater. Three of the site monitoring well samples exceeded the RSL tapwater value for cobalt, iron, and/or manganese. For the dissolved metals results, only one of these samples exceeded the RSL tapwater value for manganese.

Sediment and Dredge Material Leachability

In July 2012, EPA collected four samples (including one field duplicate) of sediment/dredge material from three locations. One sample was collected from the landslide, one sample was collected from the bed of Swift Creek near Goodwin Road, and two samples (including the field duplicate) were collected from dredge material stockpiled on Whatcom County's property at the corner of Oat Coles and South Pass Roads.

The sediment / dredge material samples were analyzed for total TAL metals, SPLP TAL metals, and DI water leach TAL metals. The results are summarized in Tables 8, 9, and 10. The SPLP leachability test is commonly used to evaluate potential leaching and its impacts on groundwater as a result of natural precipitation, and the SPLP extraction fluid used for the samples consisted of slightly acidified DI water that is adjusted to a pH of 5.0 with a mixture of sulfuric and nitric acids. The DI water leach test was used to evaluate leachability under neutral pH conditions (i.e., a pH of 7).

The results of the totals metals analyses (Table 8) indicate that 15 metals were detected in the sediment and dredge materials, including aluminum, calcium, chromium, cobalt, iron,

magnesium, and nickel. The total metal results were compared to natural soil background concentrations in Washington State, and four metals (chromium, cobalt, magnesium, and nickel) were detected in all four samples at concentrations that were significantly (i.e., at least an approximate order of magnitude) greater than the natural background levels. Additionally, iron was detected in three of the four samples at concentrations just above the natural background level.

The results of the SPLP metals analyses are summarized in Table 9. Six metals (barium, calcium, magnesium, potassium, sodium, and zinc) were detected in one or more of the SPLP leachate samples; the remaining TAL metals were not detected. Of the detected metals, four metals (calcium, magnesium, potassium, and sodium) are common earth crust metals. The SPLP concentrations for calcium, magnesium, and sodium ranged from 2.9 to 15.2 milligrams per liter (mg/L), while the concentrations for barium, potassium, and zinc were all below 1 mg/L.

The results of the DI water leach metals analyses are summarized in Table 10. Eight metals (aluminum, barium, calcium, iron, magnesium, potassium, sodium, and zinc) were detected in two or more of the DI water leach samples; the remaining TAL metals were not detected. Of the detected metals, six metals (aluminum, calcium, iron, magnesium, potassium, and sodium) are common earth crust metals. In general, the results for the DI water leach were very similar to the SPLP results, with the exception that aluminum and iron were detected in the DI water leach samples but not the SPLP leachate samples. The DI water leach concentrations for calcium, magnesium, and sodium ranged from 1.1 to 17.9 mg/L, while the concentrations for aluminum, barium, iron, potassium, and zinc were all below 1 mg/L.

To evaluate the relative leachability of metals contained in the sediment and dredge materials, the SPLP and DI water leach metals concentrations were compared to total metals concentrations. The proportions (as percentage) of the total metal content in the sediment and dredge material that were solubilized via the SPLP leach test and DI water leach test were calculated, and the results are presented in Table 11. Most of the calculated relative leachability values are low, below 2 percent. Only calcium, which is a common earth crust element, exhibited relative solubility values higher than 2 percent. Barium and zinc, the only metals detected in leachate samples that are not common earth crust elements, exhibited low relative leachability, with maximum values of 0.56 percent and 1.7 percent, respectively.

To further evaluate the significance of leachability of metals in the sediment and dredge materials, SPLP and DI water leach test results were compared to EPA MCLs, RSL tapwater values, and Washington State ambient water quality criteria (Table 11). There are no primary MCLs for common earth crust elements, but primary MCLs are established for barium and zinc, and there are also secondary MCLs for aluminum and iron. None of the metals detected in either the SPLP or DI water leach tests exceeded their respective primary or secondary MCL. Further, for most metals detected in the leach tests, the leach test results were one or two orders of magnitude below the MCL value. Similarly, there were no exceedences of the RSL tapwater values or the ambient water quality criteria. Therefore, leaching of metals from the sediment and dredge materials is expected to have no significant impact on water quality.

Total Suspended Solids

The results of TSS analyses performed on the October 2012 groundwater samples are summarized in Table 15. TSS analyses were performed on the groundwater samples to provide additional information regarding particulate content in the unfiltered sample aliquots collected for total TAL metals and asbestos analysis. TSS concentrations above the reporting limit of 5 mg/L were only reported for one sample, at 7 mg/L.

Geotechnical Testing

The sediment and dredge material samples collected in July 2012 were submitted to several geotechnical tests, including soil classification, moisture content, Atterberg limits, and grain size distribution. These results are included in Appendix B. Based on the geotechnical results, the excavation and construction of large sediment basins appears to be feasible. If Alternative A4 is chosen, it is recommended that additional geotechnical tests be conducted at the proposed sediment basin locations to aid in the final design.

Table 1

EPA Sample Information
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID	Sample Location	Latitude	Longitude	Matrix	Sample Date	Sample Analyses						
						Asbestos (EPA Methods 100.2 and modified 100.2)	Total TAL Metals (EPA Methods 6010, 7470 and/or 7471)	Dissolved TAL Metals (EPA Methods 6010 and 7470)	SPLP TAL Metals (EPA Methods modified 1312, 6010 and 7470)	DI Leach TAL Metals (EPA Methods modified 1312, 6010 and 7470)	Total Suspended Solids (EPA Method 160.2)	Geotechnical Methods (1)
12070001	SC-01	48.91088949	-122.2516293	Surface Water	7/18/2012		X	X				
12070002	SC-02	48.91055968	-122.2875291	Surface Water	7/18/2012		X	X				
12070003	DW-01	48.91170853	-122.2884016	Ground Water	7/18/2012		X	X				
12070004	DW-02	48.91944148	-122.292066	Ground Water	7/18/2012		X	X				
12070005	DW-03	48.91965357	-122.303115	Ground Water	7/18/2012		X	X				
12070006	PMW-01	48.912786	-122.278713	Ground Water	7/19/2012	X	X	X				
12070007	PMW-02	48.912169	-122.283135	Ground Water	7/19/2012	X	X	X				
12070008	PMW-03	48.91065	-122.286787	Ground Water	7/19/2012	X	X	X				
12070009	PMW-04	48.909347	-122.280412	Ground Water	7/19/2012	X	X	X				
12070010	HMW-01	48.910596	-122.28776	Ground Water	7/19/2012		X	X				
12070011	HMW-02	48.918892	-122.304161	Ground Water	7/19/2012		X	X				
12070012	HMW-12 (Field Duplicate of HMW-02)	48.918892	-122.304161	Ground Water	7/19/2012		X	X				
12070013	HMW-03	48.905478	-122.304034	Ground Water	7/19/2012		X	X				
12070014	FB-01	n/a	n/a	Field Blank	7/19/2012	X						
12070021	SC-01	48.91088949	-122.2516293	Sediment	7/18/2012		X		X	X		X
12070022	SC-02	48.91055968	-122.2875291	Sediment	7/18/2012		X		X	X		X
12070023	DM-01	48.91920026	-122.3040732	Sediment	7/18/2012		X		X	X		X
12070024	DM-02	48.91920026	-122.3040732	Sediment	7/18/2012		X		X	X		
12101001	PMW-01	48.912786	-122.278713	Ground Water	10/9/2012	X	X	X			X	
12101002	PMW-02	48.912169	-122.283135	Ground Water	10/9/2012	X	X	X			X	
12101003	PMW-05 (Field Duplicate of PMW-02)	48.912169	-122.283135	Ground Water	10/9/2012	X	X	X			X	
12101004	FB-02	n/a	n/a	Field Blank	10/9/2012	X	X				X	
12101005	RB-02	n/a	n/a	Rinsate Blank	10/9/2012	X	X	X			X	
12101006	PMW-04	48.912786	-122.278713	Ground Water	10/9/2012	X	X	X			X	
12101007	HMW-02	48.912169	-122.283135	Ground Water	10/9/2012	X	X	X			X	
12101008	HMW-01	48.910596	-122.28776	Ground Water	10/10/2012	X	X	X			X	
12101009	HMW-03	48.905478	-122.304034	Ground Water	10/10/2012	X	X	X			X	
12101010	PMW-03	48.91065	-122.286787	Ground Water	10/10/2012	X	X	X			X	

Note: (1) Geotechnical methods include soil classification (ASTM Method D2487), moisture content (ASTM Method D2216), Atterberg Limits (ASTM Method D4318), and Grain Size Distribution (ASTM Methods D-421/422).

Key:

ASTM = ASTM International
DI = deionized
EPA = United States Environmental Protection Agency
ID = identification
n/a = not applicable
SPLP = Synthetic Precipitate Leaching Procedure
TAL = Target Analyte List

Table 2

Monitoring Well Information
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Well ID	Property/ Location	Installed By	Date Installed	Surface Completion	Construction	Sandpack Material	Borehole Total Depth (feet bgs)	Well Total Depth (feet bgs)	Screened Interval (feet bgs)
HMW-01	Goodwin Road / Swift Creek	Whatcom County Health Department	3/26/2009	Flush mount	2-inch PVC	n/a	at least 21.5	Approx. 20	10 - 20
HMW-02	Oat Coles Road / Swift Creek	Whatcom County Health Department	3/26/2009	Flush mount	2-inch PVC	n/a	at least 21.5	Approx. 20	10 - 20
HMW-03	Oat Coles Road / Massey Road	Whatcom County Health Department	3/26/2009	Flush mount	2-inch PVC	n/a	at least 21.5	Approx. 20	10 - 20
PMW-01	Great Western Lumber	Whatcom County Public Works	3/8/2010	Flush mount	2-inch PVC	Monterey #2/12	61.5	Approx. 60	50 - 60
PMW-02	Great Western Lumber	Whatcom County Public Works	3/8/2010	Flush mount	2-inch PVC	Monterey #2/12	41.5	Approx. 40	30 - 40
PMW-03	Great Western Lumber	Whatcom County Public Works	3/9/2010	Flush mount	2-inch PVC	Monterey #2/12	61	Approx. 60	40 - 60
PMW-04	Great Western Lumber	Whatcom County Public Works	3/9/2010	Flush mount	2-inch PVC	Monterey #2/12	41.5	Approx. 40	30 - 40

Key:

bgs = below ground surface
ID = identification
n/a = not available
PVC = polyvinyl chloride

Table 3

EPA Groundwater Field Data
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Well ID	Date	Activity	Screened Interval (feet bgs)	Measured Total Depth of Well (feet below TOIC)	Depth to Water (feet below TOIC)	Purge/Sample or Development Method and Equipment	Total Volume Purged/ Developed (Gallons)	Flow Rate (Liters per Minute)	Maximum Turbidity (NTU)	Final Measurements					
										Turbidity (NTU)	Temp (deg C)	pH	Conductivity (mS/cm)	DO (mg/L)	ORP (mv)
HMW-01	7/19/12	Sample	10 - 20	19.6	12.56	low-flow, peristaltic	n/a	n/a	n/a	n/a	14.3	6.97	0.232	11.27	437
	10/10/12	Sample		n/a	16	low-flow, peristaltic	1.8	0.2 - 0.27	18.6	1.0	15.45	8.47	0.321	n/a	192
HMW-02	7/19/12	Sample	10 - 20	19.4	2.93	low-flow, peristaltic	n/a	n/a	n/a	n/a	5.92	6.42	n/a	10.41	202.1
	10/9/12	Sample		n/a	5.11	low-flow, peristaltic	5	0.6 - 0.8	34.4	0.0	11.38	6.62	0.285	26.74	-127
HMW-03	7/19/12	Sample	10 - 20	19.3	4.16	low-flow, peristaltic	n/a	n/a	n/a	n/a	15.46	6.51	0.277	10.15	131.7
	10/10/12	Sample		n/a	5.29	low-flow, peristaltic	2.8	0.6	0	0.0	11.64	6.39	0.266	36.45	-114
PMW-01	7/19/12	Sample	50 - 60	61	49.93	bailer	3 well volumes	n/a	n/a	n/a	14.2	6.29	0.71	12.35	291.41
	9/26/12	Develop		59.82	52.75	surge and pump, submersible	405	10	visually very turbid	15.5	11.77	6.5	0.549	21.05	n/a
	10/9/12	Sample		n/a	53.38	low-flow, electric submersible (1)	19	0.7 - 2.7	201	4.1	13.23	6.67	0.553	n/a	147
PMW-02	7/19/12	Sample	30 - 40	41.5	23.22	bailer	3 well volumes	n/a	n/a	n/a	12.4	6.4	0.448	12.8	406
	9/26/12	Develop		39.9	26.22	surge and pump, submersible	335	10	visually very turbid	10.3	10.2	6.24	0.401	8.05	n/a
	10/9/12	Sample		n/a	26.78	low-flow, electric submersible	4.5	0.3 - 0.56	141	2.6	13.68	6.46	0.394	8.05	161
PMW-03	7/19/12	Sample	40 - 60	60	17	low-flow, peristaltic	n/a	n/a	n/a	n/a	18.04	7.2	0.21	11.14	220.6
	9/27/12	Develop		59.9	19.06	surge and pump, submersible	590	10	visually very turbid	12.1	11.04	6.76	0.365	7.05	n/a
	10/10/12	Sample		n/a	19.41	low-flow, peristaltic	2.5	0.12 - 0.14	67.2	9.6	10.23	6.52	0.382	n/a	276
PMW-04	7/19/12	Sample	30 - 40	40	27.44	bailer	3 well volumes	n/a	n/a	n/a	15.3	7.02	0.284	14.3	245.4
	9/25/12	Develop		40.04	28.43	surge and pump, submersible	735	9 - 12	visually very turbid	15	9.85	6.34	0.265	7.96	n/a
	10/9/12	Sample		n/a	28.94	low-flow, electric submersible	4	0.7 - 0.8	3.4	0.0	10.66	6.19	0.270	23.22	202

Note: (1) Difficulties maintaining steady low pump rate

Key:
bgs = below ground surface
deg C = degrees Celsius
DO = dissolved oxygen
EPA = United States Environmental Protection Agency
ID = identification
mg/L = milligrams per liter
mS/cm = milliSiemens per centimeter
mV = millivolts
n/a = not available
NTU = nephelometric turbidity units
ORP = oxidation reduction potential
TOIC = top of inner casing

Table 4

EPA July 2012 Water Asbestos Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID	Sample Location	Sample Volume (ml)	Fibers > 0.5 micron				Fibers > 10 micron			
			Asbestos Type	Fibers Detected	Analytical Sensitivity (MFL)	Concentration (MFL)	Asbestos Type	Fibers Detected	Analytical Sensitivity (MFL)	Concentration (MFL)
Maximum Contaminant Level						**n/a**				**7**
12070006	PMW-01	0.1	Chrysotile	**102**	190	**20,000**	Chrysotile	**33**	6.9	**230**
12070007	PMW-02	1	Chrysotile	**120**	97	**12,000**	None Detected	ND	6.9	<6.9
12070008	PMW-03	5	Chrysotile	**101**	9.7	**980**	Chrysotile	**3**	0.78	**2.3**
12070009	PMW-04	1	Chrysotile	**104**	32	**3,400**	Chrysotile	**2**	6.9	**14**
12070014	Field Blank	100	Chrysotile	**5**	0.05	**0.24**	None Detected	ND	0.05	<0.05

Note: A **BOLD** result indicates a positive detection.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MFL = millions of fibers per liter
ml = milliliters
n/a = not applicable
ND = not detected

Table 5

EPA July 2012 Surface Water Total and Dissolved TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

		Total Metals				Dissolved Metals			
EPA Sample ID:				**12070001**	**12070002**			**12070001**	**12070002**
Sample Location:				**SC-01**	**SC-02**			**SC-01**	**SC-02**
Sample Type:		**Washington State Ambient Water Quality Criteria (3)**		**Total Metals**		**Washington State Ambient Water Quality Criteria (3)**		**Dissolved Metals**	
				Swift Creek	**Swift Creek**			**Swift Creek**	**Swift Creek**
Location:	**MCL (1)**	**Acute**	**Chronic**	**Landslide**	**Goodwin Road**	**Acute**	**Chronic**	**Landslide**	**Goodwin Road**
TAL Metals (µg/L)									
Aluminum	50-200 (2)	--	--	**520**	**129**	--	--	**5.9**	**8.3**
Antimony	6	--	--	10 U	10 U	--	--	10 U	10 U
Arsenic	10	--	--	10 U	10 U	360	190	10 U	10 U
Barium	2,000	--	--	**55.7**	**23.5**	--	--	**51.6**	**22.1**
Beryllium	4	--	--	0.4 U	0.4 U	--	--	0.4 U	0.4 U
Cadmium	5	--	--	0.5 U	0.5 U	6.8 / 4.4 (4)	1.4 / 1.2 (4)	0.5 U	0.5 U
Calcium	--	--	--	**9,120**	**7,220**	--	--	**8,990**	**7,010**
Chromium	100	--	--	**22.7**	**2.6**	870 / 630 (4)	282 / 160 (4)	2 U	2 U
Cobalt	--	--	--	**4.8**	1 U	--	--	1 U	1 U
Copper	1,300	--	--	2 U	2 U	30 / 22 (4)	18 / 13 (4)	2 U	2 U
Iron	300 (2)	--	--	**3,010**	**382**	--	--	20 U	20 U
Lead	15	--	--	10 U	10 U	118 / 78 (4)	5.1 / 3.1 (4)	10 U	10 U
Magnesium	--	--	--	**51,200**	**26,600**	--	--	**37,100**	**24,500**
Manganese	50 (2)	--	--	**66.6**	**8.9**	--	--	**2.3**	**2.2**
Mercury	2	--	0.012	0.2 U	0.2 U	2.1	--	0.2 U	0.2 U
Nickel	--	--	--	**116**	**16.3**	2,273 / 1,631 (4)	252 / 181 (4)	**5.3**	**4.6**
Potassium	--	--	--	**1,060**	**724**	--	--	**1,080**	**652**
Selenium	50	20	5	20 U	20 U	--	--	20 U	20 U
Silver	100 (2)	--	--	2 U	2 U	9.0 / 4.6 (4)	--	2 U	2 U
Sodium	--	--	--	**3,780**	**4,320**	--	--	**3,780**	**4,260**
Thallium	2	--	--	10 U	10 U	--	--	10 U	10 U
Vanadium	--	--	--	**2.9**	2 U	--	--	2 U	2 U
Zinc	5,000 (2)	--	--	**3.3**	2 U	184 / 132 (4)	168 / 121 (4)	2 U	**2.2**

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
(3) Values for water quality criteria apply to either total or dissolved metals, as indicated.
(4) These water quality criteria were calculated from estimated hardness values (calculated from calcium and magnesium concentrations) for samples SC-01 and SC-02, respectively.
a - Presented as criteria for samples SC-01/SC-02 for cadmium, chromium, copper, lead, nickel, silver, and zinc.
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.

Key:

EPA = United States Environmental Protection Agency
ID = identification
µg/L = micrograms per liter
MCL = maximum contaminant level
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 6

EPA July 2012 Groundwater Total TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:			**12070003**	**12070004**	**12070005**	**12070006**	**12070007**	**12070008**	**12070009**	**12070010**	**12070011**	**12070012**	**12070013**
Sample Location:			**DW-01**	**DW-02**	**DW-03**	**PMW-01**	**PMW-02**	**PMW-03**	**PMW-04**	**HMW-01**	**HMW-02**	**HMW-12 (Field Duplicate)**	**HMW-03**
Sample Type:			**Domestic Well**	**Domestic Well**	**Domestic Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**
Location:	**MCL (1)**	**RSL Tapwater Values**	**St. Innocent Church**	**Gelwick Property**	**Parker Property**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**ROW**	**ROW**	**ROW**	**ROW**
Total TAL Metals (µg/L)													
Aluminum	50-200 (2)	16,000	3 U	**10.7**	**4.5**	**7,590**	**1,860**	**715**	**1,950**	**4.4**	**784**	**516**	**75.4**
Antimony	6	6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Arsenic	10	0.045	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Barium	2,000	2,900	**12.6**	**23.2**	**21**	**74**	**23.6**	**19.8**	**19.2**	**2**	**113**	**65.5**	**67.4**
Beryllium	4	16	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Cadmium	5	6.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Calcium	--	--	**15,800**	**17,400**	**42,200**	**14,400**	**5,940**	**17,800**	**7,860**	**1,760**	**10,800**	**10,200**	**13,000**
Chromium	100	16,000	**7.2**	2 U	2 U	**40.6**	**19.5**	**5.8**	**12**	2 U	**2.4**	2 U	2 U
Cobalt	--	4.7	1 U	1 U	1 U	**13.1**	**2.6**	**1.3**	1 U	1 U	1 U	1 U	1 U
Copper	1,300	620	**66.8**	**4.7**	**4.6**	**22.4**	**4.5**	**4**	**4.7**	2 U	2 U	2 U	2 U
Iron	300 (2)	11,000	**52**	**214**	20 U	**16,400**	**3,330**	**1,810**	**2,970**	20 U	**11,000**	**5,800**	**9,580**
Lead	15	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Magnesium	--	--	**52,500**	**47,600**	**9,330**	**91,000**	**55,700**	**8,310**	**31,800**	**18,700**	**27,500**	**27,100**	**19,700**
Manganese	50 (2)	320	**1.1**	**118**	**5.7**	**406**	**104**	**53**	**49.1**	0.6 U	**290**	**261**	**514**
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	--	300	2 U	**6.2**	2 U	**209**	**51.2**	**12.6**	**36.7**	2 U	**2.4**	2 U	2 U
Potassium	--	--	**554**	**1,060**	**2,010**	**1,480**	**624**	**1,120**	**544**	**715**	**1,870**	**1,900**	**1,750**
Selenium	50	78	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Silver	100 (2)	71	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	--	--	**3,490**	**7,240**	**6,100**	**5,160**	**2,600**	**11,100**	**3,790**	**3,480**	**12,100**	**12,100**	**6,230**
Thallium	2	0.16	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vanadium	--	78	**2.3**	2 U	2 U	**24.3**	**6.2**	**2.4**	**7**	2 U	**5**	**3.6**	**2**
Zinc	5,000 (2)	4,700	**214**	**56.5**	**7.6**	**78.8**	**9.9**	**155**	**15**	2 U	**3.7**	**3.2**	2 U

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.
An underlined number indicates that the result exceeds the RSL tapwater value.

Key:

EPA = United States Environmental Protection Agency
ID = identification
µg/L = micrograms per liter
MCL = maximum contaminant level
ROW = right of way
RSL = Regional Screening Levels
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 7

EPA July 2012 Groundwater Dissolved TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:			**12070003**	**12070004**	**12070005**	**12070006**	**12070007**	**12070008**	**12070009**	**12070010**	**12070011**	**12070012**	**12070013**
Sample Location:			**DW-01**	**DW-02**	**DW-03**	**PMW-01**	**PMW-02**	**PMW-03**	**PMW-04**	**HMW-01**	**HMW02GW**	**HMW-12 (Field Duplicate)**	**HMW-03**
Sample Type:			**Domestic Well**	**Domestic Well**	**Domestic Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**
Location:	**MCL (1)**	**RSL Tapwater Values**	**St. Innocent Church**	**Gelwick Property**	**Parker Property**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**ROW**	**ROW**	**ROW**	**ROW**
Dissolved TAL Metals (ug/L)													
Aluminum	50-200 (2)	16,000	3 U	3 U	3 U	3 U	3 U	**6.9**	3 U	**5.5**	**11.1**	**9.3**	**5.8**
Antimony	6	6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Arsenic	10	0.045	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Barium	2,000	2,900	**12.1**	**23.2**	**21.6**	**13.8**	**9.1**	**12.6**	**4.9**	**2.1**	**47.7**	**45.9**	**67.6**
Beryllium	4	16	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Cadmium	5	6.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Calcium	--	--	**15,800**	**17,800**	**43,100**	**12,200**	**5,460**	**17,300**	**7,450**	**1,780**	**10,400**	**9,930**	**13,200**
Chromium	100	16,000	**5.9**	2 U	2 U	**6.8**	**11.7**	2 U	**5.5**	2 U	2 U	2 U	2 U
Cobalt	--	4.7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Copper	1,300	620	**40.6**	2 U	**2.7**	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Iron	300 (2)	11,000	20 U	**41.9**	20 U	20 U	20 U	20 U	20 U	20 U	**3,380**	**3,240**	**9,240**
Lead	15	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Magnesium	--	--	**52,300**	**48,000**	**9,400**	**80,300**	**52,600**	**7,750**	**29,600**	**18,700**	**26,800**	**26,000**	**19,600**
Manganese	50 (2)	320	**1.6**	**120**	**1.5**	**0.6**	**1.1**	**5**	**0.6**	0.6 U	**257**	**247**	**508**
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	--	300	2 U	**2.4**	2 U	**9.6**	**15.6**	2 U	**10.2**	2 U	2 U	2 U	2 U
Potassium	--	--	**562**	**1,020**	**2,090**	**679**	**506**	**1,050**	400 U	**740**	**1,780**	**1,770**	**1,740**
Selenium	50	78	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Silver	100 (2)	71	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	--	--	**3,480**	**7,310**	**6,120**	**4,780**	**2,460**	**11,000**	**3,600**	**3,500**	**12,100**	**11,700**	**6,310**
Thallium	2	0.16	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vanadium	--	78	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	**2.2**	**2.1**	2 U
Zinc	5,000 (2)	4,700	**222**	**37.6**	**7.2**	**5.5**	**2.3**	**83.7**	**6.7**	2 U	2 U	2 U	2 U

Note:
(1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.
An underlined number indicates that the result exceeds the RSL tapwater value.

Key:
EPA = United States Environmental Protection Agency
ID = identification
µg/L = micrograms per liter
MCL = maximum contaminant level
ROW = right of way
RSL = Regional Screening Level
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 8

EPA July 2012 Sediment Total TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:	**Natural Soil Background Concs. in Washington State [1]**	**12070021**	**12070022**	**12070023**	**12070024**
Sample Location:		**SC-01**	**SC-02**	**DM-01**	**DM-02 (Field Duplicate)**
Sample Type:		**Swift Creek Sediment**	**Swift Creek Sediment**	**Dredge Material**	**Dredge Material**
Location:		**Landslide**	**Goodwin Road**	**Parker Property**	**Parker Property**
Sediment TAL Metals (mg/kg)					
Aluminum	37,200	**599 JL**	**3,410 JL**	**4,010 JL**	**5,040 JL**
Antimony	5.2 [2]	2 UJL	2 UJL	2 UJL	2 UJL
Arsenic	7	3.9 U	4 U	4 U	4 U
Barium	255	**0.6**	**16.6**	**28.2**	**32**
Beryllium	1.4	0.1 U	0.1 U	0.1 U	0.1 U
Cadmium	1	**0.5**	**0.3**	**0.3**	**0.3**
Calcium	5,500 [2]	**311 JK**	**1,370 JK**	**2,380 JK**	**3,150 JK**
Chromium	42	**361**	**321**	**274**	**253**
Cobalt	11 [2]	**76.2**	**87.8**	**85**	**73.5**
Copper	36	0.6 U	**6.9**	**7.6**	**11.8**
Iron	42,100	**45,800**	**45,200**	**43,300**	**40,800**
Lead	17	2 U	2 U	2 U	2 U
Magnesium	300 [2]	**24,200**	**21,400**	**200,000**	**171,000**
Manganese	1,100	**788**	**727**	**659**	**634**
Mercury	0.07	0.02 U	**0.01**	0.02 U	0.01 U
Nickel	38	**1,770**	**1,920**	**1,880**	**1,660**
Potassium		79.4 U	**163**	**229**	**229**
Selenium	0.8 [2]	5.9 U	6 U	6 U	6 U
Silver	0.6 [2]	0.5 U	0.5 U	0.5 U	0.5 U
Sodium		79.4 U	78.7 U	78.8 U	79.5 U
Thallium		2 U	2 U	2 U	2 U
Vanadium	45 [2]	**7.5**	**16.6**	**17.9**	**21.2**
Zinc	86	**22.9**	**33.8**	**33.8**	**34.1**

Notes: A **BOLD** result indicates a positive detection.
A highlighted result indicates the compound exceeds the natural background concentration.
(1) Natural Background Soil Metals Concentrations in Washington State, WDOE Publication 94-115, 1994.
(2) Background concentration is based on a limited data set.

Key:

Conc. = Concentration
EPA = United States Environmental Protection Agency
ID = identification
JK = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias.
mg/kg = milligrams per kilogram
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJL = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate with a low bias and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 9

EPA July 2012 Sediment SPLP TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:	**12070021**	**12070022**	**12070023**	**12070024**
Sample Location:	**SC-01**	**SC-02**	**DM-01**	**DM-02 (Field Duplicate)**
Sample Type:	**Swift Creek Sediment**	**Swift Creek Sediment**	**Dredge Material**	**Dredge Material**
Location:	**Landslide**	**Goodwin Road**	**Parker Property**	**Parker Property**
Sediment SPLP TAL Metals (mg/L)				
Aluminum	0.02 U	0.02 U	0.02 U	0.02 U
Antimony	0.01 U	0.01 U	0.01 U	0.01 U
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U
Barium	0.002 U	**0.0028**	**0.0066**	**0.0027**
Beryllium	0.0004 U	0.0004 U	0.0004 U	0.0004 U
Cadmium	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Calcium	**3.56**	**3.96**	**4.32**	**2.9**
Chromium	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.001 U	0.001 U	0.001 U	0.001 U
Copper	0.01 UJL	0.01 UJL	0.01 UJL	0.01 UJL
Iron	0.01 U	0.01 U	0.01 U	0.01 U
Lead	0.01 U	0.01 U	0.01 U	0.01 U
Magnesium	**13.1**	**4.48**	**12.1**	**15.2**
Manganese	0.0006 U	0.0006 U	0.0006 U	0.0006 U
Mercury	0.001 U	0.001 U	0.001 U	0.001 U
Nickel	0.002 U	0.002 U	0.002 U	0.002 U
Potassium	0.1 U	0.1 U	**0.1**	0.1 U
Selenium	0.02 U	0.02 U	0.02 U	0.02 U
Silver	0.01 U	0.01 U	0.01 U	0.01 U
Sodium	1.1 U	**6.1**	**7.4**	**7.6**
Thallium	R	R	R	R
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	0.01 U	**0.02**	**0.017**	**0.023**

Note: A **BOLD** result indicates a positive detection.

Key:

EPA = United States Environmental Protection Agency
ID = identification
mg/L = milligrams per liter
R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
SPLP = synthetic precipitate leaching procedure
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJL = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate with a low bias and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Table 10

EPA July 2012 Sediment Deionized Water Leach TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:	**12070021**	**12070022**	**12070023**	**12070024**
Sample Location:	**SC-01**	**SC-02**	**DM-01**	**DM-02 (Field Duplicate)**
Sample Type:	**Swift Creek Sediment**	**Swift Creek Sediment**	**Dredge Material**	**Dredge Material**
Location:	**Landslide**	**Goodwin Road**	**Parker Property**	**Parker Property**
Sediment Deionized Water Leach Metals (mg/L)				
Aluminum	**0.006**	**0.009**	**0.023**	**0.02**
Antimony	0.01 U	0.01 U	0.01 U	0.01 U
Arsenic	0.01 U	0.01 U	0.01 U	0.01 U
Barium	0.002 U	**0.0035**	**0.0079**	**0.0046**
Beryllium	0.0004 U	0.0004 U	0.0004 U	0.0004 U
Cadmium	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Calcium	**3.67**	**3.56**	**3.51**	**3.22**
Chromium	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	0.001 U	0.001 U	0.001 U	0.001 U
Copper	0.01 U	0.01 U	0.01 U	0.01 U
Iron	0.01 U	**0.02**	**0.02**	**0.01**
Lead	0.01 U	0.01 U	0.01 U	0.01 U
Magnesium	**17.9**	**4.92**	**11.1**	**14.1**
Manganese	0.0006 U	0.0006 U	0.0006 U	0.0006 U
Mercury	0.001 U	0.001 U	0.001 U	0.001 U
Nickel	0.002 U	0.002 U	0.002 U	0.002 U
Potassium	**0.1**	0.1 U	0.1 U	**0.1**
Selenium	0.02 U	0.02 U	0.02 U	0.02 U
Silver	0.01 U	0.01 U	0.01 U	0.01 U
Sodium	**1.1**	**6.5**	**6.1**	**8.7**
Thallium	0.01 U	0.01 U	0.01 U	0.01 U
Vanadium	0.002 U	0.002 U	0.002 U	0.002 U
Zinc	**0.02**	**0.009**	**0.012**	**0.008**

Note: A **BOLD** result indicates a positive detection.

Key:

EPA = United States Environmental Protection Agency
ID = identification
mg/L = milligrams per liter
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 11

EPA July 2012 Leachability Comparison
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:					12070021					12070022					12070023					12070024				
Sample Location:					SC-01					SC-02					DM-01					DM-02 (Field Duplicate)				
Sample Type:					Swift Creek Sediment					Swift Creek Sediment					Dredge Material					Dredge Material				
Location:					Landslide					Goodwin Road					Parker Property					Parker Property				
Sediment TAL Metals	MCL [1] (mg/L)	RSL Tapwater Values (mg/L)	Wash. State Ambient Water Quality Criteria - Acute (mg/L)	Wash. State Ambient Water Quality Criteria - Chronic (mg/L)	Total (mg/kg)	SPLP (mg/L)	Percent of Total Metal Solubilized via SPLP	DI Leach (mg/L)	Percent of Total Metal Solubilized via DI Leach	Total (mg/kg)	SPLP (mg/L)	Percent of Total Metal Solubilized via SPLP	DI Leach (mg/L)	Percent of Total Metal Solubilized via DI Leach	Total (mg/kg)	SPLP (mg/L)	Percent of Total Metal Solubilized via SPLP	DI Leach (mg/L)	Percent of Total Metal Solubilized via DI Leach	Total (mg/kg)	SPLP (mg/L)	Percent of Total Metal Solubilized via SPLP	DI Leach (mg/L)	Percent of Total Metal Solubilized via DI Leach
Aluminum	0.05 - 0.2 [2]	16	--	--	**599 JL**	0.02 U		**0.006**	0.020%	**3410 JL**	0.02 U		**0.009**	0.005%	**4010 JL**	0.02 U		**0.023**	0.011%	**5040 JL**	0.02 U		**0.02**	0.008%
Antimony	0.006	0.006	--	--	2 UJL	0.01 U		0.01 U		2 UJL	0.01 U		0.01 U		2 UJL	0.01 U		0.01 U		2 UJL	0.01 U		0.01 U	
Arsenic	0.01	0.000045	0.36	0.19	3.9 U	0.01 U		0.01 U		4 U	0.01 U		0.01 U		4 U	0.01 U		0.01 U		4 U	0.01 U		0.01 U	
Barium	2	3	--	--	**0.6**	0.002 U		0.002 U		**16.6**	**0.0028**	0.34%	**0.0035**	0.42%	**28.2**	**0.0066**	0.47%	**0.0079**	0.56%	**32**	**0.0027**	0.17%	**0.0046**	0.29%
Beryllium	0.004	0.16	--	--	0.1 U	0.0004 U		0.0004 U		0.1 U	0.0004 U		0.0004 U		0.1 U	0.0004 U		0.0004 U		0.1 U	0.0004 U		0.0004 U	
Cadmium	0.005	0.0069	0.0044	0.0012	**0.5**	0.0005 U		0.0005 U		**0.3**	0.0005 U		0.0005 U		**0.3**	0.0005 U		0.0005 U		**0.3**	0.0005 U		0.0005 U	
Calcium	--	--	--	--	**311 JK**	**3.56**	23%	**3.67**	24%	**1,370 JK**	**3.96**	5.8%	**3.56**	5.2%	**2,380 JK**	**4.32**	3.6%	**3.51**	2.9%	**3,150 JK**	**2.9**	1.8%	**3.22**	2.0%
Chromium	0.1	16	0.63	0.16	**361**	0.002 U		0.002 U		**321**	0.002 U		0.002 U		**274**	0.002 U		0.002 U		**253**	0.002 U		0.002 U	
Cobalt	--	0.0047	--	--	**76.2**	0.001 U		0.001 U		**87.8**	0.001 U		0.001 U		**85**	0.001 U		0.001 U		**73.5**	0.001 U		0.001 U	
Copper	1.3	0.62	0.022	0.013	0.6 U	0.01 UJL		0.01 U		**6.9**	0.01 UJL		0.01 U		**7.6**	0.01 UJL		0.01 U		**11.8**	0.01 UJL		0.01 U	
Iron	0.3 [2]	11	--	--	**45,800**	0.01 U		0.01 U		**45,200**	0.01 U		**0.02**	0.001%	**43,300**	0.01 U		**0.02**	0.001%	**40,800**	0.01 U		**0.01**	0.0005%
Lead	0.015	--	0.078	0.0031	2 U	0.01 U		0.01 U		2 U	0.01 U		0.01 U		2 U	0.01 U		0.01 U		2 U	0.01 U		0.01 U	
Magnesium	--	--	--	--	**24,200**	**13.1**	1.1%	**17.9**	1.5%	**21,400**	**4.48**	0.42%	**4.92**	0.460%	**200,000**	**12.1**	0.12%	**11.1**	0.11%	**171,000**	**15.2**	0.18%	**14.1**	0.16%
Manganese	0.05 [2]	0.32	--	--	**788**	0.0006 U		0.0006 U		**727**	0.0006 U		0.0006 U		**659**	0.0006 U		0.0006 U		**634**	0.0006 U		0.0006 U	
Mercury	0.002	0.00063	0.0021	0.000012	0.02 U	0.001 U		0.001 U		**0.01**	0.001 U		0.001 U		0.02 U	0.001 U		0.001 U		0.01 U	0.001 U		0.001 U	
Nickel	--	0.3	1.631	0.181	**1,770**	0.002 U		0.002 U		**1,920**	0.002 U		0.002 U		**1,880**	0.002 U		0.002 U		**1,660**	0.002 U		0.002 U	
Potassium	--	--	--	--	79.4 U	0.1 U		**0.1**	N/A	**163**	0.1 U		0.1 U		**229**	**0.1**	0.87%	0.1 U		**229**	0.1 U		**0.1**	0.87%
Selenium	0.05	0.078	0.02	0.005	5.9 U	0.02 U		0.02 U		6 U	0.02 U		0.02 U		6 U	0.02 U		0.02 U		6 U	0.02 U		0.02 U	
Silver	0.1 [2]	0.071	0.0046	--	0.5 U	0.01 U		0.01 U		0.5 U	0.01 U		0.01 U		0.5 U	0.01 U		0.01 U		0.5 U	0.01 U		0.01 U	
Sodium	--	--	--	--	79.4 U	1.1 U		**1.1**	N/A	78.7 U	**6.1**	N/A	**6.5**	N/A	78.8 U	**7.4**	N/A	**6.1**	N/A	79.5 U	**7.6**	N/A	**8.7**	N/A
Thallium	0.002	0.00016	--	--	2 U	R		0.01 U		2 U	R		0.01 U		2 U	R		0.01 U		2 U	R		0.01 U	
Vanadium	--	0.078	--	--	**7.5**	0.002 U		0.002 U		**16.6**	0.002 U		0.002 U		**17.9**	0.002 U		0.002 U		**21.2**	0.002 U		0.002 U	
Zinc	5 [2]	4.7	0.132	0.121	**22.9**	0.01 U		**0.02**	1.7%	**33.8**	**0.02**	1.2%	**0.009**	0.53%	**33.8**	**0.017**	1.0%	**0.012**	0.71%	**34.1**	**0.023**	1.3%	**0.008**	0.47%

Notes: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.

Key:
DI = deionized
EPA = United States Environmental Protection Agency
ID = identification
JL = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low direction of bias.
JK = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias.
MCL = maximum contaminant level
mg/kg = micrograms per kilogram
mg/L = micrograms per liter
N/A = not applicable
R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
RSL = Regional Screening Level
SPLP = Synthetic Precipitate Leaching Procedure
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above The reported sample quantitation limit.
UJL = The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate with a low bias and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

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Table 12

EPA October 2012 Water Asbestos Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID	Sample Location	Sample Volume (ml)	Fibers > 0.5 micron				Fibers > 10 micron			
			Asbestos Type	Fibers Detected	Analytical Sensitivity (MFL)	Concentration (MFL)	Asbestos Type	Fibers Detected	Analytical Sensitivity (MFL)	Concentration (MFL)
Maximum Contaminant Level						**n/a**				**7**
12101001	PMW-01	25	Chrysotile	**139**	3.9	**540**	Chrysotile	**2**	0.19	**0.39**
12101002	PMW-02	10	Chrysotile	**92**	9.7	**890**	ND	ND	0.49	< 0.49
12101003	PMW-05 (Duplicate of PMW-02)	10	Chrysotile	**116**	1.9	**230**	ND	ND	0.49	< 0.49
12101010	PMW-03	25	ND	ND	0.19	< 0.19	ND	ND	0.19	< 0.19
12101006	PMW-04	25	Chrysotile	**96**	0.19	**19**	Chrysotile	**1**	0.19	**0.19**
12101008	HMW-01	25	ND	ND	0.19	< 0.19	ND	ND	0.19	< 0.19
12101007	HMW-02	1	Chrysotile	**5**	4.9	**24**	ND	ND	4.9	< 4.9
12101009	HMW-03	1	ND	ND	4.9	< 4.9	ND	ND	4.9	< 4.9
12101004	FB02	50	Chrysotile	**2**	0.19	**0.39**	ND	ND	0.19	< 0.19
12101005	RB02	50	Chrysotile	**23**	0.19	**4.5**	ND	ND	0.19	< 0.19

Note: A **BOLD** result indicates a positive detection.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MFL = million fibers per liter
ml = milliliters
n/a = not applicable
ND = none detected

Table 13

EPA October 2012 Water Total TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:			**12101001**	**12101002**	**12101003**	**12101004**	**12101005**	**12101006**	**12101007**	**12101008**	**12101009**	**12101010**
Sample Location:			**PMW-01**	**PMW-02**	**PMW-05 (Field Duplicate of PMW-02)**	**FB-02**	**RB-02**	**PMW-04**	**HMW-02**	**HMW-01**	**HMW-03**	**PMW-03**
Sample Type:			**Groundwater**			**Quality Assurance**		**Groundwater**				
			Monitoring Well	**Monitoring Well**	**Monitoring Well**	**Field Blank**	**Rinsate Blank**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**
Location:	**MCL (1)**	**RSL Tapwater Values**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**n/a**	**n/a**	**Great Western Lumber**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Great Western Lumber**
Total TAL Metals (µg/L)												
Aluminum	50-200 (2)	16,000	**81.3**	**148**	**84.9**	**5.8**	**15.7**	**7.5**	**51.8**	2 U	**18.6**	**198**
Antimony	6	6	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Arsenic	10	0.045	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Barium	2,000	2,900	**13.8**	**10.2**	**9.6**	2 U	2 U	**5.7**	**41.7**	**4**	**71.8**	**11.5**
Beryllium	4	16	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Cadmium	5	6.9	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Calcium	--	--	**11,100**	**5,160**	**4,980**	50 U	**61.1**	**7,390**	**8,980**	**3,570**	**13,500**	**11,100**
Chromium	100	16,000	**8**	**16.8**	**17.6**	2 U	2 U	**6.5**	2 U	2 U	2 U	**6.5**
Cobalt	--	4.7	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Copper	1,300	620	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
Iron	300 (2)	11,000	**155**	**251**	**171**	**20.3**	**37.3**	**25.9**	**2,960**	20 U	**9,620**	**344**
Lead	15	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Magnesium	--	--	**67,100**	**50,200**	**49,300**	20 U	20 U	**29,000**	**23,600**	**37,900**	**19,500**	**43,900**
Manganese	50 (2)	320	**4.2**	**5.7**	**4.3**	**0.9**	**1.1**	0.6 U	**224**	0.6 U	**527**	**15.6**
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	--	300	**17**	**27.5**	**27.4**	2 U	2 U	**17.2**	**4.3**	2 U	**5.8**	**7.1**
Potassium	--	--	**602**	**482**	**441**	400 U	400 U	400 U	**1,710**	**1,160**	**1,790**	**498**
Selenium	50	78	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Silver	100 (2)	71	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	--	--	**4,040**	**2,460**	**2,430**	200 U	200 U	**3,540**	**11,000**	**6,940**	**6,270**	**3,960**
Thallium	2	0.16	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Vanadium	--	78	2 U	**2.4**	**2.3**	2 U	2 U	2 U	**2.7**	2 U	2 U	**2.3**
Zinc	5,000 (2)	4,700	2 U	**2.1**	**2.4**	2 U	2 U	2 U	2 U	2 U	2 U	**2.3**

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MCL = maximum contaminant level
mg/L = micrograms per liter
n/a = not applicable
ROW = right of way
RSL = Regional Screening Level
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 14

EPA October 2012 Water Dissolved TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:	MCL [1]	RSL Tapwater Values	12101001	12101002	12101003	12101004	12101005	12101006	12101007	12101008	12101009	12101010
Sample Location:			PMW-01	PMW-02	PMW-05 (Field Duplicate of PMW-02)	FB-02	RB-02	PMW-04	HMW-02	HMW-01	HMW-03	PMW-03
Sample Type:			Groundwater			Quality Assurance		Groundwater				
			Monitoring Well	Monitoring Well	Monitoring Well	Field Blank	Rinsate Blank	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well
Location:			Great Western Lumber	Great Western Lumber	Great Western Lumber	n/a	n/a	Great Western Lumber	Health Dept. (ROW)	Health Dept. (ROW)	Health Dept. (ROW)	Great Western Lumber
Dissolved TAL Metals (ug/L)												
Aluminum	50-200 [2]	16,000	2 U	2 U	**2.2**	n/a	**3.8**	2 U	**4.7**	**3.2**	**3.6**	2 U
Antimony	6	6	10 U	10 U	10 U	n/a	10 U	10 U	10 U	10 U	10 U	10 U
Arsenic	10	0.045	20 U	20 U	20 U	n/a	20 U	20 U	20 U	20 U	20 U	20 U
Barium	2,000	2,900	**13.6**	**9**	**9**	n/a	2 U	**5.7**	**41**	**4.2**	**69.7**	**8.7**
Beryllium	4	16	0.4 U	0.4 U	0.4 U	n/a	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Cadmium	5	6.9	0.5 U	0.5 U	0.5 U	n/a	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Calcium	--	--	**11,400**	**5,120**	**5,050**	n/a	50 U	**7,630**	**8,890**	**3,590**	**13,200**	**10,700**
Chromium	100	16,000	**5.9**	**13.1**	**13.2**	n/a	2 U	**6.6**	2 U	2 U	2 U	**6.2**
Cobalt	--	4.7	2 U	2 U	2 U	n/a	2 U	2 U	2 U	2 U	2 U	2 U
Copper	1,300	620	4 U	4 U	4 U	n/a	4 U	4 U	4 U	4 U	4 U	4 U
Iron	300 [2]	11,000	20 U	20 U	20 U	n/a	20 U	20 U	**2,860**	20 U	**9,200**	20 U
Lead	15	--	10 U	10 U	10 U	n/a	10 U	10 U	10 U	10 U	10 U	10 U
Magnesium	--	--	**68,600**	**49,700**	**49,000**	n/a	20 U	**29,600**	**23,200**	**37,500**	**19,100**	**43,600**
Manganese	50 [2]	320	0.6 U	**1**	**0.9**	n/a	0.6 U	0.6 U	**221**	0.6 U	**509**	0.6 U
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	n/a	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	--	300	**14.9**	**24.1**	**23.5**	n/a	2 U	**17.8**	**4.2**	2 U	**5.2**	**5.4**
Potassium	--	--	**607**	**423**	400 U	n/a	400 U	400 U	**1,670**	**1,170**	**1,790**	**460**
Selenium	50	78	20 U	20 U	20 U	n/a	20 U	20 U	20 U	20 U	20 U	20 U
Silver	100 [2]	71	2 U	2 U	2 U	n/a	2 U	2 U	2 U	2 U	2 U	2 U
Sodium	--	--	**4,130**	**2,450**	**2,390**	n/a	200 U	**3,620**	**10,800**	**6,870**	**6,130**	**3,930**
Thallium	2	0.16	10 U	10 U	10 U	n/a	10 U	10 U	10 U	10 U	10 U	10 U
Vanadium	--	78	2 U	2 U	2 U	n/a	2 U	2 U	**2**	2 U	**2**	2 U
Zinc	5,000 [2]	4,700	2 U	2 U	2 U	n/a	2 U	2 U	2 U	2 U	2 U	2 U

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MCL = maximum contaminant level
µg/L = micrograms per liter
n/a = not applicable / not analyzed
ROW = right-of-way
RSL = Regional Screening Level
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 15

EPA October 2012 Water Total Suspended Solids Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:	**12101001**	**12101002**	**12101003**	**12101004**	**12101005**	**12101006**	**12101007**	**12101008**	**12101009**	**12101010**
Sample Location:	**PMW-01**	**PMW-02**	**PMW-05 (Field Duplicate of PMW-02)**	**FB-02**	**RB-02**	**PMW-04**	**HMW-02**	**HMW-01**	**HMW-03**	**PMW-03**
Sample Type:	**Groundwater**			**Quality Assurance**		**Groundwater**				
	Monitoring Well	**Monitoring Well**	**Monitoring Well**	**Field Blank**	**Rinsate Blank**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**
Location:	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**n/a**	**n/a**	**Great Western Lumber**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Great Western Lumber**
Total Suspended Solids (mg/L)										
Total Suspended Solids	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	**7**	5 U

Note: **Bold results are greater than the sample quantitation limit.**

Key:

EPA = United States Environmental Protection Agency
ID = identification
mg/L = milligrams per liter
n/a = not applicable
ROW = right-of-way
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 16

Whatcom County October 2012 Water Asbestos Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Sample ID	Sample Location	Sample Volume (ml)	Fibers > 0.5 micron				Fibers > 10 micron			
			Asbestos Type	**Fibers Detected**	**Analytical Sensitivity (MFL)**	**Concentration (MFL)**	**Asbestos Type**	**Fibers Detected**	**Analytical Sensitivity (MFL)**	**Concentration (MFL)**
Maximum Contaminant Level						**n/a**				**7**
na	PMW-01	100	Chrysotile	**49**	0.19	**9.5**	ND	ND	0.19	< 0.19
na	PMW-02 (0.5 - 10 µm)	25	Chrysotile	**115**	1.9	**220**	ND	ND	1.9	< 1.9
na	PMW-02 (> 10 µm)	25	Chrysotile	**1**	0.19	**0.19**	Chrysotile	**1**	0.19	**0.19**
na	PMW-04 (0.5 - 10 µm)	25	Chrysotile	**120**	1.3	**160**	Chrysotile	**1**	1.3	**1.3**
na	PMW-04 (> 10 µm)	25	Chrysotile	**5**	0.19	**0.97**	Chrysotile	**5**	0.19	**0.97**
na	HMW-01 (0.5 - 10 µm)	25	Chrysotile	**122**	0.78	**95**	Chrysotile	**1**	0.78	**0.78**
na	HMW-01 (> 10 µm)	25	Chrysotile	**4**	0.19	**0.78**	Chrysotile	**4**	0.19	**0.78**
na	HMW-03	0.5	Chrysotile	**16**	9.7	**160**	ND	ND	9.7	< 9.7
na	PMW-03	25	Chrysotile	**12**	0.19	**2.3**	ND	ND	0.19	< 0.19
na	Duplicate (0.5 - 10 µm)	50	Chrysotile	**105**	0.97	**100**	ND	ND	0.97	<0.97
na	Duplicate (> 10 µm)	25	ND	ND	0.19	<0.19	ND	ND	0.19	<0.19

Note: A **BOLD** result indicates a positive detection.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MFL = million fibers per liter
ml = milliliters
n/a = not applicable
ND = none detected

Table 17

Whatcom County October 2012 Water Total TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:			**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
Sample Location:			**PMW-01**	**PMW-02**	**PMW-04**	**HMW-02**	**HMW-01**	**HMW-03**	**PMW-03**	**Duplicate**
Sample Type:			**Groundwater**							
			Monitoring Well	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	**Monitoring Well**	
Location:	**MCL (1)**	**RSL Tapwater Values**	**Great Western Lumber**	**Great Western Lumber**	**Great Western Lumber**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Health Dept. (ROW)**	**Great Western Lumber**	
Total TAL Metals (µg/L)										
Aluminum	50-200 (2)	16,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Antimony	6	6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Arsenic	10	0.045	1 U	1 U	1 U	**3**	1 U	**5**	1 U	1 U
Barium	2,000	2,900	**14**	**9**	**16**	**49**	**6**	**88**	**9**	**10**
Beryllium	4	16	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	5	6.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Calcium	--	--	**12,300**	**5,600**	**8,500**	**9,800**	**5,000**	**14,700**	**11,500**	**5,600**
Chromium	100	16,000	**7**	**14**	**9.6**	**3**	**3**	**2**	**7**	**13**
Cobalt	--	4.7	1 U	1 U	**1**	1 U	1 U	1 U	1 U	1 U
Copper	1,300	620	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Iron	300 (2)	11,000	50 U	50 U	**900**	**3,490**	50 U	**10,330**	50 U	50 U
Lead	15	--	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Magnesium	--	--	**70,800**	**53,500**	**31,800**	**24,800**	**39,300**	**20,400**	**44,800**	**53,600**
Manganese	50 (2)	320	1 U	**1**	**2.5**	**207**	1 U	**539**	1 U	**1**
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Molybdenum	--	78	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nickel	--	300	**9**	**16**	**22**	**3**	**3**	**4**	**1**	**15**
Potassium	--	--	500 U	500 U	500 U	**1,700**	**900**	**1,800**	500 U	500 U
Selenium	50	78	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Silver	100 (2)	71	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Sodium	--	--	**4,300**	**2,500**	**3,900**	**11,400**	**6,000**	**6,800**	**4,000**	**2,500**
Thallium	2	0.16	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vanadium	--	78	1	**3**	**3**	**3**	**1**	**3**	**2**	**2**
Zinc	5,000 (2)	4,700	5 U	5 U	**7**	5 U	5 U	5 U	5 U	5 U

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MCL = maximum contaminant level
µg/L = micrograms per liter
n/a = not applicable
ROW = right of way
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

Table 18

Whatcom County October 2012 Water Dissolved TAL Metals Results
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

EPA Sample ID:			na	na	na	na	na	na	na	na
Sample Location:			PMW-01	PMW-02	PMW-04	HMW-02	HMW-01	HMW-03	PMW-03	Duplicate
Sample Type:			Groundwater							
			Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	
Location:	MCL (1)	RSL Tapwater Values	Great Western Lumber	Great Western Lumber	Great Western Lumber	Health Dept. (ROW)	Health Dept. (ROW)	Health Dept. (ROW)	Great Western Lumber	
Dissolved TAL Metals (ug/L)										
Aluminum	50-200 (2)	16,000	10 U	10 U	10 U	**15**	10 U	10 U	10 U	10 U
Antimony	6	6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Arsenic	10	0.045	1 U	1 U	1 U	**2**	1 U	**3**	1 U	1 U
Barium	2,000	2,900	**13**	1 U	**6**	**36**	**6**	**70**	**9**	**9**
Beryllium	4	16	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Cadmium	5	6.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Calcium	--	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chromium	100	16,000	**6**	**13**	**7**	**1**	**2**	1 U	**6**	**13**
Cobalt	--	4.7	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Copper	1,300	620	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Iron	300 (2)	11,000	50 U	50 U	50 U	**1,880**	50 U	**5,210**	50 U	50 U
Lead	15	--	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Magnesium	--	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Manganese	50 (2)	320	1 U	1 U	1 U	**217**	1 U	**522**	1 U	1 U
Mercury	2	0.63	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	--	300	**9**	**15**	**11**	1 U	**3**	1 U	**2**	**14**
Potassium	--	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Selenium	50	78	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Silver	100 (2)	71	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Sodium	--	--	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Thallium	2	0.16	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Vanadium	--	78	10 U	10 U	**1**	10 U	10 U	10 U	10 U	10 U
Zinc	5,000 (2)	4,700	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U

Note: (1) Primary Drinking Water Standard unless otherwise indicated.
(2) Secondary Drinking Water Standard
A **BOLD** result indicates a positive detection.
A highlighted number indicates that the result exceeds the MCL.

Key:

EPA = United States Environmental Protection Agency
ID = identification
MCL = maximum contaminant level
µg/L = micrograms per liter
n/a = not applicable / not analyzed
TAL = target analyte list
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

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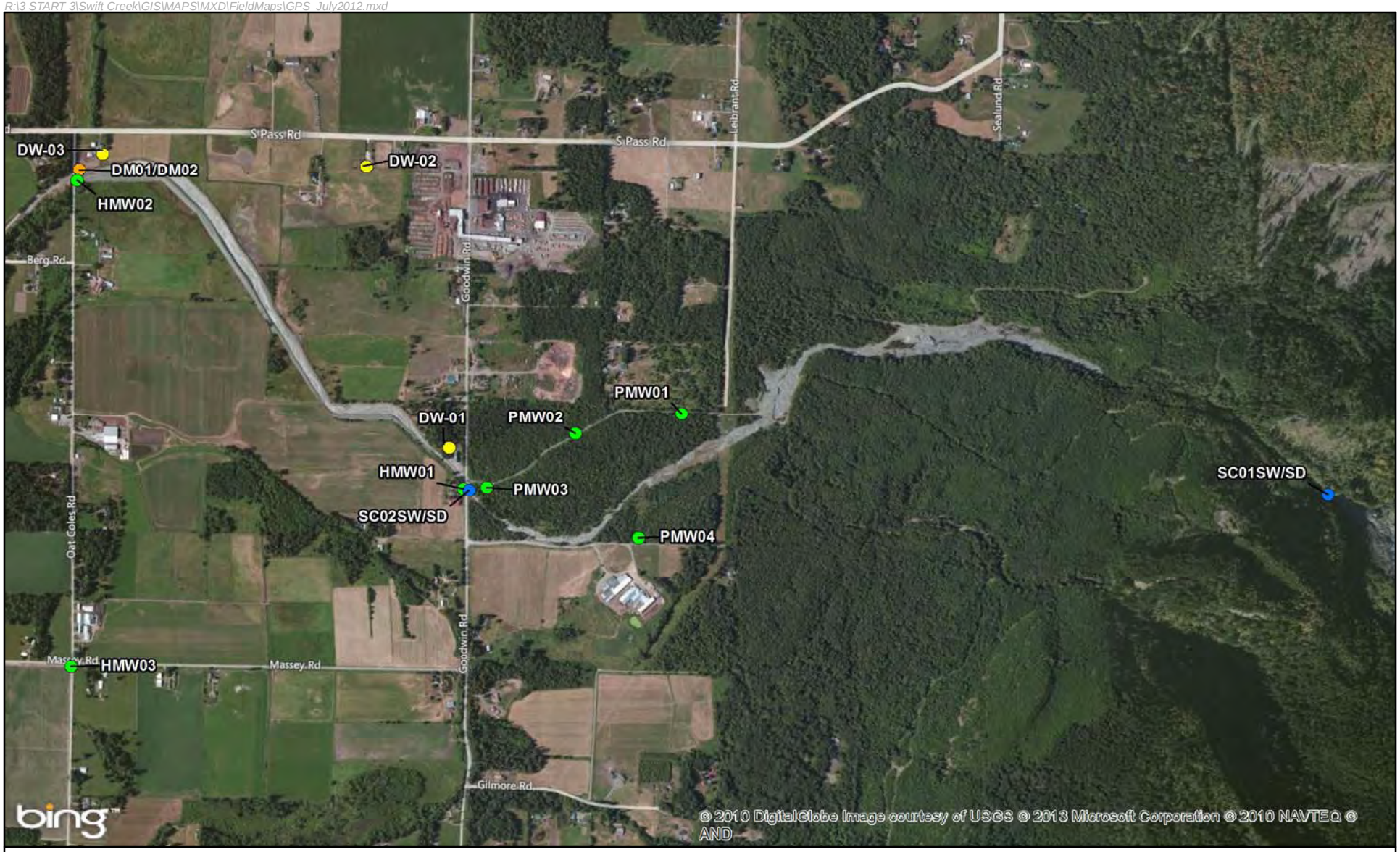

Source: Bing 2012

- Domestic Wells
- Dredge Material
- Monitoring Well
- Surface Water / Sediment

0 500 1,000 2,000 Feet

N

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 1

EPA Sample Locations

July 2012

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R:\3 START 3\Swift Creek\GIS\MAPS\MXD\Fig2_ProposedSampleLocs.mxd

Source: Bing 2012

Monitoring Well

0 500 1,000 2,000 Feet

N

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 2

EPA Sample Locations

October 2012

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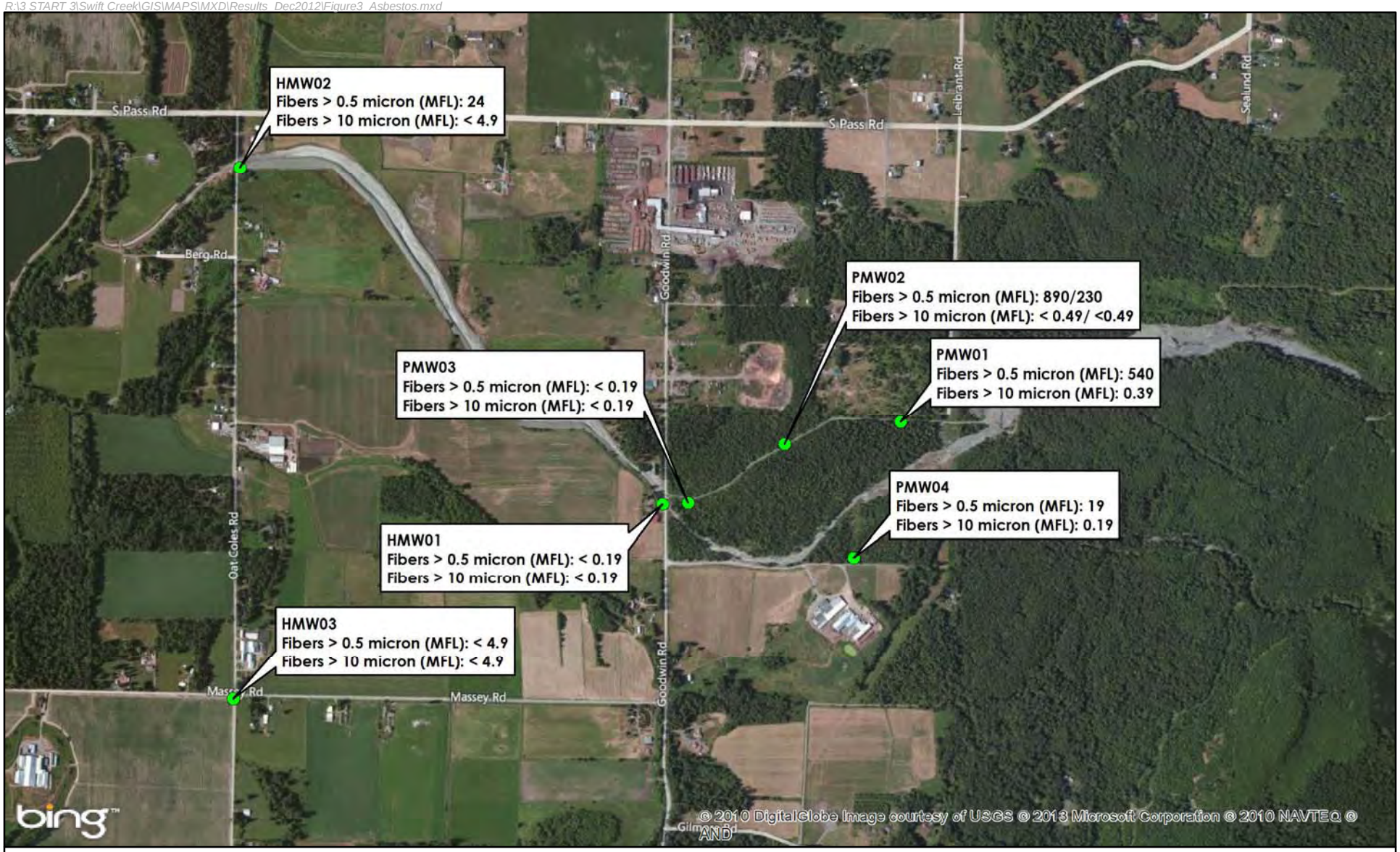
R:\3 START 3\Swift Creek\GIS\MAPS\MXD\Results_Dec2012\Figure3_Asbestos.mxd



Source: Bing 2012

Monitoring Well

MFL = million fibers per liter

0 500 1,000 2,000 Feet

N

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 3

Asbestos Results in EPA Groundwater Samples

October 2012

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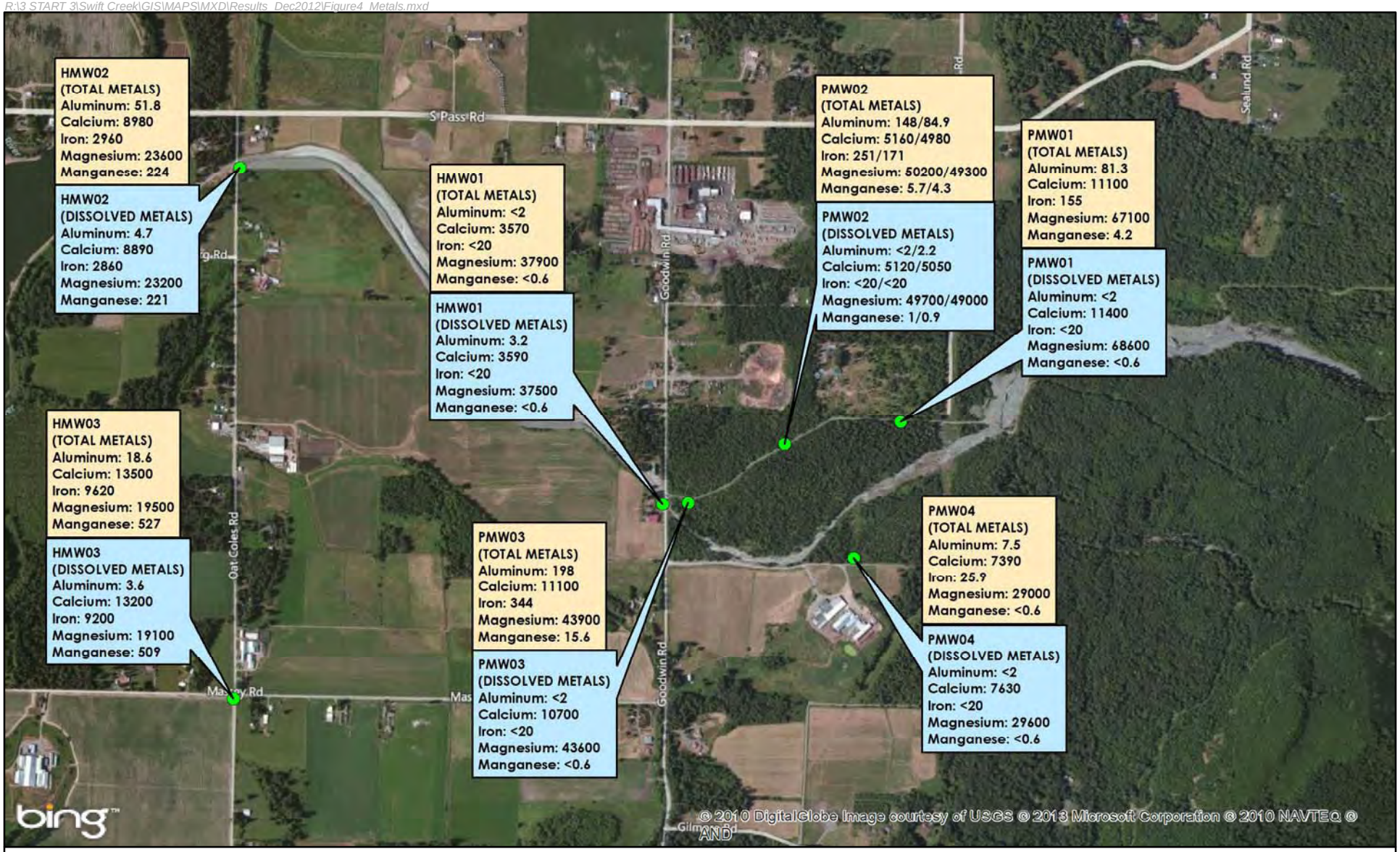

Source: Bing 2012

Monitoring Well

Metal results are in micrograms per liter.

0 500 1,000 2,000 Feet

N

Sumas Mountain Asbestos (aka Swift Creek) Site

Whatcom County, Washington

Figure 4

Select Total and Dissolved Metals Results in EPA Groundwater Samples

October 2012

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B Analytical Data Reports and Validation Memoranda for EPA 2012 Sampling Events

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720 Third Avenue, Suite 1700, Seattle, WA 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: September 11, 2012

TO: Steve Hall, Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-3 Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Sumas Mountain Asbestos (Swift Creek) Site, Whatcom County, Washington**

REF: TDD: 12-02-0006 PAN: 002233.0771.01RA

The data quality assurance review of five water samples collected from the Sumas Mountain Asbestos (Swift Creek) site in Whatcom County, Washington, has been completed. EPA Method 100.2 (counting of all fibers > 10 μm; EPA 600/R-94/134) and modified EPA Method 100.2 (counting of all fiber sizes ≥ 0.5 μm) transmission electron microscopy (TEM) asbestos analyses were performed by EMSL Analytical, Inc., Cinnaminson, New Jersey. All sample analyses were evaluated following EPA's Stage 2 Data Validation Manual Process (S2VM).

The samples were numbered:

12070006	12070007	12070008	12070009	12070014

Data Qualifications:

The samples were collected on July 19, 2012, and were analyzed by July 31, 2012. No discrepancies were noted in the laboratory case narrative.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan, the OSWER Guidance Document "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures" (EPA/540/G-90/004) and the analytical method. Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Phone/Fax: (800) 220-3675 / (856) 786-5974
http://www.emsl.com / cinnarblab@EMSL.com

EMSL Order ID: 041219217
Customer ID: ECOL44
Customer PO:
Project ID:

Attn: Steven Hall
Ecology & Environment, Inc.
720 3rd Ave
Suite 1700
Seattle, WA 98104

Phone: (206) 624-9537
Fax: (206) 621-9832
Collected: 07/19/2012
Received: 07/21/2012
Analyzed: 07/31/2012

Proj: Site # 10EG
Project No. 4500000475-EE-002233-0771-01110

Test Report: Determination of Asbestos Structures >10µm in Drinking Water Performed by the 100.2 Method (EPA 600/R-94/134)

Sample ID Client / EMSL	Sample Filtration Date/Time	Original Sample Vol. Filtered (ml)	Effective Filter Area (mm²)	Area Analyzed (mm²)	ASBESTOS Asbestos Types	Fibers Detected	Analytical Sensitivity	Concentration	Confidence Limits
							MFL (million fibers per liter)		
12070006 041219217-0001	7/21/2012 12:10 PM	0.10	1282	1.8460	Chrysotile	33	6.90	230.00	160.00 - 320.00
12070007 041219217-0002	7/21/2012 12:10 PM	1	1282	0.1848	None Detected	ND	6.90	<6.90 U	0.00 - 26.00
12070008 041219217-0003	7/21/2012 12:10 PM	5	1282	0.3300	Chrysotile	3	0.78	2.30	0.48 - 6.80
12070009 041219217-0004	7/21/2012 12:10 PM	1	1282	0.1848	Chrysotile	2	6.90	14.00	1.70 - 50.00
12070014 041219217-0005	7/21/2012 12:10 PM	100	1282	0.2640	None Detected	ND	0.05	<0.05 U	0.00 - 0.18

Fibers <10 µm observed in all samples.

Analyst(s)
Debbie Little (5)

Stephen Siegel, CIH, Laboratory Manager
or Other Approved Signatory

Any questions please contact Steve Siegel.

Initial report from: 08/28/2012 12:32:37

Sample collection and containers provided by the client, acceptable bottle blank level is defined as ≤0.01MFL>10µm. ND=None Detected. This report may not be reproduced, except in full, without written permission by EMSL Analytical, Inc. The test results contained within this report meet the requirements of NELAC unless otherwise noted. This report relates only to the samples reported above. Samples received in good condition unless otherwise noted.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NELAC NYS ELAP 10872, NJ DEP 03036, FL DOH E37975

MW 9-11-12

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Phone/Fax: (800) 220-3675 / (856) 786-5974
http://www.emsl.com / cinnasblab@EMSL.com

EMSL Order ID: 041219217
Customer ID: ECOL44
Customer PO:
Project ID:

Attn: Steven Hall
Ecology & Environment, Inc.
720 3rd Ave
Suite 1700
Seattle, WA 98104

Phone: (206) 624-9537
Fax: (206) 621-9832
Collected: 07/19/2012
Received: 07/21/2012
Analyzed: 07/31/2012

Proj: Site # 10EG
Project No. 4500000475-EE-002233-0771-01110

Test Report: Determination of Asbestos Structures ≥ 0.5 µm & > 10µm in Drinking Water Performed by the 100.2 Method (EPA 600/R-94/134)

Sample ID Client / EMSL	Sample Filtration Date/Time	Original Sample Vol. Filtered (ml)	Effective Filter Area (mm²)	Area Analyzed (mm²)		ASBESTOS Asbestos Types	Fibers Detected	Analytical Sensitivity	Concentration	Confidence Limits
								MFL (million fibers per liter)		
12070006 041219217-0001	7/21/2012 12:10 PM	0.10	1282	0.0660	≥ 0.5 µm	Chrysotile	102	190.00	20000.00	000.00 - 24,000.00
					> 10 µm only	Chrysotile	2	190.00	390.00	47.00 - 1,400.00
12070007 041219217-0002	7/21/2012 12:10 PM	1	1282	0.0132	≥ 0.5 µm	Chrysotile	120	97.00	12000.00	700.00 - 14,000.00
					> 10 µm only	None Detected	~~ND~~ MW	97.00	<97.00 U	0.00 - 360.00
12070008 041219217-0003	7/21/2012 12:10 PM	5	1282	0.0264	≥ 0.5 µm	Chrysotile	101	9.70	980.00	800.00 - 1,200.00
					> 10 µm only	Chrysotile	3	9.70	29.00	6.00 - 85.00
12070009 041219217-0004	7/21/2012 12:10 PM	1	1282	0.0396	≥ 0.5 µm	Chrysotile	104	32.00	3400.00	2,800.00 - 4,100.00
					> 10 µm only	None Detected	~~ND~~ MW	32.00	<32.00 U	0.00 - 120.00
12070014 041219217-0005	7/21/2012 12:10 PM	100	1282	0.2640	≥ 0.5 µm	Chrysotile	5	0.05	0.24	0.08 - 0.57
					> 10 µm only	None Detected	~~ND~~ MW	0.05	<0.05 U	0.00 - 0.18

Analyst(s)
Debbie Little (5)

Stephen Siegel, CIH, Laboratory Manager
or Other Approved Signatory

Any questions please contact Steve Siegel.

Report amended: 09/06/2012 13:15:52 Replaces initial report from:08/28/2012 13:08:19 Reason Code: Data Entry-Results Changed

Sample collection and containers provided by the client, acceptable bottle blank level is defined as ≤0.01MFL>10um. ND=None Detected. This report may not be reproduced, except in full, without written permission by EMSL Analytical, Inc. The test results contained within this report meet the requirements of NELAC unless otherwise noted. This report relates only to the samples reported above. Samples received in good condition unless otherwise noted.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NELAC NYS ELAP 10872, NJ DEP 03028, FL DOH E87975

MW 9-11-12

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700, Seattle, WA 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: August 20, 2012

TO: Steve Hall, Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-3 Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Sumas Mountain Asbestos (Swift Creek) Site, Whatcom County, Washington**

REF: TDD: 12-02-0006 PAN: 002233.0771.01RA

The data quality assurance review of 4 sediment and 13 water samples collected from the Sumas Mountain Asbestos (Swift Creek) site in Whatcom County, Washington, has been completed. Target Analyte List (TAL), Synthetic Precipitate Leaching Procedure (SPLP), dissolved, and deionized water leach metals analyses (EPA Methods 1312, modified 1312, 6010, 7470, and 7471) were performed by Columbia Analytical Services (part of the ALS Group), Kelso, Washington. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2VM and/or S4VM).

The samples were numbered:

12070001	12070002	12070003	12070004	12070005	12070006
12070007	12070008	12070009	12070010	12070011	12070012
12070013	12070021	12070022	12070023	12070024	

Data Qualifications:

1. **Sample Holding Times: Acceptable.**

All liquid samples were preserved to a pH < 2. The samples were maintained at < 6°C. The samples were collected on July 18 and 19, 2012, and were extracted and/or analyzed by August 4, 2012, therefore meeting QC criteria of less than 6 months (28 days for mercury) between collection and SPLP/modified SPLP extraction and/or less than 6 months between collection, extraction, and analysis (28 days for mercury).

2. **Initial and Continuing Calibration: Acceptable.**

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits of 90% to 110%. All AA recoveries were within QC limits of 80% to 120%.

3. **Blanks: Satisfactory.**

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A preparation blank was analyzed for each 20 samples or per matrix per concentration level.

Blanks were analyzed after each Initial or Continuing Calibration Verification. The following elements were detected in the applicable calibration and/or preparation blanks and affected sample results:

Blank	Element	Concentration
Method Blank (SPLP)	Sodium	1.0 mg/L

Associated sample results were qualified as not detected (U) if the sample result was less than five times the positive blank concentration.

4. ICP Interference Check Sample: Satisfactory.

An Interference Check Sample (ICS) was analyzed at the beginning and end of each sequence or at least twice every 8 hours, whichever was more frequent. All ICS (solution AB) results were within QC limits of 80% - 120% recovery except copper (50%) and thallium (0%) associated with the SPLP samples. Positive sample results and sample quantitation limits associated with the low recovery outliers were qualified as estimated quantities with a low bias (JL or UJL) for copper and rejected (R) for thallium.

5. Precision and Bias Determination: Not Performed.

Samples necessary to determine precision and bias were not provided to the laboratory. All results were flagged "PND" (Precision Not Determined) and "RND" (Recovery Not Determined), although the flags do not appear on the data sheets.

6. Performance Evaluation Sample Analysis: Not Provided.

Performance evaluation samples were not provided to the laboratory.

7. ICP Serial Dilution: Acceptable.

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All serial dilution results were within QC limits.

8. Matrix Spike Analysis: Satisfactory.

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike and spike duplicate recoveries were within the QC limits except aluminum and antimony (low recoveries) associated with the sediment samples. Sample results associated with the low recovery outliers were qualified as estimated quantities with a low bias (JL or UJL).

9. Duplicate Analysis: Satisfactory.

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits except antimony calcium associated with the sediment samples. Associated sample results were qualified as estimated quantities with an unknown bias (JK or UJK).

10. Laboratory Control Sample Analysis: Acceptable.

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

11. Overall Assessment of Data for Use

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan, the OSWER Guidance Document "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures" (EPA/540/G-90/004), the analytical methods, and, when applicable, the Office of Emergency and Remedial Response Publication "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

JH - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a high bias.

JL - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.

JK - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias.

JQ – The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).

N - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070001 Lab Code: K1207087-007

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	520		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	55.7		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	9120		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	22.7		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	4.8		
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	3010		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	51200		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	66.6		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	116		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1060		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3780		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.9		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	3.3		

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Comments:

MW 8-20-12

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070001 Lab Code: K1207087-007DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	5.90		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	51.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	8990		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	37100		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	2.30		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	5.3		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1080		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3780		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

S2VM

Comments:

MW 8-2012

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070002 Lab Code: K1207087-008

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	129		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	23.5		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	7220		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.6		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	382		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	26600		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	8.90		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	16.3		
Potassium	6010C	400	1.0	07/24/12	07/28/12	724		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	4320		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

52VM

Comments:

MW 8-20-12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070002 Lab Code: K1207087-008DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	8.30		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	22.1		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	7010		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	24500		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	2.20		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	4.6		
Potassium	6010C	400	1.0	07/24/12	07/28/12	652		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	4260		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.2		

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Comments:

MW 8/20/12

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070003 Lab Code: K1207087-009

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	12.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	15800		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	7.2		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	66.8		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	52.0		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	52500		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	1.10		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	554		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3490		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.3		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	214		

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Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070003 Lab Code: K1207087-009DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	12.1		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	15800		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	5.9		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	40.6		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	52300		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	1.60		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	562		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3480		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	222		

SCVM

Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070004 Lab Code: K1207087-010

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	10.7		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	23.2		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	17400		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	4.7		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	214		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	47600		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	118		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	6.2		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1060		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	7240		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	56.5		

S2VM

Comments:

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8-20-12

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070004 Lab Code: K1207087-010DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	23.2		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	17800		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	41.9		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	48000		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	120		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.4		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1020		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	7310		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	37.6		

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Comments:

MW 8-20-12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070005 Lab Code: K1207087-011

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	4.50		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	21.0		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	42200		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	4.6		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	9330		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	5.70		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	2010		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	6100		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	7.6		

52/M

Comments:

MN 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/18/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070005 Lab Code: K1207087-011DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	21.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	43100		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.7		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	9400		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	1.50		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	2090		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	6120		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	7.2		

SZVM

Comments:

MW
8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070006 Lab Code: K1207087-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	50.0	1.0	07/24/12	07/28/12	7590		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	74.0		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	14400		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	40.6		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	13.1		
Copper	6010C	2.0	1.0	07/24/12	07/28/12	22.4		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	16400		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	8000	1.0	07/24/12	07/28/12	91000		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	406		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	209		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1480		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	5160		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	24.3		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	78.8		

S2V/M

Comments:

MW 8-2012

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070006 Lab Code: K1207087-001DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	13.8		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	12200		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	6.8		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	80300		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	0.60		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	9.6		
Potassium	6010C	400	1.0	07/24/12	07/28/12	679		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	4780		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	5.5		

S2VM

Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070007 Lab Code: K1207087-002

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	50.0	1.0	07/24/12	07/28/12	1860		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	23.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	5940		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	19.5		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	2.6		
Copper	6010C	2.0	1.0	07/24/12	07/28/12	4.5		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	3330		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	55700		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	104		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	51.2		
Potassium	6010C	400	1.0	07/24/12	07/28/12	624		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	2600		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	6.2		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	9.9		

52YM

Comments:

8-20-12

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070007 Lab Code: K1207087-002DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	9.1		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	5460		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	11.7		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	52600		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	1.10		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	15.6		
Potassium	6010C	400	1.0	07/24/12	07/28/12	506		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	2460		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.3		

S2VM

Comments:

MW 8-26-12

COLUMBIA ANALYTICAL SERVICES, INC.
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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070008 Lab Code: K1207087-003

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	715		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	19.8		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	17800		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	5.8		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.3		
Copper	6010C	2.0	1.0	07/24/12	07/28/12	4.0		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	1810		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	8310		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	53.0		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	12.6		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1120		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	11100		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.4		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	155		

52VM

Comments:

MW 8/28/12

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070008 Lab Code: K1207087-003DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	6.90		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	12.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	17300		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	7750		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	5.00		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1050		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	11000		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	83.7		

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Comments:

MM 8-20-12

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070009 Lab Code: K1207087-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	50.0	1.0	07/24/12	07/28/12	1950		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	19.2		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	7860		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	12.0		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	4.7		
Iron	6010C	20.0	1.0	07/24/12	07/28/12	2970		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	31800		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	49.1		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	36.7		
Potassium	6010C	400	1.0	07/24/12	07/28/12	544		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3790		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	7.0		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	15.0		

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Comments:

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070009 Lab Code: K1207087-004DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	3.00	U	
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	4.9		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	7450		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	5.5		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	29600		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	0.60		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	10.2		
Potassium	6010C	400	1.0	07/24/12	07/28/12	400	U	
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3600		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	6.7		

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070010 Lab Code: K1207087-012

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	4.40		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	2.0		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	1760		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	18700		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	0.60	U	
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	715		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3480		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070010 Lab Code: K1207087-012DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	5.50		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	2.1		
Beryllium	6010C	0.40	1.0	07/24/12	08/01/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	1780		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	18700		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	0.60	U	
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	740		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	3500		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070011 Lab Code: K1207087-013

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	784		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	113		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	10800		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.4		
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	11000		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	27500		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	290		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.4		
Potassium	6010C	400	1.0	07/24/12	07/28/12	1870		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	12100		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	5.0		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	3.7		

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070011 Lab Code: K1207087-013DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	11.1		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	47.7		
Beryllium	6010C	0.40	1.0	07/24/12	08/01/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	10400		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	3380		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	26800		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	257		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1780		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	12100		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.2		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070012 Lab Code: K1207087-005

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	516		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	65.5		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	10200		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	5800		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	27100		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	261		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1900		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	12100		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	3.6		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	3.2		

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070012 Lab Code: K1207087-005DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	9.30		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	45.9		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	9930		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	3240		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	26000		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	247		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1770		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	11700		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.1		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070013 Lab Code: K1207087-006

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	75.4		
Antimony	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	67.4		
Beryllium	6010C	0.40	1.0	07/24/12	07/28/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	13000		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	9580		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	19700		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	514		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1750		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	6230		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0		
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

S2VM

Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	NA	Date Collected:	07/19/12
Project Name:	Site #: 10EG	Date Received:	07/21/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12070013 Lab Code: K1207087-006DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	3.00	1.0	07/24/12	07/28/12	5.80		
Antimony	6010C	10.0	1.0	07/24/12	07/29/12	10.0	U	
Arsenic	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Barium	6010C	2.0	1.0	07/24/12	07/28/12	67.6		
Beryllium	6010C	0.40	1.0	07/24/12	07/29/12	0.40	U	
Cadmium	6010C	0.5	1.0	07/24/12	07/28/12	0.5	U	
Calcium	6010C	50.0	1.0	07/24/12	07/28/12	13200		
Chromium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Cobalt	6010C	1.0	1.0	07/24/12	07/28/12	1.0	U	
Copper	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Iron	6010C	20.0	1.0	07/24/12	07/28/12	9240		
Lead	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Magnesium	6010C	30.0	1.0	07/24/12	07/28/12	19600		
Manganese	6010C	0.60	1.0	07/24/12	07/28/12	508		
Mercury	7470A	0.20	1.0	07/25/12	07/26/12	0.20	U	
Nickel	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Potassium	6010C	400	1.0	07/24/12	07/28/12	1740		
Selenium	6010C	20.0	1.0	07/24/12	07/28/12	20.0	U	
Silver	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Sodium	6010C	400	1.0	07/24/12	07/28/12	6310		
Thallium	6010C	10.0	1.0	07/24/12	07/28/12	10.0	U	
Vanadium	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	
Zinc	6010C	2.0	1.0	07/24/12	07/28/12	2.0	U	

SLVM

Comments:

MW 8-20-12

Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1207087
Project No.: Site #: 10EG
Date Collected: 07/18/12
Project Name: NA
Date Received: 07/21/12
Matrix: SEDIMENT
Units: mg/Kg
Basis: DRY

Sample Name: 12070021
Lab Code: K1207087-014

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	9.9	2.0	07/25/12	07/27/12	599	JL	N
Antimony	6010C	2.0	2.0	08/02/12	08/04/12	2.0	U JL	N MW
Arsenic	6010C	3.9	2.0	08/02/12	08/04/12	3.9	U	
Barium	6010C	0.5	2.0	07/25/12	07/27/12	0.6		
Beryllium	6010C	0.1	2.0	08/02/12	08/04/12	0.1	U	
Cadmium	6010C	0.1	2.0	07/25/12	07/27/12	0.5		
Calcium	6010C	9.9	2.0	07/25/12	07/27/12	311	JK	MW
Chromium	6010C	0.5	2.0	07/25/12	07/27/12	361		
Cobalt	6010C	0.5	2.0	07/25/12	07/27/12	76.2		
Copper	6010C	0.6	2.0	07/25/12	07/27/12	0.6	U	
Iron	6010C	4.0	2.0	07/25/12	07/27/12	45800		
Lead	6010C	2.0	2.0	07/25/12	07/27/12	2.0	U	
Magnesium	6010C	7.9	2.0	07/25/12	07/29/12	24200		
Manganese	6010C	0.20	2.0	07/25/12	07/27/12	788		
Mercury	7471B	0.02	1.0	07/24/12	07/25/12	0.02	U	
Nickel	6010C	0.4	2.0	07/25/12	07/27/12	1770		
Potassium	6010C	79.4	2.0	07/25/12	07/27/12	79.4	U	
Selenium	6010C	5.9	2.0	08/02/12	08/04/12	5.9	U	
Silver	6010C	0.5	2.0	07/25/12	07/27/12	0.5	U	
Sodium	6010C	79.4	2.0	07/25/12	07/27/12	79.4	U	
Thallium	6010C	2.0	2.0	07/25/12	07/27/12	2.0	U	
Vanadium	6010C	1.0	2.0	07/25/12	07/27/12	7.5		
Zinc	6010C	0.99	2.0	07/25/12	07/27/12	22.9		

S2VM

% Solids: 84.7

Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070021 DI SPLP Lab Code: K1207087-014

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.005	1.0	07/25/12	07/27/12	0.006		
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0020	U	
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.67		
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	17.9		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1		
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	1.1		
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.007	1.0	07/25/12	07/27/12	0.020		

S2YM

Comments: DI WATER LEACHATE

MW 8-2012

COLUMBIA ANALYTICAL SERVICES, INC.
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SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070021 Lab Code: K1207087-014

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.020	1.0	07/25/12	07/27/12	0.020	U	
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0020	U	
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.56	~~J~~	
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U J	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	13.1		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1	U	
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	1.1	U	
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	~~0.010~~	~~U~~	R
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	

SZVM

Comments:

JMW 8-20-12

SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070022 DI SPLP Lab Code: K1207087-015

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.005	1.0	07/25/12	07/27/12	0.009		
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0035		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.56		
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.02		
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	4.92		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1	U	
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	6.5		
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.007	1.0	07/25/12	07/27/12	0.009		

SVM

Comments: DI WATER LEACHATE

JMW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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SPLP Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070022 Lab Code: K1207087-015

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.020	1.0	07/25/12	07/27/12	0.020	U	
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0028		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.96	J	
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	UJ	L
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	4.48		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1	U	
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	6.1		
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	~~0.010~~	~~U~~	R
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.010	1.0	07/25/12	07/27/12	0.020		

SZVM

Comments:

MW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1207087
Project No.: Site #: 10EG
Date Collected: 07/18/12
Project Name: NA
Date Received: 07/21/12
Matrix: SEDIMENT
Units: mg/Kg
Basis: DRY

Sample Name: 12070022
Lab Code: K1207087-015

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	9.8	2.0	07/25/12	07/27/12	3410	JL	
Antimony	6010C	2.0	2.0	08/02/12	08/04/12	2.0	UJL	
Arsenic	6010C	4.0	2.0	08/02/12	08/04/12	4.0	U	
Barium	6010C	0.5	2.0	07/25/12	07/27/12	16.6		
Beryllium	6010C	0.1	2.0	08/02/12	08/04/12	0.1	U	
Cadmium	6010C	0.1	2.0	07/25/12	07/27/12	0.3		
Calcium	6010C	9.8	2.0	07/25/12	07/27/12	1370	JK	
Chromium	6010C	0.5	2.0	07/25/12	07/27/12	321		
Cobalt	6010C	0.5	2.0	07/25/12	07/27/12	87.8		
Copper	6010C	0.6	2.0	07/25/12	07/27/12	6.9		
Iron	6010C	3.9	2.0	07/25/12	07/27/12	45200		
Lead	6010C	2.0	2.0	07/25/12	07/27/12	2.0	U	
Magnesium	6010C	7.9	2.0	07/25/12	07/29/12	21400		
Manganese	6010C	0.20	2.0	07/25/12	07/27/12	727		
Mercury	7471B	0.01	1.0	07/24/12	07/25/12	0.01		
Nickel	6010C	0.4	2.0	07/25/12	07/27/12	1920		
Potassium	6010C	78.7	2.0	07/25/12	07/27/12	163		
Selenium	6010C	6.0	2.0	08/02/12	08/04/12	6.0	U	
Silver	6010C	0.5	2.0	07/25/12	07/27/12	0.5	U	
Sodium	6010C	78.7	2.0	07/25/12	07/27/12	78.7	U	
Thallium	6010C	2.0	2.0	07/25/12	07/27/12	2.0	U	
Vanadium	6010C	1.0	2.0	07/25/12	07/27/12	16.6		
Zinc	6010C	0.98	2.0	07/25/12	07/27/12	33.8		

S2VM

% Solids: 75.3

Comments:

MW 8-20-12

SPLP Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070023 DI SPLP Lab Code: K1207087-016

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.005	1.0	07/25/12	07/27/12	0.023		
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0079		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.51		
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.02		
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	11.1		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1	U	
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	6.1		
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.007	1.0	07/25/12	07/27/12	0.012		

S2VM

Comments: DI WATER LEACHATE

JMW 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070023 Lab Code: K1207087-016

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.020	1.0	07/25/12	07/27/12	0.020	U	
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0066		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	4.32	~~J~~	
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	UJ	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	12.1		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1		
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	7.4		~~X~~
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	~~0.010~~	~~U~~	R
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.010	1.0	07/25/12	07/27/12	0.017		

S2VM

Comments:

JMV
8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1207087
Project No.: Site #: 10EG
Date Collected: 07/18/12
Project Name: NA
Date Received: 07/21/12
Matrix: SEDIMENT
Units: mg/Kg
Basis: DRY

Sample Name: 12070023
Lab Code: K1207087-016

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	9.9	2.0	07/25/12	07/28/12	4010	JL	~~N~~
Antimony	6010C	2.0	2.0	08/02/12	08/04/12	2.0	U	~~N~~
Arsenic	6010C	4.0	2.0	08/02/12	08/04/12	4.0	U	
Barium	6010C	0.5	2.0	07/25/12	07/28/12	28.2		
Beryllium	6010C	0.1	2.0	08/02/12	08/04/12	0.1	U	
Cadmium	6010C	0.1	2.0	07/25/12	07/28/12	0.3		
Calcium	6010C	9.9	2.0	07/25/12	07/28/12	2380	JK	~~N~~
Chromium	6010C	0.5	2.0	07/25/12	07/28/12	274		
Cobalt	6010C	0.5	2.0	07/25/12	07/28/12	85.0		
Copper	6010C	0.6	2.0	07/25/12	07/28/12	7.6		
Iron	6010C	3.9	2.0	07/25/12	07/28/12	43300		
Lead	6010C	2.0	2.0	07/25/12	07/28/12	2.0	U	
Magnesium	6010C	78.8	20.0	07/25/12	07/29/12	200000		
Manganese	6010C	0.20	2.0	07/25/12	07/28/12	659		
Mercury	7471B	0.02	1.0	07/24/12	07/25/12	0.02	U	
Nickel	6010C	0.4	2.0	07/25/12	07/28/12	1880		
Potassium	6010C	78.8	2.0	07/25/12	07/28/12	229		
Selenium	6010C	6.0	2.0	08/02/12	08/04/12	6.0	U	
Silver	6010C	0.5	2.0	07/25/12	07/28/12	0.5	U	
Sodium	6010C	78.8	2.0	07/25/12	07/28/12	78.8	U	
Thallium	6010C	2.0	2.0	07/25/12	07/28/12	2.0	U	
Vanadium	6010C	1.0	2.0	07/25/12	07/28/12	17.9		
Zinc	6010C	0.99	2.0	07/25/12	07/28/12	33.8		

SZ/MM

% Solids: 94.0

Comments:

MW 8-20-12

SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070024 DI SPLP Lab Code: K1207087-017

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.005	1.0	07/25/12	07/27/12	0.020		
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0046		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	3.22		
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01		
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	14.1		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1		
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	8.7		
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.007	1.0	07/25/12	07/27/12	0.008		

52VM

Comments: DI WATER LEACHATE

MK 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
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SPLP Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1207087
Project No.:	Site #: 10EG	Date Collected:	07/18/12
Project Name:	NA	Date Received:	07/21/12
Matrix:	SPLP	Units:	mg/L
		Basis:	NA

Sample Name: 12070024 Lab Code: K1207087-017

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	0.020	1.0	07/25/12	07/27/12	0.020	U	
Antimony	6010C	0.010	1.0	07/25/12	07/29/12	0.010	U	
Arsenic	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Barium	6010C	0.0020	1.0	07/25/12	07/27/12	0.0027		
Beryllium	6010C	0.0004	1.0	07/25/12	08/01/12	0.0004	U	
Cadmium	6010C	0.0005	1.0	07/25/12	07/27/12	0.0005	U	
Calcium	6010C	0.05	1.0	07/25/12	07/27/12	2.90	~~J~~	
Chromium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Cobalt	6010C	0.001	1.0	07/25/12	07/27/12	0.001	U	
Copper	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U J L	
Iron	6010C	0.01	1.0	07/25/12	07/27/12	0.01	U	
Lead	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Magnesium	6010C	0.02	1.0	07/25/12	07/27/12	15.2		
Manganese	6010C	0.0006	1.0	07/25/12	07/27/12	0.0006	U	
Mercury	7470A	0.001	1.0	07/25/12	07/26/12	0.001	U	
Nickel	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Potassium	6010C	0.1	1.0	07/25/12	07/27/12	0.1	U	
Selenium	6010C	0.02	1.0	07/25/12	07/27/12	0.02	U	
Silver	6010C	0.010	1.0	07/25/12	07/27/12	0.010	U	
Sodium	6010C	1.0	1.0	07/25/12	08/01/12	7.6		~~X~~
Thallium	6010C	0.010	1.0	07/25/12	07/27/12	~~0.010~~	~~U~~	R
Vanadium	6010C	0.002	1.0	07/25/12	07/27/12	0.002	U	
Zinc	6010C	0.010	1.0	07/25/12	07/27/12	0.023		

SZVM

Comments:

MV 8-20-12

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group

Metals
- 1 -
INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1207087
Project No.: Site #: 10EG
Date Collected: 07/18/12
Project Name: NA
Date Received: 07/21/12
Matrix: SEDIMENT
Units: mg/Kg
Basis: DRY

Sample Name: 12070024
Lab Code: K1207087-017

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	9.9	2.0	07/25/12	07/28/12	5040	JL	J
Antimony	6010C	2.0	2.0	08/02/12	08/04/12	2.0	UJL	J
Arsenic	6010C	4.0	2.0	08/02/12	08/04/12	4.0	U	
Barium	6010C	0.5	2.0	07/25/12	07/28/12	32.0		
Beryllium	6010C	0.1	2.0	08/02/12	08/04/12	0.1	U	
Cadmium	6010C	0.1	2.0	07/25/12	07/28/12	0.3		
Calcium	6010C	9.9	2.0	07/25/12	07/28/12	3150	JK	
Chromium	6010C	0.5	2.0	07/25/12	07/28/12	253		
Cobalt	6010C	0.5	2.0	07/25/12	07/28/12	73.5		
Copper	6010C	0.6	2.0	07/25/12	07/28/12	11.8		
Iron	6010C	4.0	2.0	07/25/12	07/28/12	40800		
Lead	6010C	2.0	2.0	07/25/12	07/28/12	2.0	U	
Magnesium	6010C	59.6	20.0	07/25/12	07/29/12	171000		
Manganese	6010C	0.20	2.0	07/25/12	07/28/12	634		
Mercury	7471B	0.01	1.0	07/24/12	07/25/12	0.01	U	
Nickel	6010C	0.4	2.0	07/25/12	07/28/12	1660		
Potassium	6010C	79.5	2.0	07/25/12	07/28/12	229		
Selenium	6010C	6.0	2.0	08/02/12	08/04/12	6.0	U	
Silver	6010C	0.5	2.0	07/25/12	07/28/12	0.5	U	
Sodium	6010C	79.5	2.0	07/25/12	07/28/12	79.5	U	
Thallium	6010C	2.0	2.0	07/25/12	07/28/12	2.0	U	
Vanadium	6010C	1.0	2.0	07/25/12	07/28/12	21.2		
Zinc	6010C	0.99	2.0	07/25/12	07/28/12	34.1		

S2VA

% Solids: 93.2

Comments:

MW 8-20-12

ecology and environment, inc.
Global Environmental Specialists

720 Third Avenue, Suite 1700, Seattle, WA 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: August 13, 2012

TO: Steve Hall, Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-3 Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Sumas Mountain Asbestos (Swift Creek) Site, Whatcom County, Washington**

REF: TDD: 12-02-0006 PAN: 002233.0771.01RA

The data quality assurance review of three sediment samples collected from the Sumas Mountain Asbestos (Swift Creek) site in Whatcom County, Washington, has been completed. Soil classification (ASTM Method D2487), moisture content (ASTM Method D2216), Atterberg Limits (ASTM Method D4318), and Grain Size Distribution (ASTM Methods D-421/422) were performed by Analytical Resources, Inc., Seattle, Washington.

The samples were numbered: 12070021 12070022 12070023

Data Qualifications:

The samples were collected on July 18, 2012, and were analyzed by August 3, 2012. The sample for triplicate analysis was selected from another batch. Sample 12070023 required curve fitting between the sand and silt fractions; no actions were required based on this.

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan and/or Sampling and Quality Assurance Plan and the geotechnical methods. Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

J - The associated numerical value is an estimated quantity because the reported concentrations were less than the sample quantitation limits or because quality control criteria limits were not met.

R - The sample results are rejected (analyte may or may not be present) due to gross deficiencies in quality control criteria. Any reported value is unusable. Resampling and/or reanalysis are necessary for verification.

U - The material was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.

UJ - The material was analyzed for, but not detected. The reported detection limit is estimated because quality control criteria were not met.

recycled paper

Ecology and Environment, Inc.
10EG

Soil Classification
ASTM D2487

ARI ID	Client ID	Group Symbol	Group Name
A	12070021	SM	Silty sand with gravel
B	12070022	MH	Sandy elastic silt
C	12070023	SW-SM	Well-graded sand with silt

VD09

MW 8/3/12

GEOTECHNICAL ANALYSIS DATA SHEET
Moisture Content by Method ASTM D2216

ANALYTICAL RESOURCES INCORPORATED

Data Release Authorized: AR
Reported: 08/03/12
Date Received: 07/20/12
Page 1 of 1

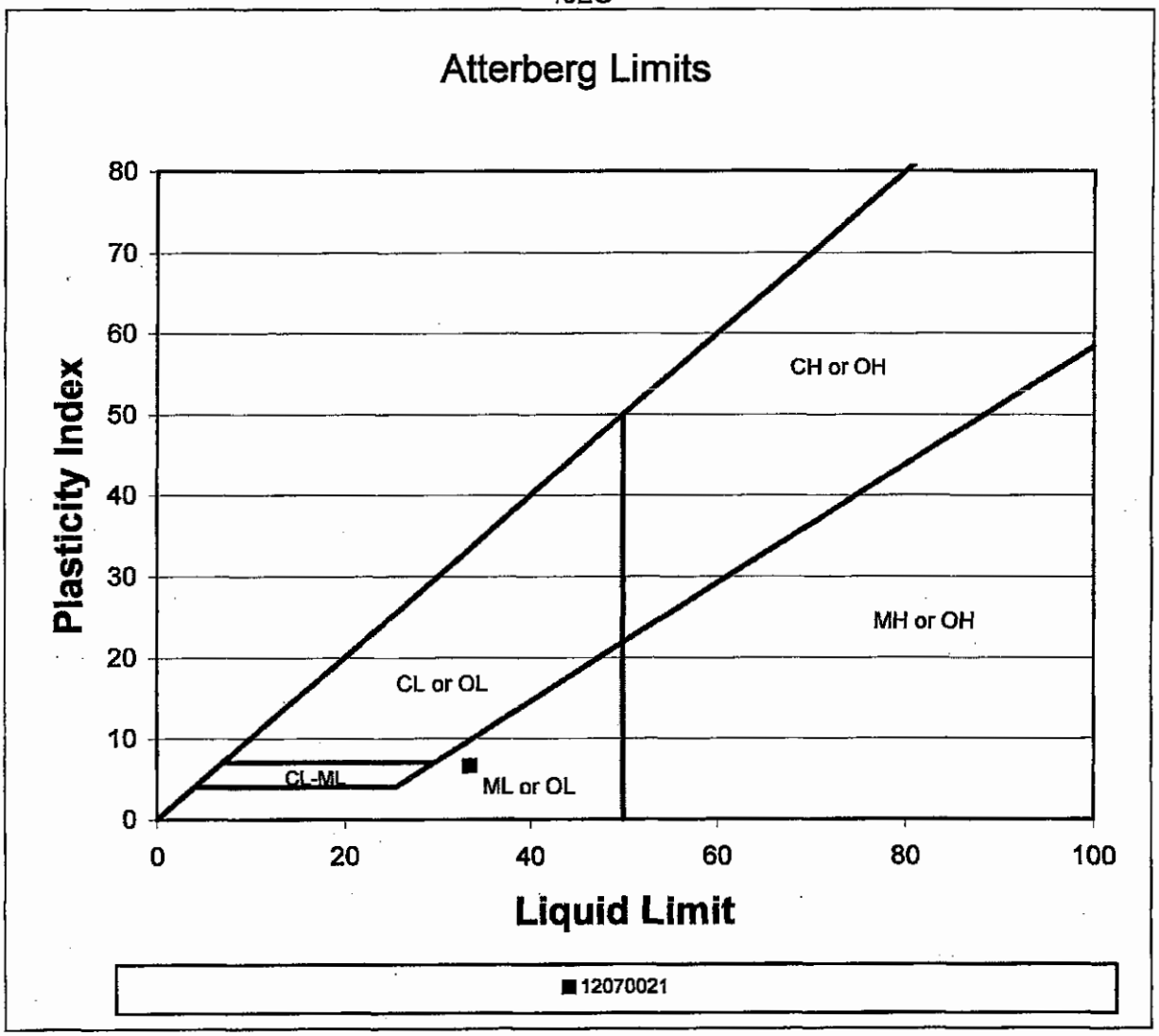
QC Report No: VD09-Ecology and Environment, Inc.
Project: 10EG

Client/ ARI ID	Date Sampled	Matrix	Analysis Date	Result
12070021 VD09A 12-13677	07/18/12	Sediment	07/23/12 12:00	12.77
12070022 VD09B 12-13678	07/18/12	Sediment	07/23/12 12:00	50.92
12070023 VD09C 12-13679	07/18/12	Sediment	07/23/12 12:00	7.99

Reported in Percent

JMW 8-13-12

Ecology and Environment, Inc.
10EG



Sample Identification	As-Received Moisture Content	Plasticity Index	Liquid Limit	Plastic Limit	USCS
12070021	12.77	6.6	33.4	26.8	ML
12070022	50.92	NA	NA	NA	NP
12070023	7.99	NA	NA	NA	NP

VD09

8/13/12

Ecology and Environment, Inc.
10EG

Percent Finer (Passing) Than the Indicated Size

Sieve Size (microns)	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	#4 (4750)	#10 (2000)	#20 (850)	#40 (425)	#60 (250)	#100 (150)	#200 (75)	32	22	13	9	7	3.2	1.3
TQ21 H	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.8	99.8	98.4	86.9	37.4	23.3	21.7	14.6	12.0	11.3	10.7	9.3	4.0	3.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.5	85.8	36.8	23.0	22.2	14.7	12.0	11.3	10.0	8.7	4.0	3.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.3	86.5	37.4	23.5	21.6	16.0	11.3	10.0	9.3	7.3	4.0	3.3
12070021	100.0	100.0	100.0	91.3	88.4	79.2	76.2	69.3	58.2	44.0	34.2	26.9	20.5	13.0	8.4	7.6	7.2	6.7	6.3	5.9	5.5
12070022	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.9	99.4	98.9	96.9	87.5	61.4	36.4	27.3	23.3	20.2	18.2	15.2	13.1
12070023	100.0	100.0	100.0	100.0	100.0	100.0	97.8	92.9	83.1	64.4	43.9	24.3	13.0	7.0	3.9	2.8	2.5	2.1	2.1	2.1	2.1

Testing performed according to ASTM D421/D422

VD09

VD09 : 00012

Ecology and Environment, Inc.
10EG

Percent Retained in Each Size Fraction

Description	% Coarse Gravel				% Gravel			% Coarse Sand	% Medium Sand		% Fine Sand			% Very Coarse Silt	% Coarse Silt	% Medium Silt	% Fine Silt	% Fine Silt	% Very Fine Silt	% Clay	
Particle Size (microns)	3-2"	2-1 1/2"	1 1/2"-1"	1-3/4"	3/4-1/2"	1/2-3/8"	3/8"-4750	4750-2000	2000-850	850-425	425-250	250-150	150-75	75-32	32-22	22-13	13-9	9-7	7-3.2	3.2-1.3	<1.3
TQ21 H	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.4	11.5	49.5	14.1	1.6	7.1	2.7	0.7	0.7	1.3	5.3	0.7	3.3
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	12.7	49.0	13.9	0.8	7.5	2.7	0.7	1.3	1.3	4.7	0.7	3.3
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	11.8	49.1	14.0	1.8	5.7	4.7	1.3	0.7	2.0	3.3	0.7	3.3
12070021	0.0	0.0	8.7	2.9	9.2	2.9	7.0	11.0	14.2	9.8	7.2	6.4	7.5	4.6	0.8	0.4	0.4	0.4	0.4	0.4	5.5
12070022	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.5	2.0	9.4	26.1	25.0	9.1	4.0	3.0	2.0	3.0	2.0	13.1
12070023	0.0	0.0	0.0	0.0	0.0	2.2	4.9	9.7	18.7	20.5	19.6	11.3	5.9	3.2	1.1	0.4	0.4	0.0	0.0	0.0	2.1

VD09

VD09 : 000013

2/28/12

Client:	Ecology and Environment, Inc.	Project No.:	10EG
ARI Triplicate Sample ID:	TQ21 H	Batch No.:	VD09-01
Client Triplicate Sample ID:	TQ21 H	Page:	1 of 1

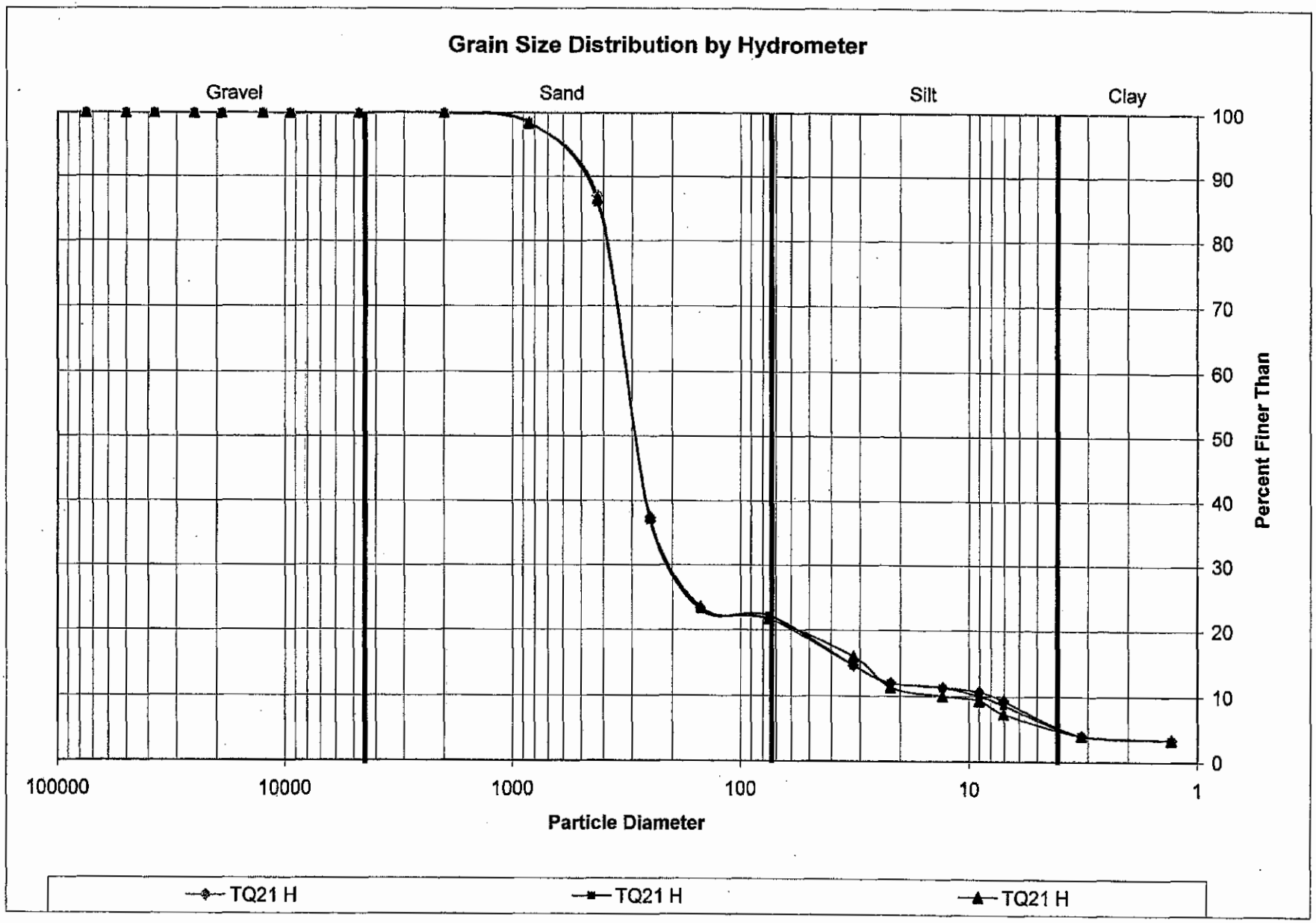
Relative Standard Deviation, By Size

Sample ID	75000	50000	37500	25000	19000	12500	9500	4750	2000	850	425	250	150	75	32	22	13	9	7	3.2	1.3
TQ21 H	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.8	99.8	98.4	86.9	37.4	23.3	21.7	14.6	12.0	11.3	10.7	9.3	4.0	3.3
TQ21 H	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.5	85.8	36.8	23.0	22.2	14.7	12.0	11.3	10.0	8.7	4.0	3.3
TQ21 H	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.3	86.5	37.4	23.5	21.6	16.0	11.3	10.0	9.3	7.3	4.0	3.3
AVE	100.00	100.00	100.00	100.00	100.00	100.00	99.95	99.95	99.93	98.42	86.39	37.20	23.25	21.84	15.10	11.77	10.88	9.99	8.44	4.00	3.33
STDEV	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.09	0.10	0.56	0.33	0.25	0.29	0.77	0.38	0.77	0.66	1.02	0.00	0.00
%RSD	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.09	0.10	0.11	0.64	0.88	1.09	1.32	5.10	3.26	7.06	6.64	12.04	0.05	0.05

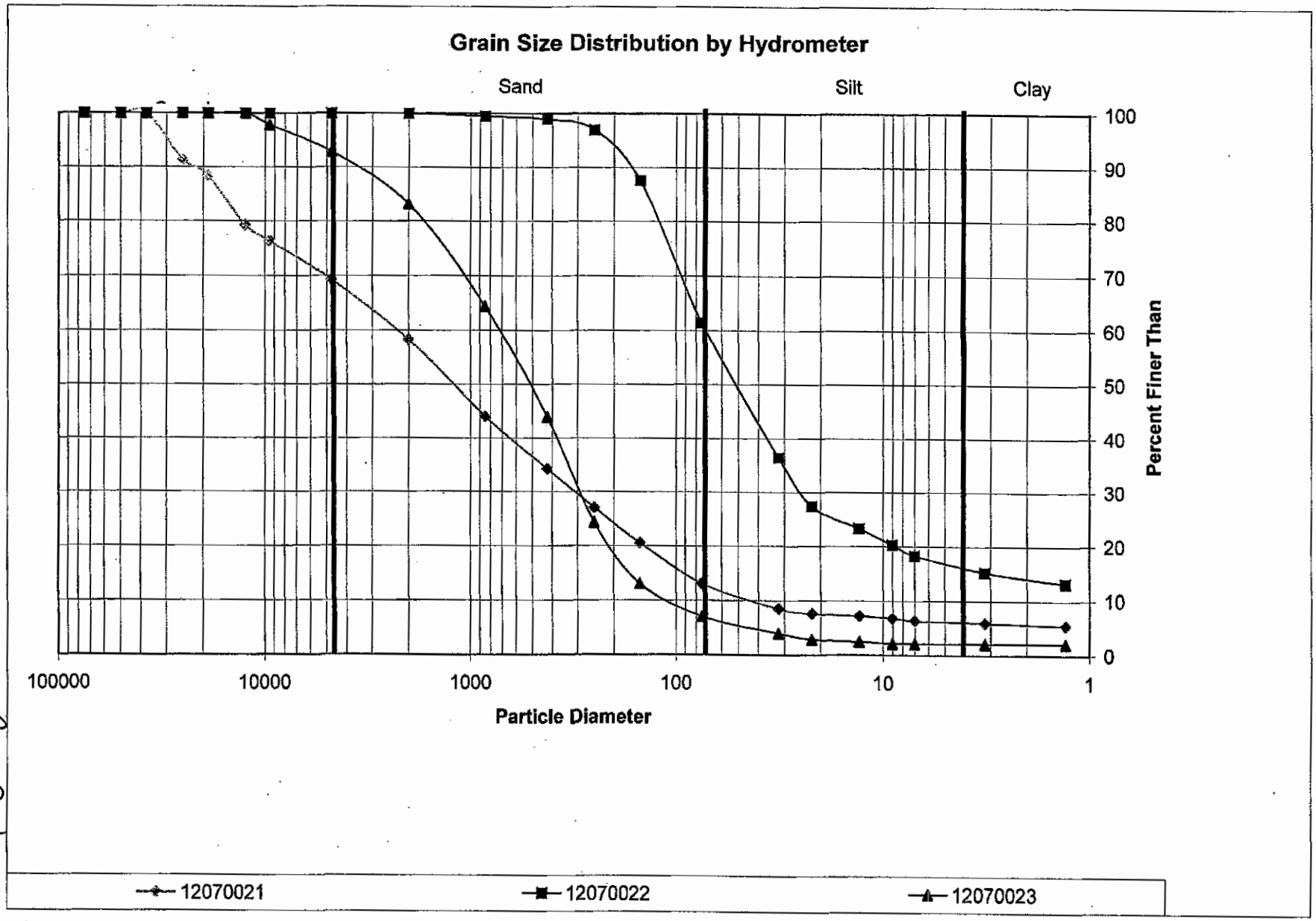
This Triplicate applies to the Batch Containing the Following Samples

Sample ID	Date Sampled	Date Set up	Date Started	Date Complete	Data Qualifiers
TQ21 H	10/5/2011	10/11/2011	10/17/2011	10/24/2011	
	10/5/2011	10/11/2011	10/17/2011	10/24/2011	
	10/5/2011	10/11/2011	10/17/2011	10/24/2011	
12070021	7/18/2012	7/23/2012	7/26/2012	8/2/2012	
12070022	7/18/2012	7/23/2012	7/26/2012	8/2/2012	
12070023	7/18/2012	7/23/2012	7/26/2012	8/2/2012	

VD09 : 00001


Grain Size Distribution by Hydrometer
Gravel
Sand
Silt
Clay
100
90
80
70
60
50
40
30
20
10
0
Percent Finer Than
100000
10000
1000
100
10
1
Particle Diameter
TQ21 H
TQ21 H
TQ21 H

UD69 : 000015


Grain Size Distribution by Hydrometer
Sand
Silt
Clay
100
90
80
70
60
50
40
30
20
10
0
Percent Finer Than
100000
10000
1000
100
10
1
Particle Diameter
12070021
12070022
12070023

VDOS:00016

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700, Seattle, WA 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: October 31, 2012

TO: Steve Hall, Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-3 Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Sumas Mountain Asbestos (Swift Creek) Site, Whatcom County, Washington**

REF: TDD: 12-02-0006 PAN: 002233.0771.01RA

The data quality assurance review of 7 water samples collected from the Sumas Mountain Asbestos (Swift Creek) site in Whatcom County, Washington, has been completed. Target Analyte List (TAL) metals and dissolved TAL metals (EPA Methods 6010 and 7470) and total suspended solids (TSS: EPA Method 160.2) analyses were performed by ALS, Inc., Kelso, Washington. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2VM and/or S4VM).

The samples were numbered:

12101001 12101002 12101003 12101004 12101005 12101006 12101007

Data Qualifications:

1. Sample Holding Times: Acceptable.

All liquid samples were preserved to a pH < 2. The samples were maintained at < 6°C. The samples were collected on October 9, 2012, and were analyzed by October 12, 2012 (TSS) and October 24, 2012 (TAL metals), therefore meeting TAL metals QC criteria of less than 6 months (28 days for mercury) between collection and analysis (28 days for mercury). TSS does not have a listed holding time, therefore TSS analysis was considered acceptable.

2. Initial and Continuing Calibration: Acceptable.

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits of 90% to 110%. All AA recoveries were within QC limits of 80% to 120%.

3. Blanks: Acceptable.

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. No elements were detected in the applicable calibration and/or preparation blanks.

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4. **ICP Interference Check Sample: Acceptable.**

An Interference Check Sample (ICS) was analyzed at the beginning of each sequence. All ICS (solution AB) results were within QC limits of 80% - 120% recovery.

5. **Precision and Bias Determination: Not Performed.**

Samples necessary to determine precision and bias were not provided to the laboratory. All results were flagged "PND" (Precision Not Determined) and "RND" (Recovery Not Determined), although the flags do not appear on the data sheets.

6. **Performance Evaluation Sample Analysis: Not Provided.**

Performance evaluation samples were not provided to the laboratory.

7. **ICP Serial Dilution: Acceptable.**

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All serial dilution results were within QC limits.

8. **Matrix Spike Analysis: Acceptable.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike and spike duplicate recoveries were within the QC limits.

9. **Duplicate Analysis: Acceptable.**

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

10. **Laboratory Control Sample Analysis: Acceptable.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

11. **Overall Assessment of Data for Use**

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan, the OSWER Guidance Document "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures" (EPA/540/G-90/004), the analytical methods, and, when applicable, the Office of Emergency and Remedial Response Publication "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

JH - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a high bias.

JL - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.

JK - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias.

JQ – The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).

N - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

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Analytical Report

Client:	Ecology And Environment, Incorporated	**Service Request:**	K1210303
Project:	10EG	**Date Collected:**	10/9/12
Sample Matrix:	Water	**Date Received:**	10/11/12
Analysis Method:	160.2	**Units:**	mg/L
		Basis:	NA

Solids, Total Suspended (TSS)

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
12101001	K1210303-001	ND U	5.0	1	10/12/12 16:30	52VM
12101002	K1210303-002	ND U	5.0	1	10/12/12 16:30	
12101003	K1210303-003	ND U	5.0	1	10/12/12 16:30	
12101004	K1210303-004	ND U	5.0	1	10/12/12 16:30	
12101005	K1210303-005	ND U	5.0	1	10/12/12 16:30	
12101006	K1210303-006	ND U	5.0	1	10/12/12 16:30	
12101007	K1210303-007	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210303-MB1	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210303-MB2	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210303-MB3	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210303-MB4	ND U	4.0	1	10/12/12 16:30	

MW

MW 10/31/12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101001 Lab Code: K1210303-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	81.3		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	13.8		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	11100		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	8.0		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	155		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	67100		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	4.2		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	17.0		
Potassium	6010C	400	1.0	10/17/12	10/20/12	602		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	4040		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

S4VM

Comments:

MW 10-31-12

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101001 Lab Code: K1210303-001DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	13.6		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	11400		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	5.9		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	68600		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	14.9		
Potassium	6010C	400	1.0	10/17/12	10/20/12	607		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	4130		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

SHVM

Comments:

MW 10/31/12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101002 Lab Code: K1210303-002

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	148		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	10.2		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	5160		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	16.8		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	251		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	50200		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	5.7		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	27.5		
Potassium	6010C	400	1.0	10/17/12	10/20/12	482		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	2460		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.4		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.1		

SHVM

Comments:

MW 10-3-12

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INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1210303
Project No.: NA
Date Collected: 10/09/12
Project Name: 10EG
Date Received: 10/11/12
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: 12101002
Lab Code: K1210303-002DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	9.0		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	5120		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	13.1		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	49700		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	1.0		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	24.1		
Potassium	6010C	400	1.0	10/17/12	10/20/12	423		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	2450		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

SHM

Comments:

JMW 10-31-12

COLUMBIA ANALYTICAL SERVICES, INC.
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- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1210303
Project No.: NA
Date Collected: 10/09/12
Project Name: 10EG
Date Received: 10/11/12
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: 12101003
Lab Code: K1210303-003

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	84.9		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	9.6		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	4980		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	17.6		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	171		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	49300		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	4.3		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	27.4		
Potassium	6010C	400	1.0	10/17/12	10/20/12	441		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	2430		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.3		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.4		

54/M

Comments:

MW 10-31-12

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INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1210303
Project No.: NA
Date Collected: 10/09/12
Project Name: 10EG
Date Received: 10/11/12
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: 12101003
Lab Code: K1210303-003DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.2		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	9.0		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	5050		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	13.2		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	49000		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.9		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	23.5		
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	2390		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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Comments:

MW 10-31-12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101004 Lab Code: K1210303-004

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	5.8		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	50.0	U	
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.3		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.9		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	200	U	
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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Comments:

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101005 Lab Code: K1210303-005

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	15.7		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	61.1		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	37.3		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	1.1		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	200	U	
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Service Request: K1210303
Project No.: NA
Date Collected: 10/09/12
Project Name: 10EG
Date Received: 10/11/12
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: 12101005
Lab Code: K1210303-005DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	3.8		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	50.0	U	
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	200	U	
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

54 CM

Comments:

MW 10-31-12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101006 Lab Code: K1210303-006

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	7.5		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	5.7		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	7390		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	6.5		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	25.9		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	29000		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	17.2		
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	3540		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

SYVM

Comments:

MW 10/31/12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101006 Lab Code: K1210303-006DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	5.7		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	7630		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	6.6		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	29600		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	17.8		
Potassium	6010C	400	1.0	10/17/12	10/20/12	400	U	
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	3620		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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Comments:

MN 10-31-12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101007 Lab Code: K1210303-007

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	51.8		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	41.7		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	8980		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	2960		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	23600		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	224		
~~Mercury~~	~~7470A~~	~~0.2~~	~~1.0~~	~~10/23/12~~	~~10/24/12~~	~~0.2~~	~~U~~	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	4.3		
Potassium	6010C	400	1.0	10/17/12	10/20/12	1710		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	11000		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.7		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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Comments:

MW 10/31/12

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210303
Project No.:	NA	Date Collected:	10/09/12
Project Name:	10EG	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101007 Lab Code:. K1210303-007DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	4.7		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	41.0		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	8890		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	2860		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	23200		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	221		
~~Mercury~~	~~7470A~~	~~0.2~~	~~1.0~~	~~10/23/12~~	~~10/24/12~~	~~0.2~~	~~U~~	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	4.2		
Potassium	6010C	400	1.0	10/17/12	10/20/12	1670		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	10800		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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Comments:

MW 10/23/12

ecology and environment, inc.
Global Environmental Specialists
720 Third Avenue, Suite 1700, Seattle, WA 98104
Tel: (206) 624-9537, Fax: (206) 621-9832

MEMORANDUM

DATE: November 1, 2012

TO: Steve Hall, Project Manager, E & E, Seattle, Washington

FROM: Mark Woodke, START-3 Chemist, E & E, Seattle, Washington MW

SUBJ: **Data Quality Assurance Review, Sumas Mountain Asbestos (Swift Creek) Site, Whatcom County, Washington**

REF: TDD: 12-02-0006 PAN: 002233.0771.01RA

The data quality assurance review of 3 water samples collected from the Sumas Mountain Asbestos (Swift Creek) site in Whatcom County, Washington, has been completed. Target Analyte List (TAL) metals and dissolved TAL metals (EPA Methods 6010 and 7470) and total suspended solids (TSS: EPA Method 160.2) analyses were performed by ALS, Inc., Kelso, Washington. All sample analyses were evaluated following EPA's Stage 2 and/or 4 Data Validation Manual Process (S2VM and/or S4VM).

The samples were numbered: 12101008 12101009 12101010

Data Qualifications:

1. **Sample Holding Times: Acceptable.**

All liquid samples were preserved to a pH < 2. The samples were maintained at < 6°C. The samples were collected on October 10, 2012, and were analyzed by October 12, 2012 (TSS) and October 24, 2012 (TAL metals), therefore meeting TAL metals QC criteria of less than 6 months (28 days for mercury) between collection and analysis (28 days for mercury). TSS does not have a listed holding time, therefore TSS analysis was considered acceptable.

2. **Initial and Continuing Calibration: Acceptable.**

A minimum of one calibration standard and a blank were analyzed at the beginning of the ICP analysis sequence and after every 10 samples. No results were greater than 110% of the highest calibration standard. All ICP recoveries were within the QC limits of 90% to 110%. All AA recoveries were within QC limits of 80% to 120%.

3. **Blanks: Acceptable.**

A preparation blank was analyzed for each 20 samples or per matrix per concentration level. Blanks were analyzed after each Initial or Continuing Calibration Verification. No elements were detected in the applicable calibration and/or preparation blanks.

4. **ICP Interference Check Sample: Acceptable.**

An Interference Check Sample (ICS) was analyzed at the beginning of each sequence. All ICS (solution AB) results were within QC limits of 80% - 120% recovery.

5. **Precision and Bias Determination: Not Performed.**

Samples necessary to determine precision and bias were not provided to the laboratory. All results were flagged "PND" (Precision Not Determined) and "RND" (Recovery Not Determined), although the flags do not appear on the data sheets.

6. **Performance Evaluation Sample Analysis: Not Provided.**

Performance evaluation samples were not provided to the laboratory.

7. **ICP Serial Dilution: Acceptable.**

A serial dilution analysis was performed per matrix per concentration or per sample delivery group, whichever was more frequent. All serial dilution results were within QC limits.

8. **Matrix Spike Analysis: Acceptable.**

A matrix spike analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. Spike and spike duplicate recoveries were within the QC limits.

9. **Duplicate Analysis: Acceptable.**

A laboratory duplicate analysis was performed per SDG or per matrix per concentration level, whichever was more frequent. All duplicate results were within QC limits.

10. **Laboratory Control Sample Analysis: Acceptable.**

A Laboratory Control Sample (LCS) was analyzed per SDG per matrix. All LCS results were within the established control limits.

11. **Overall Assessment of Data for Use**

The overall usefulness of the data is based on the criteria outlined in the Site-Specific Sampling Plan, the OSWER Guidance Document "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan, and Data Validation Procedures" (EPA/540/G-90/004), the analytical methods, and, when applicable, the Office of Emergency and Remedial Response Publication "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review". Based upon the information provided, the data are acceptable for use with the above stated data qualifications.

Data Qualifiers and Definitions

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

JH - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a high bias.

JL - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with a low bias.

JK - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias.

JQ – The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample with an unknown direction of bias and falls between the MDL and the Minimum (or Practical) Quantitation Limit (MQL, PQL).

N - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification".

NJ - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

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Analytical Report

Client:	Ecology And Environment, Incorporated	**Service Request:**	K1210304
Project:	Swift Creek	**Date Collected:**	10/10/12
Sample Matrix:	Water	**Date Received:**	10/11/12
Analysis Method:	160.2	**Units:**	mg/L
		Basis:	NA

Solids, Total Suspended (TSS)

Sample Name	Lab Code	Result	MRL	Dil.	Date Analyzed	Q
12101008	K1210304-001	~~ND U~~	5.0	1	10/12/12 16:30	S2VM
12101009	K1210304-002	7.0	5.0	1	10/12/12 16:30	
12101010	K1210304-003	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210304-MB1	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210304-MB2	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210304-MB3	ND U	5.0	1	10/12/12 16:30	
Method Blank	K1210304-MB4	ND U	4.0	1	10/12/12 16:30	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210304
Project No.:	NA	Date Collected:	10/10/12
Project Name:	Swift Creek	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101008 Lab Code: K1210304-001

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	4.0		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	3570		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	37900		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
~~Mercury~~	~~7470A~~	~~0.2~~	~~1.0~~	~~10/23/12~~	~~10/24/12~~	~~0.2~~	~~U~~	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Potassium	6010C	400	1.0	10/17/12	10/20/12	1160		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	6940		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210304
Project No.:	NA	Date Collected:	10/10/12
Project Name:	Swift Creek	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101008 Lab Code: K1210304-001DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	3.2		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	4.2		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	3590		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	37500		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
~~Mercury~~	~~7470A~~	~~0.2~~	~~1.0~~	~~10/23/12~~	~~10/24/12~~	~~0.2~~	~~U~~	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Potassium	6010C	400	1.0	10/17/12	10/20/12	1170		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	6870		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210304
Project No.:	NA	Date Collected:	10/10/12
Project Name:	Swift Creek	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101009 Lab Code: K1210304-002

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	18.6		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	71.8		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	13500		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	9620		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	19500		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	527		
~~Mercury~~	~~7470A~~	~~0.2~~	~~1.0~~	~~10/23/12~~	~~10/24/12~~	~~0.2~~	~~U~~	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	5.8		
Potassium	6010C	400	1.0	10/17/12	10/20/12	1790		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	6270		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210304
Project No.:	NA	Date Collected:	10/10/12
Project Name:	Swift Creek	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101009 Lab Code: K1210304-002DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	3.6		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	69.7		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	13200		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	9200		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	19100		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	509		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	5.2		
Potassium	6010C	400	1.0	10/17/12	10/20/12	1790		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	6130		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Ecology And Environment, Incorpo	Service Request:	K1210304
Project No.:	NA	Date Collected:	10/10/12
Project Name:	Swift Creek	Date Received:	10/11/12
Matrix:	WATER	Units:	ug/L
		Basis:	NA

Sample Name: 12101010 Lab Code: K1210304-003

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	198		
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	11.5		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	11100		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	6.5		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	344		
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	43900		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	15.6		
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	7.1		
Potassium	6010C	400	1.0	10/17/12	10/20/12	498		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	3960		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.3		
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.3		

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INORGANIC ANALYSIS DATA PACKAGE

Client: Ecology And Environment, Incorpo
Project No.: NA
Project Name: Swift Creek
Matrix: WATER

Service Request: K1210304
Date Collected: 10/10/12
Date Received: 10/11/12
Units: ug/L
Basis: NA

Sample Name: 12101010
Lab Code: K1210304-003DISS

Analyte	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Aluminum	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Antimony	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Arsenic	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Barium	6010C	2.0	1.0	10/17/12	10/20/12	8.7		
Beryllium	6010C	0.4	1.0	10/17/12	10/20/12	0.4	U	
Cadmium	6010C	0.5	1.0	10/17/12	10/20/12	0.5	U	
Calcium	6010C	50.0	1.0	10/17/12	10/20/12	10700		
Chromium	6010C	2.0	1.0	10/17/12	10/20/12	6.2		
Cobalt	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Copper	6010C	4.0	1.0	10/17/12	10/20/12	4.0	U	
Iron	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Lead	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Magnesium	6010C	20.0	1.0	10/17/12	10/20/12	43600		
Manganese	6010C	0.6	1.0	10/17/12	10/20/12	0.6	U	
Mercury	7470A	0.2	1.0	10/23/12	10/24/12	0.2	U	
Nickel	6010C	2.0	1.0	10/17/12	10/20/12	5.4		
Potassium	6010C	400	1.0	10/17/12	10/20/12	460		
Selenium	6010C	20.0	1.0	10/17/12	10/20/12	20.0	U	
Silver	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Sodium	6010C	200	1.0	10/17/12	10/20/12	3930		
Thallium	6010C	10.0	1.0	10/17/12	10/20/12	10.0	U	
Vanadium	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	
Zinc	6010C	2.0	1.0	10/17/12	10/20/12	2.0	U	

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C Applicable or Relevant and Appropriate Requirements

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Standard, Requirement, Criterion, or Limitation	Citation	Description	ARAR/TBC
Chemical Specific			
Clean Air Act, Sec. 112 - National Emission Standard for Asbestos (NESHAP)	42 USC 7412; 40 CFR 61.154 (for active waste disposal sites)	No visible dust emissions, or provision of daily cover of the ACM waste with 6 inches of compacted, non-ACM material, or a dust-suppression agent, or some other control method; and natural barrier or fence with warning signs to keep public out.	Relevant and appropriate to any response action involving handling, storage or disposal of asbestos-containing sediment in the project area.
Clean Air Act, Sec. 112 - National Emission Standard for Asbestos (NESHAP)	42 USC 7412; 40 CFR 61.151 (for inactive waste sites)	Either no visible dust emissions, or cover with 2 feet of compacted soil, or a dust-suppression agent, or some other control method; and record the location and establish warning signs and deed notices for the property.	Relevant and appropriate to any response action involving handling, storage or disposal of asbestos-containing sediment in the project area.
Washington Clean Air Act	RCW 70.94, 43.21A; WAC Chap. 173-400	Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.	Substantive requirements are applicable for any response actions in the project area that may create fugitive dust or other regulated air emissions.
Clean Water Act, National Pollutant Discharge Elimination System (NPDES)	33 USC § 1311, 1342; 40 CFR Part 122, 125	Prohibits discharge of pollutants to waters of the U.S. without a permit issued by EPA or a delegated state agency. In the State of Washington, WDOE has delegated authority to issue NPDES permits, including Construction Stormwater General Permits. Construction Stormwater General Permits are required where a proposed project involving clearing, grading, or evacating may disturb one or more acres of land, and result in discharge of stormwater to surface waters of the State.	Substantive requirements, including substantive elements of a Construction Stormwater General Permit, are applicable for any point source discharge of pollutants to surface water, including stormwater runoff in the Site.
Clean Water Act, Sec. 404, Discharge of Dredged or Fill Materials	33 USC § 1344	Establishes a program to regulate the discharge of dredged or fill materials into waters of the U.S.	Substantive requirements are applicable to any response actions involving dredging, filling, diversion, and/or construction activities in steams or wetlands at the Site.
Preventing Particulate Matter from Becoming Airborne	NWCAA Sec. 550	Prohibits any person from causing or permitting the release of fugitive particulate matter from any public or private lot, roadway, or open area without the use of reasonably available control technology.	Substantive requirements are applicable for any response actions that may create fugitive dust or other regulated air emissions in the project area.
Asbestos Control Standards	NWCAA Sec. 570	Applies to any project that will disturb or is likely to disturb asbestos-containing material, defined as any material containing more than one percent asbestos. Requirements include Asbestos Removal Work Practice standards of NWCAA Sec. 570.6(b) and Disposal of Asbestos-Containing Waste Material standards of NWCAA Sec. 570.8.	Substantive requirements are applicable to any response actions that will disturb or are likely to disturb asbestos-containing sediments in the project area.

Standard, Requirement, Criterion, or Limitation	Citation	Description	ARAR/TBC
Action Specific			
Resource Conservation and Recovery Act	42 USC § 6901, 40 CFR Parts 260-279	Specifies requirements for identification, treatment, storage, and disposal of hazardous waste. State-authorized program may apply in lieu of federal program.	Substantive requirements may be relevant and appropriate for handling, storage, and disposal of asbestos-contaminated sediments.
Hazardous Waste Management Act; Dangerous Waste Regulations	RCW 70.105; WAC Chap. 173-303	Governs handling and disposition of dangerous waste, including identification, accumulation, storage, transport, treatment, and disposal.	Substantive requirements may be relevant and appropriate for handling, storage, and disposal of asbestos-contaminated sediments.
Solid Waste Handling Standards	WAC 173-350-400	Establishes requirements for "limited purpose landfills," including standards for siting and design.	Substantive requirements may be applicable to siting and design of a repository for disposal of asbestos contaminated sediments.
Occupational Safety and Health Act	29 CFR 1904, 1910, 1926	Specifies minimum requirements to maintain worker health and safety during hazardous waste operations, including training and construction safety requirements.	To be considered
Dam Safety	RCW 90.03.350	Any impoundment capable of storing more than ten acre-feet of volume must be constructed according to a plan approved in advance by WDOE Dam Safety Office.	Substantive requirements are applicable for construction of sedimentation basins or other repositories greater than ten acres.
Location Specific			
Endangered Species Act	16 USC § 1536, 1538; 50 CFR 200, 402	Establishes program to conserve and protect threatened or endangered species. Requires consultation with wildlife agencies to ensure that any federal action does not jeopardize the continued existence of a listed species or result in adverse modification of habitat. Also prohibits the "take" of any listed species, including any the killing, harming, or harassing of such species.	Applicable for listed and proposed to be listed threatened or endangered species and their habitat areas which will, or could, be impacted by a response action in the project area.
Migratory Bird Treaty Act (MBTA)	16 USC § 703 et seq.	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 U.S. Fish and Wildlife Service. (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).	Applicable for protecting migratory bird species identified in the project area. The selected response action must be carried out in a manner that avoids the taking of protected migratory bird species, including individual birds or their nests or eggs.
Fish and Wildlife Coordination Act	16 USC § 661 et seq.	Requires consultation with U.S. Fish and Wildlife Service and head of state agency with jurisdiction over wildlife resources (Washington Dept. of Fish and Wildlife) to promote conservation of wildlife resources.	Substantive requirements may be applicable where where implementation of the selected response action may involve modification of waters or the channel of a water body.
Archaeological Resources Protection Act	16 USC § 470aa et seq.; 43 CFR Part 7	Prohibits the unauthorized disturbance of archaeological resources on public or Indian lands. Archaeological resources are “any material remains of past human life and activities which are of archaeological interest,” including pottery, baskets, tools, and human skeletal remains. The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit, and any archaeological investigations at a site must be conducted by a professional archeologist.	Applicable for the conduct of any selected response actions that may result in ground disturbance.
Protection of Wetlands - Exec. Order 11900	40 CFR Part 6	Requires evaluation of potential effects of actions that take place in a floodplain to avoid adverse impacts, to extent possible.	Potentially applicable to actions within 100-year floodplain of Swift Creek.
ARAR = applicable or relevant and appropriate requirement			
TBC = to be considered			

D Conceptual Design Drawings from SCSMAP Phase 1 Implementation Plan

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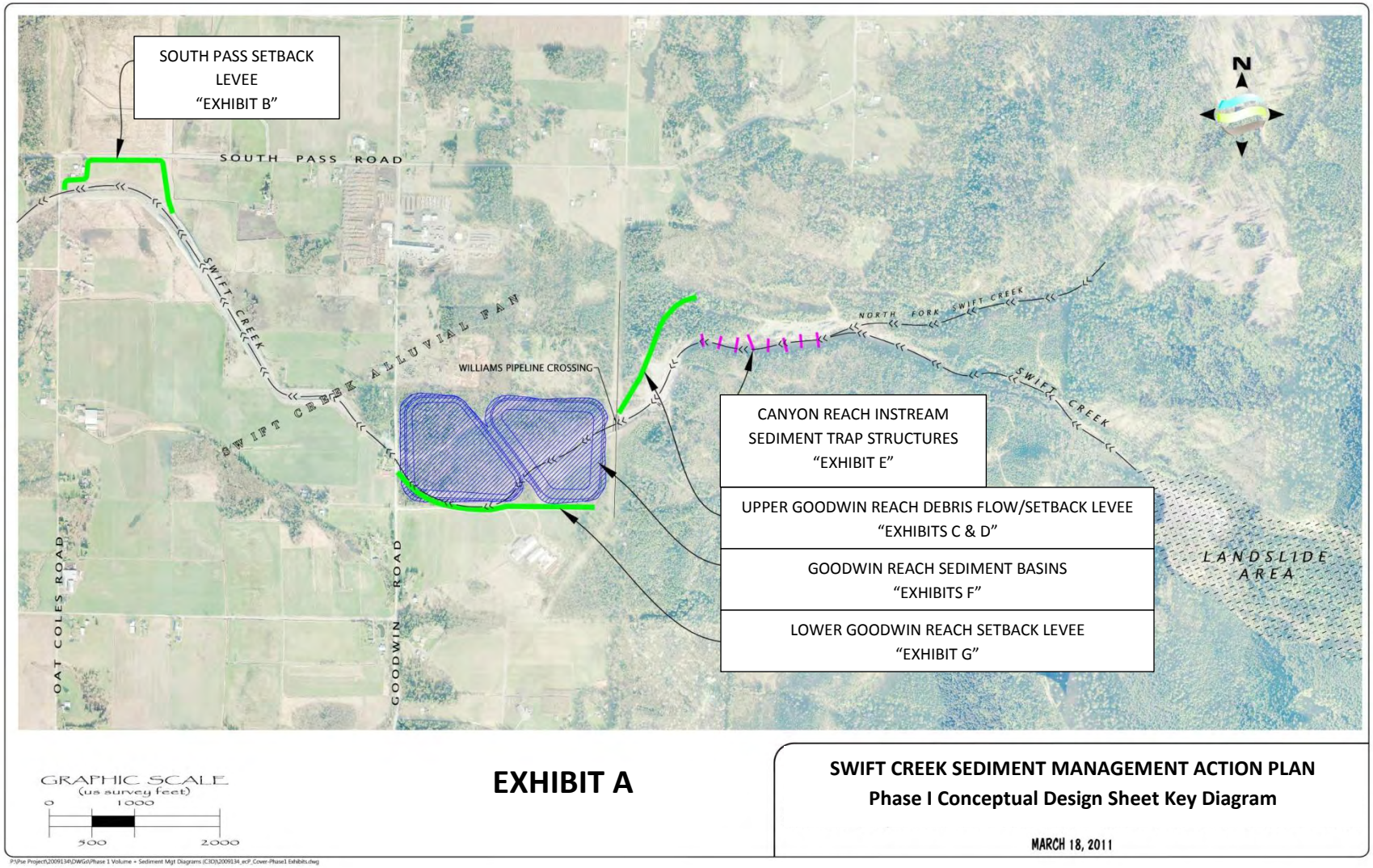

EXHIBIT A: Spatial extent of the SCSMAP Phase I Conceptual Design project components

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1812 Cornwall Avenue Bellingham WA 98225
(360) 671-7387 info@psesurvey.com

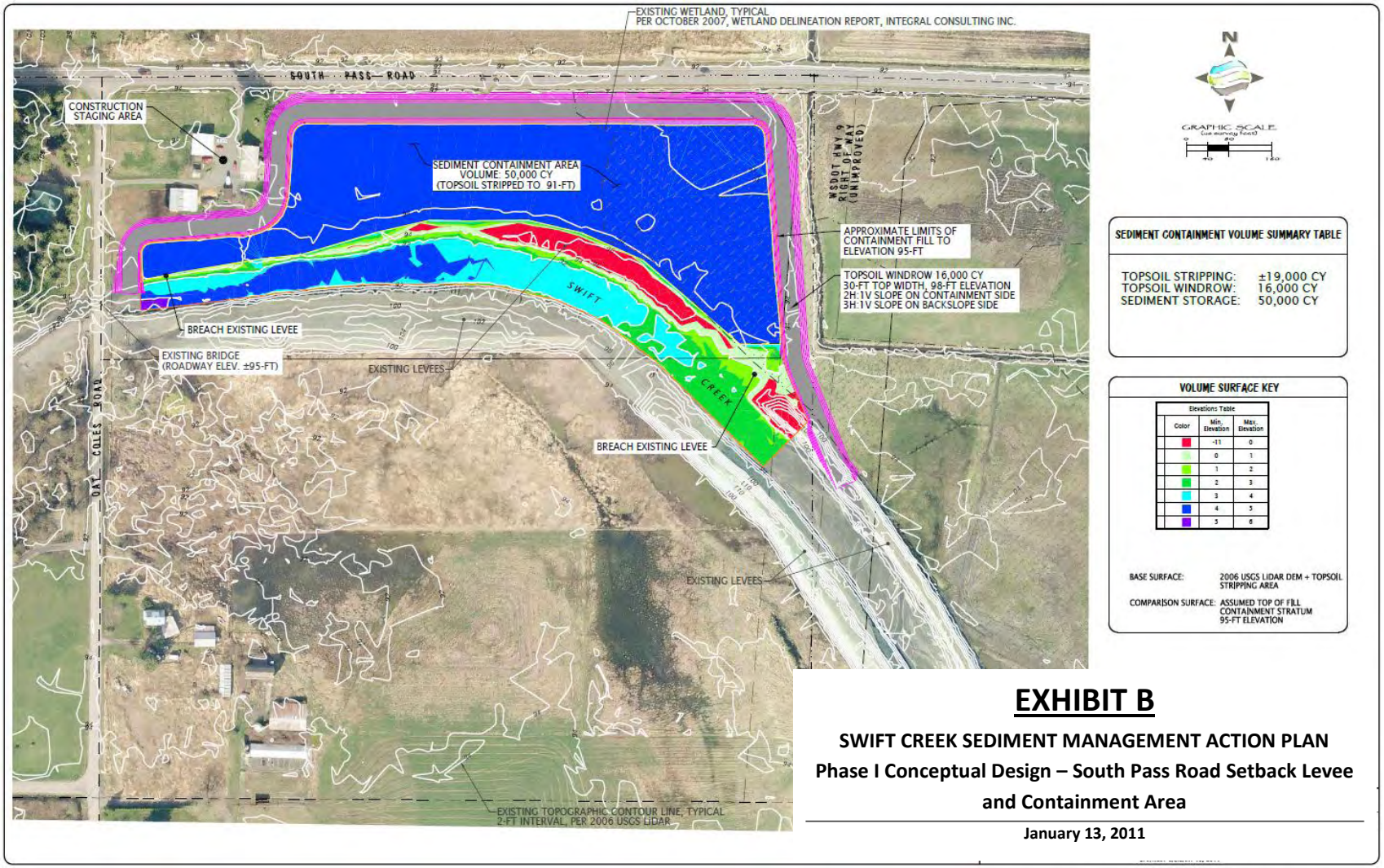

EXHIBIT B: South Pass Road Setback Levee and Sediment Containment Area Conceptual Design Diagram

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(360) 671-7387 info@psesurvey.com

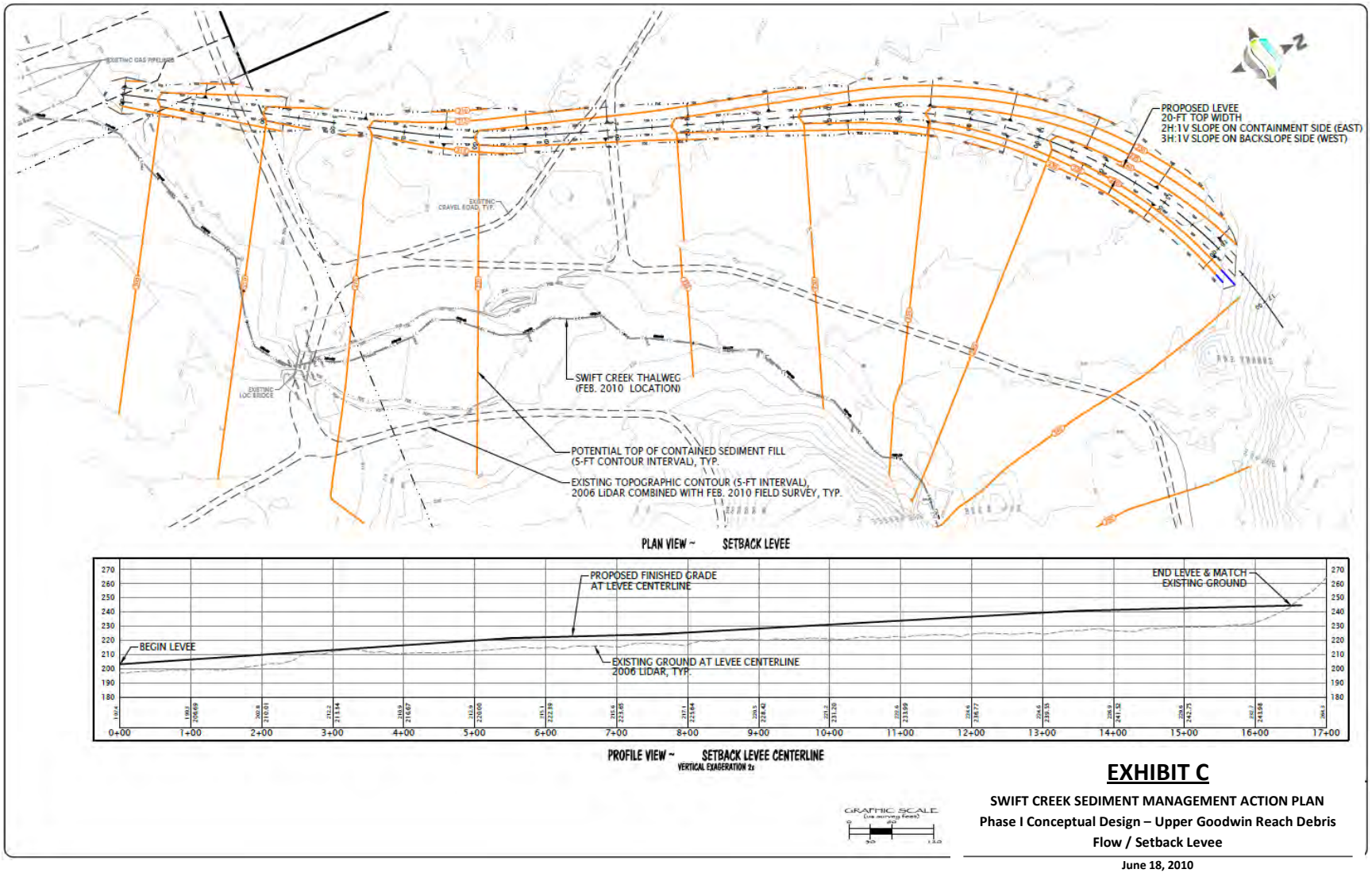

EXHIBIT C

SWIFT CREEK SEDIMENT MANAGEMENT ACTION PLAN
Phase I Conceptual Design – Upper Goodwin Reach Debris Flow / Setback Levee

June 18, 2010

EXHIBIT C: Upper Goodwin Reach Debris Flow / Setback Levee Plan and Profile Diagram

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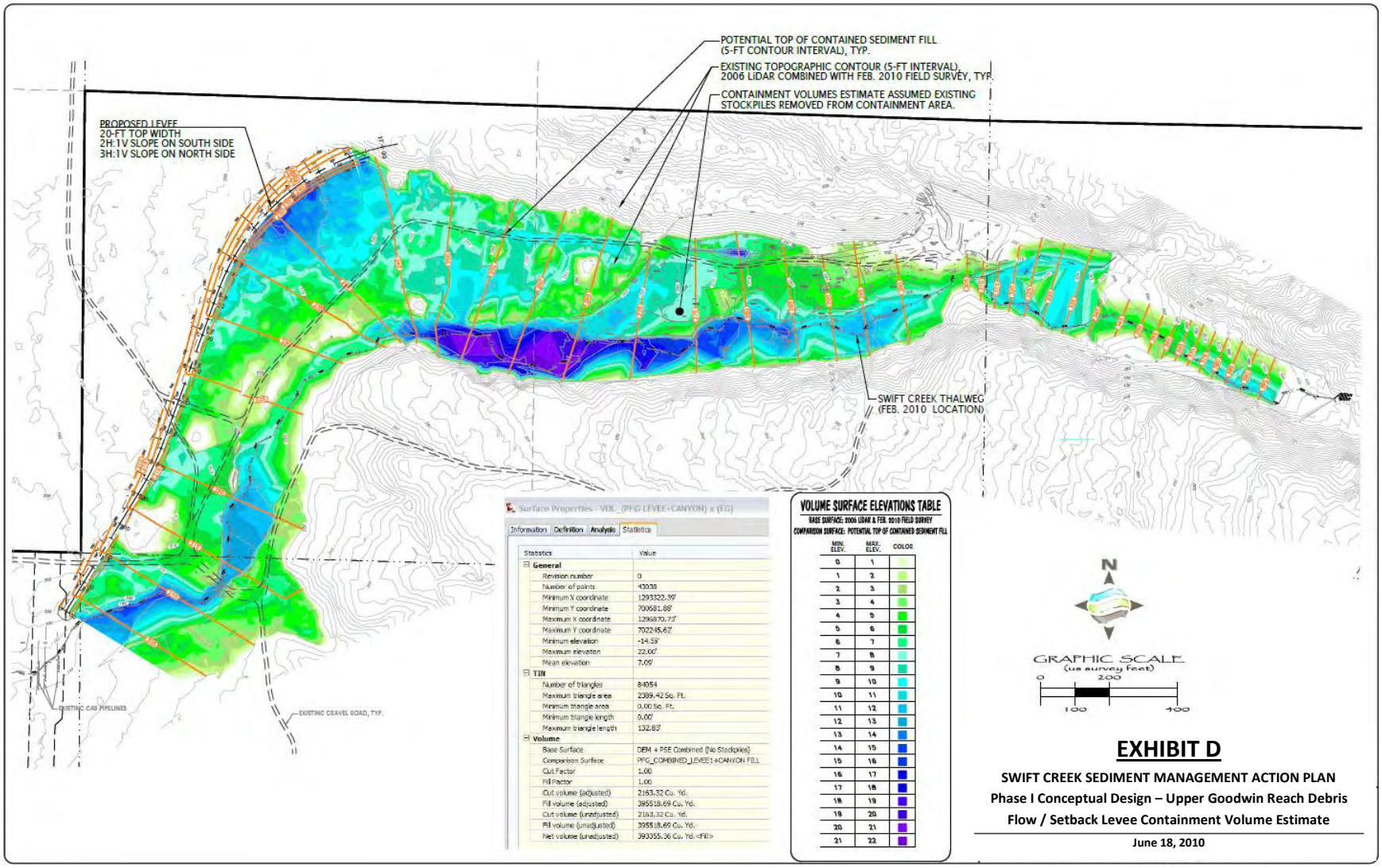

EXHIBIT D: Upper Goodwin Reach Debris Flow / Setback Levee Containment Volume Estimate Diagram

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1812 Cornwall Avenue Bellingham WA 98225
(360) 671-7387 info@psesurvey.com

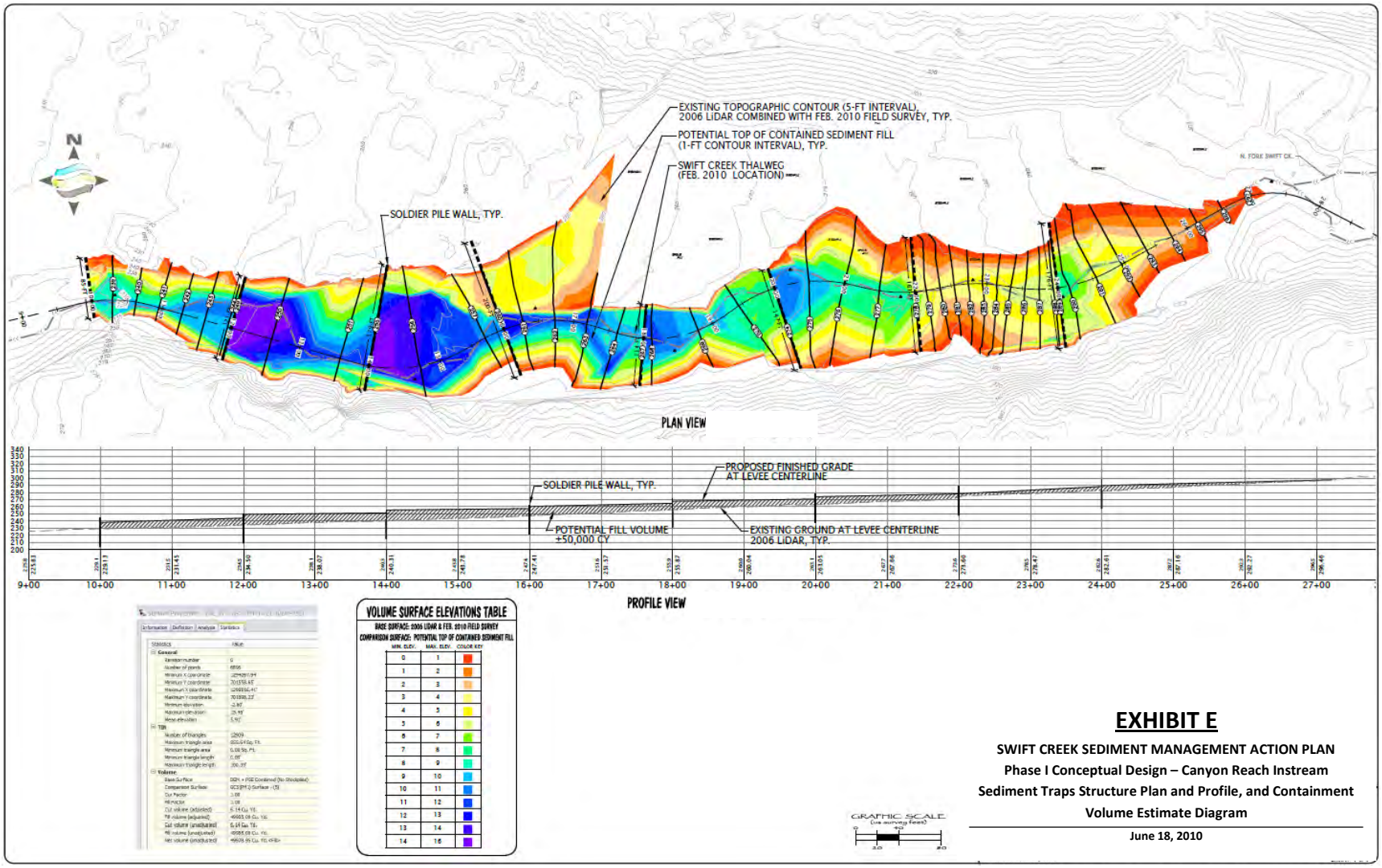

EXHIBIT E: Canyon Reach Instream Sediment Traps Structure Plan and Profile, and Containment Volume Estimate Diagram

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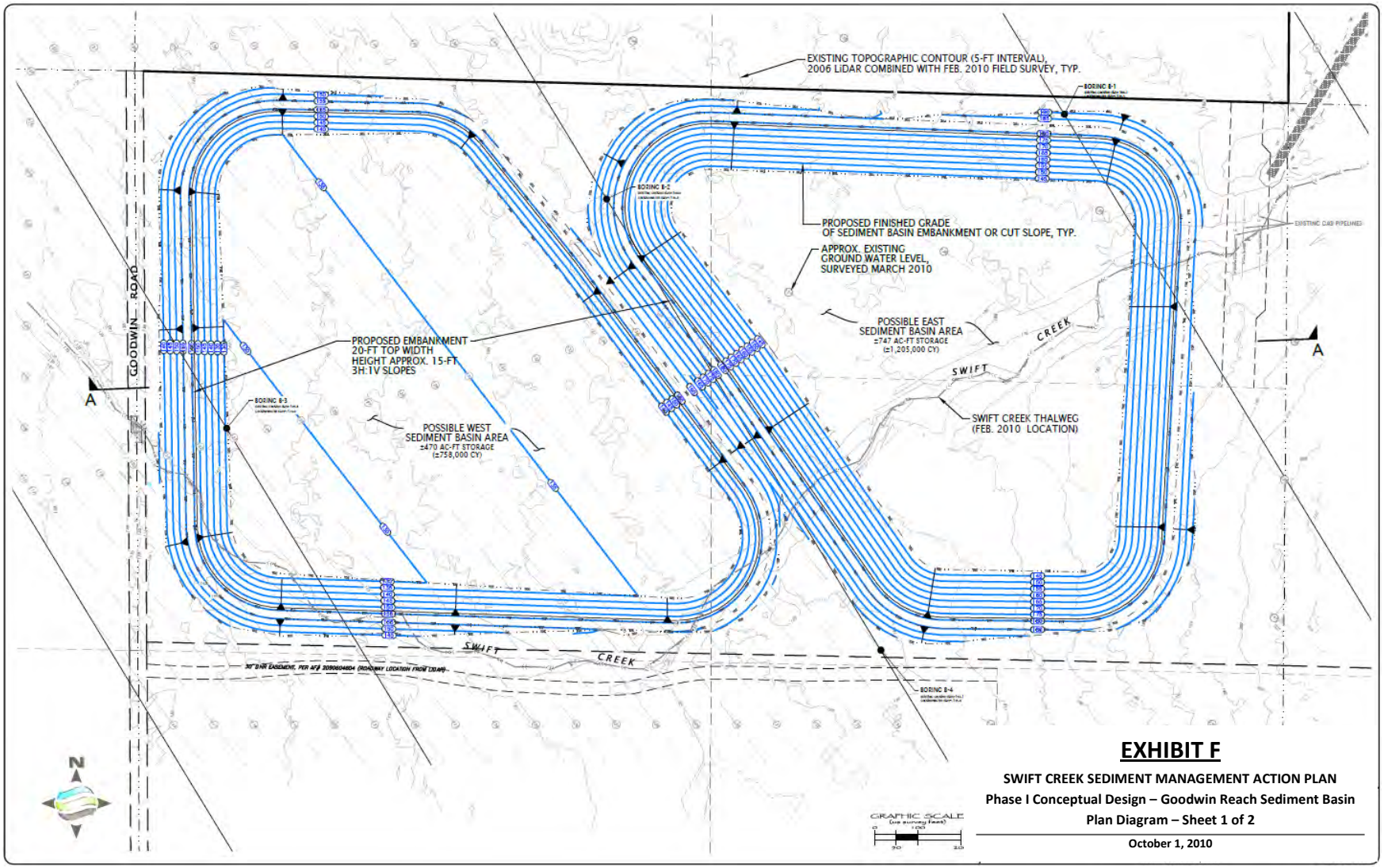

EXHIBIT F: Goodwin Reach Sediment Basin Plan, and Cross Section Diagrams (Basin Concept Diagrams - Sheet 1 of 2)

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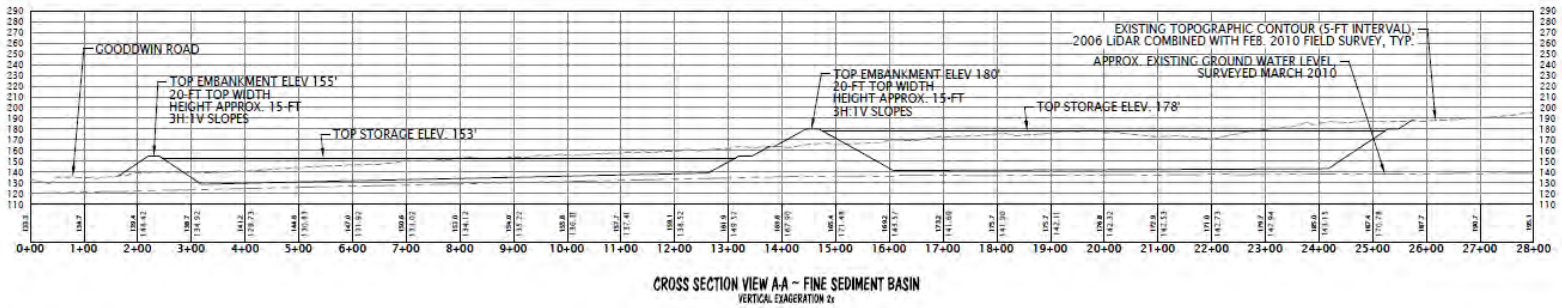

CROSS SECTION VIEW A-A ~ FINE SEDIMENT BASIN
VERTICAL EXAGERATION 2x

EXHIBIT F

SWIFT CREEK SEDIMENT MANAGEMENT ACTION PLAN
Phase I Conceptual Design – Goodwin Reach Sediment Basin
Cross Section Diagram – Sheet 2 of 2

October 1, 2010

EXHIBIT F: Goodwin Reach Sediment Basin Plan, and Cross Section Diagrams (Basin Concept Diagrams - Sheet 2 of 2)

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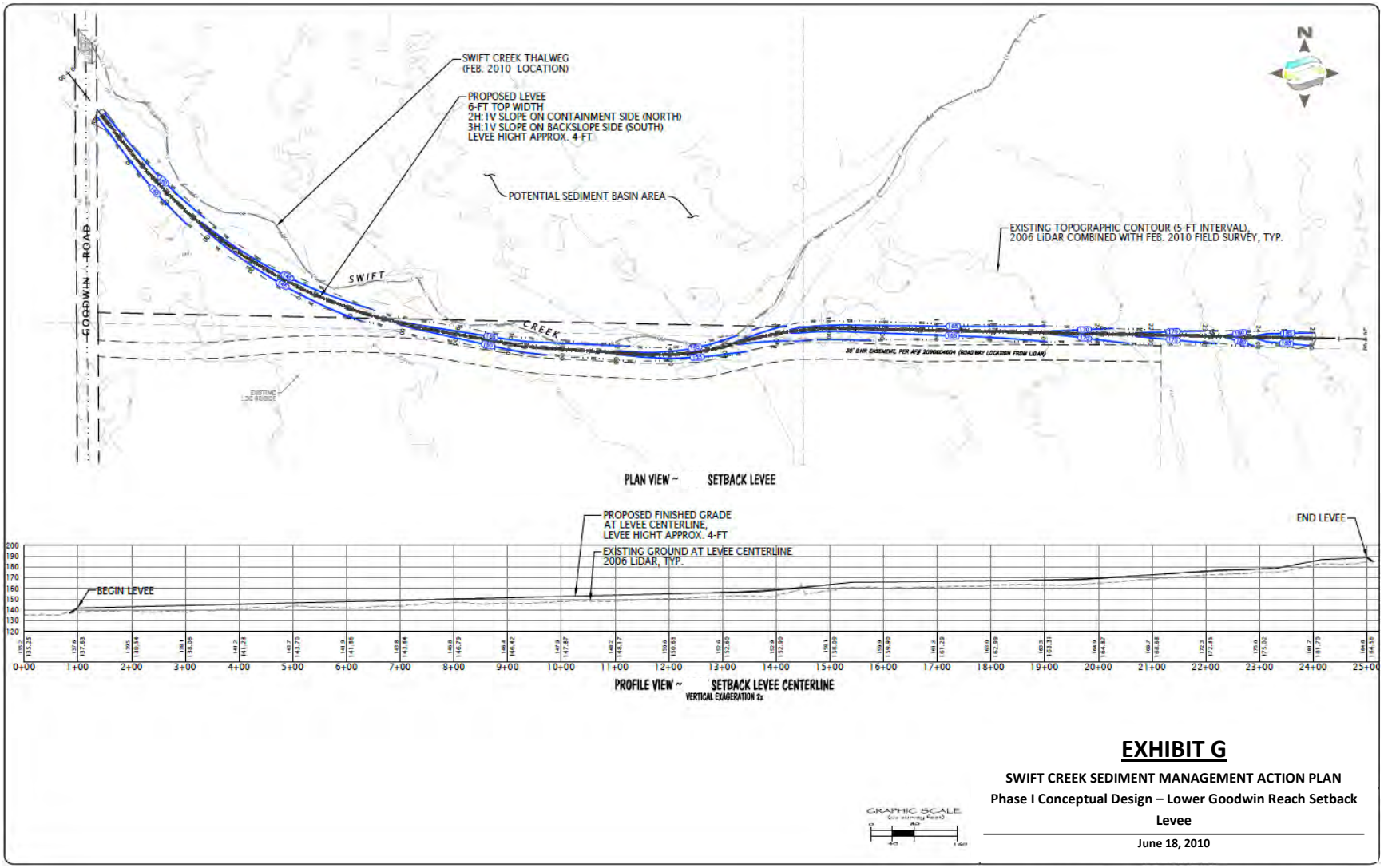

EXHIBIT G: Lower Goodwin Reach Setback Levee Plan and Profile Diagram

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E Removal Action Alternative Cost Estimate Details

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Table E-1
Cost Estimate, Alternative A2
Institutional Controls and Access Restrictions
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs					
Item Description	**Quantity**	**Unit**	**Cost/Unit**	**Cost**	**Reference**
Land Acquisition Costs	2,600	acre		Not Included	Whatcom County Assessor Office
Subtotal Direct Capital Costs (rounded to nearest $10,000)				***$0***	
Indirect Capital Costs					
Administration	3.5%			$1,411,000	
Legal Fees and License/Permit Costs	3.5%			$1,411,000	
Subtotal Indirect Capital Costs (rounded to nearest $10,000)				***$2,820,000***	
Subtotal Capital Costs				$2,820,000	
Contingency Allowance (10%)				$282,000	
Total Cost, Not Including Land Acquisition (rounded to nearest $10,000)				**$3,100,000**	

Assumptions:

Costs to acquire property are not included.

Indirect capital costs are based on the market value price ($40,310,465) of the potentially affected area (approximately 2,600 acres).

Table E-2
Cost Estimate, Alternative A3
Annual Dredging and Hauling for 10 years
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs						
Item Description	**Quantity**	**Unit**	**Cost/Unit**		**Cost**	**Reference**
Land Acquisition Cost for Repository (A3 Repository Option)	15	acre			Not Included	
Silt Fence, polypropylene	3,500	l.f.	$0.83		$2,905	2013 RSMeans, 31 25 14.16 1000
Erosion Control Hay Bales, staked	2,500	l.f.	$10.55		$26,375	2013 RSMeans, 31 25 14.16 1250
Chain Link Fence (6' high) for Repository	4,000	l.f.	$19.25		$77,000	2013 RSMeans, 32 31 13.25 0100
Total Direct Capital Costs (Rounded to Nearest $1,000)					*$106,000*	
Indirect Capital Costs						
Engineering and Design	7%				$23,940	
Administration	5%				$17,100	
Legal Fees and License/Permit Costs	5%				$17,100	
3rd Party Construction Oversight	5%				$17,100	
Total Indirect Capital Costs (Rounded to Nearest $1,000)					*$75,000*	
Total Capital Costs						
Subtotal Capital Costs					*$181,000*	
Contingency Allowance	20%				*$36,200*	
Total Capital Cost (Rounded to Nearest $1,000)					***$217,000***	
Annual Direct PRSC Costs						
Item Description	**Quantity**	**Unit**	**Cost/Unit**	**Annual Cost**	**10-Year Cost**	
Field Overhead and Oversight	2	month	$16,760	$33,520		Assembly
Air Monitoring Instrument Rental	2	month	$3,405.00	$6,810		Vendor Quote
Mobilization and Demobilization	1	l.s.	$1,614	$1,614		Assembly
Dredging of Asbestos-Containing Sediment from Creek Channel	50,000	c.y.	$4.14	$207,000		2013 RSMeans, 31 23 16.13 1346
Material Hauling (from dredging location to staging area)	50,000	c.y.	$5.30	$265,000		2013 RSMeans, 31 23 23.20 4020
Load Asbestos-Containing Sediment from Dump Location: front end loader, 3 c.y. bucket	50,000	c.y.	$4.14	$207,000		2013 RSMeans, 31 23 16.13 1346
Transportation of Asbestos-Containing Sediment (from staging area to repository)	50,000	c.y.	$6.40	$320,000		2013 RSMeans, 31 23 23.20 4038
Spread Dumped Material at Repository: dozer, no compaction	50,000	c.y.	$2.26	$113,000		2013 RSMeans, 31 23 23.17 0020
Compaction of Dumped Material in Repository: riding, vibrating roller, 12" lifts, 2 passes	50,000	c.y.	$0.26	$13,000		2013 RSMeans, 31 23 23.23 5060
Finish Grading of Repository: slopes, steep	75,000	s.y.	$0.25	$18,750		2013 RSMeans, 31 22 16.10 3310
Water Truck: soil wetting	50,000	c.y.	$2.38	$119,000		2013 RSMeans, 31 23 23.23 9000
Purchase and Transport of Topsoil for Repository Cover	12,500	c.y.	$7.00	$87,500		Estimate
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	12,500	c.y.	$2.26	$28,250		2013 RSMeans, 31 23 23.17 0020
Seeding for Repository Cover	15	acre	$1,250.00	$18,750		2013 RSMeans, 32 92 19.13 0020
Total Annual Direct PRSC Costs (Rounded to Nearest $1,000)				*$1,439,000*		
Annual Indirect PRSC Costs						
Administration	5%			$71,950.00		
Insurance, Taxes, Licenses	3%			$43,170.00		
Total Annual Indirect PRSC Costs (Rounded to Nearest $1,000)				*$115,000*		
Total Annual PRSC Costs						
Subtotal Annual PRSC Costs				*$1,554,000*		
Contingency Allowance	20%			$310,800		
Total Annual PRSC Cost, with Discount Rate (Rounded to Nearest $10,000)				***$1,860,000***	***$15,470,000***	
Total Cost						
Total Cost, Not Including Land Acquisition (Rounded to Nearest $10,000)					**$15,690,000**	

Assumptions:
Costs to acquire property are not included.
Indirect Capital Costs are based in part on estimated land value for repository.
Does not include sediment that is already placed in berms along Swift Creek.
Sediment quantity estimate of 50,000 c.y. for annual PRSC assumes bedload sediment deposited on the lower reach of Swift Creek.
100 truckloads (20 cy capacity)/day were assumed to estimate duration of dredging and hauling to repository activities.
Transportation assumes the repository is 5 miles away from the staging/loading area (i.e., 10 miles round trip).
Maintenance costs of the repository cover layer are not included.
10-year cost projection assumes a discount rate of 3.5% per year.
In accordance with NESHAP, a cover soil layer of 6 inches was assumed.

Key:
c.y. = cubic yard
l.f. = linear foot
l.s. = lump sum
NESHAP = National Emission Standards for Hazardous Air Pollutants
PRSC = post-removal site control
s.y. = square yard

Table E-3
Cost Estimate, Alternative A4
Sediment Basins, Setback Levees, and In-Stream Sediment Traps
Draft Engineering Evaluation / Cost Analysis
Sumas Mountain Asbestos (aka Swift Creek) Site
Whatcom County, Washington

Direct Capital Costs						
Item Description	**Quantity**	**Unit**	**Cost/Unit**		**Cost**	**Reference**
Direct Capital Costs						
Sediment Basin						
Field Overhead and Oversight	8	month	17,960.00		$145,186	Assembly
Air Monitoring Instrument Rental	8	month	$3,405.00		$27,526	Vendor Quote
Mobilization and Demobilization	1	l.s.	4,304.00		$4,304	Assembly
Land Acquisition Cost for Sediment Basin	80	acre	15,750.00		Not Included	
Land Acquisition Cost for Repository (A4 Repository Option)	50	acre	15,750.00		Not Included	
Clearing and Grubbing	80	acre	1,650.00		$132,000	2013 RSMeans, 31 13 13.10 0400
Stripping	242,500	c.y.	0.93		$225,525	2013 RSMeans, 31 14 13.23 0200
Embankment	1,157,500	c.y.	0.96		$1,111,200	2013 RSMeans, 31 23 23.14 5020
Waste Excavation	150,000	c.y.	4.14		$621,000	2013 RSMeans, 31 23 16.13 1346
Filter Blanket	162,500	s.y.	2.33		$378,625	2013 RSMeans, 31 32 19.16 1500
Slope Protection	95,000	s.y.	2.33		$221,350	2013 RSMeans, 31 32 19.16 1500
Channel Excavation	27,500	c.y.	4.14		$113,850	2013 RSMeans, 31 23 16.13 1346
Drop Inlet Control Structures						
Concrete (including structure excavation)	360	c.y.	485.00		$174,600	2013 RSMeans, 03 30 53.40 4200
Pre-stress conc. Pipe.	180	l.f.	241.00		$43,380	2013 RSMeans, 33 41 13.60 2090
Slide Gates	4	each	20,230.00		$80,920	Estimate
Training Dike						
Clearing	2	acre	1,650.00		$3,300	2013 RSMeans, 31 13 13.10 0400
Stripping	2,000	acre	0.93		$1,860	2013 RSMeans, 31 22 16 .10 0200
Embankment	11,000	c.y.	0.96		$10,560	2013 RSMeans, 31 23 23.14 5020
Slope Protection	1,000	s.y.	2.33		$2,330	2013 RSMeans, 31 32 19.16 1500
Excavation of Asbestos-Containing Sediment in Berms along Swift Creek	200,000	c.y.	4.14		$828,000	2013 RSMeans, 31 23 16.13 1346
Transportation of Asbestos-Containing Sediment (from berm location to repository)	200,000	c.y.	6.40		$1,280,000	2013 RSMeans, 31 23 23.20 4038
Spread Dumped Material at Repository: dozer, no compaction	200,000	c.y.	2.26		$452,000	2013 RSMeans, 31 23 23.17 0020
Compaction of Dumped Material in Repository: riding, vibrating roller, 12" lifts, 2 passes	200,000	c.y.	0.26		$52,000	2013 RSMeans, 31 23 23.23 5060
Water Truck: soil wetting	200,000	c.y.	2.38		$476,000	2013 RSMeans, 31 23 23.23 9000
Purchase and Transport of Topsoil for Repository Cover	50,000	c.y.	7.00		$350,000	Estimate
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	50,000	c.y.	$2.26		$113,000	2013 RSMeans, 31 23 23.17 0020
Seeding for Repository Cover	50	acre	$1,250.00		$62,500	2013 RSMeans, 32 92 19.13 0020
Access Road for Sediment Basins	4,000	l.f.	14.75		$59,000	2013 RSMeans, 01 55 23.50 0100
Channel Restoration	50,000	c.y.	4.14		$207,000	2013 RSMeans, 31 23 16.13 1346
South Pass Road Setback Levee (1)	1	l.s.	159,957.00		$159,957	SCSMAP
Upper Goodwin Reach Debris Flow Deflection/Setback Levee (1)	1	l.s.	534,879.00		$534,879	SCSMAP
Canyon Reach Instream Sediment Trap Structures (1)	1	l.s.	565,956.00		$565,956	SCSMAP
Silt Fence, polypropylene	8,000	l.f.	0.83		$6,640	2013 RSMeans, 31 25 14.16 1000
Erosion Control Hay Bales, staked	6,000	l.f.	10.55		$63,300	2013 RSMeans, 31 25 14.16 1250
Chain Link Fence (6' high) for Sediment Basins and Repository	17,000	l.f.	19.25		$327,250	2013 RSMeans, 32 31 13.25 0100
Total Direct Capital Costs (Rounded to Nearest $1,000)					*$8,835,000*	
Indirect Capital Costs						
Engineering and Design	10%				$883,500	
Administration	5%				$441,750	
Legal Fees and License/Permit Costs	5%				$441,750	
3rd Party Construction Oversight	5%				$441,750	
Total Indirect Capital Costs (Rounded to Nearest $1,000)					*$2,209,000*	
Total Capital Costs						
Subtotal Capital Costs					*$11,044,000*	
Contingency Allowance	20%				*$2,208,800*	
Total Capital Cost (Rounded to Nearest $10,000)					***$13,250,000***	
Annual Direct PRSC Costs						
Description	**Quantity**	**Unit**	**Cost/Unit**	**Annual Cost**	**10-Year Cost**	
Field Overhead and Oversight	4	month	17,960.00	$68,248		Assembly
Mobilization and Demobilization	1	l.s.	2,690.00	$2,690		Assembly
Excavation of Asbestos-Containing Sediment from Sediment Basins	150,000	c.y.	4.14	$621,000		2013 RSMeans, 31 23 16.13 1346
Transportation of Asbestos-Containing Sediment (from sediment basins to repository)	150,000	c.y.	6.40	$960,000		2013 RSMeans, 31 23 23.20 4038
Spread Dumped Material: dozer, no compaction	150,000	c.y.	2.26	$339,000		2013 RSMeans, 31 23 23.17 0020
Compaction: riding, vibrating roller, 12" lifts, 2 passes	150,000	c.y.	0.26	$39,000		2013 RSMeans, 31 23 23.23 5060
Water Truck: soil wetting	150,000	c.y.	2.38	$357,000		2013 RSMeans, 31 23 23.23 9000
Purchase and Transport of Topsoil for Repository Cover	40,500	c.y.	7.00	$283,500		Estimate
Spread Imported Topsoil for Repositoy Cover: dozer, no compaction	40,500	c.y.	$2.26	$91,530		2013 RSMeans, 31 23 23.17 0020
Seeding for Repository Cover	50	acre	$1,250.00	$62,500		2013 RSMeans, 32 92 19.13 0020
Total Annual Direct PRSC Costs (Rounded to Nearest $1,000)				*$2,824,000*		
Annual Indirect PRSC Costs						
Administration	5%			$141,200.00		
Insurance, Taxes, Licenses	3%			$84,720.00		
Total Annual Indirect PRSC Costs (Rounded to Nearest $1,000)				*$226,000*		
Total Annual PRSC Costs						
Subtotal Annual PRSC Costs				*$3,050,000*		
Contingency Allowance	20%			$610,000		
Total Annual PRSC Cost, with Discount Rate (Rounded to Nearest $10,000)				***$3,660,000***	***$30,440,000***	
Total Cost						
Total Cost, Not Including Land Acquisition (Rounded to Nearest $10,000)					**$43,690,000**	

Note: (1). The costs for these items are from the Whatcom County Swift Creek Sediment Management Action Plan (SCSMAP).

Assumptions:
Costs to acquire property are not included.
Indirect Capital Costs are based in part on estimated land value for repository.
Assumes two sediment basins to be constructed with the total storage capacity presented in the SCSMAP.
Sediment quantity estimate of 150,000 c.y. for annual PRSC assumes total of bedload and suspended sediment released to Swift Creek.
A factor of 2.5 was applied to sediment basin quantities to account for the SCSMAP sediment storage capacity of 1,963,000 cubic yards.
The 1976 Converse cost estimate was based on a sediment storage capacity of 771,173 cubic yards.
A 10-year lifespan was assumed for the sediment basin. 150,000 cy/yr @ 10 yrs = 1,500,000 cubic yards.
100 truckloads (20 cy capacity)/day were assumed to estimate duration of dredging and hauling for repository activities.
Transportation assumes the repository is 5 miles away from the staging/loading area (i.e., 10 miles round trip).
Maintenance costs of the repository cover layer are not included.
10-year cost projection assumes a discount rate of 3.5% per year.
In accordance with NESHAP, a cover soil layer of 6 inches was assumed.

Key:
c.y. = cubic yard
l.f. = linear foot
l.s. = lump sum
NESHAP = National Emission Standards for Hazardous Air Pollutants
PRSC = post-removal site control
SCSMAP = (Whatcom County) Swift Creek Sediment Management Action Plan, 2012
s.y. = square yard

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