Bellingham/Lake Whatcom Coal Mines
Geneva Mine
Preliminary Assessment Report
Whatcom County, Washington
TDD: 03-01-0002

Ecology and Environment, Inc.
Contract: 68-S0-01-01
September 2004

Region 10

START-2

Superfund Technical Assessment and Response Team

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BELLINGHAM/LAKE WHATCOM COAL MINES
GENEVA MINE
PRELIMINARY ASSESSMENT REPORT
WHATCOM COUNTY, WASHINGTON
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LIST OF ACRONYMS

Acronym	Definition
AMD	acid mine drainage
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CLP	Contract Laboratory Program
CRQL	Contract Required Quantitation Limit
E & E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
IDW	investigation-derived waste
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
PAs	preliminary assessments
PPE	probable point of entry
ppm	parts per million
START	Superfund Technical Assessment and Response Team
SQL	sample quanititation limit
TDL	target distance limit
USGS	United States Geological Survey
WCHD	Whatcom County Health Department
WCHHS	Whatcom County Health and Human Services
WDFW	Washington Department of Fish and Wildlife
WDOH	Washington Department of Health

BELLINGHAM/LAKE WHATCOM COAL MINES
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1. INTRODUCTION

Ecology and Environment, Inc. (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of preliminary assessments (PAs) and pre-Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) screenings at several abandoned coal mines in the Bellingham/Lake Whatcom area, located in Whatcom County, Washington. The EPA is doing this work in response to a citizens' petition filed by two environmental groups in Bellingham, the Environmental Exposure Network and the Clean Water Alliance. These groups believe the mines may contain pollutants, such as mercury and other heavy metals.

Following site visits and review of existing information, three of the mines, including the Geneva Mine, were selected for sampling. E & E completed PA activities under Technical Direction Document Number 03-01-0002, issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-2 Contract Number. 68-S0-01-01.

The specific goals for the Geneva Mine PA, identified by the EPA, are:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

Completion of the PA included reviewing existing site information, collecting receptor information within the range of site influence, determining regional characteristics, and conducting a site visit. This document includes a discussion of background site information (Section 2), a discussion of migration/exposure pathways and potential receptors (targets; Section 3), conclusions (Section 4), and a list of pertinent references (Section 5).

2. SITE BACKGROUND

2.1 SITE LOCATION

Site Name:	Geneva Mine
CERCLIS ID Number:	WAN001002518
Location:	Whatcom County, Washington
Latitude:	48° 44' 10.8" North
Longitude:	122° 24' 46.2" West
Legal Description:	Section 34, Township 38 North, Range 3 East, Willamette Meridian
Site Owner/Contact:	Mr. Lee Denke 601 North Fourth Street Mount Vernon, Washington 98273-2827

2.2 SITE DESCRIPTION/OWNERSHIP HISTORY

The Geneva Mine is an abandoned coal mine situated in a recently clear-cut area near the northern end of Lake Whatcom. The mine lies within Section 34, Township 38 North, Range 3 East (Figure 2-1).

The Geneva Mine originally was opened in 1921 by Otho Williams under the name of the Pacific Atomized Fuel Company (Vonheeder 1975).

The main workings of the Geneva Mine consisted of a 360-foot adit driven on strike of a coal seam averaging 28 to 29 inches thick, and a 174-foot long crosscut drift with an entry located approximately 150 feet from the surface opening. The coal seam strikes north 80° west and dips between 21° and 25° toward the northeast. Some overhead stoping was carried out along the coal seam in the main tunnel. The crosscut drift is reported to have cut several smaller coal seams. A second adit was reportedly located approximately 250 feet down the hill from, and 68 feet lower in elevation than, the main tunnel. The second adit was driven along the strike of a coal seam approximately 40 feet

stratigraphically higher than the main coal seam. This coal seam strikes north 60° west and dips 24° toward the northeast. (Jenkins 1923)

A skid road led from the mine 2,800 feet to bunkers located adjacent to the "Geneva pavement, near a big bend in the road in the center of the northern part of section 34, about three miles from the center of the city." (Jenkins 1923).

It was noted that, as of 1969, "for the most part, nothing remains" at the Geneva Mine (Moen 1969).

2.3 SITE OPERATIONS AND WASTE CHARACTERISTICS

The Geneva Mine opened in 1921, and apparently ceased operations in 1922. A total of 350 tons of coal is reported to have been mined in 1921 and 1922; no records for subsequent production are available (Vonheeder 1975). The coal was hauled out on a skid road to bunkers, and was used locally (Jenkins 1923). No other specific information regarding the mining operations at the Geneva Mine was located during the PA.

START-2 interviewed Ray Hiller, a resident familiar with the Geneva Mine, on February 10, 2004. Mr. Hiller stated that he and his family moved to the neighborhood near the Geneva Mine in 1979. Mr. Hiller reported that a trail previously traversed through the woods from near his residence to a mine portal. It is not known which of the two portals the trail accessed. Subsequent to clear cutting on the mine property, the trail has become largely overgrown. Mr. Hiller stated that in 1981, the slope above the mine opening collapsed, thereby closing off physical access to the portal. Mr. Hiller noted that prior to the collapse, a horizontal adit and an inclined shaft branching off the adit were visible from the adit entrance. Mr. Hiller reported a "tailings pile" near the mine. Mr. Hiller reported that he never observed any garbage or waste other than the "tailings" in the vicinity of the mine. Mr. Hiller stated that he had not observed any other portals or mine features. (Hiller 2004)

2.4 SITE CHARACTERIZATION

Based on available information, no investigations of the Geneva Mine have been conducted. However, ancillary background information gathered as part of the PA may be pertinent to the Geneva Mine, as discussed in the subsections below.

2.4.1 United States Geological Survey Coal Quality Data

The United States Geological Survey (USGS) has collected information on coal sampled from across the United States over the last 25 years (Tewalt et al. 2001). Results are compiled in USGS's COALQUAL database (USGS 2004a). Although most samples represented in the database were collected from major coal producing areas around the country, two coal samples were collected from exposures of the Chuckanut Formation in Whatcom County (near Glacier, Washington) and Skagit County (near Hamilton, Washington) in 1979 and 1975, respectively. The Chuckanut Formation is the geologic unit that contains the coal beds developed in the Bellingham/Lake Whatcom area (Jenkins 1923). These two samples were collected from distances greater than 20 miles from the Bellingham/Lake Whatcom area coal mines (including the Geneva Mine), and may not be representative of the coal beds targeted in the Bellingham/Lake Whatcom area mines. Nonetheless, it is important to note that the total mercury concentrations in these samples were relatively high, at 0.46 parts per million (ppm) and 1.1 ppm (USGS 2004a). By comparison, for the more than 7,000 samples in the COALQUAL database, the mean mercury concentration is 0.17 ppm, and the median concentration is 0.11 ppm. The maximum mercury database value for coal in the ground is 1.8 ppm, after deleting one higher value as a statistical outlier (Tewalt et al. 2001).

2.4.2 1999 Fish and Sediment Sampling Study

A study conducted by the Washington State Department of Ecology (Ecology) reported a mercury concentration of 0.5 milligrams per kilogram (mg/kg), wet weight, in a composite sample of smallmouth bass fillets collected from Lake Whatcom. The study also sampled sediments from the lake and several tributaries. Total mercury concentrations ranged from 0.04 to 0.46 mg/kg, dry weight, with a mean of 0.19 mg/kg, dry weight. (Ecology 1999)

2.4.3 2001 Fish Sampling

To determine if consumers of Lake Whatcom fish were at risk from mercury exposure, Ecology, the Washington Department of Fish and Wildlife (WDFW), the Washington State Department of Heath (WDOH), and the Whatcom County Health Department (WCHD), at the request of Whatcom County Health and Human Services (WCHHS), conducted a fish tissue and consumption study (Ecology 2001). Approximately 273 samples of finfish were collected and analyzed for mercury. The average mercury level in smallmouth bass was 0.49 mg/kg, wet, with a maximum concentration of 1.84 mg/kg, wet.

Thirteen samples collected during this study exceeded the EPA National Toxics Rule human health criterion of 0.825 mg/kg, wet. (Ecology 2001)

Following the study, the WDOH conducted a health assessment to determine whether fish from Lake Whatcom pose a potential threat to consumers. As a result of the health assessment, the WDOH recommended to WCHHS a fish advisory for smallmouth bass and yellow perch. (WDOH 2001)

2.4.4 2004 Lake Whatcom Mercury Study

In 2002, Ecology, USGS, and the WCHD initiated a joint investigation to evaluate distribution and possible sources of mercury in Lake Whatcom and five other lakes in Whatcom County. Objectives of the investigation are summarized below:

- Determine the distribution of mercury in surface sediments from Lake Whatcom.(Ecology 2004);
- Evaluate historical trends in total mercury levels and sedimentation rates (Ecology 2004);
- Estimate mercury loadings in 10 tributaries to Lake Whatcom (Ecology 2004);
- Use differences in mercury accumulation rates in other lakes in Whatcom County along with other data to infer the deposition from known local and regional sources of airborne mercury and to determine if accumulation rates can be attributed to global sources (USGS 2004b);
- Use available data on concentrations of mercury in the tissue of fish from Lake Whatcom and other lakes in Whatcom County to help identify sources of mercury (USGS 2004b);
- Estimate the relative importance of potential sources of mercury in Lake Whatcom tributaries and in water diverted from the Middle Fork of the Nooksack River by examining the relation between concentrations of mercury in surface sediments of the lake and the proximity of potential sources (USGS 2004b);
- Investigate the possibility that geochemical, biological, and physical processes occurring in Lake Whatcom or in connected wetlands affect the distribution of mercury in sediment and fish tissue (USGS 2004b); and
- Suggest additional sampling or other information needed to confirm mercury sources and refine the understanding of processes identified after completing the first four objectives (USGS 2004b).

Results of the study are provided in two separate reports (USGS 2004b; Ecology 2004), and briefly summarized below.

Possible sources of mercury to Lake Whatcom that were evaluated include atmospheric deposition from local, regional, and global sources of airborne mercury; tributaries to Lake Whatcom; and local landfills, dumpsites, and mining operations (USGS 2004b; Ecology 2004). It was noted that another possible mechanism of mercury loading to Lake Whatcom is percolation of groundwater into the lake; however, possible mercury inputs from groundwater were not evaluated during the study due to lack of data (USGS 2004b).

Local airborne sources of mercury include the Georgia Pacific chloralkali plant, which operated in Bellingham between 1964 and 2000 and three nearby incinerators, the first of which began operating in 1974. Relative contributions of mercury deposition to Lake Whatcom and other lakes in Whatcom County from local sources of aerial emissions were estimated by air modeling. Improvements in air pollution controls and operating procedures at these facilities have resulted in reduced mercury air emissions from these sources over their history (USGS 2004b).

To estimate mercury loading by tributaries, surface water was sampled periodically from 10 Lake Whatcom tributaries between July 2002 and May 2003. One of the streams sampled is referred to in the study as Euclid Creek. Euclid Creek receives inputs from two tributaries that flow through the area of the Geneva Mine. Total mercury was detected at concentrations ranging from 0.0027 to 0.0074 micrograms per liter (µg/L) in surface water samples collected from the stream at a location near its mouth in Lake Whatcom. The calculated mercury loading to Lake Whatcom by the stream between July 2002 and May 2003was estimated to be 0.025 grams of mercury, representing 0.8% of the total mercury loading from the 10 tributaries sampled during the study (Ecology 2004; USGS 2004b).

As part of the study, approximately 30 surface sediment samples and three deep sediment core samples were collected from Lake Whatcom. All samples were analyzed for total mercury, and 15 of the samples were analyzed for methylmercury. Other analyses performed include total organic carbon, percent solids, grain size, total lead (Pb), ^{210}Pb, and cesium-137 (^{137}Cs; Ecology 2004; USGS 2004b).

Concentrations of total mercury in surface sediments throughout Lake Whatcom ranged from 0.014 to 0.22 mg/kg, dry weight. It was concluded that these mercury sediment concentrations are not high compared to levels measured at other areas in Washington (Ecology 2004).

Radiometric dating of the sediment cores was performed using stable Pb, ^{210}Pb, and ^{137}Cs data in order to evaluate sedimentation rates and timing of mercury loading. The sediment core results indicate abrupt increases in mercury enrichment after 1910 at all three Lake Whatcom core sample locations. Most of the increases in mercury deposition in Lake Whatcom sediments (and sediment in the other lakes studied) occurred in the early to mid-1900s, which is before the major local sources of airborne mercury

(Georgia Pacific chloralkali plant and the incinerators) began operating (Ecology 2004; USGS 2004b). This was interpreted to indicate that local atmospheric mercury emissions were not the dominant sources of mercury to the lake, and to suggest that the general global air pollution resulting from the Industrial Revolution in the first half of the twentieth century was responsible for a significant amount of the mercury loading in Lake Whatcom (USGS 2004b). Similar patterns of mercury enrichment were observed in core samples collected from the other Whatcom County lakes studied (Ecology 2004; USGS 2004). Mercury levels in Lake Whatcom sediment peaked in the period between approximately 1987 and 1995, and the subsequent decline in mercury concentrations appear to suggest that mercury sources to the lake have been reduced (Ecology 2004).

2.4.5 Coal Mine Drainage Studies

One of the principal environmental impacts that can result from coal mining is coal mine drainage. Coal mine drainage can be either acidic or alkaline, and can degrade receiving surface water bodies and groundwater. Acid mine drainage (AMD), in which acidity exceeds alkalinity, results from a complex suite of reactions involving the oxidation of pyrite (iron sulfide) and other sulfide minerals. AMD typically results in elevated concentrations of ferric (Fe^{3+}) and ferrous (Fe^{2+}) iron, manganese (Mn^{2+}), aluminum (Al^{3+}), and sulfate (SO_4^{2-}). Neutral or alkaline mine drainage, in which alkalinity equals or exceeds acidity, can also have relatively high concentrations of iron, manganese, sulfate, and other constituents. Upon aeration of the water or neutralization of the acidity, ferric oxides, hydroxides, and/or oxyhydroxysulfate minerals commonly precipitate, forming a reddish-yellow or yellowish-brown coating (often referred to as yellowboy) on rocks and other surfaces. (PDEP 1999)

Trace metals such as arsenic, selenium, and mercury are locally present in coal and coal waste, and can be released to surface water and groundwater under coal mine drainage conditions (Seal 2004).

The chemical reactions that occur during development of AMD are analogous to those that occur during natural geologic weathering, which takes place over extended periods of time (e.g., hundreds to thousands of years); however, with AMD, the reaction rates are orders of magnitude greater than in natural weathering systems. The exact lengths of time required for initiation, propagation, and termination of acid generation in coal mine AMD scenarios are not well characterized, but appear to be on the order of years to decades. Results of modeling and evaluation of a limited number of case studies indicate that the peak acid load occurs 5 to 10 years after mining, followed by a gradual decline over 20 to 40 years. (OSM 2003)

2.5 START-2 ACTIONS

To obtain information about coal mining in the Bellingham/Lake Whatcom area, including the area of the Geneva Mine, START-2 reviewed numerous reports, maps, and other documents. In addition, START-2 and conducted interviews with representatives of federal, state, and local agencies; representatives of academic institutions; and owners or representatives of properties in the vicinity of the former coal mining activities. A list of these data sources for the Bellingham/Lake Whatcom Coal Mines PA/pre-CERCLIS screening project is provided in Appendix A.

START-2 actions also included visits to the Geneva Mine area on January 29, February 5, February 10, and July 1, 2004. Photographic documentation of the START-2 site visits is provided in Appendix B. During the visits on January 29 and February 5, 2004, START-2 unsuccessfully attempted to locate evidence of the former mine. The area in the vicinity of the Geneva Mine has been recently clear-cut, and is covered by slash and dense brush. As such, visibility is poor and it is difficult to physically access the area of the former mine. START-2 also attempted to locate the former bunkers. The area of the former bunkers is currently developed for residential use. No evidence of the bunkers was observed on those dates.

On February 10, 2004, START-2 was accompanied by Mr. Hiller, who is familiar with the area, and who provided assistance locating the former mine. Observations made during the site visit are summarized below. Site features are illustrated in Figure 2-2. A faint, discontinuous trail leads generally southward from near the end of Piedmont Place to the mine. Portions of the trail appear to have formerly been a road, possibly the skid road that reportedly served the mine (Jenkins 1923).

Mine features observed include an apparent collapsed portal (Photograph A-4, Appendix B), a waste rock pile (Photographs A-5 and A-11, Appendix B), and the faint remains of a former dirt road across a small stream. The waste rock pile trends northward from near the collapsed portal. The waste rock pile is approximately 100 feet long, 30 feet wide at the base, and ranges from approximately 5 to 15 feet high, tapering toward the south (toward the portal). The waste rock pile was partially covered with vegetation and duff; where the underlying material was exposed, it consisted of a mixture of soil, carbonaceous shale, and black, coaly material (Photographs A-6 and A-10, Appendix B). A former road (apparently the former skid road) trends west from the collapsed portal past the southern end of the waste rock pile, and turns northward. Two unnamed intermittent tributaries to an unnamed intermittent stream flow northward through the area of the mine, and join a short distance downstream of the mine. The eastern tributary flows past the collapsed portal and along the east side of the waste rock pile. On February 10, 2004, the eastern tributary contained water upstream of the area of the collapsed portal; the

stream was estimated to flow at less than 1 cubic foot per second (cfs). In the area adjacent to and downstream of the collapsed portal, the streambed was dry, the water flowing subsurface through sandy and gravelly material accumulated near the collapsed portal. The western tributary flows northward over the top of the west-trending section of the road and continues along the west side of the waste rock pile. On February 10, 2004, water was present in the tributary and estimated to flow at less than 1 cfs. The downstream side of the road was eroded by the western tributary as it flowed over the road. Coal fragments were observed in both the eastern and western tributaries, possibly resulting from erosion of material from the waste rock pile.

On July 1, 2004, START-2 returned to the site to collect samples of sediment, soil, and coal/coaly waste rock. Sample locations are illustrated in Figure 2-3. A source sample of coaly waste rock (04274057) was collected from the waste rock pile (location GV03), and a background soil sample (04274056) was collected from a location (GV02) south and uphill of the mine. Sediment samples were collected from two locations. A background sediment sample (04274055) was collected from the eastern drainage at a location (GV01) upstream of the collapsed mine portal. A target sediment sample (04274058) was collected from the unnamed intermittent stream at a location (GV04) approximately 700 feet downstream of the area of the mine. No water was present in the streams at any of the locations observed during the July 1, 2004 site visit.

Samples were collected in accordance with the *Bellingham/Lake Whatcom Coal Mines Sampling and Quality Assurance Plan* (E & E 2004). Investigation -derived waste (IDW) generated during the sampling activities consisted of dedicated plastic scoops and bowls and personal protective equipment; IDW was disposed of at a municipal landfill. Each sample was analyzed for Target Analyte List metals and mercury following EPA Contract Laboratory Program (CLP) Statement of Work ILM05.3 (EPA 2004) by Bonner Analytical Testing Company of Hattiesburg, Mississippi, under the EPA CLP.

Analytical results of the soil and sediment samples are presented in Tables 2-1 and 2-2, respectively. Laboratory data forms are provided in Appendix C. Tables 2-1 and 2-2 show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant concentrations of contaminants in the source soil sample with respect to background concentrations are shown underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations are those concentrations that are:

- Equal to or greater than the sample's Contract Required Quantitation Limit (CRQL) or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and

- Equal to or greater than the background sample's CRQL or SQL when the background concentration is below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limits.

The analytical summary tables present all detected compounds, but only those detected analytes at potential sources or in targets meeting the significant/elevated concentration criteria are discussed in the report text. Based on EPA Region 10 policy, evaluation of aluminum, calcium, iron, magnesium, potassium, and sodium (common earth crust metals) generally is employed in water mass tracing, which is beyond the scope of this report. For this reason, these elements are included in the summary tables, but are not discussed in the report text.

Arsenic and mercury are the only contaminants detected at significant concentrations with respect to the background soil sample concentrations in the source sample (04274057) from the pile of coaly waste rock. Arsenic was detected at a concentration of 16.2 mg/kg. Mercury was detected at a concentration of 1.3 mg/kg. No contaminants were detected at elevated concentrations in the target sediment sample (04274058).

Table 2-1

SURFACE SOIL SAMPLE ANALYTICAL RESULTS SUMMARY
BELLINGHAM/LAKE WHATCOM COAL MINES
GENEVA MINE
PRELIMINARY ASSESSMENT
WHATCOM COUNTY, WASHINGTON

EPA Sample ID	**04274056**	**04274057**
CLP Inorganic ID	**MJ45M8**	**MJ45M9**
Station Location ID	**GV02**	**GV03**
Description	**Background Soil**	**Coaly Waste Rock**
TAL Metals (mg/kg)		
Aluminum	**23400**	**22700**
Antimony	R	6.7 UJL
Arsenic	**4.6**	**16.2**
Barium	**191**	**356**
Beryllium	0.53 J (SQL = 1.61)	**0.67**
Cadmium	0.62 J (SQL = 1.61)	**0.72**
Calcium	**3610**	**6120**
Chromium	**42.4**	**45.4**
Cobalt	**15.7**	**19.6**
Copper	**35.3**	**74.1**
Iron	**27800**	**25300**
Lead	**19.3**	**13.5**
Magnesium	**6940**	**7960**
Manganese	**756**	**283**
Mercury	0.64 U	**1.3**
Nickel	**43.7**	**46.3**
Potassium	**1760**	**2030**
Selenium	1.9 J	3.9 U
Silver	1.3 U	1.1 U
Sodium	47.4 U	159 U
Thallium	2.8 J	1.5 J
Vanadium	**60.4**	**97.5**
Zinc	**104**	**98.6**

Note: Bold type indicates the sample result is above the detection limit.
Underlined type indicates the sample result is significant as defined in Section 2.

Key:

CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
J	= The associated value is an estimated quantity. The value is greater than the method detection limit, but less than the laboratory's quantitation limit.
L	= Low bias.
mg/kg	= Milligrams per kilogram.
R	= The data are unusable. The analyte may or may not be present in the sample.
SQL	= Sample quantitation limit.
TAL	= Target Analyte List.
U	= The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Table 2-2

SEDIMENT SAMPLE ANALYTICAL RESULTS SUMMARY
BELLINGHAM/LAKE WHATCOM COAL MINES
GENEVA MINE
PRELIMINARY ASSESSMENT
WHATCOM COUNTY, WASHINGTON

EPA Sample ID	**04274055**	**04274058**
CLP Inorganic ID	**MJ45M7**	**MJ45N0**
Station Location ID	**GV01**	**GV04**
Description	**Background Sediment**	**Downstream Sediment**
TAL Metals (mg/kg)		
Aluminum	**21400**	**17600**
Antimony	R	R
Arsenic	**5.8**	**5.1**
Barium	**170**	**170**
Beryllium	**0.61**	0.45 J
Cadmium	0.44 J	0.44 J
Calcium	**3440**	**3400**
Chromium	**33.9**	**36.4**
Cobalt	**14.4**	**12.4**
Copper	**27.4**	**27.9**
Iron	**29700**	**24600**
Lead	**9.1**	**9.2**
Magnesium	**6600**	**5420**
Manganese	**713**	**572**
Mercury	0.56 U	0.58 U
Nickel	**39.0**	**33.3**
Potassium	**1320**	**1160**
Selenium	2.6 J	1.3 J
Silver	1.1 U	1.2 U
Sodium	67.7 U	90.3 U
Thallium	**2.8**	2.1 J
Vanadium	**59.5**	**60.6**
Zinc	**86.2**	**66.0**

Note: Bold type indicates the sample result is above the detection limit.
Underlined type indicates the sample result is significant as defined in Section 2.

Key:

CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
J	= The associated value is an estimated quantity. The value is greater than the method detection limit, but less than the laboratory's quantitation limit.
L	= Low bias.
mg/kg	= Milligrams per kilogram.
R	= The data are unusable. The analyte may or may not be present in the sample.
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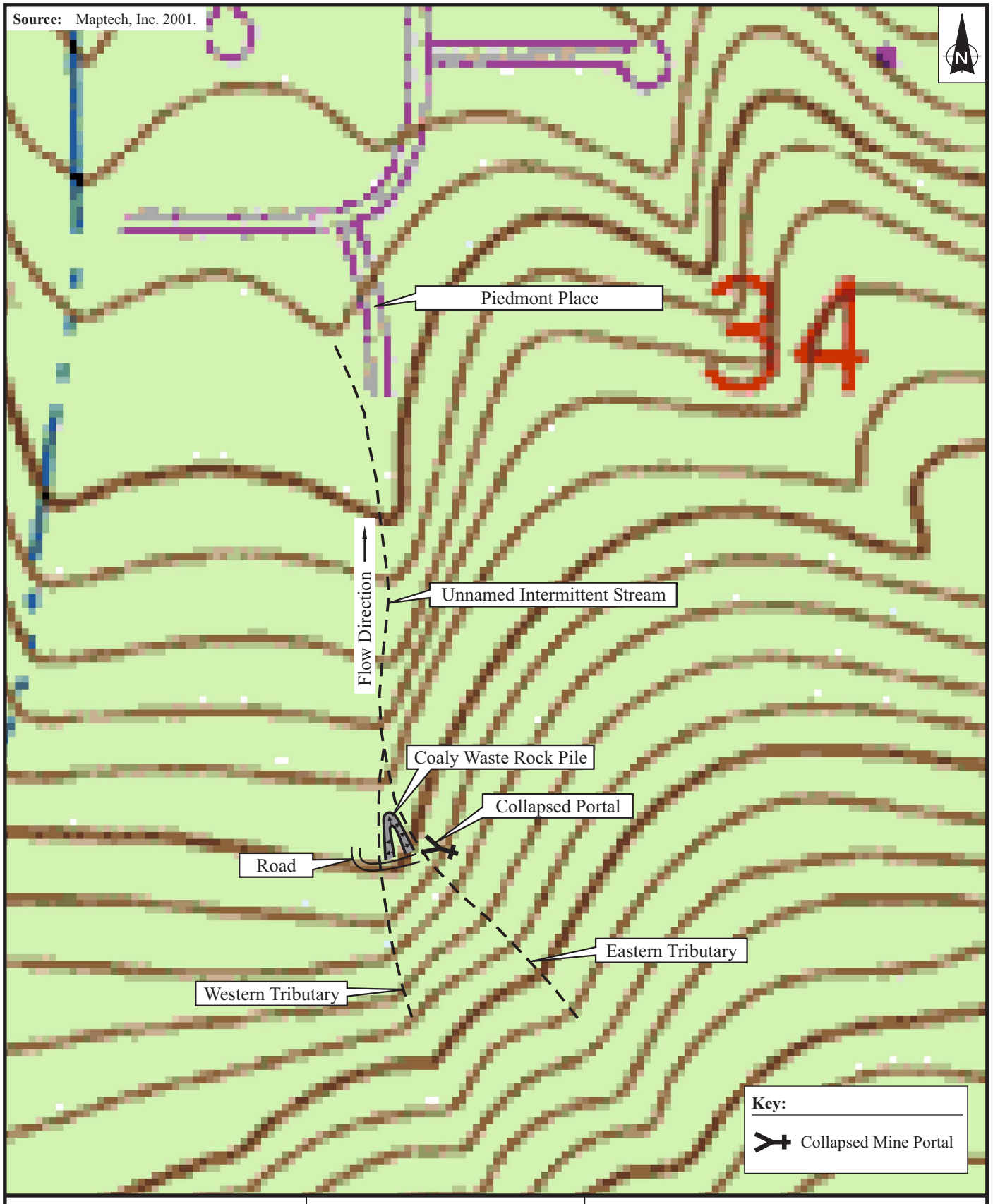
Seattle, Washington

0 .75 1.5
Approximate Scale in Miles

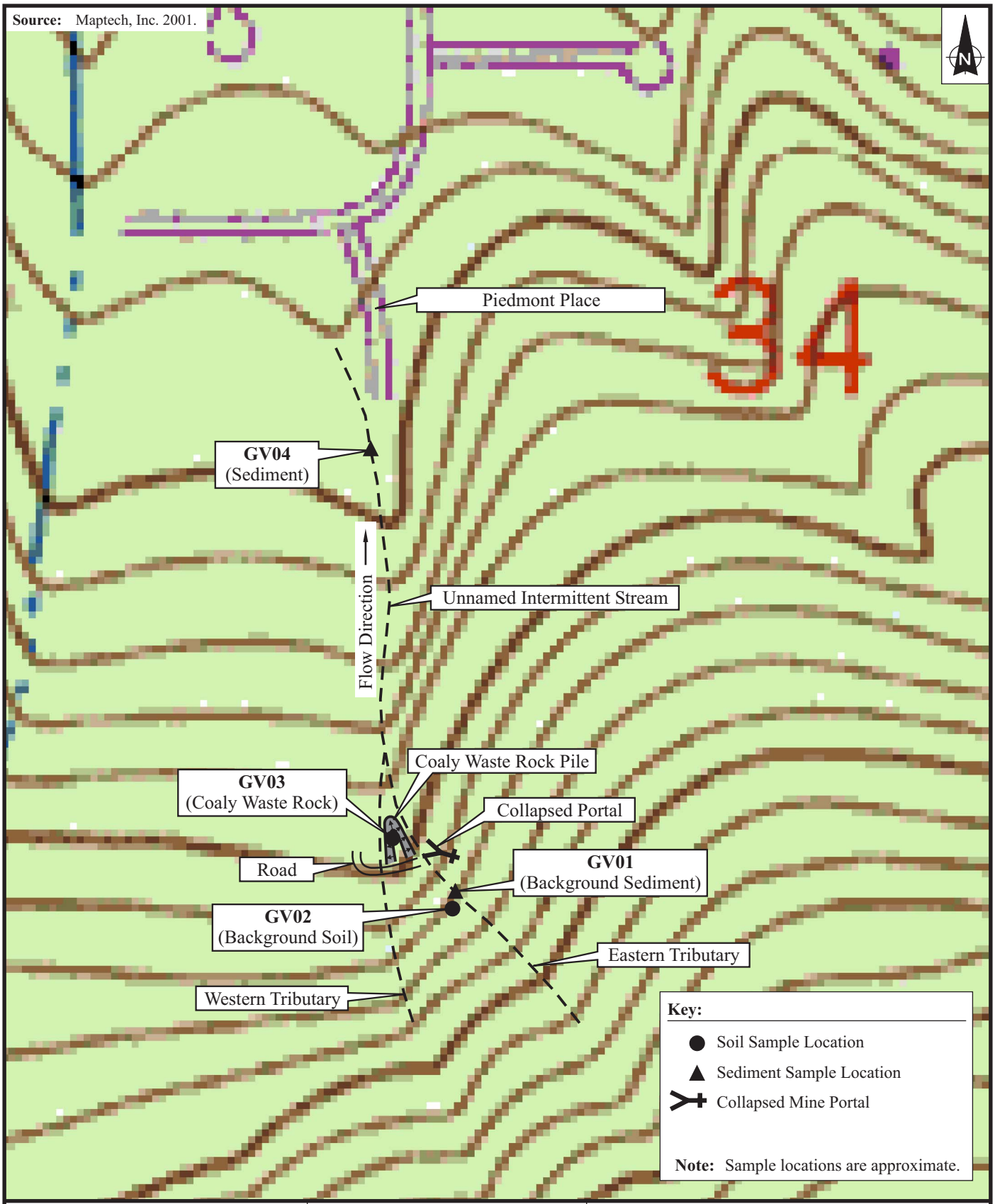
BELLINGHAM/LAKE WHATCOM COAL MINES
Whatcom County, Washington

Figure 2-1
SITE VICINITY MAP
GENEVA MINE

Date:	Drawn by:	
9/21/04	AES	10:START-2\03010002\fig 2-1



ecology and environment, inc. International Specialists in the Environment Seattle, Washington	BELLINGHAM/ LAKE WHATCOM COAL MINES Whatcom County, Washington	Figure 2-2 SITE MAP GENEVA MINE		
	0 125 250 Approximate Scale in Feet	Date: 9-21-04	Drawn by: AES	10:START-2\03-01-0002\fig 2-2



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Whatcom County, Washington

Figure 2-3
SAMPLE LOCATION MAP
GENEVA MINE

0 125 250
Approximate Scale in Feet

Date: 9-21-04 | Drawn by: AES | 10:START-2\03-01-0002\fig 2-3

3. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

This section describes migration/exposure pathways and potential targets (or receptors) within the site's range of influence. This section addresses only the surface water migration pathway and potential targets within the site's range of influence. The groundwater migration, soil exposure, and air migration pathways have been excluded at this time per direction of the EPA Task Monitor because relatively few receptors have been identified for these pathways.

The surface water migration pathway target distance limit (TDL) begins at the probable point of entry (PPE) of surface water runoff from the site to a surface waterbody and extends downstream for 15 miles. Surface water in the vicinity of Geneva Mine will enter an unnamed intermittent stream on the east side of the waste rock pile or the unnamed intermittent stream on the west side of the waste rock pile (Figure 2-2). These two streams merge a short distance downstream of the mine area, forming another unnamed intermittent stream that follows a path northward for approximately 1 mile until it empties into Lake Whatcom, the PPE. These intermittent streams are treated in this PA as overland pathways since the average annual rainfall in the area of the site is greater than 20 inches (WRCC 2004). All of Lake Whatcom is included within the surface water TDL. In addition, Whatcom Creek flows out of Lake Whatcom at the lake's northwestern end, approximately 1.4 miles from the PPE. The surface water migration pathway continues another 4.2 miles in Whatcom Creek until the creek empties into Bellingham Bay. The surface water TDL extends radially from the mouth of Whatcom Creek another 9.4 miles into Bellingham Bay. Figure 3-1 depicts the surface water 15-mile TDL for Geneva Mine.

START-2 estimates an average annual flow in Lake Whatcom of 15 cfs by combining the individual annual average flows for seven identified creeks that empty into Lake Whatcom and subtracting the average annual flow of Whatcom Creek. The seven creeks are: Carpenter Creek, Olsen Creek, Smith Creek, Anderson Creek, Brannian Creek, Silver Beach Creek, and Austin Creek. Whatcom Creek had an annual average flow rate of 88 cfs over 11 years of record between 1946 and 1968. (USGS 2003).

Potential source areas at the mine have no containment to prevent a release of hazardous substances to the surface water pathway. START-2 estimates the drainage area above and including the potential source areas at 65 acres (USGS 1995). Soils in the vicinity of the site consist of Chuckanut loam, bedrock substratum with 15% to 30% slopes. It formed in a mixture of volcanic ash and colluvium

derived from glacial drift and sandstone. Permeability is moderate, and available water capacity is high. Runoff is slow, and the hazard of water erosion is slight (USDA 1992). The two-year, 24-hour probable maximum rainfall for the Bellingham area is 2.5 inches (NOAA 1973). START-2 assumes the potential source at the Geneva Mine is not located within a floodplain given its elevation approximately 500 feet higher than the PPE.

Lake Whatcom is the drinking water source for the city of Bellingham. The city has a single water intake located in Lake Whatcom near the community of Geneva. The intake operates continuously through the year and supplies water to approximately 17,000 hook-ups (Evans 2003). The Whatcom County Water Resources Department estimates that 85,700 people obtain their drinking water through the public supply. In addition, another 250 residences draw their drinking water directly from the lake (Whatcom 2003). START-2 estimates that these 250 domestic intakes serve an additional 627.5 individuals (250 intakes multiplied by 2.51, the average number of persons per household for Whatcom County; DOC 2001). Therefore, the total count of individuals obtaining their drinking water from Lake Whatcom is estimated at 86,328.

Lake Whatcom is popular for boating, and therefore, is considered a major water recreation area. Sport fishing is also a popular activity in Lake Whatcom. The lake is a productive fishery for smallmouth and largemouth bass, kokanee, cutthroat trout, rainbow trout, mackinaw, and perch; however, the WDFW, the regulatory agency over sport fishing in the state of Washington, does not track harvest data for Lake Whatcom. Whatcom Creek also is fished, and the WDFW tracks the salmon harvest in the creek. During 1999, the most recent year of data, 672 salmon were harvested from Whatcom Creek for an estimated total harvest of 6,120 pounds (WDFW 2002; Wydoski and Whitney 1979). Lastly, Bellingham Bay also is fished for salmon. Bellingham Bay is part of the WDFW's statistical Area 7, which comprises the area of the Strait of Georgia. The 1999 harvest for salmon in statistical Area 7 was 98,915 pounds (WDFW 2002). START-2 estimates that the portion of the surface water TDL that lies within statistical Area 7 is approximately 15%. Therefore, 15% of the salmon harvest (14,822 pounds) from statistical Area 7 is assumed to occur in the surface water TDL. No Tribal or subsistence fisheries were identified in the TDL. Table 3-1 presents the harvest data by waterbody segment and fish type. Bellingham Bay is also used for shellfish harvest. The 1999 harvest of clams including Manila Littleneck, Native Littleneck, Butter, Soft Shell, and Horse, is 1,352 pounds from Bellingham Bay (WDFW 2002). During the 1999 season, 15,109 Dungeness crab were harvested from Bellingham Bay. The average weight of a Dungeness Crab is between 2 and 3 pounds (alaskaseafood.org 2004). Based on an assumed average weight of 2.5 pounds, approximately 37,772.5 pounds of Dungeness Crab were harvested from Bellingham Bay.

The following sensitive environments are located within the surface water pathway TDL:

- Lake Whatcom is a critical migratory pathway for anadromous fish (WDFW 2003a);
- Lake Whatcom and portions of Bellingham Bay have habitat known to be used by the bald eagle, *Haliaeetus Leucocephalus*, a Federal-listed threatened species (WDFW 2003a);
- Bellingham Bay has habitat known to be used for the Steller sea lion, *Eumetopias jubatus*, a Federal-listed threatened species (WDFW 2003a);
- Lake Whatcom has State land designated for wildlife and game management of waterfowl (WDFW 2003a); and
- Whatcom Creek is a critical migratory pathway for anadromous fish (WDFW 2003b).

It is estimated from National Wetland Inventory maps that a total of 32.21 miles of wetland frontage occur along the 15-mile surface water pathway TDL. Lake Whatcom has 0.27 mile of wetland frontage, Whatcom Creek has 0.42 mile of wetland frontage, and Bellingham Bay has the remaining 31.52 miles of wetland frontage (USFWS 1997a, 1997b, 1997c, 1997d, 1997e, 1997f, and 2001).

Table 3-1

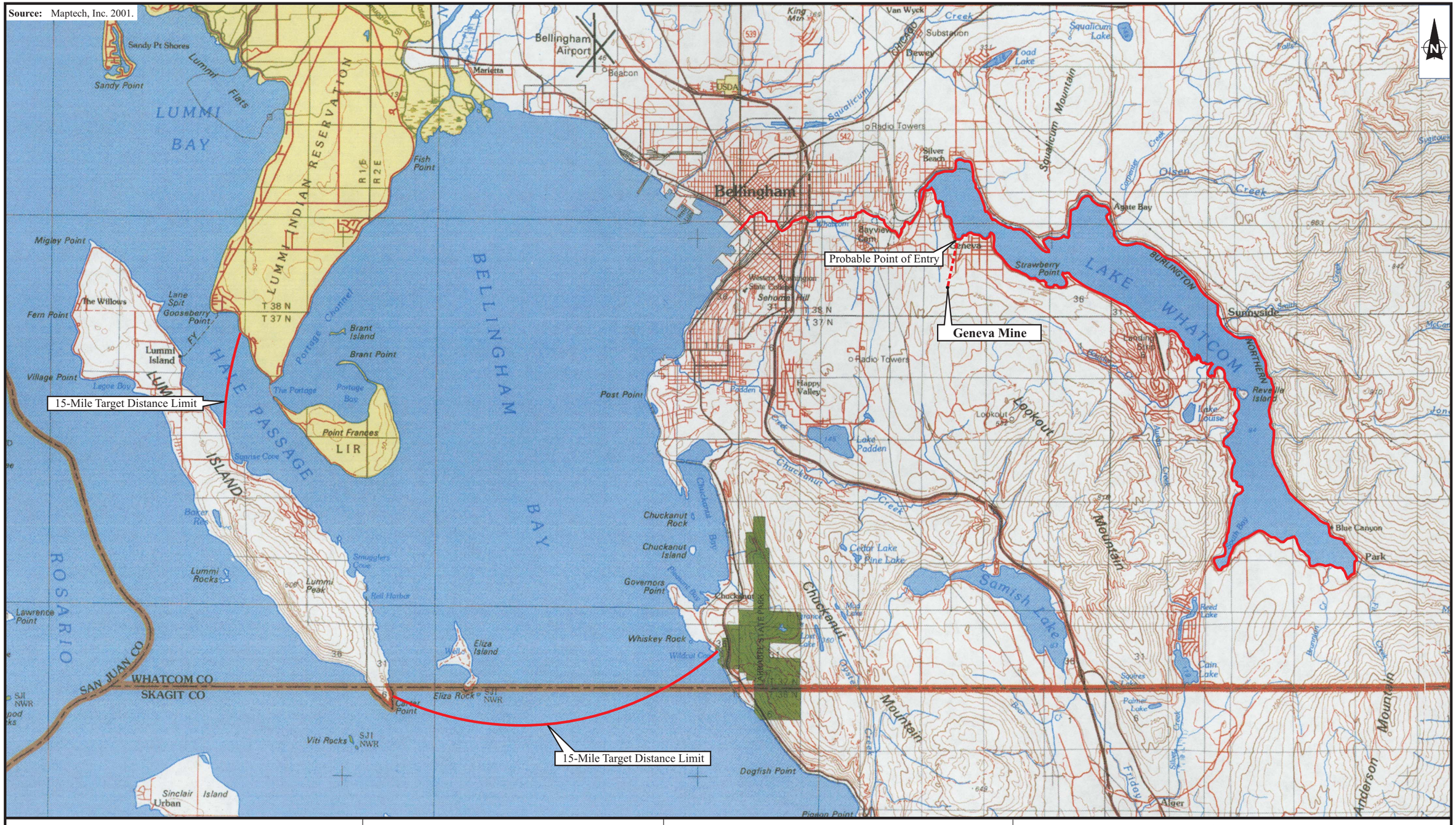
FISH HARVEST WITHIN THE 15-MILE TARGET DISTANCE LIMIT
BELLINGHAM/LAKE WHATCOM COAL MINES
GENEVA MINE
PRELIMINARY ASSESSMENT
WHATCOM COUNTY, WASHINGTON

Stream Segment	Fish Species	Number Harvested	Average Pound per Fish[a]	Pounds Harvested
Lake Whatcom	Small Mouth Bass	At least 1	At least 1	At least 1
	Large Mouth Bass	At least 1	At least 1	At least 1
	Kokanee	At least 1	At least 1	At least 1
	Cutthroat Trout	At least 1	At least 1	At least 1
	Rainbow Trout	At least 1	At least 1	At least 1
	Mackinaw	At least 1	At least 1	At least 1
	Perch	At least 1	At least 1	At least 1
Whatcom Creek	Chinook Salmon	6	22	132
	Chum Salmon	660	9	5,940
	Coho Salmon	3	12	36
	Pink Salmon	3	4	12
Bellingham Bay	Chinook Salmon	460	22	10,120
	Coho Salmon	373	12	4,476
	Pink Salmon	14	4	56
	Sockeye Salmon	7	8	56
	Chum Salmon	15	9	135
	Total	**At least 1,548**		**At least 20,970**

Source: WDFW 2002.

[a] Average pound per fish gathered from Wydoski and Whitney 1979.

Source: Maptech, Inc. 2001.



ecology and environment, inc. International Specialists in the Environment Seattle, Washington	0 .75 1.5 Approximate Scale in Miles	BELLINGHAM/LAKE WHATCOM COAL MINES Whatcom County, Washington	Figure 3-1 15-MILE MAP GENEVA MINE
			Date: 9/21/04 | Drawn by: AES | 10:START-2\03010002\fig 3-1

4. CONCLUSIONS

The Geneva Mine is an abandoned coal mine that operated between 1921 and 1922. A total of 350 tons of coal were reported to have been produced (Vonheeder 1975). The mine workings reportedly consisted of two adits (Jenkins 1923), one of which was located during the PA and observed to be collapsed. Other features reportedly included bunkers and a 2,800-foot long skid road connecting the bunkers and the mine (Jenkins 1923). During the site visits, START-2 observed a pile of coaly waste rock. No visual evidence of dumping or coal mine drainage were observed. Arsenic and mercury were detected in the source soil sample (coaly waste rock) at significant concentrations. No metals were detected at elevated concentrations in the target sediment sample.

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APPENDIX A
PROJECT DATA SOURCES

PROJECT DATA SOURCES:

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RESEARCH FACILITY CONTACTS

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210 Central Avenue
Bellingham, Washington 98225
Margaret Ziegler, Reference Librarian

Center for Pacific Northwest Studies/Washington State Archives: Northwest Regional Branch
Goltz-Murray Archives Building
Western Washington University
Bellingham, Washington 98225-9123

Washington State Department of Natural Resources
Division of Geology and Earth Resources
1111 Washington Street SE, Room 148
P.O. Box 47007
Olympia, Washington 98504-7007

APPENDIX B

PHOTOGRAPHIC DOCUMENTATION

PHOTOGRAPH IDENTIFICATION SHEET

Camera:
Kodak Max HQ Flash 35 mm reusable camera (Photographs A-4 through A-6)
Fujifilm Quicksnap 35mm reusable camera (Photographs A-8 through A-12) TDD #: 03-01-0002
Lens Type: 35mm **Site Name: Geneva Mine**

Photo	Time	Date	By	DIR.	Description
A-4	1250	2/10/04	ML	E	Collapsed mine portal.
A-5	1310	2/10/04	ML	N	Waste rock pile.
A-6	1312	2/10/04	ML	Down	Coaly material in waste rock pile.
A-8	1650	7/1/04	ML	Down	Background sediment sample at location GV01. Shady.
A-9	1705	7/1/04	ML	Down	Background soil sample at location GV02. Shady.
A-10	1735	7/1/04	ML	Down	Coaly waste rock sample at location GV03. Sunny.
A-11	1736	7/1/04	ML	E	Waste rock pile and sample location GV03. Mixed sun and shade.
A-12	1830	7/1/04	ML	Down	Downgradient sediment sample at location GV04. Shady.

Key:

E = East.
ML = Mark Longtine.
N = North.
TDD = Technical Direction Document.


A-4


A-5


A-6


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A-9


A-10


A-11


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