SITE INSPECTION REPORT FOR
THANE MINE DUMP SITE
JUNEAU, ALASKA

TDD F10-8712-02
PAN FAK0109SAR

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Submitted to: J.E. Osborn, Regional Project Officer
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U.S. Environmental Protection Agency
Region X
Seattle, Washington

SITE INSPECTION REPORT
THANE MINE DUMP SITE
JUNEAU, ALASKA
TDD F10-8712-02

Site Name/Address

Thane Mine Dump
4404 Thane Road
Juneau, Alaska 99801

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Date of Investigation

December 10, 1987 1415 - 1600

Dates of Sampling

February 8-12, 1988

- Tailings Samples
- Marine Water and Sediment Samples
- Benthic Organism Samples
- Creek Water and Sediment Samples
- Domestic Well Samples
- Off-Site Soil Samples

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ABSTRACT

Under U.S. Environmental Protection Agency (EPA) Technical Directive Document (TDD) F10-8712-02, a file review and site inspection was conducted on the Thane Mine Dump Site, near Juneau, Alaska, to evaluate the site's status within the Agency's Uncontrolled Hazardous Waste Site Program. Primary objectives of the SI included: 1) collection of data adequate to determine the hazardous constituent quantity within the tailings dumps; 2) determine the existence of, or potential for, releases of contaminants to ground water, surface water, air, and off-site soil; and 3) evaluate the existence of, or potential for, human food chain contamination of fisheries in Gastineau Channel. As part of the field investigation, a total of 88 samples were collected from the following matrices: processed mine tailings, surface water, ground water, soil/sediment, and mussel tissue. Samples were analyzed for compounds and/or elements on EPA's Target Compound List (TCL). In addition, six tailings samples were analyzed for various metals using the Extraction Procedure (EP) Toxicity method.

Sampling data indicate that arsenic and lead are present in the tailings dumps at elevated concentrations. However, neither of these elements, nor any of several additional inorganic elements detected in a sample from a second source, the Nowell Mill Site, were determined to be contributing to off-site surface water, ground water, or surficial soil concentrations. Mussel tissue data from samples collected at one of the tailings dumps indicated lead concentrations approximately three to four times those found in a background sample. The single soil sample collected from the Nowell Mill Site displayed elevated concentrations of several elements, including mercury. Additional data are required to accurately assess potential soil contamination problems in the Nowell Mill Site area.

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1.0 INTRODUCTION

The Thane Mine Dump Site, near Juneau, Alaska, has been identified by the United States Environmental Protection Agency (EPA) from Preliminary Assessment screening as requiring additional information to accurately profile the nature and extent of past waste disposal activity at the site. Ecology and Environment, Inc. (E&E) was requested by the EPA under Contract No. 68-01-7347, and Technical Directive Document (TDD) No. F10-8712-02 to conduct a Site Inspection (SI) of the dump site and associated areas. The SI was intended to evaluate the existence and nature of potential heavy metals contamination identified in a Preliminary Assessment (PA) completed by E&E in October 1987 (1).

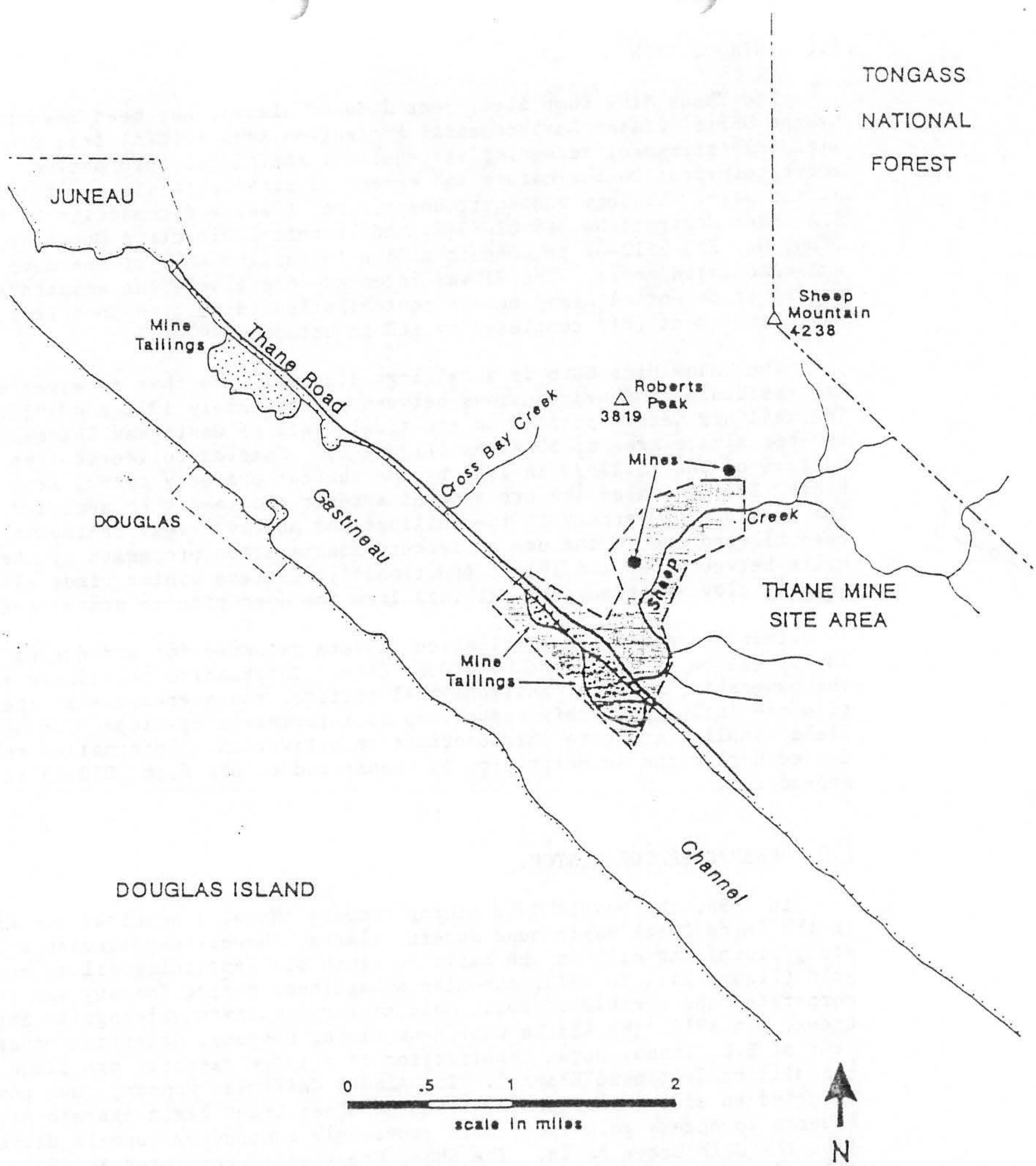
The Thane Mine Dump is a tailings disposal site that received milling residuals from nearby mines between approximately 1912 and 1920. The tailings were deposited on the tidal flats of Gastineau Channel over an approximate area of 50 acres (Figure 1). Samples collected from the surface of the tailings in 1987 by the current property owner, Echo Bay Mines (EB), revealed the presence of arsenic and lead when analyzed. The presence of mercury in the tailings and nearby stream sediments has been alleged due to the use of mercury amalgamation processes by the mills between 1896 and 1914. Additionally, extreme winter winds allegedly blow and transport tailings from the dump site to nearby areas.

This document is a compilation of data gathered for and during the investigation of the Thane Mine Dump Site. Information pertaining to the ownership, history, environmental setting, and operations at the site are included in this report, as is information developed during field sampling and site characterization activities. Information collected during the investigation is summarized on EPA Form 2070-13 in Appendix A.

2.0 OWNER/OPERATOR HISTORY

In 1896, the Nowell Gold Mining Company (Nowell) acquired two mines in the Sheep Creek Basin near Juneau, Alaska. Nowell constructed a 20-stamp processing mill in the basin to crush ore containing silver and gold (Figure 2). In 1911, the Alaska Gastineau Mining Company was incorporated and purchased Nowell Gold Mining Company's holdings in Sheep Creek. In 1912, the Alaska Gastineau Mining Company, under the management of B.L. Thane, began construction of a large capacity ore processing mill on Gastineau Channel. The Alaska Gastineau Company then constructed an adit (mine tunnel) from the Sheep Creek Basin beneath Mt. Roberts to access gold-rich zones previously reached by tunnels driven from the Gold Creek Basin. The Sheep Creek adit, completed in 1914, allowed ore to be transported from the mines via a rail system in Sheep Creek to the mill being constructed on Gastineau Channel (2).

While the Alaska Gastineau Company was completing the new processing mill, a test mill was set up in the Old Nowell Mining Company's mill to determine the most economical method of treating the ore. From their experiments, the management of the Alaska Gastineau Company decided to use gravity separation techniques in the new mill on Gastineau Channel.



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Job: F10-8712-02	Waste Site: AK 0109
Drawn by: B.T.	Date: Jan. 8, 1988

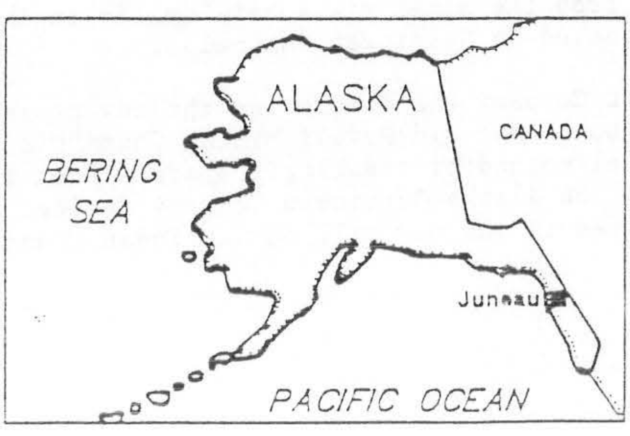
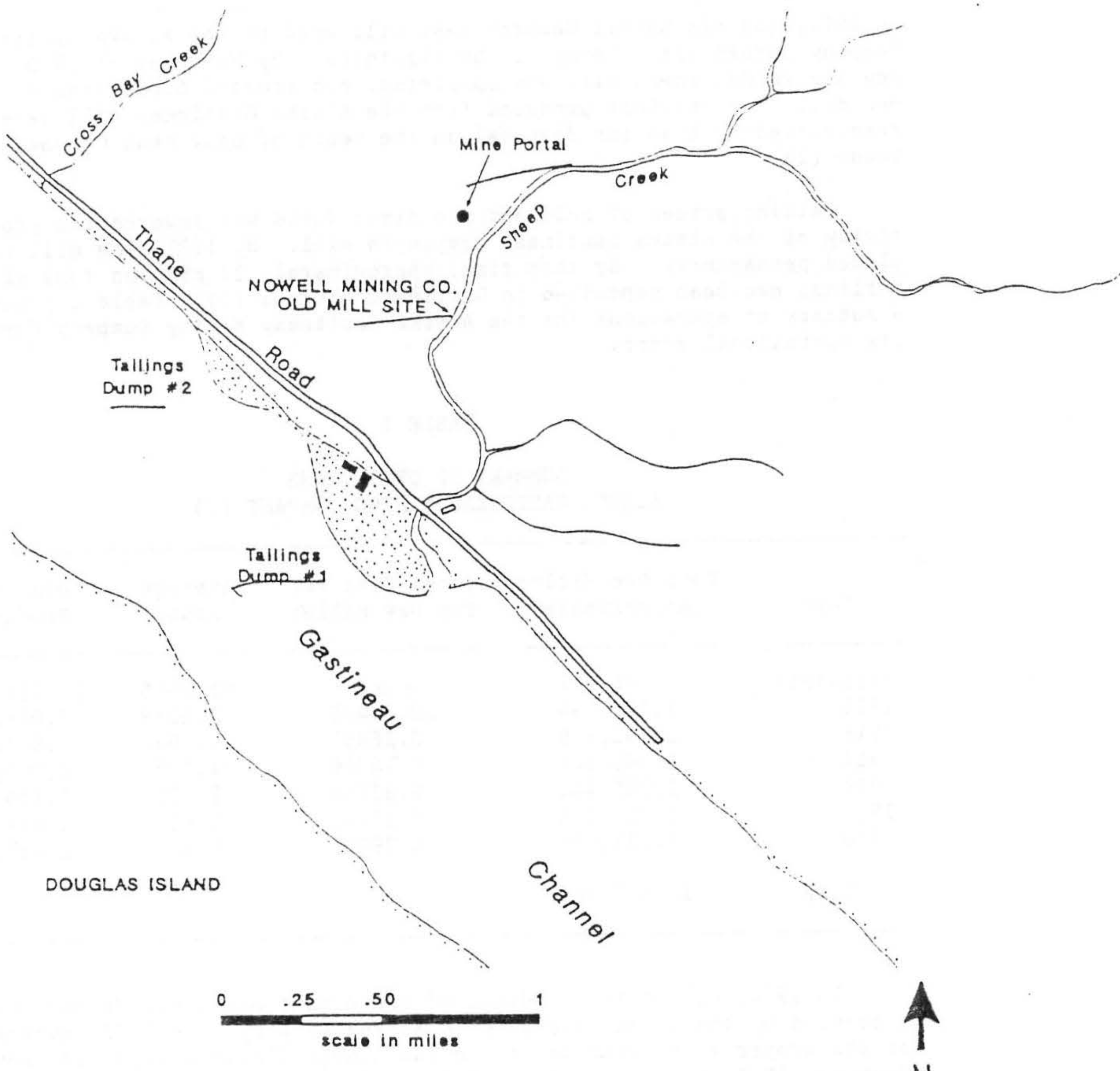


FIGURE 1
LOCATION MAP
THANE MINE DUMP
Juneau, AK

4 sites



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Drawn by: B.T.	Date: Jan. 12, 1988

FIGURE 2
SITE MAP
THANE MINE DUMP
Juneau, AK

In 1914, the old Novell Company test mill used by the Alaska Gastineau Company burned after being hit by lightning. By November of 1915, the new Alaska Gastineau mill was completed, and treated 6,000 tons of ore per day. The tailings produced from the Alaska Gastineau mill were transported by tram for disposal on the beach of Gastineau Channel near Thane (2).

Falling prices of gold and the first World War lowered the productivity of the Alaska Gastineau Company's mill. By 1921, the mill was closed permanently. By this time, approximately 11 million tons of tailings had been deposited in Gastineau Channel (3). Table 1 presents a summary of operations for the Alaska Gastineau Mining Company during its operational years.

TABLE 1

SUMMARY OF OPERATIONS
ALASKA GASTINEAU MINING COMPANY (2)

Year	Tons Ore Milled (Approximate)	Total Cost Per Ton Ore Milled	Average Assay	Total Value Produced
1912-1914	74,977	Unknown	$1.5985	$ 111,067
1915	1,115,294	$0.30448	1.1569	1,046,103
1916	1,892,788	0.26881	1.193	1,837,290
1917	2,240,346	0.26026	1.103	2,009,631
1918	1,285,445	0.32706	1.109	1,136,223
1919	2,251,658	0.27441	0.83	1,474,490
1920	2,133,458	0.29201	0.88	1,487,575
Total	10,993,966			$9,102,379

In 1934, all of the holdings of the Alaska Gastineau Company were purchased by the Alaska Juneau Gold Mining Company. In 1972, ownership of the property was transferred to the Alaska Electric Light and Power Company (AELP) and the City and Borough of Juneau. The State of Alaska has retained lands used for tailings disposal below mean high tide (2,4).

In approximately 1983, the Juneau Gold Mining Company (no relation to the Alaska Juneau Gold Mining Company) acquired a lease on the property previously used for tailings disposal by the Alaska Gastineau Company. The Juneau Gold Mining Company constructed a small mill on the tailings with the intent of using gravity separation methods to extract trace gold from the tailings. This operation failed financially after two to three months of operation (1). In 1986, Echo Bay Mines (EB) acquired the tailings dump (Figure 2) near Sheep Creek. EB is currently conducting mining feasibility tests in the old mine shafts in the Sheep Creek Basin to determine if gold mining is economically viable. EB plans to utilize the tailings disposal site for office and warehouse space in support of mining activities in Sheep Creek (5). A summary of property ownership related to the Thane Mine Dump Site is presented in Table 2.

TABLE 2

OWNERSHIP SUMMARY

Year	Property	Owner
1896	Sheep Creek Mill Site	Nowell Gold Mining Company
1911	Sheep Creek Mill Site	Alaska Gastineau Gold Mining Company
	Sheep Creek Adit and Portal	Alaska Gastineau Gold Mining Company
	Gastineau Channel Mill Site	Alaska Gastineau Gold Mining Company
	Tailings Dump #1 and #2*	Alaska Gastineau Gold Mining Company
1934	All properties	Alaska Juneau Gold Mining Company
1972	Sheep Creek Mill Site	State of Alaska
	Sheep Creek Portal	State of Alaska
	Gastineau Channel Mill Site	AELP and City/Borough of Juneau
	Tailings Dump #1	AELP and City/Borough of Juneau
	Tailings Dump #2	State of Alaska (State Tidelands)
1983	Tailings Dump #1	Juneau Gold Mining Company (leasee to State of Alaska)
1986	Tailings Dump #1	Echo Bay Mines (leasee to State of Alaska)
	Sheep Creek Adit and Portal	Echo Bay Mines

* Tailing Dumps #1 and #2 are described in Section 3.0, and are illustrated in Figure 2.

3.0 LOCATION

The Thane Mine Dump Site is located approximately four miles south of the City of Juneau, in southeastern Alaska. The site area is accessed by Thane Road. For the purposes of this investigation, the site was defined as four spatially separated potential contaminant sources: Tailings Dump #1, Tailings Dump #2, the Nowell Mining Company Mill Site, and the Sheep Creek Mine Portal (Figure 2). Tailings Dump #1, the property currently used by EB for office and warehouse space, is located in Section 5, Township 42 South, Range 68 East of the Copper River Meridian. Tailings Dump #2, located northwest of Tailings Dump #1, is located in the SW 1/4 of Section 32, Township 41 South, Range 68 East. The Nowell Mining Company old mill site, located in the Sheep Creek Basin at an approximate elevation of 600 feet above sea level, is located in the SW 1/4 of Section 32, Township 41 South, Range 68 East. The Sheep Creek Mine Portal currently used by EB is located at an approximate elevation of 800 feet above sea level. The entire site area lies between latitudes 58° 16′ 41" to 58° 15′ 28", and longitudes 134° 20′ 17" to 134° 18′ 18" (6).

4.0 SITE DESCRIPTION AND SURROUNDING AREA

The tailings dumps located on Gastineau Channel cover a total area of approximately 50 to 60 acres, and are located on top of natural tidal flats that make up the majority of the shoreline along Gastineau Channel (Figure 2). The tailings are uncovered, and are not known to be underlain by clay or other impermeable materials (7). Land use surrounding the tailings dumps is primarily low density residential along Thane Road, multiple-family housing (apartments) near Juneau, and commercial near Sheep Creek (fish hatchery and AELP sub-station). In addition, the Thane Orehouse Restaurant, which operates during summer months, is located on tailings adjacent to the EB offices (8). Gastineau Channel is used for recreation, commercial fishing, and transportation (7).

The old Nowell mill site located in the Sheep Creek Basin covers an area of approximately one acre, although burned timbers indicating the existence of a building foundation were observed to cover approximately 1/4 acre. The old mill site is surrounded by dense underbrush and trees. The EB mine portal is considered a potential point source for contamination, and buildings and ore unloading docks at the portal cover an area of approximately one acre. Land use in the Sheep Creek Basin is primarily recreational and commercial (mining) (7).

The largest population center in the site area is the City of Juneau, with an approximate population of 30,000. Population demographics within a four-mile radius of Tailings Dump #1 are summarized in Table 3.

5.0 TOPOGRAPHY AND DRAINAGE

The tailings dumps are located on the eastern shore of Gastineau Channel, and form broad, exposed flats during low tide. Directly east of Gastineau Channel, mountains of the Coast Range rise from saltwater at an average gradient of 50%. Sheep Creek flows out of these mountains to Gastineau Channel. The creek's headwaters are at approximately 1,500 feet above sea level, and the creek drains a total area of approximately 3,700 acres. Approximately five tributary valleys supply additional runoff to the creek between its headwaters and Gastineau Channel (6). Average annual flow in Sheep Creek between 1911 and 1969 is approximately 50 cubic feet per second, although during the SI, flow was estimated at 23 cubic feet per second using field measurements (7,9). Numerous ground-water seeps and small unnamed streams exist within the creek basin. Peaks surrounding the Sheep Creek Basin average 2,000 to 3,000 feet above sea level, and are glaciated on their north and east slopes. Timberline in the area is approximately 1,500 feet above sea level (6).

TABLE 3

DEMOGRAPHICS AND LAND USE

Radial Distance (from Tailings Dump #1)	Demographic Description	Land Use	Reference
On-Site	EB (Number of Employees): 4	Commercial (mining)	(10)
0 - 1/4 Mile	Orehouse Restaurant: 2 Avg. # customers/day served at restaurant: 50*	Commercial and Residential/ Recreation	(8)
	Fish Hatchery: 2		(11)
	AELP Substation: 4		(12)
	Residents: approx. 18		(13)
1/4 - 1/2 Mile	Residents: approx. 35	Residential/ Recreation	(13)
1/2 - 1 Mile	Residents: approx. 61	Residential/ Recreation	(13,14)
1 - 2 Miles	EB: approx. 14	Commercial/ Industrial	(10)
	Residents: 75	Residential/ Recreation	(14)
2 - 3 Miles	Residents: 1,719	Residential/ Recreation	(14)
3 - 4 Miles	Residents: 2,746	Residential/ Recreation	(14)

* Restaurant operates during summer months only.

6.0 GEOLOGY/HYDROLOGY

6.1 Regional Geology/Hydrology

Of the many geologic processes that have shaped the land surface in the Juneau area, glaciation has been the dominant process. The major peaks, valleys, and channels, including Gastineau Channel, were carved out of bedrock by glaciers during the Pleistocene Epoch (15). Streams and rivers that drain the upland areas have played an additional role in shaping the geologic character of the area.

The primary geologic materials in the area include consolidated bedrock and unconsolidated glacial and alluvial sediments (15). Bedrock in the area is composed of slate, schist, and metagabbro. Metamorphic bedrock in the area is the host rock for the gold and silver bearing quartz lenses that have been mined since the late 19th century (16).

The unconsolidated deposits include silts, sands, gravels, and clays that can be subdivided by mode of deposition. The Gastineau Channel Formation is a sequence of glaciomarine sediments exposed along Gastineau Channel. These sediments are a heterogeneous sequence of pebbles and larger clasts that are mixed in a matrix of fine-grained silts and sands. They are interpreted as deposits resulting from the melting of debris-laden sea ice and/or ice-bergs (17). Other unconsolidated sediments in the area are derived from rivers and streams. These alluvial silts, sands, and gravels are localized in comparison to the glaciomarine sediments.

An additional group of sediments include the recent beach gravels found along the modern shorelines in the area. The beach gravels occur in a thin layer overlying other deposits, and are the result of recent erosion (7).

Ground water in the Juneau area is found both in bedrock and in the unconsolidated sediments. The bedrock yields water from fractures, and tends to yield only small volumes. The quantities of water from bedrock are sufficient for small private wells, but generally not for primary municipal supplies (15). Bedrock is an important source of ground water in outlying areas along the mountain fronts where surficial deposits are thin.

The gravels and sands in the unconsolidated deposits are the most important ground water resource in the area. The availability and quality of ground water in the unconsolidated deposits is dependent on elevation and proximity to saltwater. Deposits located at higher elevations tend to be drained of any water, and deposits near the shoreline tend to be influenced by saltwater intrusion (15). The thicker sections of the saturated sands and gravels yield quantities of water adequate for municipal supplies.

Ground water in the area occurs under both unconfined and confined conditions. In most areas, ground water occurs under unconfined conditions, but confined conditions exist in areas where saturated zones are overlain by local layers of silt and clay. No extensive confining layers are reported to exist above the major ground water supplies, and local confining layers are seldom completely impermeable (15).

Recharge to the ground water system is primarily via infiltration of precipitation and ice/snow meltwater. The primary methods of ground water discharge include subsurface outflow to the ocean and seepage to streams (15).

6.2 Site Geology/Hydrology

The Thane area is underlain by the glaciomarine deposits that mantle the lower portions of the mountain front south of Juneau (15). In the area adjacent to Sheep Creek, the glaciomarine deposits are overlain by recent alluvial deposits. The thickness of the surficial deposits and the depth to bedrock in the Thane area are unknown. No geologic logs are available for the private wells that exist in the area. However, the shallowest well identified in the area has a total depth of 80 feet below ground surface (bgs). Other wells in the Thane area have been completed to depths up to 400 feet bgs (13). All wells in the Thane area reportedly tap ground water from fractured bedrock (18).

Wells in the Thane area generally yield only small amounts of water (18). The movement of ground water in the vicinity is assumed to be generally toward Gastineau Channel. However, in the immediate vicinity of the Sheep Creek Basin, ground water is assumed to flow toward the creek, where a portion may discharge to the creek.

Soil layers, generally less than a few feet in thickness, overlie the unconsolidated sediments in the Thane area. Two soil types are identified in the area: the Kupreanof Series and Wadleigh Series, both of which are generally gravely loams (19). The Kupreanof Series occurs on 3.5 to 70% slopes, and is generally well drained. The Wadleigh Series occurs on 12 to 20% slopes, and is poorly drained (19).

The ore bodies within the metamorphic rocks mined locally contain various mineral assemblages that include nickel, lead, iron, zinc, and arsenic among other constituents (16).

7.0 WATER USE

7.1 Surface Water

The closest surface water (fresh water) to the site is Sheep Creek, which originates in the upper Sheep Creek Basin at an approximate elevation of 1,500 feet above sea level (6). Sheep Creek flows southwesterly for approximately 3.5 stream miles and discharges to Gastineau Channel. Sheep Creek is used as a drinking water source by 14 people and as source water for fish pens at the Douglas Island Pink and Chum Company fish hatchery (13). In addition, a small natural salmon run reportedly spawns in Sheep Creek below the dam each year, and a natural trout population inhabits the upper section of the creek (7). All 14 persons using Sheep Creek for drinking purposes receive water drawn from a single intake located approximately 200 feet upstream of the fish hatchery. The intake is located downstream of the Nowell Mill Site and upstream of Tailings Dump #1 (Figure 2) (6,7).

Gastineau Channel is a saltwater body connected with the Pacific Ocean. Mine tailings were disposed of directly into the channel, and therefore are in continual contact with surface water. The channel is used for private and commercial fishing and recreation (20). Shellfish collection in Gastineau Channel near Thane is discouraged by the Alaska Department of Environmental Conservation due to the history of paralytic shellfish poisoning (red tide) in the area (21).

Several small unnamed streams south of Sheep Creek are utilized for drinking purposes. These streams were not evaluated as part of the SI due to their spatial separation from suspected contaminant migration routes associated with the site (22). Surface water use in the site area is summarized in Table 4.

TABLE 4

THANE AREA SURFACE WATER USE

Surface Water	Use	Population Served	Distance to Site
Sheep Creek	Drinking/ Fish Hatchery	14	Approx. 1/2 mile (Novell Mill Site)
Gastineau Channel	Private/ Commercial Fishing	NA	0 (tailings)
Unnamed Streams	Drinking	Unknown	1 - 2 miles

7.2 Ground Water

Ground water in the Thane area is used for domestic drinking purposes and for commercial food preparation. Ten wells and one spring serve approximately 40 people within three miles of the site. All of the wells are completed in fractured bedrock between 80 and 400 feet below ground surface (13,18,22). The Thane Orehouse Restaurant owns a registered well, 80 feet in depth, that is immediately adjacent to Tailings Dump #1. This well is assumed to be partially used for commercial food preparation. Four permanent employees of Echo Bay Mines drink water drawn from a natural spring located several hundred feet east of Tailings Dump #1 (10,22).

The City and Borough of Juneau Water Department maintains a public supply well located approximately 3.75 miles north of Thane. This well was not evaluated during the SI for the following reasons: 1) the well is used only as a backup to the public water supply; 2) a mine tailings dump similar to the Thane dumps, known as the A.J. Rock Dump, is located between Thane and the municipal well, and could not have been isolated as an additional contaminant source using existing wells; and 3) the ground water gradient is not expected to be in the direction of the municipal well from Thane (6,15). Ground water use in the site area is summarized in Table 5.

TABLE 5

THANE AREA GROUND WATER USE

Owner	Intake	Depth	Approximate Distance to Site	Population Served
Ray	Well	400′	< 1/4 mi.	~ 3.8
Thane Orehouse	Well	80′	< 1/4 mi.	2
Byington	Well	80′	~ 1/4 mi.	0
Clare	Well	147′	~ 1/3 mi.	~ 3.8
Hagerup	Well	100′	~ 1/2 mi.	1
Sperl	Well	300′	~ 1/3 mi.	6
Dicostanzo	Well	80′	~ 2/3 mi.	4
Charon	Well	290′	~ 2/3 mi.	2
Terrell	Well	120′	~ 2/3 mi.	6
Cassell	Well	175′	~ 1 mi.	7
Echo Bay Mines	Spring	N/A	< 1/4 mi.	4

8.0 CLIMATE

Juneau's climate is dictated by marine weather systems originating in the Pacific Ocean and the rugged mountainous terrain surrounding the area. Summertime high temperatures generally reach only 60 to 75°F, while wintertime lows often drop below 0°F. Rainfall is highly variable and is a function of topography. The Juneau airport receives approximately 53 inches of precipitation annually, while downtown Juneau, only six miles to the southeast, receives approximately 88 inches per year (23). The two-year 24-hour maximum rainfall for the greater Juneau area is approximately 2.6 inches (24).

High velocity winds originating from the glaciers east of Juneau occur often during the winter months. These high winds, known locally as the Taku Winds, reach 100 miles per hour in some instances, and have been observed to blow dust and small particles from the tailings dumps hundreds of feet into the air (1,7,13).

9.0 OVERVIEW OF SITE OPERATIONS

Tailings Dump #1 is currently being used for offices and warehouse space by Echo Bay Mines. EB has recently constructed a road into the Sheep Creek Basin to the mine portal area. EB is reopening parts of the former Alaska-Gastineau mine tunnels to determine if modern mining techniques can be economically viable. According to EB representatives, tailings generated by future large scale mining would be deposited underground or transported by barge for deep sea disposal (7).

There are currently no commercial or industrial activities being conducted at Tailings Dump #2 or the Novell Mill Site.

10.0 CHARACTERISTICS OF POTENTIAL CONTAMINANT SOURCES

In general, heavy metals contained within the mine tailings are the primary basis for concern at the Thane Mine Dump Site. Additionally, mercury, which was transported to the site for ore processing, is a potential contaminant. This section provides a description of potential/known contaminants associated with each of the four identified sources at the site.

10.1 Tailings Dump #1

Tailings Dump #1 is composed of processed ore tailings from the Alaska Gastineau mill. The dump covers an area of approximately 50 acres, part of which is submerged during high tide in Gastineau Channel (Figure 2). Of the approximately 11 million tons of tailings disposed of by the Alaska Gastineau mill, an estimated 80 to 90 percent of the tailings were deposited at Tailings Dump #1 (3). The tailings originated from the sulfide ores found beneath Mt. Roberts. The sulfide ores are comprised of minerals containing arsenic, lead, nickel, and zinc (16). EB, the current leasee of a portion of Tailings Dump #1, collected 13 surface samples from the tailings for total lead, arsenic, and mercury analyses in 1987. The results of this testing revealed an average concentration of lead, arsenic, and mercury of 77 mg/kg, 22 mg/kg, and 0.01 mg/kg, respectively (25).

10.2 Tailings Dump #2

Tailings Dump #2 is also composed of processed ore tailings from the Alaska Gastineau mill. The dump covers an area of approximately 7-10 acres, part of which is submerged by high tide in Gastineau Channel. Tailings were deposited at this dump for a short time during the early operational years of the Alaska Gastineau mill, until its abandonment in approximately 1915 or 1916. No previous analyses of the tailings of Dump #2 have been conducted (3,7).

10.3 Novell Mill Site

The Novell Mill Site was identified as a potential contaminant source from information suggesting that mercury amalgamation ore purification processes were used at the site. Mercury for amalgamation was brought to the mill in 70-pound iron flasks. The potential for spills, and the unknown quantity of mercury left at the mill after its abandonment following a fire in 1914, are the basis of concern for mercury deposition at this site (26). No previous analysis of soils surrounding the mill site have been conducted, and no containment provisions are known to have existed (7).

10.4 Sheep Creek Mine Portal

Mine portals frequently act as a migration route for acidic waters containing heavy metals. The Sheep Creek Adit used by EB discharges a small volume (estimated 2-3 ft^3/sec) of water which infiltrates the ground approximately 500 feet south of the portal. However, it is reported that the majority of this drainage originates as surface runoff on the steep slopes above the mine, and is not the result of seepage from the tunnel (7). EB collected a water sample from the drainage in 1987 and analyzed the sample for selected Federal Primary Drinking Water Standard elements (27). Table 6 summarizes the results of the analyses (28).

TABLE 6

SUMMARY OF MINE PORTAL DRAINAGE
WATER SAMPLE - October 6, 1987

Element	Concentration (mg/l)	Federal Primary Drinking Water Standard (m/l)
Arsenic	$<$ 0.001	0.05
Barium	$<$ 0.10	1.00
Cadmium	$<$ 0.005	0.010
Chromium	$<$ 0.010	0.05
Lead	$<$ 0.001	0.05
Mercury	$<$ 0.0002	0.002
Selenium	$<$ 0.002	0.01
Silver	$<$ 0.01	0.05

11.0 PREVIOUS INVESTIGATIVE HISTORY

The Thane Mine Dump Site was identified as a potential hazardous waste site in 1984 by the Alaska Department of Environmental Conservation. No on-site inspection was conducted, although a citizen complaint reporting the presence of mercury in Sheep Creek was filed with the state. A Preliminary Assessment (PA) of the site was conducted in October 1987 by the EPA Region X Field Investigation Team (1). The PA included a brief history of the site and identified potential human and environmental targets associated with the tailings dump. Following the completion of the PA, EB collected thirteen surface samples from the tailings, as mentioned in Section 10.1.

12.0 SITE INSPECTION BY E&E

12.1 Objectives and Scope

The objectives of the site inspection were to:

- o determine if the site poses a public health or environmental risk;

TABLE 7

SAMPLE TYPES, NUMBERS, AND ANALYSES

Sample Matrix	Number of Samples	Location of Samples	QA/QC Samples: Blanks	QA/QC Samples: Duplicates	Total Samples	Sample Type	Analytical Parameters	Sample Numbers
Tailings	26	Tailings Dump #1	0	0	26	Composite	TCL Inorganics	1A1 - 1F1
Tailings	4	Tailings Dump #1	0	0	4	Composite	EP Toxicity (metals only)	1A2 and 1A3 (0-4'), 1D1 and 1D4 (bottom)
Tailings	12	Tailings Dump #2	0	0	12	Composite	TCL Inorganics	2A1 - 2C2
Tailings	2	Tailings Dump #2	0	0	2	Grab	EP Toxicity (metals only)	2B3 and 2C1 (0-4')
Marine Water	4	Gastineau Channel	0	0	4	Grab	TCL Inorganics	GCW 1 - GCW 4
Marine Sediments	6	Gastineau Channel	0	0	6	Composite	TCL Inorganics	GCS 1 - GCS 6
Creek Water	6	Sheep Creek	1	0	8	Grab	TCL Inorganics	SCW 1 - SCW 5, SCW 7 and SCW 9
Mine Portal Discharge Water	1	Mine Portal	0	0	1	Grab	TCL Inorganics	SCW 8
Creek Water	1	Intake on Sheep Creek	0	0	1	Grab	Full Inorganic & Organic TCL	SCW 2
Creek Sediments	7	Sheep Creek and Mine Portal	0	0	7	Grab	TCL Inorganics	SCS 1 - SCS 5, SCS 7 and SCS 9
Surface Soil	1	Nowell Mill Site	0	0	1	Grab	TCL Inorganics	SCS 6
Benthic Organisms (Mussels)	4	Gastineau Channel and Background Location	0	0	4	Composite	TCL Inorganics	B1 - B4
Ground Water	6	Domestic Wells Between Cross Bay Creek and End of Thane Road	1	1	8	Grab	Full Inorganic & Organic TCL	DW 1 - DW 6
Surface Soil	7	Residences Between Cross Bay Creek and End of Thane Road	0	1	8	Composite	TCL Inorganics	OSS 1 - OSS 7

- o determine if there is a need for emergency action, or other less urgent action at the site;
- o collect adequate data to determine the waste quantity of tailings using several alternatives (i.e., hazardous constituent quantity, source volume, and source area);
- o determine the existence or potential for contamination of surface water in Sheep Creek, Gastineau Channel, and ground water in the site vicinity;
- o determine whether local drinking water supplies have been impacted by contaminants from the site; and
- o determine the existence or potential for human food chain contamination in fisheries of Gastineau Channel.

To accomplish these objectives, the following field activities were conducted:

- o collection of samples from each potential contaminant source identified by background research;
- o collection of water and sediment samples from Sheep Creek and Gastineau Channel;
- o collection of ground water samples from nearby, potentially affected domestic wells;
- o collection of benthic organism samples from Gastineau Channel intertidal zones;
- o collection of surface soil samples from nearby residences;
- o measurement of site boundaries and distances to potential targets;
- o determination of target and/or receptor populations and densities;
- o analysis of samples for EPA Target Compound List (TCL) parameters (Appendix B); and
- o evaluation of tailings leachability using Extraction Procedure (EP) Toxicity methods.

12.2 Sample Numbers, Types, and Analytes

Table 7 summarizes the numbers, types, and analytical parameters of samples collected during the investigation. A total of 30 tailings samples were collected from Tailings Dump #1. Of this total, 22 samples were collected as 0-4 foot depth composites. Four other samples were collected at discrete depths approximately 18 feet below the surface.

All of these samples were analyzed for TCL inorganic elements. Four additional samples collected from selected locations at Tailings Dump #1 were submitted for EP Toxicity testing (metals only).

A total of 14 tailings samples were collected from Tailings Dump #2. Eleven 0-4 foot depth composites were collected, as well as one sample from a discrete depth of approximately five feet. All of these samples were analyzed for TCL inorganic elements. Two samples collected from selected locations at Tailings Dump #2 were submitted for EP Toxicity testing (Figure 3).

Twelve surface water samples were collected during the SI. Four samples were collected from Gastineau Channel, one at the mine portal, and seven from Sheep Creek (Figures 3 and 4). One of the Sheep Creek water samples was collected at the drinking water intake. All samples were analyzed for TCL inorganic elements. In addition, the water sample collected at the drinking water intake was analyzed for the full range of TCL organic compounds. Sample SCW 9 was collected as a background sample.

Thirteen surface water sediment samples were collected. Six samples were collected as surficial composites from transects established perpendicular to the shoreline of Gastineau Channel, located north and south of the tailings dumps. The remaining seven were collected from Sheep Creek, at locations corresponding to those where water samples were collected (Figures 3 and 4). In addition, a single soil sample was collected at the Novell Mill Site, and was analyzed for TCL inorganic elements.

Four mussel samples were collected during the SI. Three were collected from the periphery of Tailings Dump #1 (Figure 3). The fourth (background) was collected from the north shore of Douglas Island, approximately 12 miles north of Thane. Whole tissue analyses were performed on the mussel samples for the following inorganic analytes: total antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, nickel, silver, and zinc.

Six ground water samples were collected as part of the SI. The samples were collected from domestic wells located between the site and the south end of Thane Road (Figure 5). The ground water samples were analyzed for the entire EPA TCL.

Seven off-site surface soil samples were collected from properties between the site and the south end of Thane Road (Figure 5). The off-site soil samples were analyzed for TCL inorganic elements.

12.3 Sampling Methodologies and Equipment Decontamination

Sampling techniques, methodologies, and rationale used during the Thane Mine Dump SI were as described in the Field Operations Study Plan (TDD F10-8702-02, January 1988) (29). Decontamination procedures used for equipment and personnel are also discussed in the Study Plan.

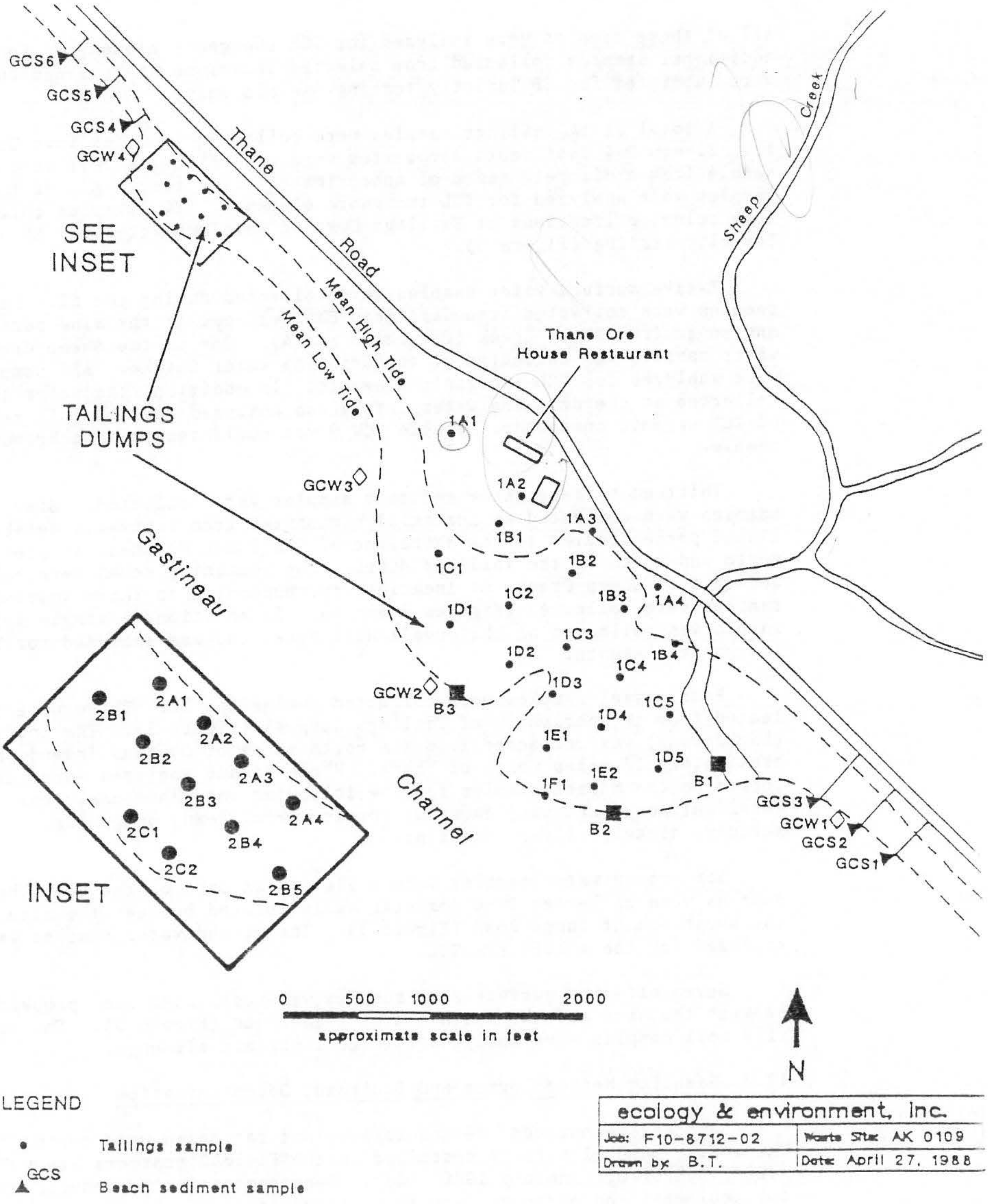
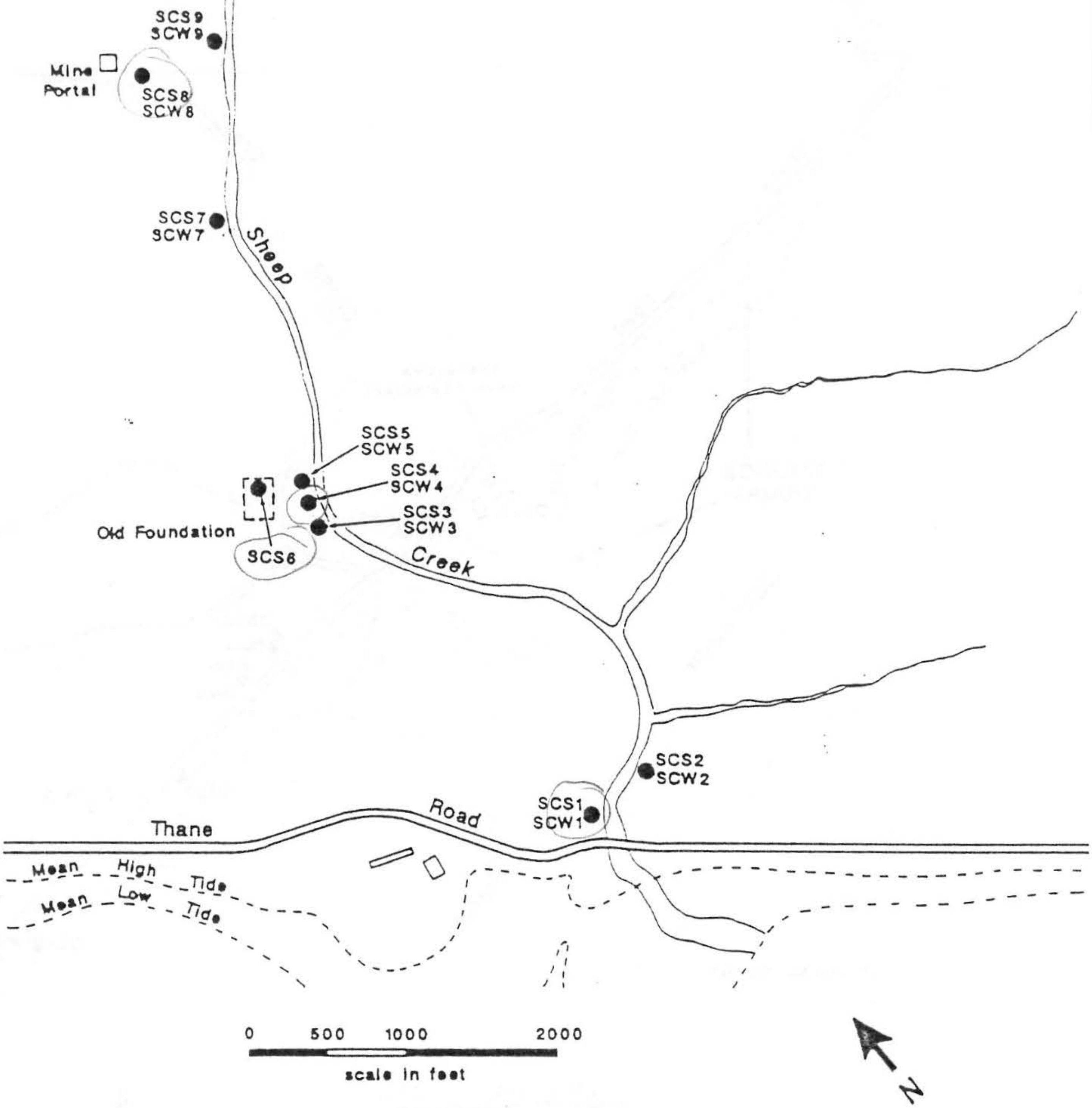


FIGURE 3
TAILINGS SAMPLE LOCATION MAP
THANE MINE DUMP
Juneau, AK



LEGEND

● SCW# Water sample

● SCS# Sediment sample

ecology & environment, inc.	
Job: F10-8712-02	Waste Site: AK 0109
Drawn by: B.T.	Date: Jan. 12, 1988

FIGURE 4
SHEEP CREEK SAMPLE LOCATION MAP
THANE MINE DUMP
Juneau, AK

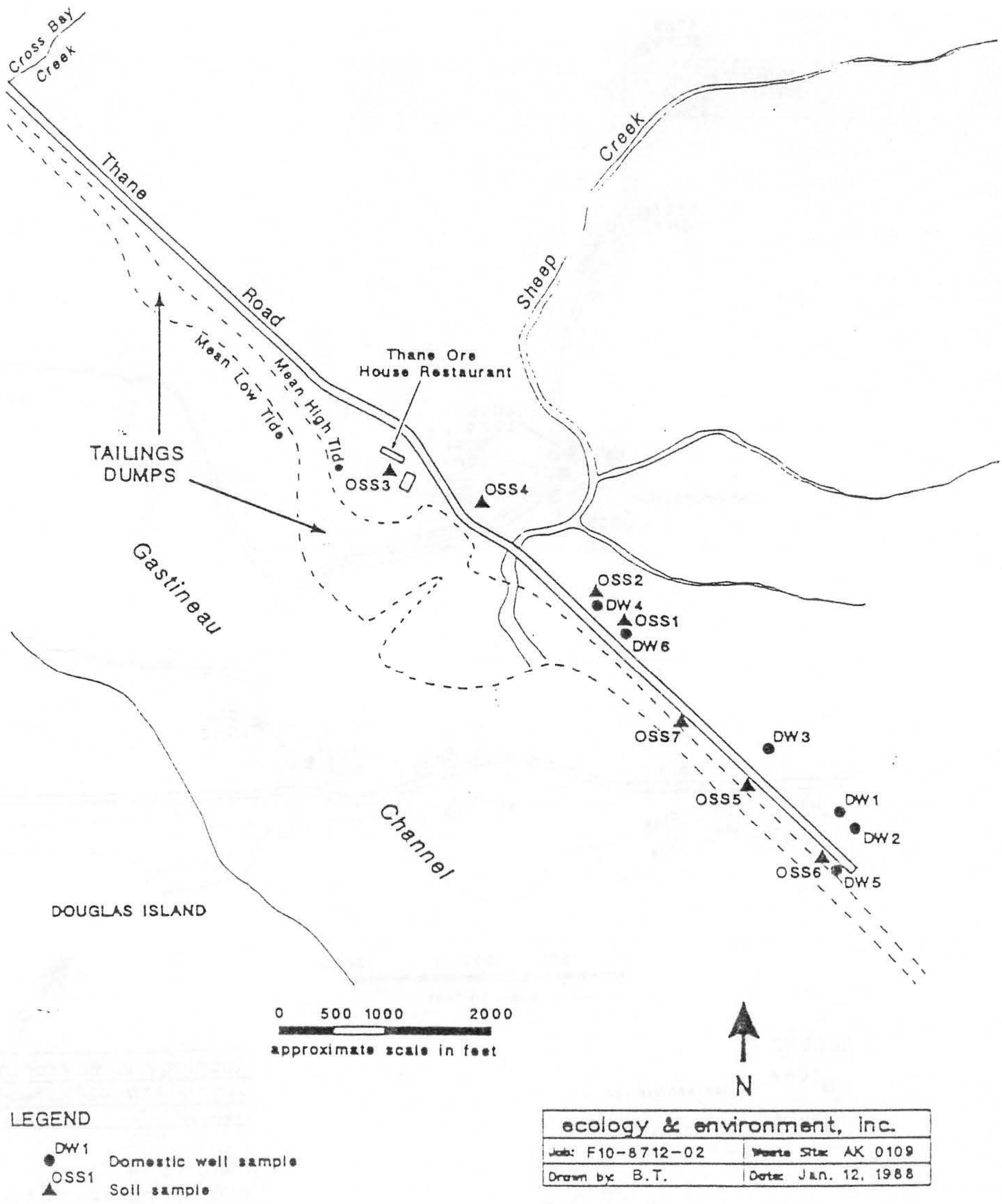


FIGURE 5
OFF-SITE SAMPLE LOCATION MAP
THANE MINE DUMP
Juneau, AK

13.0 ANALYTICAL RESULTS

Complete data tables, including detection limits for all samples collected during the SI are included in Appendix C. Results of quality assurance reviews of the analytical data are summarized in Appendix D. Field sample documentation is summarized in Appendix E.

13.1 Tailings Dumps

A total of 72 samples were collected to characterize the tailings dumps on Gastineau Channel. The objectives of the sampling were two-fold: 1) to collect a sufficient number of evenly spaced samples at the same depth to assess waste homogeneity and facilitate quantity calculations; and 2) to determine if migration or biological uptake of inorganic contaminants from the site is occurring.

A total of 33 samples were collected from shallow boreholes at the tailings dumps (22 from Dump #1, 11 from Dump #2) (Figure 3). The samples were collected as composites from 0-4 feet bgs. Table 8 summarizes the inorganic elements detected in the shallow tailings samples. A total of 20 TCL inorganic elements were detected in at least one of the samples.

Five tailings samples were collected from the bottom of deep boreholes ranging between 16 and 18 feet in depth. Four deep tailings samples were collected from Tailings Dump #1 and one was collected from Tailings Dump #2. Table 9 summarizes the inorganic elements detected in the deep tailings samples. Twenty-one TCL inorganic elements were detected in at least one of the samples.

Tailings samples from six locations were submitted for Extraction Procedure Toxicity analyses (EP Toxicity). Two of the samples were collected as discrete samples at a depth of four feet (1D1 bottom and 1D4 bottom), while the remaining four were collected as composites over the upper four feet. Table 10 summarizes the metal concentrations detected during the EP Toxicity analyses.

Six sediment samples were collected from transects on the beaches of Gastineau Channel to the north and south of the tailings dumps (Figure 3). The samples were collected to determine if tailings are being dispersed along the beaches as a result of aerial deposition or tidal action. Table 11 summarizes the inorganic elements detected in the marine sediment samples. A total of 17 TCL inorganic elements were detected in at least one of the samples.

Four marine water samples were collected from locations surrounding the tailings dumps (Figure 3). The sample collected south of Tailings Dump #1 (GCW 1) was collected during a rising tide to characterize potential effects from the tailings dumps to the north of the site (flow in Gastineau Channel is to the north during rising tides), and is considered to be reflective of background conditions in relation to the other samples. The three remaining samples were collected during a

TABLE 8

SUMMARY OF INORGANIC ANALYSES FOR SHALLOW (0-4 Feet) TAILINGS SAMPLES
(Samples Collected February 8-11, 1988)
(mg/kg)

Element	1A1 0-4'	1A2 0-4'	1A3 0-4'	1A4 0-4'	1B1 0-4'	1B2 0-4'	1B3 0-4'	1B4 0-4'	1C1 0-4'	1C2 0-4'
Aluminum	15,900	16,200	16,980	15,800	15,400	18,200	11,900	14,000	15,600	18,100
Antimony	U	U	U	U	U	U	U	U	U	U
Arsenic	28.0	51.0	26.0	13.0	22.0	30.0	34.0	40.0	62.0	36.0
Barium	R	R	R	R	R	R	R	R	R	R
Beryllium	1.10	1.0	1.0	1.2	1.0	1.4	0.9	1.0	1.2	1.2
Cadmium	10.0	16.0	12.0	9.6	10.0	11.0	11.0	11	12.0	15.0
Calcium	4,910	7,230	12,900	11,500	11,400	5,950	6,500	3,560	4,710	7,330
Chromium	40.0	37.0	42.0	40.0	39.0	43.0	30.0	39.0	42.0	42.0
Cobalt	8.9	17.0	14.0	10.0	11.0	10.0	9.7	17.0	18.0	10.0
Copper	31.0	45.0	37.0	33.0	40.0	29.0	41.0	41.0	45.0	50.0
Iron	28,400	37,100	32,300	27,100	29,900	30,900	25,400	32,900	38,300	35,400
Lead	67.0	129	36.0	28.0	20.0	47.0	62.0	47.0	73.0	120
Magnesium	7,510	8,030	9,850	9,200	9,240	8,790	7,200	8,230	8,480	8,960
Manganese	245	397	418	391	405	295	311	545	508	171
Mercury	U	U	U	U	U	U	U	U	U	U
Nickel	28.0	45.0	37.0	28.0	34.0	26.0	32.0	39.0	39.0	34.0
Potassium	5,910	5,250	6,240	5,960	5,530	6,690	5,500	4,260	6,870	6,500
Selenium	U	U	U	U	U	U	U	U	U	U
Silver	U	U	U	U	U	U	U	U	U	U
Sodium	886	1,070	911	842	835	1,520	2,330	2,200	2,380	3,190
Thallium	U	U	U	U	U	U	U	U	U	U
Vanadium	50.0	50.0	35.0	52.0	51.0	55.0	40.0	51.0	53.0	53.0
Zinc	173	366	182	96.0	127	159	238	155	281	271
Cyanide	U	U	U	U	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 8 (Cont.)

Element	1C3 0-4′	1C4 0-4′	1C5 0-4′	1C6 0-4′	1D1 0-4′	1D2 0-4′	1D3 0-4′	1D4 0-4′	1D5 0-4′	1E1 0-4′	1E2 0-4′	1F1 0-4′	2A1 0-4′
Aluminum	19,600	14,700	18,700	13,100	17,100	16,100	15,000	9,720	9,600	14,200	5,940	12,300	15,000
Antimony	U	U	U	U	U	U	U	U	U	U	U	U	U
Arsenic	35	33	31	10	9.4	17	44	11	7.8	8.8	U	7.4	22
Barium	R	R	R	R	R	R	R	R	R	R	R	R	R
Beryllium	1.4	1.1	2.1	1.7	1.2	1.2	U	U	1.1	U	U	U	1.3
Cadmium	16	9.7	11	9.1	7.9	13	12	6.4	6.0	8.2	4.1	7.0	7.4
Calcium	19,[illegible]00	5,780	6,060	3,910	6,380	6,720	7,060	50,000	3,900	59,300	21,900	18,200	5,310
Chromium	47	38	73	55	51	44	35	44	43	61	22	53	41
Cobalt	12	16	18	15	7.6	9.2	9.3	8.6	10	12	4.7	9.5	6.9
Copper	57	45	56	38	18	56	52	25	29	24	26	30	12
Iron	35,700	31,700	34,300	28,300	24,500	28,700	36,200	18,000	20,100	26,100	11,700	22,400	24,800
Lead	193	69	9.9	7.5	19	86	129	11.0	6.4	21	4.8	10	16
Magnesium	13,000	8,710	14,300	11,000	9,370	9,000	8,390	7,970	7,910	12,800	5,160	10,900	9,200
Manganese	553	295	396	416	313	264	190	293	328	338	146	262	266
Mercury	0.16	U	U	U	U	U	U	U	U	U	U	U	U
Nickel	39	33	59	48	22	29	31	31	33	37	16	46	20
Potassium	7,480	4,420	2,390	1,110	6,860	5,820	5,680	1,760	1,630	1,850	640	2,920	6,470
Selenium	U	U	U	U	U	U	U	U	U	U	U	U	U
Silver	4.5	U	U	U	U	U	U	U	U	U	U	U	U
Sodium	5,940	3,670	2,810	1,370	4,110	3,570	4,490	2,200	1,310	6,620	5,800	7,470	3,800
Thallium	U	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	66	51	81	54	55	56	52	39	40	64	23	54	52
Zinc	341	193	130	79	119	158	316	66	65	83	44	80	94
Cyanide	U	U	U	U	U	U	U	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 8 (Cont.)

Element	1C3 0-4'	1C4 0-4'	1C5 0-4'	1C6 0-4'	1D1 0-4'	1D2 0-4'	1D3 0-4'	1D4 0-4'	1D5 0-4'	1E1 0-4'	1E2 0-4'	1F1 0-4'	2A1 0-4'
Aluminum	19,600	14,700	18,700	13,100	17,100	16,100	15,000	9,720	9,600	14,200	5,940	12,300	15,000
Antimony	U	U	U	U	U	U	U	U	U	U	U	U	U
Arsenic	35	33	31	10	9.4	17	44	11	7.8	8.8	U	7.4	22
Barium	R	R	R	R	R	R	R	R	R	R	R	R	R
Beryllium	1.4	1.1	2.1	1.7	1.2	1.2	U	U	1.1	U	U	U	1.3
Cadmium	16	9.7	11	9.1	7.9	13	12	6.4	6.0	8.2	4.1	7.0	7.4
Calcium	19,100	5,780	6,060	3,910	6,380	6,720	7,060	50,000	3,900	59,300	21,900	18,200	5,310
Chromium	47	38	73	55	51	44	35	44	43	61	22	53	41
Cobalt	12	16	18	15	7.6	9.2	9.3	8.6	10	12	4.7	9.5	6.9
Copper	57	45	56	38	18	56	52	25	29	24	26	30	12
Iron	35,700	31,700	34,300	28,300	24,500	28,700	36,200	18,000	20,100	26,100	11,700	22,400	24,800
Lead	193	69	9.9	7.5	19	86	129	11.0	6.4	21	4.8	10	16
Magnesium	13,000	8,710	14,300	11,000	9,370	9,000	8,390	7,970	7,910	12,800	5,160	10,900	9,200
Manganese	553	295	396	416	313	264	190	293	328	338	146	262	266
Mercury	0.16	U	U	U	U	U	U	U	U	U	U	U	U
Nickel	39	33	59	48	22	29	31	31	33	37	16	46	20
Potassium	7,480	4,420	2,390	1,110	6,860	5,820	5,680	1,760	1,630	1,850	640	2,920	6,470
Selenium	U	U	U	U	U	U	U	U	U	U	U	U	U
Silver	4.5	U	U	U	U	U	U	U	U	U	U	U	U
Sodium	5,940	3,670	2,810	1,370	4,110	3,570	4,490	2,200	1,310	6,620	5,800	7,470	3,800
Thallium	U	U	U	U	U	U	U	U	U	U	U	U	U
Vanadium	66	51	81	54	55	56	52	39	40	64	23	54	52
Zinc	341	193	130	79	119	158	316	66	65	83	44	80	94
Cyanide	U	U	U	U	U	U	U	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 8 (Cont.)

Element	2A2 0-4'	2A3 0-4'	2A4 0-4'	2B1 0-4'	2B2 0-4'	2B3 0-4'	2B4 0-4'	2B5 0-4'	2C1 0-4'	2C2 0-4'
Aluminum	18,500	17,100	18,100	16,100	15,800	17,700	14,400	15,600	18,600	18,800
Antimony	U	U	U	U	U	U	U	U	U	U
Arsenic	17	32	19	21	26	23	25	13	22	7.2
Barium	R	R	R	R	R	R	R	R	R	R
Beryllium	1.3	1.3	1.2	1.3	U	1.2	U	U	1.4	1.4
Cadmium	7.8	8.4	7.9	9.2	12	8.5	9.8	9.1	13	14
Calcium	7,060	6,390	7,510	5,280	6,760	7,450	4,160	8,070	9,200	15,300
Chromium	44	45	47	40	40	50	52	34	41	46
Cobalt	8.7	8.9	7.2	7.2	8.8	8.8	8.9	7.8	12	15
Copper	24	18	19	32	53	17	41	23	66	44
Iron	24,800	26,000	25,200	28,200	34,100	26,800	28,800	25,700	35,200	29,800
Lead	21	41	35	48	79	37	58	22	54	22
Magnesium	9,720	9,510	9,770	8,750	8,440	9,950	8,260	9,140	11,400	11,500
Manganese	318	354	293	209	195	352	170	285	393	471
Mercury	U	U	U	U	U	U	U	U	U	U
Nickel	23	26	24	23	32	24	28	24	43	55
Potassium	5,960	6,880	6,320	6,000	6,000	7,390	3,230	6,720	7,480	882
Selenium	U	U	U	U	U	U	U	U	U	U
Silver	U	U	U	U	U	U	U	U	U	U
Sodium	1,940	2,750	1,730	4,880	4,200	2,260	2,820	3,720	4,400	2,980
Thallium	U	U	U	U	U	U	U	U	U	U
Vanadium	58	57	60	50	48	61	50	54	60	64
Zinc	108	117	116	194	242	127	221	121	218	233
Cyanide	U	U	U	U	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 9

SUMMARY OF INORGANIC ANALYSES FOR
DEEP (16-18 feet bgs) TAILINGS SAMPLES
(Samples Collected February 8-11, 1988)
(mg/kg)

Element	1A1 Bottom	1A2 Bottom	1A3 Bottom	1A4 Bottom	2A1 Bottom
Aluminum	12,800	13,500	11,000	12,900	19,500
Antimony	U	U	8.4	U	U
Arsenic	32.0	34.0	55.0	20.0	25
Barium	R	R	R	R	R
Beryllium	1.2	1.1	U	1.3	1.8
Cadmium	11.0	11.0	10.0	9.1	10
Calcium	12,800	17,300	13,200	5,690	8,500
Chromium	37.0	35.0	34.0	43.0	53
Cobalt	13.0	11.0	11.0	10.0	8.3
Copper	33.0	38.0	64.0	41.0	17
Iron	27,000	31,000	22,900	25,300	28,000
Lead	80.0	84.0	155	51.0	24
Magnesium	8,510	8,800	7,910	8,880	11,500
Manganese	321	419	276	254	307
Mercury	U	U	0.72	U	U
Nickel	46.0	39.0	36.0	36.0	28
Potassium	3,740	4,560	4,200	1,870	6,900
Selenium	U	U	U	U	U
Silver	U	U	17.0	4.7	28
Sodium	1,010	772	664	633	11,770
Thallium	U	U	U	U	U
Vanadium	42.0	44.0	39.0	48.0	64
Zinc	251	204	261	145	132
Cyanide	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 10

SUMMARY OF EP TOXICITY ANALYSES
FOR SIX TAILINGS SAMPLES
Samples Collected February 8-11, 1988)
(mg/l)

Element	1A2 0-4' EP Tox	1A3 0-4' EP Tox	1D1 Bottom EP Tox	1D4 Bottom EP Tox	2B3 0-4' EP Tox	2C1 0-4' EP Tox	EP Tox Maximum Conc.
Arsenic	U	U	U	U	U	U	5.0
Barium	0.239	0.463	0.096	0.518	0.088	0.115	100.0
Cadmium	0.0008	0.0071	0.0011	0.0009	0.0012	0.0028	1.0
Chromium	U	U	U	U	U	U	5.0
Lead	0.007	0.014	0.020	0.017	U	U	5.0
Silver	0.0019	0.003	U	U	U	U	5.0
Selenium	U	U	U	U	U	U	1.0
Mercury	U	U	U	U	U	U	0.2

U - Element was undetected in EP Toxicity extract. For detection limits, see Appendix C.

TABLE 11

SUMMARY OF INORGANIC ANALYSES
FOR MARINE SEDIMENT SAMPLES FROM GASTINEAU CHANNEL
(Samples Collected February 11, 1988)
(mg/kg)

Element	GCS 1	GCS 2	GCS 3	GCS 4	GCS 5	GCS 6
Aluminum	13,500	12,400	12,000	9,450	12,600	13,700
Antimony	U	U	U	U	U	U
Arsenic	8.9	14	11	2.8	35	7.5
Barium	R	R	R	R	R	R
Beryllium	2.4	2	2.2	U	U	1.2
Cadmium	8.9	8.0	10	4.6	11	9.1
Calcium	67,200	117,000	24,700	10,700	35,700	43,100
Chromium	46	29	38	34	40	42
Cobalt	14	13	15	6.3	15	12
Copper	13	13	21	13	55	18
Iron	25,800	21,200	31,400	16,800	29,700	27,000
Lead	11	12	4.8	7.2	61	8.4
Magnesium	12,600	9,610	11,300	6,940	11,800	11,000
Manganese	542	464	634	239	451	403
Mercury	U	U	U	U	U	U
Nickel	44	26	40	18	46	36
Potassium	1,630	2,140	1,320	3,460	2,370	888
Selenium	U	U	U	U	U	U
Silver	U	U	U	U	U	U
Sodium	3,340	1,410	2,620	2,290	16,500	2,650
Thallium	U	U	U	U	U	U
Vanadium	49	39	44	37	59	47
Zinc	57	56	67	61	173	84
Cyanide	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

slack tide. Table 12 summarizes inorganic elements detected in the samples. A total of 12 TCL inorganic elements were detected in at least one of the samples.

TABLE 12

SUMMARY OF INORGANIC ANALYSES
FOR MARINE WATER SAMPLES FROM GASTINEAU CHANNEL
(Samples Collected February 11, 1988)
(mg/l)

Element	GCW 1	GCW 2	GCW 3	GCW 4
Aluminum	0.231	0.228	0.256	0.247
Antimony	U	U	U	U
Arsenic	U	U	U	U
Barium	R	R	R	R
Calcium	301	305	304	311
Copper	U	U	0.019	0.014
Iron	0.128	0.275	0.160	0.108
Lead	U	U	U	U
Magnesium	806	808	804	815
Manganese	R	R	R	R
Mercury	U	U	0.0003	0.0004
Nickel	0.064	0.076	0.066	0.072
Potassium	499	512	523	516
Selenium	U	U	U	U
Silver	U	U	U	U
Sodium	12,100	10,400	10,500	11,200
Thallium	U	U	U	U
Vanadium	0.166	0.164	0.165	0.170
Zinc	U	0.029	U	0.034
Cyanide	U	U	0.019	0.019

U - Element was undetected in sample. For detection limits, see Appendix C.

R - Data was rejected because analytical quality criteria were not met. See Appendix D.

Three composite mussel samples were collected from the periphery of Tailings Dump #1 to determine whether biological intake of heavy metals from the tailings is occurring. Sample B4 was collected from the north shore of Douglas Island (approximately 12 miles from the site), and is considered to be reflective of background conditions. Table 13 summarizes inorganic elements detected in the mussel samples. A total of 10 TCL inorganic elements were detected in at least one of the samples.

TABLE 13

SUMMARY OF INORGANIC ANALYSES FOR
MUSSEL SAMPLES
(Samples Collected February 10, 1988)
(mg/kg)

Element	B1	B2	B3	(Background) B4
Antimony	0.02	U	U	0.02
Arsenic	0.08	0.052	0.071	0.047
Cadmium	0.041	0.032	0.031	0.041
Copper	0.08	0.15	0.05	0.052
Iron	312	154	111	65
Lead	0.034	0.029	0.037	0.01
Manganese	0.59	0.37	0.34	0.16
Mercury	U	U	U	U
Nickel	0.054	0.047	0.027	0.026
Silver	U	U	0.001	U
Zinc	0.065	0.74	0.77	0.41

U - Element was undetected in sample. For detection limits, see Appendix C.

Seven off-site surface soil samples were collected from nearby residential and commercial properties to determine if tailings are being transported off site by aerial deposition. Table 14 summarizes the inorganic elements detected in the samples. A total of 18 TCL inorganic elements were detected in at least one of the samples.

Six ground water samples were collected from private domestic wells located near the site to determine if the tailings are impacting local potable ground water. Table 15 summarizes the organic compounds and inorganic elements detected in the samples. A total of four TCL organic compounds were detected in all of the well samples, while a total of nine TCL inorganic elements were detected in at least one of the samples.

13.2 Novell Mill Site

A single soil sample was collected from beneath an old wood foundation that marks the site of the Novell Mill. Five additional sediment samples were collected from Sheep Creek, downstream of the probable point of entry of runoff originating at the mill site (Figure 4). Table 16 includes a summary of the inorganic elements detected in the soil sample collected at the mill site (SCS 6) and the five downstream sediment samples (SCS 1 - SCS 5). A total of nineteen TCL inorganic ele-
-e detected in the mill site sample, while 16 TCL inorganic
tected in at least one of the downstream samples.

TABLE 14

SUMMARY OF INORGANIC ANALYSES
FOR OFF-SITE SURFACE SOIL SAMPLES
(Samples Collected February 11, 1988)
(mg/kg)

Element	OSS 1	OSS 2	OSS 3	OSS 4	OSS 5	OSS 6	OSS 7
Aluminum	15,400	16,800	13,400	16,300	15,900	14,200	11,800
Antimony	U	U	U	U	U	U	U
Arsenic	18	14	27	13	4.6	5.9	45
Barium	R	R	R	R	R	R	R
Beryllium	U	U	U	U	2.6	1.9	U
Cadmium	9.3	7	9.0	9.3	11	9.6	6.2
Calcium	7,100	8,580	4,820	7,060	12,500	21,400	15,800
Chromium	66	64	31	125	42	29	31
Cobalt	15	10	8.9	14	16	13	8.6
Copper	27	26	26	48	15	33	19
Iron	28,900	25,200	26,100	30,200	32,700	29,600	19,100
Lead	26	11	65	78	9.4	1.3	46
Magnesium	13,100	9,360	6,550	10,100	13,400	11,100	8,350
Manganese	528	349	252	463	598	552	420
Mercury	U	U	U	U	U	U	U
Nickel	67	45	26	43	43	70	27
Potassium	1,910	3,480	5,210	3,020	1,620	958	14,900
Selenium	U	U	U	U	U	U	U
Silver	U	U	U	U	U	U	U
Sodium	U	U	742	1,100	325	586	4,720
Thallium	U	U	U	U	U	U	U
Vanadium	66	59	41	69	55	42	42
Zinc	95	82	184	350	89	116	151
Cyanide	4.6	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 16

SUMMARY OF INORGANIC ANALYSES FOR SEDIMENT SAMPLES FROM SHEEP CREEK
(Samples Collected February 10, 1988)
(mg/kg)

Element	SCS 1	SCS 2	SCS 3	SCS 4	SCS 5	(Nowell Mill Site) SCS 6	SCS 7	SCS 8	SCS 9
Aluminum	8,630	10,200	7,990	13,200	5,570	12,300	13,200	11,700	12,600
Antimony	U	U	U	U	U	46	U	U	U
Arsenic	4.7	13	14	22	8.1	155	23	48	17
Barium	R	R	R	R	R	R	R	R	R
Beryllium	U	U	U	U	U	U	U	U	U
Cadmium	5.8	7.1	5.3	11	5.9	31	9.7	13	9.0
Calcium	1,700	2,990	2,930	2,950	1,930	3,820	3,190	5,700	2,920
Chromium	33	49	31	63	22	49	54	47	56
Cobalt	8.2	11	6.9	14	3.8	15	13	20	13
Copper	34	33	26	52	30	255	59	93	57
Iron	19,200	22,500	18,200	30,600	19,000	34,900	28,000	37,600	27,800
Lead	2.5	10	3.4	4.4	2.0	1,550	4.3	19	3.8
Magnesium	6,310	7,610	5,640	9,350	3,700	7,750	8,600	9,640	8,520
Manganese	289	304	183	399	215	462	497	507	479
Mercury	U	U	U	U	U	3.8	U	0.15	U
Nickel	36	41	29	56	25	41	51	81	58
Potassium	360	1,140	420	711	286	1,410	811	1,240	697
Selenium	U	U	U	U	U	U	U	U	U
Silver	U	U	U	U	U	95	U	U	U
Sodium	U	U	U	376	U	432	401	U	373
Thallium	U	U	U	U	U	U	U	U	U
Vanadium	37	51	42	52	23	50	52	58	50
Zinc	75	79	51	109	58	1,940	106	179	105
Cyanide	U	U	U	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 15

SUMMARY OF INORGANIC AND ORGANIC ANALYSES
FOR DOMESTIC WELL SAMPLES
(Samples Collected February 8 and 9, 1988)
(mg/l)

Element	DW 1	DW 2	DW 3	DW 4	DW 5	DW 6	Federal Primary Drinking Water Standard
Aluminum	U	0.613	0.110	0.110	U	U	
Antimony	U	U	U	U	U	U	
Arsenic	U	U	0.029	0.012	U	0.0053	0.05
Barium	R	R	R	R	R	R	1.0
Beryllium	U	U	U	U	U	U	
Cadmium	U	U	U	U	U	U	0.01
Calcium	19.5	43.9	21.0	18.7	51.6	50.2	
Chromium	U	U	U	U	U	U	0.05
Cobalt	U	U	U	U	U	U	
Copper	U	U	U	0.019	0.081	0.015	
Iron	U	1.24	U	0.134	U	0.439	
Lead	0.0066	0.0095	0.0064	0.0051	0.0058	0.0037	0.05
Magnesium	4.96	4.14	4.07	5.48	3.20	11.9	
Manganese	R	R	R	R	R	R	
Mercury	U	U	U	U	U	U	0.002
Nickel	0.010	0.015	0.012	0.014	U	U	
Potassium	4.6	2.55	4.13	3.72	2.93	5.81	
Selenium	U	U	U	U	U	U	0.01
Silver	U	U	U	U	U	U	0.05
Sodium	13.8	4.15	9.02	14.6	7.30	10.3	
Thallium	U	U	U	U	U	U	
Vanadium	U	U	U	U	U	U	
Zinc	U	0.013	U	U	0.020	U	
Cyanide	U	U	U	U	U	U	
Ethylbenzene	NA	0.001	U	U	U	U	
Total Xylenes	NA	0.002	U	U	U	U	
Trichloroethane	NA	U	U	0.0006	U	U	
Toluene	NA	U	U	U	0.0005	U	

NA - Compound not analyzed for in this sample.
U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

TABLE 17

SUMMARY OF INORGANIC ANALYSES FOR WATER SAMPLES FROM SHEEP CREEK
(Samples Collected February 10, 1988)
(mg/l)

Element	SCW 1	SCW 2	SCW 3	SCW 4	SCW 5	SCW 7	(Mine Portal) SCW 8	SCW 9
Aluminum	U	U	U	U	U	U	U	U
Antimony	U	U	U	U	U	U	U	U
Arsenic	U	U	U	U	U	U	U	U
Barium	R	R	R	R	R	R	R	R
Beryllium	U	U	U	U	U	U	U	U
Cadmium	U	U	U	U	U	U	U	0.050
Calcium	16.6	170	17.0	17.7	16.8	16.0	45.3	12.6
Chromium	U	U	U	U	U	U	U	U
Cobalt	U	U	U	U	U	U	U	U
Copper	0.018	0.021	0.022	0.016	U	0.015	0.019	0.028
Iron	U	0.100	0.138	0.127	U	0.118	0.202	U
Lead	0.0048	0.0046	0.0043	0.0087	0.0049	0.0057	0.0069	0.0075
Magnesium	1.35	1.25	1.28	1.59	1.29	1.28	1.03	1.24
Manganese	R	R	R	R	R	R	R	R
Mercury	U	U	U	U	U	U	U	U
Nickel	U	0.011	U	U	U	U	0.025	U
Potassium	0.840	0.910	0.800	1.31	0.630	0.630	2.86	U
Selenium	U	U	U	U	U	U	U	U
Silver	U	U	0.011	0.023	U	U	U	U
Sodium	1.98	1.41	1.166	2.53	1.22	U	10.2	1.48
Thallium	U	U	U	U	U	U	U	U
Vanadium	U	U	U	U	U	U	U	U
Zinc	U	U	U	U	U	U	U	U
Cyanide	U	R	U	U	U	U	U	U

U - Element was undetected in sample. For detection limits, see Appendix C.
R - Data were rejected because analytical quality criteria were not met. See Appendix D.

Five surface water samples were collected from Sheep Creek downstream of the Nowell Mill Site (Figure 4). Table 17 includes a summary of the inorganic elements detected in the downstream samples (SCW 1 - SCW 5). A total of nine TCL inorganic elements were detected in at least one of the samples. Sample SCW 2, collected at the drinking intake on Sheep Creek, revealed no detectable levels of TCL organic compounds.

13.3 Sheep Creek Mine Portal

The mine portal sediment sample (SCS 8) was collected from the mine drainage ditch approximately 200 feet downstream of the portal. Two additional sediment samples were collected in Sheep Creek to characterize background conditions (SCS 9) and downstream conditions (SCS 7) (Figure 4). Table 16 includes a summary of the inorganic elements detected in the sediment samples. A total of 17 TCL inorganic elements were detected in the mine drainage sample, and 16 TCL inorganic elements were detected in the two Sheep Creek sediment samples.

A single water sample was collected from the mine drainage ditch (SCW 8). Two additional water samples were collected from nearby locations on Sheep Creek (SCW 7 and SCW 9) (Figure 4). Table 17 includes a summary of the inorganic elements detected in the samples. A total of eight TCL inorganic elements were detected in the mine drainage water, while six elements were detected in at least one of the Sheep Creek samples.

13.4 QA/QC Samples

A single transport blank was prepared for the water samples collected during the SI. An additional volatile organic analyses (VOA) blank was sent with a second shipment of water samples. Table 18 summarizes the TCL compounds and elements detected in the blank samples. A total of two TCL organic compounds and four inorganic elements were detected in the field blank. Two volatile compounds were detected in the VOA blank.