

G JOHNSON ENVIRONMENTAL
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(510) 376-2861 • FAX (510) 376-6883

December 6, 1996

Mr. William Corbus
Alaska Electric Light and Power Company
134 Franklin Street
Juneau, Alaska 99801

Mr. Steve Gilbertson
City and Borough of Juneau
155 South Seward Street
Juneau, Alaska 99801

Dear Bill and Steve:

In late 1995, a precipitate of reddish orange material was noted in a creek which flows adjacent to the upper cyanide tailings pile at the Treadwell Mine on Douglas Island. To determine the significance of the presence of the precipitate, AJT Mining Properties, Inc., and the City and Borough of Juneau initiated an investigation of the cyanide tailings area. The actions taken and the results of the investigation are presented below.

The Treadwell Mine cyanide tailings are located approximately 4,000 feet south of Sandy Beach on Douglas Island. The physical appearance of the tailings is that of a dark-grey, fine-grained sand. Under magnification, the tailings are yellow-gold in color with a metallic luster. The tailings appear to be pyrite, a sulfide mineral composed primarily of iron and sulfur with trace amounts of other metals. The tailings are found both at tidewater (the lower tailings pile) and near the mill approximately 500 feet inland (the upper tailings pile). The lower tailings pile is approximately 70 feet long, 40 feet wide, and six to 12 feet thick. It is bounded by a beach which extends to Gastineau Channel on the east and steep, forested mountains on the west.

The upper tailings pile is approximately 140 feet long and 65 feet wide. The thickness is difficult to estimate because the underlying topography is unknown, but it appears to be six to 10 feet thick. The tailings are in a flat cleared area surrounded by forested slopes. A small stream on the south side of the pile flows to the top of the beach at Gastineau Channel where it disappears into the sand. For most of its length, the stream is 18 to 24 inches wide and one to four inches deep. The total length of the stream from the tailings pile to the beach is approximately 400 feet. Tailings are found mixed with soil downslope from the pile for a distance of approximately 45 feet. The percentage of tailings in the soil decreases gradationally with distance from the pile.

Mr. William Corbus and Mr. Steve Gilbertson

December 6, 1996

Page 2

The initial step was to review the results of a previous study in the area of the Treadwell Mine. In 1988, as part of a larger study of historical mining sites in the Juneau area, samples were collected from the upper and lower Treadwell cyanide tailings piles, the soil below the upper tailings pile, and from the water in the stream below the upper tailings pile. Measurements of pH were taken from above and below the tailings pile. Details of the investigation are given in the report prepared for AEL&P and CBJ titled: "Site Investigations of Selected Mine Sites Near Juneau, Alaska," prepared by Versar, Inc., dated January 4, 1989. The authors of the report concluded that the presence of the tailings do not present a threat to the environment. For purposes of comparison of the analytical results of that investigation with the present investigation, the results of the analysis of the stream water sample are given in Table 1, the results of chemical analyses of the tailings and soil samples are given in Table 2, and the results of the pH measurements are given in Table 3, all of which are appended to this letter.

The current investigation was conducted on August 20, 1996. The lower tailings pile appeared to be unchanged since the 1988 investigation. Two features not present in the 1988 investigation were noted by the upper tailings pile. In 1988, a small stormwater drainage channel ran diagonally from northwest to southeast across the western half of the upper tailings pile. Since that time, regrading of the area during a minelands restoration program appears to have diverted the stormwater around the edges of the tailings pile.

The second change observed is that the stream on the south side of the upper tailings pile has deposits of a precipitate consisting of a reddish-orange, fine-grained mud. These precipitates were not seen during the 1988 investigation. The precipitates are found where the stream has a lower velocity or forms ponds. In the parts of the stream with the lowest velocity, the upper surface of the mud has a botryoidal or nodular appearance. The thickest deposit of mud observed was three inches. Up to ninety percent of the stream bed immediately adjacent to and immediately below the tailings pile was covered with the precipitate. The amount of the precipitate present decreased gradationally over a short distance downstream. The precipitate appears to be deposited by solutions emanating from the upper tailings pile. It is probable dissolution of pyrite (FeS_2) forms an iron rich solution. The solution which forms from the dissolution of pyrite will have a low oxidation-reduction potential (eH). As the oxygen content and pH increases when the solution is mixed with the stream water, iron compounds are precipitated. Probable compositions of the compounds include iron oxy-hydroxides and hydrous iron sulfates.

To evaluate the significance of these changes, and to compare the current environmental conditions to those observed in 1988, three water samples were collected from the stream flowing on the south side of the upper tailings pile, and a sample of the precipitate was collected. An additional water sample was collected from a stream approximately 500 feet south of the Treadwell tailings to provide background metal concentrations. The samples were placed in precleaned containers provided by the analytical laboratory. The water samples for metal were

Mr. William Corbus and Mr. Steve Gilbertson

December 6, 1996

Page 3

preserved using acid to reduce the pH to less than two; the samples for cyanide were preserved with sodium hydroxide to increase the pH to greater than 12. The sample containers were placed in a cooler with blue ice to maintain the temperature at approximately 4° C, and shipped via overnight courier to the analytical laboratory. All of the samples were submitted for analysis for arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, and cyanide. The results of the chemical analyses of the water samples are given in Table 1, which also includes the results of the analysis of the water sample collected from the stream in 1988. The water samples were collected from above the upper tailings pile, immediately below the tailings pile, and at the upper beach, where the surface water flow terminates. The results of the chemical analysis of the precipitate sample are given in Table 2, which also includes the results of the tailings and soil samples collected in 1988. Measurements of pH were taken at five locations along the stream. The pH values measured and the pH values measured in 1988 are given in Table 3.

The results of the analyses show that the concentrations of metals present in the stream do not constitute an environmental threat. Small increases in the concentrations of cadmium (0.0066 parts per million (ppm) and 0.02 ppm), and chromium (0.018 ppm) were observed in the two samples collected below the upper tailings pile (CNT2 and CNT3), but lead and mercury, which were found in 1988, were not detected in this sampling event. Lead was found in the background water sample (CNT4), but not a concentration of environmental concern in this setting.

The analysis of the precipitate found very low levels of metals present: barium (1.2 ppm), cadmium (0.34 ppm), chromium (3.4 ppm), and lead (2.4 ppm). In 1988, Ecology and Environment, Inc. collected background soil samples near Juneau as part of an investigation conducted for the United States Environmental Protection Agency at the Thane Mine. The results of that investigation were documented in a report titled: "Site Investigation Report for the Thane Mine Dump Site, Juneau, Alaska, dated May 1988 (EPA reference TDD F10-8712-02, PAN FAK0109SAR). The results of those analyses are summarized in Table 4. The average background levels were: cadmium, 9.15 ppm; chromium, 43.25; and lead, 6.13. Barium was not analyzed in the study. These results indicate that the levels found are below the background levels for the area. Because the precipitate is stable under the conditions present in the stream, and the concentrations of metals, including barium, which could be of concern are low, the presence of the precipitate is not an environmental concern.

The pH values measured in the stream are consistent with those found in 1988. Because of the changes made in the drainage by the grading done during the mine restoration project, the pH measurements above the upper tailings pile were taken in different locations in 1988 and 1996. However, it can be seen that the same pattern of a sharp decrease in the pH at and below the tailings pile is present in both 1988 and 1996.

Mr. William Corbus and Mr. Steve Gilbertson
December 6, 1996
Page 4

The conclusions that can be drawn from the results of the 1996 investigation are:

1. The results of the analyses of the stream water show that metals are not leaching out of the tailings in quantities which represent an environmental threat.
2. The rate of leaching of metals from the tailings, as determined from the analyses of water in 1988 and 1996, has remained stable since 1988.
3. The precipitate is iron rich with trace amounts of barium, calcium, chromium, and lead. The presumption that the precipitate is iron rich is based on the composition of the tailings (FeS_2). The precipitate is stable under the conditions present at the site and does not represent an environmental threat.
4. No actions are necessary with regard to the tailings to prevent environmental impairment.

If you have any questions concerning the contents of this letter, please call me. I will provide any additional information you may require.

Sincerely,


Clarence Johnson

CJnj

TABLE 1

Analyses of Stream Water Samples

Analyte	Sample Number				
	1996				1988
	CNT1	CNT2	CNT3	CNT4	DSW1
Arsenic	ND	ND	ND	ND	ND
Barium	ND	ND	ND	ND	NA
Cadmium	ND	0.0066	0.020	ND	NA
Chromium	ND	ND	0.018	ND	NA
Lead	ND	ND	ND	0.018	0.017
Mercury	ND	ND	ND	ND	0.00036
Selenium	ND	ND	ND	ND	NA
Silver	ND	ND	ND	ND	NA
Cyanide	ND	ND	ND	ND	ND
Zinc	NA	NA	NA	NA	0.199

All values in parts per million

ND - Not detected

NA - Not analyzed

CNT1 - Above upper cyanide tailings pile

CNT2 - Immediately below upper cyanide tailings pile

CNT3 - At bottom of slope adjacent to beach

CNT4 - Drainage 500 feet south of Treadwell tailings

DSW1 - Immediately below upper cyanide tailings pile

TABLE 2**Analyses of Precipitate, Tailings, and Soil Samples**

Analyte	Sample Number			
	1996	1988		
	SCNT2	DT2	DT4	DT3
Arsenic	ND	191	350	64
Barium	1.2	NA	NA	NA
Cadmium	0.34	NA	NA	NA
Chromium	3.4	NA	NA	NA
Lead	2.4	316	511	60
Mercury	ND	57	10	0.22
Selenium	ND	NA	NA	NA
Silver	ND	NA	NA	NA
Cyanide	ND	19.9	49.1	0.79
Zinc	NA	649	147	38

All values in parts per million

ND - Not detected

NA - Not analyzed

SCNT2 - Precipitate sample

DT2 - Upper cyanide tailings pile

DT4 - Lower cyanide tailings pile

DT3 - Soil sample collected downslope from upper cyanide tailings pile

TABLE 3

Stream Water pH Measurements

Location	1996	1988
Above upper cyanide tailings	7.91	6.71
Adjacent to upper cyanide tailings	3.30	NM
Immediately below upper cyanide tailings	3.11	2.67
Sixty feet below upper cyanide tailings	2.91	2.80
At bottom of slope adjacent to beach	2.81	2.80

NM - Not measured

TABLE 4

**EPA Analyses of Background Soil Samples
February, 1988**

Analyte	Sample Number				
Sample Number	SCS9	GCS1	GCS6	OSS6	Average
Arsenic	17	8.9	7.5	5.9	9.8
Barium	NA	NA	NA	NA	NA
Cadmium	9.0	8.9	9.1	9.6	9.15
Chromium	56	46	42	29	43.2
Lead	3.8	11	8.4	1.3	6.13
Mercury	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA
Zinc	105	57	84	116	90.5

Source: Site Inspection Report for Thane Mine Dump Site, Juneau, Alaska,
May, 1988. TDD F10-8712-02. PAN FAK0109SAR

All values in parts per million

NA - Not analyzed

525 Del Rey Avenue, Suite E • Sunnyvale, CA 94086 • (408) 735-1550 • Fax (408) 735-1554

Attn: Clarence Johnson
CJE
57 Amberwood Ct.
Moraga, CA 94556


Date:	8/28/96
Date Received:	8/21/96
Date Analyzed:	8/23-8/27/96
Project:	Juneau
Sampled By:	Client

Certified Analytical Report

Water Sample Analysis:

Test	CNT 1	CNT 2	CNT 3	CNT 4	Units	PQL	EPA Method #
Sample Method	Grab	Grab	Grab	Grab			
Sample Date	8/19/96	8/19/96	8/19/96	8/19/96			
Sample Time	14:31	14:35	14:47	15:03			
Lab #	C11098	C11099	C11100	C11101			
Arsenic	ND	ND	ND	ND	mg/liter	0.005 mg/l	206.2
Barium	ND	ND	ND	ND	mg/liter	0.10 mg/l	208.1
Cadmium	ND	0.0066	0.020	ND	mg/liter	0.0010 mg/l	213.2
Chromium	ND	ND	0.018	ND	mg/liter	0.005 mg/l	218.2
Lead	ND	ND	ND	0.018	mg/liter	0.005 mg/l	239.2
Mercury	ND	ND	ND	ND	mg/liter	0.0005 mg/l	245.1
Selenium	ND	ND	ND	ND	mg/liter	0.005 mg/l	270.2
Silver	ND	ND	ND	ND	mg/liter	0.10 mg/l	272.1
Cyanide	ND	ND	ND	ND	mg/liter	0.020 mg/l	335.2

1. DLR=DF x PQL (DF=1 unless noted)
2. Analysis performed by Entech Analytical Labs, Inc. (CAELAP #1369)


 Michael N. Golden, Lab Director

DF=Dilution Factor
 DLR=Detection Reporting Limit

PQL=Practical Quantitation Limit
 ND=None Detected at or above DLR

QUALITY CONTROL RESULTS SUMMARY

METHOD: Flame Atomic Absorption

QC Batch #: WN-0048

Date Analyzed: 08/27/96

Matrix: Water

Units: mg/L

PARAMETER	Method #	SA mg/L	SR mg/L	SP mg/L	SP %R	SPD mg/L	SPD % R	RPD	QC LIMITS	
									%R	RPD
Antimony	204.1	na	na	na	na	na	na	na	80- 120	20.0
Barium	208.1	na	na	na	na	na	na	na	80- 120	20.0
Beryllium	210.1	na	na	na	na	na	na	na	80- 120	20.0
Cadmium	213.1	0.50	0.00	0.50	99	0.50	100	1.0	80- 120	20.0
Chromium	218.1	0.50	0.00	0.51	102	0.52	104	1.2	80- 120	20.0
Cobalt	219.1	na	na	na	na	0.54	na	na	80- 120	20.0
Copper	220.1	0.50	0.09	0.59	100	0.58	97	2.6	80- 120	20.0
Lead	239.1	0.50	0.00	0.53	105	0.52	104	1.5	80- 120	20.0
Molybdenum	246.1	na	na	na	na	na	na	na	80- 120	20.0
Nickel	249.1	0.50	0.02	0.52	99	0.52	99	0.8	80- 120	20.0
Silver	270.1	0.050	0.000	0.058	116	0.055	110	5.3	80- 120	20.0
Thallium	279.1	na	na	na	na	na	na	na	80- 120	20.0
Vanadium	286.1	na	na	na	na	na	na	na	80- 120	20.0
Zinc	289.1	0.50	0.00	0.53	107	0.53	105	1.7	80- 120	20.0

Definition of Terms:

- na: Not analyzed in QC batch
- SA: Spike Added
- SR: Sample Result
- SP: Spike Result
- SP (%R) Spike % Recovery
- SPD Spike Duplicate Result
- SPD (%R) Spike % Recovery

QA/QC OFFICER Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: Graphite Furnace Atomic Absorption

QC Batch #: WN-0047

Date Analyzed: 08/26/96

Matrix: Water

Units: mg/L

PARAMETER	Method #	SA mg/L	SR mg/L	SP mg/L	SP %R	SPD mg/L	SPD % R	RPD	QC LIMITS	
									%R	RPD
Antimony	204.2	0.50	0.00	0.50	100	0.47	94	5.6	80- 120	25
Arsenic	206.2	0.50	0.00	0.47	93	0.47	94	0.6	80- 120	25
Barium	208.2	na	na	na	na	na	na	na	80- 120	25
Beryllium	210.2	na	na	na	na	na	na	na	80- 120	25
Cadmium	213.2	0.50	0.00	0.44	89	0.47	93	4.8	80- 120	25
Chromium	218.2	0.50	0.00	0.46	92	0.44	89	3.3	80- 120	25
Cobalt	219.2	na	na	na	na	na	na	na	80- 120	25
Copper	220.2	na	na	na	na	na	na	na	80- 120	25
Lead	239.2	0.50	0.00	0.49	98	0.50	100	2.4	80- 120	25
Molybdenum	246.2	na	na	na	na	na	na	na	80- 120	25
Nickel	249.2	0.50	0.00	0.54	108	0.49	98	9.3	80- 120	25
Selenium	270.2	0.50	0.00	0.42	84	0.41	83	1.9	80- 120	25
Silver	272.2	na	na	na	na	na	na	na	80- 120	25
Thallium	279.2	0.50	0.00	0.45	90	0.44	87	2.9	50- 150	25
Vanadium	286.2	na	na	na	na	na	na	na	80- 120	25
Zinc	289.2	na	na	na	na	na	na	na	80- 120	25

Definition of Terms:

na: Not Analyzed in QC batch

SA: Spike Added

SR: Sample Result

RPD: Relative Percent Difference (between duplicate analyses)

SP: Matrix Spike Result

SP (%R): Matrix Spike % Recovery

SPD: Matrix Spike Duplicate Result

SPD (%R): Matrix Spike Duplicate % Recovery

QA/QC Officer: Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: Cold Vapor Atomic Absorption

QC Batch #: WHG960811
Matrix: Water
Units: mg/L

Date Analyzed: 08/26/96

PARAMETER	Method #	SA mg/L	SR mg/L	SP mg/L	SP %R	SPD mg/L	SPD %R	RPD	QC LIMITS %R
Mercury	245.1	0.0050	0.0000	0.0038	76	0.0036	72	4.9	70- 130

Definition of Terms:

- SA: Spike Added
- SR: Sample Result
- SP: Spike Result
- SP (%R) Spike % Recovery
- SPD Spike Duplicate Result
- SPD (%R) Spike Duplicate % Recovery

QA/QC OFFICER Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: EPA 335.2

QC Batch #: WCN960806
Matrix: Water
Units: mg/L

Date Analyzed: 08/26/96

PARAMETER	Method #	SA mg/L	SR mg/L	SP mg/L	SP %R	SPD mg/L	SPD %R	RPD	QC LIMITS %R
Cyanide (Total)	335.2	0.20	0.00	0.21	104	0.21	106	2.4	50- 150

Definition of Terms:

- RPD: Relative Percent Difference (Duplicate Analyses)
- SA: Spike Added
- SR: Sample Result
- SP: Spike Result
- SP (%R): Spike % Recovery
- SPD: Spike Duplicate Result
- SPD (%R): Spike Duplicate % Recovery

QA/QC OFFICER Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: Flame Atomic Absorption

QC Batch #: SM960804
Matrix: Soil/Sand
Units: mg/Kg

Date Analyzed: 08/22/96
Extraction Method: EPA 3050

PARAMETER	Method #	SA mg/Kg	SR mg/Kg	SP mg/Kg	SP %R	SPD mg/Kg	SPD %R	RPD	QC LIMITS %R
Antimony	7040	25.	0.7	19.	73	20.	76	4.3	50-150
Barium	7080	25.	24.	39.	62	42.	73	15.1	50-150
Beryllium	7090	25.	0.0	21.	85	22.	89	4.1	50-150
Cadmium	7130	25.	0.4	21.	83	21.	84	1.0	50-150
Chromium	7190	25.	5.0	28.	91	28.	92	1.1	50-150
Cobalt	7200	25.	1.7	25.	95	25.	92	2.7	50-150
Copper	7210	25.	5.1	30.	101	30.	98	2.8	50-150
Lead	7420	25.	4.5	24.	80	24.	77	2.7	50-150
Molybdenum	7480	25.	0.0	19.	76	19.	78	2.7	50-150
Nickel	7520	25.	5.6	34.	112	33.	111	0.8	50-150
Silver	7760	25.	0.1	21.	83	21.	82	1.3	50-150
Thallium	7840	25.	1.4	26.	100	27.	103	3.3	50-150
Vanadium	7910	25.	19.	40.	86	41.	90	3.9	50-150
Zinc	7950	25.	36.	63.	107	61.	101	5.7	50-150

Definition of Terms:

- na: Not Analyzed in QC batch
- SA: Spike Added
- SR: Sample Result
- SP: Spike Result
- SP (%R): Spike % Recovery
- SPD: Spike Duplicate Result
- SPD (%R): Spike Duplicate % Recovery

QA/QC OFFICER Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: Graphite Furnace Atomic Absorption

QC Batch #: SM960804

Date Analyzed: 08/22/96

Matrix: Soil

Extraction Method: EPA 3050

Units: mg/Kg

PARAMETER	Method #	SA	SR	SP	SP	SPD	SPD	RPD	QC LIMITS	
		mg/Kg	mg/Kg	mg/Kg	%R	mg/Kg	%R		%R	RPD
Arsenic	7060	25.0	0.0	22.5	90	21.6	86	4.1	50-150	25
Selenium	7740	25.0	0.0	22.7	91	21.9	88	3.6	50-150	25

Definition of Terms:

- na: Not Analyzed in Q.C. Batch
- SA: Spike Added
- SR: Sample Result
- SP: Spike Result
- SP (%R): Spike % Recovery
- SPD: Spike Duplicate Result
- SPD (%R): Spike Duplicate % Recovery

QA/QC OFFICER Nick J. Gaone
N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: Cold Vapor Atomic Absorption

QC Batch #: SHG960813

Date Analyzed: 08/27/96

Matrix: Soil

Units: mg/kg

PARAMETER	Method #	SA mg/kg	SR mg/kg	SP mg/kg	SP %R	SPD mg/kg	SPD %R	RPD	QC LIMITS %R
Mercury	7471	2.00	0.00	1.97	99	1.97	99	0.0	70-130

Definition of Terms:

SA: Spike Added

SR: Sample Result

SP: Spike Result

SP (%R) Spike % Recovery

SPD Spike Duplicate Result

SPD (%R) Spike Duplicate % Recovery

QA/QC OFFICER

Nick F. Gaone

N. Gaone

QUALITY CONTROL RESULTS SUMMARY

METHOD: 9010

QC Batch #: SCN960805

Date Analyzed: 08/23/96

Matrix: Soil

Units: mg/Kg

PARAMETER	Method #	SA	SR	SP	SP	SPD	SPD	RPD	QC LIMITS	
		mg/Kg	mg/Kg	mg/Kg	%R	mg/kg	%R		%R	RPD
Cyanide, Total	9010	10.0	0.0	10.2	102	10.5	105	3.4	70-130	30

Definition of Terms:

SA: Spike Added

SR: Sample Result

SP: Spike Result

SP (%R): Spike % Recovery

SPD: Spike Duplicate Result

SPD (%R): Spike Duplicate % Recovery

QA/QC OFFICER

Nick J. Gaone
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Entech Analytical Labs, Inc.

525 Del Rey Avenue, Suite E • Sunnyvale, CA 94086 • Telephone: (408) 735-1550 (800) 287-1799 • Fax: (408) 735-1554

Chain of Custody/Analysis Work Order

LAB USE ONLY

Samples arrived chilled and intact:
 Yes No

Notes: _____

Client: CJE Project ID: Juneau

Address: 57 Amberwood Ct. Purchase Order #: _____

Contact: Morgan CA 94556 Telephone #: 510-376-2861

Telephone #: 510-376-2861

Date Received: 8/21/90

Turn Around: Normal

Sampler/Company: _____ Telephone #: _____

Special Instructions/Comments: _____

Sample Information							Requested Analysis			
Lab #	Sample ID	Grab/Composite	Matrix	Date Collected	Time Collected	Pres. Method	Sample Container	PCPA Metals	Cyanide	Time
C11098	CNT1	Grab	Water	8/19/95	14:31	AWG	2 Plastic	✓	✓	
C11099	CNT2	↓	↓	↓	14:35	AWG	↓	✓	✓	
C11100	CNT3	↓	↓	↓	14:47	↓	↓	✓	✓	
C11101	CNT4	↓	↓	↓	15:03	↓	↓	✓	✓	
C11102	SCNT2	↓	Soil	↓	14:51	↓	Glass	✓	✓	
Relinq. By: <u>[Signature]</u>							Date: <u>8/21/90</u> Time: <u>10:30 AM.</u>			
Relinq. By: _____							Date: _____ Time: _____			
Relinq. By: _____							Date: _____ Time: _____			