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HYDROLOGIC INVESTIGATION OF COASTAL WATERS AND STREAMS FOR THE PROPOSED SHEPARD POINT ROAD, ORCA INLET, NEAR CORDOVA, ALASKA

by

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Division of Mining and Water Management
Alaska Hydrologic Survey

September 1994

Releasedby

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Fairbanks, Alaska 99709-3645

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INTRODUCTION

The Alaska Department of Transportation and Public Facilities requested the Department of Natural Resources, Division of Mining and Water Management (DMWM), Alaska Hydrologic Survey, to survey the water-quality of streams and coastal waters of Orca Inlet north of Cordova, Alaska along the proposed route of the Shepard Point road. The proposed road alignment follows the coastline of Orca Inlet from Orca Cannery 4.8 miles to Shepard Point. The purpose of the road is to establish access to a future deep-draft, oil-response port site at Shepard Point. This report presents baseline water-quality and hydrologic information to assess the environmental condition of coastal waters within the proposed road corridor.

The objectives of this investigation are to:

1. Survey water quality of Humpback Creek and an unnamed creek by conducting on-site measurements of key water-quality parameters.

2. Collect water samples and analyze them for selected inorganic and organic constituents.

3. Measure streamflow of Humpback Creek and an unnamed creek.

4. Produce a written report of field and laboratory results.

STUDY AREA

The study area, sampling sites, drainage basin boundaries, and proposed road alignment are shown in figure 1. Water samples were collected on July 12, 1994 at five sites: Humpback Creek, an unnamed creek, ocean at Shepard Point, ocean at Humpback Creek, and ocean at Orca Cannery (fig. 1). Photographs of the physical setting, sampling sites, hydrologic measurements, and sampling techniques are presented in appendix A.

HYDROLOGY

Background

Humpback Creek and the unnamed creek are located approximately 5 mi northeast of Cordova (fig. 1). Humpback Creek is the largest stream in the study area, flowing four miles west to Orca Inlet and draining an area of 4.4 sq mi. The upper Humpback Creek basin has a high elevation of 3400 ft, and three small snowfields along with two small lakes are located in the basin. The unnamed creek flows 1.25 mi northwest to Orca Inlet and drains a narrow basin with an area of 0.43 sq mi, a high point of 2180 ft, and no snowfields or lakes in the basin. The drainage basins for both streams are steep and rugged, and approximately half of both basins are above treeline.

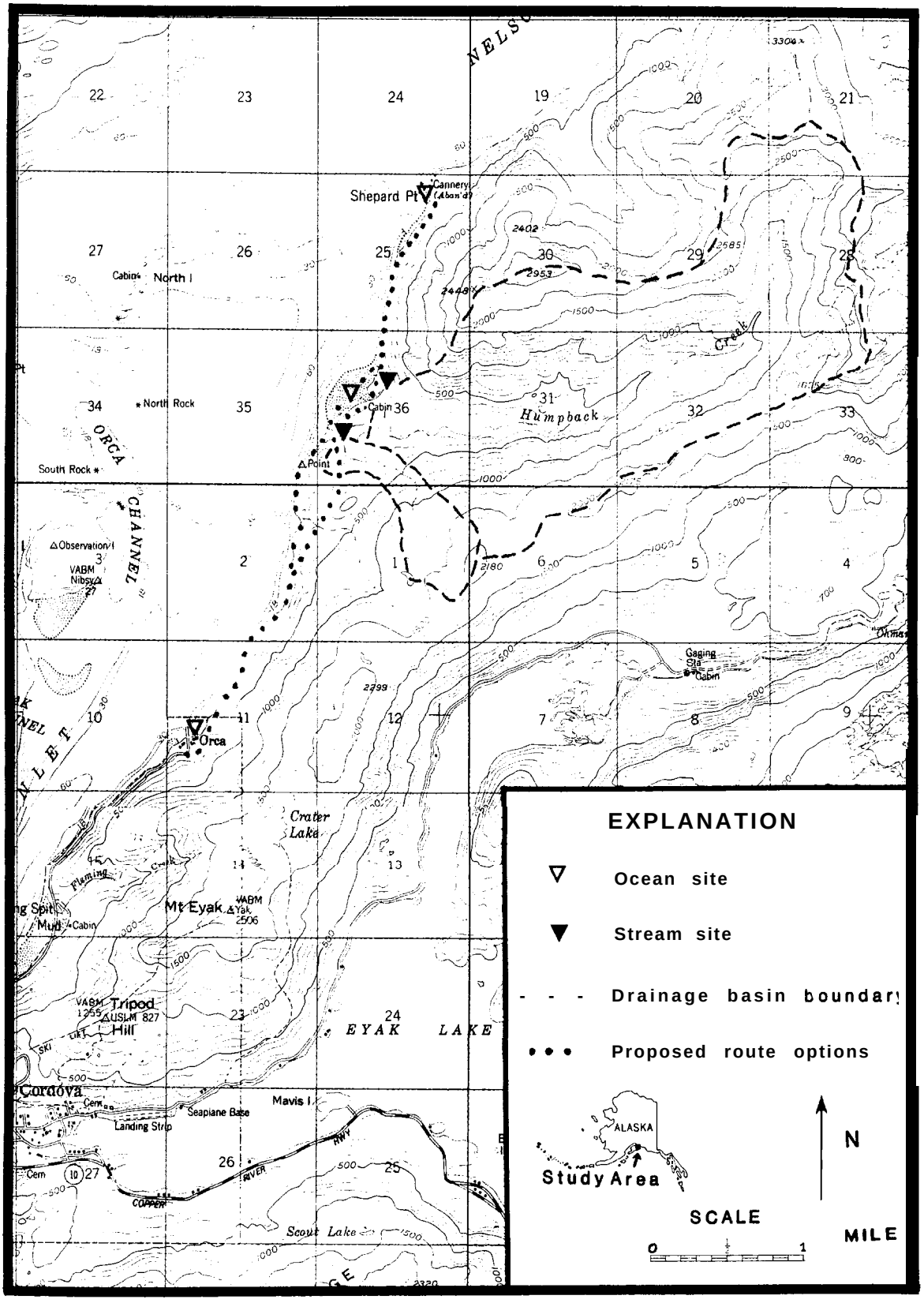


Figure 1. Study area, Orca Inlet, near Cordova, Alaska.

Precipitation in the area is heavy, and deep snowpack at higher elevations can persist into mid-summer. The nearest weather station is at the Orca cannery 1 mi north of Cordova, where the mean annual precipitation is 170 in. Fall is the wettest month with September averaging nearly 25 in. of rain, while June and July are typically drier with July averaging 6 in. of rain. Precipitation at the two study streams should be similar to Cordova, though precipitation increases in the higher areas of the drainage basins.

Humpback Creek is a clear water, anadromous stream 15-75 ft wide, with a streambed composed of gravel, cobbles, and boulders (see appendix A photos). The creek has a small, run-of-river hydropower installation, with the powerhouse located approximately 250 ft upstream of the mouth and the intake situated approximately 0.5 mi above the powerhouse. Water for the powerhouse is delivered via a penstock that runs adjacent to the south and west side of the channel down to the powerhouse, where the water is returned to the stream after passing through the power generation system.

The unnamed creek is a small, clear, anadromous stream 5-15 ft wide and flanked with heavy vegetation. The streambed is primarily composed of cobbles and boulders with lesser amounts of sand and gravel (see appendix A photos).

Streamflow Data

No long-term stream gaging data exists for either stream, but Humpback Creek does have two years of gage data (Oct. 1973-Sept. 1975) collected by the U.S. Geological Survey [USGS] (1975). The mean flow for the two years of record was 38.5 cubic feet per second (cfs) with a minimum recorded flow of 2 cfs and a maximum flow of 638 cfs. However, the first half of the period-of-record was abnormally dry, so the two year mean is misleading. The second half of the gaging record experienced near normal precipitation and the annual flow was 49 cfs (Carrick and Long, 1985); consequently, the long-term mean annual flow is probably closer to 40-50 cfs.

DMWM hydrologists visited Humpback Creek and the unnamed creek on July 12, 1994, to collect miscellaneous streamflow data. Discharge measurements were conducted on both streams using a Price Pygmy flow meter. Streamflow conditions were probably lower than normal for the time of year, because June was approximately 30% drier than normal, and no significant rain had fallen in the area for 7 days prior to the field measurements. Table 1 summarizes DMWM flow data for the two sites, while table 2 gives monthly flow data for Humpback Creek as collected by the USGS.

Table 3 provides a regression analysis developed by Orsborn and Storm (1991) that estimates mean monthly and extreme flows for both streams based on discharge data from other area streams. The regression analysis method is often used when little or no flow data is available for a particular stream. The regression formulas are valid for streams in different regions of the Chugach National Forest, and the derived figures compare favorably with flow data collected to date.

Based on the streamflow data presented in tables l-3, spring breakup occurs in April and the streams flow until November and December when freezing takes place. Humpback Creek streamflow is augmented over the drier summer months by snowmelt from the

Table 1. DMWM field discharge measurement data.

Stream Site	Date	Width (ft)	Avg Depth (ft)	Avg Vel (fps[1])	Discharge (cfs)
Humpback Creek	7/12/94	21.3	0.77	1.91	34.6
Unnamed Creek	7/12/94	5.4	0.49	0.41	1.2

Table 2. USGS (1975) Humpback Creek mean monthly flow (cfs), Oct. 1973--Sep. 1975.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
7.1	4.1	2.7	17	58	72	62	36	84	63	36	18	39

Table 3. Streamflow (cfs) estimates using Orsborn and Storm (1991) regression analysis[2].

Stream Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg	100-yr Flood
Humpback Creek	12	10	7.4	8.6	32	72	86	83	79	56	28	14	41	1596
Unnamed Creek	0.45	0.37	0.27	0.31	1.2	2.6	3.2	3.0	2.9	2.0	1.0	0.52	1.5	109

[1] feet per second

[2] 100-yr Flood is the estimated peak flow for a flood with a 100-year recurrence interval.

perennial snowfields in the basin, while flows in the unnamed creek will not be sustained during dry periods because of the lack of persistent snowfields or glaciers. Because both streams lie in relatively small confined basins, flooding effects would be limited in scope. However, large floods on Humpback Creek would spread out at the mouth and throughout the tidally influenced delta. Subsequent changes in channel alignment are possible as the stream deposits the large amounts of sand, gravel, and cobbles that are typically transported by flooding mountain streams like Humpback Creek.

WATER QUALITY

On-site Measurements

On-site water-quality measurements were taken at the two stream sites. Water temperature, dissolved oxygen concentration, pH, and specific conductance were measured with a model-4041 Hydrolab that was pre- and post-calibrated according to the instrument's operation and maintenance instructions (Hydrolab, 1981). Total alkalinity was determined by potentiometric titration with a digital titrator and a Beckman Φ 11 pH meter. Alkalinity was calculated using Gran's graphical methods (Stumm and Morgan, 1981). Total hardness was determined with a model-HA-DT test kit, manufactured by Hach Company, of Loveland, Colorado. Turbidity was determined with a PortaLab turbidimeter, model-l 6800, manufactured by Hach Company. Settleable solids were measured with lmhoff cones according to Standard Method 209 F of the American Public Health Association [APHA] (1989).

Field Sampling Procedure

Although no quality-assurance plan was written prior to sampling, water samples were collected in general accordance with the methods of the U.S. Geological Survey (1977).

Water for laboratory analysis of inorganic constituents and sediment was collected with a depth-integrated sampler in Humpback Creek and a dip bottle in the unnamed creek, which was too shallow for depth-integrated sampling. The water from the sampler or dip bottle was poured into a churn splitter (an 8-liter covered bucket with a churn and spigot) from which a set of five water samples per site were taken: total suspended sediment (unfiltered), total iron (unfiltered), dissolved cations (filtered), dissolved anions (filtered), and nutrients (filtered). The bottles for unfiltered samples were filled at the churn splitter's spigot while operating the churn, to ensure the water was well-mixed. Water for the filtered samples was drawn from the churn splitter with a MASTERFLEX hand pump equipped with silicone tubing and a 142-mm GEOTECH filter assembly containing a 0.45-pm membrane filter. The filter assembly was flushed with approximately 500-ml of filtrate prior to filling sample bottles. Water for gasoline range petroleum hydrocarbon/BTEX and diesel range petroleum hydrocarbon analyses was obtained by dipping the sample bottle below the stream's surface.

Samples were collected at the three ocean sites for the laboratory analysis of total suspended sediment, gasoline range petroleum hydrocarbons/BTEX, and diesel range

petroleum hydrocarbons. All water samples from the ocean were obtained by dipping the sample bottle below the surface of the water, approximately 10 ft from the shoreline.

All samples requiring acidification were collected in bottles that were precharged with preservative acid. Samples were placed in coolers and chilled with blue ice packs during transit to the laboratory. Samples were stored at 4°C in the laboratory until analyzed.

Laboratory Analyses

Water sample holding times, as described by the U.S. Environmental Protection Agency [USEPA] (1983) and Standard Methods (APHA, 1989), were not exceeded for any of the samples.

Analyses of inorganic constituents and sediment in water samples were conducted at the DMWM Water Quality Laboratory, located at the University of Alaska, Fairbanks. Turbidity was measured with a Turner nephelometer. Analytical methods and detection limits are listed on the analytical reports (appendix B). For each constituent analyzed, laboratory instruments were calibrated using National Bureau of Standards traceable standards, where applicable. General data reduction procedures are described in Standard Methods (APHA, 1989).

Analytical Technologies, Inc., located in Anchorage, Alaska, analyzed water samples to determine concentrations of gasoline range petroleum hydrocarbons, diesel range petroleum hydrocarbons and selected volatile organic compounds -- benzene, toluene, ethylbenzene, and xylene. The laboratory's analytical reports and quality assurance results are shown in appendix C.

Stream Sites

On-site measurements and test results are shown on table 4. Both streams have high dissolved oxygen concentrations and acidic pH. The water temperature of Humpback Creek was 6.5 °C, which was 3°C colder than the unnamed creek. Humpback Creek had a specific conductance of 26 µS/cm, compared to 57 µS/cm for the unnamed creek. Humpback Creek and the unnamed creek have total hardness values of 20 and 29 mg/L, respectively. Water having a hardness value less than 60 mg/L is considered soft, 61-120 mg/L is considered moderately hard, and 121-l 80 mg/L is considered hard (Hem, 1985).

Total suspended-sediment concentrations, settleable solids and turbidity are shown in table 5. Both streams have very low suspended-sediment concentrations and undetectable concentrations of settleable solids. Turbidity readings in both streams approach the lower limit of resolution of the turbidity instruments, which accounts for the slight difference between on-site- and laboratory-determined readings.

The results of the inorganic constituent analyses for water collected from Humpback Creek and the unnamed creek are shown in table 6. Complete analytical reports are presented in

Table 4. **On-site water-quality measurements taken in streams on July 12, 1994.**

Property or Constituent	Humpback Creek[1]	Unnamed Creek[2]	Water Quality Standard[3]
Discharge (cfs)	34.6	1.2	
Time (hours)	1400	1145	
Water temperature (°C)	6.5	9.5	≤ 13
Specific conductance (µS/cm)	26	57	
Dissolved oxygen (mg/L)	14.3	13.5	> 7
pH (units)	6.3	6.4	6.5(min.)--9.0 (max.)
Alkalinity, total (mg/L as $CaCO_3$)	14.2	33.8	
Hardness, total (mg/L as $CaCO_3$)	20	29	
Turbidity (NTU)	1.2	0.3	≤ 25 NTU above natural conditions
Settleable solids (ml/L)	<1	<1	

1 Site location is approximately 250 ft above high tide mark (120 ft upstream of bridge)
2 Site location is 150 ft above high tide mark
3 Alaska Water Quality Standards 18 AAC 70 (1989), based on 'growth and propagation of fish, shellfish, other aquatic life, and wildlife' water use designation

Table 5. Summary of total suspended sediment, turbidity, and settleable solids data for stream and ocean sites.

Site[1]	Total Suspended Solids (mg/L)	Turbidity (NTU)		Settleable Solids (ml/L)
		Field	Lab	
Humpback Creek	0.10	1.2	0.3	<1
Unnamed Creek	0.44	0.3	0.6	<1
Ocean at Shepard Point	5.83	6.5	1.3	not measured
Ocean at Humpback Creek	6.96	2.5	1.6	not measured
Ocean at Orca Cannery	6.67	3.3	1.8	not measured

[1] Site locations: Humpback Creek: 250 ft above high tide mark, 120 ft upstream of bridge, 1400 hrs
Unnamed Creek: 150 ft above high tide mark, 1145 hrs
Ocean at Shepard Point: 200 ft East of point, 1530 hrs (2 hrs before high tide)
Ocean at Humpback Creek: 200 ft NW of stream mouth, 1605 hrs (1 1/2 hrs before high tide)
Ocean at Orca Cannery: center of pilings at cannery, 1630 hrs (1 hr before high tide)

Table 6. Results from laboratory analyses for inorganic constituents. All concentrations reported in milligrams per liter (mg/L).

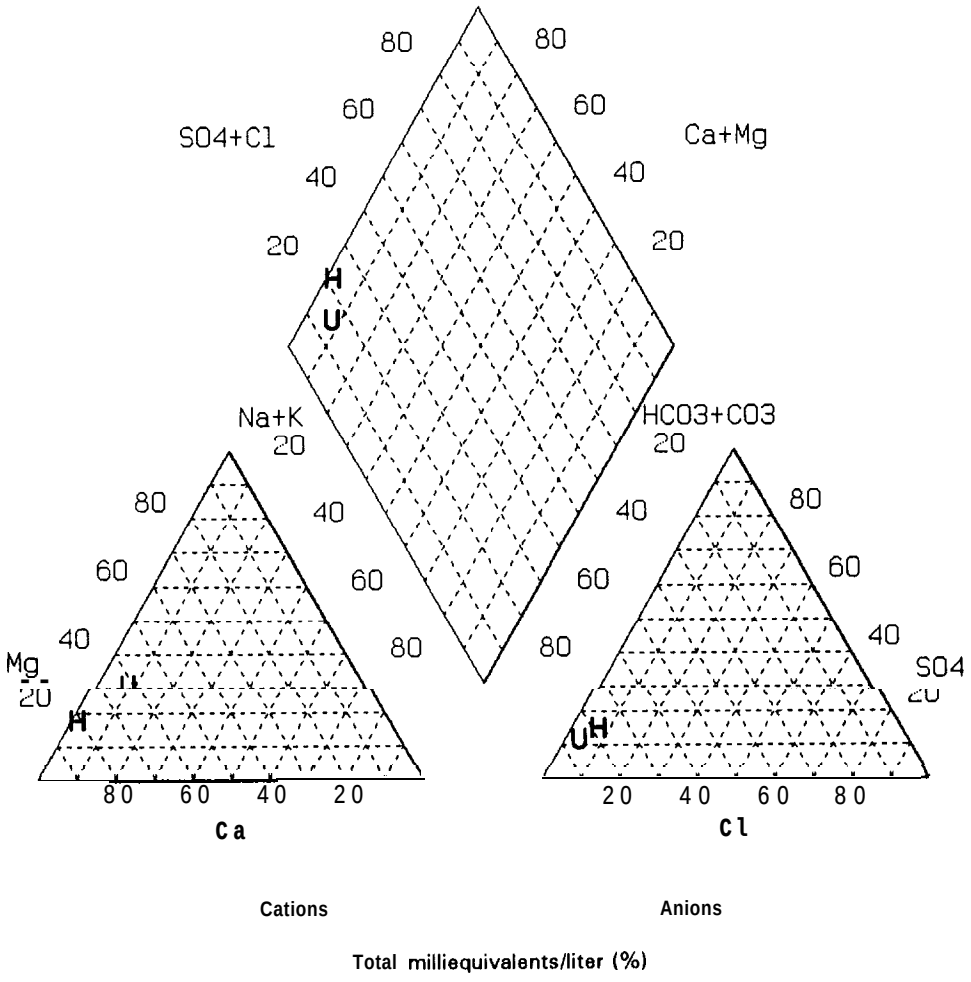
Constituent	Form	Humpback Creek	Unnamed Creek	MCL[1]
Major Ions				
Calcium	dissolved	6.09	9.17	
Magnesium	dissolved	0.76	2.75	
Sodium	dissolved	<0.03	1.00	250
Potassium	dissolved	0.27	0.59	
Bicarbonate[2]	total	17.3	41.2	
Chloride	dissolved	0.86	1.09	250
Sulfate	dissolved	2.47	4.26	250
Fluoride	dissolved	0.15	0.21	4.0
Silica	dissolved	3.49	3.75	
Dissolved solids[3]		22.6	43.0	500
Nutrients				
Nitrate as N	dissolved	0.07	0.03	10
Phosphate as P	dissolved	<0.05	<0.05	
Metals				
Iron	total dissolved	0.26 0.11	0.09 0.08	0.3

[1] MCL = maximum contaminant level *in* Alaska Drinking Water Regulations (1994) 18 AAC 80.070
[2] Bicarbonate, computed value (based on the on-site alkalinity measurement)
[3] Sum of constituents, computed value (based on the sum of dissolved-constituent concentrations)

appendix B. Both streams have low mineralization, indicated by low specific conductance measurements and total dissolved solid concentrations less than 50 mg/L.

A trilinear diagram is used to illustrate the chemical character or "water type" of a stream (Hem, 1985). Ratios of selected cations (calcium, magnesium, and sodium plus potassium) and anions (bicarbonate, chloride, and sulfate) for each water analysis are shown in a trilinear diagram as percentages of the total cations and anions, in milliequivalents per liter (meq/L). Thus a "water type" can be described on the basis of predominant cations and anions found in the water. Humpback Creek and the unnamed creek have calcium bicarbonate water (fig. 2). These data indicate that the streams have similar geochemistry.

Concentrations of volatile organic compounds (benzene, toluene, ethylbenzene, and xylene), gasoline range hydrocarbons, and diesel range hydrocarbons were below analytical detection limits in both streams (table 7).



EXPLANATION

Svmbol	Site	Water type
H	Humpback Creek	Calcium bicarbonate
U	Unnamed Creek	Calcium bicarbonate

Figure 2. Trilinear diagram showing water-type classification of water collected from Humpback Creek and unnamed creek on July 12, 1994.

Table 7. Summary of hydrocarbon analyses at stream and ocean sites.

Site	Time Sampled (hours)	Benzene, total (mg/L)	Toluene, total (mg/L)	Ethyl-benzene, total (mg/L)	Xylene, total (mg/L)	Gasoline Range Organics, as Gasoline (mg/L)	Diesel Range Organics, as Diesel (mg/L)
Humpback Creek	1534	<0.005	< 0.005	<0.005	< 0.005	<1.0	co.25
Unnamed Creek	1145	co.005	< 0.005	co.005	< 0.005	< 1 .o	<0.25
Ocean at Shepard Point	1545	co.005	< 0.005	< 0.005	< 0.005	c l . 0	<0.25
Ocean at Humpback Cr.	1605	< 0.005	<0.005	< 0.005	< 0.005	<1.0	<0.25
Ocean at Orca Cannery	1630	< 0.005	co.005	<0.005	< 0.005	< 1 .o	<0.25
Trip Blank		< 0.005	< 0.005	< 0.005	< 0.005	C l . 0	

Ocean Sites

Total suspended sediment concentrations at the three ocean sites were low, ranging from 5.83 to 6.96 mg/L (table 5). Turbidity measurements were similar among sites, ranging from 1.3 to 6.5 nephelometric turbidity units (NTU). Different sample aliquots were used for on-site- and laboratory-determined turbidity measurements, which account for the small range in turbidity readings for each site.

The concentrations of benzene, toluene, ethylbenzene, xylene, gasoline range petroleum hydrocarbons, and diesel range petroleum hydrocarbons were below their respective analytical detection limit at all three ocean sites (table 7).

Water-quality Impacts

The most probable water-quality impacts to streams and coastal waters within the proposed road are an increase in suspended-sediment concentrations and turbidity. Heavy precipitation and steep topography in the project area make disturbed areas subject to soil erosion. Vegetation removal, blasting, culvert installation, and dredge and fill operations will contribute to increased sediment loading. Landslides and avalanches are other possible sources of sediment loading in streams and coastal waters. Erosion control measures during and after road construction will be needed to lessen the impacts of sediment loading and increased turbidity in the lower reaches of streams and the nearshore waters of Orca Inlet.

SUMMARY

This report presents a “snap-shot” look at the hydrology and water quality of two streams and coastal waters of Orca Inlet that are within the proposed Shepard Point road corridor. Water-quality findings are based on one field visit on July 12, 1994. Under summer low streamflow conditions, the streams have low temperatures, high dissolved oxygen concentrations, acidic pH, and low specific conductance. Hardness values in both streams are indicative of ‘soft’ water. Both streams have low concentrations of soluble minerals, and calcium bicarbonate water. The waters of Humpback Creek and the unnamed creek meet Alaska Water Quality Standards for the inorganic and organic constituents that were analyzed. Suspended sediment concentrations and turbidity are low in both streams and Orca Inlet. No contamination by gasoline range petroleum hydrocarbons, diesel range petroleum hydrocarbons, or select volatile organic compounds was detected in stream and nearshore coastal marine waters of Orca Inlet.

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APPENDIX A

Photographs

Orca Cannery, on Orca Inlet, near Cordova, Alaska. July 12, 1994

Stan Carrick measuring stream discharge of an unnamed creek, 1/4 mile south of Humpback Creek, near Cordova, Alaska. July 12, 1994

Stan Carrick measuring stream discharge of Humpback Creek, near Cordova, Alaska. July 12, 1994

Mary Maurer collecting water with a depth-integrating sampler in Humpback Creek, near Cordova, Alaska. July 12, 1994

Mary Maurer collecting water with a depth-integrating sampler in Humpback Creek, near Cordova, Alaska. July 12, 1994

Mary Maurer collecting water with a depth-integrating sampler in Humpback Creek, near Cordova, Alaska. July 12, 1994

Mary Maurer collecting water with a depth-integrating sampler in Humpback Creek, near Cordova, Alaska. July 12, 1994

Water-quality sampling site at Shepard Point, Orca Inlet, near Cordova, Alaska July 12, 1994

Shepard Point, Orca Inlet, near Cordova, Alaska. July 12, 1994

Intertidal area of Humpback Creek, Orca Inlet, near Cordova, Alaska July 12, 1994

Stan Carrick collecting water for hydrocarbon analysis in Humpback Creek, near Cordova, Alaska. July 12, 1994

Stan Carrick taking turbidity measurement at ocean site, intertidal area of Humpback Creek, Orca Inlet, near Cordova, Alaska. July 12, 1994

Landslide area along Orca Inlet, 1/2 mile north of Humpback Creek, near Cordova, Alaska.

Landslide area along Orca Inlet, 1/2 mile north of Humpback Creek, near Cordova, Alaska. July 12, 1994

Intertidal area of Humpback Creek, Orca Inlet, near Cordova, Alaska. July 12, 1994

Orca Inlet, looking north towards Shepard Point, near Cordova, Alaska July 12, 1994

Water-quality sampling site (center of photo, 10 ft from shore) at Orca Cannery, Orca Inlet, near Cordova, Alaska. July 12, 1994

Orca Cannery, on Orca Inlet, near Cordova, Alaska. July 12, 1994

APPENDIX B

Laboratory analytical reports of DMWM Water Quality Laboratory

State of Alaska
Department of Natural Resources / Division of Water
WATER QUALITY LABORATORY
209 O'Neill University of Alaska Fairbanks Fairbanks, Alaska 99775 (907)474-7713

Project: Shepard Point

Submitted By: Mary Maurer

Date Submitted: 13 July 94

Sample	Calcium	Magnesium	Sodium	Potassium	Silica
Humpback Cr	6.09	0.76	co.03	0.27	3.49
Unnamed Cr	9.17	2.75	1.00	0.59	3.75
units	mg/L	mg/L	mg/L	mg/L	mg/L as Si02
EPA Method	AES 0029	AES 0029	273.1	258.1	AES 0029
Detection Limit	0.01	0.01	0.1	0.01	0.1
RPD	6.7	5.6	1.7	3.8	3.2
% Recovery	102	95	102	103	95

Approved By _____ Date 9AUG94

Jim Vohden, Chemist

State of Alaska
Department of Natural Resources / Division of Water
WATER QUALITY LABORATORY
209 O'Neill University of Alaska Fairbanks Fairbanks, Alaska 99775 (907)474-7713

Project: Shepard Point

Submitted By: Mary Maurer

Date Submitted: 13 July 94

Sample	Fluoride	Chloride	Nitrate	Phosphate	Sulfate
Humpback Creek	0.15	0.86	0.07	co.05	2.47
Unnamed Creek	0.21	1.09	0.03	co.05	4.26
Units	**mg/L**	**mg/L**	**mg/L as N**	**mg/L as P**	**mg/L**
EPA Method	340.2	300.0	300.0	300.0	300.0
Detection Limit	0.01	0.01	0.02	0.05	0.01
RPD	3.8	2.3	5.3	5.7	1.6
% Recovery	93	90	92	98	90

Approved By _____ Date 9 AUG 94

Jim Vohden, Chemist

State of Alaska
Department of Natural Resources / Division of Water
WATER QUALITY LABORATORY
209 O'Neill University of Alaska Fairbanks Fairbanks, Alaska 99775 (907)474-7713

Project: Shepard Point

Submitted By: Mary Maurer

Date Submitted: 13 July 94

Sample	Iron, Dissolved	Iron, Total
Humpback Cr	0.11	0.26
Unnamed Cr	0.08	0.09
units	mg/L	mg/L
EPA Method	AES 0029	AES 0029
Detection Limit	0.03	0.03
RPD	6.4	5.7
% Recovery	92	98

Approved By _____ Date 9AUG94

Jim Vohden, Chemist

State of Alaska
Department of Natural Resources / Division of Water
WATER QUALITY LABORATORY
209 O'Neill University of Alaska Fairbanks Fairbanks, Alaska 99775 (907)474-7713

Project: Shepard Point

Submitted By: Mary Maurer

Date Submitted: 13 July 94

Sample	Turbidity	Total Suspended Solids
Humpback Cr	0.30	0.10
Unnamed Cr	0.60	0.44
Ocean near Humpback Cr	1.6	6.96
Orca Cannery	1.8	6.67
Shepard Point	1.3	5.83
units	NTU	mg/L
EPA Method	180.1	160.2
Detection Limit	0.1	0.1

Approved By _____ Date 9AUG94

Jim Vohden, Chemist

APPENDIX C

Laboratory analytical reports of Analytical Technologies, Inc.

Client: Alaska Department of Natural Resources

Project Name: --

Case Narrative for

Sample Control

The following samples were received in good condition on 7/13/94.

The samples were rececived cool and the tempature recorded on the COC.

Client ID	Laboratorv ID
Ocean @ Orca Cannery	407018 1
Unnamed Stream S.	407018 2
Humpback Stream	407018 3
Ocean Near Humpback Cr.	407018 4
Ocean at Shepard Ft.	407018 5
Trip Blank	407018 6

BTEX/GRO by **8020/8015** Extraction: 5030 Analysis: 8020m/8015m

No problems encountered.

DRO by 8100 Extraction: 3540 Analysis: 8 1 00m

No problems encountered.

Analytical **Technologies,** Alaska

2000 W. International Airport Rd. Ste. C6
Anchorage, Ak 99502

SUMMARY REPORT of ANALYSIS

Report Date: 7/21/94

Client: Alaska Department of Natural Resources
Address: P.O Box 107005
Anchorage, AK995 10
Project ID: --
Lab Accession: 4070 18
Date Received: 7/13/94
Matrix: Water

Contact: Mary Maurer
Phone: (907)762-2575
Fax: (901)562-1384

Reviewed By: C. Homestead

Client Sample	Lab Accession #	Date Collected	% Solid	Conc. Benzene (mg/L)	Conc. Toluene (mg/L)	Conc. Ethyl-Benzene (mg/L)	Conc. Total Xylene (mg/L)	Conc. GRO as Gasoline (mg/L)	Conc DRO as Diesel (mg/L)	Conc RRO as 10w40 oi (mg/L)
WRB	--	--	--	co.005	<0.005	co.005	co.005	<1.0	<10	--
Ocean @ Orca Cannery	407018 1	7/12/94	--	co.005	co.005	co.005	co.005	<1.0	<0.25	--
Unnamed Stream S.	407018 2	7/12/94	--	co.005	co.005	co.005	co.005	<1.0	<0.25	--
Humpback Stream	407018 3	7/12/94	--	<0.005	co.005	co.005	co.005	<1.0	<0.25	--
Ocean Near Humpback Cr.	4070 18 4	7/12/94	--	co.005	co.005	co.005	co.005	<1.0	<0.25	--
Ocean at Shepard Ft.	407018 5	7/12/94	--	co.005	co.005	co.005	co.005	<1.0	<0.25	--
Trip Blank	407018 6	7/8/94	--	co.005	co.005	co.005	co.005	<1.0	--	--

Analytical Technologies, Alaska

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REPORT of ANALYSIS 8020(mod)/8015(mod)

Method 5030/8020m/8015m

Report Date: 7/2 1/94

Client: Alaska Department of Natural Resources
P.O Box 107005
Anchorage, AK995 10

Contact: Mary Maurer
Phone: (907)762-2575
Fax: (901)562-1384

Project ID: --
Lab Accession: 407018
Date Received: 7/13/94
Date Extracted:
Matrix: Water

Analyst:

Client Sample	Lab Accession #	Date Collected	Date Analyzed	% Solid	Dilution	Surrogate% Recovery 8020	Surrogate% Recovery GRO	Benzene conc. (mg/L)	Benzene PQL (mg/L)	Toluene conc. (mg/L)	Toluene PQL (mg/L)	Ethylbenzene conc. (mg/L)	Ethylbenzene PQL (mg/L)	Total Xylene conc. (mg/L)	Total Xylene PQL (mg/L)	GRO as Gasolin conc. (mg/L)	GRO as Gasolin PQL (mg/L)
X	SRB	X	7/14/94	--	1	104	97	ND	0.040	ND	0.040	ND	0.040	ND	0.040	ND	1.0
Ocean @ Orca Cannery	407018 1	7/12/94	7/14/94	--	1	111	93	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
Unnamed Stream S.	407018 2	7/12/94	7/14/94	--	1	103	90	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
Humpback Stream	407018 3	7/12/94	7/14/94	--	1	104	89	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
Ocean Near Humpback Cr.	407018 4	7/12/94	7/14/94	--	1	100	83	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
Ocean at Shepard Ft.	407018 5	7/12/94	7/14/94	--	1	100	87	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
Trip Blank	407018 6	7/8/94	7/14/94	--	1	110	91	ND	0.005	ND	0.005	ND	0.005	ND	0.005	ND	1.0
- - - -																	

QC Limits for Surrogate %Recovery: BTEX/GRO 50 - 150

Matrix Spike and Blank Spike Report for BTEX/GRO

Client: Alaska Department of Natural Resources
P.O Box 107005
Anchorage, AK995 10

Contact: Mary Maurer
Phone: (907)762-2575
Fax: (901)562-1384

Project ID: --
Lab Accession: 4070 18
Date Received: 7/13/94
Date Extracted: --
Matrix: Water
Non-Spiked Sample: **40701801**

Analyst: _____

Analyte	Sample Conc.	Spike Conc. (mg/L)	Matrix spike Conc.(mg/L)	Spike Dup Conc.(mg/L)	Matrix spike % recovery	Spike Dup % recovery	RPD	QC Limits RPD	QC Limits % Rec
Benzene	ND	0.050	**0.053**	0.055	**106**	**110**	**3.7**	**30**	50-150
Toluene	ND	**0.050**	**0.052**	**0.056**	**104**	**112**	**7.4**	**30**	**50-150**
Ethylbenzene	ND	**0.050**	**0.054**	**0.055**	**108**	**110**	**1.8**	**30**	**50-150**
Total Xylene	ND	**0.150**	**0.161**	**0.168**	**- 1 0 7**	**112**	**4.3**	**30**	50-150
GRO*	ND	5.0	4.9	**4.7**	98	94 - -	**4.2**	**30**	**50-150**

Blank Spike Summary

Analyte	Spike Conc (mg/L)	Matrix spike Conc.(mg/L)	Matrix spiker % recovery	% Rec
Benzene	0.05	**0.05**	**104**	**50-150**
Toluene	**0.05**	**0.05**	**102**	**50-150**
Ethylbenzene	**0.05**	**0.05**	**104**	**50-150**
Total Xylene			104	50-150
GRO*	0515	5.2	104	50-150

*GRO as Gasoline

REPORT of ANALYSIS 8100(mod)

Method 8 1 00m

Report Date: 7/21/94

Client: Alaska Department of Natural Resources
P.O Box 107005
Anchorage, AK995 10

Contact: Mary Maurer
Phone: (907)762-2575
Fax: (901)562-1384

Project ID: --
Lab Accession: 4070 18
Date Received: 7/13/94
Date Extracted:
Matrix: Water

Analyst:

Client Sample	Lab Accession #	Date Collected	Date Analyzed	% Solid	Dil-ution	Surrogate % Rec 8100	DRO as Diesel Conc (mg/Kg)	PQL	RRO as 10w40oil Conc (mg/Kg)	PQL
WRB 6/694	--	--	6/18/94	--	1	74	ND	0.25	—	--
Ocean @ Orca Cannery	407018 1	7/12/94	7/18/94	--	1	74	ND	0.25	--	--
Unnamed Stream S.	407018 2	7/12/94	7/18/94	--	1	74	ND	0.25	--	--
Humpback Stream	407018 3	7/12/94	7/18/94	--	1	62	ND	0.25	—	--
Ocean Near Humpback Cr.	4070 18 4	7/12/94	7/18/94	---	1 1	881	ND	0.25	—	--
Ocean at Shepard Ft.	407018 51	7/12/94	7/18/94	--	1	55	ND	0.25	--	--
Trip Blank	407018 61	--	--	--	--	--	--	--	--	--

** **Surrogate** diluted beyond quantitation

Matrix Spike and Blank Spike Report for DRO

Client: Alaska Department of Natural Resources
P.O Box 107005
Anchorage, AK995 10

Contact: Mary Maurer
Phone: (907)762-2575
Fax: (901)562-1384

Project ID: --
Lab Accession: 4070 18
Date Received: 7/13/94
Date Extracted: 7/13/94
Matrix: Water

Blank Spike Summary

Analyte	Spike Conc (mg/L)	Matrix spike Conc.(mg/L)	Spike Dup Conc.(mg/L)	Matrix spike % recovery	Spike Dup % recovery	RPD	QC Limits RPD	QC Limits %Rec
DRO*	1.20	0.74	0.72	62	60	3	30	50-150

*DRO as diesel