Eyak – Heney Landscape Assessment
Cordova Ranger District
Chugach National Forest

09/30/2002

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Executive Summary

This Eyak-Heney Landscape Assessment is an ecosystem analysis at the landscape scale; it is both an analysis and an information gathering process. The purpose is to develop and document an understanding of the processes and interactions occurring in the Eyak-Heney Watersheds.

The assessment focuses on the issues and key questions identified for this analysis area. The area is described in terms of its biological, physical, and social features. Types of information used in the analysis include water uses, vegetative patterns and distribution, disturbance factors, fish and wildlife species and their habitats, hydrology, soils, and human use patterns including heritage, subsistence, and recreation.

The Chugach Forest Land and Resource Management Plan was revised and the Record of Decision signed in May 2002. Landscape analyses are an intermediary step between the Forest Plan and project implementation. They provide a means of refining the desired condition of the landscape given the goals and objectives, management prescriptions, and standards and guidelines from the Forest Plan, current policy and other applicable State and Federal regulations. They illustrate how the Forest Plan can be implemented in a particular area. The resulting report is not a decision document.

This analysis area encompasses 61,160 acres called the Eyak – Heney Landscape association. A team of resource specialists from the Cordova Ranger District and Chugach National Forest Supervisor's Office prepared this assessment. During the analysis, participation and involvement of other Federal and State Agencies, City of Cordova, local Tribal Governments, and landowners was encouraged. A public meeting was held August 28, 2002.

Following are the six steps used to conduct the analysis and corresponding chapters in this report.

Step 1 – Characterize area (Chapter 2)
Step 2 – Identify Key Issues and Questions (Chapter 3)
Step 3 – Describe Current conditions (Chapter 2, 4)
Step 4 – Describe Historical Conditions (Chapter 2, 4)
Step 5 – Interpretation & Synthesis (Chapter 4)
Step 6 – Make Recommendations (Chapter 5)

Chapter 1 – Introduction

Purpose

This Eyak-Heney assessment is an ecosystem analysis at the landscape scale; it is both an analysis and an information gathering process. One goal is to develop and document an understanding of the processes, interactions and issues occurring in the Eyak-Heney watershed association, displayed in Figure 1.1. Another goal is to identify and prioritize restoration and land management actions necessary to achieve the desired future condition for the area as described in the Revised Chugach Forest Land Management Plan.

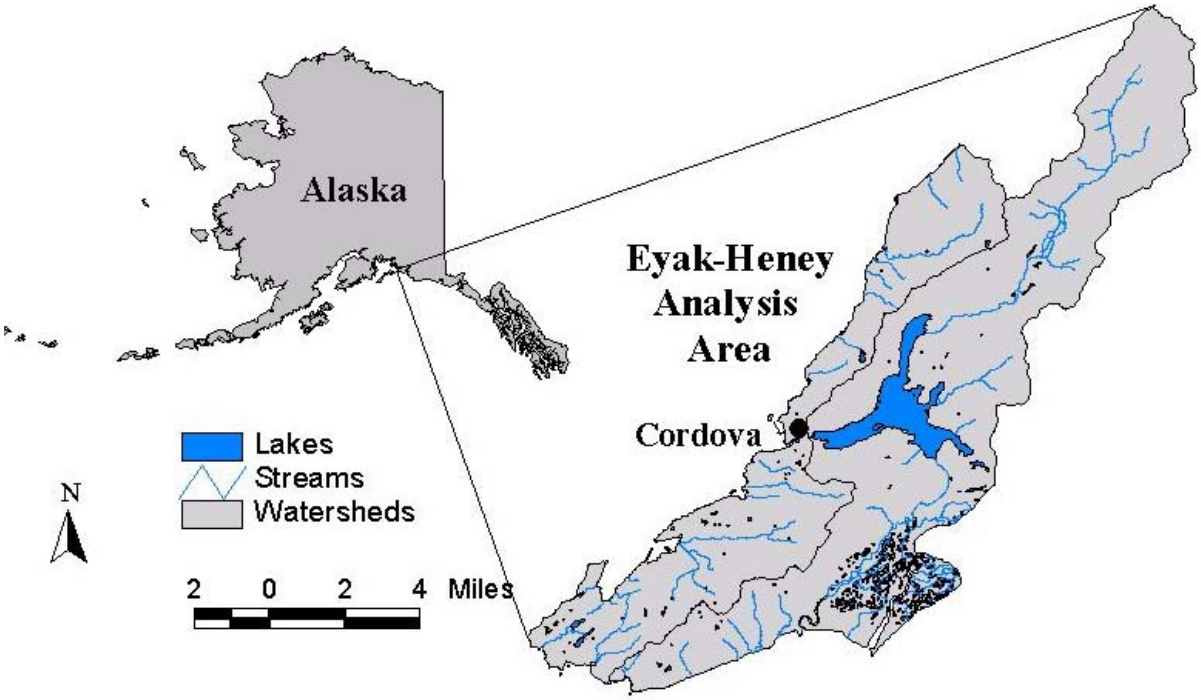

Figure 1.1: Location of the Eyak-Heney landscape analysis area.

The Analysis Area

This analysis addresses an area that covers approximately 61,160 acres surrounding Cordova, Alaska. It includes two main watersheds, Eyak River and Lake and the Heney range. These two watersheds are bounded by Orca Inlet on the northwest, Copper River flats on the south, Eyak River on the southeast, and the Scott River drainage on the northeast.

The Eyak-Heney analysis area is the portion of the Cordova Ranger District that receives the greatest human use. It includes the town of Cordova, outlying homes, and areas used by people to hunt, fish, trap, hike, snowmobile, and ski. The area has a mix of ownerships,

including City, State, Eyak Native Corporation, and other private landowners. Figure 1.2, on page 3, displays the land status in the area, and Table 1.1 summarizes the acreage for each. Approximately 21,250 acres of National Forest System land were conveyed to Eyak Native Corporation in the 1980's. Timber was harvested from portions of these lands. In 1998**,** the *Exxon Valdez* Oil Spill (EVOS) Trustee council bought about 15,260 acres of this land back from the Eyak Native Corporation and transferred the lands back to the National Forest System. The landowner controls access to their lands where the Forest Service has timber and conservation easements. In most cases this is most often Eyak Native Corporation. Chugach Alaska Corporation retained subsurface rights on portions of the lands that were bought from the Eyak Native Corporation and became National Forest System land. On these lands, the Forest Service administers the surface resources and public access and Chugach Alaska Corporation is entitled to access for exploration and development of the subsurface estate such as minerals, oil, and gas.

Table 1.1: Summary of land ownership

Ownership	Acres	Percent of area
National Forest	28,874.0	47.2%
State of Alaska	2,898.9	4.7%
Private	1,754.0	2.9%
Eyak Native Corporation	5,992.0	9.8%
USFS Conservation Easement on Eyak lands	819.9	1.3%
USFS Timber Easement on Eyak lands	3,692.7	6.0%
Selected by Eyak Corp.	1,279.3	2.1%
USFS Surface, Chugach Alaska Corp. - Subsurface	10,537.5	17.2%
Selected - State	2,949.2	4.8%
Fresh water (Lake Eyak)	2,364.0	3.9%
Total	61,161.5	100%

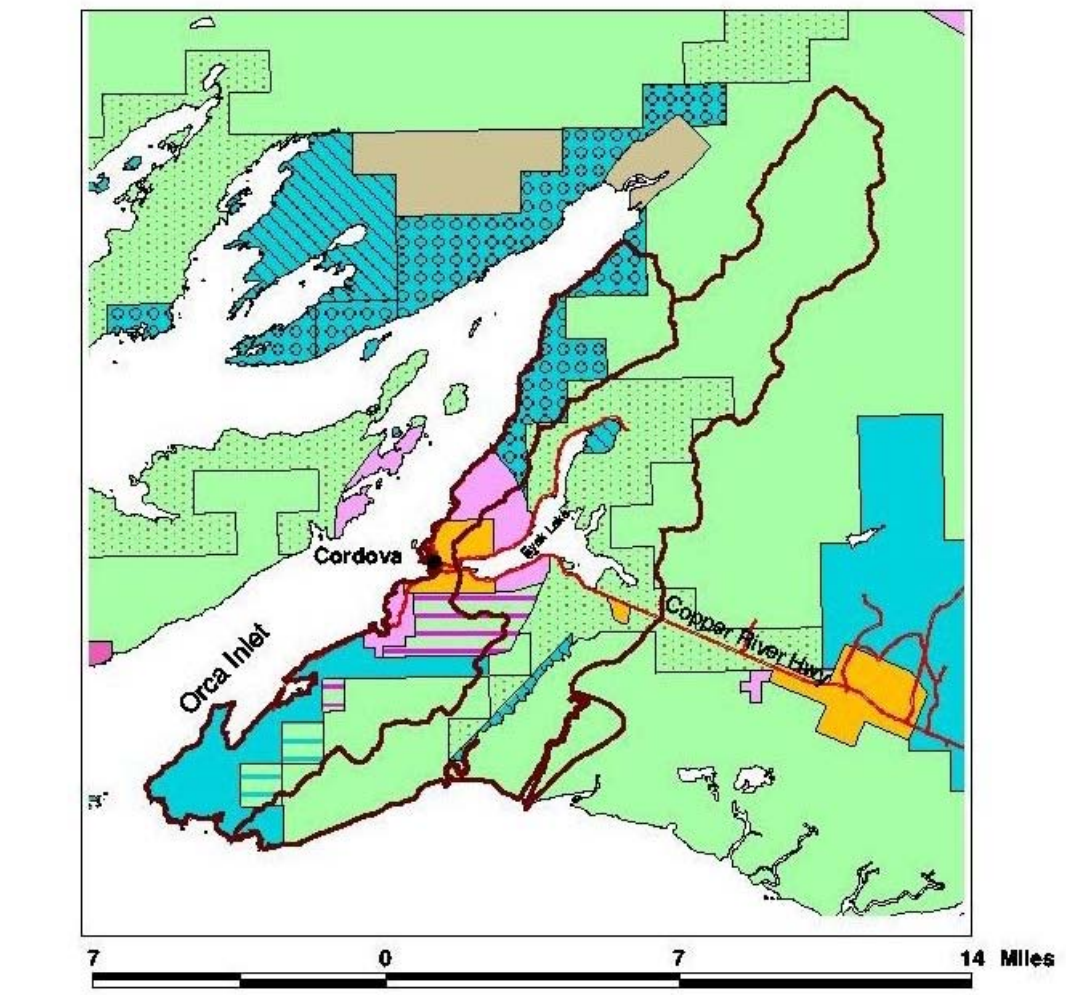

Figure 1.2: Land status in the Eyak-Heney landscape analysis area

Relationship to the Revised Chugach Land Management Plan

The Chugach Forest Land and Resource Management Plan was revised and the Record of Decision signed in May 2002. Chapter 2 of the Revised Forest Plan outlines Forest-wide direction, goals and objectives, and standards and guidelines that apply to this area. Chapter 3 of the Forest Plan gives detailed description of the management prescriptions and site specific standard and guidelines that apply to each planning polygon in this analysis area. This analysis area includes planning polygons C067 through C073, C077, C079, C081, C092, C095, and C146. Forest Plan prescriptions for the area range from primitive, backcountry, to ANILCA 501(b)-2. Table 1.2 and Figure 1.3 display the management direction for the area. The type of motorized use allowed also varies across the analysis area. If the summer motorized use direction is "Open to all motorized use", it includes off-highway vehicles (OHV's), helicopters, and airboats on land between May 1 and November 30. If the winter recreation motorized direction is "Open to all motorized use", it includes snow machines, helicopters, and other craft from December 1 through April 30.

The EVOS fee simple lands have specific management goals that reflect the goals of the *Exxon Valdez* Oil Spill Settlement and purchase agreement. Lands acquired under the EVOS purchases are surface estate or surface conservation easements. The Chugach Alaska Corporation reserves the subsurface title and is entitled to access for exploration and development of the subsurface estate such as minerals, oil, and gas.

Table 1.2: Management direction for planning polygons in landscape analysis area

Watershed #	Overall Prescription	Summer Recreation motorized use	Winter Recreation Motorized Use
C067, C068	210: Backcountry	Open to All Motorized Use	Open to all Motorized Use
C069	210: Backcountry - Selected for conveyance. Contains municipal watershed	Closed to motorized use, except for subsistence *There is a section closed to OHV.	Open to all motorized use
C070, C079, C146	213: ANILCA 501(b)-2	Closed to motorized use, except for subsistence	Open to all motorized use
C071, C073, C081	221: EVOS fee simple - with other subsurface ownership or term interests	Closed to motorized use (EVOS acquisition)	Closed to motorized use (EVOS acquisition)
C072	111: Primitive	Closed to all motorized use	Closed to all motorized Use
C077, C092	210: Backcountry	Closed to motorized use, except for subsistence	Open to all motorized use
C095	210: Backcountry - contains municipal watershed	Closed to motorized use, except for subsistence. *There is a section closed to OHV.	Open to all motorized use

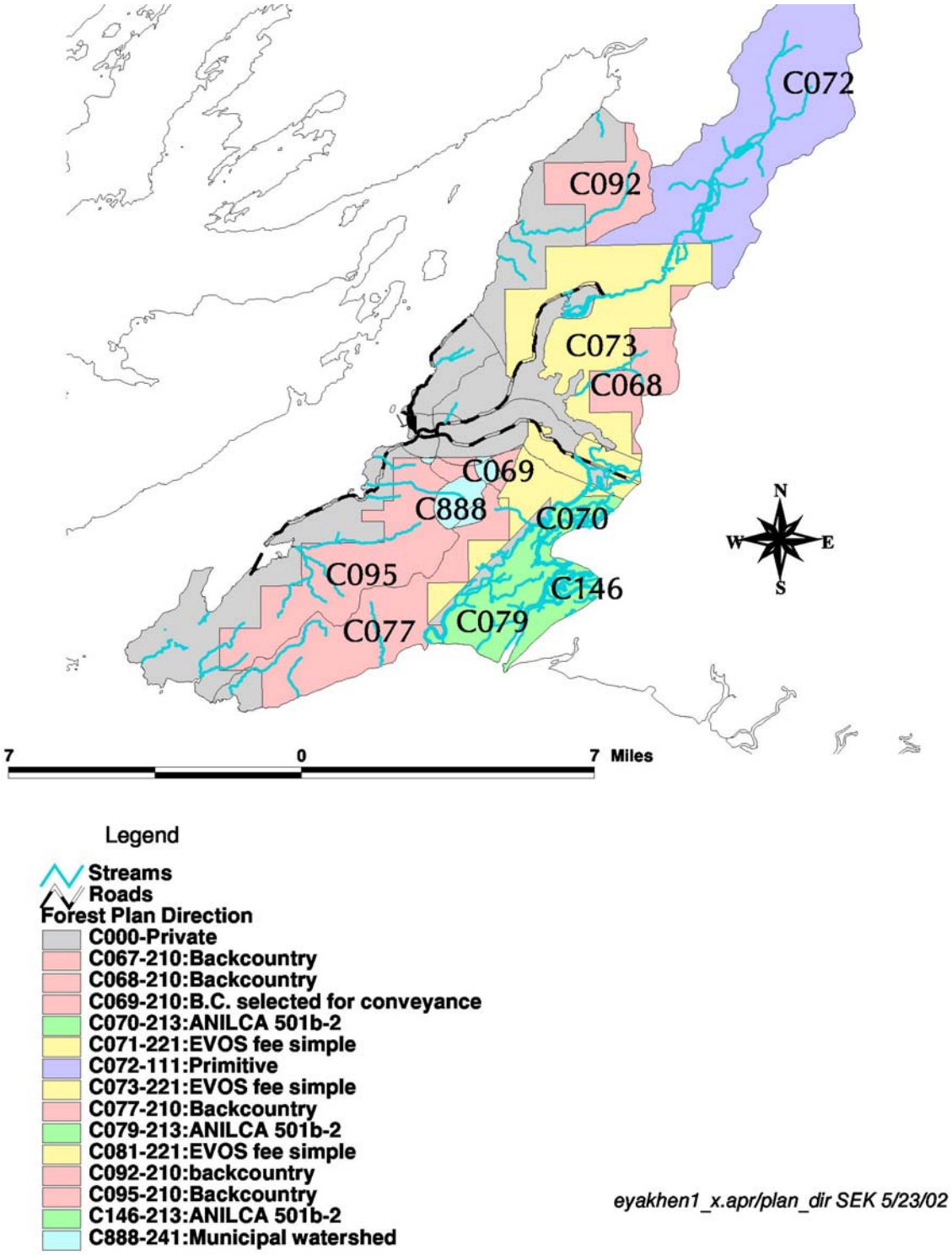

Figure 1.3: Forest Plan prescriptions for Eyak-Heney analysis area

Chapter 2 – Analysis Area Description

Physical Characteristics

Geographic Location

The Eyak-Heney Landscape assessment addresses a 61,160-acre area that lies east of Prince William Sound on the mainland surrounding the town of Cordova, Alaska. The analysis area consists of many small watersheds bounded by the Gulf of Alaska to the south, Orca Inlet and the Rude River to the northwest, the Scott Glacier to the northeast, and the flat, tidal marshland environment of the Copper River Delta to the east. Eyak Lake and the city of Cordova lie in the low gap between the Chugach Range to the north and the Heney Range, a sub-range of the Chugach Mountains, to the south. Power Creek is the largest stream draining into Eyak Lake and the only glacially fed stream in this analysis area. Figures 2.1 and 2.2 are photos of the Eyak-Heney analysis area.

Figure 2.1: Looking northeast across the Eyak-Heney Analysis area toward Cordova and the Chugach Mountains.

(Orca Inlet is on the left, and the North Arm of Eyak Lake is on the right.)

Figure 2.2: View of Heney Range, looking northwest.

Eyak River meanders at the base of the Heney Range in the Scott River outwash plain.

Climate

The analysis area lies within the Humid Temperate Domain of ECOMAP (ECOMAP1993) and has a maritime climate with annual precipitation ranging from 100 – 200 inches, most falling as rain. Annual snowpacks range from 20 inches at sea level near the southern end of the Heney range to 160 inches at higher elevations northeast of Mount Eyak. The Cordova area experiences cool summers, mild winters, and heavy precipitation year round. Generally, this area has a high incidence of cloudiness with low seasonal and diurnal temperature variations. Strong winds and storms from the Gulf of Alaska are common. Historical weather records are available from 2 stations, Cordova North near Cordova (1955 to 1972 and 1986 to 2000) and the Merle K. "Mudhole" Smith Airport, 9 miles east of Cordova and 5 miles inland from the Gulf of Alaska (1946 to 2000) (WRCC, 2002). The locations of weather and stream gauging stations are displayed in Figure A-1 located in Appendix A. The Eyak Hydrologic Condition Assessment located in the planning record contains tables that compile station metadata, daily temperatures, monthly climate summary, and snowfall and precipitation records for Cordova and the Airport.

Storms normally circulate counterclockwise in the Gulf of Alaska, and weather and winds in Cordova generally come from the east. The average wind speed is 4.5 knots (4.8 mph). However, storms commonly have surface winds occasionally reaching 75 to over 100 mph, and these strong winds are common in the Copper River Delta. These winds gust into Cordova through the "Eyak Gap," the low valley containing Eyak Lake. As moisture-laden clouds move across the Copper River Delta and encounter the lofty Heney Range, the moist air is lifted and cooled, resulting in abundant precipitation in the Cordova area (Professional Fishery Consultant, 1982). This causes snow to build up on the west sides of high alpine peaks and ridges, creating permanent snowfields in the mountains northeast of Cordova. Also,

precipitation in Cordova is significantly higher than at the Cordova Airport, located 9 miles east.

In Cordova, the mean annual temperature is 41.5° F, the mean minimum January temperature is 24.0° F, and the mean maximum July temperature is 61.4° F (WRCC, 2002). The mountains surrounding Cordova shelter it from the frequent strong winds coming down the Copper River. The average growing season (number of days with temperatures above 40°F) in the Eyak Lake area is 145 days. On average the last spring freeze occurs on May 27, and the first fall freeze occurs on September 13 (Professional Fishery Consultant, 1982).

Cordova receives an average of 164 inches of precipitation per year (WRCC, 2002) as a result of storm systems from the southeast that encounter the Chugach Range and subsequently release moisture. The area averages 262 cloudy days per year (Professional Fishery Consultant, 1982). Within the analysis area, precipitation increases with elevation. No site-specific precipitation data have been collected in any of the Eyak-Heney watersheds. However, Carrick and Long (1985) estimated the average annual precipitation at Humpback Creek to be 177 inches, based on measured runoff for a normal year (1975). We assumed that the Cordova North weather data adequately characterizes this and other watersheds draining the mountains surrounding Cordova, although Power Creek likely receives more precipitation because of its higher elevation.

Both snow and rain occur in the analysis area. At elevations below 1000 feet, snowfall generally falls between mid-October and mid-May, and rain can occur at any time of the year. September is the wettest month and June is the driest. Large, high intensity rainstorms are common in the fall during September and October.

No monitored snow courses or SNOTEL sites are in or near the Eyak-Heney analysis area. However, weather records show an average annual total snowfall of 105 inches at the Cordova Airport and 118 inches in Cordova (WRCC, 2002). The average March snowpack depth is 11 inches at the Cordova Airport and 14 inches in Cordova (WRCC, 2002). Snowfall in this area increases with elevation, and alpine watersheds receive considerably more snowfall than the two weather stations.

Geology

The Cordova area is characterized by high relief glacial landforms, a dynamic tectonic environment, and rapid down cutting by streams, producing local slope instability. The eastern coastline of Prince William Sound has a sequence of northeast-southwest trending fjords and ridges, and most major drainages flow toward the southwest (Professional Fishery Consultant, 1982). The rocks around Cordova are sedimentary and low-grade metamorphic rocks of the Mesozoic Orca Group that stretches from Port Fidalgo to south of Cordova. These highly deformed and fractured rocks consist of thick bedded brown and gray sandstones, black limestone, arkoses, thin zones of slate, greywacke, argillite, and conglomerate greenstones with basalt flows (Professional Fishery Consultant, 1982).

Eyak Lake lies in a glacially scoured valley. The low-lying area between Orca Inlet and Eyak Lake consists of up to 140 feet of unconsolidated fluvio-glacial deposits of sand, clay, and

glacial till (Walters, 1963; Professional Fishery Consultant, 1982). This is possibly an end moraine from a more recent glacial advance. The earthquake of March 27, 1964 caused a tectonic uplift of about 6 feet in the Cordova area and from 6 to 11 feet in the Copper River Delta, causing extensive damage to port facilities as well as all of the bridges in the Copper River Delta (Plafker et al., 1969; Dorava and Sokup, 1994). Figure 2.3 on the next page displays the geology of the area.

Elevations range from sea level to 4820 feet. Of the 61,160 acres in the analysis area, 56.8% of the area is less than 1000 feet in elevation and less than 5% of the area is greater than 3000 feet in elevation. Hillslope gradients within the analysis area range from 0 to over 100%. Only 38.5% of the area has slopes less than 20% (refer to Appendix A, figures A-2 and A-3, on pages 92-93).

Geology of Power Creek - Power Creek follows a major northeast-trending valley that parallels the predominant topographic trend of the region. The upper portion is a broad glacial valley with a floor of unconsolidated glacial and fluvial deposits. From this valley, Power Creek enters a steep canyon with a gravel to boulder substrate, eventually emerging into a one-half mile wide delta consisting of fine silt to medium gravel, approximately one-half mile upstream of Eyak Lake (Miller, 1951; Whitewater Engineering Corporation, 1996a).

A large landslide from the northwest valley wall is assumed to have created the 2 square mile, 1,100 foot high fan-like ridge of the lower canyon of Power Creek, 2 to 4 miles upstream of Eyak Lake (Miller, 1951) (figure 2.4). This landslide deposit, consisting of blocks of rock as large as 100 feet across (Miller, 1951), historically dammed Power Creek forming a large lake that rapidly filled with glacial sediments consisting of silt, sand, and gravel. Over time, Power creek incised into the landslide deposits, creating the deep canyon at Ohman Falls (Professional Fishery Consultant, 1982). This gorge consists of bedrock on the south side (Miller, 1951) and Quaternary landslide deposits on the north. The bedrock is composed of intensely deformed, fractured, and metamorphosed argillites, greywacke, and volcanic rocks. A fault zone passes through the upstream end of the Power Creek canyon.

Just upstream of Ohman Falls lies a large run out path for avalanches from the south side of the valley. Snow depths of 70 feet have been observed in the Power Creek canyon in late June (Professional Fishery Consultant, 1982). Large avalanches have been documented at the Power Creek Hydroelectric project site. Twenty-one documented avalanches recently affected the work site between December 1998 and April 2001. An avalanche killed a worker at the project site in April 1999 (Cordova Times, 2001). As a result of this avalanche debris, there is a semi-permanent ice bridge over Power Creek immediately upstream of the falls, spanning Power Creek most months of the year (Whitewater Engineering Corporation, 1996b).

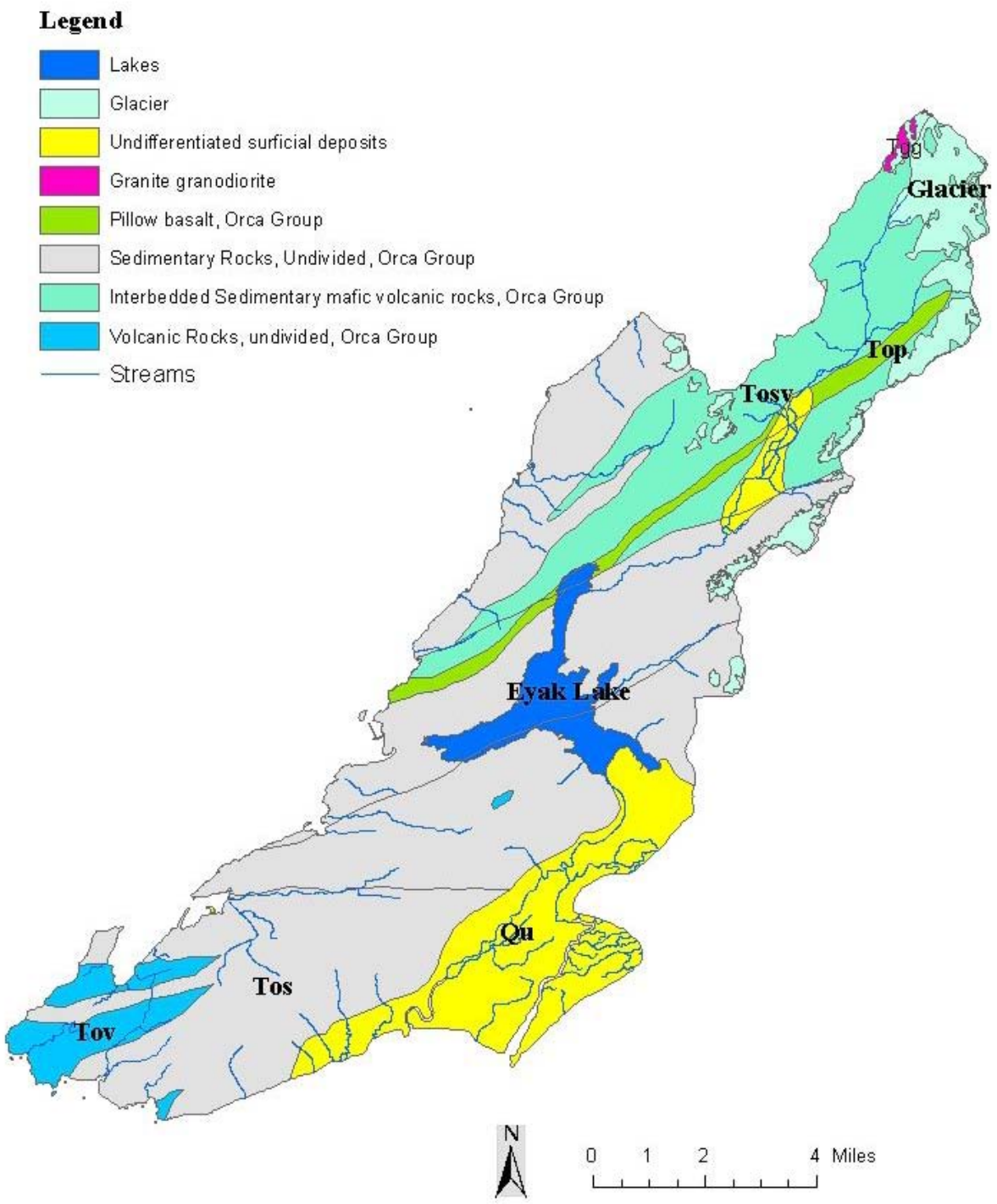

Figure 2.3: Geology of the Eyak-Heney analysis area.

Data from USDA Forest Service (1997).

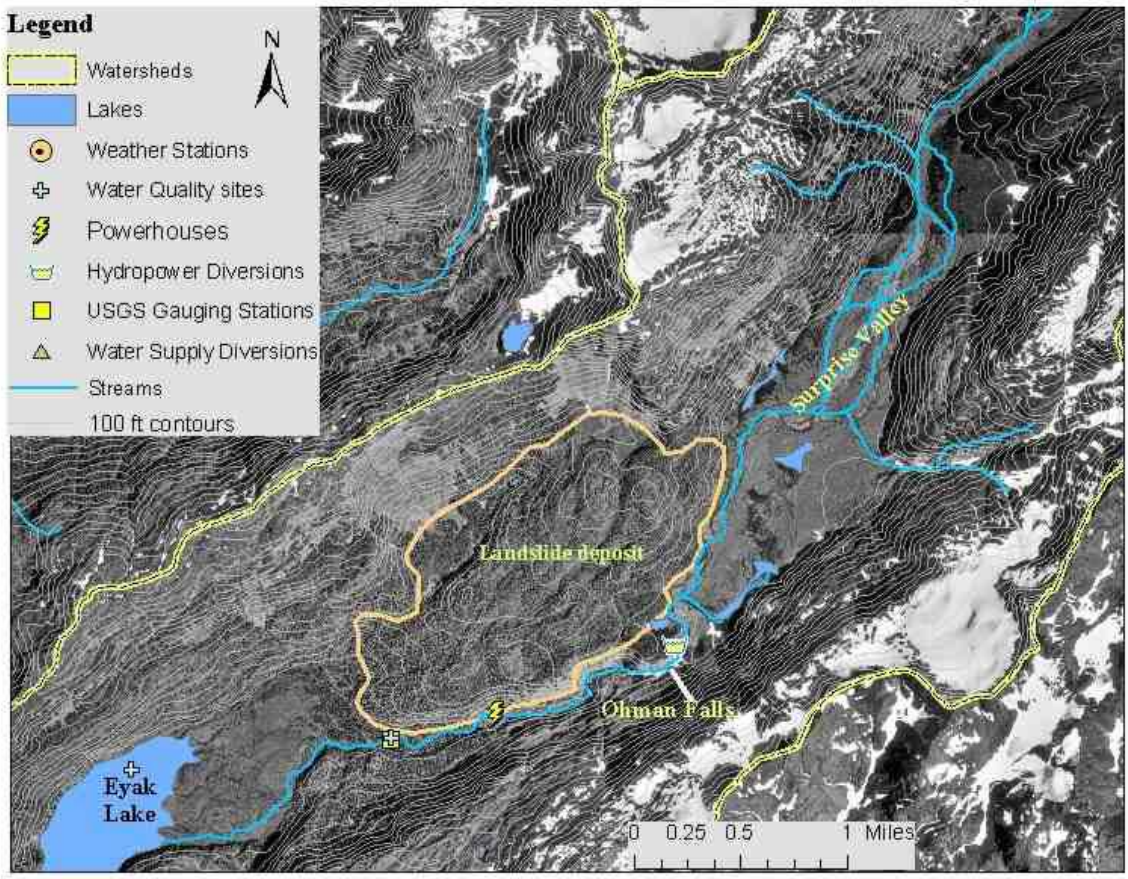

Figure 2.4: Power Creek canyon, showing ancient landslide deposit.

Ecological Classification

Davidson (1997) delineated the Ecological subsections for the Chugach National Forest (USDA Forest Service, 1997) (figure 2.5). Eighty-one percent of the Eyak- Heney analysis area (49,485 acres) lies within the Prince William Sound Islands Subsection of the Northern Gulf Fjordlands Section. Vegetated, steep, and rugged mountains, a marine climate, and forests of Sitka spruce, mountain hemlock, and western hemlock characterize this coastal area. The northeast end of the analysis area that makes up 7% of the analysis area (4,167 acres) lies within the Chugach Icefields Subsection of the Kenai Mountains Section. This area consists of jagged peaks, numerous glaciers and ice fields, abundant precipitation mainly as snow, and very little vegetation. The southern end of the analysis area or 12% of the analysis area (7,505 acres) lies within the Copper River Delta Subsection of the Northern Gulf Forelands Section. This area consists of broad outwash plains, tidal flats, constantly changing coastal landforms, marine precipitation, forests of Sitka spruce and western hemlock, and abundant wetlands.

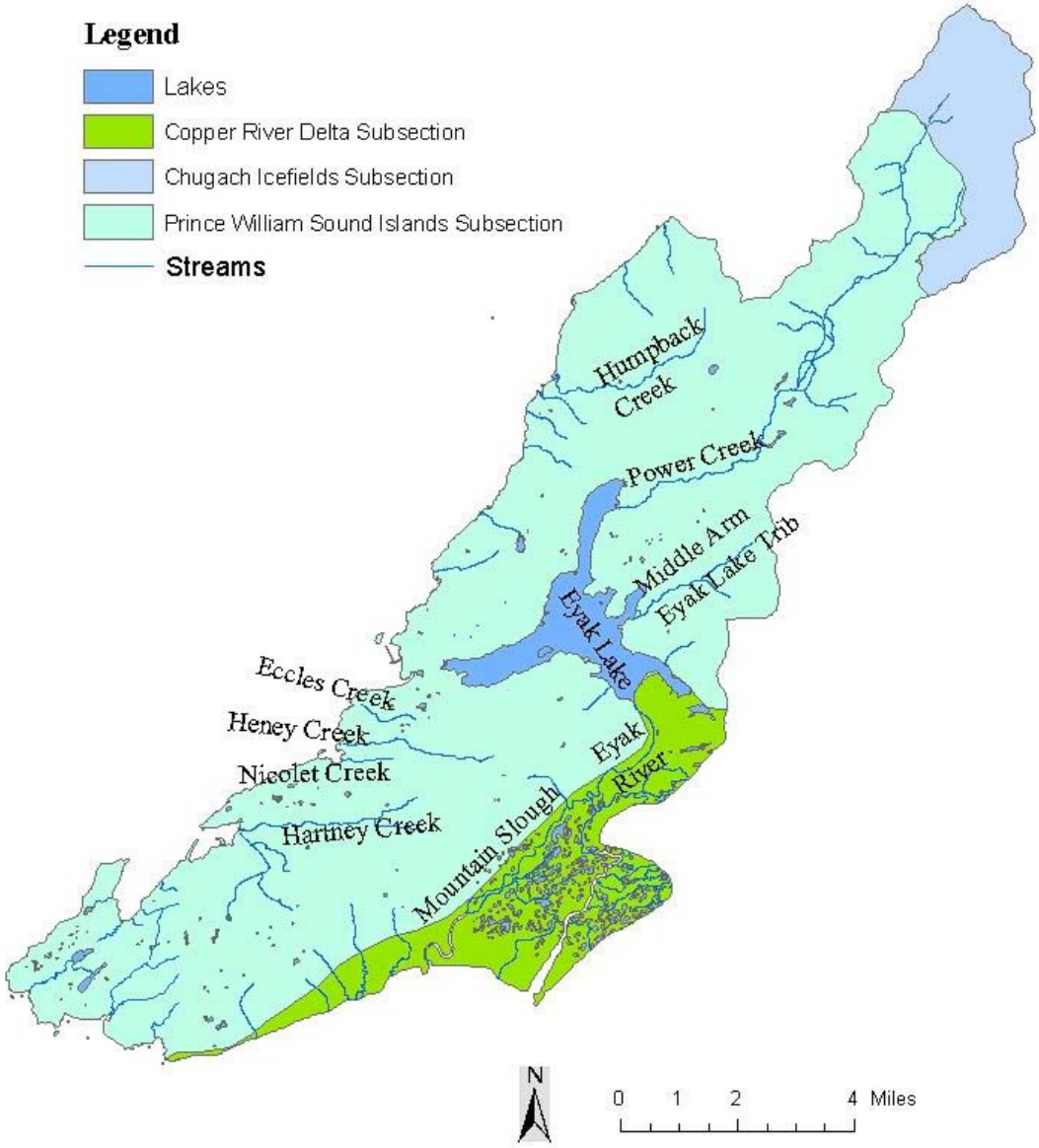

Figure 2.5: Ecological subsections for the Eyak-Heney analysis area.

Data from USDA Forest Service (1997).

Soils

The terrain throughout much of the Eyak-Heney analysis area consists of steep glacial side slopes, ice-scoured hills, and numerous bedrock exposures. Soils throughout this area are generally shallow. However, the lowlands in the west Copper River Delta consist of outwash plains with stratified soils and a high water table (Professional Fishery Consultant, 1982).

Above timberline, alpine soils are shallow and rocky. Detailed descriptions of soil surveys are found in Davidson and Harnish (1978).

Power Creek - Soils on both sides of Power Creek are thin and poorly developed (Whitewater Engineering Corporation, 1996b). The landslide deposits that make up the north side of the Power Creek canyon consist of permeable, poorly sorted material, containing blocks as large as 100 feet across. There is active groundwater flow in this area.

Murcheson Watershed - Above 900 feet, numerous exposed outcrops with sporadic thin organic soil occur. Between 500 and 900 ft, soils consist of less than 1 foot of organic soil and gravel over bedrock, with some rock outcrops. Below 500 ft, soils consist of organic soil and gravel as deep as a few feet. There is evidence of numerous rock slides in the upper, steeper portion of the Murcheson Creek watershed, as well as frequent avalanche activity affecting areas as low as the upper dam at 250 feet in elevation (CH2M Hill and Stephl Engineers, 1997).

Orca Watershed - The upper portion of the Orca watershed and the area around Crater Lake consists of 20 to 30% exposed bedrock, shallow gravels, and a thin organic layer less than 6 inches deep. Some minor, rainstorm-induced erosion occurs in the stream channels that discharge into Crater Lake, and erosion occurs along the footpath around Crater Lake. Crater Lake acts as a settling basin, and outflows generally carry little or no sediment. The lower portion of the watershed consists of steep rock outcroppings overlain by thin organic soils, as well as flat timbered benches with deeper, well-drained soils overlain by 4 inches or more of organic material. Significant erosion occurs in Crater Creek upstream of the municipal water supply dam, causing the small impoundment to constantly fill with sand and gravel. Although city crews remove this debris annually, the Orca watershed collects the most debris and sediment of the 4 municipal Cordova watersheds (CH2M Hill and Stephl Engineers, 1997).

Heney Creek/ Meals Reservoir Watersheds - Above 1000 feet elevation, the terrain consists of numerous rock outcrops with sporadic, thin organic soil. There is evidence of some rockslides and avalanches. Between 400 and 1000 feet elevation, there is generally less than 1 foot of organic soil and gravel over bedrock, with some exposed rock and steep cliffs. Along the Heney Creek canyon, there are numerous exposed rock slopes up to 30 ft high. Erosion occurs along Heney Creek, and city crews clean gravel and cobbles from the catchment behind the water supply dam annually (CH2M Hill and Stephl Engineers, 1997). The small Meals Reservoir Watershed, lying on a forested low elevation bench, consists of 1 to 2 feet of thick organic soils and gravels overlying bedrock, with very few exposed rock areas, and peat under saturated moss in low-lying areas (CH2M Hill and Stephl Engineers, 1997).

Hydrology

The analysis covers two main watersheds; Eyak River and Lake and the Heney range. It contains many small subwatersheds that drain the mountains surrounding Cordova (figure 2.6; table 2.1). Power Creek, the largest subwatershed in the area, is the main contributor to Eyak Lake. The Eyak River is the main outlet of the area, draining Eyak Lake and flowing into the western Copper River Delta. Numerous small watersheds also drain southeast into the Copper River Delta and west into Orca Inlet, the largest of these being Humpback Creek. Eyak Lake,

covering 2400 acres, lies in the topographic low in the middle of the analysis area at 20 feet in elevation.

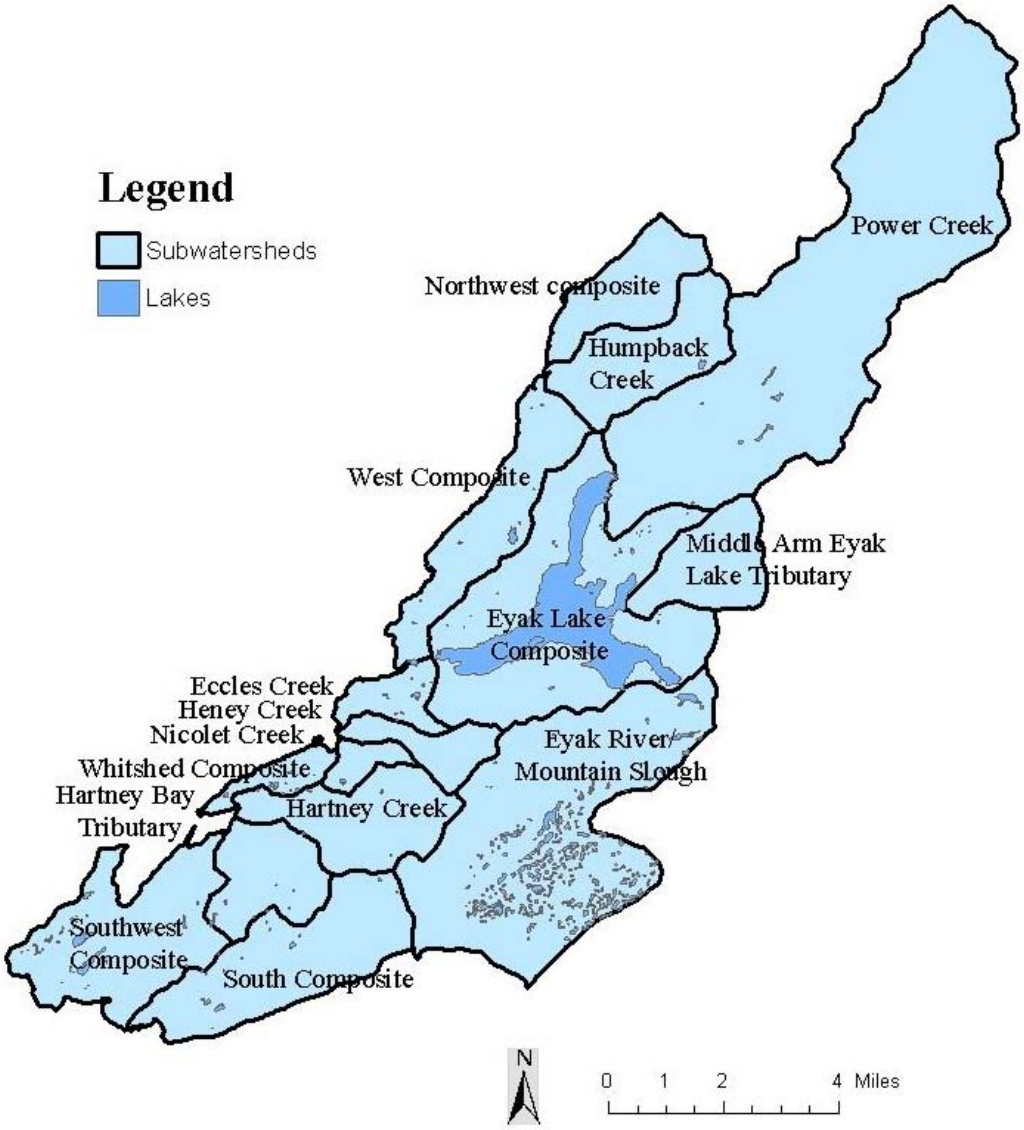

Figure 2.6: Eyak-Heney analysis area subwatersheds.

Stream and contour data are from USDA Forest Service (1998). Subwatersheds were delineated for significant larger streams, gauged streams, and composites of multiple small drainages.

Table 2.1: Characteristics of subwatersheds in the Eyak –Heney analysis area.

Subwatershed	Drainage Area (mi^2)	Drainage Area (acres)	Approx Max elevation (feet)	Approx Min elevation (feet)
Power Creek[1]	24.3	15,552	4800	20
Northwest Composite	3.28	2,099	3400	0
Humpback Creek[1]	4.41	2,822	3400	0
West Composite	4.86	3,110	2500	0
Eyak Lake Composite	14.2	9,088	2900	20
Middle Arm Eyak Lake Tributary [1]	3.13	2,003	3100	20
Eccles Creek	1.45	928	1600	0
Heney Creek[1]	1.73	1,107	3151	0
Nicolet Creek[1]	0.85	544	1600	0
Eyak River/Mountain Slough	15.6	9,984	2900	0
Whitshed Composite	1.09	698	700	0
Hartney Creek	4.39	2,810	3100	0
Hartney Bay Tributary	3.17	2,029	2600	0
Southwest Composite	7.06	4,518	1500	0
South Composite	6.69	4,282	2900	0

[1] Indicates gauged site (USGS)

A total of 126 miles of stream lie within the Eyak-Heney analysis area, (USDA Forest Service, 1998). This represents a drainage density of approximately 1 mile of stream per square mile of area. However, this method of delineation did not recognize many of the existing streams in the analysis area, such as Murcheson Falls Creek and Crater Creek. About eighty-seven percent of the streams are at elevations less than 1000 feet, and 12.0% are at elevations between 1000 and 2000 feet (Refer to Figure A-4 in Appendix A). The longest stream is Power Creek, which flows approximately 11 miles into Eyak Lake.

Streams in the analysis area were classified using a stream classification system developed in the Tongass National Forest (USDA Forest Service, 1992). Streams in the Eyak-Heney analysis area are varied in type, but predominantly in the glacial outwash (GO) and high gradient contained (HC) process groups (Table 2.2 and Figure A-5 in Appendix A).

Table 2.2: Miles of each stream class in the analysis area. Data from USDA Forest Service (1998).

Code	Channel type description	Stream miles	% of total
AF1	Moderate Gradient Alluvial Fan Channel	0.94	0.75
ES2	Narrow Small Substrate Estuarine Channel	9.81	7.78
ES4	Large Estuarine Channel	7.41	5.88
FP2	Foreland Uplifted Estuarine Channel	0.67	0.53
FP3	Narrow Low Gradient Flood Plain Channel	4.56	3.62
GO1	Glacial Outwash Flood Plain Side Channel	12.13	9.62
GO2	Large Meandering Glacial Outwash Channel	5.68	4.51
GO3	Large Braided Glacial Outwash Channel	8.49	6.74
G04	Moderate Width Glacial Channel	1.67	1.32
HC2	Shallowly to Moderately Incised Footslope Channel	5.58	4.43
HC4	Deeply Incised Muskeg Channel	0.83	0.66
HC5	Shallowly Incised Very High Gradient Channel	8.55	6.78
HC6	Deeply Incised Mountain slope Channel	8.02	6.36

Code	Channel type description	Stream miles	% of total
HC8	Moderate/High Gradient Glacial Cascade Channel	7.77	6.16
HC9	High Gradient Incised Glacial Torrent Channel	10.19	8.08
L	Bodies of water (Lakes)	8.05	6.39
MC1	Narrow Shallow Contained Channel	4.29	3.40
MC2	Moderate Width and Incision, Contained Channel	4.05	3.21
MM1	Narrow Mixed Control Channel	2.08	1.65
PA1	Narrow Placid Flow Channel	0.46	0.36
PA2	Moderate Width Placid Flow Channel	0.14	0.11
PA3	Shallow Groundwater Fed Slough	10.28	8.16
PA4	Flood Plain Backwater Slough	4.40	3.49
	TOTAL	126.1	100

Streams were also classified by their fish habitat values (figure 2.7 and table 2.3) (USDA Forest Service, 1992). Streams in the Eyak-Heney analysis area are predominantly Class I, with 70.6% of the streams containing anadromous or adfluvial lake and stream habitat. However, this over-represents the number of Class I streams in the area, as many streams designated Class I are too steep to support anadromous or adfluvial fish populations. For example, Power Creek is most likely a Class II stream upstream of Ohman falls, which acts as a barrier to fish migration. Additional field verification is required for many of these stream classifications.

Table 2.3: Miles of each stream class based on fish habitat in the analysis area. Data from USDA Forest Service (1998).

Class	Description	Miles of stream	Percent of total
Class I	Streams with anadromous or adfluvial lake and stream habitat.	89.0	70.6
Class II	Streams with resident fish populations. Generally steep (6-15% gradient), can include streams from 0-5% gradient without anadromous fish	11.8	9.4
Class III	Streams with no fish populations that have potential water quality influence on downstream aquatic habitats	25.2	20.0

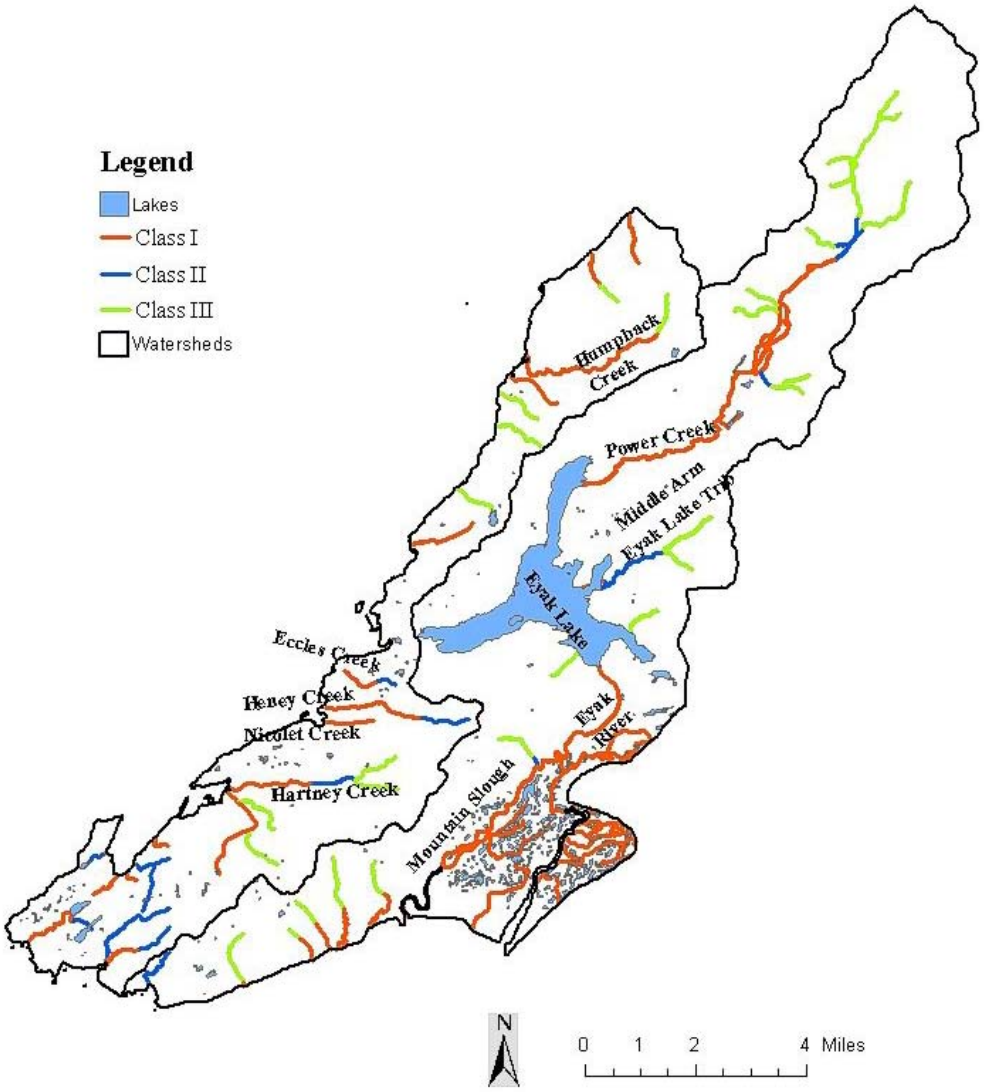

Figure 2.7: Stream classes based on fish habitat. Data from USDA USFS (1998).

Power Creek - Power Creek originates about 13 miles northeast of Cordova at the base of a small glacier southwest of the Shephard Glacier, at approximately 1,500 feet elevation. It flows 11 miles into the northern arm of Eyak Lake at 20 feet elevation. Power Creek has a total drainage area of 24.2 square miles, and elevations in the watershed range from 20 to 4800 feet. The watershed has approximately 5 square miles of glacier, concentrated along its northern rim. Numerous permanent snowfields also occupy the upper elevations.

The uppermost 4.5 miles of Power Creek, known as Power Creek Valley, is a broad glacial valley averaging 0.25 to 0.5 miles wide at its base, with a floor of unconsolidated glacial and fluvial deposits, and steep valley walls rising 2,000 to 3,500 feet from the valley floor (Miller,

1951) (figure 2.8). In the lower portion of this valley, Power Creek is braided and meandering with gradients from 0.5 to 1.5% (Whitewater Engineering Corporation, 1996b).

Two miles upstream of Eyak Lake, Power Creek enters a steep-walled 200 to 450-foot deep canyon in which lies the 52-foot Ohman Falls (Miller, 1951; Whitewater Engineering Corporation, 1996c). In this gorge, the stream drops 175 feet in a horizontal distance of 500 feet, with channel substrates ranging from large boulders to small gravels (figure 2.9). Downstream of the falls, gradients decrease from 15% to 0.4%, and the channel substrate sizes decrease from large boulders to small and medium gravel (Whitewater Engineering Corporation, 1996a).

One half mile upstream of Eyak Lake, Power Creek emerges from the canyon into a small delta, measuring one half mile in length and width and consisting of low gradient braided channels with deposition of fine silts to medium gravel (Miller, 1951; Whitewater Engineering Corporation, 1996a). This delta provides spawning habitat for a large percentage of Eyak River salmon runs.

The headwaters of Power Creek, as well as its tributaries originating on the steep valley walls, are generally classified as high gradient incised glacial torrent channels (HC9). Power Creek valley is predominantly classified as a large braided glacial outwash channel (GO3). The Power Creek canyon also represents the high gradient contained process group (HC9). The Power Creek delta is classified as a large braided glacial outwash channel (GO3) (USDA Forest Service, 1998).

Figure 2.8: Power Creek Valley, upstream of the canyon, looking upstream.

Figure 2.9: Power Creek Canyon downstream of dam site, looking downstream.

Humpback Creek - Humpback Creek originates about 8 miles northeast of Cordova, flows 4 miles westward, and enters Orca Inlet about 5 miles north of Cordova. This 4.4 square mile watershed ranges from sea level to approximately 3400 feet in elevation and contains several small snowfields at upper elevations. Humpback Creek is a clear-water anadromous stream with widths ranging from 15 to 75 feet and substrates of gravel, cobbles, and boulders (Maurer and Carrick, 1994). Approximately 60% of the watershed is above timberline, and Humpback Creek is steep and rugged (Carrick and Long, 1985). Most of Humpback Creek is classified as a moderate/high gradient glacial cascade channel (HC8), and the headwaters are classified as high gradient incised glacial torrent channels (HC9) (USDA Forest Service, 1998). Two small lakes occupy 11 acres in the drainage basin.

Cordova Municipal Water Supply Watersheds - Many small watersheds drain the high peaks of this area into Orca Inlet, Eyak Lake, and the Copper River Delta. Their excellent water quality provides good water sources for the city of Cordova. The Heney watershed is located one mile south of Cordova and flows west from the Heney Range into Orca Inlet. This 1.7 square mile watershed ranges in elevation from sea level to 3151 feet at Heney Peak. It is classified predominantly as a narrow shallow contained channel (MC1), although it is a shallowly to moderately incised footslope channel (HC2) in its upper reaches (USDA Forest Service, 1998). The Heney Creek watershed is characterized by rugged, mountainous terrain with steep slopes and bedrock outcrops. Hillslope gradients range from 25% to nearly 100%. A dam at 420 feet elevation diverts water 1 mile into Meals Reservoir at 390 feet elevation, which serves as a water supply source for the city of Cordova (CH2M Hill and Stephl Engineers, 1997). The Meals Reservoir watershed is approximately 0.06 square miles, and consists of gentle slopes ranging from 5 to 25% and elevations ranging from 371 feet to approximately 600 feet (CH2M Hill and Stephl Engineers, 1997).

The Murcheson Falls Creek watershed lies two miles southeast of Cordova and drains north into Eyak Lake. This small, 0.37 square mile watershed, ranges from 20 feet elevation at Eyak Lake to 2585 feet at the summit of Mt. Shiels. This watershed is characterized by rugged, mountainous terrain with slopes of nearly 100% on the steep mountain faces above 600 feet elevation and 5 to 30% on the flatter, forested slopes below 600 feet elevation (CH2M Hill and Stephl Engineers, 1997). Murcheson Creek is a water supply source for the city of Cordova.

The Orca Watershed, located two miles north of Cordova, flows west into Orca Inlet. This small, 0.62 square mile watershed ranges in elevation from sea level to approximately 2400 feet. The watershed includes Crater Lake at 1550 feet elevation and Crater Creek, which flows west out of Crater Lake. Rugged mountainous terrain and steep valley walls characterize the Orca watershed. Above Crater Lake, slopes range from 5% near the lake to 60% on the steep mountain slopes (CH2M Hill and Stephl Engineers, 1997). Crater Creek is classified as a deeply incised mountain slope channel (HC6) (USDA Forest Service, 1998). Crater Creek is a water supply source for the city of Cordova.

Eyak Lake and Eyak River - Eyak Lake is a natural 2,400-acre "Y"-shaped lake that lies immediately east of the Cordova boat harbor at an elevation of 20 feet. Eyak Lake is separated from Orca Inlet by a low divide and separates the 2000 to 4000 foot high peaks of the Chugach range to the north and south. Eyak River flows out of the southeast arm and Power Creek flows into the northern arm. Eyak Lake drains 40.5 square miles, half of which is the Power Creek Watershed. A total of 41 streams enter the lake (HDR Alaska Inc., 2001). Eyak Lake has 18.9 miles of shoreline, an average depth of 8 feet, and a maximum depth of 20 feet, with 19,200 acre-feet of water at normal depth (Professional Fishery Consultant, 1982). The deepest portion of the lake lies in the northern arm (HDR Alaska Inc., 2001). After the 1964 earthquake, a weir was constructed at the outlet of Eyak Lake to maintain a higher lake level (Professional Fishery Consultant, 1982).

The Eyak River begins at the outlet of Eyak Lake at 20 feet elevation and flows six miles south across the glacial outwash plains of the western portion of the Copper River Delta to the Gulf of Alaska. The Eyak River has an average gradient of 0.06%, a meandering channel pattern with a wide floodplain, and plentiful marshes and sloughs. The entire Eyak River is classified as a large meandering glacial outwash channel (GO2) (USDA Forest Service, 1998). Tidal influence reaches about 3 miles from Eyak Lake (Pellissier and Somerville, 1987). A portion of the Scott River enters the Eyak River about 1 mile downstream from Eyak Lake and through the Lydick Slough about 2 miles south of Eyak Lake. Two miles south of Eyak Lake, Mountain Slough branches from the Eyak River and flows southwest to the Gulf of Alaska.

Surface water quantity - Six streams in the Eyak-Heney analysis area have historic daily USGS streamflow data (figure A-1 is a map that displays their location and table A-1 provides the metadata. Both are in Appendix A). Streamflows in the Eyak-Heney analysis area near Cordova are dominated by rainfall runoff, with rapid and frequent flow variations especially common during the fall rainy season (Dorava and Sokup, 1994). High flows in the alpine streams of this area are caused by two factors leading to two pronounced peaks. Snowmelt runoff in late spring and summer causes a broad, sustained peak in mid-summer and high

precipitation during the summer and fall creates a series of flashy peaks throughout September and October (Dorava and Sokup, 1994). This bimodal pattern is more pronounced in watersheds that drain glaciers and snowfields, such as Power Creek. Smaller watersheds with smaller alpine drainage areas have a larger potential for flashy peaks created by intense rainfall, and a lesser influence from summer snowmelt runoff. In all watersheds, the potential for the highest flows is during September and October, although these high flows often last only one to three days. Late fall conditions of impermeable land surfaces created by frozen soils with little snow cover can sometimes lead to large flash floods resulting from intense late fall rainstorms. Low flows generally occur from mid-December to mid-April, and many of the smaller streams are frozen during this period and have very little flow. Following is information about streamflows for the watersheds in the area. The hydrograph for Power creek is included since it represents much of the analysis area (Figure 2.10). Other streamflow hydrographs and flow statistics are located in the Eyak-Heney Hydrologic Condition Assessment in the planning record.

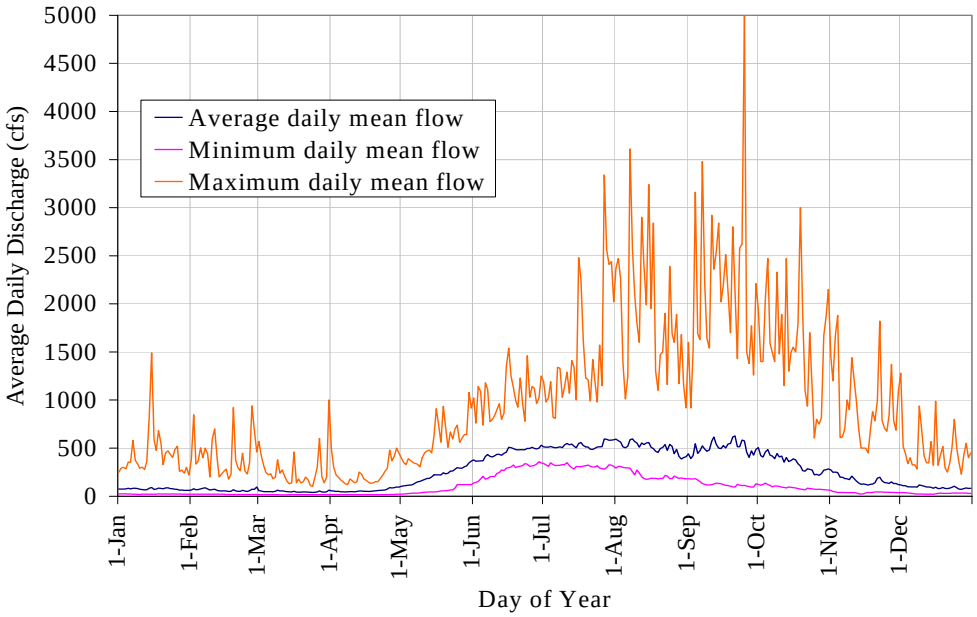

Figure 2.10: **Average daily streamflows for Power Creek near Cordova, AK. USGS station # 15216000 period of record 8/6/47 to 9/30/95 (USGS, 2002).**

Power Creek. The USGS gauging station on Power Creek, located 1.6 miles upstream of Eyak Lake, has a drainage area of 20.5 square miles. The gauging station has 48 years of daily flow records, from 1947 to 1995. Streamflow in Power Creek is highly variable, as it is affected by snowmelt, glacial melt water, and precipitation. The average annual low flow, approximately 50 cfs, generally occurs in late March. Flows increase drastically in May and June as a result of snowmelt, and glacial melting begins in late June. On average, a first streamflow peak occurs in late July or Early August, averaging about 600 cfs. Extreme high flows can occur any time depending on duration and intensity of precipitation, and flow response is rapid because of steep topography and shallow soils, leading to a flashy hydrograph (Whitewater Engineering Corporation, 1996a). A second, larger peak flow generally occurs as

a series of large spikes in September and October, as a result of intense rainstorms. These short duration peak flows range from 2000 to 6000 cfs. Stream flows reduce rapidly in October and November, returning to winter base flows.

Humpback Creek. Two years of daily historic USGS streamflow data are available for Humpback Creek. The gauge is located about 800 feet upstream of the mouth and has a drainage area of 4.37 square miles. Humpback Creek remains mostly frozen during part or all of the winter, with base flows less than 10 cfs. Spring breakup occurs in April, and Humpback Creek freezes again in November or December (Maurer and Carrick, 1994). Humpback Creek generally has two distinct periods of peak flows. A sustained summer peak in June or July, averaging approximately 100 cfs, occurs as a result of snowmelt. A larger set of peak flows generally occurs in September and October with flows ranging from 100 to 638 cfs. These highly erratic, flashy flows are the result of intense fall rainstorms, steep topography, and shallow soils.

Middle Arm Eyak Lake Tributary. The stream entering the Middle Arm of Eyak Lake has 2 years of daily historic streamflow data available from the USGS. The watershed above the gauge, located approximately 0.7 miles upstream of the mouth, drains 2.9 square miles. The two years of available flow records do not necessarily reflect long-term flows on this stream, but the average daily flows suggest a flow regime similar to that of other streams in the area. The average daily flow for the two years of record was 41 cfs. Winter base flows from December through April are approximately 10 cfs. A sustained snowmelt peak generally occurs in June and July, with peaks on the order of 100 cfs. A larger set of flashy peak flows generally occurs in August, September, and October, with instantaneous peak flows from 100 to 1000 cfs. Flows fluctuate rapidly during the entire hydrograph, a result of the small drainage area, steep topography, shallow soils, and timing of rainfall and snowmelt.

Nicolet Creek. Nicolet Creek has 13 months of daily historic streamflow data, as well as 10 years of peak flow data available from the USGS. The gauge is located just upstream of the mouth and measures flows of a 0.75 square mile drainage. The 13 months of available flow records do not necessarily reflect long-term flows on Nicolet Creek, but the average daily flows suggest a flow regime similar to that of other streams in the area. Daily flows during the 13 months of record ranged from less than 1 cfs to 140 cfs. The average daily flow for the 2000 water year was 41 cfs. Winter base flows from December through April are less than 5 cfs, although winter flows are characterized by many small peaks as a result of rainfall and/or thaw events. Snowmelt augmented the hydrograph during the months of May and June, but was not a major influence because of the low elevation and lack of alpine terrain in the watershed. Flows during the entire hydrograph fluctuate rapidly, a result of the small drainage area, steep topography, shallow soils, and timing of precipitation. Flashy peak flows occurred throughout the entire year, but were most pronounced in the winter months from October to February. Instantaneous peak flows during the 10 years of peak flow records ranged from 257 to an extreme of 988 cfs recorded on November 3, 1994.

Heney Watershed. The city constructed a dam on Heney Creek in the upper portion of the creek at 400 ft elevation. This dam diverts a fairly constant 3 cfs from Heney Creek into Meals Reservoir (CH2M Hill and Stephl Engineers, 1997). Based on the 1992-1993 data, the

USGS estimated that the annual runoff from Heney Creek is 17,690 acre-feet (CH2M Hill and Stephl Engineers, 1997). Heney Creek has two years of daily historic USGS flow records. The gauge measures flows of a 1.53 square mile drainage area and is located at 130 feet elevation, 0.7 miles upstream of the Whitshed Road and 0.7 miles downstream of the municipal water supply diversion dam. The two years of available flow records do not necessarily reflect long-term flows on Heney Creek, but the average daily flows suggest a flow regime similar to that of other streams in the area. The average daily flow for the two years of record was 23 cfs. Winter base flows from mid-December to mid-April are very low, generally less than 10 cfs with small peaks resulting from winter rainfall and/or thaw events. A sustained snowmelt peak generally occurs in early June, with flows averaging 50 to 100 cfs. A later, larger set of peak flows occurs in August, September, and October, with flashy peak flows ranging from 50 to 500 cfs. Flows during the entire hydrograph fluctuate rapidly because of the small drainage area, steep topography, shallow soils, and timing of rainfall events.

Murcheson Creek. Murcheson Creek, a municipal watershed for Cordova, has two years of daily historic USGS streamflow data. The gauge measures flows of a 0.37 square mile drainage area, and is located 150 feet upstream of Eyak Lake and 0.2 miles downstream of the lower water supply dam at Murcheson Falls (CH2M Hill and Stephl Engineers, 1997). The two years of available flow records do not necessarily reflect long-term flows on Murcheson Creek, but the average daily flows suggest a flow regime similar to that of other streams in the area. The average daily flow for the two years of record was 4.2 cfs. During the winter months of December through April, Murcheson Creek ices over, with flows generally less than 1 cfs and often no flow. Rainfall events can cause short spikes in the hydrograph. A sustained peak occurs from late May to July as a result of snowmelt, with high flows averaging 10 to 20 cfs. A set of larger peaks generally occurs from August through October, with flashy, short duration peaks ranging from 25 to 65 cfs. Flows fluctuate rapidly because of the small drainage area, steep topography, shallow soils, and timing of rainfall events. An extreme instantaneous peak flow of 269 cfs was measured on September 16, 1993, and the minimum daily flow was 0 cfs. The USGS estimated that annual runoff from Murcheson Creek for the 1992 and 1993 water years was 3040 acre-feet (CH2M Hill and Stephl Engineers, 1997). Two dams were constructed on Murcheson Falls Creek just upstream of Murcheson Falls. The upper dam is no longer in service, although it captures sediment from upstream. The lower dam, at 195 feet elevation and just upstream of Murcheson Falls, diverts water to the water treatment plant on the Copper River Highway for the municipal water supply.

Eyak Lake/ Eyak River. There are no flow records or stream gauges on the Eyak River, the outlet to Eyak Lake with a drainage area of 41.6 square miles. High water in Eyak Lake poses a flood danger to a number of structures surrounding the lake. The Eyak River does not have a large capacity for peak flows because of its low gradient and low water velocities as it meanders across the western Copper River Delta and into tidal flats. Therefore, high flows on Power Creek, the main tributary to the lake, can cause the lake level to rise significantly. The weir that was constructed at the lake outlet increases the flooding problem by increasing the lake level. Floods have occurred in Eyak Lake in the 1930's, 1949, 1958, 1981, 1995 and 1997 (Professional Fishery Consultant, 1982) (Hodges 2001.). Professional Fishery Consultant (1982) calculated a 10-year flood on the Eyak River to be 8700 cfs with a lake elevation of 22.5 feet, and a 50-year flood to be 13,700 cfs with a lake elevation of 24.8 feet. Floodwaters

in Eyak Lake could escape through Cordova into Orca Inlet, but this is blocked by highway fill. The construction of a channel through Cordova to eliminate flood potential in Eyak Lake was once proposed to alleviate flood concerns (Professional Fishery Consultant, 1982).

There are no historical flow records for the Scott River, part of which flows into the Eyak River through Lydick Slough. Flow and flood quantities are difficult to determine on this river because of its low relief, braided channels, and the difficulty of predicting outburst floods (Dorava and Sokup, 1994). Flows increase rapidly in late May through July as a result of glacial melt. As with other streams in this area, the largest flood flows occur in August through October, during intense rainfall events. Low flows occur from December through April. Flood flows from the Scott River occasionally enter the Eyak River about 1 mile below the lake outlet and cause flooding upstream in subdivisions along the Eyak River by backing up flows out of Eyak Lake. Also sediment from Scott River has reduced water flow by reducing channel depth.

Orca Watershed. Crater Creek, which drains the 0.62 square mile Orca Watershed, has no historical flow records, although it is a municipal water supply for Cordova. There is a small catchment dam on Crater Creek at 263 ft elevation, which diverts water through a chlorination building and into the city water system (CH2M Hill and Stephl Engineers, 1997). The flow measured on Aug 24, 1993 was 4.5 cfs at the dam, mostly coming from the North Fork Crater Creek (CH2M Hill and Stephl Engineers, 1997). Crater Creek historically freezes in winter and stops providing water.

Water Quality And Sedimentation

Water quality data for streams in the Eyak-Heney Analysis area are limited to Power Creek, Humpback Creek, and small water supply sources for Cordova. However, numerous water quality measurements have been recorded on Eyak Lake. During normal runoff, streams in the analysis area generally have low suspended sediment and turbidity. An exception is Power Creek, which carries glacial sediment, and the Eyak Lake/Eyak River system, which receives suspended sediment from Power Creek as well as industrial and residential pollutants from Cordova. All streams show increases in suspended sediment during high flow conditions. A compilation of published water quality data of the analysis area is presented in the Eyak-Heney Hydrologic Assessment Report.

Power Creek - Because it is glacial in origin, Power Creek carries highly suspended sediment and bed loads. The water is cloudy in the spring, summer, and early fall, but relatively clear in late fall and winter. Significant bedload transport causes recognizable changes in the alignment and physical character of Power Creek and its delta (Whitewater Engineering Corporation, 1996b). The USGS predicted an average of 3500 to 5400 tons of sediment delivery per year, or 3200 to 5000 cubic yards of sand, silt, and clay per year. These figures are likely to double or triple during years of high flow (Professional Fishery Consultant, 1982).

Power Creek is a cool to cold aquatic environment with saturated dissolved oxygen levels measured for all samples (Whitewater Engineering Corporation, 1996a). Dissolved oxygen levels ranged from 12.2 to 14.7 mg/l, normal levels for a cold, highly aerated stream (Kelly,

1995; Kelly and Major, 1997). Power Creek sample temperatures ranged from 0 to 8.4 degrees C, and pH ranged from 6.2 to 7.5 (Kelly, 1995; Kelly and Major, 1997, USGS, 2002).

Eyak Lake - Power Creek delivers its sediment load to its delta and into Eyak Lake in the form of suspended glacial flour and silt. Most of the sediment delivery occurs during glacial melting in the summer months and during high runoff events in the late summer and fall (Professional Fishery Consultant, 1982). Eyak Lake acts as a settling basin, and the northern arm and the southeast basin can remain relatively turbid as a result of Power Creek sediment making its way toward the Eyak River outlet. The west arm generally remains clear, although strong southeasterly winds can cause high turbidity in this area as well (Pellissier and Somerville, 1987). Measured turbidities throughout Eyak Lake ranged from 1 to 7 NTU (nephelometric turbidity units) (USGS, 2002).

Industrial and residential pollution have acted to impair water quality in Eyak Lake. Eyak Lake was listed on the 303(d) list in the early 1980's for urban and commercial pollutants, but was later removed from the list in 1994 (HDR Alaska Inc., 2001). The western arm of the lake, adjacent to Cordova, has the most water quality problems resulting from storm water runoff from developed areas and incidental spills (Professional Fishery Consultant, 1982; HDR Alaska Inc., 2000). The Alaska Department of Environmental Conservation (ADEC) found a majority of the higher readings for pollutants were in samples from the west arm of the lake (HDR Alaska Inc., 2001). Eyak Lake has experienced numerous specific incidents in which water quality was impaired. Four small oil or gasoline spills occurred in 1999 and 2000, and unknown quantities of old waste oil and diesel were spilled at the Cordova Electric Cooperative Site between 1977 and 1980. Floatplane fueling may also be a concern (HDR Alaska Inc., 2001). HDR Alaska Inc. (2001) found low concentrations of BTEX compounds (benzene, ethyl benzene, toluene, and xylene) in Eyak Lake water in 1991, but none were detected in 2001. In August 2001, HDR Alaska, Inc. found diesel range organics in sediments of the North Arm of Eyak Lake, possibly related to nearby fuel spills from 1999.

Water temperatures measured in Eyak Lake range from 0 to 15.9 degrees C, dissolved oxygen from 1.4 to 12.7 mg/l, and pH from 6.3 to 7.9 (McCoy and Freethy, 1978; HDR Alaska Inc., 2002; USGS, 2002). The four dissolved oxygen values measured in March 1974 range from 1 to 3 mg/L, whereas summer values throughout the period of record range from 10 to 14.5 mg/L. Water temperatures measured in Eyak Lake in 1985 and 1986 were the lowest in the north arm, where Power Creek enters the lake, and the warmest in the west arm, adjacent to Cordova (Pellissier and Somerville, 1987). During the winter of 1981-1982, ADEC found some areas of domestic sewage contamination, low dissolved oxygen concentrations when the lake was ice-covered, concentrations of cadmium and lead, and concentrations of manganese and iron greater than the EPA standard for drinking water (Professional Fishery Consultant, 1982).

Humpback Creek - Because of its steep gradient, Humpback Creek is able to transport large quantities of gravel sediment. This caused the reservoir upstream of the log-crib dam built in 1909 to completely fill with sediment (Loeffler et al., 1985). Water quality measurements on Humpback Creek are limited, but Maurer and Carrick (1994) measured a temperature of 6.5

degrees C, an acidic pH of 6.3, high dissolved oxygen, and low specific conductance on July 12, 1994.

Cordova Water Supply Sources - The Cordova municipal water supply derives surface water from Murcheson Falls Creek, the Orca watershed, and the Heney Creek/Meals Reservoir watersheds. These sources generally yield high-quality, clear water with turbidities less than 1.0 NTU, except during short duration turbidity spikes created by intense precipitation events (Jose Rubio plant manager, personal communication). From August 1994 to July 1996, the average maximum daily turbidity was 0.21 NTU for Murcheson Creek, 0.23 NTU for the Orca watershed, and 0.34 NTU for Heney Creek and Meals Reservoir. Turbidity spikes as high as 2.4 NTU were also measured during this period. These values are significantly less than the 5 NTU limit required by the State of Alaska to avoid water filtration (CH2M Hill and Stephl Engineers, 1997). Meals Reservoir showed the highest turbidity of the Cordova water sources, as a result of erosion along the reservoir shoreline, where water has undermined the topsoil around the reservoir to expose the root mass. The 5-foot annual water fluctuations may be responsible for shoreline erosion and high turbidity (CH2M Hill and Stephl Engineers, 1997). Recreation, landslides, and wildlife have few detrimental effects on water quality or turbidity in the Heney Creek or Meals Reservoir watersheds (CH2M Hill and Stephl Engineers, 1997).

Samples measured between August 1994 and July 1996 show water pH values ranging from 6.5 to 8.2, with anomalous values of 5.6 and 5.9 on Heney Creek and 8.6 on Murcheson Creek. The pH averaged 7.2 on Murcheson Creek, 7.3 in the Orca watershed, and 6.9 in Heney Creek and Meals Reservoir (CH2M Hill and Stephl Engineers, 1997). Seasonal temperature fluctuations in these streams ranged from 0.9 degrees C to 13.4 degrees C, averaging 5.3 degrees C on Murcheson Creek, 5.4 degrees C in the Orca watershed, and 6.4 degrees C in Heney Creek and Meals Reservoir (CH2M Hill and Stephl Engineers, 1997).

Murcheson Falls Creek is a good source of water for Cordova because of its low suspended sediment load. Suspended sediment loads remain low during heavy runoff because of low soil erosion rates in the watershed (Professional Fishery Consultant, 1982). However, the impoundment created by the upper dam fills with bedload gravel, which city crews clean annually. There is very little erosion of rock and gravel into the lower dam, located just upstream of Murcheson Falls (CH2M Hill and Stephl Engineers, 1997).

Two wells west of Eyak Lake provide an alternate source of water for Cordova, used only in emergencies and to satisfy peak demands. Groundwater in this area has relatively poor water quality compared to Murcheson and Heney Creeks, with higher sulfides and irons. Also, these wells have low yields and are difficult to pump, as a result of the low transmissibility of ground water through the glacial deposits beneath Cordova (Merrell & Associates/Black & Veatch, 1980).

Groundwater

A thick layer of glacial deposits and an impermeable, although fractured, argillite and greywacke bedrock underlies the Cordova area. The bedrock material is not capable of storing large quantities of groundwater (Walters, 1963). The glacial deposits, up to 140 feet thick west of Eyak Lake, consist of fine to medium grain sizes, and have poor absorption capacities and

moderate to low bearing capacities (Professional Fishery Consultant, 1982). Because of the low transmissibility of ground water through the poorly sorted glacier deposits beneath Cordova, groundwater extraction is limited in the Cordova area (Walters, 1963).

In the Power Creek canyon northeast of Cordova, the large landslide deposit on the north side of Power Creek contains considerable groundwater flow. These springs contribute to the flow in Power Creek throughout the entire year, emerging at several points downstream of Ohman Falls (Whitewater Engineering Corporation, 1996a).

Biological Characteristics

Fish

The primary streams in the Eyak-Heney Landscape Analysis Area provide approximately 21.3 miles of aquatic habitat necessary to support both resident and anadromous fish species. These seven streams included in this analysis are Eyak River, Power Creek, Humpback Creek, Eccles Creek, Heney Creek, Hartney Creek, and Nicolet Creek. While all of these streams are relatively short, productive habitat ranges from braided estuarine channels located near the mouths of these streams to deeply incised upper valley channels. Eyak Lake, covering an area of 2,364 acres, contributes additional spawning, rearing, and over wintering habitat. Many other small streams and lakes in the area undoubtedly provide varying degrees of usable habitat but are not thought to contribute significantly.

The fish species present in the Eyak-Heney area streams and lakes include sockeye salmon (*Oncorhynchus nerka*), pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*Oncorhynchus keta*), coho salmon (*Oncorhynchus kisutch*), Dolly Varden (*Salvelinus malma*), and coastal cutthroat trout (*Oncorhynchus clarki clarki*). All of these species are considered anadromous, however, some coastal cutthroat trout and Dolly Varden in the analysis area are thought to be year-round freshwater residents (Trotter 1997; Schmidt 1997). Other species that have been documented in the area include chinook salmon (*Oncorhynchus tshawytscha*), humpback whitefish (*Coregonus pidschian*), eulachon (*Thaleichthys pacificus*), and three-spine stickleback (*Gasterosteus aculeatus*) (Professional Fishery Consultant 1984). Burbot (*Lota lota*) and certain sculpin species (*Cottus* spp.) are known to be in the analysis area, but have not been encountered in any documented fisheries studies. All of these species are indigenous to this region of Alaska and while some are rarely seen, none are federally listed as threatened or endangered.

Power Creek – Eyak Lake Watershed – The Power Creek-Eyak Lake drainage provides productive spawning and rearing habitat primarily for sockeye and coho salmon, Dolly Varden, and coastal cutthroat trout. Power Creek, the largest tributary of Eyak Lake, contributes about 2.5 miles of critical spawning habitat (Sea-run Fisheries 1996). From the delta area of Power Creek to the U.S.G.S. gauging station, about 1.6 miles upstream, the stream is characterized by glides and riffles and a homogenous substrate consisting of gravels predominately less than two inches in diameter. This stretch is considered to contain some of the largest spawning concentrations of sockeye and coho salmon, as well as Dolly Varden, in the drainage. From the gauging station upstream to the base of a series of cascades, a distance of about 0.8 miles, Power Creek is characterized by an increasing stream gradient, greater number of pools and

pocket water, and a heterogeneous substrate consisting of gravel, cobble, and boulder. Spawning areas in this section are most numerous in the tail outs of the pools. Upstream of this section, fish encounter stream gradients as high as 15% and averaging 5% with little suitable spawning habitat. At mile 3, a set of 52-foot falls (Hanna 1980) is known to block any further upstream migration.

Eyak Lake contributes a significant amount of spawning and rearing habitat. Professional Fishery Consultant (1984) estimated that 75,361 yd^2 (15.57 acres) of shoreline gravels were available for spawning sockeye and coho salmon. This estimate was based on measurements taken in areas where spawning sockeye and coho salmon were observed. For rearing potential, Eyak Lake has 2,364 surface acres, a maximum depth of 23 ft, and a mean depth of 5.6 ft (Pellissier and Somerville 1987). It appears plenty of rearing habitat is available for juvenile fish, however, over wintering habitat may be limited in years when ice cover persists for a long duration and dissolved oxygen concentrations drop. However, the numerous creeks, seeps and groundwater flows that enter the lake should provide sufficient oxygen for most of the lake habitat.

The Eyak River serves primarily as a migration corridor for smolts and adult fish. It provides access between marine and freshwater environments. Spawning habitat for sockeye and coho salmon is essentially nonexistent, however a few pink salmon spawn in the upper reaches of the river. The gentle current, overhanging vegetation, large wood debris, and undercut banks that characterize this river provide excellent habitat for juvenile fish.

Sockeye and coho salmon spawning migrations in the Power Creek-Eyak Lake drainage are an important component of the local commercial salmon gillnet fishery. In the summer the Alaska Fish and Game (ADF&G) conducts weekly aerial surveys to provide a relative index of adult escapement into this drainage. In addition, catch reports from each commercial harvest are available to the local ADF&G commercial finfish area management biologist within 24 hours of a fishing period closer. With this information and the use of historical harvest tables, State biologists can then manage current adult returns and forecast future returns.

Sockeye salmon spawning migrations in this drainage begin in mid-May and continue through September. A bimodal adult migration exists in this system with early returning stocks peaking in June and late returning stocks peaking in July and August (S. Moffitt, ADF&G, personal communication). Peak aerial escapement counts in the last ten years have ranged from 5,900 sockeye salmon in 1997 to 24,100 sockeye salmon in 2000 (Sharp et al. 2000) **(**Figure 2.11). However, these counts are used as an index and not to estimate the total escapement for the system. The accuracy of these aerial counts can be limited by weather conditions and water clarity.

Sockeye salmon use shoreline areas of Eyak Lake and the lower three miles of Power Creek for spawning and rearing (Professional Fishery Consultant 1984; Kelly 1995; Sea-Run Fisheries 1996). Spawning along the lake shoreline is concentrated in areas where wave action or upwelling keeps the gravels well aerated. Once sockeye fry emerge from the gravel, they will typically spend two summers in Eyak Lake. Most will smolt in May and June when they reach 3 to 4 inches in length and migrate to the sea.

Coho salmon begin to enter the Power Creek-Eyak Lake drainage in late July and persist into December (Professional Fishery Consultant 1984; Sea-Run Fisheries, 1996). Peak aerial escapement counts for coho salmon in this drainage can occur from August through October (S. Moffitt, ADF&G, personal communication). In the past ten years, peak coho salmon escapement counts have ranged from 1,900 to 11,300 fish (Sharp et al. 2000) (Figure 2.11 on next page).

Coho salmon also spawn along the shorelines of Eyak Lake and in the lower three miles of Power Creek (Professional Fishery Consultant 1984; Kelly 1995; Sea-Run Fisheries 1996). Most coho salmon juveniles remain in Eyak Lake, middle arm creek and a few other small creeks for one to two years after emerging from the gravel. Most will smolt in May and June after reaching a size of 3 to 4 inches in length and begin their seaward migration.

Several studies indicate that Dolly Varden use Power Creek, from the delta at the mouth to the base of the cascades located 2.5 miles upstream, for spawning and rearing (Hanna and Bowker 1980; Kelly 1995; Sea-Run Fisheries 1996 and 1997). Anadromous spawning migrations begin entering Power Creek in August and reach peak numbers in September and October (Kelly 1995). Spawning adults have been observed in Power Creek as late as January (Sea – Run Fisheries 1996).

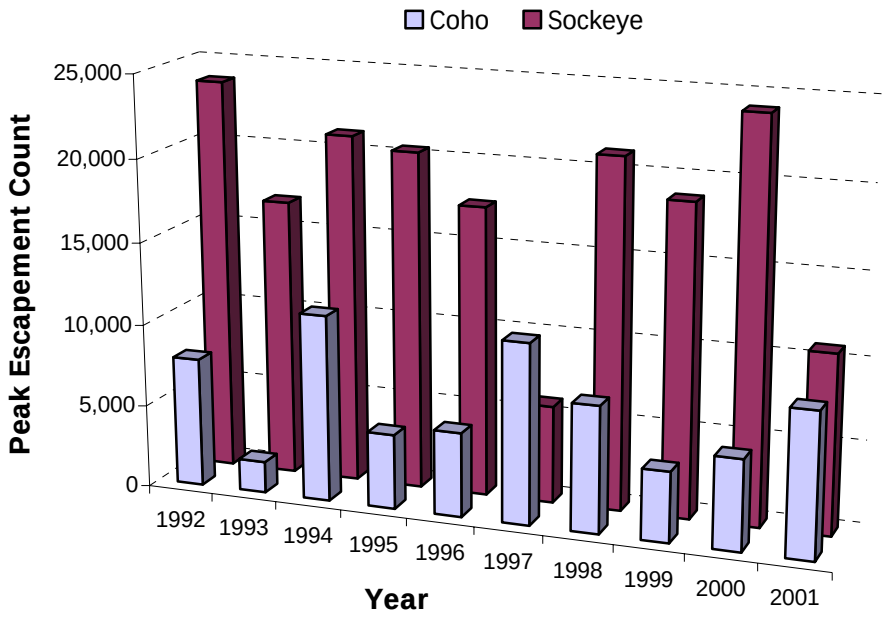

Figure 2.11: Peak aerial escapement counts for sockeye and coho salmon in the Power Creek-Eyak Lake drainage from 1992 to 2001.

Sea-Run Fisheries (1996) reported an absence of adult Dolly Varden in Power Creek during times other than the spawning period. Additionally, only juveniles primarily smaller than 6 inches in length were captured during fry trapping and electro fishing surveys. This small size

suggests that Dolly Varden have a 3 to 4 year residence in Power Creek and Eyak Lake before migrating to the marine waters.

Prince William Sound represents the northern-most range of coastal cutthroat trout (Morrow 1980; Schmidt 1997). Sea-run cutthroat trout in Alaska will typically spawn from March to late May or early June. They prefer small, clear, low-gradient streams or tributaries (Morrow 1980; Pearcy 1997; Schmidt 1997) where interspecific competition is reduced (Leider 1997). This species rears in freshwater, over winters in lakes, and spends only a short period of time feeding in marine waters (Pearcy 1997).

Information about distribution and abundance of coastal cutthroat trout in the Power Creek-Eyak Lake drainage is insufficient to make management decisions concerning this species. Professional Fishery Consultant (1984) captured cutthroat trout in Eyak Lake and observed cutthroat trout spawning, or their redds, in 9 small tributaries of the lake. This species has not been observed or captured in Power Creek by any other studies referenced in this analysis (Hanna and Bowker 1980; Professional Fishery Consultant 1984; Kelly 1995; Sea-Run Fisheries 1996 and 1997).

West Heney Watershed - The streams on the west side of the Eyak-Heney Landscape Analysis Area are very short in length due to the proximity of the Heney Range and Orca Inlet. The primary streams of Orca Inlet used by anadromous fish include Hartney Creek, Nicolet Creek, Heney Creek, Eccles Creek, and Humpback Creek. Habitat complexity in these streams probably remains very near to what it has been for the last 50 years. Very few anthropogenic changes have occurred in the headwaters and along the course of these streams. However, there is very limited information on these streams and the total quantity of useable habitat is thought to be only about eight miles of quality to marginal habitat.

The only extensive aquatic habitat survey of Orca Inlet streams was conducted on Hartney Creek for coho salmon. The coho salmon escapement is thought to be low. Only 103 adult coho salmon were counted in 1996 (Hodges and Schmid 1997). Hodges and Schmid (1997) estimated that Hartney Creek had 659 yd^2 of spawning habitat, 17,347 yd^2 of spring rearing habitat, 13,067 yd^2 of summer rearing habitat, and 5,954 yd^2 of over winter habitat. In addition, quantity of glide, riffle, and pool characteristics were identified as well as the amount of large woody debris (LWD) present.

The primary fish species for commercial and sport fishing in Orca Inlet are pink salmon, chum salmon, and Dolly Varden. However, a targeted commercial fishery does not exist in the West Heney watershed area due to restrictive regulations. Most sport fishing is concentrated at the mouth of Hartney Creek for pink and chum salmon in July and August. Any contribution of pink or chum salmon from these streams to the commercial fishery would be incidental catch of migrating fish.

In Prince William Sound, pink and chum salmon are less likely to make long spawning migrations, as do other species of salmon. Therefore, the character of these streams is suitable to their life history. These two species enter the streams of Orca Inlet in July and August. Pink and chum salmon have different spawning requirements and choose different redd sites, but are

frequently observed spawning at the same time and place. However, even though both species commonly use intertidal areas of short coastal streams to spawn (Morrow 1980; Heard 1991; Salo 1991), chum salmon will rarely spawn in these intertidal areas if pink salmon are already using it for spawning (Salo 1991).

After emerging from the gravel, pink and chum salmon fry will quickly migrate downstream to estuarine waters. In short coastal streams, migration of chum salmon fry can be over in less than 30 days (Salo 1991). Heard (1991) reports that, on average, pink salmon fry spend the least amount of time in freshwater than any other Pacific salmon.

Aerial surveys on these streams from 1992 to 2001 indicate that Hartney Creek and Humpback Creek produce the greatest numbers of returning pink salmon. After adjusting the aerial counts to compensate for a 17.5-day stream life of adult pink salmon, Hartney Creek had an estimated low of 1,911 fish in 1992 and an estimated high of 27,226 fish in 2001 (Figure 2.12). Humpback Creek had an estimated low of 222 fish in 1992 and an estimated high of 22,111 in 2001 (ADF&G, unpublished data). Chum salmon are less numerous than pink salmon in these streams.

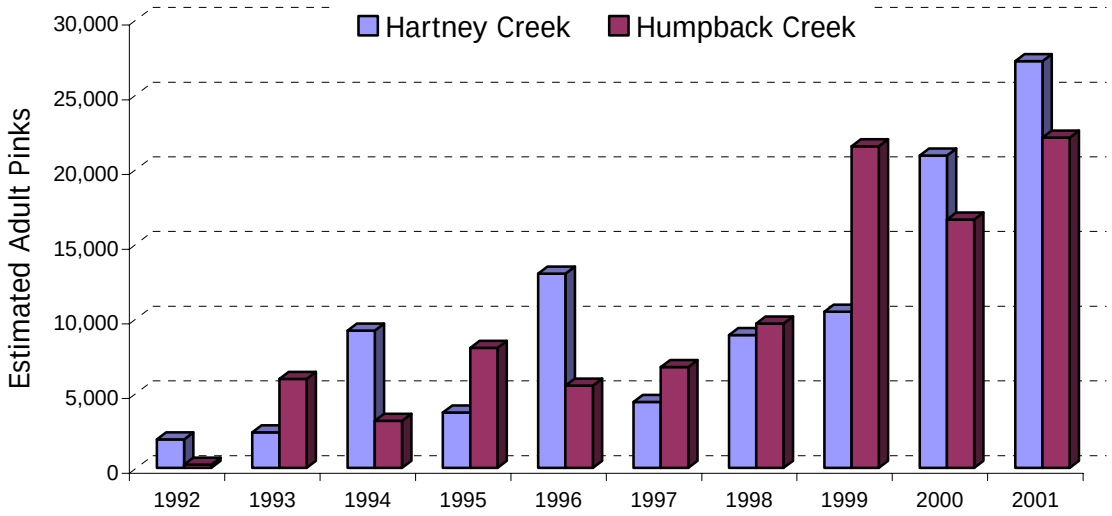

Figure 2.12: Adjusted aerial estimates of pink salmon escapement for Hartney Creek and Humpback Creek, 1992 to 2001.

Vegetation

The analysis area falls within the Northern Gulf Fjordlands Ecological Section. The vegetation cover type in the analysis area ranges from marsh, grass, willow, muskeg, needle leaf forests, alpine, rock, snow and ice. The characteristic needle leaf forest species include Sitka Spruce, mountain hemlock, and western hemlock. The understory of these forests is composed of salmonberry, devils club, early blueberry, Alaska blueberry, skunk cabbage, rusty menziesia, and copperbush. Shrublands and herblands include salmonberry, crowberry, bob blueberry, bog cranberry, Stellers cassiope, Aleutian mountain heath, luetkea, tall cottongrass, tufted bulrush, bluejoint reedgrass, beach rye, sedges and mosses. Dominant wetland herbaceous

communities include swamp horsetail, marsh five-finger, buckbean, sedges, pond lily, fireweed, beach rye, Pacific silverweed, Nootka lupine, and dwarf alkali grass.

Timberline lies at about 2000 feet in elevation (Stratton, 1989). Glaciers or snowfields cover approximately five percent of the analysis area. Wetlands in the area generally consist of alders and willows (Dorava and Sokup, 1994). Upland areas, which are generally well drained, are dominated by hemlock and Sitka spruce with intermittent black spruce, whereas the lowland areas contain mostly willows, sedges, rushes, and grass (Professional Fishery Consultant, 1982). Table 2.4 displays the amount of each vegetation cover type. This information is based on 1976 data and aerial photo interpretation. It has not been updated since that date. Figure 2.13, on page 33**,** displays a map of the vegetation cover types of the analysis area. For the most part, private land will show up as acres with "no data" since the information is not in the database.

Table 2.4: Vegetation characteristics of Heney-Eyak analysis area

Vegetation Type	Acres	Percent of Area
Alder	1,191.2	1.9%
Brush - other	4,363.7	7.1%
Black Spruce	8.7	trace
Grass and Alpine	2,471.5	4.0%
Hemlock	10,039.4	16.4%
Hemlock-Spruce	893.4	1.5%
Sitka Spruce	1,537.5	2.5%
Muskeg	118.3	0.2%
Willow	3,452.2	5.6%
Rock	11,271.9	18.4%
Snow and Ice	3,282.0	5.4%
Other nonforest	62.1	0.1%
Water	3,681.7	6.0%
No Data	18,786.4	30.7%
Total Area	61,160.0	99.8%

The upper valley of Power Creek is mostly unvegetated, but the lower valley is heavily vegetated with spruce and hemlock (Ellsworth and Davenport, 1915). Power Creek has typical vegetation found in this region, consisting of Sitka spruce, western hemlock, alder, blueberry, salmonberry, and devil's club (Whitewater Engineering Corporation, 1996b).

In the Murcheson Watershed, vegetation above 500 ft elevation includes alder, willow, grass, and pockets of taller spruce, hemlock, and cedar. Above 900 feet elevation, about 50% of area is devoid of vegetation. Below 500 feet elevation, spruce and hemlock up to 24 inches diameter dominate, with moss, brush, devil's club, willow, and alder in the understory (CH2M Hill and Stephl Engineers, 1997).

In the Orca Watershed, sparse low lying alpine vegetation covers the area surrounding Crater Lake, with approximately 30% exposed bedrock. Above 1500 feet elevation, vegetation consists of upland tundra and alpine vegetation, with sedges and brush lower than 5 feet in

height. Sparse vegetation also exists above 2000 feet elevation. Below 1500 feet elevation, vegetation is characterized by thicker brush with Sitka spruce, western hemlock, mountain hemlock, and yellow cedar (CH2M Hill and Stephl Engineers, 1997).

In the Heney Creek watershed, above 400 feet elevation, alder, willows, grassy areas, and pockets of spruce, hemlock, and cedar are common. Above 1000 feet elevation, numerous rock outcrops exist with 50% unvegetated areas, fewer trees, and more brush (CH2M Hill and Stephl Engineers, 1997). The small Meals Reservoir Watershed consists of 25% spruce and hemlock forests with trees up to 12 inches diameter. The remainder of the area consists of low brush, grass, devil's club, moss, and muskeg (CH2M Hill and Stephl Engineers, 1997).

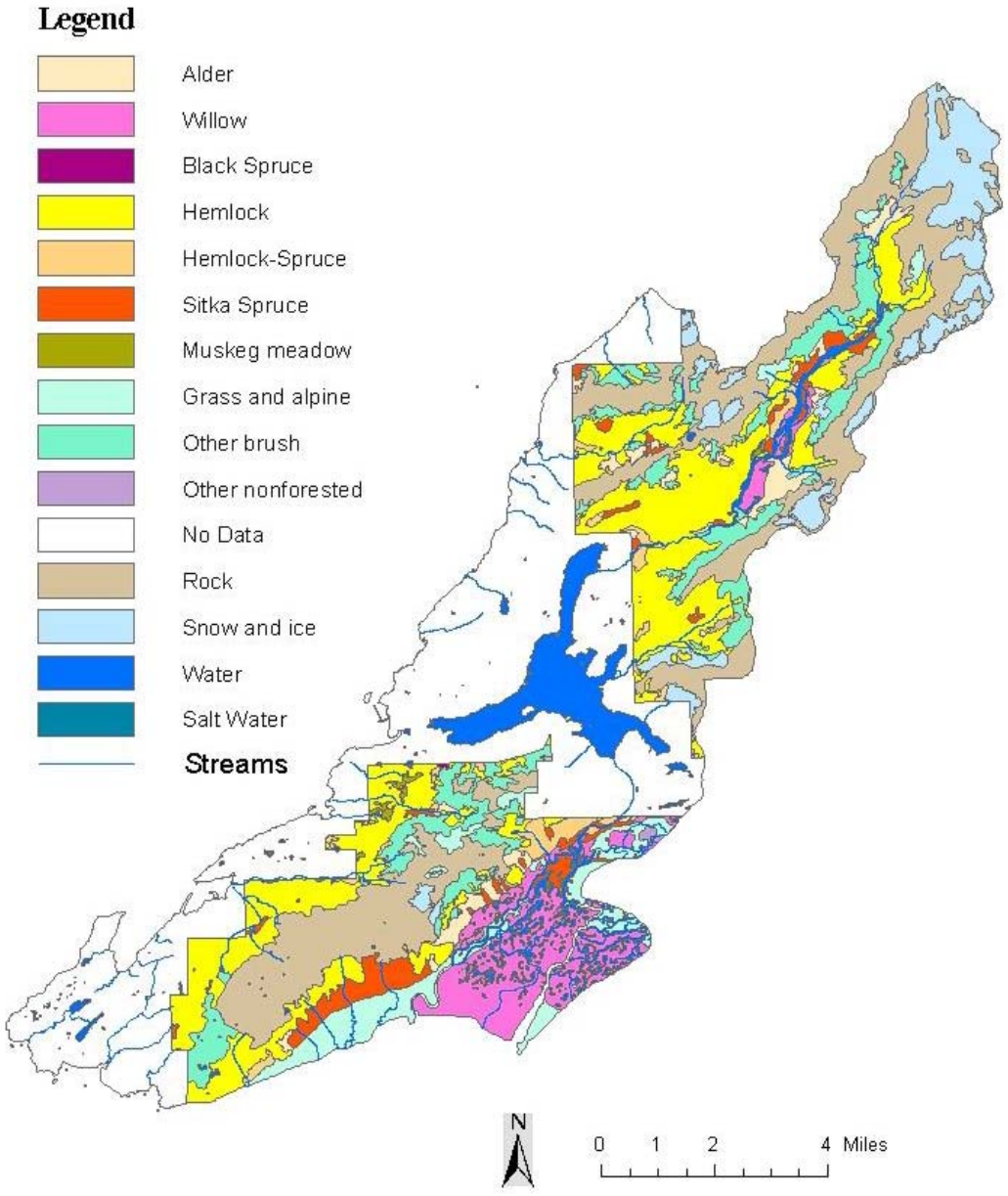

Figure 2.13: Cover types for the Eyak-Heney analysis area. Data from USDA USFS (1997).

Wildlife

Terrestrial wildlife habitats in the analysis area are representative of those occurring in coastal south-central Alaska. The Eyak-Heney area is diverse including tidal and low elevation riparian habitats, extensive spruce and hemlock forests, muskeg, subalpine, and alpine habitats. The fauna inhabiting this area include the compliment of species found elsewhere in coastal south-central Alaska with a few exceptions. Moose (*Alces alces*), not present in historical times, were introduced to the Copper River Delta from 1949 to 1958. Sitka black-tailed deer (*Odocoilus hemionus sitkaensis*), native to southeast Alaska, were introduced to islands throughout Prince William Sound from 1916 to 1923 and have spread to adjacent portions of the mainland, including the analysis area. Another exotic in the area is the European black slug (*Arion ater*); it was introduced accidentally and has become widespread in the analysis area.

The area's fauna is well documented from a number of sources. Wildlife surveys done to develop a management plan for Eyak Lake, bird observations by long-time residents, and wildlife surveys conducted by the USFS and others have resulted in baseline wildlife data for the area. Following is a discussion of species or groups of species of special concern to the US Forest Service, US Fish and Wildlife Service, and Alaska Department of Fish and Game or have other notable issues concerning them (i.e. hunting, viewing).

Birds - The Eyak-Heney analysis area includes diverse habitats, ranging from tidal areas to alpine habitats. The avifauna is diverse with 186 species of birds recorded in the immediate area surrounding Eyak Lake, and 210 species recorded within 10 nautical miles of Eyak Lake (Professional Fishery Consultant 1984) (Refer to Appendix A, Table A-3). Although much of the habitat in the area and the associated avifauna is in near pristine conditions, some bird-related issues exist in the area. Following are species or groups of birds meriting special attention in the analysis area.

Trumpeter Swan. Trumpeter swans (*Cygnus buccinator*) are a Region 10 sensitive species. The majority of the population of trumpeter swans is migratory; however some are yearlong residents of the Copper River Delta, Eyak Lake, and surrounding wetlands. Trumpeters nest in wetland ponds on the Delta and some birds over-winter on ice-free waters. Nesting swans have been documented throughout the Copper River Delta, including the lower Eyak River area, which is within the Eyak-Heney landscape analysis area. The 25-year average for the Copper River Delta is 610 total birds in spring and 408 pairs (Groves et al. 2000). Of these, anywhere from 8–41 birds have been documented in the analysis area each spring since 1992 (figure 2.14). Nesting swans have been documented in the south and middle arms of Eyak Lake, and on the Power Creek delta. Two swan nests have been found in wetlands within the Power Creek drainage. Each year one or two nests are documented in the analysis area, but numbers of adult pairs and singles suggest that this area may produce 3 or 4 nests per year.

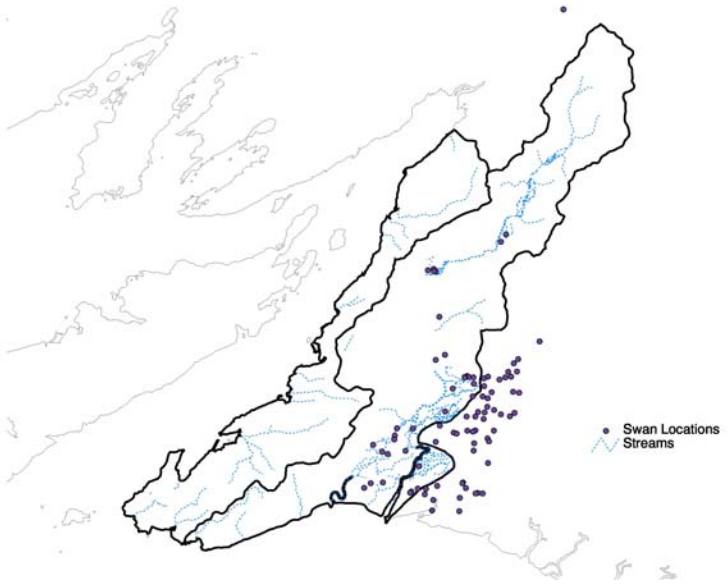

Figure 2.14: Swan locations in and near the analysis area. Data is from aerial surveys conducted 1992–1995.

The winter population of swans has increased dramatically in the Cordova area (figure 2.15). Christmas Bird Count data show winter swan numbers increasing from fewer than 20 swans in the 1970's to over 100 swans in 1992, 1993, and 1997. Over 300 swans were counted at the Eyak Lake outlet during the winters of 2000-2001 and 2001-2002, largely associated with feeding by a local resident. This feeding began in the mid-1990's and has continued through the winter of 2001-2002. The low count in 1999 is due to inclement weather on the count day.

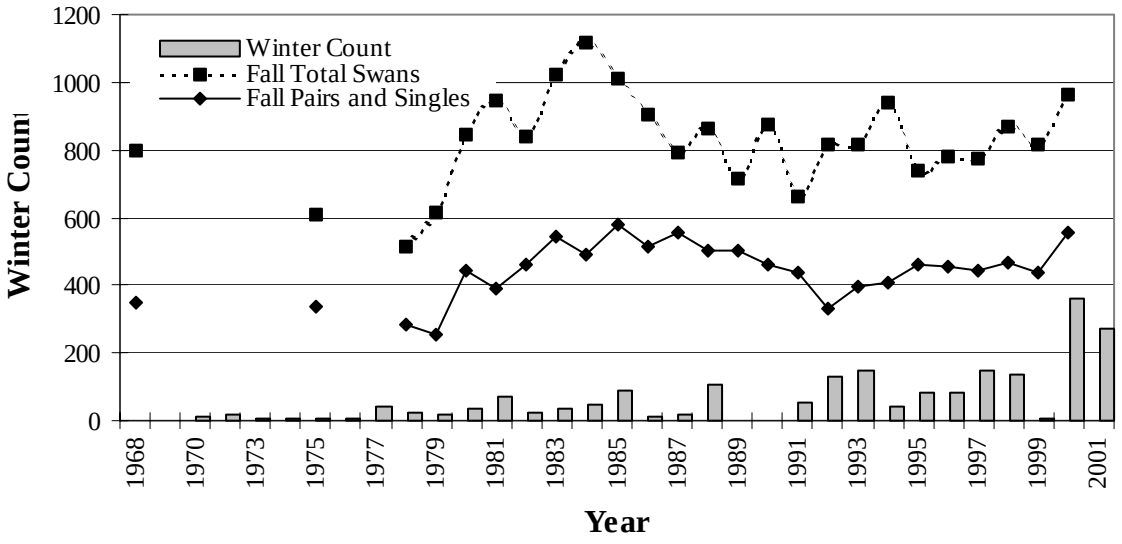

Figure 2.15: Winter and fall counts of Trumpeter Swans on the Copper River Delta.

Dusky Canada goose. The dusky Canada goose (*Branta canadensis occidentalis*) is a Region 10 sensitive species. Its breeding range is restricted to the Copper River Delta and wetlands east to Bering Glacier (Campbell 1990). It winters primarily in the Willamette Valley in Oregon and along the Columbia River in Washington (Comely et al. 1988, Bartonek 1971). The lower Eyak River area makes up the western edge of the Copper River Delta. Breeding pair aerial surveys have classified this area as medium and low density nesting habitat for geese. It is possible that geese also nest on wetlands surrounding Eyak Lake, including the delta at the mouth of Power Creek and the South Arm of Eyak Lake.

Shorebirds. Coastal areas of south-central Alaska are important migration stopovers for migrating shorebirds. Each May 4-6 million western sandpipers (*Calidris mauri*) and Pacific dunlins (*C. alpina*) use the Copper River Delta as a migration stopover. Red knots (*C. canutus*), least sandpipers (*C. minutilla*), pectoral sandpipers (*C. melanotos*), lesser yellowlegs (*Tringa flavipes*), short (*Limnodromus griseus*) and long-billed dowitchers (*L. scolopaceus*), marbled godwits, black-bellied plovers (*Pluvialis squatarola),* Pacific (*P. fulva*) and American golden plovers (*P. dominica*), and many other species use this area during migration as well. These birds use mudflats as critical feeding areas to replenish their fat reserves during their long migrations to breeding grounds.

Hartney Bay, which lies along the southwest shore of the Eyak-Heney analysis area, is an important feeding area for migrating shorebirds and is the most important area for viewing this migration in the Cordova area. Shorebirds also make extensive use of tidal areas near the mouth of the Eyak River and some use of the shorelines north of Hartney Bay.

Northern Goshawk. The northern goshawk (*Accipiter gentilis*) is a Region 10 sensitive species. The northern goshawk is the largest North American accipiter. It is a forest habitat generalist, breeding in coniferous, deciduous, and mixed forests across its holarctic range (Reynolds et al. 1992). While goshawks occur in a variety of forest successional stages, it is believed that nesting birds are most commonly associated with mature forests (Crocker-Bedford 1993, Titus et al. 1994, Titus 1996). Preferred habitat during the breeding season is mature and old growth forest with structural characteristics that allow goshawks to maneuver in and below the canopy while foraging and provide large trees for nesting (Reynolds et al. 1992). In Alaska, goshawks are most often associated with old growth forests (McGowan 1975, Crocker-Bedford 1993, Titus 1996). The species is considered a non-migratory resident in the Prince William Sound area (Isleib and Kessel 1973).

Due to concerns over population declines, the U.S. Fish and Wildlife Service currently lists the northern goshawk as a species of management concern. Species of management concern include those that there is some evidence of vulnerability but there are not enough data to consider a listing proposal under the Endangered Species Act of 1973. Goshawk population declines may be associated with forest harvest activities and habitat loss associated with roads (Bosakowski and Speiser 1994, Bright-Smith and Mannan 1994).

The northern goshawk is a fairly common resident of the North Gulf Coast and Prince William Sound (Isleib and Kessel 1973). The USFS conducted goshawk surveys during the summer of

1996 along the proposed route of the Shepard Point road corridor. Two goshawk sightings were made during the survey, and evidence of a nesting territory was found. Goshawks have been observed on most Cordova Christmas bird counts.

Bald eagle. The bald eagle (*Haliaeetus leucocephalus*) is a Region 10 sensitive species. It is an abundant and conspicuous resident of the North Gulf Coast and Prince William Sound region. Bald eagles are year-round residents using old growth timber (spruce hemlock, cottonwood) for nest sites, and feeding in streams, lakes, and marine waters. Salmon in spawning streams can concentrate large numbers of eagles. Isleib counted 416 eagles feeding on spawned-out salmon on Eyak Lake in December 1969 (Isleib and Kessel 1973). From 21 to 410 bald eagles have been observed on Cordova Christmas Bird Counts between 1970 and 2001.

USFS bald eagle nest surveys have located many nests within the Eyak-Heney landscape analysis area. These nests are most common near the shorelines of Orca Inlet and along the lower eastern flanks of the Heney Range (figure 2.16).

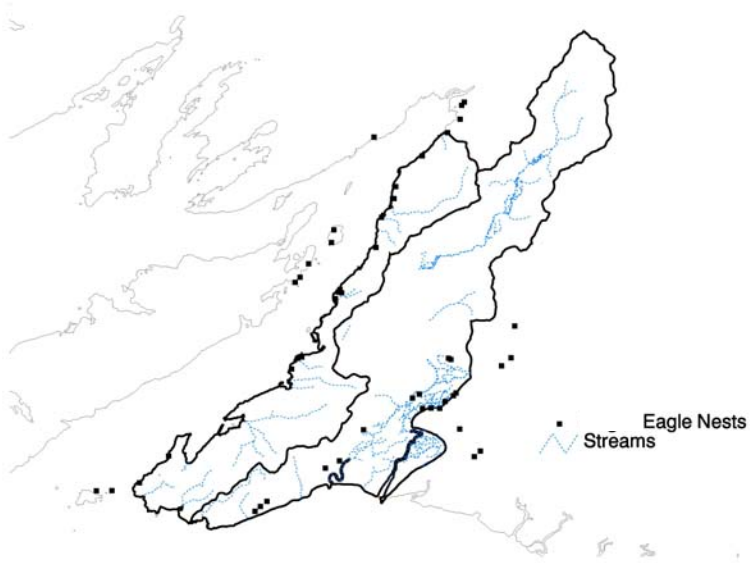

Figure 2.16. Eagle nests in and around the Eyak-Heney analysis area.

Peregrine falcon. The Peale's subspecies of peregrine falcon (*Falco peregrinus pealei*) is a Region 10 sensitive species. The peregrine falcon is a rare resident of the North Gulf Coast and Prince William Sound Region. Most birds in the region appear to be *F. p. pealei*, but some migrants and one winter observation appear to be the rare *F. p. anatum* (Isleib and Kessel 1973). During spring migration, peregrines appear most frequently between 15 April and 5 May. Twelve to 20 pairs breed along the North Gulf Coast (Isleib and Kessel 1973). Eyries are on or in view of the coast and are generally associated with nesting seabird colonies or waterfowl breeding area. No falcon eyries are known within the Eyak-Heney analysis area.

Osprey. The osprey (*Pandion haliaetus*) is a Region 10 sensitive species. It is an uncommon migrant and rare local breeder in the north Gulf Coast-Prince William Sound

Region (Isleib and Kessel 1973). No osprey nests are known within the Eyak-Heney analysis area.

Rufus Hummingbird. The Rufus Hummingbird (*Selasphorus rufus*) is a species of management concern in Alaska. Rufus Hummingbirds are common breeders and common migrants in the Prince William Sound region and in Cordova (Isleib and Kessel 1973). They are also common in the Eyak-Heney analysis area.

Alder Flycatcher. The Alder Flycatcher is a species of management concern in Alaska. This species can be uncommon to fairly common in some years but rare in others. Isleib and Kessel (1973) make no mention of Alder Flycatchers in the Prince William Sound Region. Breeding bird surveys (BBS) from 1993–1997 show Alder Flycatchers east of the 27-mile bridge in 1993, but absent in all other years. A partial BBS in 2002 showed Alder Flycatchers to be fairly common east of mile 17 (the section running through the Eyak-Heney analysis area was not surveyed in 2002). The presence of this species on the Eyak-Heney analysis area is unknown, but it is likely to occur in the southern region between Eyak River and the Heney Range in some years.

Gray-cheeked Thrush. The Gray-cheeked thrush is a species of management concern in Alaska. Isleib and Kessel (1973) state that the Gray-cheeked thrush is a rare migrant and rare local breeder in the Prince William Sound-North Gulf Coast region. However, breeding bird surveys show this species to be fairly common east of mile 30 of the Copper River Highway. There are also scattered reports of sightings in the Alaganik area in fall. Although this species may migrate through the Eyak-Heney analysis area, it is probably not common and an unlikely breeder.

Olive-sided flycatcher**.** The olive-sided flycatcher (*Contopus cooperi*) is listed as a species of special concern by the state of Alaska. Olive-sided flycatchers are listed as rare within the analysis area (Isleib and Kessel 1973), although they have been seen near Cordova during migration. Olive-sided flycatchers breed in interior Alaska, and breeding pairs could occur in forested portions of the analysis area.

Townsend's warbler. The Townsend's warbler (*Dendroica townsendi*) is listed as a species of special concern by the state of Alaska. The Townsend's warbler is a common, migratory breeder throughout south-central Alaska. Townsend's warblers usually arrive from mid-May through early June and leave Alaska in August (Isleib and Kessel 1973). Townsend's warblers were detected in spruce-hemlock/alder forest, spruce-hemlock forest, and alder habitats on breeding bird surveys conducted along the proposed Shepard Point Road (Lance et al. 1996). On these same breeding bird surveys, spruce-hemlock forest had the greatest species richness (16 species), followed by spruce-hemlock/alder forest (11 species), alder (7 species), and beach-rye/alder (6 species) (Lance et al. 1996). Strong species-habitat relationships were detected in 3 species: savannah sparrow (*Passerculus sandwichensis*), and yellow warbler (*Dendroica petechia*) in beach-rye/alder and winter wren (*Troglodytes troglodytes*) in spruce-hemlock forest (Lance et al. 1996).

Mammals - The Eyak-Heney landscape analysis area includes diverse habitats, ranging from tidal areas to alpine habitats. Thirty-one species of mammals were documented in the area surrounding Eyak Lake during the development of a management plan for the lake (Table 2.5). (Professional Fishery Consultant 1984).

Table 2.5: Mammal species documented in the Eyak Lake area (Professional Fishery Consultant 1984).

Species	Latin name
Masked shrew	*Sorex cinereus*
Dusky shrew	*Sorex obscurus*
Water shrew	*Sorex palustrus*
Little brown myotis	*Myotis lucifigus*
Collared pika	*Ochotona collaris*
Snowshoe hare	*Lepus americanus*
Hoary marmot	*Marmota caligata*
Red squirrel	*Tamiasciurus hudsonicus*
Beaver	*Castor canadensis*
Northern red-backed vole	*Clethrionomys rutilus*
Tundra vole	*Microtus oeconomus*
Muskrat	*Ondatra zibethicus*
Northern bog lemming	*Synaptomys borealis*
Norway rat	*Rattus norvegicus*
House mouse	*Mus musculus*
Porcupine	*Erithizon dorsatum*
Coyote	*Canis latrans*
Gray wolf	*Canis lupus*
Red fox	*Vulpes vulpes*
Black bear	*Ursus americanus*
Brown bear	*Ursus arctos*
American Marten	*Martes americana*
Ermine	*Mustela erminea*
American mink	*Mustela vison*
Wolverine	*Gulo gulo*
Northern river otter	*Lontra canadensis*
Canada lynx	*Lynx canadensis*
Harbor seal	*Phoca vitulina*
Sitka black-tailed deer	*Odocoilus hemionus sitkensis*
Moose	*Alces alces*
Mountain goat	*Oreamnos americanus*

A complete mammal list for the Eyak-Heney analysis area, which includes a larger area, would also include marine species including sea otter (*Enhydra lutris)*, harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), and occasional killer whales (*Orcinus orca*), humpback whales, and Minke whales (*Balaenoptera acutorostrata*). A few other species, not previously documented at Eyak Lake are probably present. These include the least weasel (*Mustela nivalis*) and several small mammals including voles, lemmings, and mice. Although

much of the habitat in the area is in near pristine condition, some issues exist concerning associated mammal species in the area. Following are species meriting special attention in the Eyak-Heney analysis area.

Brown bear. Brown bears (*Ursus arctos*) are found throughout the area, but certain habitats receive concentrated use. Avalanche paths are important early summer sources of herbaceous vegetation, berry patches are used during summer, and salmon streams are important during summer and fall. Authors of the Eyak Lake cooperative management plan estimated 10-20 brown bears using the area around Eyak Lake, particularly streams feeding into the lake at Power Creek and the northeast shoreline of the lake to Southeast Arm, east to Ibeck Creek (Professional Fishery Consultant 1984). Brown bears are also seen around the Heney Range.

Of particular note is the brown bear viewing opportunity that exists at Power Creek. While sockeye salmon are in the river, generally from mid-June through mid-August, brown bears can be observed close to Power Creek Road. On summer evenings, many people drive down this road to view bears. "Unusual numbers of people were congregated near Hatchery Creek to view the bears in July 1997" (Whitewater Engineering Corporation 1998). Although the area has no specific wildlife viewing designation, it is well known to local residents and is often recommended to visitors wishing to see bears.

Steller sea lion. The Steller sea lion (*Eumetopias jubatus*) is an Alaskan species of special concern and the western population is considered endangered by the U.S. Fish and Wildlife Service. The centers of abundance and distribution are the Gulf of Alaska and the Aleutian Islands. Populations have declined in south-central Alaska, but are fairly stable in southeast Alaska. Steller sea lion habitat includes marine and terrestrial areas that are used for a variety of purposes. Sea lions use haul outs on suitable beaches or rock outcrops. Adults also congregate on rookeries for pupping and breeding. Rookeries are generally located on relatively remote islands, often in exposed areas where access by humans and predators is difficult. Steller sea lions eat a variety of fish and invertebrates.

Steller sea lions inhabit Prince William Sound, including the waters of Orca Inlet, which makes up the western border of the analysis area. No sea lion haul-outs or rookeries occur in Orca inlet, however, they can regularly be seen on buoys near Observation Island. Groups of sea lions in Orca Inlet can be seen feeding on schools of herring in winter and are sometimes concentrated at the mouth of Humpback Creek while pink salmon are spawning.

Harbor seal. The harbor seal (*Phoca vitulina*) is listed as a species of special concern by the state of Alaska. Harbor seals haul out of the water periodically to rest, give birth, and nurse their pups. Reefs, sand and gravel beaches, sand and mud bars, and glacial and sea ice are commonly used for hauling sites. Harbor seals are sometimes found in rivers and lakes. Harbor seals have declined in several areas of the Gulf of Alaska and Prince William Sound since the mid 1970s. Alaska Natives, under the 1972 Marine Mammal Protection Act, hunt harbor seals.

Harbor seals inhabit Prince William Sound, including the waters of Orca Inlet, which makes up the western border of the analysis area. No seal haul-outs or rookeries occur in Orca inlet. Harbor seals are commonly seen in the analysis area, however, especially near the Cordova town site and at the mouths of streams while salmon are spawning, including Humpback Creek, Hartney Creek, and Fleming Spit. Harbor seals follow spawning salmon throughout the Eyak River and into Eyak Lake. Up to 30 seals have been counted in Eyak Lake in summer (Professional Fishery Consultant 1984).

Mountain goat**.** Mountain goats inhabit most mountainous portions of the analysis area. The Heney Range has been closed to the hunting of mountain goats since 1975 to protect the resource and provide goat-viewing opportunities. Goat surveys conducted in the Heney Range since the closure have not documented mountain goats; however, occasional sightings have been reported. Long-time local resident, Ed King, reports that hunters from the Crystal Falls Cannery harvested goats from the Heney Range in the 1940's or 1950's. Ed King observed goat tracks crossing the valley in that location on several occasions. In summary, it appears that a small goat population used the Heney Range, for at least a portion of the year, through the 1950's and was reduced to very low numbers or just transient individuals after that time.

Sitka black-tailed deer**.** Sitka black-tailed deer were introduced to islands in Prince William Sound in the 1930's. Deer have subsequently populated most of the islands in the Sound and portions of the adjacent mainland. Deer populations on the mainland, including the Eyak-Heney analysis area are thought to be of low density. One estimate places deer numbers surrounding Eyak Lake to be between 25 and 50 deer (Professional Fishery Consultant 1984). Some deer probably inhabit the forested areas at low elevation throughout the analysis area and use alpine habitats in summer.

Moose. The Eyak-Heney area in general has very low-density moose population. Moose make much greater use of the Copper River Delta than the forested uplands. Moose do, however, make extensive use of the habitat along the Eyak River, which represents the western edge of the Delta and the southeastern border of the analysis area. Moose are occasionally seen at the Middle Arm of Eyak Lake and at the delta at the mouth of Power Creek.

Montague Island vole. The Montague Island vole (*Microtus oeconomus elymocetes*) is a Region 10 sensitive species. The Montague Island vole is known only from Montague Island in Prince William Sound. It does not occur within the Eyak-Heney landscape analysis area. Another subspecies of tundra vole (*M. o. operarius*) is common in appropriate mainland habitats in Prince William Sound, including the analysis area.

Amphibians - Three species of amphibians occur in Alaska of which two are found in the analysis area. The western toad (*Bufo boreas*) is a common resident of the area, and the wood frog (*Rana sylvatica*) is uncommon. Wood frogs inhabit diverse vegetation from grasslands to forest, muskeg, and tundra while the western toads are generally found in open, non-forested areas near fresh water. Although declines in amphibian populations have been documented worldwide, no data exists on the status of amphibians on the Chugach National Forest.

Invertebrates - The European black slug (*Arion ater*) was probably introduced accidentally at least 15 years ago and has become widespread in the Eyak-Heney analysis area. One local resident, living at 4.5-mile on the Copper River Highway killed 5 slugs on his property in 1998, 15 in 1999, 45 in 2000, and 170 in 2001 (Bob Behrends, pers. comm.). In town, some folks kill hundreds each day. Total extent of their invasion and implications to native fauna and flora are unknown.

Human Dimension

Cordova was once a transport center for copper ore derived from the Kennecott mining district, from about 1912 to 1938. Today it is mainly a regional fishing, canning, and distribution center (Plafker et al., 1969) with a population of about 2,500. In the summer, the population doubles with returning fishermen and cannery workers.

Heritage Resources

The cultural resources of the Eyak-Heney analysis area include both prehistoric and historic remains and a variety of historic properties that are either on or are eligible for the National Register of Historic Places. Inventories that have taken place have been associated with specific projects as trail construction, however the entire analysis area has not been inventoried. Over 100 historic properties are known within the City of Cordova. Fifteen known historic and prehistoric properties are outside the City of Cordova but within the analysis area. Of these, 13 are historic and two are prehistoric in nature.

Prehistoric archaeological sites in Prince William Sound are only known to date from within the past 4000 years, encompassing three cultural phases: Uqciuvit (about 4000-2500 B.P.), Palugvik (about 2500-900 B.P.) and Chugach (about 900-200 B.P.) (Yarborough 2000). The protohistoric period dates between A.D. 1741, when Vitus Bering made landfall on Kayak Island, and A.D. 1778, when Captain James Cook made direct contact with Native inhabitants of Prince William Sound. The cultural use of the analysis area may span this 4000-year period. One artifact collected from COR-00052 in 1933 is diagnostic for the Palugvik phase (de Laguna 1956). However, the two known prehistoric sites within the analysis area have not been radiocarbon dated, and no testing or analysis has occurred that would firmly place these sites within the known culture history of the area.

The historic period began in the analysis area in A.D. 1778. The time that followed through A.D. 1867 is characterized as the Russian Period. Nuchek, a Russian American Company trading post, was the only European settlement in Prince William Sound during this time. The Suqpiaq/Chugach of Prince William Sound controlled the territory east to Controller Bay until the early nineteenth century. At that time, “Tlingitized” Eyak, whose original homeland stretched from an area east of Yakutat to Cape Suckling and possibly Controller Bay, pushed the Chugach out of Controller Bay, resulting in “mostly pure Eyak people” occupying the Copper River Delta and the very eastern margin of Prince William Sound (de Laguna 1990:189). In 1933, Eyak Natives described Eyak territory as extending from Cordova Bay, inside Prince William Sound, east to Martin River, including the Copper River north as far as Miles and Childs Glaciers at one time. Kayak Island was then described as having been within Tlingit territory (Birket-Smith and de Laguna 1938:17). The Russians enforced peace between

the Eyak and the Suqpiaq/Chugach, after which the Eyak expanded their territory as far north as Port Gravina (Birket-Smith and de Laguna 1938:18). Three Eyak sites within the analysis area may date from this time period: a village on the isthmus between Eyak Lake and Cordova Bay, the village of Eyak on Eyak River, and a village/Russian trading post at Glacatl or "Fort", downstream about 1/2 mile on the opposite bank (Birket-Smith and de Laguna 1938:21). Point Whitshed was the site of an intermittent fishing camp, which may correspond with one of the prehistoric sites noted above.

The American Period began in A.D.1868. The Alaska Commercial Company took over the assets of the Russian Commercial Company after the purchase of Alaska by the U.S. It continued the declining fur trade and at the same time expanded into salmon fishing and canneries. The development of the commercial fishing industry in the 1880s had a great impact on the local economy**.** Two canneries were established in Prince William Sound, on Odiak Slough (Birket-Smith and de Laguna 1938:22). The village of Eyak, noted by an ethnographer and several U.S. military expeditions between 1883 and 1885, was razed about the end of the nineteenth century between Eyak Lake and Odiak Slough for a cannery that was never built (Birket-Smith and de Laguna 1938:17). In 1906, Eyak village was described as a "fishing village of some 200 people" (Arvidson 1984:10). Historic sites in the analysis area associated with early twentieth commercial fishing include the Moore Cannery at Stevens Creek, the Shepard Point Cannery, and the Crystal Falls Cannery.

In 1897, copper was found in the Valdez area. Over the next 10 years, copper and gold prospects were located in Prince William Sound and in the mountains east of the sound. Cordova was developed in 1906 as the terminus for the railroad used to transport ore from various mines, especially the Kennecott copper mines. The city's location was chosen for its potential as a deep-water port. The buildings in the Cordova Historic District are associated with constructing the Copper River and Northwestern Railway. During the early 1900s, various attempts were made to harness the water of Power Creek for hydroelectric power for the growing city. The Ohman Falls site is associated with that effort.

The U.S. Navy began to establish wireless communications facilities in the Cordova area in 1908. The remains of two are within the analysis area. The Whitshed Navel Radio Station was constructed first, followed later in the year by the Eyak Navel Radio Station. Cable linked the Whitshed Station to a cable office on the Copper River Flats. The site also had telephone connections. The Eyak station received U.S. ship-to-shore and overseas wireless communication (AHRS 2001).

Most of the known sites are associated with the American Period, post A.D. 1867. Over 100 historic buildings or historic sites that are either eligible for, or on, the National Register exist within the City of Cordova. Most are privately owned. However, the Forest Service owns the Cordova Post Office and Federal Building, built in 1921. Of the 13 known historic properties outside the City of Cordova, two are associated with the U.S. Navy and the development of wireless communications, three are canneries, one is a Native village site, one is an Orthodox Christian church site, one is associated with shipping and commerce, and one is associated with early attempt to develop hydroelectric power. Not enough data have been collected from the other four historic sites to document their association with particular historic themes (AHRS 2001). Table A-2 in Appendix A lists the known sites.

Cordova Water Supply

Cordova derives its water supply from 4 sources: Heney Creek, Murcheson Falls Creek, Meals Reservoir watershed, and Orca Watershed, which includes Crater Lake and Crater Creek (figure 2.17). Disinfection is required for these sources, but no filtration is needed. Because of its high turbidity, Power Creek is not considered a viable water supply source. Although it is subject to pollution, water is taken from Eyak Lake when other sources are inadequate during winter low flows (Walters, 1963). Jose Rubio, city sewer and water plant manager estimates that when the canneries are running, Cordova requires a total of 3 million gallons per day for domestic and industrial uses and in the winter requires 400,000-600,000 gallons per day. A discussion of each water supply source follows.

Heney Creek / Meals Reservoir - A concrete and gabion dam in the upper part of Heney Creek at 420 feet elevation diverts a fairly constant 3 cfs into a 10 inch diameter pipeline and into Meals Reservoir, 1 mile away at 390 feet elevation (CH2M Hill and Stephl Engineers, 1997). Meals Reservoir, constructed in 1974, has a 17 million gallon useful capacity. The reservoir provides storage between Heney Creek and the Cordova water distribution system. Water from Meals Reservoir is transported in a 10-inch pipeline to a disinfection facility on Whitshed road, and then into the water distribution system (CH2M Hill and Stephl Engineers, 1997).

The Heney Creek watershed receives very little human use, estimated to be less than 10 persons per year (CH2M Hill and Stephl Engineers, 1997). However, snow machine use has increased significantly in recent years, creating potential for petroleum products to impair surface water quality. Meals reservoir is occasionally used by hikers, skiers, ATV's, and motorcycles and is visited by an estimated 250 people per year (CH2M Hill and Stephl Engineers, 1997). The access road to the dam is impassable and closed to motor vehicles.

Murcheson Falls Creek - Murcheson Falls Creek, located on the northern slopes of Mt. Eccles, is a water source consisting of two small diversion dams about 1.5 miles east of Cordova. The upper dam is to catch debris. The lower dam, a small concrete dam built in the early 1900's and located just above Murcheson Falls at an elevation of 195 feet, diverts water through a 12-inch pipeline to the city water treatment plant on the Copper River Highway (Merrell & Associates/Black & Veatch, 1980; CH2M Hill and Stephl Engineers, 1997). Murcheson Falls Creek is limited as a water supply because of its low or sometimes nonexistent winter flows (Merrell & Associates/Black & Veatch, 1980). The Murcheson Falls Creek Watershed receives little recreational use, with fewer than 20 people using the area each year (CH2M Hill and Stephl Engineers, 1997).

Orca Watershed - The Orca watershed and Crater Creek serve as a source of water for Cordova. A small catchment dam on Crater Creek, located at 263 ft elevation and 0.2 miles from the Orca Inlet, diverts water through a chlorination building and into the city water system (CH2M Hill and Stephl Engineers, 1997). The Orca watershed receives frequent recreational use. In 1997, the US Forest Service estimated that 1200 to 2000 people use the area each year for hiking and berry picking. Some erosion occurs on the trail that circles Crater Lake (CH2M Hill and Stephl Engineers, 1997).

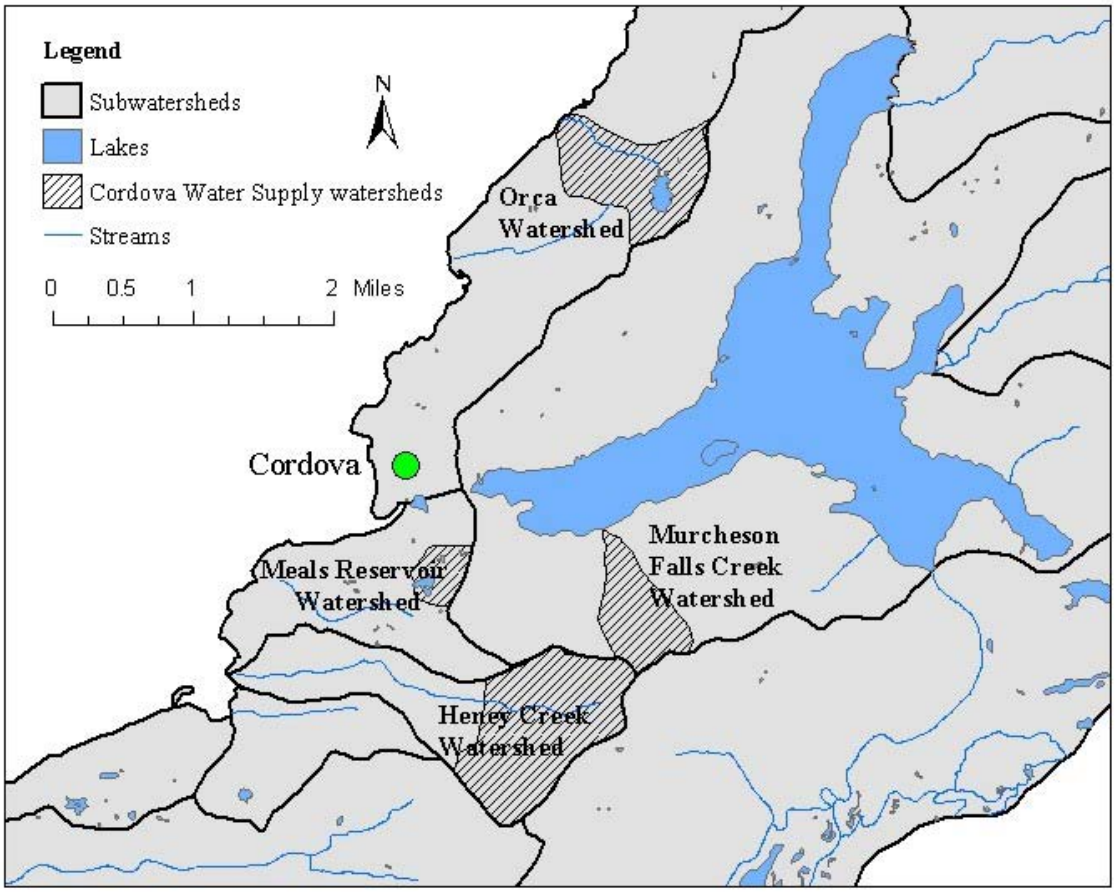

Figure 2.17: Cordova water supply watersheds.

Hydroelectric Power

As its name suggests, Power Creek was recognized for its hydroelectric project potential as early as the early 1900's. This small hydroelectric project on Humpback Creek was constructed because no agreement could be reached between the power company and the owners of the water rights on Power Creek, which was the more desirable location (Ellsworth and Davenport, 1915). However, this project did not become a reality until 2001 because of land ownership issues, geologic concerns, and the potential for avalanches at the site. Humpback Creek was the site of a small hydroelectric project that began operation in 1909. After being shut down for many years, a new plant on Humpback Creek began operation in 1991. Power Creek and Humpback Creek produce the only hydroelectric power generated in the Eyak-Heney Analysis area.

Humpback Creek - A 47-foot high log-crib dam and 125 kW pelton wheel were constructed on Humpback Creek near its mouth in the early 1900's. This project generated electricity for Cordova from 1909 until the late 1940's or early 1950's (Loeffler et al., 1985). Despite 2 log-crib dams constructed upstream of this dam to prevent sedimentation, the reservoir completely filled with coarse stream gravels (Loeffler et al., 1985).

A new run-of-river hydroelectric power plant began operation of Humpback Creek in 1991, with an installed peak capacity of 1.25MW and capability to produce 2.5 to 3.5 million KWh per year (Loeffler et al., 1985; Whitewater Engineering Corporation, 1996B). This project consists of a small, 10-foot high dam located 500 feet upstream of the old log-crib dam (Loeffler et al., 1985), about 0.5 miles upstream of the mouth. Water is diverted into a penstock on the south side of the channel, returning to the channel at a powerhouse about 250 feet upstream of the mouth (Maurer and Carrick, 1994). A majority of the power generation from Humpback Creek occurs in May through September (Whitewater Engineering Corporation, 1996b).

Power Creek - The Power Creek canyon, located 2 to 3 miles upstream from Eyak Lake, was considered a source of power generation for Cordova in the early 1900's. In 1913, a 60-foot long tunnel was driven through the canyon side to a proposed powerhouse upstream of Eyak Lake, but it was abandoned and collapsed many years later. Because of the permeability of the landslide deposits making up the north side of the canyon as well as high sediment loads that would quickly fill a reservoir, the Corps of Engineers eliminated the possibility of developing a large storage dam above Ohman Falls to regulate Power Creek (Professional Fishery Consultant, 1982).

A run-of-river hydroelectric project for Power Creek was constructed in 2001. It consists of an 8-foot high rubber inflatable diversion weir with a 70 foot crest length located about 700 feet upstream of Ohman Falls, or 3.3 miles upstream of the mouth at 420 feet elevation (Covel, personal communication) (figure 2.18). From the dam, a 500-foot pipeline extends to the upstream tunnel portal on the southeast side of Power Creek. The 2900-foot long pipeline through the tunnel joins a 300-foot long pipeline that extends over Power Creek. A final pipeline on the north side of Power Creek extends an additional 2250 feet to the powerhouse, located 700 feet upstream from the end of the Power Creek Road, or 2.2 miles upstream of the mouth. Two access roads, comprising 2.5 miles, were built to access the powerhouse and the intake (Whitewater Engineering Corporation, 1996a).

The impoundment created by the Power Creek diversion dam has a surface area of 1 acre and a gross storage of 5 acre-feet. The dam was constructed on alluvial and landslide deposits consisting of boulders and cobbles with a sand and silt matrix. Grouting and a clay blanket were used to minimize seepage through this material (Whitewater Engineering Corporation, 1996b). Because of the high sediment load in Power Creek, the weir is operated in a manner to provide for unimpeded sediment transport. The forebay water level is adjusted in response to flows. The overflow section will handle the 100-year flood event (Covel, personal communication). Because there is little ponding upstream of the dam, the Power Creek hydroelectric project has little impact on water quality. Water temperature and streamflow should be the same above and below the project (Whitewater Engineering Corporation, 1996b).

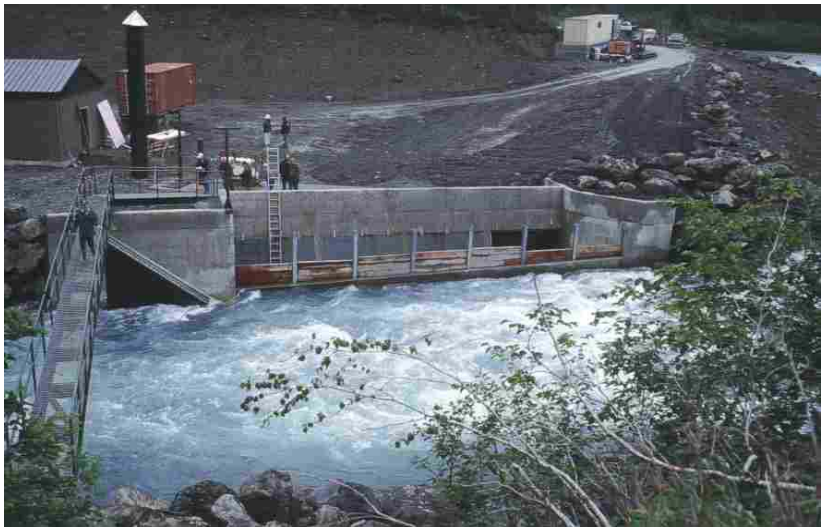

Figure 2.18: Power Creek diversion dam and intake.

Prior to construction of the Power Creek hydroelectric project, Cordova derived 86% of its power from diesel generators and 14% from the small hydroelectric project on Humpback Creek. In November 2001 the Power Creek hydroelectric plant was finished and it began generating power for Cordova. This plant was constructed to generate a cheaper and cleaner source of power for Cordova and offset diesel-generated power. It has an installed peak capacity of 6MW and is capable of producing 25,000 MWh (Whitewater Engineering Corporation, 1996a, 1996b). Because it is a run-of-river project, summer flows are more than adequate to meet power needs, but winter flows are less. A minimum of 5 cfs is required to bypass the dam at all times for instream flow. A maximum of 320 cfs is diverted into the power plant, and extra spill occurs in summer and fall when streamflows are the highest (Covel, personal communication).

Roads

The analysis area contains approximately 24 miles of road. There are no Forest Service system roads within the analysis area. All roads are State, City or private.

State Highway #10 (Copper River Highway) provides the primary access through the watershed and community of Cordova. The seven miles of the Copper River Highway that traverse the analysis areas are two lanes and paved. The highway starts at the Ferry terminal, Mile 0, passes through Cordova then travels along the southern shore of Eyak Lake. From there it crosses the Eyak River bridge at mile 5 and proceeds easterly 1 mile to the boundary of the analysis area and continues across the Copper River Delta to the Million Dollar Bridge, at Mile 48. This route was originally designed as a railroad to transport copper ore from the Kennecott Mine at McCarthy to the port of Cordova. In the 1950's the Copper River Highway was established, using the abandoned railbed.

Other State maintained roads within the watershed are Whitshed Road, Power Creek Road, and Orca Road. Whitshed Road is a two-lane road paved for the first 2.1 miles and a native gravel surface for the last 3.8 miles. It travels southwest along Orca Inlet to Hartney Bay providing year round access to residences and backcountry in the outer perimeter of Cordova's city

limits. Recreational opportunities include; fishing, hunting (big game and waterfowl), wildlife viewing, cross country skiing, and snow machining. Hartney Bay offers the best, road accessible, opportunity for viewing the spring migration of shorebirds.

Power Creek road is a narrow, two lane, native gravel surfaced road approximately 7 miles in length that travels from Cordova along the northeast shore of Eyak Lake. It was originally known as Eyak Highway and accessed the old American Legion lodge. From there the trail lead back to Oman Falls and Power Creek valley where hydropower exploration began in early 1900's. The road provides year round access to the City airstrip, residences, Crater Lake and Power Creek trailheads, Skaters Cabin (a City public recreation cabin) and the Power Creek Hydroelectric plant. It offers several opportunities for wildlife viewing (bear, eagles & salmon) as well as hiking, hunting, fishing, camping and cross country skiing. The two roads accessing to the intake and powerhouse at the Power Creek hydroelectric plant are new.

The only private roads within the watershed are on Eyak Native Corporation lands. They access either the Power Creek hydroelectric plant or timber harvest areas. These roads were generally constructed to low to moderate standards and are surfaced with native gravel.

Even though the Eyak-Heney Analysis Area has relatively few roads, with approximately 24 miles of paved and unpaved road for a the 95.6 square mile analysis area, nearly 2/3 of Eyak Lake is bordered by roads. This represents a road density of 0.24 miles of road per square mile. These roads are not expected to have impacts on water quality, sediment delivery, or water quantity in the small streams of the analysis area. However, spawning habitat and water quality in Eyak Lake may be harmed as a result of sedimentation and pollution along these roads.

The proposed Shepard Point road, located on the coastline of Orca Inlet from the Orca Cannery 4.8 miles north to Shephard Point, would likely impact Humpback Creek by increasing suspended sediment concentrations and turbidity. This would be the result of soil erosion in disturbed areas, as related to vegetation removal, blasting, culvert installation, and dredge and fill operations (Maurer and Carrick, 1994). This proposed road is not on National Forest System land.

Recreation Facilities and Use

Recreational developments within the Eyak watershed include; trails, easements, public recreation cabins, a public recreation shelter, a boat launch, fishing sites, migratory bird viewing areas, a downhill ski area, and camping facilities. Combined, these facilities provide a variety of recreational activities including: hunting, fishing, boating, hiking, camping, sight seeing, wildlife viewing, cross-country skiing, snowboarding, downhill skiing and snow machining. Figure 2.19 displays the location of trails, easements, cabins, and shelters in the analysis area.

Boat Launches - Eyak River boat launch provides the primary access to Eyak River. It is located east of Cordova at Mile 6 of the Copper River Highway. Recreation opportunities include sport fishing, accessing the Isolated Cabins, canoeing, and kayaking. A few

commercial fishermen use the launch to access the fishing grounds beyond the mouth of the river. Recreation use is considered low to moderate.

Eyak Lake boat launch provides access to Eyak Lake and sometimes to Eyak River. It is located at mile 1 of the Power Creek road on the northwest shore of Eyak Lake. This is not a Forest Service facility and ownership and maintenance responsibilities lay with the State or City. The condition is fair to poor and the use level is low.

Camping Facilities - Camping facilities within the analysis area are scarce; there are no Forest Service facilities. The City of Cordova operates a 20 to 23-unit campground that accommodates both RVs and tent campers. Local individuals and organizations such as the Boy Scouts use islands in Eyak Lake for camping and space in limited.

Cabins and Shelters - Power Creek cabin was constructed in 1991 by Forest Service crews and Operation Raleigh, a United Kingdom based volunteer organization. It is one of 17 public recreation cabins on the Cordova Ranger District. Access is hike-in only and is reached via the Power Creek trail. It is a Panabode style cabin that sleeps six plus a second level sleeping loft. Wildlife in the area includes brown bear, black bear, mountain goat, beaver, and swans. The area offers excellent backcountry hiking opportunities as well as hunting and spectacular scenery. Use level is considered low.

Power Creek shelter is located on the Alice Smith Intertie trail, about halfway between Crater Lake and the Power Creek valley. The shelter can be reached by either the Crater Lake trail or the Power Creek trail; both routes are five to six mile hikes. The shelter was built in 1993 and has a small covered deck and an enclosed area that will sleep two to three people. It does not have a stove, water, or outhouse but does offer spectacular views of the Copper River Delta and Prince William Sound. The shelter is used year round by hikers and cross-country skiers. Due to the heavy snow accumulation at the site the shelter has suffered structural damage. Forest Service crews are scheduled to do repairs during FY 2002. Use level is considered low.

Skaters Cabin is located about ½ mile east of the City Airstrip on Power Creek road by the Crater Lake trailhead. The Forest Service originally administered it as a warming cabin for ice skaters. The State of Alaska now owns the land and Cordova's Park & Recreation Department manages the cabin. It is a popular swimming and picnic site and. Facilities include picnic tables, fire ring, grill, outhouse, and a parking lot.

Trails – The Eyak River trail is located at mile 5 on the Copper River Highway at the north end of the Eyak River bridge. The trail is officially an easement allowing access to public lands even though it existed prior to the ANILCA land selection. The original 3.3 miles are maintained at the Class III level (developed/improved) the remaining 1.8 miles is more typical of our normal easements, which are maintained at the Class I level (primitive /undeveloped). Recreation use at the site is considered low to moderate. Future plans include evaluating the feasibility of connecting this trail with the Heney Ridge trail.

Crater Lake Trail is located at mile 1 of the Power Creek Road. The trail starts by the shore of Eyak Lake and meanders 2.2 miles uphill to Crater Lake and the ridge. The trail is maintained to the Class III level with the majority in fair to good condition. Several sections are in poor condition and need to be relocated. The recreation opportunities for this trail are hunting, hiking, fishing, and viewing scenery and wildlife. Recreation use is considered low to moderate.

Alice Smith Intertie connects the Power Creek trail with the Crater Lake trail. It is 6.2 miles in length traveling along the ridge northeast from Crater Lake to the headwaters of Humpback Creek, and then switchbacks down the slope easterly to the Power Creek Valley. Recreation opportunities are hunting, hiking, camping, and viewing scenery and wildlife. The Power Creek Shelter is located approximately 3 miles northeast of Crater Lake and serves as a base camp for backcountry hiking and cross-country skiing. Recreation use is considered low.

Heney Ridge trail is located about 5 miles southwest of Cordova, near the end of Whitshed road by Hartney Creek and Hartney Bay. This trail is an easement that is maintained at the Class III level rather then Class I. It is a relatively new trail; the majority of construction took place between 1997 and 1999. Minor construction and relocation work remains to be completed. The trail is 3.5 miles long and traverses forests, muskegs and alpine areas. Recreation opportunities are hunting and viewing scenery and wildlife. Recreation use is considered low.

Power Creek trail is located 7 miles east of Cordova at the end of Power Creek road and provides access to Power Creek valley. The trail is 4.2 miles long and provides opportunities for hunting, hiking, camping, berry picking, and viewing scenery and wildlife. The Power Creek cabin is located at the end of the trail and offers a base from which visitors can explore the upper valley. This trail is also an easement but maintained at the Class III level rather than Class I. Use level is considered low. The Power Creek trail was constructed in 1925 and was an offshoot of a pioneer overland route connecting Cordova and Valdez in the early 1900s.

Mount Eyak trail is not a Forest Service trail. It was constructed with State grant monies by a private contractor and crosses both State and City lands. It originates at Mt. Eyak ski hill, traverses Mt. Eyak from west to east and connects at the midway point of Crater Lake Trail. The trail is 2.6 miles long and provides hiking and scenery and wildlife viewing opportunities. Recreation use is considered low to moderate.

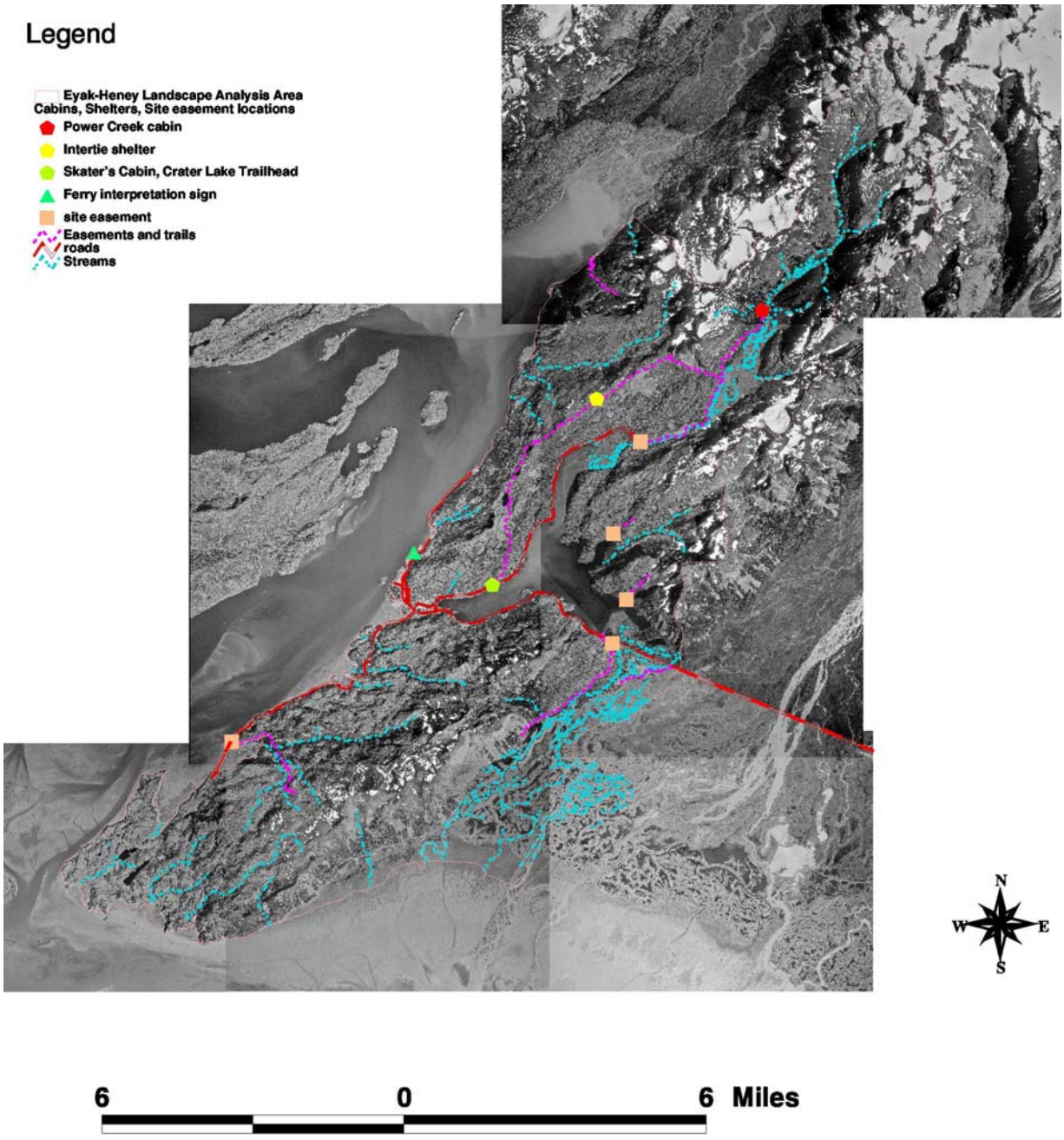

Figure 2.19: Location of trails, cabins, and easements in the Eyak-Heney analysis area

Easements – With the passage of Alaska Native Claims Settlement Act (ANCSA) the Forest Service and other federal agencies in Alaska established trail and site easements across the new private land holdings in order to access isolated parcels of public land. These easements are commonly referred to as "17(b) easements", referring to section 17(b) of ANCSA. The Forest Service and other federal agencies are appointed as administrators of 17(b) easements within their lands jurisdiction, but the Bureau of Land Management is the agency assigned overall responsibility for the recording, final platting, and rule making responsibilities. Site easements

are authorized along salt and fresh water shorelines, navigable rivers or at easement trailheads. Trail and site easements are not recreational trails and sites. Trails are intended for accessing federal lands only; they may not be used simply as a hiking trail or for any other purposes. Similarly, sites may not be used for recreational purposes but may be used for day use or overnight camping if the user either intends to access public lands from the easement or is using a site for day use or overnight camping if adjacent to navigable salt or fresh waters.

The use allowed on easements depends on the easement type. Travel by foot, dogsleds, animals, snowmobiles, two and three-wheeled vehicles, and small all-terrain vehicles, less than 3,000 lbs gross weight are allowed on 25-foot Right-of-Way trails. For One-Acre Sites, vehicle parking (e.g., aircraft, boats, all terrain vehicles, snowmobiles, cars, trucks), temporary camping, loading or unloading shall be limited to 24 hours.

Table 2.6 lists the 11 trail easements and 10 site easements that the Cordova District administers. In 1998, the *Exxon Valdez* Oil Spill Trustee Council negotiated a lands agreement that included fee simple buy-back of approximately 23 sections within the analysis area. Some district trail easements coincide with pre-existing trails. The Eyak boat launch existed before it became a site easement.

Table 2.6: Easement trails and sites within the analysis area

Name	Easement ID Number	Comments
Trails		
Shepard Pt Easement Tr	114b G	From ein 124cG
Heney Ridge Easement Tr	116a G D9	From trailhead ein 116 G, D9 on Hartney Bay, 3 miles
Eyak River Trail Ease	118 G, D9	Existing 7 mi. trail from Eyak Lake down right bank Eyak River
Ibeck Creek N Tr	120 G D9	Road easement release of interest > 25 ft, old Eyak townsite, 2 mi.
Eyak Lk Mid Arm Ease Tr	122a G D9	From trailhead ein 122 G, D9 middle arm of Eyak Lake
Eyak Lk S Arm Ease Tr	122c G D9	From S. arm site ein 122bGD9 on Eyak Lk
Lydic Slough Easement Tr	139 G D9	Old Eyak slough, 2 miles
Crater Lk Tr ease	156 D9	Crater Lk. Tr.
Eyak Lake Weir Ease Tr	159a D9	
Power Cr Cableway ease Tr.	171b E	From site ein 171a E access to USGS cable way facility, Power cr
Power Creek Easement Tr	206 G	BLM Sect 8, 15S 2W, 3 mile
Sites		
Shepard Pt Site	114CG	TH to ein 114bG
Hartney Bay Site	116 G D9	BLM sect 1, trailhead for ein 116a G, D9
North Ibeck Site	120aGD9	TH to ein 120GD9
Eyak Lk Mid Arm Site	122 G D9	TH to ein 122aGD9
Eyak Lk S Arm Site	122b G D9	Sec 18 (BLM), release of interest > 1 acre, TH to 122cGD9
Eyak River boat Site	123 G, D9	Release interest > 3.6 acre
Eyak Lk. N. Arm Site	160a D9	Release of Interest area greater than 1 acre
Power Cr stream gauge site	171a E	1/4 ac. site for USGS stream gauge adj. Eyak Lake Rd at FAS 839
Power Cr strm gauge cableway	171c E	USGS facilities 2 A-frame structures stream gauges 100' X 250' ease.
Power Creek Site	205 G	Trailhead for ein 206G

Typically district easements have been marked with a mixture of signs, carsonite posts, orange diamonds (5" X 7"), and chainsaw blazes on trees greater than 6" diameter. Trails however are not placed to normal Forest Standards. No tread is developed on trail easements. They are normally cleared with chainsaws to a 6-foot wide corridor with an 8-foot high clearing limit. Where possible, easements are designed at 20% grades or less. Most easements are surveyed. Corner monuments are placed at sites and at the beginning and end of trail easements.

Recreation Areas – There are no Forest Service designated "Recreation Areas" in the analysis area. However, the Heney Ridge area, in particular Mt Baldy, Super Bowl and Fountain of Youth, is a popular winter recreation site for people cross-country and back country skiing, snowboarding, snow shoeing, and riding snow machines and 4 wheelers. It does not have established boundaries nor does it have any constructed facilities, maintenance or patrol schedule or special designations. The Heney Range runs southwest from Cordova to Whitshed Point. The right-of-way and lands owned by the University of Alaska at mile 2 of Whitshed Road that accesses the major use area (Mt. Baldy), is experiencing erosion damage in the muskegs and hill slopes due to motorized use during periods of no snow cover. Since the areas at higher elevations have not been conveyed yet, administration duties remain with the Forest Service. It may be necessary in the future for the State and Forest Service to jointly address the problem. The other landowner in the immediate area is the Eyak Native Corporation.

Hartney Bay Area is similar to the Heney Range area in that it has mixed land ownership and does not have a management plan per se. It is located at the end of Whitshed Road approximately 5.5 miles southwest of Cordova. Prior to the ANSCA land selections, the Forest Service maintained a day use facility complete with picnic tables, fire rings, an outhouse and parking. After selection by the Eyak Native Corporation, the Forest Service removed everything except the outhouse. The outhouse was later removed due to vandalism. The site has since become overgrown with Sitka alder. With the inception of the Cordova Shorebird Festival, the area has seen some resurgence in visitation. Besides the standard picnicking, hiking and fishing, large numbers of visitors spend the first two weeks of May watching the shorebird migration. Additionally, school groups use the areas as a field lab for their science classes.

Ski Area - There is a downhill ski area complete with chair lift, snack shack, rental shop, and downhill and cross-country ski trails on Mount Eyak. It is located on city land and is run by a non-profit organization and volunteers.

Sport Fishing - Several popular fishing sites are located in the analysis area. One is Fleming Spit about ½ mile north of the ferry dock on Orca road. Through the efforts of the City of Cordova (developing accessible fishing sites and restroom facilities in the early 1990s) and Prince William Sound Aquaculture (developing a sport fish enhancement program in the mid 1980s) it has become one of two major sport-fishing sites within the analysis area. Alaska Department of Fish and Game and Prince William Sound Aquaculture (PWSAC) maintain this terminal fishery. It is considered a significant sport fishery because it provides the best opportunity in the area to catch Chinook salmon with hook and line. Not only does it provide an opportunity for a variety of users to fish for Chinook and coho salmon, but it also acts as a buffer for other, more fragile, fishery resources on the Copper River Delta. This fishery may

help to alleviate fishing pressure on other local streams because harvest restrictions on coho salmon at Fleming Spit are more lenient than the surrounding waters.

Sport fishing in the Power Creek-Eyak Lake drainage is an increasingly popular activity for locals and visitors alike. Whereas fishing for any salmon species is prohibited in Eyak Lake and Power Creek, Eyak River provides about 2.5 miles of quality sport fishing for all species present. The Eyak River weir is located at Mile 5 of the Copper River Highway upstream from the Eyak River bridge. It was built after the 1964 earthquake to stabilize the level of the lake. Just east of the Eyak River bridge, a highway guardrail blocks a short road that provides walk-in access to the weir. Since the late 1980s, an area 200 yards above the weir to a line 200 yards below the bridge has restricted to fly fishing only and as a result the weir has become a popular sport fishing site.

Special Uses

Nine special use authorizations (or leases) for commercial, personal, or public interest use are present in the analysis area. The following organizations and agencies are authorized use on the National Forest System lands within the analysis area:

Outfitter/Guides

Sound Experience (COR12) - Specific authorized activities within the analysis area include guided hiking for parties of up eight (8) on the Crater Lake trail. Other activities on the district include guided freshwater fishing, hiking, photography, bear watching and interpretation in numerous locations.

Alaska River Rafters (COR6) - Permit holder is authorized occasional day hike use of the Crater Lake trail. In addition, they are authorized to conduct commercial guided river rafting on the district.

Other Uses

Prince William Sound Science Center (COR416302) - The permit holder maintains a site at the Heney Ridge communications site in addition to numerous other data research communication sites.

City of Cordova (COR1009.04) - The Cordova Public Utilities maintains a sewer line cleanout access near the northeast corner of the Forest Service compound.

Cordova Wireless Communications - This leaseholder maintains a communications building and antennae tower at the Heney Ridge communications site.

Copper Valley Cellular – The leaseholder maintains a communication shelter and antenna at the Heney Ridge Communications site, as well as on other locations on the Forest.

State of Alaska, Div. of Telecom - The leaseholder maintains two communication shelters and an antenna at the Heney Ridge Communications site, in addition to other locations on the Forest.

Subsistence Fishing

Subsistence salmon fishing with nets in Eyak Lake occurred prior to 1960. A ban on using nets in Eyak Lake in 1960 resulted in most subsistence users converting to rod and reel to take salmon for subsistence. In 1985, the lake and its tributaries were completely closed to salmon fishing and people went elsewhere to harvest salmon for subsistence (Stratton 1989). Now,

nearly all of the subsistence fishing for salmon occurs in the marine waters off the Copper River Delta using small boats with 50 fathom gillnets. The number of subsistence permits issued for the marine water area from 1995 through 1999 has been increasing, with 126 issued in 1995 and 294 issued in 1999. The subsistence harvest has fluctuated between 880 salmon and 3,022 salmon during those same years, with 1997 being the peak year (Sharp et al. 2000). The Eyak watershed empties into this area and some of the sockeye and coho salmon harvested by gillnet in marine waters for subsistence are probably bound for the Eyak watershed. At the present time, some salmon are also harvested for subsistence purposes using rod and reel in the Eyak River under sportfishing regulations.

Subsistence fishing for salmon and rainbow trout is allowed in freshwaters of this analysis area by Federal subsistence fishing permit only. However, as of 2002, specific harvest limits by species have not been determined. Salmon are currently being harvested under sportfishing regulations. The Eyak watershed is the only system in the analysis area used by sockeye salmon with the Eyak River portion of the watershed open to sportfishing of salmon. The daily sportfishing bag limit of three salmon from the river allows for a subsistence opportunity in freshwater. Sockeye salmon are not easily caught with rod and reel. Therefore, most of the subsistence harvest of sockeye salmon occurs in the marine gillnet fishery. Coho salmon are readily harvested using rod and reel and the sportfishing bag limit of three coho salmon per day provides an opportunity for subsistence users to obtain salmon from freshwater. In addition, a six coho salmon bag limit on a hatchery return at Fleming Spit provides an alternative for subsistence users to harvest more salmon in a shorter time.

The subsistence harvest of fish other than salmon and rainbow trout is allowed in the freshwaters of this analysis area by state regulation. Federal subsistence regulations are the same as the state regulations regarding the harvest of freshwater fish other than salmon and rainbow trout in this area. The only non-salmon species that has a significant subsistence harvest in freshwater at this time is eulachon (*Thaleichthys pacificus)* smelt. The state Board of Fisheries has determined that eulachon have a customary and traditional subsistence use in Prince William Sound. The allowable take for subsistence use is unlimited per individual. The most common means of harvest is with a dip net. In this analysis area, only the Eyak River contains eulachon, however very little subsistence harvest occurs in the Eyak River at this time. Eulachon most often enter into the lower reaches of the Eyak River in mid-winter before branching off into a tributary, which originates outside of this analysis area. When eulachon enter the lower Eyak River in January or February, ice and weather conditions make access to the lower river difficult. Occasionally, eulachon will enter the Eyak River in late spring and migrate into Eyak Lake. These fish are available for subsistence harvest, but the wide slow moving river does not concentrate the fish near the shoreline and the abundance of eulachon at other locations, which are readily accessible make it highly unlikely that eulachon will be exploited on the Eyak River in the future.

Sport and Subsistence Hunting

Mountain goat - No federal subsistence harvest of mountain goats (*Oreamnos americana*) occurs within the analysis area, however, subsistence harvest does occur in Hunt Unit 6D to the west. ADFG offers up to 25 permits on a first come, first serve basis for hunting mountain goats within unit 6C, which includes the northern portion of the analysis area. Currently, the

Heney Range is closed to the hunting of mountain goats. Goat surveys conducted in the Heney Range since the closure have not documented mountain goats, however, occasional sightings have been reported. ADFG has records of 1 goat harvested in each of the 2 years prior to the closure (1972 and 1973). Harvest history before that time was not recorded. Stratton (1989) reported that the Eyak hunted goat in the Heney Range above Mountain Slough. Long-time local resident, Ed King, reports that hunters from the Crystal Falls Cannery harvested goats from the Heney Range in the 1940's or 1950's. Also, goats were regularly shot north of the Copper River Highway at Mile 7 and those animals could have also used the Heney Range.

Sitka black-tailed deer - Residents of Cordova, Tatitlek, and Chenega currently have a customary and traditional use determination for 4 Sitka black-tailed deer per season. Currently, state bag limits in Game Management Unit 6 allows the harvest of 5 deer by state residents, therefore, no special subsistence season exists.

Moose - Moose are an important big game species throughout Alaska. They are not native to the Cordova area, but were introduced in the late 1940's and early1950's. Moose in the Cordova area (Hunting Unit 6C) are also managed for subsistence hunting opportunity and currently 5 cow and 15 bull permits are offered only to Cordova residents through a drawing. The ADFG offers another 5 permits for bull moose to any resident of Alaska.

Chapter 3 – Issues and Key Questions

Following are issues and key questions identified through both internal and external scoping. Besides one-on-one discussions with interested publics, an open house was held on August 28, 2002 so people could provide input.

Physical

1. What is the erosion potential in the analysis area, in particular in areas where construction of trails is being considered, development proposed and human use is occurring?

   - Areas of high erosion potential have been identified and mapped. There is some damage occurring on lands owned by University of Alaska Anchorage near mile 2 of Whitshed Road. Some people are running their snow machines and 4-wheelers across muskegs and wetlands in the lower elevations when the snow is gone to reach areas still covered with snow at higher elevations. Chapter 5 includes recommendations for these areas.

Fish Issues

1. Maintain quality of spawning and rearing habitat and water quality for anadromous and resident fish in the primary streams and lakes in the analysis area.
   - Not sure of impact of dewatered flows in Power Creek and Humpback creek below the hydro diversions and effects on fish and channel morphology. The weir is operated in a manner to provide for unimpeded sediment transport. Chapter 5 lists proposed monitoring and inventory projects to answer this question.

2. What is the status of cutthroat trout and Dolly Varden in the primary fish bearing streams and lakes in the analysis area?
   - Chapter 5 proposes monitoring and inventory projects to answer this question.

3. What extent does sport fishing target cutthroat trout and Dolly Varden in the analysis area and what are the potential impacts to these species based on this level of use? How about impact of by catch of Dollies and cutthroat trout during coho salmon fishing?
   - Proposed monitoring and inventory projects to answer this question are listed in Chapter 5.

Human Use Issues

Economic

1. Is there potential to assist with economic diversity for the town of Cordova, as has been in the past? Examples are the shorebird festival, outdoor camps, trails, cabins, sport fishing, and wildlife viewing.

2. Residents of Cordova feel that the natural environment and scenic beauty around the town enhances the quality of life. (From Town meeting held May 3, 2002)

Recreation

1. What is the public demand for recreation opportunities within the analysis area and how does it compare to capacity? (Trails, heliskiing, outfitter guides, wildlife viewing, motorized and non-motorized)
   - See Chapter 4 for conditions of trails and trends in use.

Special Uses

1. What is the demand for special use permits for other land uses in the analysis area such as radio repeaters and water supplies?

Heritage Resource Issues

1. There is concern that the Native Village of Eyak be consulted for any inventory or work related to heritage resources.

- The National Historic Preservation Act, Section 101(d)(6)(B), and its accompanying federal regulations require that federal agencies "identify any Indian tribes...that might attach religious and cultural significance to historic properties in the area of potential effects and invite them to be consulting parties. Such Indian tribe...that requests in writing to be a consulting party shall be one" (36 CFR 800.3(f)(2). In addition, the Programmatic Agreement between Region 10 of the Forest Service, the Alaska State Historic Preservation Officer and the National Advisory Council (Agreement #02MU-111001-076, executed 7/29/02) requires that consultation in accordance with NHPA, as noted above, take place.

2. Where are the areas where proposed development may have an impact on heritage resources?

- Chapter 2 and Appendix A describe known sites in the analysis area. However the existence of sites in other parts of the analysis area cannot be ruled out, as most previous archaeological survey in the area has been project related, and no predictive model has been developed for the Cordova Ranger District.

3. How many Historic and Prehistoric Properties are actually within the Eyak-Heney analysis area?

- Although over 100 historic and prehistoric properties are known from within the City of Cordova, only 13 are known from outside the City. The actual number of historic and prehistoric cultural resources, or properties, is not currently known, and may be expected to increase with future investigations.

4. Which of the Known Historic and Prehistoric Properties within the analysis area are eligible for the National Register of Historic Places?

- All of the currently known historic and prehistoric properties, or cultural resources, are assumed eligible for the National Register of Historic Places, until formally evaluated and determined otherwise. This is a question that relates directly to proposed projects, as

sites that have been determined not eligible for the National Register are of no concern in project development, while proposed impacts on sites or properties that are legitimately eligible for the National Register must be evaluated in terms of having "no effect" on sites, or having either a "no adverse" or "adverse" effect. The last would require proposals of mitigation and Memorandums of Understanding (MOU's) with the Alaska State Historic Preservation Officer and possibly the National Advisory Council on Historic Properties.

5. What is the age and context of prehistoric sites in the analysis area?

- The ages of the two prehistoric sites in the analysis area are unknown, but they are assumed to date from within the past 4000 years. The date of the initial settlement of Eyak sites in the analysis area is uncertain, although they appear to have been occupied during the Russian period. Should opportunities arise for further study of these sites, whether through Forest projects, or requests for partnerships or technical assistance from private organizations, knowledge of age and historic or prehistoric context of these sites will enhance development of a predictive model of site locations for the Cordova Ranger District. It will also allow development of accurate educational interpretations for the public.

Vegetation Issues

1. Could any Threatened, Endangered or Sensitive plant species occur in the area? ----- Yes, see chapter 2.
2. Are there any invasive plant species? It is unknown, but there is potential.

Water Quality/ Hydrologic Issues

1. What is the flooding potential on Scott and Eyak River and impact of levee proposals?

- The Army Corps of Engineers is running through models to determine if a levee would decrease potential flooding. Currently they do not think it would help. However there were comments received at the open house questioning this. One person strongly suggested the Army Corp reevaluate placement of a levee to prevent flooding in Eyak Lake and River. They felt that although stream flow and direction varies and is not currently a problem, it will become a problem again as it has in the past. A levee to divert Scott Creek from emptying high* into Eyak River is necessary. (* Just below last house on river)

2. Since there are municipal watersheds and backup areas identified in the analysis area, what standards need to be applied to activities in those areas? (Whitshed road, Orca Cannery & Crater Lake, Mile 2 along Copper River Highway, and Lake Eyak –backup)

- During the open house, people said that there is a problem with snowmachines using municipal watershed even though road says closed. Snowmachines should be allowed west of Heney Mountain; they should be banned from City's watershed.

- There is potential for erosion in Heney Creek watershed as a result of increasing recreational use (e.g. snowmobiles). Not sure of effect on water quality.

3. What has been impacts of pollution in Eyak Lake from shoreline development and transporting of fuels along roads next to the lake?

- There is potential for oil and gas spills impacting fish as well as Cordova's backup water supply.

Wildlife Issues

1. What are the Threatened, Endangered and Sensitive species in the analysis area and what is their status? How about invasive species?

- TES wildlife species are present in the area. Chapter 2 describes the wildlife species present in the area.

- Invasive species include the European black slug.

2. What is the distribution of game species hunted and those popular for wildlife viewing in the analysis area?

- Chapter 2 describes the distribution of wildlife species in the area. There are opportunities for bear and other wildlife viewing in the analysis area.

Chapter 4 – Conditions, Trends, and Interpretation

Landtype Association

Landtype Associations (LTA's) are the most generalized topographic landscapes delineated based on similar geomorphic process, soil complexes, stream types, geology, and plant communities in repeatable patterns. They provide guidance as to limitations of implementing management activities or projects. A short description of the characteristics and processes defining the associations follow:

Coastal - This association includes landscapes resulting from marine processes such as tidal fluctuations, wave action, and blowing sand. Examples include estuaries, beaches, marine deltas, and marine terraces. Most often these sites have slopes less than 15 percent. The soil may consist of either poorly drained silts deposited in low energy environments or well-drained sands deposited in high energy environments. Portions of the landscapes have been uplifted by isostatic rebound after glacial recession or from earthquakes. Uplifted landscapes are no longer associated with the active processes of the ocean and may be located inland from the ocean. The vegetation found on these landforms depends on how long the site has been separated from active wave processes, and the drainage of the soil. Old uplifted beaches have some of the most productive forested sites on the forest. The poorly drained soils on deltas or tidal flats and marine terraces produce the largest expanses of wetlands.

Glaciers - This association includes all active major glaciers, ice fields, and rock peaks or nunataks. The major process shaping this unit is the formation and movement of ice and associated rock and soil.

Hills - This association includes hills and plateaus that do not receive surface or subsurface water flow from adjacent uplands. It excludes major rivers or creeks that may flow through the hills that originate from other areas. The surface character is often controlled by the stratigraphy of the bedrock. A veneer of glacial till frequently covers these landscapes. The soils are normally well-drained, medium to coarse texture on the side slopes, and poorly drained fine to medium textured and shallow in the basins or low areas between the hills. The vegetation usually consists of forested communities on the slopes and hilltops where the soils are well drained. The vegetation in the small basins or valleys in-between the hills will commonly be that associated with wet soils or wetlands

Mountain Sideslopes - This association includes side slopes, glaciated or non-glaciated, smooth or irregular, that normally receive surface or subsurface water draining from the alpine. Slope steepness generally ranges from 15 to 70 percent. The most dominant process shaping the steeper slopes is erosion and transportation of sediment down slope due to gravity. Erosion from surface water usually results in a parallel drainage pattern with V-notched channels of variable depths and densities. Soil and rock that is loosened by frost and water rolls down the slopes or is carried down by avalanches. This material is deposited on the lower, less steep slopes. The soils are normally medium textured, well drained, and moderately to well developed. Some of these soils on the lower slopes consist of compact glacial till which is more poorly drained and less productive for forests than other soils in the association. The

upper side slopes are commonly vegetated with low growing subalpine plants which grade into mixed communities of grasses, shrubs, and trees on the lower slopes. The location of trees is strongly dependent on the frequency of disturbance by avalanches.

Mountain Summits - This association includes the ridges, peaks, cirque headwalls and basins and scree slopes. Glaciation has been the most dominant historical geomorphic force that shaped the landscape. In some cases, frost fracturing has resulted in rounded mountaintops and ridges covered by a layer of loose rock. Most of the water runs off the surface where bedrock is exposed or beneath the surface where significant depths of loose rock have accumulated. The vegetation is mostly low growing forbs, grasses, and lichens where there is sufficient soil, and willows and other woody plants in localized wet areas.

Outwash - This association includes all landscapes resulting from fluvial deposition of sediment from upland erosion. Much of this association is exposed to occasional or frequent flooding depending on the proximity of rivers. Examples are alluvial plains, glacial outwash plains, braided glacial rivers and the associated islands or sand bars, large sand dunes, low relief river terraces, and narrow valley bottoms that contain a combination of the above landscapes. Soils can be poorly drained lacustrine silts and clays or well-drained alluvial loams, sands, and gravels. The vegetation on the poorly drained, fine textured soils will be a wetland type where the surface is level and a forest with low productivity on gentle slopes. The coarse textured soils will produce highly productive forests.

Table 4.1 shows the amount of each Landtype Association represented in the analysis area and Figure 4.1, on page 62 illustrates where each type is located.

Table 4.1: Acres of each Landtype Association in the analysis area.

Landtype Association (Map Unit Code)	Acreage
Glaciers (00)	5,082
Mountain Summits (10)	15,388
Mountain Sideslopes (30)	16,153
Coastal (70)	5,767
Outwash (80)	2,747
Hills (90)	13,639
Clear Water (CW)	2,385

Wetlands

The Eyak-Heney analysis area borders the 1100 square mile Copper River Delta to the east, the largest wetland in the Gulf of Alaska. Eyak River flows through this area of wetlands, which consists of estuaries, mudflats, marshes, and barrier islands (Dorava and Sokup, 1994). No other large wetlands exist in the analysis area because of the steep topography throughout much of the area, but small wetlands occur in the valley bottoms and areas of flatter topography. Wetlands cover 13,886 acres or 22% of the analysis area.

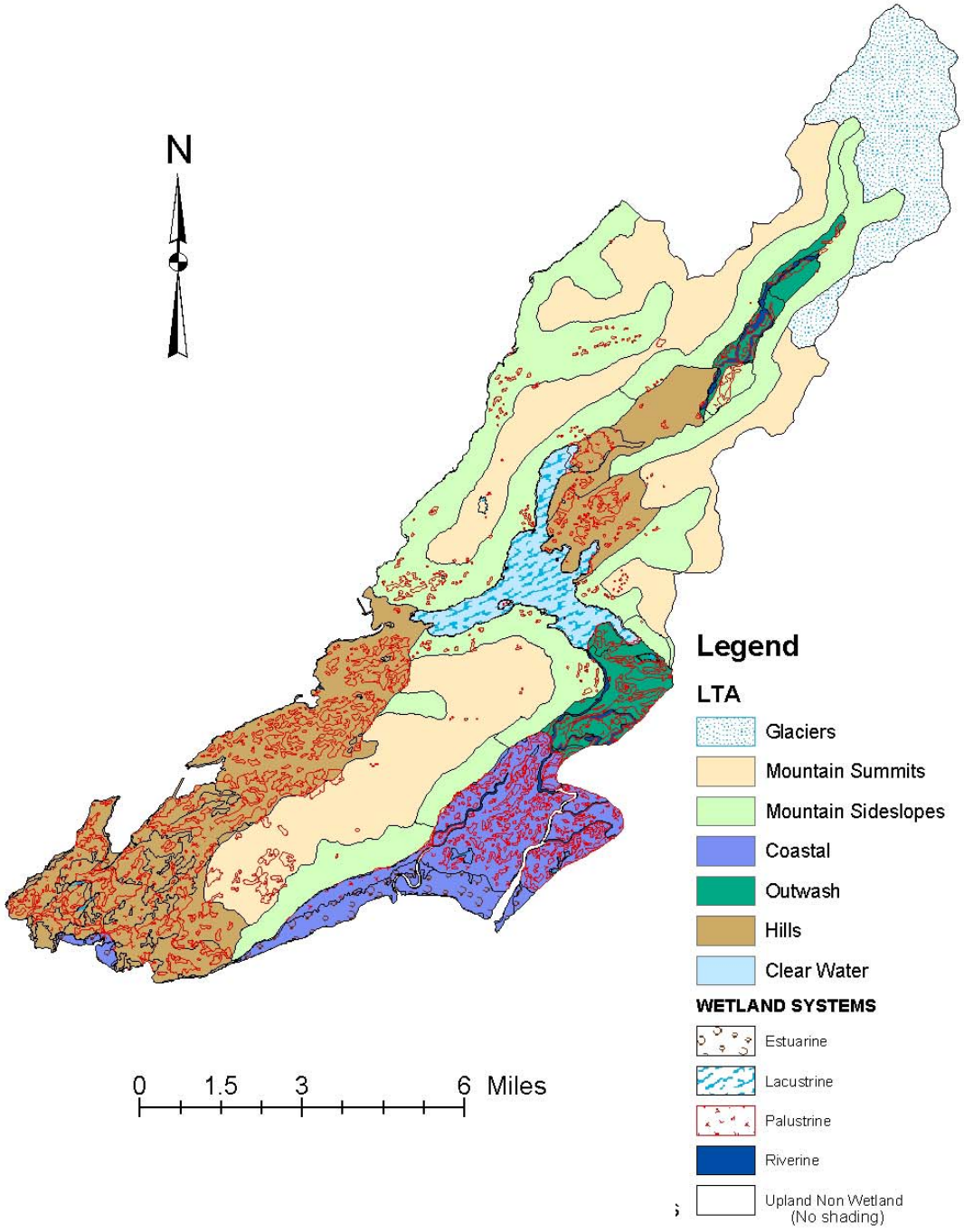

Figure 4.1: Landtype Associations in the analysis area and type of wetland associated with each.

The National Wetlands Inventory developed by the National Resources Conservation Service delineated four types of wetlands: Estuarine, Palustrine, Riverine, and Lacustrine. Figure 4.1 on page 62 displays where each type of wetland occurs in the analysis area. It may appear that some wetlands occur in Landtype Associations where they would not be expected; however, the landtype associations are large somewhat general units, and it is common for small inclusions of contrasting landforms to be included during mapping.

The two most extensive wetland types that occur in the analysis area are the Estuarine and Palustrine. Estuarine wetlands include deepwater tidal habitats and adjacent tidal wetlands where there is some dilution of salt water from fresh water flowing off the land (Cowardin, 1979). Palustrine wetlands include nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens and tidal areas where salinity from ocean water is minimal. Palustrine wetlands are by far the most common type of wetland in the analysis area. The Lacustrine and Riverine wetlands occur as minor components as lakes and rivers. Table 4.2 shows how much of each wetland occurs by Landtype Association.

Table 4.2: Amount and type of wetlands by landtype association

Landtype Association	Wetland Type	Wetland (acres)
Glaciers	-	0
Mountain Summits	Lacustrine	23
	Palustrine	312
Mountain Sideslopes	Lacustrine	49
	Estuarine	38
	Palustrine	470
	Riverine	8
Coastal	Estuarine	1,537
	Lacustrine	62
	Palustrine	3,940
	Riverine	155
Outwash	Lacustrine	35
	Palustrine	1,299
	Riverine	346
Hills	Estuarine	233
	Lacustrine	81
	Palustrine	5,293
	Riverine	5

Disturbance Regimes

Tectonic, Glacial

The features of the Eyak-Heney analysis area were predominantly shaped by glaciers, which created the low valley in which Cordova and Eyak Lake lie. Today, Shephard Glacier is the only glacier in the analysis area, but numerous small permanent snowfields exist at the higher elevations in the Chugach Mountains northeast of Cordova.

The 60 square mile Scott Glacier borders the analysis area to the northeast. The Scott Glacier terminates at 120 to 150 feet in elevation as of 1972 (Field, 1975). The Scott River emerges from the Scott Glacier onto a braided outwash plain that forms the western portion of the Copper River Delta (Dorava and Sokup, 1994). Between 1938 and the 1960's, the Scott Glacier receded about 650 feet, and the ice surface may have lowered about 100 feet in the terminal part of the glacier.

Glaciers cover approximately 5 square miles (roughly 5%) of the analysis area, mostly in the headwaters of Power Creek. These glaciers have a significant effect on the quantity, quality, and timing of runoff in Power Creek, but all other subwatersheds in the analysis area are unaffected. Power Creek experiences a pronounced summer high flow that persists from June until November, the result of melting of glacial ice. During these high flows, the turbidity in Power Creek increases greatly with the addition of glacial flour. This increase in turbidity also affects Eyak Lake and the Eyak River.

A small percentage of the melt water from the Scott Glacier flows down the western side of the outwash fan through Lydick Slough and into the Eyak River, which enters the western Copper River Delta downstream of Eyak Lake (Boothroyd, 1972) (figure 4.2). The Scott River is a dynamic system; as a result, the Scott Glacier outlet and the Scott River channel experience frequent changes. Aggradation of sediment in the Scott Glacier outwash fan creates a natural dam for Eyak Lake. Subsequently, peak flows on the Scott River pose a flood danger to Eyak Lake and houses along Eyak River, commonly called "6-mile subdivision". A dike was built north of the Copper River highway in the 1960's to prevent this flooding. The presence of this dike and the fixed location of the Scott River at the highway bridge prevent channel migration and cause continued aggradation of the outwash plain in the current location of the Scott River, exacerbating the flooding risk. Downstream of the highway, the Scott Glacier outwash fan extends to the tidal flats. Numerous small sloughs with natural levees traverse this area, and numerous brackish to fresh ponds lie between the sloughs (Boothroyd, 1972).

The area was uplifted about 6 – 8 feet during the 1964 earthquake. Generally the Copper River Delta is subsiding and is uplifted every 400 years or so.

Figure 4.2: Scott River outwash plain, looking northwest toward Eyak Lake on the left side of the photograph. The Copper River Highway and the flood control dike are visible in the center of the photograph.

Wind
Wind influences forest structure and composition to varying degrees depending on the extent and severity of the disturbance. Some storm events can result in many acres being blown down or tree tops being snapped. Other wind events may only affect single trees or small group of trees altering the forest structure and composition on a much smaller scale. Often the wind generated from avalanches can cause trees to be blown over ahead of the snow.

Insect and Diseases
Insect and diseases are two more disturbance regimes that shape forest composition, structure and development. In this area, these agents most commonly affect forest ecosystems on an individual or group of trees basis, not on a landscape scale. In 1996 and 1997 a Western black-headed budworm outbreak caused quite a bit of defoliation of spruce and hemlock in and around Cordova. About 30,000 acres of defoliation were observed in those years in Prince William Sound. No outbreaks were observed in 1998-2000, however nearly 21,000 acres were affected in 2001. These outbreaks are cyclical in nature, characterized by rapid increase in numbers followed 1 – 5 years later by rapid declines. Inclement weather often limits extent of budworm outbreaks.

Timber harvest
Scattered harvest of trees around Cordova has taken place since people have been settled in the area. Timber harvest records indicate harvest and forest disturbance events that have occurred in the Eyak-Heney area since the early 1900's. Table 4.3 displays the amount of harvest recorded in the analysis area. The timber was used for fuel, houses, buildings, boats, railroads, mining timbers, fish wheels, and canneries. Areas were also cleared of trees to build roads, mines, gravel pits, and to make room for houses and businesses. Most of the hills surrounding Cordova are regenerated stands from early clear-cut and select harvest of trees. The following table displays the amount of harvest that has taken place in the area. All harvest has occurred on State, Eyak or private ownership; none has taken place on National Forest System lands. Harvest in the 1980's to present has occurred on private or Eyak Native Corporation land only. The Eyak Corporation selectively harvested Sitka Spruce in the Power Creek hydroelectric project area in April and May of 1996. They conducted logging by helicopter and built no roads, causing minimal disturbance to the land and watershed (Whitewater Engineering Corporation, 1996b).

The one documented wind event was on National Forest System land near the Scott River dike. Scattered windthrow occurs every year in the area, most frequently along edges of old and newly cleared areas. Avalanches are also natural stand and tree replacing disturbance events in the area.

Table 4.3 Recorded harvest and stand replacing disturbance events

Year	Acres Harvested	Number of harvest units	Acres affected by avalanches or wind
Unknown	314.3	26	25.0 (wind)
1900 - 1919	245.2	21	
1920-1939	58.0	5	
1940-1959	0		
1960-1979	8.8		3.6 (avalanche)
1980-1999	46.4 (Eyak)	3	3.9 (avalanche)
2000-2002	1.4 (private – est.)		2.7 (avalanche - est)
Total Harvest	626.3		

Hill slope processes - landslide risk analysis

Areas that have frequent or have the potential for landslides usually present an unnecessary risk for most soil disturbing types of management activities. Landslides most frequently occur on slopes greater than 72 percent (Swanston, 1997). That isn't to exclude slopes with gradients less than 72 percent if the correct soil and hydrologic conditions are present. The most critical factor used in the risk assessment is the steepness of the slope. Figure 4.1 shows slope gradients of less that 56 percent, 56 to 72 percent, and greater than 72 percent superimposed on Landtype associations. Figure A-2 in Appendix A, displays slope gradients of less that 56%, 56 to 72%, and greater than 72% on an aerial photo mosaic.

There are two places in and adjacent to the analysis area having a history of landslides, Power Creek and the west side slope of the Scott River Valley. A large landslide, located about two to four miles from Eyak Lake up Power Creek, is thought to have slid off the western slope during the Quaternary Period. It blocked the entire valley, damming Power Creek and forming a lake (Miller, 1951). The lake basin rapidly filled with glacial silt, much of which is still a constituent of the soil on the sideslopes. The lake subsequently drained eventually forming the Power Creek Canyon downstream. A second site is located adjacent the analysis area on the lower portion of the western slope of the Scott Glacier valley where Ibeck Creek undercuts the mountain slope. Undercutting the slope produces periodic surface mantel landslides. These landslides will continue as long as the creek continues to erode the bottom of the slope. This site is typical of a significant portion of the analysis area.

Although an extensive examination of the soil along this slope has not been done, it is thought that compact till should be quite extensive on all of the lower portions of the Mountain Sideslope LTA in the analysis area. This is verified somewhat in a local soil inventory completed for the area around Eyak Lake from the shoreline to an elevation of 500 feet in 1981 (Huecker, 1981). This survey indicates that the soils on the steeper, undisturbed, tree covered, slopes consist of a loamy soil texture with less coarse fragments than on slopes with more disturbances such as avalanches, etc. The soil frequently contains a compact layer of glacial till which restricts the downward movement of water; hence an increase in the potential for landslides. Long sideslopes draining adjacent alpine areas typically have high amounts of

ground water, which if perched on a relatively shallow impermeable layer such as compact till or bedrock, contributes to landslides.

A preliminary analysis for the potential occurrence of landslides was done for the sideslopes and soils that are thought to occur in the two sites. Douglas N. Swanston (1997) developed the method used. This system uses data easily collected in the field including soil properties such as soil texture, parent material, depth, drainage; and specific topographic conditions such as slope shape, length, gradient and drainage density. The risk assessment weights each of the characteristics as to their relative importance, and then provides a numerical landslide failure rating. Sites with a risk rating above 63 are considered to have a "high risk" for landslides.

Both sites are estimated to be in the "high risk" category for a potential landslide in natural conditions. Any soil disturbance will increase the risk. Using the estimated soil conditions for the west slope of Scott River Valley for site 1, the preliminary landslide risk rating is 69. If increased ground water was draining through the soil at this site, the rating would increase to 73. Site 2, located in Power Creek where the soil parent material originated from a glacial lake, has a rating of 78. Data for these sites has not been verified on the ground. The analysis shows that soils derived from lake deposits have a "very high risk" for landslides because fine textured soils derived from lake deposits absorb large amounts water and have little cohesion. The individual calculation sheets for each site, summary table, and the definitions for the ratings are located in Appendix B.

There is a high potential for landslides on slopes greater than 56 percent when there is a restricting layer in the soil profile such as compact glacial till. This landslide analysis indicates that there is approximately 16,052 acres of land with slopes over 56 percent in the Eyak-Heney landscape analysis area. Of that, 6,687 acres occur in the Mountain Sideslopes Landtype Association **(**Figure 4.3). The Mountain Summits Landtype Association has about 6,204 acres of land with slopes greater than 56 percent, but most of these areas are rock cliffs, rock talus, and relatively stable bedrock slopes with alpine vegetation. Landslides occur most on the Mountain Sideslopes Landtype Association. The reasons for this include the fact that this association contains long, straight slopes that have a slope gradient greater than 56 percent and there is usually a large alpine area above to collect ground water that runs down the sideslope. Most of the side slopes in south-central Alaska have been shaped by glaciers and in the process have compact till on the lower slopes. All these factors contribute to the occurrence of landslides. Table 4.4 displays the acres of each slope by Landtype.

Table 4.4: Acreage by slope category for each landtype association.

Landtype Association	**Acreage for each Slope Category**		
	Slopes < 56%	**56 to 72%**	**Slopes > 72%**
Glaciers (00)	3,318	983	743
Mountain Summits (10)	9,187	3,265	2,939
Mountain Sideslopes (30)	9,472	3,579	3,108
Coastal (70)	5,764	2	0
Outwash (80)	2,692	24	30
Hills (90)	13,160	360	119

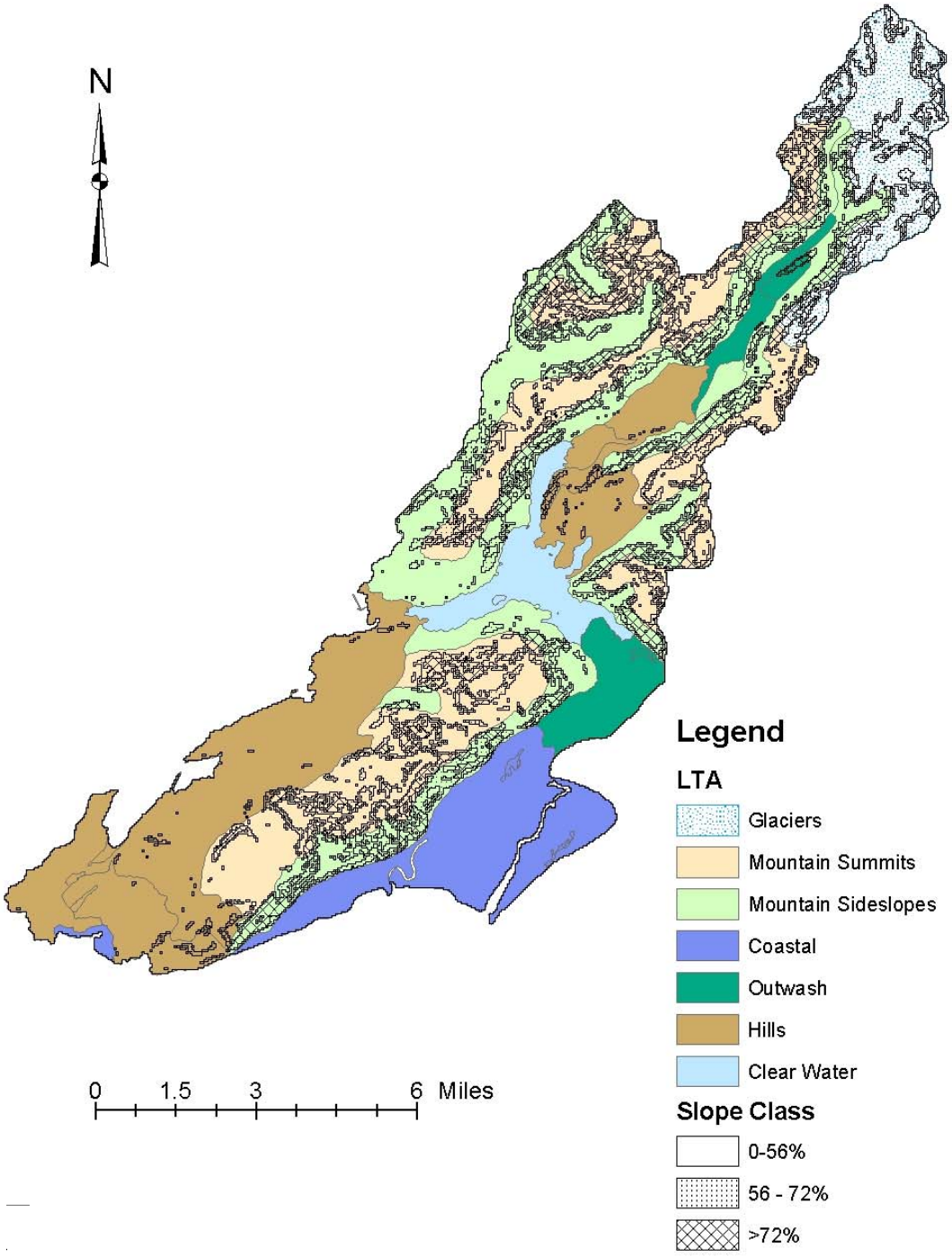

Figure 4.3: Distribution of slope by landtype for the analysis area

Hydrology and Water Quality

The relative importance and influence of the environmental and human related factors presented in Chapter 2 on the quantity, quality, and timing of runoff in watersheds of the analysis area is summarized in Table 4.5. All factors have some influence on flow quantity, quality, and timing, and these factor ratings are relative. Because these ratings represent a collection of diverse watersheds, they represent averages of the processes occurring throughout this area. Although the ratings are subjective, they are based on professional judgment and knowledge of the physical and biological systems within the watersheds.

Table 4.5: Factor ratings, quantifying the relative influence on quantity, quality, and timing of flow in the Eyak-Heney area watersheds: 1 = High, 2 = Moderate, 3 = Low.

FACTOR		QUANTITY	QUALITY	TIMING
DRAINAGE BASIN CHARACTERISTICS				
Drainage basin morphometry		2	2	1
Channel Type/Channel geometry		3	2	1
Soil depth and infiltration		3	2	1
Geology		3	2	3
Vegetation		2	2	2
METEOROLOGY				
Rain	Amount	1	2	1
	Duration	1	2	1
	Frequency/Intensity	1	1	1
Snow	Amount	1	2	2
	Duration	3	3	3
	Frequency/Intensity	3	3	3
Glaciers		2	2	2
Air Temperature- Monthly/Daily Maximums		2	2	2
Air Temperature- Monthly/Daily Minimums		2	3	3
Evaporation		3	3	3
Wind		3	3	3
SURFACE WATER				
High Streamflows		1	1	1
Natural Lakes		3	2	3
Wetlands/Riparian Areas		3	2	2
GROUNDWATER				
Springs, wells, and aquifers		3	3	3
HUMAN INFLUENCE				
Roads		3	2	3
Hydroelectric power development		2	2	2
Water supply diversions		2	3	3
Urban/residential/industrial pollution		3	1	3
Recreation		3	2	3

Considering these relative ratings, the factors with a rating of 1 for flow, quality and/ or timing of water were considered to be the most important for the analysis area. These include rain frequency/intensity, high streamflows, drainage basin morphometry, channel type/channel geometry, soil depth and infiltration, rain amount, rain duration, snow amount, and urban/residential/industrial pollution. Other factors relevant to the analysis are hydroelectric power development on Humpback and Power creeks and the effects of recreational activities on erosion and water quality. Narratives describing each of these factors are presented below. Discussion of all factors is located in the Eyak –Heney Hydrologic Condition Assessment in the Planning Record.

Drainage basin morphometry

High relief, steep slopes, and small watersheds characterize the drainage basin morphometry of the analysis area. These factors have a moderate effect on the quantity of surface water since the high elevations influence the total snowpack and increase the quantity of runoff. The steep slopes in this area are susceptible to landslides and avalanches, which are capable of contributing sediment to stream channels, thereby increasing sediment loads and turbidity. The steep slopes and small watersheds, in addition to soil and vegetative characteristics, have the largest effect on the timing of flows, as this topography contributes to flashy peak flows after precipitation events.

Channel type/channel geometry

Channel type and geometry have few effects on surface water quantity. However, channel type has a moderate effect on erosion, sedimentation, and water quality in these streams. Incision and stream bank scouring contribute to sediment input into the numerous high gradient contained channels during high flows, but turbidity in these streams generally increases only during peak flow events. The glacial outwash channel of Power Creek is characterized by high gravel bedloads and high turbidity from glacial scour. The timing of flows is greatly influenced by channel type and channel geometry. The headwater high gradient contained channels rapidly convey water through the small watersheds. On the other hand, Eyak River has a very low gradient, and low flow velocities cause Eyak Lake to flood during high flow events.

Soil depth and infiltration

With the exception of the deep soils in the wetlands of the Copper River Delta, soils in the analysis area are generally shallow with numerous bedrock exposures. The steep alpine areas, covering 25% of the analysis area, have very low infiltration rates, and these soils have little effect on the quantity of runoff. Water quality is moderately affected by these soil properties, as shallow soils on steep slopes are susceptible to erosion and landslides. Snowmelt and precipitation both commonly exceed infiltration capacities of the soils throughout the analysis area, causing flashy flows.

Rainfall

Amount – The amount of rainfall directly influences streamflow quantity and timing throughout the watershed. Large rainstorms associated with the frequent storm systems circulating through the Gulf of Alaska in August, September, and October create many flood

events. These rainfall peaks are generally greater than the summer snowmelt peaks but shorter in duration. Because of the coastal climate and low elevations throughout much of the analysis area, large rainstorms occur throughout the year. Lower elevation subwatersheds are more affected by the amount of rainfall, whereas subwatersheds with higher elevation headwaters are more affected by snowmelt. The amount of rainfall has a lesser influence on water quality in these streams because the dense vegetative cover below timberline protects the shallow soils from erosion. With the exception of the glacially fed Power Creek, surface water in the analysis area generally remains clear. After large storms, turbidity increases as stream banks are scoured, but water quality returns to normal levels within 1 to 3 days after a storm.

Duration - Stream response to rainfall in the analysis area is flashy because of the small size of the watersheds, the steep topography, and the generally shallow soils with low infiltration capacities. Short duration rainfall events often exceed the soil infiltration capacity. Watersheds in the analysis area respond quickly to these short duration events, and flows increase dramatically with long duration events. Rainfall duration has a lesser influence on water quality because of the heavy vegetative cover.

Frequency/intensity - Large rainstorms occur frequently in the fall months, creating large peak flows during this period. The largest potential for increased turbidity is also during these storms. Because of the flashy nature of these watersheds, an intense rainstorm can create an immediate response in the form of a flood peak. Each large storm is capable of producing peak flows that recede within 1 to 3 days, and several of these peak flow events can occur each month. Between these peak events, flows generally drop to base flow levels. Small streams in the watershed have the largest potential for large rainfall runoff peaks, whereas larger watersheds such as Power Creek are more dominated by snow and glacier melting. Large rainstorms that occur in the late fall when the ground is frozen or ice-covered can lead to very large runoff events because of the low infiltration capacity of the ground.

Snow

The amount of snowfall in the analysis area has a direct influence on the quantity of runoff in the form of snowmelt in the summer. Snowmelt peaks are more pronounced in the larger subwatersheds with higher elevation headwaters. The Power Creek and Humpback Creek watersheds contain permanent snowfields and glaciers that produce high summer flows that persist throughout June, July, and August. Larger snowpacks in the spring lead to larger snowmelt peak flows. These snowmelt peak flows are shorter and much less prevalent in the low elevation watersheds. Snowmelt effects are almost non-existent in small watersheds such as Nicolet Creek because considerably less snow falls in these low elevation areas. Although snowmelt generally occurs in the late spring and summer, winter warm spells and rain on snow events can cause significant melting, leading to peak flow events.

Surface Water

High streamflows - Short duration peak streamflows are common in the analysis area as a result of large storm systems during the months of August, September, and October. These have significant effects on the quantity, quality, and timing of runoff. Shortly after these events, runoff quantity and quality generally returns to near normal.

Human Influences

Hydroelectric power development - Small hydroelectric projects operate on Power Creek and Humpback Creek. Because no large impoundment of water is created in either hydroelectric project, evaporation is not increased and water temperature remains constant. Water quantity and timing are only influenced in the sections of the streams between the diversion dam and the powerhouse, or 1.1 miles of Power Creek and about 0.5 miles of Humpback Creek. During power generation, flows in these sections fluctuate more rapidly, and the total amount of flow through these sections is reduced by 320 cfs. The extent of the reduction is the proportion 320 cfs is of the current flow (Covel, personal communication).

Urban/residential/industrial pollution - The city of Cordova only affects Eyak Lake and the Eyak River. Industrial and residential pollution from Cordova can directly enter Eyak Lake. Eyak Lake water quality has been shown to be most impaired in the west arm, nearest to Cordova. The sources of this pollution include street runoff, oil spills along roads, and airport pollution from floatplane fueling. Aside from the water supply diversions discussed above, urban activities do not affect the quantity or timing of flow in the analysis area.

Recreation - Recreation has no impact on the quantity and timing of surface water runoff in the analysis area. Hikers in alpine and subalpine areas cause a limited amount of erosion around stream banks and lakes. Fishing and other activities on Eyak Lake cause some bank damage, increasing sedimentation into the lake. Widespread snowmobile use in the winter, fall, and spring, particularly in the Heney Creek watershed, increases the potential for soil erosion as well as oil and gasoline spills to impair the water quality of Heney Creek. ATV use as well as spring and fall snowmobile use in the lower elevations of the Heney Creek watershed can cause irreparable soil and vegetation damage. Although these effects are not currently significant, they may increase in the future with increased recreational use in the area. Residential use is also increasing in the Heney watershed.

Analysis of selected factors

Management cannot influence factors as rain frequency/intensity, high streamflows, drainage basin morphometry, channel type/channel geometry, soil depth and infiltration, rain amount, rain duration, or snow amount. However, they are important descriptors to supplement and support conclusions about the hydrologic condition of the analysis area.

Management can influence the following factors.

- Urban/residential/industrial pollution – Water quality in Eyak Lake
- Hydroelectric power development – Manipulated flows on Power Creek and Humpback Creek
- Recreation – Water quality effects in the Heney Creek watershed

Significance and recovery potential - A summary of the current and reference conditions for each of the selected factors, the significance of the differences between these two conditions, and the recovery potential for the hydrologic system are presented in Table 4.6. The reference

and current range of values for each measure identified above serve as benchmarks from which change is determined and provide a basis for comparison. Relative significance is based on an evaluation of the magnitude, direction, and rate of change between reference and current values. Recovery potential is based on the physical capabilities of a watershed to respond to corrective actions, considering the social, economic, and technical feasibility and the need for recovery. The scale for these ratings as well as narratives explaining the rationale for each are presented in the Hydrologic report.

Table 4.6: Summary of current and reference conditions and ratings of significance and recovery.

Factor	Current	Reference	Significance (1-3)	Recovery Potential (1-3)
QUANTITY				
Average August flow in Power Creek below diversion dam[1]	70 – 250 cfs	400 – 600 cfs	1	3
Average August flow in Humpback Creek below[2] diversion dam	0 – 10 cfs	25 - 47 cfs	1	3
QUALITY				
BTEX compounds in Eyak Lake water[3]	<MDL to 0.001 mg/kg	<MDL	2	2
DRO in Eyak Lake sediments[3]	<MDL to 40.7 mg/kg	<MDL	2	2
Suspended sediment loads in Heney Creek[4]	Unknown	0 – 1.2 tons/day	3	2

Rating	Relative significance	Recovery potential
1	Significant difference	High potential
2	Moderate difference	Moderate potential
3	Slight/no difference	Slight/no potential

Flows in Power Creek and Humpback Creek - Summer flows in the "dewatered" portions of Power Creek and Humpback Creek, between the diversion dams and the powerhouses, are significantly less than reference flows. These reductions occur during power production. These dewatered portions include a 1.1-mile stretch of Power Creek and a 0.5-mile stretch of Humpback Creek.

The lower 2.5 miles of Power Creek contains abundant spawning habitat for coho salmon, sockeye salmon and Dolly Varden (Sea-run Fisheries, 1996), and the cascades at and below Ohman Falls restrict upstream migration. Flow reductions may impact spawning habitat in the 0.3-mile section of stream between the powerhouse (2.2 miles upstream of the mouth) and the upper limit of fish migration (2.5 miles upstream of the mouth). More research is needed to characterize fish habitat and use on this reach and the effects of the hydroelectric project on fish habitat. Monitoring of streamflows and sediment delivery below the diversion dam is essential. The inflatable diversion weir on Power Creek is designed so as not to impede sediment flow.

Pollutants in Eyak Lake - The very limited water quality data for Eyak Lake show isolated incidences of elevated BTEX compounds and DRO in the water and sediment of Eyak Lake.

Although these can generally be linked to specific oil spills (HDR Alaska, Inc., 2001), a portion of this pollution is derived from non-point sources within the vicinity of Cordova. Much of this pollution can be prevented through better emergency spill clean-up response. Because roads surround a majority of Eyak Lake, oil and gas spills from vehicles are likely to occur in the future.

Suspended sediment loads in Heney Creek - No water quality data exist for Heney Creek. It is likely that current suspended sediment conditions are fairly similar to reference conditions, but recreational and residential use of the Heney Creek watershed is increasing. The lack of data and the increasing recreational and residential use confirm the need for water quality sampling to develop baseline data and describe changes that are occurring as a result of recreational activities such as snowmobiling and ATV use and residential use. It is important to monitor suspended sediment loads that may be the result of vegetation damage and soil erosion, as well as concentrations of pollutants that might be the result of motorized use in the area. Management regulations that would restrict the use of snowmobiles during spring and fall to access alpine areas when snow cover is absent or marginal in the lower elevations of the watershed can mitigate any current effects. These measures would also prevent further vegetation damage and soil erosion throughout the watershed, possibly decreasing concentrations of suspended sediment in Heney Creek.

More detailed information is available in the Eyak-Heney Hydrologic Condition Assessment.

Fish

Documented information on historic distribution and relative abundances of fish species and aquatic habitat condition in the analysis area previous to the 1970's is extremely limited. Therefore, reference conditions are based on traditional ecological knowledge, scientific speculation, and known effects of human development.

There is very little reason to believe that the current condition of most of the fishery resource and associated habitat in the analysis area has changed significantly since the early to mid 1900's. Logging and mining, two activities known to have a high potential for impacting the fisheries resource, have had relatively little impact in the analysis area. Since 1960, only 56.6 acres of land (47.8 acres private) have been logged in the area. Currently, no logging or mining practices are occurring in the analysis area and none is expected to take place within the next 10 years. Overall, the majority of these streams are in relatively pristine condition due to the absence of anthropogenic impacts.

The amount of roads in the analysis area is very limited. One road, the Shepherd Point road, is proposed (Not on national Forest System lands). No roads are proposed on National Forest System lands in the near future. However, roads currently cross five of the seven primary streams in this landscape analysis area and border about two-thirds of Eyak Lake. The primary concern is whether the roads and associated culverts around Eyak Lake have blocked or replaced potential spawning habitat for coastal cutthroat trout. Professional Fishery Consultant (1984) surveyed 17 tributaries of Eyak Lake and reported that 14 of these tributaries had fair to excellent (nine were rated excellent) spawning habitat for cutthroat trout and Dolly Varden. In addition, spawning cutthroat trout were documented in nine of these streams. In 1995, Forest

Service crews completed a more detailed survey of 33 tributaries of Eyak Lake and estimated that 1,860 ft^2 of cutthroat trout spawning habitat existed and that 1,207 ft^2 had been lost to road construction. Spawning cutthroat trout were not seen during this survey. It appears that a significant amount of cutthroat trout spawning habitat previously available in these tributaries has been lost because of road construction and this loss may be impacting the cutthroat trout population using Eyak Lake.

Associated with road construction around Eyak Lake is residential and commercial development. When development takes place in close proximity to lakes and streams, it can affect water quality. Water quality problems can arise from point and non-point sources and often include sewage treatment and disposal, storm water runoff, and incidental spills. Potential impacts of water quality on fish species can include ingestion of poisonous compounds, increased biological oxygen demand (BOD), decreased dissolved oxygen (DO), and increased incidence of fish disease. It is not currently known if fish using Eyak Lake are impacted by these potential problems. A more detailed description of water quality in Eyak Lake was described earlier under Water Quality and Sedimentation.

A run-of-river hydroelectric project incorporating an inflatable rubber weir on Power Creek was completed in 2001. Because this weir creates very little ponding upstream of its location, is upstream of a known barrier to anadromous fish (Ohman Falls), and maintains a minimum instream flow during low-flow periods, the project should have little impact on the existing water quality and fisheries resource in Power Creek. However, because 2.5 miles of suitable spawning habitat for resident and anadromous species exists below the diversion dam, this section of stream should be monitored closely to identify potential changes to the aquatic habitat.

It appears that Eyak Lake and some of its smaller tributaries have undoubtedly suffered more impacts than other streams in the analysis area. With the information available, it will be hard to estimate the cumulative effect on the historical condition of the fisheries resource in this area. Sockeye salmon, coho salmon, and Dolly Varden appear to have healthy, self-sustaining populations in the Power Creek-Eyak Lake drainage. However, anecdotal information from long-time residents raises concerns about a diminishing coastal cutthroat trout population as well as the status of other local species such as whitefish and burbot.

Human

Heritage resources

As previously described, the Eyak-Heney analysis area includes both prehistoric and historic remains and a variety of historic properties that are either on or are eligible for the National Register of Historic Places. The entire analysis area has not yet been inventoried, although required by the National Historic Preservation Act and Executive Order 11593**.** Inventories have been completed for specific projects. Archaeological surveys on the Chugach National Forest have, until very recently, been limited to support for site-specific projects, as required by Section 106 of the National Historic Preservation Act. Most identified cultural resources in the analysis area have not been formally evaluated for the National Register of Historic Places (NRHP).

The newly revised Forest Plan designates only one management strategy for the Heritage resources in the analysis area. Essentially, they will appear in an undisturbed state. Cabins and other historic, aboveground features will be present in their natural state, with minimal on-site interpretation. Data recordation is a preferred mitigation method (USDA 2002). Currently, no Forest managed sites in the Eyak-Heney analysis area outside the City of Cordova are interpreted, and no special efforts have been taken to preserve such sites. No condition assessments have been made at this time for any of the sites. All the Forest managed sites noted in the Chapter 2, with the exception of the Cordova Post Office, are in various states of deterioration.

Recreation

Trails - Of the 21.1 miles of trail within the analysis area 15.7 have been constructed within the past 15 years in an effort to meet the growing demand. Users have a variety of hiking preferences; from well established, highly maintained trails to simple access routes that allow freelance hiking through alpine areas.

Currently hikers have the ability to select a variety of short hikes or multiple day hikes that that can include overnights in a public recreation cabin or shelter. Future demand will probably necessitate expansion in all areas: addressing our deferred maintenance on existing trails to bring them up to standard; connecting existing trails (Eyak River Tr. and Heney Ridge Tr.) or extending trails (Power Cr. Tr.) for extended trips into the back country and identifying easements that could offer new access or opportunities.

Wildlife viewing- This recreation activity has been occurring for years. For the most part viewing wildlife was the past time of locals and visiting friends and relatives. As commercial development grew (Outfitters, Guides and Bed & Breakfasts) wildlife watching became an additional activity. Only recently has it been deemed viable as a commercial venture. Providing transportation and ornithological expertise to shorebird viewing areas is a rapidly growing business in the spring. Bear, fish and other waterfowl viewing are quickly gaining attention as well. Sites within the analysis areas that offer wildlife viewing opportunities or have the potential include: Power Creek road, Hatchery Creek, Eyak River, Mountain Slough, Hartney Bay, the headwaters of Power Creek and the North, South and Middle Arms of Eyak Lake.

Motorized and non-motorized activities- The demand by the public for both motorized and non-motorized activities is high and expected to grow in intensity in the future. This analysis area generally falls within the home range boundaries. The home range concept identifies areas within close proximity to a community as an area where commercial activities such as fish and game guiding and guided heli-skiing are in direct conflict with activities by local residents. Therefore, commercial activities such as these will not be a significant factor in this analysis area because they will not be permitted.

The preferred alternative of the Forest Plan shows the Power Creek basin in the northern end of the analysis area as being closed to motorized use in both winter and summer periods. The

southern end of the analysis area, the Mt. Eccles Heney Ridge area, is closed to summer motorized use but open to winter motorized use. Sites such as Super Bowl, Baldy, Fountain of Youth, and Heney Meadows have a long history of use by both motorized and non-motorized users. The Mount Eyak ski area offers downhill and backcountry skiing opportunities but no motorized opportunities. The Power Creek basin provides the best opportunity for future non-motorized winter recreation use.

Sport fishing - A statewide mail-in sportfish survey has generated estimates of angler use of Eyak River including total number of anglers and the total days fished. During a five-year period from 1996 to 2000, 1998 had the lowest estimated number of anglers with 967 while the greatest number was 1,316 anglers in 2000 (Figure 4.4). Estimated days of angling was lowest in 1997 (1,986) and highest in 1999 (4,659) (Miller 2002). Because of its access, close proximity to Cordova, and angler's increasing success rate, the number of people fishing Eyak River has grown in recent years and is expected to continue to expand in the future.

These mail-in surveys were also used to estimate the number of fish people caught and harvested. Figure 4.5 displays the average of the estimated number of each species captured and harvested for the combined five years of survey results (1996 to 2000) (Miller 2002). Coho salmon had the greatest percentage of harvest with 63% followed by sockeye salmon (54%), coastal cutthroat trout (29%), pink salmon (16%), and Dolly Varden (5%).

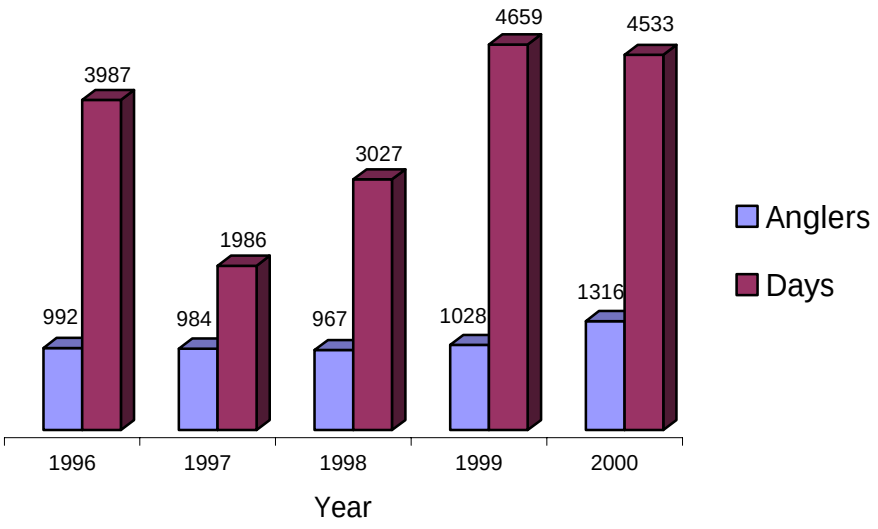

Figure 4.4: Estimated number of anglers and days fished on the Eyak River from 1996 to 2000, generated from a statewide mail-in angler survey.

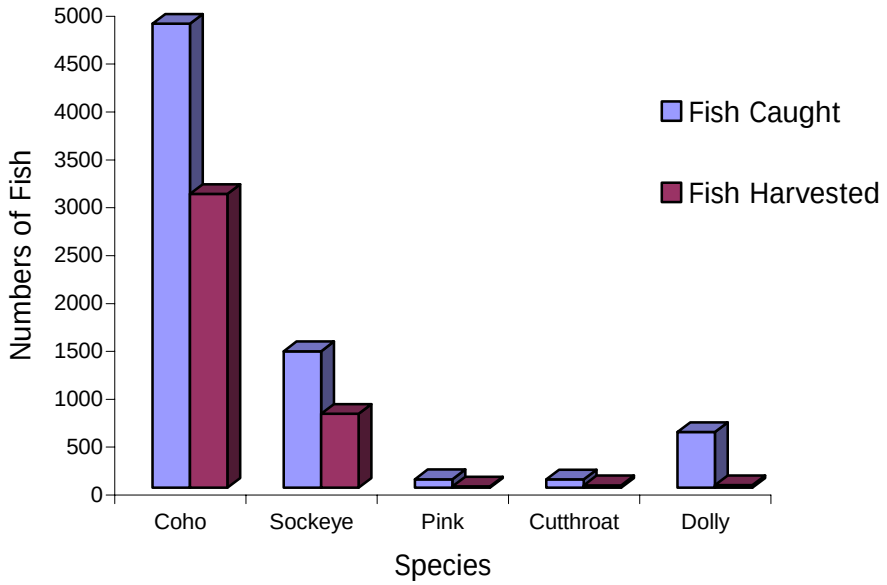

Figure 4.5: Five-year averages of the estimated number of fish captured and harvested by sport fishing on Eyak River, from a statewide mail-in survey for the years 1996 to 2000.

Estimates of sport fishing pressure, catch, and harvest are not available for the streams of Orca Inlet (M. Miller, ADF&G, personal communication). With the relatively small number of anglers using these streams for sport fishing, ADF&G did not receive enough responses from their mail-in survey to generate meaningful estimates. A minor sport fishery for pink and chum salmon does exist at the mouth of Hartney Creek but is usually limited to a short duration from early July to mid August.

Subsistence Use of fish and wildlife resources

Subsistence use of the resources and trends were described in chapter 2. In general, subsistence use of the resources is expected to continue at current rate as long as both the human and resource populations remain stable.

Timber Harvest

Timber harvest from the area has gradually declined over the years until it only occurs in small areas or as single tree harvest on private lands, usually associated with individual homeowners. There is a demand for firewood, house logs, and sawtimber from National Forest System lands near Cordova. However, this analysis area may not be able to provide for those needs since it is relatively unroaded and the accessible areas are predominately private land. Most personal use timber is gathered further out on the Delta on both private and public lands. The Forest Plan does not identify commercial timber harvest, either chargeable or nonchargeable, as an appropriate activity. Personal Use Timber and Personal Use Special products are an appropriate activity.

Table 4.7 summarizes the known size class for each forest type based on 1976 data and aerial photo interpretation. Since the National Forest System lands in this area have not been actively

managed for the timber resources and there is quite a bit of private land, there is quite a bit of area with no information in the district database. The database has not been updated since 1976. The timber type records only include information for National Forest System lands.

Table 4.7: Acres of timber type by size class for National Forest System lands (1976)

Size Class	Hemlock (acres)	Spruce (acres)	Hemlock – Spruce (ac)	Black Spruce (acres)
No stand information	6,719.5	758.5	0	8.6
Pole size (5-8.9" dbh)	306.7	53.5	0	
Young Growth Saw timber (9.0" dbh or greater & <150 yrs old)	659.1	0	112.4	
Old Growth Saw timber (9.0" dbh or greater & >150 yrs old)	2,353.7	725.5	781.0	
Total	10,039.4	1,537.5	893.4	8.6

Mining

There are 23 mining claims in the area. Of these eleven are on National Forest System lands, of which 4 are located in areas where Chugach Alaska Corporation has retained subsurface rights. Chugach Alaska Corporation retained subsurface rights on 10,537 acres. (Refer to Fig 1.2 on page 3.) Past production has been limited to sand, gravel and stone. The other claims, mainly for copper, are inactive and are exploratory in nature and their value has not been proven.

Vegetation

Invasive Species

This analysis area has potential for problems with invasive species due to the proximity of the town of Cordova. Many ornamentals are brought in for landscaping. Wildflower mixes are commonly used. No surveys have been conducted for invasive species in the analysis area and no invasive plant species have been identified.

Threatened, Endangered and Sensitive Plant Species

The only federally listed plant in Alaska is *Polystichum aleuticum* and it is listed as endangered. It is only known from Adak Island and is not expected to occur in the analysis area. Eighteen vascular plants are designated as sensitive in the Alaska Region (approved by Regional Forester on May 11, 1999). Of these, the following are known or suspected to occur on the Chugach National Forest. Included is their general habitat.

Known on Chugach:

Escholtz's little nightmare (*Aphragmus escholtzianus*) – heath, alpine and subalpine
Norberg arnica (*Arnica lessingii* spp. *Norbergii*) – open forest habitats and wet meadows, alpine and subalpine
Goose-grass sedge (*Carex lenticularis* var. *dolia*) – heath, wet meadows, alpine and subalpine
Tundra whitlow-grass (*Draba kananaskis*) – alpine and subalpine

Pale poppy (*Papaver alboroseum*) – gravel bars, dry meadows, alpine and subalpine, rock outcrops
Smooth alkali grass (*Puccinellia glabra*) – maritime beaches, upper beach meadows
Unalaska mist-maid (*Romanzoffia unalaschcensis*) – forest edges
Truncate quillwork (*Isoetes truncata*) – stream banks, wet meadows, shallow freshwater

Suspected on Chugach

Calder lovage (Ligusticum calderi) – forest edges, rock outcrops, alpine and subalpine
Circumpolar starwort (*Stellaria ruscifolia* ssp. *aleutica*) – stream banks, rock outcrops, alpine and subalpine

Due to the variety of habitats represented in the analysis area, there is potential for sensitive plant species to occur. The Alaska Natural Heritage Program database shows one species on this list, *Arnica lessingii spp Norborgii*, to occur in the analysis area. The precision for this occurrence is 6.2 miles which means that one could expect to find a population of the listed plant within 6.2 miles of the mapped point. Surveys have been and will be conducted prior to individual projects such as trail construction or other ground disturbing activities. No analysis area wide survey has been conducted.

Wildlife

Trends and conditions for wildlife species present in the analysis area were discussed in Chapter 2. It is anticipated that the desired future condition as described in the forest plan can be met.

Chapter 5 – Recommendations

Inventory and Monitoring

Fish

1. Determine the quality and quantity of spawning and rearing habitat as well as water quality for anadromous and resident fish in the primary streams and lakes in the analysis area. This includes "ground-truthing" channel types to determine accuracy of existing information. Emphasis will be placed on the first 2.5 miles of Power Creek immediately above Eyak Lake.
2. Monitor streamflows in Power Creek to ensure minimum flows provided to maintain fisheries habitat.
3. Survey fisheries habitat and fish escapement in Power Creek to determine if spawning, over wintering, and rearing habitat and water quality is maintained for anadromous and resident fish.
4. Determine status and relative abundance of cutthroat and Dolly Varden trout. Conduct a creel census to determine impact sport fishing is having on cutthroat and Dolly Varden trout.
5. Update GIS layer with existing channel type data collected in 1989-91

Heritage Resources

Forest Service management of cultural resources is legislated by Acts of Congress and Executive Orders, which mandate inventories of cultural resources, and preservation and interpretation of all types of cultural resources for the benefit of the public. The requirements of three of these, plus a Programmatic Agreement between Region 10 of the Forest Service, the State Historic Preservation Officer and the Advisory Council on Historic Preservation, are summarized in Appendix C.

1. Identify ancient shorelines and past use.
2. Survey National Forest System lands and develop an inventory of sites.
3. Consult with Native Village of Eyak on inventory, ancient shorelines & past use and all matters relating to Heritage Resources.

Soils

a. Inventory extent of trenching in muskegs and wetlands being caused by off road vehicles trying to access National Forest System lands in periods of no snow at mile 2 of Whitshed road. Trenching is occurring on private land. (Folks at open house would like to see this problem addressed. Suggestion was to consider a partnership with UAA to provide a trail and use information.

Wildlife

1. Determine reason for lack of goats on Heney range. Is there potential for reintroduction in areas not accessed by motorized vehicles?
2. Monitor human/bear encounters as a result of wildlife viewing and construction of the Power Creek Hydroelectric power plant.

3. Monitor invasive species such as European black slug and evaluate methods of eradication.
4. Monitor trumpeter swans and bald eagle nesting in Power Creek Area.

Potential projects to consider

Following is a list of projects to consider for the area. These are a result of both internal and external brainstorming sessions to meet concerns or desires of public and future demand. Each would be further analyzed through the NEPA process and additional public involvement, and the decision to implement or not would be documented in the appropriate decision document.

1. Contact UAA about damage that is occurring on their lands as a result of snowmachines accessing National Forest System lands. Determine course of action. Potential project may be inventory and reparation of trenching in muskegs and wetlands being caused by snow machines and 4-wheelers during periods of inadequate snow cover. May suggest using signs, educating users about the problem, and rehabilitating damaged area.
2. Rehabilitate bank at Eyak River Boat landing to reduce erosion. Provide means for public to access river, launch canoes, tie up boats while retrieving vehicles, and fish without damaging bank in the process.
3. Stabilize bank where Eyak River trail meets Eyak River. This is a popular silver salmon sport fishing site that use is starting to cause bank sloughing and erosion. May be on Eyak Native Corporation land so coordination will be needed. People at the open house suggested that the trail be fixed before we stabilize the bank.
4. Connect Heney Ridge easement trail with Eyak River trail. People suggested considering a shelter on the top.
5. Provide bear viewing site at Power Creek or another location in the analysis area. This idea met with a resounding no at the open house. No one thought providing a viewing platform would make the situation safer for either bears or the public. It would only exacerbate the situation. The Power creek viewing site should not be considered further.
6. Provide wildlife viewing site(s) in analysis area (near Eyak Lake Weir?)
7. If habitat is adequate, consider reintroducing goats in the Heney range to provide wildlife viewing opportunities. The area is currently closed to hunting by the State and is classified as a Goat Observation Area.
8. Develop a public education program for cultural resources. Coordinate with Eyak Native Corporation, Native Village of Eyak, and museum. The city is considering a new community center that includes a new museum. Be sure to contact the Native Village of Eyak Cultural Center and Museum.
9. Consider special use permit for an extreme skiing event (short term) somewhere in analysis area. (for winter economic boost to town) Some folks at the open house thought this would be a good idea, once wildlife, emergency access & other human use effects have been considered (e.g. fuel spills). Areas to consider might be Wolverine, Baldy, and Fountain of youth. Might have to close to snowmachines for a short duration for event (5 days or so)

Project Implementation Recommendations

Soils

The Revised Forest Plans standards and guidelines state that no activities will take place on slopes greater than 72 percent without the consultation of a soils scientist or a landslide risk analysis. When projects are planned in areas where slopes exceed 56 percent, the sites should be investigated for the potential of landslides prior to the design and implementation of all management activities.

Wetlands

Wetlands perform the very important hydrologic functions of water storage and regulation of water flow. Some wetlands include the greatest diversity of plant species of any other ecosystem. The Standards and Guidelines also specify that wetlands will be avoided by all soil disturbing activities unless there is absolutely no other alternative. The responsible action of any forest manager is to be aware of the type and locations of wetlands before the design and implementation of a project, and to include them in the design any time a soil disturbing activity is proposed.

Heritage Resources

The Revised Forest Plan states that the Chugach National Forest will follow all applicable laws and regulations that apply to Heritage resources. All projects must go through the Section 106 process of the National Historic Preservation Act, which is guided by the Programmatic Agreement between the Alaska Region of the Forest Service, the Alaska State Historic Preservation Officer and the National Advisory Council on Historic Preservation (see Appendix C). The Act, the applicable regulations, and the Programmatic Agreement, all specify that Tribal consultation will occur for all projects, in addition to public consultation. The regulations for the Act, and the Programmatic Agreement, set out, and expedite, the procedure for specialist review, historic properties identification, documentation, avoidance or mitigation, and monitoring.

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Town meeting notes held May 3, 2002 in Cordova.

Appendix A – Maps, Tables, and Graphs

Hydrology - Soils

Figure A-1: Weather stations, stream gauge sites, and water quality measurement sites in the Eyak-Heney analysis area.

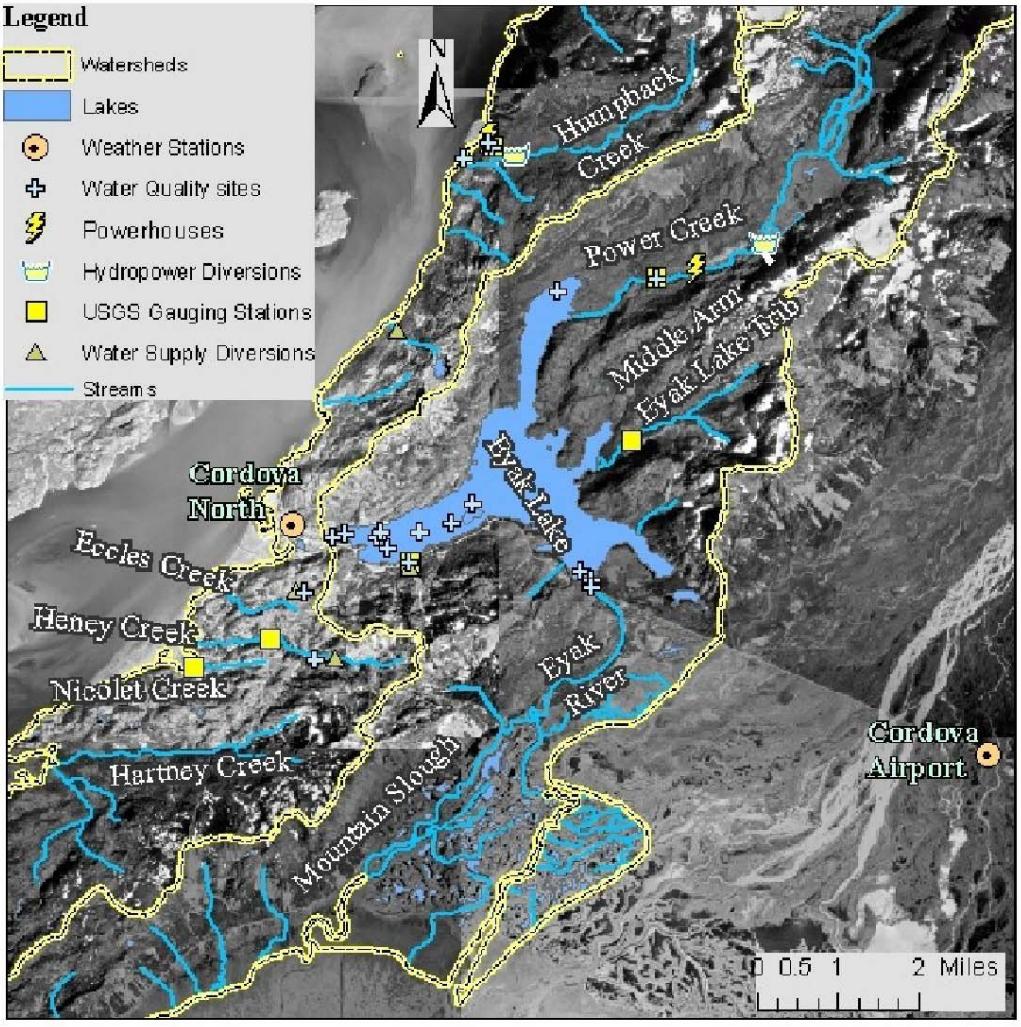

Table A-1: USGS gauging stations metadata in the Eyak-Heney analysis area (USGS, 2002)

Station	USGS Site#	Latitude	Longitude	Datum	Drainage area (sq mi)
Nicolet C Nr Cordova	15215990	60°31'09"	145°47'23"	NAD27	0.75
Heney C at Canyon Mth	15215992	60°31'26"	145°45'41"	NAD27	1.53
Power Creek Nr Cordova	15216000	60°35'14"	145°37'05"	NAD27	20.50
Middle Arm Eyak L. Trib nr Crd	15216003	60°33'29"	145°37'44"	NAD27	2.90
Murcheson C Nr Cordova	15216008	60°32'13"	145°42'51"	NAD27	0.37
Humpback C Nr Cordova	15216100	60°36'41"	145°40'36"	NAD27	4.37

	Period of record (number of records)		
Station	Peak Streamflow	Daily Streamflow	Water Quality Samples
Nicolet C Nr Cordova	08/17/91 - 12/21/99 (10)	04/30/99 - 09/30/00 (399)	
Heney C at Canyon Mth		10/01/91 - 09/30/93 (731)	
Power Creek Nr Cordova	10/01/47 - 09/21/95 (48)	08/06/47 - 09/30/95 (17570)	07/27/49 - 08/16/79 (39)
Middle Arm Eyak L. Trib nr Crd	08/24/92 - 08/15/93 (2)	10/01/91 - 09/3093 (731)	
Murcheson C Nr Cordova		10/01/91 - 09/30/93 (731)	
Humpback C Nr Cordova	09/20/74 - 09/11/75 (2)	10/01/73 - 09/30/75 (730)	04/17/75 - 08/13/75 (2)

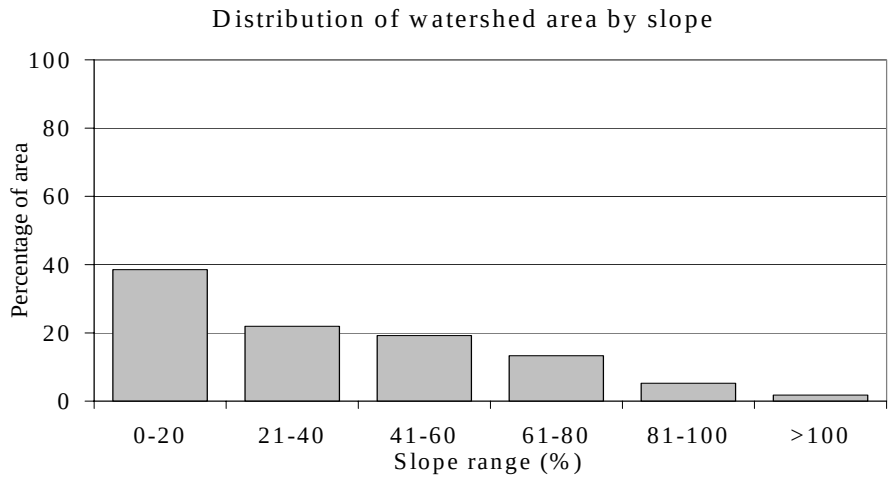

Figure A-2: Distribution of analysis area by slope. Data from USDA USFS (1997).

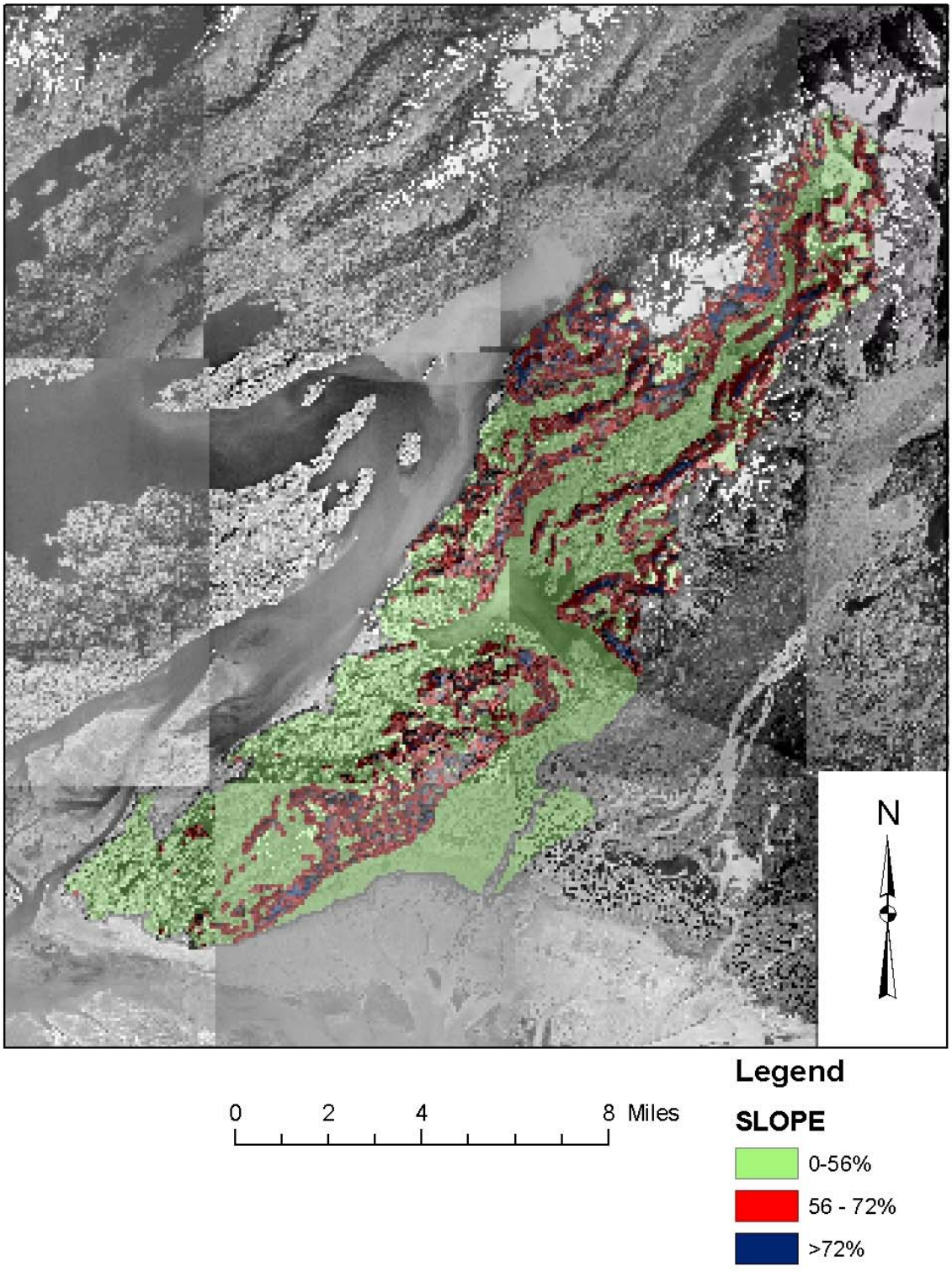

Figure A-3: Slope gradient for analysis area

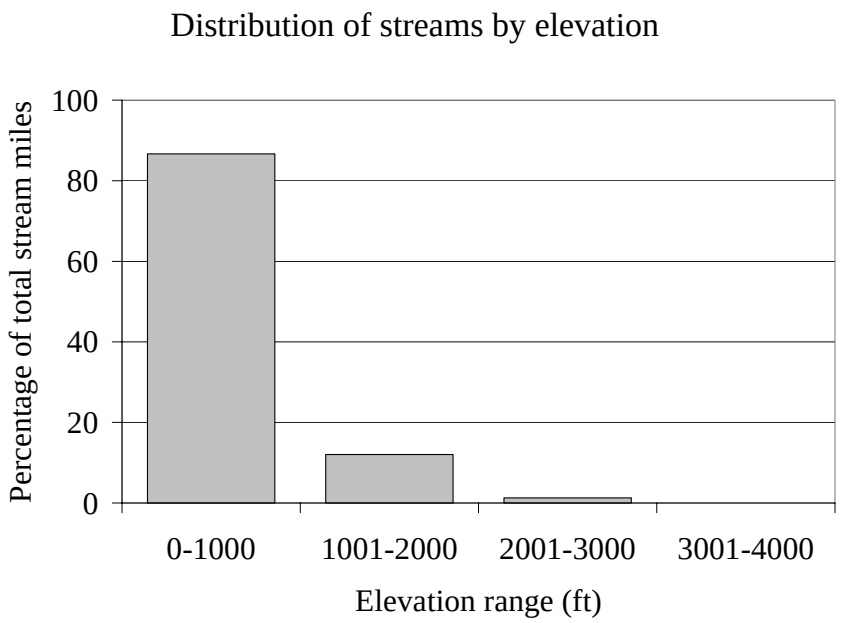

Figure A-4: Distribution of stream miles by elevation. Data from USDA USFS (1996).

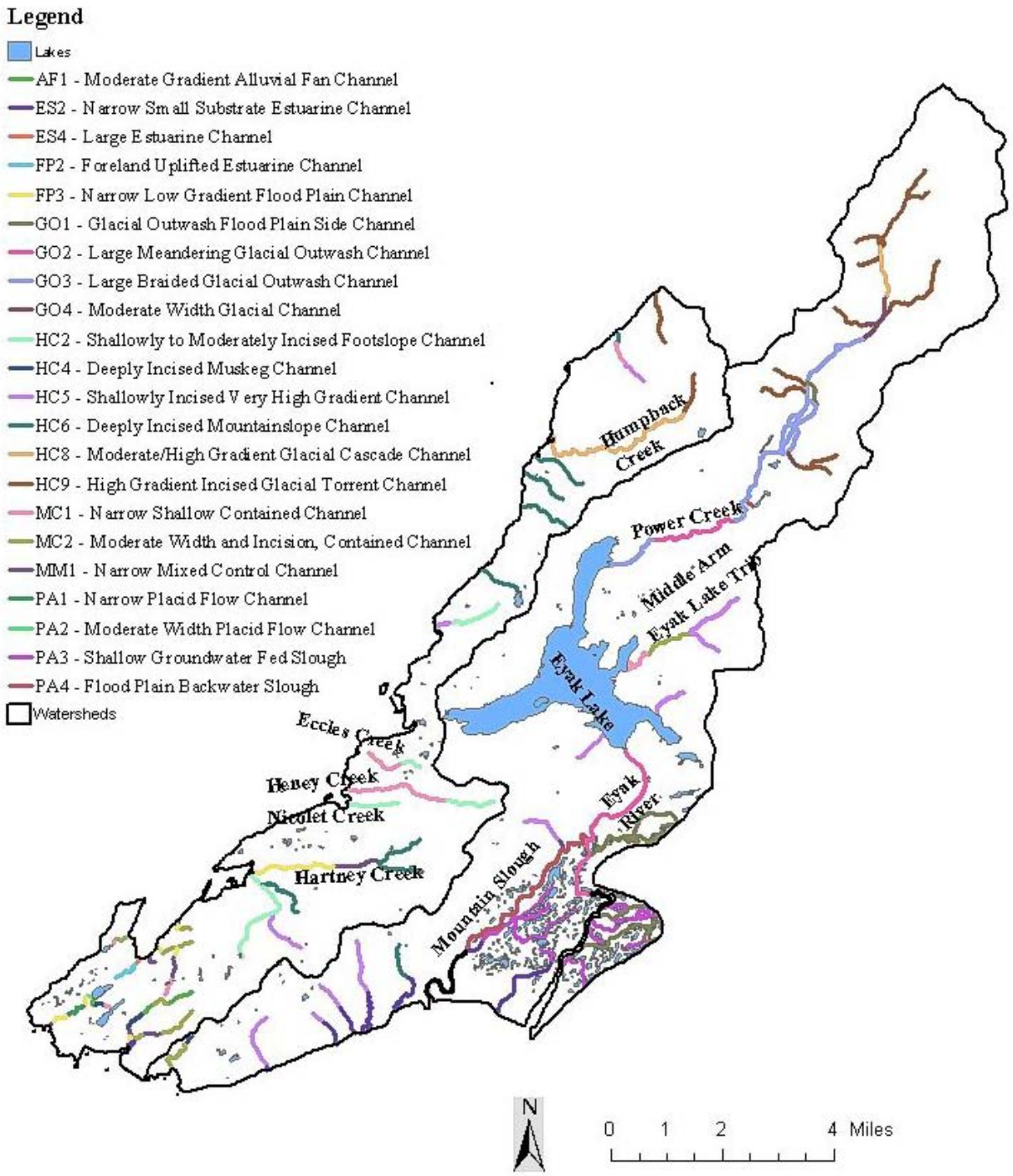

Figure A-5: Stream classification for the area, based on USDA USFS (1992).

Heritage Resources

Following are the known Historic and Prehistoric Properties within the Eyak-Heney Ecological Landscape Analysis Area.

Table A-2: Known cultural resource sites in the analysis area

Site number	site name	quad	hist/prehist
COR-00187	Crystal Falls Cannery	B5	historic
COR-00052	Txalam Qidl Ua	B6	prehistoric
COR-00053	COR-00053	B6	prehistoric
COR-00099	Whitshed Navel Radio Station	B6	historic
COR-00003	Cordova Historic District	C5	historic
COR-00008	Eyak Village (Hyacks, Ighiak, Ikhiak, Odiak)	C5	historic
COR-00016	Naval Radio Station, Cordova, Eyak Site	C5	historic
COR-00022	St. Theodosios of Chernigov Church, Eyak	C5	historic
COR-00083	Cordova Post Office	C5	historic
COR-00089	Shepard Point Cannery (WFC Cannery)	C5	historic
COR-00103	Sternwheeler W.H. Bancroft	C5	historic
COR-00329	Ohman Falls (Historic Mining Camp)	C5	historic
COR-00400	Humpback Creek Log Dam	C5	historic
COR-00434	Moore Cannery at Stevens Creek	C5	historic
COR-00438	American Legion Cabin	C5	historic
COR-00440	Historic Depression	C5	historic

Wildlife

The following table is the list of bird species recorded in the Eyak-Heney analysis area.

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Common loon	C, K	
Yellow-billed loon	U	
Pacific loon	U	
Red-throated loon	U	
Red-necked grebe	U	
Horned grebe	C, S	
Pied-billed grebe	R	
Northern fulmar		R
Fork-tailed storm petrel		U
Pelagic cormorant		C, K
Red-faced cormorant		C, S
Double-crested cormorant	C	
Great blue heron	C	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Tundra swan	U	
Trumpeter swan	C, K	
Whooper swan		A
Canada goose	C, S	
White-fronted goose	U	
Snow goose	U	
Brant		U
Emperor goose		R
Mallard	C, K	
Gadwall	U	
Northern pintail	C, K	
Green-winged teal	C, P	
Blue-winged teal	R	
Northern shoveler	U, S	
Eurasian wigeon	R	
American wigeon	C, P	
Black duck		R
Cinnamon teal		R
Canvasback	U	
Redhead	U	
Ring-necked duck	U	
Greater scaup	C	
Lesser scaup	U	
Tufted duck	R	
Common goleneye	C	
Barrow's goldeneye	C, P	
Bufflehead	C	
Long-tailed duck	U	
Harlequin duck	C, K	
White-winged scoter	U	
Surf scoter	U	
Black scoter		C
Steller's eider		U
Common eider		R
King eider		U
Hooded merganser	U	
Common merganser	C, K	
Red-breasted merganser	U, S	
Northern goshawk	U, S	
Sharp-shinned hawk	U, S	
Rough-legged hawk	U	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Red-tailed hawk		R
Swainson's hawk		R
Bald eagle	C, K	
Golden eagle		R
Northern harrier	U, S	
Osprey	R	
Gyrfalcon	R	
Peregrine falcon	R	
Merlin	U, S	
American kestrel	U	
Spruce grouse	C, K	
Willow ptarmigan	C, P	
Rock ptarmigan		U, P
Sandhill crane	U	
American coot	R	
Black oystercatcher		C, K
American golden plover		C
Black bellied plover		C
Semipalmated plover	U	
Killdeer	R	
Dotteral		A
Bar-tailed godwit		R
Marbled Godwit		R
Husonian godwit	R	
Whimbrel	U	
Bristle-thighed curlew		R
Greater yellowlegs	C, K	
Lesser yellowlegs	U, S	
Solitary sandpiper	U	
Upland plover		R
Wandering tattler		U
Ruddy turnstone		C
Black turnstone		C
Spotted sandpiper	C, K	
Red-necked phalarope	C, P	
Red phalarope		R
Common snipe	C, K	
Long-billed dowitcher		C
Short-billed dowitcher	U	
Western sandpiper	U	
Least sandpiper	C, P	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Pectoral sandpiper	R	
Dunlin	U	
Surfbird		C
Red knot		C
Sanderling		C
Semipalmated sandpiper		U
Rufous-necked sandpiper		R
Baird's sandpiper		U
Sharp-tailed sandpiper		R
Rock sandpiper		C
Curlew sandpiper		A
Buff-breasted sandpiper		A
Ruff		R
Parasitic jeager	R	
Long-tailed jaeger		R
Pomerine jaeger		U
Glaucous gull	R	
Glaucous-winged gull	C	
Herring gull	U	
Mew gull	C, S	
Bonaparte's gull	U	
Ivory gull	R	
Thayer's gull		U
Ring-billed gull		R
Black-legged kittiwake		C
Sabine's gull		U
Arctic tern	U, P	
Aleutian tern		C
Common murre		C
Thick-billed murre		R
Pigeon guillemot		C
Marbled murrelet	R	
Kittlitz's murrelet		U
Ancient murrelet		U
Horned puffin		R
Tufted puffin		U
Mourning dove	A	
Great horned owl	C, P	
Northern hawk owl	U	
Short-eared owl	U	
Boreal owl	R	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Northern saw-whet owl	R, S	
Western screech owl		R
Snowy owl		R
Common nighthawk		R
Vaux's swift		A
Rufous hummingbird	C, K	
Anna's hummingbird		R
Belted kingfisher	C, K	
Northern flicker	U	
Yellow-bellied sapsucker	R	
Hairy woodpecker	R, S	
Downy woodpecker	U, S	
Northern three-toed woodpecker	R	
Alder flycatcher	U, S	
Olive-sided flycatcher	R	
Eastern kingbird		R
Western kingbird		R
Say's phoebee		R
Western wood pewee		U
Horned lark		R
Purple martin		A
Violet-green swallow	C, P	
Tree swallow	C, K	
Barn swallow	C, K	
Bank swallow	U, P	
Cliff swallow	U	
Steller's Jay	C, K	
Black-billed magpie	C, P	
Common raven	C, P	
Northwesterm crow	C, P	
Gray jay		R
Black-caped chickadee	R	
Chestnut-backed chickadee	C, K	
Red-breasted nuthatch	U, S	
Brown creeper	U, P	
Wheatear		R
Dipper	C, K	
Yellow wagtail		R
Winter wren	U, S	
American robin	C, K	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Varied thrush	C, K	
Hermit thrush	C, K	
Swainson's thrush		U
Gray-cheeked thrush		U
Townsend's solitaire	C, S	
Golden-crowned kinglet	C,S	
Ruby-crowned kinglet	C, K	
American pipit	U, S	
Bohemian waxwing	R	
Cedar waxwing		
Northern shrike	U, S	
Starling	R	
Orange-crowned warbler	C, K	
Yellow warbler	C, P	
Yellow-rumped warbler	U	
Townsend's warbler	C, K	
Wilson's warbler	C, P	
Blackpoll warbler		R
Northern waterthrush		U
Common yellowthroat		R
Rusty blackbird	U, S	
Yellow-headed blackbird		
Red-winged blackbird		A
Pine grosbeak	C, P	U
Brown-headed cowbird		U
Scarlet tanager		A
Gray-crowned rosy finch	R, S	
Hoary redpoll	R	
Common redpoll	C, P	
Pine sisken	C, P	
Red crossbill	R, S	
White-winged crossbill	U, S	
Savannah sparrow	C, K	
Dark-eyed junco	C ,K	
Tree sparrow	R	
White-crowned sparrow	U	
Golden-crowned sparrow	C, K	
Fox sparrow	C, K	
Lincoln's sparrow	C, P	
Song sparrow	C, K	
Lapland longspur	U	

Table A-3: Birds of the Eyak-Heney analysis area.

(A – accidental, R – rare, U – uncommon, C – common, P – probable breeder, S – suspected breeder, K – known breeder) (Professional Fishery Consultant 1984)

Species	Observed near Eyak Lake	Observed within 10 Nautical Miles of Cordova
Snow bunting	U	
White-throated sparrow		R
Brambling		R

Appendix B – Landslide Risk Assessment

Two sites in the Eyak-Heney analysis area were rated as to their landslide risk potential. This section provides the back-up information for description of the sites in chapter 2.

Landslide risk is divided into the following four categories:

High to Extreme - Natural failures are frequent and large, and the risk of management induced failure is high. Standard management practices can be expected to have only limited success, and on-the-ground assessment is necessary to determine the need for mitigating measures.

Moderate - Natural failures are usually small and infrequent, but the risk of management-induced failure is moderate. Standard and best management practices are usually successful, but on-the-ground investigation is still recommended. Mitigation measures occasionally may be needed.

Low - Natural failures are usually rare or small. The risk of management induce failures is low except on unstable micro-sites such as scarps, V-notches, and stream banks. Standard best management practices that control streamflows and surface disturbance can be expected to be highly successful.

Table B-1: Site 1- Potential landslide rating for the soil on the lower part of an undisturbed, tree covered, mountain sideslope

Criteria	1	2	3	4	Criteria Value	Weighting Factor	Rating
Landform							
Slope shape	Vertical	Broken	Convex	Concave-straight	4	5	20
Slope length (ft)	0-300	301-700	701-1500	>1500	4	5	20
Slope gradient (%)	May-35	36-55	56-72	>72	3	20	60
Drainage features:							0
Drainage density (% of area)	0 to 9	10 to 19	20 to 39	>40	2	10	20
Soils							0
Soil drainage class	WD	MWD	SPD	VP,PD	2	10	20
Soil Depth (in)	>40		20-40	<20	3	5	15
Geology							0
Parent material	Carbonate, colluvium, alluvium	Noncarbonate, granitics, glacial till	Compact till, marine sediments	Volcanic ash	3	5	15
Textural class	Sand, gravel, fragmental loam	loam	silt	silty clay	2	5	10
Total of Ratings							180

Failure Hazard Rating	0.6923

*>63,High: 62-50,Moderate; 28-49,low: <28, None;

Table B-2: Site #1a- Potential landslide rating for the soil on the lower part of an undisturbed, tree covered, mountain sideslope with increased ground water.

Criteria	1	2	3	4	Criteria Value	Weighting Factor	Rating
Landform							
Slope shape	Vertical	Broken	Convex	Concave-straight	4	5	20
Slope length (ft)	0-300	301-700	701-1500	>1500	4	5	20
Slope gradient (%)	May-35	36-55	56-72	>72	3	20	60
Drainage features:							0
Drainage density (% of area)	0 to 9	10 to 19	20 to 39	>40	2	10	20
Soils							0
Soil drainage class	WD	MWD	SPD	VP,PD	3	10	30
Soil Depth (in)	>40		20-40	<20	3	5	15
Geology							0
Parent material	Carbonate, colluvium, alluvium	Noncarbonate, granitics, glacial till	Compact till, marine sediments	Volcanic ash	3	5	15
Textural class	Sand, gravel, fragmental loam	loam	silt	silty clay	2	5	10
Total of Ratings							190
Failure Hazard Rating							0.7308

*>63,High: 62-50,Moderate; 28-49,low: <28, None;

Table B-3: Site 2- Landslide assessment for a lake deposited soil on the sideslope up Power Creek.

Criteria	1	2	3	4	Criteria Value	Weighting Factor	Rating
Landform							
Slope shape	Vertical	Broken	Convex	Concave-straight	3	5	15
Slope length (ft)	0-300	301-700	701-1500	>1500	3	5	15
Slope gradient (%)	May-35	36-55	56-72	>72	4	20	80
Drainage features:							0
Drainage density (% of landform area)	0 to 9	10 to 19	20 to 39	>40	2	10	20
Soils							0
Soil drainage class	WD	MWD	SPD	VP,PD	3	10	30
Soil Depth (in)	>40		20-40	<20	3	5	15
Geology							0
Parent material	Carbonate, colluvium, alluvium	Noncarbonate, granitics, glacial till	Compact till, marine sediments	Volcanic ash	3	5	15
Textural class	Sand, gravel, fragmental loam	loam	silt	silty clay	3	5	15
Total of Ratings							205
Failure Hazard Rating							0.7885

*>63,High: 62-50,Moderate; 28-49,low: <28, None;

Table B-4 Landslide risk rating for two sites in the analysis area.

Sites	Risk Rating
Scott River Site 1	69
Scott River Site 1 with wet soil	73
Power Creek Site 2 (Lake sediment soil)	78

Appendix C – Laws, Executive Orders, and Programmatic Agreements pertaining to Heritage Resources

Management of cultural resources is governed by Federal legislation, primarily the National Historic Preservation Act of 1966 as amended in 2000 (NHPA), Executive Order 11593 of 1971, and the Archaeological Resources Protection Act of 1979 (ARPA). As allowed under the regulations for NHPA, Region 10 of the Forest Service has operated since 1995 under a Programmatic Agreement with the Alaska State Historic Preservation Officer (SHPO) and the National Advisory Council on Historic Preservation (ACHP), regarding compliance with NHPA section 106.

NHPA regulates survey for and inventory of cultural resources, under sections 110 and 106. Section 106 stipulates that "prior to the approval of the expenditure of any Federal funds on the [proposed Federal or federally assisted] undertaking, or prior to the issuance of any license…take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register" (16 U.S.C. 470f). Section 110 stipulates that Federal agencies "use, to the maximum extent feasible, historic properties available to the agency", " establish a program to locate, inventory, and nominate…all properties…that appear to qualify for inclusion on the National Register", "undertake…any preservation, as may be necessary to carry out this section", "exercise caution to assure that any such property that might qualify for inclusion [for the National Register of Historic Places] is not inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate significantly" (16 U.S.C. 470h-2).

Executive Order 11593 was created to further "the purposes and policies of the National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C. 4321 et seq.), the National Historic Preservation Act of 1966 (80 Stat. 915, 16 U.S.C. 470 et seq.), the Historic Sites Act of 1935 (49 Stat. 666, 16 U.S.C. 461 et seq.), and the Antiquities Act of 1906 (34 Stat. 225, 16 U.S.C. 431 et seq.)" (36 FR 8971). It reiterates the requirements of the above laws stating:

> (1) Administer the cultural properties under their control in a spirit of stewardship and trusteeship for future generations, (2)initiate measures necessary to direct their policies, plans and programs in such a way that federally owned sites, structures, and objects of historical, architectural or archaeological significance are preserved, restored and maintained for the inspiration and benefit of the people, and (3), in consultation with the Advisory Council on Historic Preservation (16 U.S.C. 470i), institute procedures to assure that Federal plans and programs contribute to the preservation and enhancement of non-federally owned sites, structures and objects of historical, architectural or archaeological significance.

ARPA's purpose "is to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands" (16 U.S.C. 1b 470aa). This law provides for criminal prosecution of people who undertake "Unauthorized excavation, removal, damage, alteration, or defacement of archaeological

resources" or traffic "in archaeological resources the excavation or removal of which was wrongful under Federal [State or local] law" (16 U.S.C. 1b 470ee).

The "Second Amended Programmatic Agreement among the USDA Forest Service, Alaska Region, The Advisory Council on Historic Preservation, and the Alaska State Historic Preservation Officer Regarding Heritage Resource Management on National Forests in the State of Alaska" (Agreement #02MU-111001-076, executed 7/29/02) expedites compliance with the 36 CFR 800 review process, and allows some modifications which slightly streamline the process of inventory, documentation, evaluation, and reporting (ultimately to Congress). Although it deals primarily with NHPA section 106, and it is expected that, as a result of this agreement, "implementation of this Agreement will enable the Forest Service to fulfill other heritage program goals. This greater flexibility should provide measurable results in compliance with responsibilities listed in Section 110 of the NHPA." Section 110 addresses monitoring, determinations of eligibility of previously unevaluated properties, development of predictive models, non-project related historic properties inventories, historic building and property preservation and maintenance, integration of historic properties management with landscape-scale analyses, conduct public outreach programs, encourage responsible heritage tourism and recreation opportunities, promote heritage stewardship, and curation of artifacts, among other things. Stipulation VII. Heritage Management Program states, "The Heritage Management Program of the Forest Service shall meet the requirements of Section 110 of the NHPA. The Programmatic Agreement does not eliminate the need for the Forest to conduct surveys to identify cultural resources in project areas, *unless* the Historic Preservation Specialist determines that the undertaking meets the conditions of one or more of 22 technically defined undertakings that are identified as having "No Potential to Affect Historic Properties" in Appendix B of the agreement.

Appendix D – List of available resource reports and GIS products.

All reports and GIS products are electronically filed at Cordova District in J:/fsfiles/office/proj/1900/land_ass/eyak_hen

Resource Reports

Fisheries Report – Sean Stash
Recreation Resource Report – Dixon Sherman and Bruce Campbell
Eyak-Heney Hydrologic Assessment Report – Bill MacFarlane and Dave Blanchet
Cultural Resources Report for the Eyak-Heney Landscape Analysis - Linda Yarborough
Eyak-Heney Soil Assessment – Dean Davidson and Linda Kelly

GIS products

Two arcview projects are available for use in the electronic file as shown above. They are eyak_hen1_x.apr and eyak_hen2_x.apr, located in j:fsfiles/office/proj/1900/ land_ass/eyak_hen. **Please note – these must be accessed through Exceed**.

Table D-1: Available arcview projects and products

Arcview Project	Views available	Themes on View
Eyak_hen1_x.apr	Ortho base map	Cabins, shelters, easements, trails, mineral potential, timber type code, stand class
	Ownership	Land status, roads
	Plan prescription	Revised Forest Plan prescription polygons, streams, land ownership, 1984 plan prescription
	Vicinity	Cordova District boundary, Eyak-Heney boundary, CRD land status
	Wl base (wildlife base)	Streams, eagles, swans, goats dusky plots, dusky nests (89-91)
	Working Base	Contour lines, mines, land status, lakes, streams
	Slope	0-56%, 56-72%. 72+%, contours, Land Type Associations (LTA's)
	Shield	Fs shield
	Eyak_hen1_x layouts	Land status 8x11, ortho base large, ortho base large-timber, ownership/admin, plan prescription 11x22, plan direction 8x11, rec 8x11, slope, wl base map
Eyak_hen2_x.apr	Contour base	Mines, roads, sensitive plants, easements, anadromous streams, streams, land status
	Cover type	VQO's (1984 plan) (visual quality obj), ROS class (1984 plan) (Recreation Opportunity Spectrum), landline, roads

Table D-1: Available arcview projects and products		
Arcview Project	**Views available**	**Themes on View**
	Elev_owner	Ownership, contour lines
	Ortho base	Land status, rds, trails
	Eyak_hen2_x layouts	Crater lake land status, elev base, mile 2 land status

The arcview projects (.apr's) contain information about the resources clipped to the analysis area. Coverages and shapefiles include recreation sites, trails, easements, roads, streams, mining claims, sensitive plants, timber type, land ownership, land status, eagles, swans, dusky nests, goats, slope, landtype association, ROS class, visuals, and Forest Plan prescriptions. There is a readme.doc in the eyak_hen gis folder that describes the shapefiles and coverages created and used for the project.