Tulsequah Chief Mine Air Cushion Barge Transportation System Volume 2:

Supporting Information for the BC Project Approval Certificate Amendment and the Alaska Coastal Zone Consistency Review

Prepared for Redfern Resources Ltd.

Submitted by Gartner Lee

Tulsequah Chief Mine ACB Transportation System

Volume 2: Supporting Information for the BC Project Approval Certificate Amendment and the Alaska Coastal Zone Consistency Review

Prepared for

Redfern Resources

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Executive Summary

The Tulsequah Chief Mine project, owned by Redfern Resources Ltd., is located in a remote area of northwestern British Columbia, far from existing transportation infrastructure. The method of shipping ore concentrate off site and re-supplying the mine has been a major consideration for this project. Redfern received approval under a Project Approval Certificate issued by British Columbia in 1998 for the project that included construction of a new 160 km access road from the mine to Atlin, BC. Recently, Redfern requested an amendment to this Certificate to use a ACB transportation system that would operate year-round on the Taku River between the minesite and Juneau, Alaska. The ACB transportation system would be a mutually exclusive alternative to the 160 km road.

Advantages of the ACB transportation system are:

- shorter distance for transporting concentrate and mine supplies;
- significantly smaller ecological footprint, resulting in reduced environmental impact;
- lower capital and transportation operating costs; and
- safer transportation alternative in winter months.

The Air Cushion Barge (ACB) Operations

The ACB is an amphibious barge that will be towed by a shallow draft tug during the open water season on the Taku River, and by an amphitrac during the remainder of the year. The amphitrac is a modified Rolligon vehicle used on the sensitive tundra of Alaska's north slope. The amphitrac will be modified to operate on land, snow and in the water. Low ground pressure tires will be used on snow and land, and Archimedes screws will be used to manoeuvre in the water, or transiting from water to land. A marine tug will tow the ACB between Taku Inlet and Juneau, Alaska. In Juneau, the sealed concentrate containers will be transferred to Alaska Marine Line's conventional ocean barges that operate regularly between Juneau and Skagway. At Skagway, the concentrate will be handled at the existing bulk loading facilities for shipment overseas.

The ACB system will not only transport mineral concentrate from the mine to Juneau, but will also transport supplies into the mine. The ACB and amhpitrac are amphibious vessels, allowing barging operations to be carried out year-round. On average, there will be one round trip between Juneau and the mine each day, although the actual number of trips from season to season will vary due to weather, routine maintenance, and other logistical requirements. A landing site will be built at the confluence of the Taku and Tulsequah Rivers, and 8.5 km (5.3 miles) of an existing exploration road between the landing site and the mine will be upgraded for year-round truck use. Trucks will haul concentrate and supplies between the landing site and the mine.

Redfern has prepared supporting information documents (Volumes 1 and 2) for the assessment of the proposed ACB transportation system in both British Columbia and Alaska. Regulatory approvals in Canada include an Amendment of the Project Approval Certificate issued by British Columbia, as well as a Screening under the Canadian Environmental Assessment Act, to be completed by the Department of Fisheries and Oceans Canada. Approvals in Alaska will include a

Consistency Review associated with a Title 41 permit, and a Land Use permit, issued by the State of Alaska. The information contained in Volumes 1 and 2 is intended to support regulatory reviews in both jurisdictions.

Redfern has examined the potential effects of the ACB transportation system on the Taku River environment, including fish and fish habitat, terrestrial resources, and human activities. Salmon, grizzly bears, moose, marine mammals and birds were the focus of the aquatic and terrestrial assessments. Effects on human activities are mostly related to possible disruption or interference with existing activities, particularly the commercial, personal use, subsistence and sport fisheries.

The Taku River has been used historically and currently as a transportation corridor to the sea from northwestern BC, and its role in navigation has been formally recognized since the time Alaska gained statehood. The proposed barging operation on the Taku River is consistent with the Taku River's role as an international navigation corridor. Mining in the 1950s at Tulsequah relied on seasonal barging to ship concentrate to markets and resupply the mine.

Measures to avoid or minimize potential effects have been incorporated into the proposed ACB operation. These include measures that have been embedded into equipment design, choice of route, timing and pattern of operations. Redfern is committed to undertaking monitoring to verify predicted effects, and if warranted, adjust operations to further minimize adverse effects.

Redfern has carefully designed the ACB transportation system to ensure it will not result in significant adverse effects to the environment or human activities. Redfern has also found that the proposed activities within Alaska are consistent with the navigational role of the Taku River, and are also consistent with the Juneau State Land Plan and the Alaska Coastal Management Program Standards. In the context of comparing access alternatives of the 160 km road and the ACB system, Redfern has concluded that the ACB system is viable, environmentally sustainable, less costly, and presents an opportunity to reduce the overall footprint of its activities on the landscape.

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Appendices

Appendix A. Environmental Management Plan Outline

1. Introduction

Redfern Resources Limited (Redfern) has identified that year-round use of air cushion barges (ACBs) on the Taku River represents a technically, financially and environmentally preferable option for shipment of mine supplies and mineral concentrate to and from the Tulsequah Chief Mine in northwestern BC. It is proposed that the ACBs would operate between Juneau, Alaska and an ACB landing site on the Taku River near its confluence with the Tulsequah River in British Columbia, Canada. A complete description of the proposed ACB transportation system is provided in Volume 1: Project Description of this documentation set.

The Tulsequah Chief Mine Project currently has a valid Project Approval Certificate (under the British Columbia *Environmental Assessment Act*), a positive screening pursuant to the *Canadian Environmental Assessment Act,* and a Special Use Permit from the Province of British Columbia for the construction and operation of a limited access, all-season road from Atlin B.C. to the Tulsequah Chief Minesite. The ACB transportation system is proposed as a mutually exclusive **access alternative** to the Atlin road. It is Redfern's intent that the timely approval and permitting of the ACB transportation system will replace the approval for the Atlin road in the Tulsequah Chief Mine Project Approval Certificate.

1.1 Document Purpose

This document, Volume 2, is a multi-purpose document fulfilling information requirements for both the Canadian and the United States (Alaska) portions of the project:

- For the Canadian portion of the transportation system, this document provides a strategic environmental assessment for the amendment of the Tulsequah Chief Mine's Project Approval Certificate and supports a screening under the *Canadian Environmental Assessment Act*.
- For the Alaskan portion of the transportation system, this document provides social and environmental information, and a review of potential issues and mitigation opportunities to support State of Alaska permit applications and the Coastal Zone Consistency Review.

1.2 Document Structure

Although British Columbia, Canada, and the State of Alaska have different regulatory regimes and requirements, many of the potential issues associated with the transportation system may occur in both Canada and Alaska. Furthermore, the proposed transportation system is a transboundary activity, potentially affecting and benefiting both jurisdictions. Therefore, this information package has been prepared as a single document; however, there are clear distinctions presented within this document that identify issues pertinent to only the Canadian or Alaskan portions of the transportation system and these are identified accordingly.

Chapter 2 – Consultation provides a summary of the consultation that has been carried out to date with stakeholders, First Nations, and the public, to identify key concerns and issues associated with the proposed ACB transportation system. This section provides an overview of the key issues that were identified during these consultation discussions, open houses and meetings, and formed the basis for determining the scope of the assessment for this project.

Chapter 3 – Project Setting provides background environmental and social information relevant to the proposed transportation system. As the Taku River is a single watershed, this information is presented as common to both Canada and Alaska and is not subdivided between jurisdictions. Where certain activities occur primarily or exclusively in one jurisdiction, these have been identified in the broader discussion.

Chapter 4 – Effects Assessment in British Columbia, Canada provides a strategic, issues-driven effects assessment of the proposed transportation system in Canada. This assessment is presented as an amendment to the access component of the current Project Approval Certificate. This chapter also includes conclusions and mitigation and/or monitoring recommendations drawn from the effects assessment of the Canadian portion of the transportation system.

Chapter 5 – Supplemental Information for State of Alaska Coastal Zone Consistency Review and State Permits provides a review of the proposed transportation system activities in the State of Alaska regulatory context. This chapter also provides a review of potential issues and mitigation opportunities, if warranted, associated with the operation of the Alaskan portion of the proposed transportation system. This chapter also includes conclusions and recommendations drawn from the issues review of the Alaskan portion of the transportation system.

1.3 Existing Project Approval for the Tulsequah Chief Mine Access

In the 1997 Project Report, Redfern proposed that the Tulsequah Chief Mine Project include a 160 km all-season, controlled access road from Atlin, BC, through the upper Taku River watershed to the Tulsequah River valley. A Project Approval Certificate under the British Columbia *Environmental Assessment Act* was issued in 1998 for this project, including the Atlin road access, subject to the conditions, mitigation measures and environmental follow-up and monitoring program identified in the Project Committee's Report. Furthermore, the harmonized screening pursuant to the *Canadian Environmental Assessment Act* determined that the development of the project would not cause significant adverse environmental effects.

Following a series of legal challenges and significant additional assessment work and studies, the Project Approval Certificate was re-issued by the Province of British Columbia in 2002 (MN02-01). In 2004 a Supplemental Screening pursuant to the *Canadian Environmental Assessment Act* determined that with the implementation of the proposed mitigation measures the Tulsequah Chief Mine project is not likely to cause significant adverse environmental effects.

1.4 Scope of the ACB Transportation System

For the purposes of this document, the scope of the proposed ACB transportation system is defined to include the following components and activities:

1. Year-round ACB operation between the proposed landing site on the Taku River and Juneau, Alaska. The ACB route is located in British Columbia and Alaska.
2. Construction of an ACB landing and loading facility located near the confluence of the Taku and Tulsequah Rivers, located in British Columbia.
3. Upgrading of the exploration access (haul) road to all-weather operational standard between the minesite and the ACB landing site – a total road haulage distance of approximately 12 km from the minesite to the ACB landing. This 12 km road is entirely located in British Columbia.

Figure 1-1 provides an overview of the study area. All concentrate will be containerized at the mine and the sealed containers will be transported to Skagway, Alaska with no re-handling of the concentrate between the mine and the bulk loading facility in Skagway. The commercial barging operation between Juneau and Skagway and the bulk loading operations in Skagway are not included in the scope of this document. Similarly, the ACB loading facilities owned and operated by Alaska Marine Lines (AML) at Juneau are not included in the scope of this document, as it is understood that AML is fully capable of handling the trans-shipment within its standard operating procedures and permits.

1.4.1 Scope of ACB Transportation System Activities in Canada

For the purposes of the assessment and amendment of the Project Approval Certificate, the changed project activities consist of:

a) upgrading 8.5 km of exploration access (haul) road to an all-weather operational standard between the minesite and the ACB landing site *as the alternative to construction and operation of the Atlin access road;*
b) construction of an ACB landing and loading facility located near the confluence of the Taku and Tulsequah Rivers; and
c) year-round ACB operation on 10 km of the Taku River between the proposed landing site and the US/Canada border *as the alternative to truck haulage to Skagway, AK via the Atlin access road.*

The spatial scope of the proposed transportation system activities in Canada is illustrated schematically on Figure 1-2.

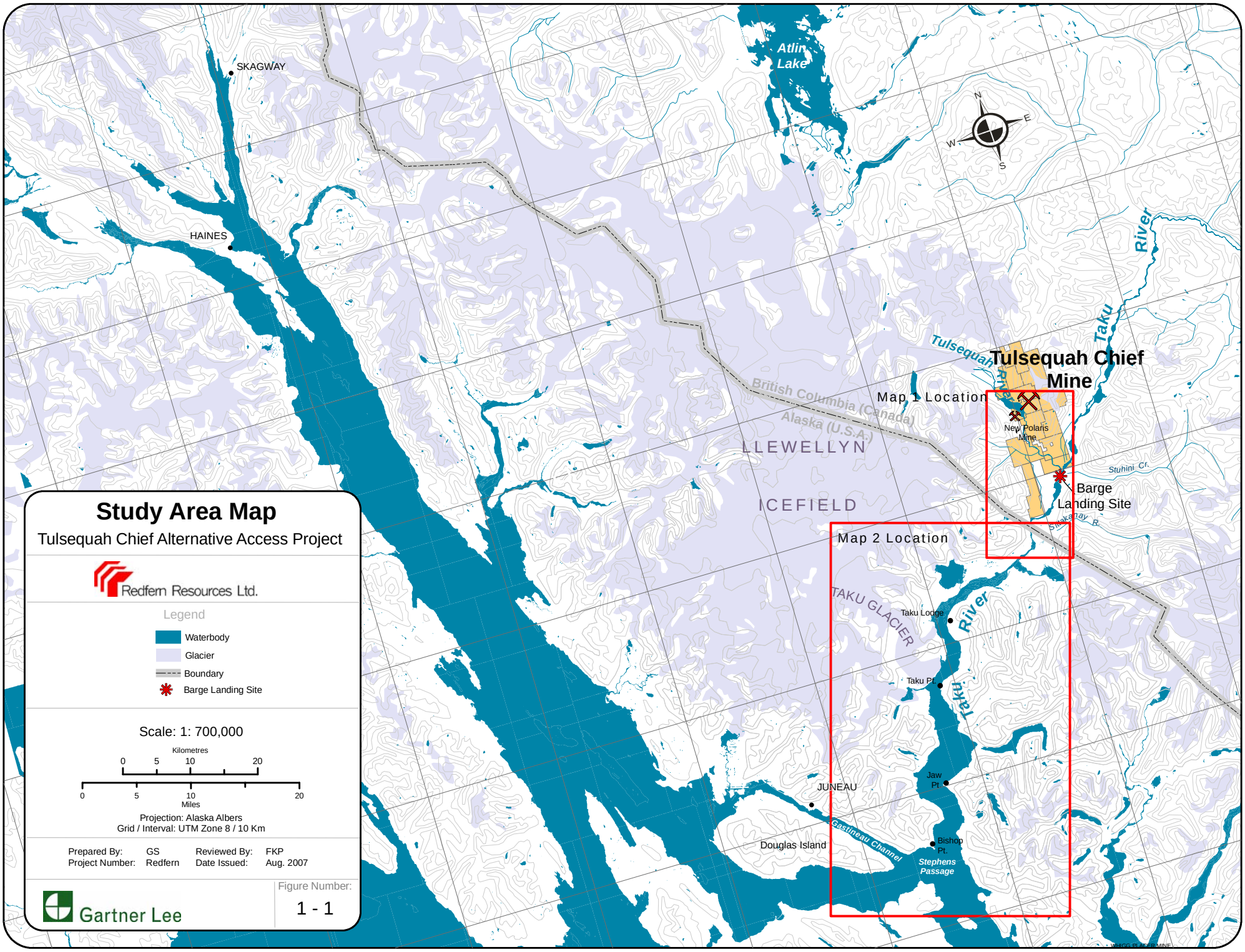
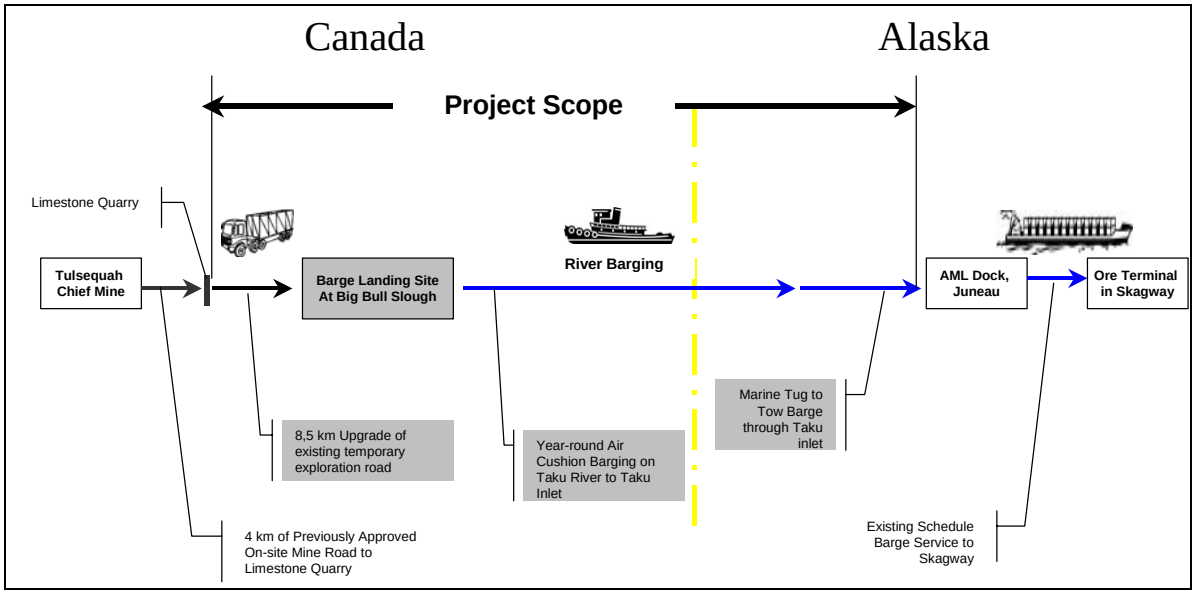

Study Area Map
Tulsequah Chief Alternative Access Project
Redfern Resources Ltd.
Legend
Waterbody
Glacier
Boundary
Barge Landing Site
Scale: 1: 700,000
Kilometres
0 5 10 20
0 5 10 20
Miles
Projection: Alaska Albers
Grid / Interval: UTM Zone 8 / 10 Km
Prepared By: GS
Reviewed By: FKP
Project Number: Redfern
Date Issued: Aug. 2007
Gartner Lee
Figure Number:
1 - 1
SKAGWAY
HAINES
Atlin Lake
Tulsequah Chief Mine
Map 1 Location
New Polaris Mine
Barge Landing Site
Stuhini Cr.
Skakamay R.
Tulsequah River
Taku River
British Columbia (Canada)
Alaska (U.S.A.)
LLEWELLYN
ICEFIELD
Map 2 Location
TAKU GLACIER
Taku Lodge
Taku Pt.
Taku River
JUNEAU
Douglas Island
Jaw Pt.
Bishop Pt.
Eastineau Channel
Stephens Passage
N
S
E
W

Figure 1-2. Spatial Scope of Transportation System



1.4.2 Scope of Transportation System Activities in Alaska

For the purposes of the Coastal Zone Consistency Review and State of Alaska permits, the transportation system activities consist of:

a) year-round ACB operation on the Taku River between the US/Canada border and standard marine shipping lanes in Stephens Passage/Gastineau Channel.

The spatial scope of the proposed transportation system activities in Alaska is illustrated schematically on Figure 1-2.

1.5 Rationale for the Proposed Amendment

The Taku River route from the minesite to Juneau and Skagway is a shorter route for transporting concentrate and mine supplies, requires little in the way of infrastructure development (existing marine shipping facilities will be used at the ports of Juneau and Skagway), and is predicted to have significantly lower unit costs of transporting concentrate as compared to trucking by road.

The Taku River was the transportation route when the mine was operated in the 1950s. Mine supplies and concentrate were transported by conventional river tug and barge; however, these conventional vessels could not operate during winter when the river remained frozen, nor could they operate during the spring and fall seasons when water levels in the Taku River provided

insufficient depth to accommodate the draft of these vessels. Conventional barging was again considered in 1995, but rejected for many of the same reasons. Nonetheless, it is worth noting that conventional barging operations on the Taku River carried out in the past have no reported, significant effects to the river geomorphology or to fish or fish habitat.

In late 2006, Redfern identified an alternative transportation option that would use ACBs and an amphibious tow vessel (amphitrac) operating year-round on the Taku River between the minesite and Juneau, Alaska. Unlike a conventional barge system, the use of an ACB, towed by either a shallow draft tug (summer) or amphitrac (remainder of year) would be able to operate year-round over water, ice and land. This option offers several distinct and significant advantages over the road, including:

a) reduced environmental impact;
b) smaller overall project footprint;
c) lower capital cost;
d) reduced operating cost of shipping concentrate and mine re-supply;
e) accelerated project construction schedule;
f) reduced risk of cost overruns associated with road construction schedule;
g) greater operational flexibility; and
h) safer transportation alternative in winter months.

Redfern's commitment to continue to look for ways to minimize the environmental effects of its proposed operation is reflected in its decision to examine the concept of the ACB as a viable alternative to the 160 km access road that generated much of the concern about the project when it was initially proposed, assessed and permitted.

2. Consultation

Consultation with stakeholders regarding Redfern's application to amend the Project Approval Certificate to consider ACB transport as the primary means of access was carried out to identify key issues and to respond to stakeholder concerns. Further to initial information meetings with stakeholders that indicated general support for the concept as an alternative to the access road, the consultation program sought to address concerns pertaining to ACB operations, amphitrac technology, and effects on the river and its users by demonstrating the feasibility of the ACB option as a viable and environmentally sound means of access.

Meetings with key stakeholders were held in February, March, May, and June of 2007, ensuring that commercial fishing groups were consulted prior to the onset of the fishing season and that river users were available to participate prior to the busy summer season. Consultation with First Nations evolved through ongoing discussions with the Taku River Tlingit First Nation (TRTFN) in British Columbia, and with the Douglas Indian Association (DIA) in Alaska.

A list of stakeholders contacted and the results of the consultation program to date have been compiled and summarized below. The manner in which issues and concerns raised have been addressed/mitigated is outlined in Sections 4 and 5 of this report.

Table 2-1. List of Stakeholders Contacted

Date	Organization	Consultation Method
February 6, 2007	Juneau Rotary Club	Luncheon
February 6, 2007	Taku River Recreation Association (TRRA) Board	Briefing Meeting
February 6, 2007	United Fishermen of Alaska; SE Alaska Gillnetters Association	Briefing Meeting
February 6, 2007	Alaska Miners Association, Alaska General Contractors Association, Alaska Truckers Association	Joint Legislative Reception
February 7, 2007	Gold Belt Inc	Briefing Meeting
February 7, 2007	Juneau Economic Development Board	Briefing Meeting
February 7, 2007	Alaska State Chamber of Commerce	Briefing Meeting
February 8, 2007	Alaska Electric Light and Power	Briefing Meeting
February 8, 2007	Juneau Chamber of Commerce	Briefing Meeting
February 8, 2007	Southeast Alaska Conservation Council (SEACC), Trout Unlimited, Douglas Indian Association , Rivers Without Borders/Transboundary Watershed Alliance	Briefing Meeting
February 22, 2007	Letter of Agreement reached with Taku River Tlingit First Nation (TRTFN) that provides framework and capacity for their participation in the EA amendment review	
March 20, 2007	Juneau Rotary Club	Briefing Meeting
March 20, 2007	National Federation of Independent Businesses	Briefing Meeting

Date	Organization	Consultation Method
March 20, 2007	North Pacific Salmon Council, Alaska Seafood Processors Association	Briefing Meeting
March 20, 2007	Marine Pilots Beneficiary Association	Briefing Meeting
March 22, 2007	Alaska Miners Association (Redfern hosted a table of fishing interests and Taku River Recreation Association members	Banquet
March 23, 2007	Alaska Miners Association	Convention Booth
May 2, 2007	United Fishermen of Alaska	Briefing Meeting
May 2, 2007	Southeast Alaska Conservation Council, Rivers Without Borders/ Transboundary Watershed Alliance, Trout Unlimited	Briefing Meeting
May 3, 2007	Juneau Open House (public open house)	Open House
May 3, 2007	Taku River Recreation Association	Briefing Meeting
May 31, 2007	Taku River Tlingit First Nation	Briefing Meeting
June 7, 2007	Taku River Tlingit First Nation and Douglas Indian Association	Site Visit
June 7, 2007	Douglas Indian Association community meeting with TRTFN leadership participation	Briefing Meeting
June 21, 2007	Taku River Recreation Association	Briefing Meeting
June 21, 2007	United Fishermen Association, Se Alaska Gillnetters Association,	Briefing Meeting
June 21, 2007	Juneau Chamber of Commerce	
June 22, 2007	Douglas Indian Association	Briefing Meeting
July 2007	Taku Fishermen	River Visits

2.1.1 Public Issues and Concerns

Issues and concerns raised by fishing organizations, recreation associations, miners associations, and community and legislative leadership related to the ACB operations and amphitrac technology, potential effects on the Taku River and its resources, and effects on river users are summarized as follows.

2.1.1.1 ACB Operations and Amphitrac Technology

ACB operations and amphitrac technology issues included concerns about the overall ACB technology in general, the benefits of the ACB over the road option, and how the ACB would perform in the Taku River and marine environment in terms of hover capacity, amount of noise, and size of wake. Additionally, there were questions raised about permitting and regulatory processes associated with the ACB, weather issues, operating timelines and travel routes, and transportation procedures including shipping containers, fuel transport, and spill clean-up measures.

2.1.1.2 Effects on the River

Concerns related to the effects the ACB operations on the river included overall environmental issues and potential impacts to the riverbed and banks (benthic invertebrates, mud, sandbar, and

shallow areas), to fish (spawning areas and out-migrating smolt and fry), and impacts on terrestrial mammals, waterfowl, and shorebirds. Further, there was concern that the ACB could potentially block channels in narrow areas impacted by debris in the river. Discussion included suggestions for reclamation bonds and public access to biophysical impact data and reports.

2.1.1.3 Effects on River Users

A key concern raised by river users was the issue of compensation for property damage as a result of ACB operations. Additional concerns related to the potential for increased traffic on the river (mining camp boats, ATVs, and snowmobiles) and conflicts at Taku Lodge with regard to aircraft landing. Further, discussion focused on economic benefits and impacts to river users and nearby communities.

2.1.2 First Nation Issues and Concerns

Issues and concerns raised by First Nations included ACB operations and amphitrac technology and effects on fisheries and impacts on traditional land use in the Taku area are as follows. Further discussion identified the need to explore partnership and impact and benefit agreement processes.

2.1.2.1 ACB Operations and Amphitrac Technology

Information sharing related to ACB and amphitrac technology identified open, effective communication regarding ACB testing and progress as a key priority for First Nations. Additionally, First Nations provided suggestions regarding potential ACB routing.

2.1.2.2 Effects on Fisheries and Traditional Land Use

Initial consultation discussions raised questions regarding compensation for damage to fisheries and restoration to disrupted riverbeds. Subsequent meetings more clearly laid out Tlingit Land Use Impact Study initiatives for the development/gathering of Tlingit Land Use Baseline information (contemporary land use activities, historic and cultural values) to feed impact analysis and plans for mitigation.

2.1.2.3 Partnership / Impact and Benefit

First Nations requested an overall commitment to impact and benefit agreement processes that include potential monitoring and co-management opportunities, employment opportunities, and overall socio-economic benefits for their people and communities. Further, the Taku River Tlingit First Nation (TRTFN) and the Douglas Indian Association (DIA) proposed the signing of a TRTFN/DIA Memorandum of Understanding outlining their resolve to share information and jointly protect the river on both sides of the border.

2.1.3 Ongoing / Future Consultation and Communications Program

Concerns will continue to be addressed through project design and mitigation as identified through structured communication with TRTFN and through open dialogue with stakeholders including Douglas Indian Association and Taku River Recreation Association. Seasonal updates will be provided to fishermen.

3. Project Setting

The Taku River drains one of the largest roadless watersheds remaining on the Pacific coast of North America and supports healthy runs of all five species of Pacific salmon (Neal 2007). The Taku River originates on the Stikine Plateau in northwest British Columbia and flows through the Boundary Range for approximately 265 km before discharging to Taku Inlet, located approximately 30 km south and east of Juneau, Alaska. Two major tributaries, the Nakina and Inklin Rivers, join to form the Taku River about 55 km upstream of the Canada – U.S. border. The river is influenced in its higher reaches by the cooler, drier climate of interior Canada, while the lower reaches are subject to the maritime influences of the Pacific Ocean.

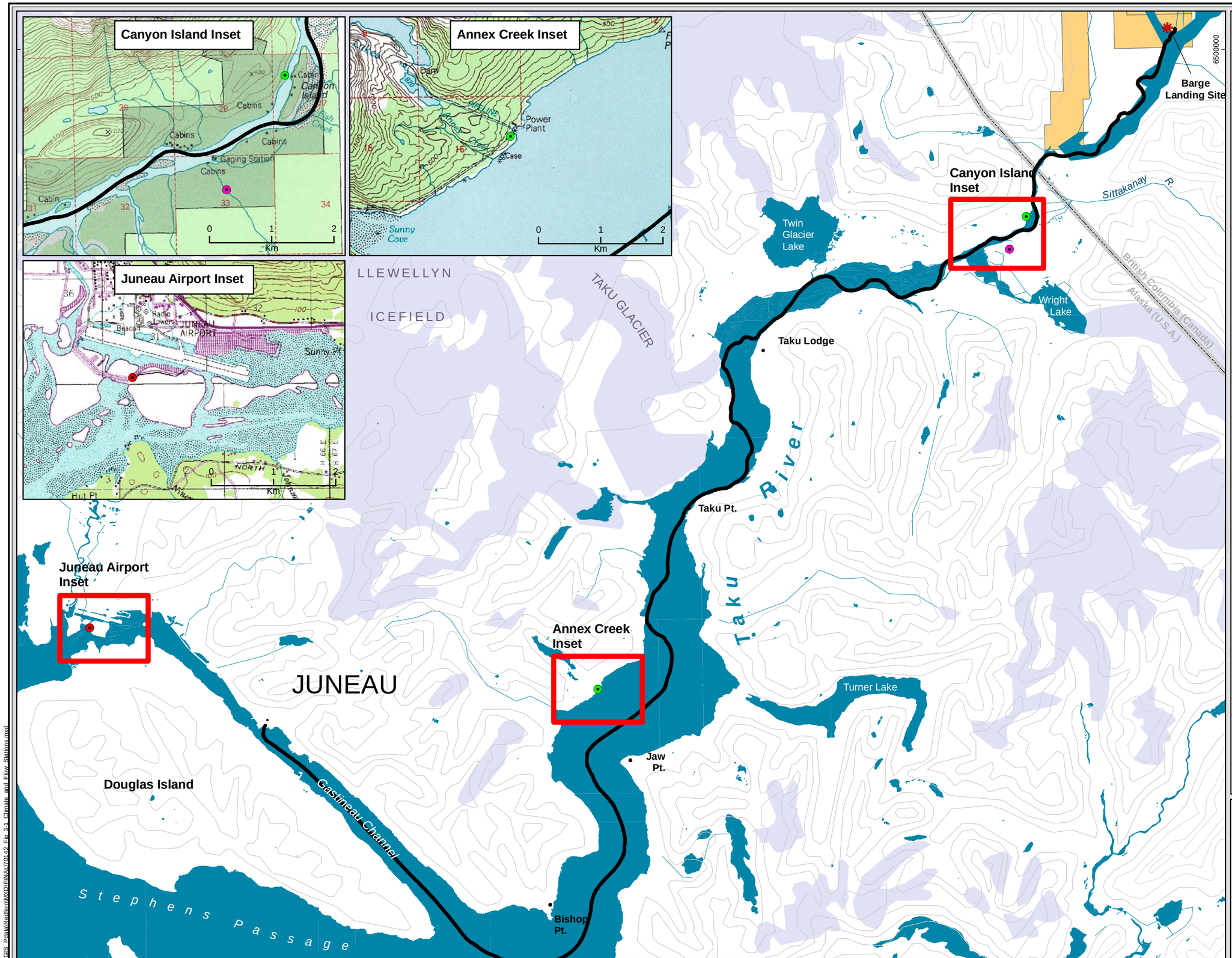
3.1 Climate

The climatic conditions in the study area are a key consideration for the proposed ACB transportation system. Southeast Alaska and northern British Columbia experience a wide range of severe weather conditions with heavy rainfalls occurring in the fall, high amounts of snowfall over the winter, and wet summers. The southeast Alaskan coast near Juneau is subject to winter storms and heavy fog, frequently occurring in November and December. The proposed ACB route has been divided into three sections between Juneau to the confluence of the Taku and Tulsequah Rivers. These route sections are summarized in Table 3-1, and are illustrated on Maps 1 and 2 located in the back pocket.

Table 3-1. Proposed ACB Route Sections

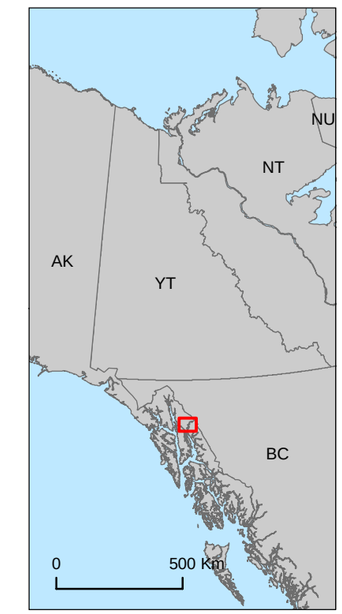
Segment No.	Description	Distance km (mi)	
		Segment	Cumulative
1	**Marine Route**: Gastineau Channel; Taku Inlet to Annex Creek	35 (22)	35 (22)
2	**Lower Taku River** Annex Creek to Taku Lodge	27 (17)	62 (39)
3	**Upper Taku River**: Taku Lodge to Tulsequah confluence	33 (20)	95 (59)

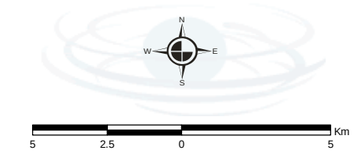
Climate is often difficult to adequately summarize and predict due to lack of local data. Some data exists along each section of the proposed ACB route and is summarized below. For the purposes of this report, data from three climate stations were used: Juneau Airport, Annex Creek, and Canyon Island. Figure 3-1 shows the location of all three stations. Data from Juneau is used to characterize the weather in the Marine Route. Data from the Annex Creek weather station, located in the Taku Inlet, is used to characterize weather on the Lower Taku River, and data from Canyon Island, an island in the Taku River just downstream of the confluence with the Tulsequah River, is used to represent weather on the Upper Taku River. In the cases of Annex Creek and Canyon Island, the period of record is short and the observations subjective, however given the limited data



Legend

- Automated Meterolgoical Station
- Volunteer Meterology Station
- Streamflow Station
- Barge Landing Site
- Proposed Barge Route
- Water Courses
- Boundary
- Waterbody
- Glacier
- Redfern Claim Block





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Reviewed By:	GS	Prepared By:	JW
Date Issued:	August 2007	Project Number:	70142

Redfern Resources Ltd.

Proposed Barge Route Including Climate and Flow Stations

16 August 2007

Gartner Lee

Figure 3-1
Version 1

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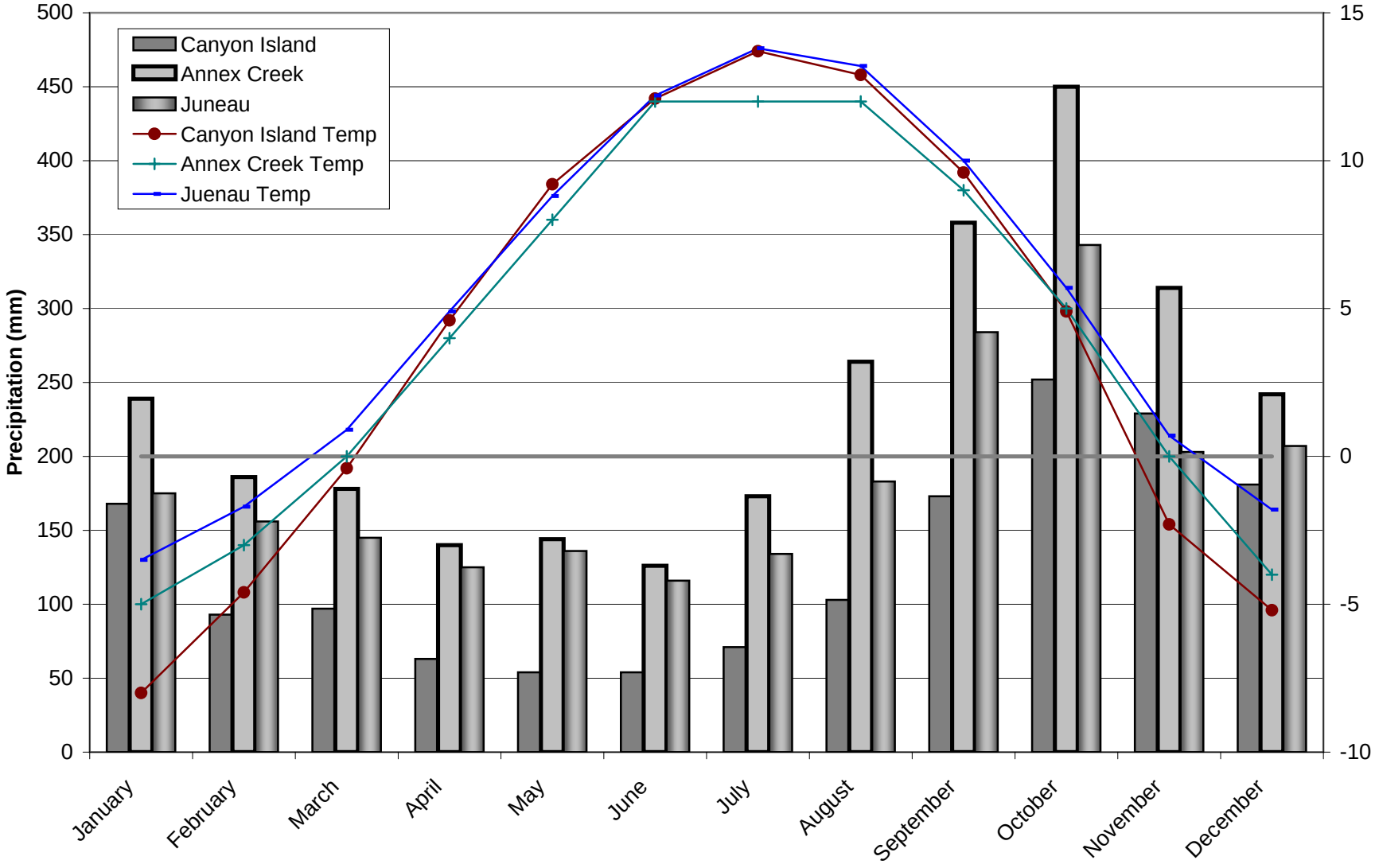
available in these areas the data from these stations have been used to provide an overview of the climate along the ACB route.

An additional climate station is located at Bishop Point on Taku Inlet, however it has generated only one year of published data (2006). Given its location in a well-protected area in Taku Inlet, data from Bishop Point is understood by locals to under-represent the strength of wind in the Inlet. Given its very short record length and known bias, data from Bishop Point, therefore, was not used in this analysis.

As is evident in Figure 3-1, the ACB route crosses from a coastal region around Juneau and Taku Inlet to a continental region as it moves upstream on the river. Typically, as the weather moves inland, total annual precipitation decreases. However, the Taku inlet and river act as a corridor through the Coast Mountains that brings heavy coastal precipitation much further inland than would otherwise be expected. The mean monthly precipitation at Canyon Island, Annex Creek and Juneau Airport are presented in Figure 3-2. Precipitation is highest at Annex Creek and precipitation at Juneau Airport is greater than that recorded at Canyon Island. The months of highest precipitation at all three stations are October and November. Snow accumulates from November to April and May is the month of greatest snowmelt as the mean temperatures are steadily above 0°C. It is also important to note that although the project is located at a relatively high latitude, the winter temperatures along the river are greatly influenced by the marine weather and are typically much warmer than what is typically found at a similar location that is not subject to coastal influence. For example, average winter temperatures for Atlin, BC, only 100 km northeast of the site are approximately 10°C lower than at the Tulsequah Chief site.

Snowfall is very high in the region. Juneau airport receives on average 0.5 m of snow per month over the winter months of December, January and February. A record year in Juneau, 1994, recorded over 5 m of snowfall. Typically at Juneau, at least half of the total annual precipitation is snow. Based on available climate data, it is estimated that on average only one day per month over the winter months will be without precipitation. Snowfall data reported for Juneau, AK by the National Climatic Data Centre is published with a warning that the data are erroneous and will be revised. Snow data at Canyon Island and Annex Creek is very sparse. Therefore, no further snow data analysis was possible.

Figure 3-2. Mean Monthly Precipitation (mm) and Temperature along the Taku River



3.1.1 Winds

3.1.1.1 Marine Section

The *Coast Pilot* for Stephen's Passage published by the National Oceanic and Atmospheric Administration (NOAA) (2007) reports north winter gales that sweep down Taku Inlet, often accompanied by blinding snowstorms. Periodically, in the winter between October and April, uncommonly strong northerly winds occur that often are followed by a period of severe cold. The Taku, winds as they are called, are caused by a northerly wind blowing over the Taku icefields down into the channel. According to the City of Juneau, these winds typically occur four times a year between October and April, and frequently exceed 40 m/s (144 km/hr). The City of Juneau estimates these winds reach hurricane strengths (>72 mph) every two years. The winds are the result of the combination of the unique topography of the Juneau area, the Gastineau Channel and the proximity of the Juneau Icefields as well as particular combinations of atmospheric conditions (Colman and Dierking, p. 63). The prediction of the occurrence of these winds is still under study. Given that the Gastineau Channel has a short northeasterly fetch, the Taku Winds create navigation hazards due more to the formation of superstructure ice than to high seas (Colman and Dierking, p. 49).

3.1.1.2 Lower Taku River

The Annex Creek weather station is operated by volunteers. Here the winds are dominated by the weather in Stephen's Passage. Wind data are sparse, with only prevailing wind direction reported. However, based on these data, winds tend to remain primarily in the southeast. Winds in December and January are predominantly from the north, and winds from May to August are predominantly from the south or southeast, however wind direction has relatively high variability and fluctuates between south, southeast and north over much of the year.

3.1.1.3 Upper Taku River

The winds on the Upper Taku River, between Tulsequah River and Taku Lodge, are difficult to characterize due to a lack of data. A volunteer weather observation station operated from 1938 to 1941 and was reinstated in 2003; however wind data has not been collected at the new station. Based on the sparse data available and anecdotal observations, the winds typically come from the northeast in the winter between November and March and from the southwest between April and October. These prevailing wind directions correspond to the orientation of the Taku River, with wind blowing downstream, coming off the mountains during the winter, and upstream from the ocean during the summer. Wind speeds are estimated between 35 and 45 km/hr (23 to 25 mph) in the winter months (pers. comm. Tom Ainsworth, NOAA, Juneau. August, 2007).

3.2 Taku River Hydrology

The Taku River watershed is gauged just downstream of the international border at a USGS station located at Canyon Island shown in Figure 3-1 (station *Taku River near Juneau)*. The gauge measures approximately 90% of the overall watershed discharge. The drainage area at the station is approximately 17,100 km^2 (Bigelow et al. 1995). The mean annual flow at the gauging station is 399 m^3/s ranging from an average low flow of 55 m^3/s in February to a high of 954 m^3/s in June (Neal 2007). The Taku drainage area is similar in size to the north or south Thompson Rivers, the Stuart River and the Nass River of British Columbia. However, glacier-fed rivers typically have higher streamflow/unit drainage area than other rivers and therefore the Taku may have higher average annual discharge volumes than these rivers.

The Taku River along the ACB route widens from approximately 200 m to up to 5 km wide at its mouth at Taku Inlet. Typical characteristics of the Taku River along the proposed ACB route include:

- sand and gravel substrate;
- many gravel bars and islands along the river channel;
- peak flows in June – July;
- ice cover begins in early December;
- under-ice conditions by end of December;
- ice break-up in April;
- periodic floods caused by glacial dam outbursts (1 to 3 times/year); and
- heavy sediment load.

3.2.1 Physical Description of the River Along the Proposed Route

As discussed previously, the proposed ACB route can be described in three sections: the marine route between Juneau and the Taku Inlet; the Taku Inlet section; and upstream of Taku Inlet to the confluence with the Tulsequah River where the ACB landing site is proposed. The route is shown on Maps 1 and 2.

3.2.1.1 *The Marine Route*

The marine route can be further divided into two sections: Gastineau Channel and the mouth of Taku Inlet to Annex Creek. The Gastineau Channel is a narrow channel with high mountains on either side. The channel trends northwest and is approximately 21 km long. Juneau is located approximately 13 km north of the southeast entrance of the channel. The tides flood northwest and ebb southeast with a velocity of 4 km/hr. Juneau and the Gastineau Channel are subject to maritime influences and are in the path of many of the storms that cross the Gulf of Alaska. The mountains cause differences in weather over relatively short distances. According to the NOAA *Coast Pilot* (2007) for the region, southeast gales may occur in the vicinity of Juneau at any time of year, but are more frequent in the winter. As discussed, the channel is subject to the Taku Winds that occur periodically between October and April and can reach hurricane force.

The Taku Inlet trends mainly northeast by southwest. The inlet is much wider than the Gastineau Channel and approximately 24 km long from Bishop Point at the south end of the Gastineau Channel to the Taku Glacier. For the first 14.5 km from Bishop Point to below Jaw Point the inlet is quite deep and easily navigable. The channel is roughly 5 km wide at Annex Creek.

3.2.1.2 Taku Inlet

The Taku Inlet extends from Annex Creek to Taku Lodge through an area locally referred to as the Taku sand flats. The Taku Inlet narrows from approximately 5 km to 1 km and becomes shallower between Annex Creek and Taku Point. Large amounts of sediment are continuously deposited within this reach, as the river moves from a high energy system to a lower energy system. The deposits form sand bars and sand flats, which continuously migrate downstream. This reach is very shallow, with average depths ranging from less than 1 m to 3 m and poses a significant challenge to navigation. However, this reach is also influenced by the tides that ebb and flood the Taku Inlet. Tidal influences are highest downstream and lessen upstream so that at Taku Lodge, only high tides are noticeable. Volume 1, Appendix A summarizes the effects of the tide on this section of the river based on two hydrographic surveys conducted on the river in 1995 and 2007.

The three most significant conclusions from these hydrographic surveys are:

1. when the Taku River discharge is 700 m^3/s or greater the river is completely navigable;
2. when the Taku River discharge is 500 m^3/s and there is a low tide one section of the river at the downstream end of “Hole in the Wall Glacier” is shallower than 0.6 m (2 feet). Under such conditions, a shallow draft tug could not successfully navigate this segment of the river. Also, there is a second “pinch point” at Taku Lodge, where the channel of adequate depth is very narrow; and
3. when the river discharge is 500 m^3/s but the tide is greater than a mean tide at Juneau (2.4 m or 8 ft), the tidal influence on water levels in the river makes the section at Hole in the Wall Glacier navigable.

A frequency analysis of Taku River streamflow during the open water season is presented in Figure 3-3. During the open water season (April 1 to November 30), streamflow at Canyon Island exceeds or is equal to 700 m^3/s less than 25% of the time, and greater than 500 m^3/s 50% of the open water season.

The tides at Juneau are semi-diurnal, which means there are two tides within a 24.8 hr time period. Each tide has a high water level and a corresponding low water level; therefore in a semi-diurnal cycle there are two high-water events and two low-water events per 24.8 hr period. At Juneau the tides are not exactly the same level. For example, while there is high water twice a day, this high water level is not exactly the same. Instead there is a high-high water and a low-high water, similarly there is a high-low water and a low-low water, each day.

3.2.1.3 Taku River

The Taku River between Taku Lodge and the Tulsequah River confluence is approximately 1 km wide at the bottom of the reach and narrows to approximately 300 m wide at the confluence. The river comprises a main channel with a few side channels or braids along its banks. Here the river stage is driven only by streamflow with no effects from tides. The effects of the jökulhlaups from the Tulsequah glacier are probably most noticeable as this section of the route is the narrowest.

3.2.2 Taku River Streamflow

As mentioned previously, streamflow data on the Taku River is collected by the United States Geologic Survey (USGS) at Canyon Island. The annual average hydrograph is presented in Figure 3-4. The river peaks in June in response to snowmelt, beginning in April and increasing into June. The river, which rises from baseflow conditions to peak flows in two months (April to June), takes approximately four or five months to return to baseflow conditions (July to November). *This long falling limb* is fairly typical of glacially driven rivers. Ninety percent of the river's total annual discharge occurs in between May and November (Neal 2007). Figure 3-4 summarizes the monthly average streamflow in the Taku River near Juneau (Canyon Island).

Because the average annual hydrograph does not provide the illustration of the river's response to specific events, Figure 3-5 is provided as a representative annual hydrograph of the river. Figure 3-5 is the hydrograph of the Taku River in 1996 and 2004 as these years represent a relatively low water and a relatively high water year. Over the course of the winter, most of the watershed is under a thick layer of snow. Areas of groundwater discharge continue to contribute streamflow to the Taku River, which maintain an average baseflow in the Taku River of approximately 40 m^3/s. According to streamflow records at Canyon Island, ice forms on the river in November and under-ice conditions begin in early December and are constant by the end of December. Break-up occurs in early April. Taku River hydrographs are the peak flows that result from the glacial dam outburst, otherwise known as a jökulhlaup that occur at two glacial lakes at the Tulsequah Glacier. Two lakes, Tulsequah Lake and Lake No Lake, are dammed by the Tulsequah Glacier; once or twice a year these glacial dams fail and a large flood wave of water rushes down the Tulsequah River and into the Taku River. The magnitude of these floods is high enough to affect the streamflow records of the Taku River.

Figure 3-3. Exceedence Frequence of Streamflow in Taku River
(Open Water Season April 1- November 30)

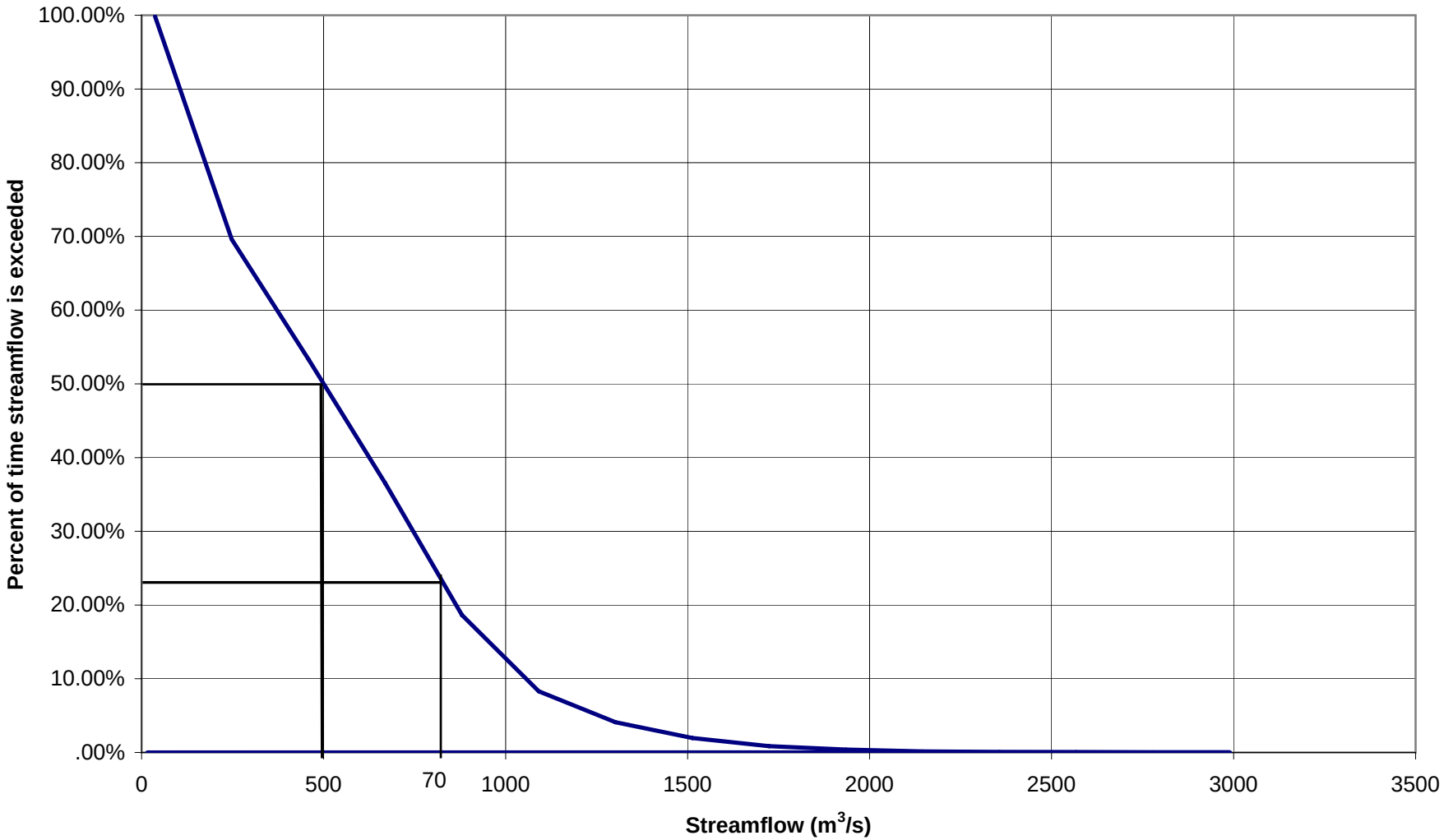


Figure 3-4 Average Annual Hydrograph of Taku River
(USGS Station: Taku River near Juneau)

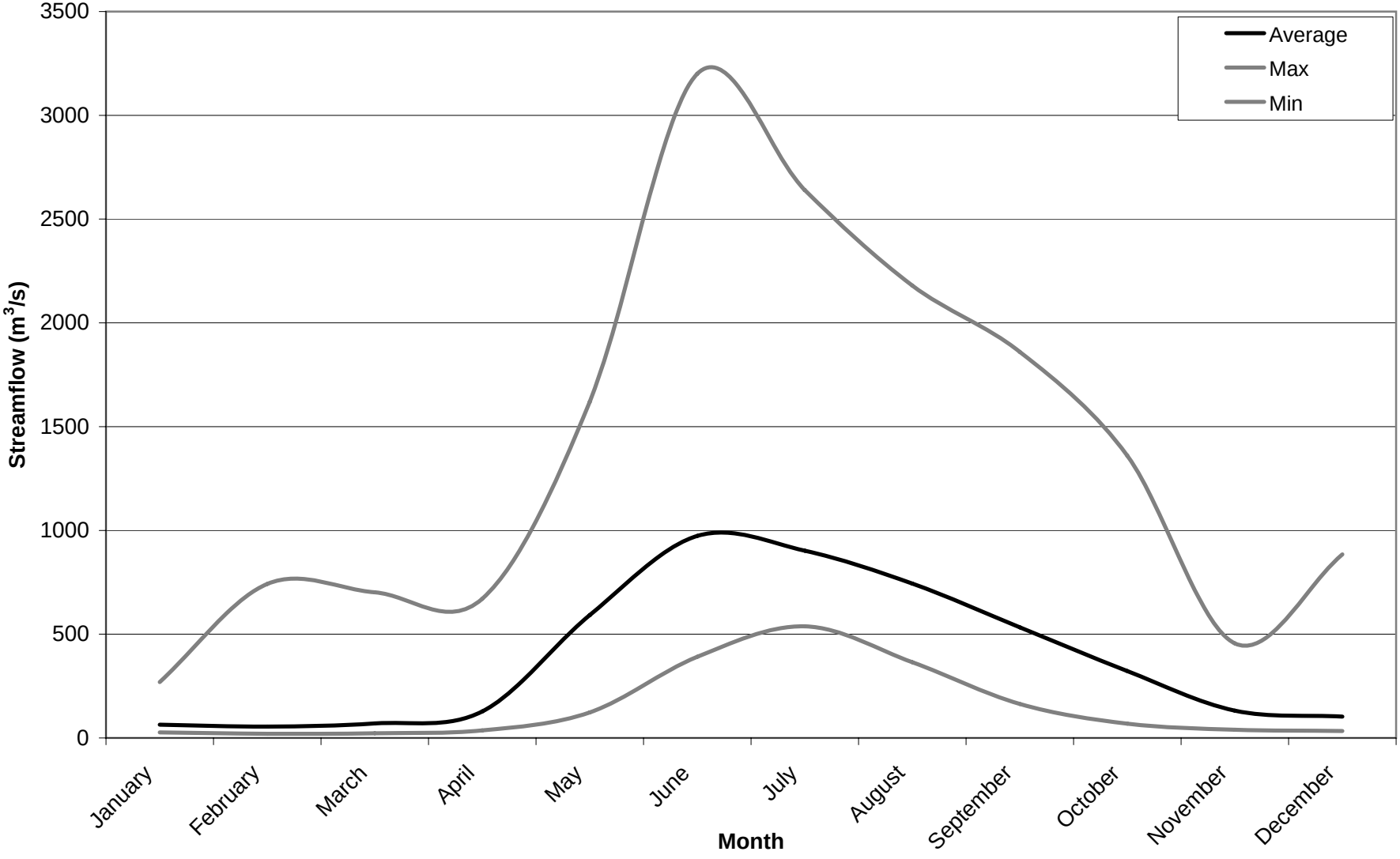


Figure 3-5 Representative Annual Hydrogprahs of the Taku River (1996 and 2004)

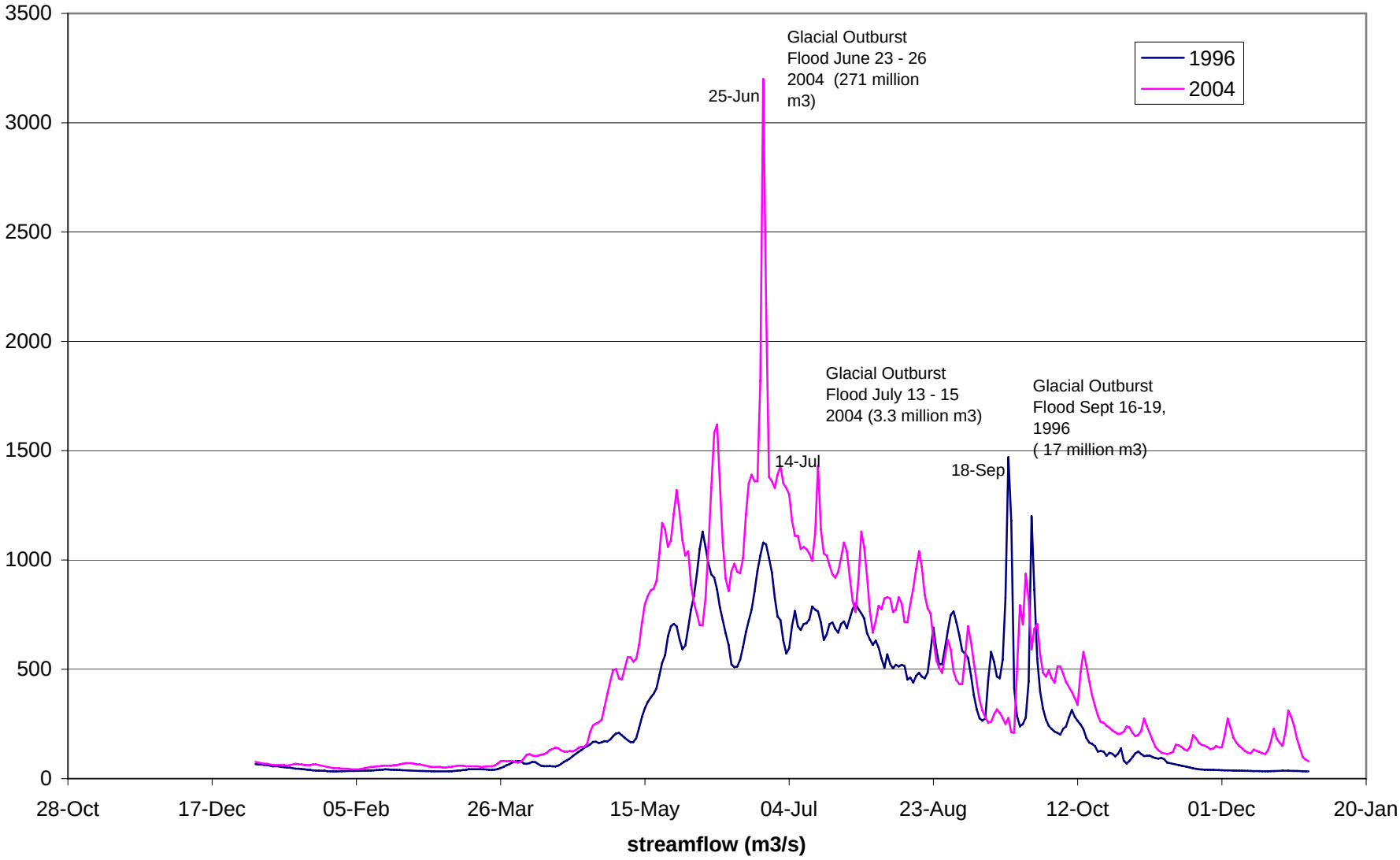


Table 3-2. Average Streamflow in the Taku River near Juneau (Canyon Island)

Monthly	Average Streamflow (m^3/s)
January*	66
February*	54
March*	71
April	121
May	571
June	971
July	908
August	750
September	539
October	331
November	134
December*	104

*Note: * under-ice conditions*

3.2.3 Floods

The USGS have set flood stages for the Taku River near Juneau as outlined in Table 3-3. The flood categories are determined based on risk and potential damage and are defined by NOAA as follows:

- **Minor Flooding** – minimal or no property damage, but possibly some public threat or inconvenience
- **Moderate Flooding** – some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- **Major Flooding** – extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

Table 3-3. USGS Flood Categories and Stage Levels at Taku River near Juneau

Flood Category	River Stage (m)
Major Flood Stage	13.72
Moderate Flood Stage	13.41
Flood Stage	13.11
Action Stage	12.80

Table 3-4 lists historical water levels on the river and the corresponding daily average streamflow for that day.

Table 3-4. Peak Stage and Streamflow on Taku River near Juneau

Date	Stage (m)	Streamflow (m^3/s)
6/25/2004	13.74	3200
7/22/2007	13.47	N/A
8/17/1989	13.45	2180
7/30/1994	13.37	2420
7/26/2000	13.34	2640
7/26/1995	13.18	2320
7/28/1993	13.07	1990
6/7/2007	13.01	N/A

Many of these peak flows are a result of jökulhlaups on the Tulsequah River and last for only a few days, and occur in the summer, although the river typically peaks in June during freshet (Figure 3-4).

3.2.4 Sediment Load

Glacier-fed rivers such as the Taku are characterized by their high sediment loads and are heavily braided. The Taku is characterized by many diverging channels that split around unvegetated gravel bars within the main floodplain. The heavy sediment load results in a constant deposition of silt and sand that builds into bars. The river pushes these bars slowly downstream. This can be seen by comparing the tide charts based on 1937 data to today's conditions. The water levels at Taku Point have actually risen 2.5 m since the 1930s due to the increasing elevation of the streambed. This is a common geomorphological process and occurs at most river deltas. The heavy sediment load combined with the high flows of the Taku River and the frequent very high flows from the jökulhlaups' push, pick up and drop all this sand, silt and gravel into new channels, reshaping them constantly. As a result, bathymetric surveys and water depths are difficult to predict based on past data. However, despite these constantly changing channels, there is often some consistency to some river features. The sandflats, encompassing the area between Taku Point and Taku Lodge, historically have been the shallowest reach of the river, and pose navigational challenges for all river users, depending on the river discharge and tidal influence at any given time.

3.2.5 Water Quality

The Taku River is glacial fed and normally carries a high load of suspended sediment. The available data for total suspended sediment (TSS) and turbidity (NTUs) have been collected by the United States Geological Survey (USGS) (see: http://nwis.waterdata.usgs.gov/ak/nwis/qwdata) and Redfern (1995). Table 3-5 provides a summary of the data that was available from those two sources. The data reported in Redfern (1997) showed that TSS levels that exceed 100 mg/L were typically recorded when water flows exceeded 700 m^3/s. The highest recorded TSS level was

280 mg/L. The data reported by the USGS from August 2003 indicated TSS levels of around 40 mg/L at flow levels that exceeded 1,000 m^3/s.

The USGS has recently released a reported entitled "Hydrology and Glacier-Lake Outburst Floods (1987-2004) and Water Quality (1998-2003) of the Taku River near Juneau, Alaska" (2007). The report provides a summary of water quality in the Taku River and the authors note that metal concentrations appear to be correlated with suspended sediment.

Table 3-5. Total Suspended Sediments and Turbidity Data for the Taku River

Date	TSS	NTU	Discharge m^3/s (mean, daily from USGS)
17-Aug-94	190	200	884
24-Aug-94	79	87	705
31-Aug-94	120	92	702
7-Sep-94	42	66	368
17-Sep-94	73	85	697
21-Oct-94	38	48	334
30-Oct-94	24	25	234
6-Nov-94	13	11	174
12-Nov-94	9	13	159
19-Feb-95	7	1.5	45
1-Mar-95	1	1.8	47
8-Mar-95	3	1.7	48
15-Mar-95	1	0.8	51
22-Mar-95	4	1.9	64
28-Apr-95	160	100	295
17-May-95	120	138	818
17-May-95	19	24	818
16-Jun-95	280	230	688
12-Jul-95	250	270	867
18-Aug-95	52	47	496
15-Sep-95	44	210	733
16-Feb-96	1	1.7	42
25-Mar-96	5	3.6	44
25-Apr-96	57	47	148
5-Apr-97	1	1.7	70
9-May-97	1	2	343

3.3 Aquatic Resources

For the purposes of the aquatic resources section, the primary project study area is considered to be Taku Inlet and the Taku River, primarily from its mouth to the proposed ACB landing site just up stream of the Tulsequah – Taku confluence at the southwest end of Big Bull Slough.

There is also a terrestrial component of this project, which is to upgrade the exploration road from the ACB landing site to the south limit of the originally approved Tulsequah Chief minesite, the limestone quarry. This road will have to cross several small streams that are tributaries to the Tulsequah River.

3.3.1 Fish and Fish Habitat

The Taku River is one of the more important transboundary rivers crossing between BC and Alaska that supports a diverse mix of fish species and large runs of commercial salmon species fished both by Canadian and American Native, commercial, subsistence and sport fishers. The Taku River has roughly 24 fish species, of which 23 may be present along the purposed ACB route.

Table 3-6. Fish Species Present in Lower Taku Watershed

Species	Presence/Primary location
Arctic Grayling	Present – upper watershed
Green Sturgeon	Unknown – estuary
Threespine Stickleback	Present – estuary lower Taku
Pacific Lamprey	Present – estuary - lower Taku
Longfin	Present – estuary
Eulachon	Unknown – lower Taku
Coastrange Sculpin	Present – lower Taku
Shad (exotic species)	Present – estuary
Prickely Sculpin	Unknown – lower Taku
Pink Salmon	Present – throughout
Coho Salmon	Present – throughout
Sockeye Salmon	Present – throughout
Chinook Salmon	Present – throughout
Chum Salmon	Present – throughout
Rainbow Trout	Present – throughout
Steelhead Trout	Present – throughout
Cutthroat Trout (resident and anadromous)	Present – throughout
Dolly Varden (resident and anadromous)	Present – throughout
Longnose Sucker	Present – throughout
Slimy Sculpin	Present – throughout
Round Whitefish	Present – throughout
Bull Trout	Present – upper watershed
Burbot	Unknown – upper watershed

Note: DFO and TRTFN 2003

Several species in this table are listed by the Province of BC's conservation data centre as red or blue meaning they are either rare or threatened species. These include the Green Sturgeon as red listed, Eulachon, Bull trout and Dolley Varden are blue listed. Red listed species are extirpated, while blue listed are endangered or threatened.

3.3.1.1 Green Sturgeon

Information about green sturgeon is limited. Clifford et al. (1967) reported that Green Sturgeon have been taken off the mouth of the Taku River. While little is known about the details of the life history of this fish, they live predominately in the marine environment at the mouths of large rivers and move up river during the spawning season (Clifford et al. 1967).

3.3.1.2 Eulachon

Eulachon (*Thaleichthys pacificus*) are anadromous fish of the smelt family. Eulachon live out much of their lives at sea but spawn in the lower reaches of rivers, just above the salt water in sandy river reaches. Eulachon broadcast spawn in flowing water, and the adhesive eggs that then attach to sandy substrate. Eggs hatch in 30 to 40 days at temperatures of 4.4 to 7.2°C (Hart, 1973). Immediately after hatching, larvae drift downstream into the estuarine habitat, which is thought to be critical to larval and juvenile eulachon, which then migrate to the sea when large enough to do so.

There is limited published literature on the eulachon population that uses the Taku River. Staff from the ADF&G (pers. comm.) have suggested that spawning occurs in the lower sections of the Taku River near Taku Inlet all the way upstream to Canyon Island. Observations by local residents suggest that the eulachon spawning may be occurring between Barrel Point and Yehring Creek. Spawning upstream of Yehring creek is likely limited because river substrate becomes increasingly gravely. The Juneau State Land Plan indicates eulachon spawning in sand flat areas proximal to the main stem of the river (see Figure 3-6). Specifically, the Land Plan indicates eulachon spawning in areas 14a44 and 14a55: these areas are generally consistent with the areas described previously. The Land Plan does not indicate eulachon spawning in the main stem river areas (area 14a40).

A study of eulachon in Berners Bay, 65 km north of Juneau, by Marston et al. (2002) reports that eulachon in that area spawn in early May and are usually complete by mid-May. Given the proximity to the Taku River, a similar spawn timing is expected. Eulachon are an integral component of the food chain in the Taku Inlet and River during spawning periods by providing high value food for seals, sea lion (Csepp et al. 2006), green sturgeon, sea birds, eagles, etc. Eulachon spawning upstream of the Taku Inlet would most likely be associated with areas of moderately shallow sands, as the eggs tend to anchor to sand grains.

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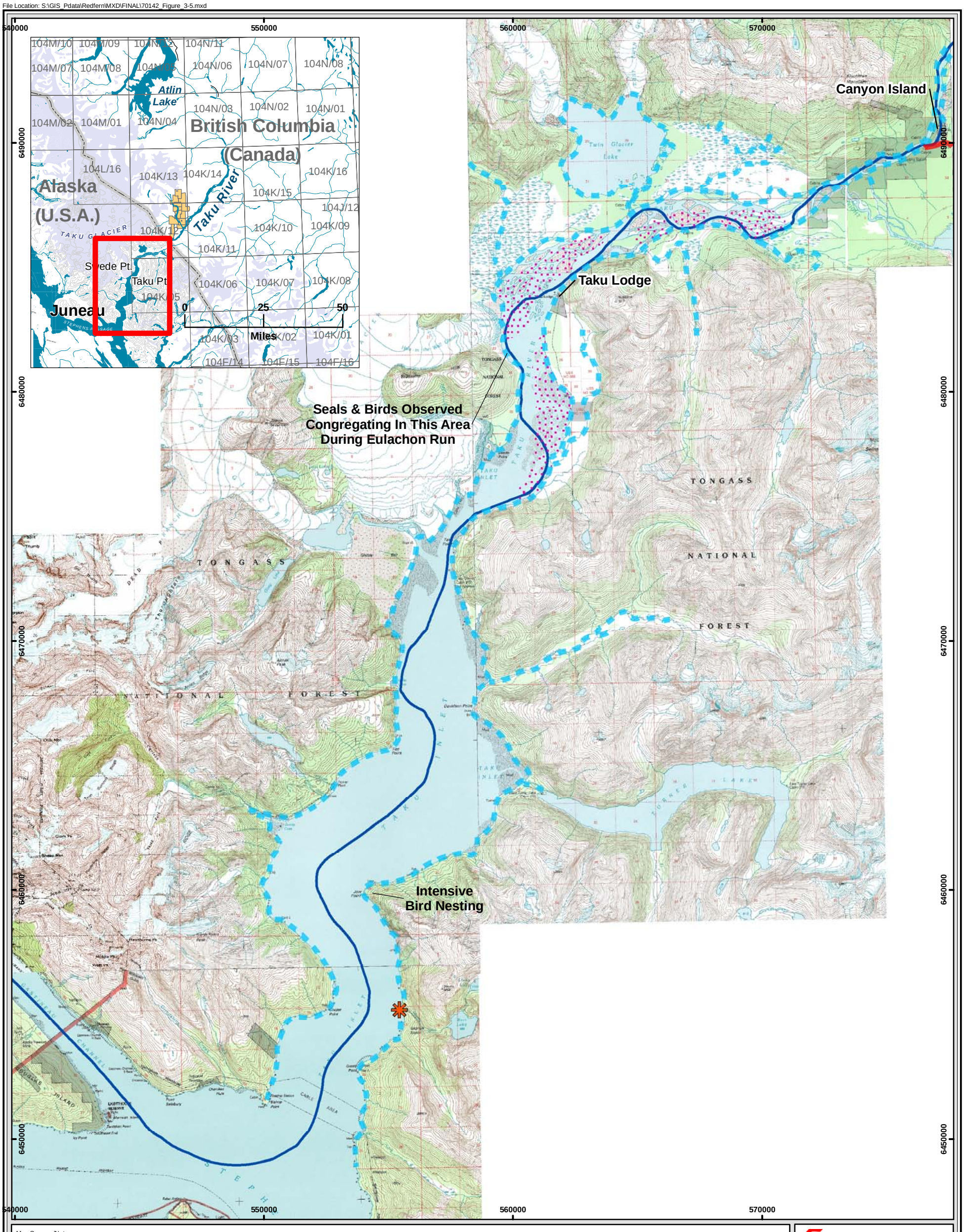

Map Sources/Notes:
- Topographic Images derived from Digital Raster Graphic (DRG) Images produced by the USGS
- Aquatic Resources information digitized from hand-drawn sketches

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UTM Zone 8N, NAD 83

File Name: 70142_Figure_3-5.mxd

Reviewed By: FP
Date Issued: August 2007
Prepared By: JW
Project Number: 70142

Legend

- Proposed ACB Transportation System Route
- Sea Lion Haul-Out
- Known Fish Presence - Use Unspecified
- Known Salmon Spawning
- Generalized Eulachon Spawning Areas from Juneau State Land Plan

Redfern Resources Ltd.

Generalized Aquatic Resources of the Taku River, Alaska

28 August 2007

Gartner Lee

Figure 3-6
Version 1

3.3.1.3 Pacific salmon

All five pacific salmon spawn in the Taku River and make extensive use of the tributary streams and river. Table 3-7 provides a summary of the escapement number and timing of various life history components in the Taku River.

Table 3-7. Summary of Pacific Salmon Populations in the Taku River

Species	Spawning Timing	Out Migration Timing	Average Escapement	Possible Mainstem Spawning
Sockeye	July – October	Late May-June after 1 or 2 years rearing	349 000 (2000 & 2001)	Yes
Chinook	Late July – September	Late April-June after 1 or 2 years rearing	42 500 (2000 & 2001)	Yes
Coho	Mid August – November	Possibly mid April-mid June after 1 or 2 years rearing	93 000 (2000 & 2001)	Unknown
Pink	August – November	Shortly after spring hatch	Roughly 23 000 (1998, 99, 2000, 2001)	Unlikely
Chum	Mid September –November	Shortly after spring hatch	No estimates of escapement available	Yes

3.3.1.4 Sockeye

Sockeye salmon (*Oncorhynchus nerka*) typically spawn in association with lakes that are used by young for rearing, however, studies of the Taku River stocks suggest that 63% of the escapement spawns in habitats in association with the mainstem such as side-channels, back-channels, sloughs and upwelling basins (Filer et al. 1988). The other 37% spawn in associations with the major lakes found near the headwaters of the Taku Watershed: Little Trapper, Tatsamenie, King Salmon and Kuthai Lakes). The majority of Taku sockeye return as four year olds.

On average (1984 – 2004) 125,523 sockeye are harvested from the Taku River: 99,510 from the US side and 26,523 from the Canadian side (Andel and Boyce 2007). The sustainable escapement goal to Canadian spawning areas is between 70,000 and 81,000 sockeye. Between 2000 and 2005 the estimated escapement ranged from 75,000 to 160,000 (Der Hovanisian and Geiger 2005) suggesting that the management objectives for sockeye stocks in the Taku River are being met.

3.3.1.5 Chinook

Chinook salmon (*Oncorhynchus tshwaytscha*) spawn throughout the Taku River watershed with the majority of spawning in clear water tributaries upstream of the Tulsequah River. This Chinook stock is considered a spring run, first entering the fishery in late April and spawning from late July through September. The majority of juveniles leave the system as 1 year old fish and rear in the

marine environment for one to five years with most spending 2 to 4 years in the ocean before returning to spawn.

Through the mid 1970s and the 1980s, significant restrictions were put on the commercial and sport fishery for Taku River Chinook salmon due to low numbers of wild fish. The Alaskan commercial fishery for Taku Chinook salmon was closed from 1975 to 2004. The drift net fishery above the Canadian border continued during this time. Considerable research was carried out and spawning escapement goals of between 30,000 and 55,000 was proposed by McPherson et al. (2000). McPherson (2005) reported that escapement has consistently met or exceeded the goal each year since 1985 (except for 1999 when escapement was estimated at 19,734 fish), however, total returns have only increased to sufficient numbers to allow the Alaskan commercial fishery to take Chinook in 2005. Based on escapement numbers, Chinook stocks in the Taku River seem to be relatively healthy subject to continued management of the commercial fishery.

3.3.1.6 Coho Salmon

Coho salmon (*Oncorhynchus kisutch*) have been described as “opportunistic” in their selection of spawning sites (Sandercock 1991) as they are found in small headwater streams, side channels and main channels of large rivers. There is limited information on specific spawning locations in the Taku River watershed but they are known to spawn throughout the watershed. Eiler et al. reported in Yanusz (2000), estimated that 22% of the coho stock spawning in the Taku River spawn below the Canada-US border.

The spawning escapement goal of Taku coho has been set at 38,000 fish. The goal has been met and generally exceeded since 1998 in spite of increased fishing effort (Shaul et al. 2005). This escapement produces between 100,000 and 300,000 adult fish that contribute to commercial, sport and subsistence fisheries both in the marine waters off the Taku River and within the Taku River. The coho stocks in the Taku River appear to be in a healthy condition.

3.3.1.7 Pink Salmon

Pink salmon (*Oncorhynchus gorbuscha*) appear to spawn in the Tulsequah River and near the upper tributaries of the Inklin and Nakina (TRTFN 2003). Details on spawning habitat preferences for Taku River pink salmon have not been reported. Pink salmon have a 2-year life cycle and most systems have a dominant cycle. Prior to 1994, odd-year escapements appeared to be dominant. However in 1994 the even-year cycle had higher returns due to failure of the odd-year return the previous year. By 1998 and 1999 returns began to even out with the odd-year group showing recovery from the 1993 crash and the even-year counts showing an increasing trend since the mid-1980s (TRTFN 2003).

3.3.1.8 Chum Salmon

The native chum salmon (*Oncorhynchus keta*) population of the Taku River exist as either summer run chum, which spawn from July to September, or fall run chum, which spawn from September to

November. Fall chum spawning habitat is quite specific as it is associated with areas that retain warmer temperatures into winter, such as zones of upwelling groundwater. Significant spawning along the Taku River has been documented in King Salmon Flats and has been noted by various sources near Yellow Bluff, and possibly in Flannigan Slough as well as several tributaries to the Taku River (Eiler et al. 1988).

Studies to specifically determine accurate estimates of chum escapement to the Taku River have not been undertaken. Der Hovanisian and Geiger (2005) reported that the harvest of Taku River fall chum salmon dropped from an average of 54,000 fish in the 1970s and 1980s to around 4,200 fish over the past 10 years. While no specific cause for the decline has been identified, Heinl, (2005) suggested factors such as natural changes in spawning habitats, over-fishing, interactions with other species of fish and interactions with the increased production of hatchery fish as possible causes.

3.3.1.9 Stealhead Trout

The anadromous form of the rainbow trout (*Oncorhynchus mykiss*) is a popular sport fish found in the Taku River. Steelhead populations typically enter the river as either a winter run or summer run and spawn in early spring before migrating back out to sea. Current information suggests that Steelhead spawn throughout the Taku system but are more likely to be found upstream of the Canada/US Border with a preference for the larger tributaries (TRTFN 2003).

Important Habitat in the Taku River

Within the project study area there are important habitats that provide spawning and rearing habitat and feeding areas for resources such as Pacific salmon and eulachon. The following habitat areas have been identified:

a) the mud flats from the mouth of the Taku Inlet up to approximately Barrel Point;
b) the section of the Taku River from the mouth to Canyon Island where eulachon likely spawn;
c) the mouths of tributary streams where salmon likely congregate and spawn, in particular the mouth of Fish Creek on the east side of Canyon Island, and Bacon Creek flowing out of Flannigan Slough; and
d) side-channels and back channels off the Taku River as they can be used by various salmon species for spawning.

The Fish Creek area is an important area containing pools that appear to be fed by groundwater upwelling. This area often stays unfrozen throughout the winter months. The upwelling also provides favourable spawning habitat for certain species. ADF&G officials have indicated that sockeye and coho are known to spawn at this location in small numbers, with increased spawning occurring further up Fish Creek, away from the Taku River mainstem. Chum (summer and fall), Chinook and steelhead have not been noted to spawn at this location (pers. comm. Jim Andel, ADF&G, Douglas).

3.3.2 Aquatic Resources Associated with Haul Road to ACB Landing Site

Redfern is currently constructing a temporary access road from the Tulsequah Chief Minesite to the Big Bull minesite under a mineral exploration Notice of Work. When the Tulsequah Chief Mine goes into operation this road will be upgraded to standards required for a haul road to transport the shipping containers from the ACB landing site to the minesite.

For the purposes of this review, the section of the haul road to be considered runs from the Limestone Quarry to the ACB landing site. The section of road north of the Limestone Quarry to the minesite was reviewed and approved in the current Project Approval Certificate. The proposed alignment is shown on Map 1 and indicates that six creeks will be crossed. Redfern commissioned stream crossing assessments along this segment of road which confirmed that all the crossings exist above significant fish passage barriers. At the vicinity of the road crossings all streams have a steep, greater than 20%, gradient. All crossings are above the upper extent of fish use in these creeks.

The ACB landing site is located just upstream of the confluence of the main channel from the Big Bull slough and the Taku River. The area is part of a large flat area created by river deposition at the confluence of the Taku and Tulsequah Rivers. The general area includes relic channels and channels that carry water only during high water conditions during the summer. These backwater channels would be used by juvenile salmonids for rearing when there is sufficient water. The layout of the landing yard has been designed to minimize impact to channels that appear to carry water (based on observation of the freshet flood flows in June 2007). Figure 3-7 shows the general layout of the ACB landing area. Note that it is constrained by a pond outlet creek to the south and a backwater channel to the north. The actual footprint will not be known until final design and there is a possibility that the backwater channel will need to be filled in to accommodate the ACB landing yard. The infilling would impact no more than 100 m of the channel that is 10 m wide for an estimated impact of up to 1,000 m^2 of backwater habitat. The likely compensation for this impact would be to reconstruct a channel around the landing area to maintain the connection with the remaining channel during high water conditions.

3.3.3 Marine Mammals

There are a number of marine mammal species with ranges that cover the Taku Inlet area within southeast Alaska. The National Oceanic and Atmospheric Administration (NOAA) stock assessments from 2006 (Anglis 2006) indicated that the following species are found in southeast Alaska.

Table 3-8. Species and Timing of Marine Mammals in SE Alaska

Species	When found in SE Alaska
Steller sea lions (eastern stock)	Year round
Harbour Seals (SE Alaska stock)	Year round
Killer whales	Year round, but some stocks are transient
Pacific White-sided Dolphin	Year round
Harbour Porpoise (SE Alaska stock)	Year round
Dall's Porpoise (Alaska stock)	Year round
Gray Whale (eastern north Pacific stock)	Have been seen feeding in SE Alaska in the summer months
Humpback Whale (Central north Pacific stock)	Summer and fall

The eastern stock of Steller sea lions is currently listed as "threatened" under the *Endangered Species Act* and as "depleted" under the *Marine Mammal Protection Act*. However, the stock is considered stable and has increased slightly in southeast Alaska in recent years. In efforts to gain more specific information on which species are likely to be found within the study area, University of Alaska researcher Beth Mathews was contacted. Mathews had conducted a literature review in 1996 that resulted in no specific information found on marine mammals in Taku Inlet (personal communication, Beth Mathews).

The Juneau State Land Plan (1993) indicates that the lower section of Taku Inlet may include a sea lion haul out. The plan indicates that the haul out supports less than 200 animals, the minimum number that is required for the site to be identified as a designated haul out by the National Marine Fisheries Service. However, the Plan still identifies that the protection of the haul out area is a concern.

3.4 Terrestrial Resources

3.4.1 General Methodology

Rescan Environmental Services Ltd. (Rescan) in their Tulsequah Chief Project Report (Rescan 1997) provided much of the terrestrial resources information reviewed in the British Columbia portion of the study area. In addition to the Rescan information, a variety of additional sources of background information on terrestrial resources was obtained and reviewed for the proposed ACB transportation route, ACB landing area and access road to the ACB landing area. The purpose of the review was to determine the existing conditions and to identify potential gaps in information. When gaps in information were identified, efforts were made to obtain additional or updated information from government or other sources. These gaps were mostly associated with the Alaskan side of the Taku River and Taku Inlet, as this area was not covered in the previous Environmental Assessment of the project. In many cases, information was obtained from existing documents from the ADF&G, the US Fish and Wildlife Service (USFW) or through conversations with ADF&G and USFW personnel.

3.4.2 Terrain and Soils

3.4.2.1 Methodology

In addition to the generalized methods outlined above, additional Terrestrial Ecosystem Mapping (TEM), which included terrain assessment and soils mapping components were conducted in 2007. This mapping and associated field assessments were conducted in support of the permitting process to provide information on ecosystems and soils within areas that will be directly affected by the approved proposed infrastructure development (e.g., tailings areas, airstrip and proposed roads). These field assessments included within Shazah Creek and the mid-Tulsequah River areas. Additional 1:10,000 scale TEM was also conducted along the proposed access route to the ACB landing site and at the ACB landing site following the BC Resources Information Standards Committee (RISC) methodologies.

3.4.2.2 Results

The majority of the information obtained for the review of terrain and soils was obtained from the ecosystem mapping reports from JMJ Holdings Ltd. (Marcoux 1997) and terrain reports from J.M. Ryder and Associates (Filatow 1998). Additional information from the field assessments conducted in June 2007 and an avalanche assessment of the road completed by Chris Stethem & Associates Ltd. (2007) were also reviewed.

ACB Landing Area

The proposed ACB landing area is located on an alluvial plain at the confluence of the Tulsequah and Taku Rivers (see Figure 3-7). The plain is generally 0 to 1 m above the Taku River level, depending on river stage, and is subject to periodic flooding associated with floods on the Taku River. The ACB landing site itself is bounded to the north by “Maple Ridge”, and to the south and east by a large side channel of the Taku River, which drains Big Bull Slough. To the northwest of the ACB landing area a small pond and wetland complex are located, with a small stream that forms an outlet from the pond along the west side. The proposed ACB landing area has a seasonal back channel to the north that is flooded during summer high water events.

The floodplain soils at the ACB landing area are very young and comprised of mainly fine sand and silt overbank deposits over fluvial sand and gravels. Due to the substrate materials, the floodplain soils are generally rapidly to very rapidly drained brunisols and regosols with thin (<5 cm) or absent organic horizons and poorly developed or absent elluvial (Ae) horizons. Floodplain areas that were inundated or had a high water table were poorly to very poorly drained sandy to fine-sandy gleysols of fluvial/glaciofluvial and lacustrine parent materials. Poorly drained floodplain soils had very thin (<3 cm) or absent organic horizons and no true elluvial (Ae) horizons.

Figure 3-7. Proposed ACB Landing Site

Haul Road Extension

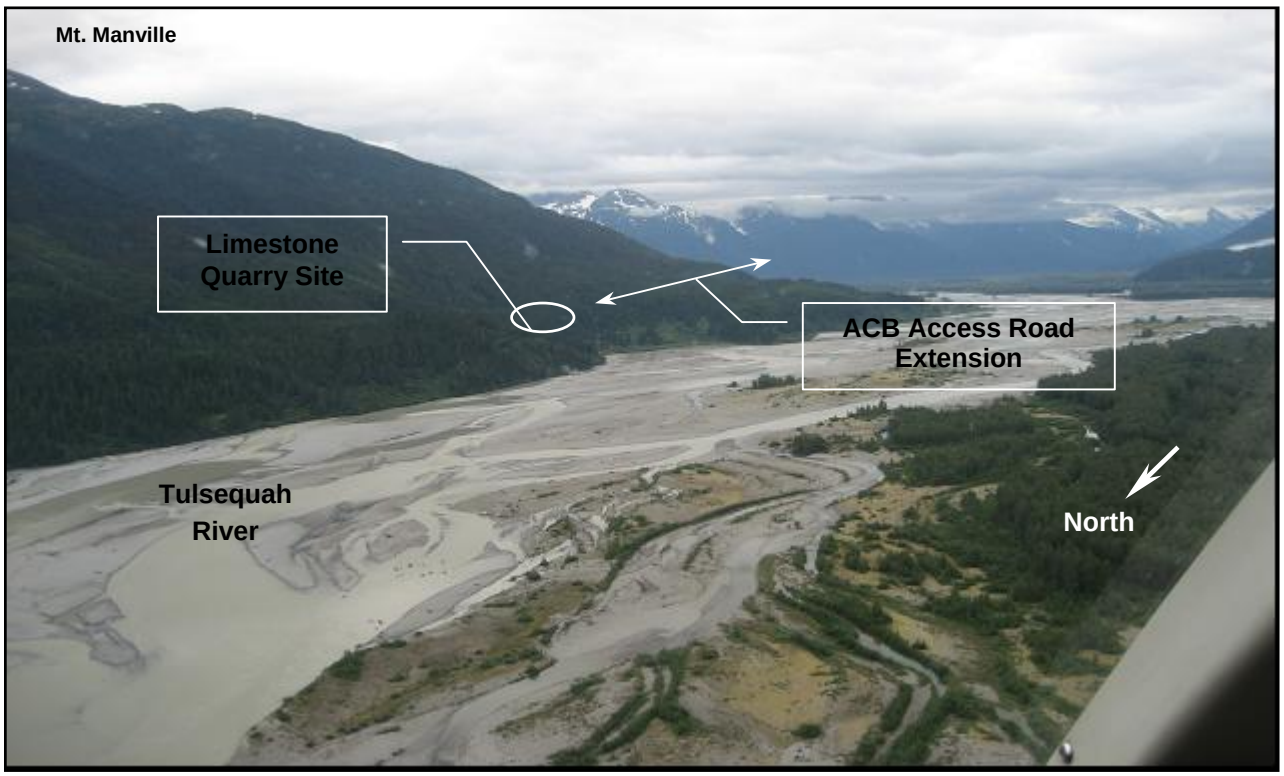
The first 3.5 km of the haul road follows Maple Ridge northwest towards the minesite. From this point northward to the Limestone Quarry, the road traverses the lower slopes of Mt. Manville, running parallel with the Tulsequah River. From km 3.5 the road climbs to a broad bedrock bench (see Figure 3-8) approximately 125 m above the Tulsequah River floodplain. At kilometre 7 the road starts to descend from this bench, crossing Windy Creek and joining the Limestone Quarry road at kilometre 9.

Maple Ridge is composed of well-drained, clean glaciofluvial gravel and is believed to be a remnant of a lateral moraine and/or glaciofluvial outwash plain. Terrain between Maple Ridge and the Limestone Quarry is generally a thin veneer of till and colluvium over bedrock. Steep side slopes are traversed by the road between kilometre 3.5 to 6 and kilometre 7 to 9. These areas were classed as potentially unstable terrain and a terrain stability field assessment has been completed for these segments of the mineral exploration road. The terrain stability field assessment provides

road design and operation considerations that are included in the road design to ensure the terrain stability of the road through areas that are potentially unstable.

Soils on Maple ridge are very thin (<5 cm), overlying the gravels that make up Maple Ridge. Organic soils along the proposed access road from Maple Ridge to the limestone quarry are predominantly thin (1 to 10 cm), although some areas have soil depths that may reach 15 to 20 cm. Soils in this area are young and mainly sandy and angular/subangular cobbly colluvial materials. Lower mountain slope soils are moderately well to rapidly drained brunisols and podzols that have good soil profile development with thick organic horizons and moderately developed elluvial (Ae) horizons.

Figure 3-8. Haul Road Looking Downstream on Tulsequah River



Taku River ACB Transportation Route

The proposed ACB transportation route along the Taku River in BC and Alaska are all fluvial plain materials primarily from the Taku and Tulsequah Rivers. Although field assessments were not conducted along the Taku River, the soils are likely typical floodplain soils, similar to those found at the ACB landing area.

3.4.2.3 Summary

The terrain and soils found within the ACB transportation route are typical of those found in northern coastal forested areas and in large river floodplains elsewhere in BC and Alaska.

3.4.3 Terrestrial Ecosystems

3.4.3.1 Methodology

As outlined in the terrain and soils section, additional TEM was conducted in support of the mine permit application and the ACB transport option. TEM field sampling was conducted in the areas of proposed infrastructure development within Shazah Creek and the mid-Tulsequah River area and along the proposed access route to the ACB landing site and at the ACB landing site. The mapping procedure followed provincial standards, consisting of air-photo interpretation and field assessments to verify the interpretations.

During the review of the existing 1:50,000 TEM and the additional 1:10,000 TEM, the ecosystems were grouped into broad ecosystem types to provide regulators with new

3.4.3.2 Results

Ecosystems identified in the 1:50,000 scale TEM completed in 1996 by JMJ Holdings (Marcoux 1997) and updated in 2002 by Forest Information Systems (Fuller 2002) included mesic and rich/wet forested sites along the proposed road to the ACB landing site and floodplain ecosystems at the proposed ACB landing site and along the Taku River on the ACB transportation route. Additional field sampling associated with the TEM conducted during the early summer of 2007 confirmed the ecosystems identified by Marcoux (1997) and Fuller (2002). For the proposed access road to the ACB landing site, ecosystems consisted primarily of mesic, mature and previously harvested forested ecosystems (01 HwSs - Blueberry [Code = HB]) with wet and rich oak fern and devil's club forested ecosystems (03 SsHw - Oak fern [SO] and 04 SsHw - Devil's club [SD]) found on lower slopes, riparian areas and gullies. Near the ACB landing site, Maple Ridge supports an extensive shrubby ecosystem type that was initially identified as an early seral SD ecosystem. Information obtained during field assessments in 2007 suggest that the ecosystem is more likely a dis-climax shrub ecosystem (Slide Alder - Devil's club [AD]) which is unlikely to progress to a forested ecosystem due to snow-press and the competing slide alder and other vegetation.

At the proposed ACB landing site, the dominant ecosystem mapped previously was a low fluvial bench floodplain ecosystem (07 Act - Willow [CW]). Mapping and field assessments of the ACB landing area in 2007 found that the middle fluvial bench floodplain ecosystem (06 Act - Red-osier

dogwood [CD]) is more common, with the CW ecosystems found adjacent to the Taku River and high fluvial bench (05 Ss - Salmonberry [SS]) located on elevated micro-sites closer to Maple Ridge. Vegetated ecosystems along the Taku River were identified as primarily middle fluvial bench (CD) floodplain ecosystems on the islands, with low fluvial bench floodplain (CW) ecosystems also present. At the confluence of the Taku and Tulsequah Rivers, along the west side of the Tulsequah there is a large wetland complex, Flannigan Slough. This complex contains a large number of small creeks and ponds as well as extensive shrub carrs and sedge fens with widespread evidence of beaver activity. Table 3-9 summarizes the ecosystems identified in the study area and the structural stages that occur in the area for each. It also provides a brief description of each ecosystem unit.

Table 3-9. Terrestrial Ecosystems within the Tulsequah ACB Access Route and Landing Area

Map Code	Site Series	Ecosystem Name	Site Description[1]	Structural Stages
Upland Forest Ecosystem Units				
AC	00	Avalanche chute	Occurs on steep slopes, subject to avalanches. Typically with deep, rich, moist soils and is dominated by Sitka alder, devil's club and ferns.	3a, 3b
AD	00	Alder Devil's club shrub site	Occurs on level to steep slopes that are not necessarily subject to avalanching. Typically with deep, rich, moist soils and is dominated by Sitka alder, devil's club and ferns.	3b
HB	01	Western Hemlock - Sitka Spruce - Blueberry	Zonal site series. Occurs primarily at mid to level slope positions on a range of parent materials. Two phases are recognized: the mineral phase (01a) and the lithic phase (01b).	5, 6, 7
SO	03	Sitka Spruce - Western Hemlock - Oakfern	Fresh to wet site. Generally located at mid to lower slopes on moderately well drained, rich soils as well as level glaciofluvial terraces and toe of slopes.	3, 5, 6, 7
SD	04	Sitka Spruce - Western Hemlock - Devil's Club	Fresh to wet site. Productive site occurring on fluvial and colluvial fans and on fluvial veneers overtop glaciofluvial deposits.	4, 5, 7
Floodplain Forest Ecosystems Units				
SS	05	Sitka Spruce - Salmonberry	Floodplain site. Occurs on elevated floodplain sites with seasonally fluctuating water tables. Highly productive forested sites.	3, 5
CD	06	Cottonwood – Red-osier Dogwood	Floodplain site. Occurs on middle fluvial benches which experience prolonged elevated water tables.	3, 3a, 3b, 4, 5
CW	07	Cottonwood - Willow	Floodplain site. Located on low fluvial benches usually directly adjacent to rivers or in back channels.	3, 3a, 3b, 5
Wetland Ecosystem Units				
AS	00	Alder - Sitka sedge - Bluejoint	Shrub swamp that typically occurs on level sites with organic soils. It can occur on fluvial terraces and is dominated by alder, Sitka sedge and bluejoint	3a
SF	00	Organic sedge-fen	Occurs in level areas on organic soils over fluvial deposits; adjacent to bodies of water.	2a, 2b

Table 3-9. Terrestrial Ecosystems within the Tulsequah ACB Access Route and Landing Area

Map Code	Site Series	Ecosystem Name	Site Description[1]	Structural Stages
Non-Forested Ecosystem Units				
GB	-	Gravel Bar	An elongated landform generated by waves and currents and usually running parallel to shore. Composed of un-consolidated small rounded cobbles, pebbles, stones and sand.	-
PD	-	Pond	A small body of water greater than 2 m deep, but less than 50 ha in size.	-
OW	-	Shallow Open Water	A wetland composed of permanent shallow open water (<2 m deep) and lacking extensive emergent plant cover.	-
RI	-	River	A watercourse formed when water flows between continuous, definable banks. The flow may be intermittent or perennial. An area that has an ephemeral flow and no channel with definable banks is not considered a river.	-
RO	-	Rock Outcrop	A gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover.	-

Note: 1. Descriptions from Banner et al. 1993, Marcoux 1997 and Fuller 2002
2. Structural Stages from RIC 1998 (2a = forb dominated, 2b = graminoid, dominated, 3 = shrub/herb, 3a = low shrub, 3b = tall shrub, 4 = pole sapling, 5 = young forest, 6 = mature forest, 7 = old forest)

No ecosystem mapping has been previously completed for the Alaska portion of the Taku River, Taku tideflats or Taku Inlet. Aerial reconnaissance conducted in the spring and summer of 2007 and some limited ground reconnaissance found that the ecosystems found along the Taku River are similar to those found in BC, primarily consisting of middle and low fluvial bench floodplain ecosystems. A number of wetland complexes are found where other watersheds enter the Taku River, such as at Wright River, Yehring Creek, Moose Creek, Johnson Creek and Sockeye Creek. These wetlands are typical shrubby fens containing sedges and willows and numerous small and large ponds (see Figure 3-3).

The Taku tideflats appear from aerial reconnaissance to be primarily made of silty-sandy habitats with little emergent vegetation within the tidal influence areas. Carstensen (2004) in his review of Alaskan estuaries found that the Taku tideflats were composed of 18% vegetated salt marsh (714 acres) and 82% (3,365 acres) of bare tidal flats. These findings correspond to those observed during reconnaissance flights in May and June, where above the high tide mark, willow and sedge habitats are evident, but the influence of high water flows from the Taku appear to have limited vegetation growth, with extensive areas of silt and sand visible (see Figure 3-10). Forests along Taku Inlet contain a mix of typical mesic and wet/rich coastal forested ecosystems dominated by mature Sitka spruce and western hemlock. There are a number of smaller tidalflat systems where freshwater systems enter the Inlet, primarily at Davidson and Turner Creeks on the south side of the Inlet. These tideflats have extensive sedge meadows and mudflats associated with them.

Figure 3-9. Wetland Ecosystems in Lower Taku River at Johnson Creek

Figure 3-10. Tideflat Ecosystems in Lower Taku River near Grizzly Bar

3.4.3.3 Summary

The terrestrial ecosystems found within and adjacent to the ACB transportation route and access road are typical of those found in northern coastal forested areas and in large river floodplains elsewhere in northern BC and southeast Alaska. The water fluctuations within the Taku River dominate the vegetation of the floodplain, while river and tidal fluctuations influence the tideflats causing vegetation complexes to shift and modify on a regular basis.

3.4.4 Rare Plants and Ecosystems

3.4.4.1 Methodology

In addition to the review of previously available information, additional sources of information were sought, including available information on rare plants and ecosystems in the Alaskan portion of the proposed ACB access route. A field assessment for rare plants was also undertaken in late June at the proposed ACB landing site and in selected areas along the proposed haul road access to the ACB landing site.

3.4.4.2 Results

There have been no comprehensive assessments for rare plants conducted in association with the previous environmental assessment, although vegetation ecologists completing the ecosystem mapping did attempt to identify all species of plants observed during vegetation plots. The BC Conservation Data Centre (BC CDC) tracks a number of rare plants that could occur in the Taku River area outlining their conservation status in BC and under the Canada Species at Risk Act (SARA) through the Committee on the Status of Endangered Wildlife Species in Canada (COSEWIC) (see Table 3-10). In late June 2007, a rare plant assessment conducted at the ACB landing found no listed plant species. The relatively young ecosystems (primarily middle bench floodplain sites) and extensive previous activities related to human occupation, likely limited the potential for rare plant species. The rare plant review along portions of the proposed road access, to the ACB landing including riparian and waterfall spray-zone habitats also did not find any evidence of rare plant species. Overall, many of the rare plants listed for the area occur in higher elevation sites or in types of habitats not found in the lower elevation floodplains of the Taku River. Two plant species, Dwarf bog bunchberry and Cryptic Paw lichen are know from the lower Taku River area, but they were not found during the rare plant assessment of the ACB landing or access road.

The 1997 Environmental Assessment completed by Rescan (Rescan 1997) outlined a number of rare plant communities identified by the BC Conservation Data Centre (BC CDC) and their occurrence within the Tulsequah River Watershed.

The 1997 Environmental Assessment completed by Rescan (Rescan 1997) outlined a number of rare plant communities identified by the BC Conservation Data Centre (BC CDC) and their occurrence within the Tulsequah River Watershed. The most recent listing of rare ecosystems for the CWHwm portion of northwestern BC (BC CDC 2007) is outlined in Table 3-11 below.

Table 3-10. Rare Plant Species Potentially within the Coastal Western Hemlock Wet Maritime Sub-zone in the Taku River Area

Common Name	Scientific Name	BC Status[1]	COSEWIC Status[2]	Alaska Status[3]	General Habitat
Aleutian Shield Fern	*Polystichum aleuticum*			E-ESA	Steep, rocky, subalpine habitats[4]
Cryptic Paw	*Nephroma occultum*	Blue	SC (Apr 2006)		Epiphytic in humid old-growth forests at lower elevations in mountainous regions[5]
Dotted Saxifrage	*Saxifraga nelsoniana ssp. carlottae*	Blue			Moist rock outcrops, scree, meadows and streambanks from the montane to alpine zones[6]
Dwarf bog bunchberry; Lapland cornel	*Cornus suecica*	Red			Moist to mesic forests and meadows in the lowland to alpine zones[6]
Hairy Butterwort	*Pinguicula villosa*	Blue			Bogs and ponds (usually in Sphagnum) in the lowland and montane zones[6]
Hornemann's Willowherb	*Epilobium hornemannii behringianum*	Blue			Wet to moist rocky cliffs, meadows, thickets, and river banks in the montane zone[6]
Kamchatka spike-rush	*Eleocharis kamtschatica*	Blue			Marshes, wet meadows and bog margins in the lowland zone[6]
Slender Moonwort	*Botrychium lineare*	Red		C-ESA	Higher elevations in a wide variety of habitats, may colonize disturbed habitats[7]
Small-flowered Lousewort	*Pedicularis parviflora. parviflora*	Blue			Wet meadows, fens and bogs in the montane and subalpine zones[6]
Small-fruited Willowherb	*Epilobium leptocarpum*	Red			Moist meadows and streambanks in the montane to alpine zones[6]
Three-forked Mugwort	*Artemisia furcata var. heterophylla*	Blue			Dry slopes in the alpine zone[6]
Whorled Lousewort	*Pedicularis verticillata*	Blue			Moist meadows, rocky slopes, heath and turfy tundra in the montane to alpine zones[6]
Yellow marsh-marigold	*Caltha palustris* var. *palustris*	Blue			Bogs and shallow, brackish marshes in the lowland zone[6]

Note: 1. BC Status: Red=Extirpated, endangered or threatened; Blue=Special concern
2. COSEWIC Status: E=Endangered; T=Threatened; SC=Special Concern; UR=Under Review; DD=Data deficient; NAR=Not at Risk
3. Alaska Status: E=Endangered; T=Threatened; SC=Species of Special Concern; C=Candidate; ESA=Federal Endangered Species Act; ADF&G=Alaska Dept. Fish and Game
4. From USFWS 1992; 5 COSEWIC 2006a; 6 From Klinkenberg 2007; 7 From USFWS 2005a

Table 3-11. Rare Ecosystems Potentially in the Coastal Western Hemlock Wet Maritime Sub-zone in the Taku River Area

Ecosystem Name	General Type	Site Series/Code	BC Status[1]
Mountain Alder / Common Horsetail	Low bench Floodplain	Fl01	Blue
Sitka Sedge - Pacific Water-Parsley	Wetland Marsh	Wm50	Blue
Sitka Sedge / Peat-mosses	Wetland Fen	Wf51	Red
Sweet Gale / Sitka Sedge	Wetland Fen	Wf52	Red
Sitka spruce / skunk cabbage	Swamp Forest	09 / SC	Blue
Sitka spruce / salmonberry Wet Maritime	High bench Floodplain	05 / SS	Blue
Black Cottonwood - Red Alder / Salmonberry	Middle bench Floodplain	06 / CD	Blue
Western hemlock - Sitka spruce / step moss	Dry Forest	02 / HM	Blue
Western hemlock / common green peat-moss	Wet Forest	08 / HS	Blue

Note: 1. BC Status: Red=Extirpated, endangered or threatened; Blue=Special concern

A small number of the rare ecosystems listed in Table 3-11 are found within the proposed ACB landing and transportation route along the Taku River. The middle bench floodplain ecosystem (CD) was the primary ecosystem found at the ACB landing site and along the Taku River. Small amounts of the low bench and high bench floodplain ecosystems are also found within and adjacent to the ACB landing area. The Mountain alder - common horsetail ecosystem - was not noted within the proposed ACB landing site. A small amount (< 1 ha) of skunk cabbage swamp forest was noted outside of the right-of-way of the proposed road to the ACB landing. No other rare ecosystems were found during the field assessments conducted in June and July, although not all wetland ecosystems along the Taku River have been extensively assessed on the ground.

Within Alaska, the rare plants listed in Table 3-10 are not likely to occur within the ACB transportation route on the Taku River although some species may be found in adjacent wetland or floodplain areas. The Aleutian Shield Fern is a small, solitary dark- to olive-green fern that is found in steep, rocky, subalpine habitats (USFWS 1992), but is only found on Adak Island in the Aleutian Islands (US FWS 1992) and is therefore very unlikely to be found within the ACB transportation route. The Slender Moonwort, also called the Linear-leaf Moonwort, is a small, pale-green fern with a single above-ground frond. Slender Moonwort has been found in a variety of habitats; however, it is often located at higher elevations and may be an opportunistic colonizer of disturbed habitats (US FWS 2005a, BC CDC 2007). In Alaska it has only been found in St. Elias National Park (US FWS 2005a), while in BC, the closest location is Mount Robson Provincial Park (P. Williston, pers. comm. 2007). Alaska has no rare ecosystem listings but many of the floodplain ecosystems found in BC extend into Alaska.

3.4.4.3 Summary

No listed rare plant species were observed within the proposed ACB transportation route, at the ACB landing site or along the access road to the ACB landing site during previous or recent investigations by plant ecologists. A small amount of rare ecosystems are within the proposed ACB landing site, and a portion of the area has been previously disturbed by human occupation.

3.4.5 Terrestrial Mammals

3.4.5.1 Methodology

In addition to the generalized methods outlined previously, Gartner Lee Limited (GLL) conducted additional field surveys in 2007 to address specific data gaps. These surveys included an aerial ungulate winter survey of the Taku River valley and Taku Inlet during March and aerial and ground reconnaissance surveys conducted in May and June to assess potential black and grizzly bear habitats. The information obtained from these surveys supplemented the existing data and provided information on habitats and habitat use along the Taku River and Taku Inlet in Alaska.

3.4.5.2 Terrestrial Mammal Species at Risk

The BC CDC lists six terrestrial mammal species as Blue-listed and two species (Keen's Myotis and Tundra Shrew) as Red-listed (see Table 3-12) within the Taku River area. The northern

mountain population of Woodland Caribou, the *luscus* subspecies of Wolverine and the Grizzly bear are listed as Species of Concern by COSEWIC. There are no terrestrial mammals listed in Alaska that are expected to be found in the ACB transportation route; for example Polar bear and Kenai Brown Bear are listed under the US Endangered Species Act (ESA), but would not occur in the Taku River area.

Table 3-12. Terrestrial Mammal Species at Risk in the Taku River Area

Common Name	Scientific Name	BC Status[1]	COSEWIC Status[2]
Woodland Caribou (northern mountain population)	*Rangifer tarandus*	Blue	SC (May 2002)
Dall's Sheep	*Ovis dalli dalli*	Blue	
Wolverine (*luscus* subspecies)	*Gulo gulo luscus*	Blue	SC (May 2003)
Keen's Myotis	*Myotis Keenii*	Red	DD (Nov. 2003)
Fisher	*Martes pennanti*	Blue	
Grizzly Bear	*Ursus arctos*	Blue	SC (May 2002)
Tundra Shrew	*Sorex tundrensis*	Red	
Meadow Jumping Mouse (*alascensis* subspecies)	*Zapus hudsonius alascensis*	Blue	

Note: 1. BC Status: Red=Extirpated, endangered or threatened; Blue=Special concern
2. COSEWIC Status: E=Endangered; SC=Special Concern; UR=Under Review; NAR=Not at Risk, DD = Data Deficient

Of the list provided in Table 3-12, Grizzly Bear are common or abundant in the Transportation System study area. There is no evidence of Woodland Caribou or Dall's Sheep in the area. Low numbers of wolverine are believed to use the Taku River valley and possibly the Tulsequah River valley. Fisher have been recorded in the study area but in very small numbers. Neither the Tundra Shrew or the Meadow Jumping Mouse were captured during the small mammal trapping program conducted in 1995-1996 and neither species is expected to be found in the study area. Keen's Moytis is not likely to be found in the area, due to their apparent association with hot-springs, which are not known to be near the ACB landing or access road.

Grizzlies appear to use the Tulsequah and Taku floodplains as a travel corridor and there were high levels of use in Flannigan and Shazah Sloughs. Grizzly bears are often seen moving along the Taku River, but there are no major concentration areas, largely because salmon are not spawning in the main river and grizzly bears tend to congregate more along tributary streams higher up, particularly Yehring Creek (E. Jones, pers. comm. 2007). Sockeye Creek, Yehring Creek, Johnson Creek and possibly Fish Creek and Boundary Creek may have high concentrations of grizzly bears in the fall due to spawning salmon, but this has not been confirmed (N. Barten, pers. comm. 2007a).

Suitability mapping by Wellwood (2001) indicated that the wetland and floodplain habitats adjacent to the Tulsequah and Taku rivers were rated moderate to high value spring, summer and fall feeding habitats for grizzlies. Areas identified as high value grizzly bear areas during aerial assessments conducted in Alaska in 2007 included wetland and sedge shoreline habitats at the

confluences of Fish Creek, Wright River, Yehring Creek, Moose Creek, Johnson Creek, Sockeye Creek, the wetlands south of Taku Lodge and at Grizzly Bar.

3.4.5.3 Other Species of Interest

Other species of interest in the Taku River area include a variety of large and small mammal species and are discussed in the following sections.

3.4.5.4 Ungulates

Ungulates known to frequent the area include moose and mountain goat. Moose are common, year-round residents in the lower elevation areas of the Taku and Tulsequah river drainages. The majority of use by moose was within the Flannigan Slough and Shazah Slough areas. Moose use of the area in the winter is much greater than in other seasons, with much higher densities of moose observed in the Taku River floodplain between Yellow Bluff and the BC border. Mountain goats, although in relatively high densities in the area typically remain in a variety of steep habitats within the Tulsequah and Taku River drainages. No observed goat locations have been noted within 2 km of the proposed ACB route on the Taku River and no goat locations were below 400 m elevation.

While Sitka black-tailed deer and stone sheep have been known to occur in the region, there is no evidence of Stone Sheep in the areas within or immediately adjacent to the lower Tulsequah and Taku Rivers within the Tulsequah EA documents (Rescan 1997). There also has been no evidence of sitka black-tailed deer use found during aerial and ground-based surveys conducted by Rescan in 1994 and 1996 on the BC side of the border along the Taku or Tulsequah Rivers (Rescan 1997). Discussions with ADF&G employees involved in the fisheries project at Canyon Island has indicated that during the summer, deer have been observed in the lower sections of the Taku River (E. Jones, pers. comm. 2007). Records indicate that most of the deer in this unit occur on Douglas, Shelter and Lincoln Islands outside of the Taku Inlet area (Barten 2005). A small number of deer (< 5 deer/year) are likely harvested near Bishop Point at the mouth of Taku Inlet (N. Barten, pers. comm. 2007).

3.4.5.5 Large Carnivores

The large carnivores known to live in the study area are black bears and grey wolves. Black bears are common to abundant in the study area and primarily use non-floodplain habitats such as lower and mid-elevation forests and avalanche tracks, with black bear sign in the Tulsequah and Taku River floodplains being at a much lower density than those of grizzly bears (Rescan 1997). Wetland and floodplain habitats adjacent to the Tulsequah and Taku rivers were rated moderate to high value spring, summer and fall feeding habitats. The habitats identified for grizzly bears in Alaska would also be considered high value black bear habitats.

Grey wolves frequently travel along the Tulsequah and Taku River floodplains (Rescan 1995, 1996). On the Alaskan side of the Taku River, wolves are thought to primarily inhabit the floodplain and adjacent upland forest areas there are reports of at least one small wolf pack in the lower Taku River drainage (N. Barten, pers. comm. 2007).

3.4.5.6 Furbearers/Small Mammals

A summary of the information available on a variety of furbearer and small mammal species is provided in Table 3-13 and outlines the results of the review of information for these species.

Table 3-13. Summary of Available Information for Selected Furbearer and Small Mammals within the Study area that may be Affected by the Proposed ACB Transportation System

Common Name	Scientific Name	Summary of Known Habitat Use and Abundance
Marten	*Martes americana*	Considered abundant in the area
Mink	*Mustela vison*	Occur around the wetlands and backchannels of the Taku river floodplain
Short-tailed Weasel (Ermine)	*Mustela erminea*	The short-tailed weasel is common in coniferous or mixed woodlands (Eder and Pattie 2001) and likely occurs throughout the Taku and Tulsequah River floodplains.
River Otter	*Lontra canadensis*	It is likely that the Taku and Tulsequah Rivers support a healthy river otter population and den sites would be found along the mainstem and backchannel habitats on the Taku River.
Lynx	*Lynx canadensis*	No lynx were detected during field assessments by Rescan (1997) or during field work in 2007. In Alaska, lynx are uncommon in subunit IC but numbers may be increasing (Barten 2004a).
Coyote	*Canis latrans*	It appears that coyote numbers are low in this area.
Red Fox	*Vulpes vulpes*	It is likely that red fox numbers are low in this area.
Beaver	*Castor Canadensis*	In the Taku and Tulsequah river floodplains area they occur in most of the wetlands (Rescan 1997) In the Alaskan portion of the Taku River, they are thought to occur at moderate population levels in the mainland drainages including the Taku (Barten 2004a).
Muskrat	*Ondatra zibethicus*	Muskrat sign was noted in wetlands in the Swede Point area but were considered by local residents to occur only occasionally (Rescan 1997). No evidence of muskrat was observed during field work conducted in 2007 and no information on muskrat was available from ADF&G.
Porcupine	*Erithizon dorsatum*	Populations of porcupines are not likely to be large in the area although it appears that they may fluctuate.
Red Squirrel	*Tamiasciurus hudsonicus*	Widespread and common in forested habitats throughout the area, primarily in forested sites associated with large spruce. It is assumed that populations and habitat use would be similar in Alaska.
Northern Flying Squirrel	*Glaucomys sabrinus*	No evidence of flying squirrel use was found in the previous or current work conducted in the study area
Hoary Marmot	*Marmota caligata*	It is unlikely that Hoary Marmot would be along the majority of the ACB transport route.
Snowshoe Hare	*Lepus americanus*	There was no evidence of snowshoe hare found during the previous or current assessments in the study area (Rescan 1997).
Jumping Mice Deer Mice	*Zapus spp.* *Peromyscus spp.*	It is likely that the study area supports both jumping and deer mice populations, but population levels are unknown.
Voles	*Clethrionomys spp.* *Microtus spp.*	During the small mammal trapping program, Rescan (1997) found that capture rates for northern red-backed vole were relatively high although population levels are unknown.
Bats	*Myotis spp.*	No assessments for bats have been conducted to date, although a limited program using a commercial bat-detector will be conducted in the late summer 2007.
Shrews	*Sorex spp.*	Rescan (1997) outlines that capture rates for common shrew were relatively high, but it is unclear if this refers to the common water shrew (*Sorex palustrus*) or a misnaming of another common shrew species such as masked shrew (*S. cinereus*) or dusky shrew (*S. monticolus*).

3.4.6 Birds

3.4.6.1 Methodology

Information from a variety of sources was reviewed to provide information on bird species and habitat use. Bird information and survey data was assessed according to the following groups: waterfowl, shorebirds, marine birds, breeding songbirds and raptors. In addition to this, GLL conducted field surveys within the ACB transportation route in 2007 to obtain more information on the composition, distribution, and habitat use of birds within the study area. Surveys conducted by GLL include: aerial survey for potential eagle nests in March, aerial waterfowl surveys in March and May, and breeding bird surveys at the ACB landing site and haul road in June.

The following sections provide the results of the literature reviews and field assessments conducted for birds within the study area.

3.4.6.2 Bird Species at Risk

The number of potential bird species at risk within the study area is relatively large due to the migratory and wide-ranging nature of bird species. A summary of the bird species at risk within the ACB transportation system area are outlined in Table 3-14.

Table 3-14 Bird Species at Risk in the Study Area

Common Name	Scientific Name	BC Status[1]	COSEWIC Status[2]	Alaska Status[3]
Ancient Murrelet	*Synthliboramphus antiquus*	Blue	SC (Nov 2004)	
Brandt's Cormorant	*Phalacrocorax penicillatus*	Red		
Buller's Shearwater	*Puffinus bulleri*	Blue		
California Gull	*Larus californicus*	Blue		
Caspian Tern	*Hydroprogne caspia*	Blue	NAR (May 1999)	
Cassin's Auklet	*Ptychoramphus aleuticus*	Blue		
Common Murre	*Uria aalge*	Red		
Double-crested Cormorant	*Phalacrocorax auritus*	Blue		
Flesh-footed Shearwater	*Puffinus carneipes*	Blue		
Horned Puffin	*Fratercula corniculata*	Red		
Kittlitz's Murrelet	*Brachyramphus brevirostris*	Accidental		C-ESA
Laysan Albatross	*Phoebastria immutabilis*	Blue		
Marbled Murrelet	*Brachyramphus marmoratus*	Red	T (Nov 2000)	
Pelagic Cormorant, spp. *pelagicus*	*Phalacrocorax pelagicus pelagicus*	Red		
Pink-footed Shearwater	*Puffinus creatopus*	Red	T (May 2004)	
Red-necked Phalarope	*Phalaropus lobatus*	Blue		
Short-tailed Albatross	*Phoebastria albatrus*	Red	T (Nov 2003)	E-ESA; E-ADF&G
Spectacled Eider	*Somateria fischeri*	Blue		T-ESA; SC-ADF&G

Common Name	Scientific Name	BC Status[1]	COSEWIC Status[2]	Alaska Status[3]
Steller's Eider	*Polysticta stelleri*	Blue		T-ESA; SC-ADF&G
Surf Scoter	*Melanitta perspicillata*	Blue		
Thick-billed Murre	*Uria lomvia*	Red		
Tufted Puffin	*Fratercula cirrhata*	Blue		
Western Grebe	*Aechmophorus occidentalis*	Red		
American Golden-Plover	*Pluvialis dominica*	Blue		
Eskimo Curlew	*Numenius borealis*		E (May 2000)	E-ADF&G
Great Blue Heron, spp. *fannini*	*Ardea herodias fannini*	Blue	SC (May 1997)	
Hudsonian Godwit	*Limosa haemastica*	Red		
Sandhill Crane	*Grus canadensis*	Blue		
Short-billed Dowitcher	*Limnodromus griseus*	Blue		
Wandering Tattler	*Tringa incana*	Blue		
Canada Goose, spp. *occidentalis*	*Branta canadensis occidentalis*	Blue		
Gyrfalcon	*Falco rusticolus*	Blue	NAR (May 1987)	
Northern Goshawk, spp. *laingi*	*Accipiter gentilis laingi*	Red	T (Nov 2000)	SC-ADF&G
Peregrine Falcon, spp. *anatum*	*Falco peregrinus anatum*	Red	SC (Apr 2007)	SC-ADF&G
Peregrine Falcon, spp. *pealei*	*Falco peregrinus pealei*	Blue	SC (Apr 2007)	
Short-eared Owl	*Asio flammeus*	Blue		
Barn Swallow	*Hirundo rustica*	Blue		
Blackpoll Warbler	*Dendroica striata*	Yellow		SC-ADF&G
Gray-cheeked thrush	*Catharus minimus*	Yellow		SC-ADF&G
Olive-sided Flycatcher	*Contopus cooperi*	Yellow		SC-ADF&G
Smith's Longspur	*Calcarius pictus*	Blue		
Townsend's Warbler	*Dendroica townsendii*	Yellow		SC-ADF&G

Notes:
1. *BC Status: Red=Extirpated, endangered or threatened; Blue=Special concern; Accidental=Infrequent and unpredictable (no status)*
2. *COSEWIC Status: E=Endangered; SC=Special Concern; UR=Under Review; NAR=Not at Risk*
3. *Alaska Status: E=Endangered; T=Threatened; SC=Special Concern; C=Candidate; ESA=Federal Endangered Species Act; ADF&G=Alaska Dept. Fish and Game*

Many of the bird species listed in Table 3-14 as Species at Risk include species that are unlikely to be found nesting in the study area as they normally nest outside of Alaska or in specialized habitats not found in the area, or forage in habitats outside of the ACB route such as in offshore ocean waters (e.g. Buller's Shearwater, Laysan Albatross). The Eskimo Curlew is possibly extinct and hasn't been seen since 1988. It had bred in northern Alaska and the NWT and migrated through central Canada and the US to South America.

Species that do not appear to have been observed along the route (as there are no records available) include: as there are no records available include: Brandt's Cormorant; Double-crested Cormorant, Buller's Shearwater, Cassin's Auklet, Flesh-footed Shearwater, Horned Puffin, Laysan Albatross, Pink-footed Shearwater, Short-tailed Albatross, Spectacled Eider, Steller's Eider, Tufted Puffin, Canada Goose, spp. *occidentalis*, and Eskimo Curlew. Species that have been observed less than three times in the past 20 years include: Thick-billed Murre, Wandering Tattler, Gyrfalcon, Red-necked Phalarope, Blackpoll Warbler, and Smith's Longspur. Many of the other identified

species have been observed a number of times during the surveys conducted within the ACB transportation route or during surveys conducted in the vicinity of Juneau.

Very few of the listed species that have been observed within or adjacent to the ACB transportation route are expected to potentially nest within areas that could be affected by the proposed activities. These species are forest nesting birds and include Marbled Murrelet, Great Blue Heron, Northern Goshawk, Gray-cheeked Thrush, and Olive-Sided Flycatcher.

The majority of the other listed species that are known to use the area would forage along the Taku River or within Taku Inlet, either within the water or along the adjacent shoreline. These species include: California Gull, Caspian Tern, Common Murre, Kittlit'z Murrelet, Marbled Murrelet, Pelagic Cormorant, Surf Scoter, Western Grebe, American Golden Plover, Great Blue Heron, Hudsonian Godwit, Sandhill Crane, and Short-billed Dowitcher.

3.4.6.3 Waterfowl

Waterfowl include both dabblers and diving ducks, swan and geese species. A wide variety of waterfowl species have been observed within the ACB transportation route although confirmed nesting is limited to only a few species.

Rescan (1997) observed a total of 14 waterfowl species in the study area, although some are believed to be present only during migration and may not be breeding. Trumpeter swans were observed in several of the wetlands from April to October and successful nesting was confirmed in Shazah Slough and Yellow Bluff Slough. Canada geese were common breeders within the study area, with high levels of use observed in Flannigan and Shazah Sloughs. Overall, the highest numbers of birds were observed in Flannigan Slough, Boundary Slough and to a lesser extent Erickson Slough, Yellow Bluff Slough, and Big Bull Slough. During Gartner Lee's winter survey in 2007, numerous waterfowl were observed using the estuary and inlet at the mouth of the Taku River and included Canada geese, common merganser, goldeneyes and mallards. In spring, waterfowl were observed in wetland ponds in both Shazah and Big Bull Slough as well as the wetland complex located along the east side of the Tulsequah River about 4.5 km upstream from the confluence with the Taku River. Waterfowl breeding pairs were also observed in many of the wetland habitats in this area. During breeding bird surveys in June, several waterfowl were encountered in many of the wetlands including mallard and green-winged teal. A pair of trumpeter swans was identified in the wetland along the east bank of the Tulsequah River and another pair was observed nesting in Shazah Slough. Based on the surveys conducted by Rescan and Gartner Lee, the most common waterfowl in the Taku and Tulsequah river area during the summer were mallards and Canada geese.

The USFWS has conducted aerial surveys for trumpeter swans in 1998, 2000 and 2005 within Taku Inlet and lower Taku River (Groves, D. pers. comm. 2007). The results from the 3 survey years suggest that the number of trumpeter swans breeding in the area may be increasing slightly; 17 adults and 8 young (3 pairs with young) were observed in 1998; 22 adults and 16 young (4 pairs with young) in 2000; and 27 adults and 15 young (5 pairs with young) in 2005. Waterfowl surveys

were also conducted in the winter and summer of 1997 in Taku Inlet and the lower Taku River by USFWS and found that the most common species in the winter were: Canada geese, goldeneyes, long-tailed ducks, mallards and mergansers; while in the summer the most common species were: Canada geese, mallards and mergansers (Groves. D. pers. comm.. 2007).

3.4.6.4 Shorebirds

A total of 13 shorebird species have been observed within the ACB transportation route, primarily during surveys conducted in wetland and river habitats in BC. A long-term study at the Medenhall Wetlands and tideflats near Juneau (Armstrong et al 2004) observed more species than those currently known to occur in the ACB route, and it could be hypothesized that more species may use the similar habitats found in Taku Inlet tideflats areas. The aerial surveys conducted during March and May, however observed only limited numbers of shorebirds on the tideflats, that unfortunately could not be identified. It is unknown if there are large numbers of shorebirds using the Taku Inlet tideflats, although there is some speculation that the Taku Inlet area is outside of the main migration routes for shorebirds (D. Chester, pers. comm. 2007).

The shorebird species that are known to forage within the ACB route are outlined in Table 3-15.

Table 3-15 Shorebird Species in the Transportation System Study Area

Common Name	Season	Common Name	Season1
Black Turnstone	W	Rock Sandpiper	W
Dunlin	W	Semi-palmated Plover	W, Su
Greater Yellowlegs	Sp, W	Solitary Sandpiper	Su
Killdeer	Sp, Su, W	Spotted Sandpiper	Sp, Su, W
Least Sandpiper	Su	Surfbird	W
Lesser Yellowlegs	Sp, Su	Wilson's Snipe (Common Snipe)	Sp, Su, W
Marbled Godwit	W		

Notes: 1. Seasons: W=Winter (Nov-Mar); Sp=Spring (Apr-Jun); Su=Summer (Jul-Aug); F=Fall (Sep-Oct)

3.4.6.5 Marine Birds

The majority of marine birds known to occur within the ACB transportation route were observed during Christmas Bird Counts and aerial surveys conducted by the USFWS in February and June 1997 and GLL in March and May 2007. Most of the marine birds observed are gull species including Bonaparte's Gull, Glaucous-winged Gull, Herring Gull, Mew Gull and Thayer's Gull. Grebe species including Horned Grebe and Red-necked Grebe have been observed at Juneau during the winter, while unidentified grebes were observed in the Taku/Tulsequah area by Rescan (1997) and a Pied-billed Grebe was observed during breeding bird surveys in June 2007 by GLL. Loons, including Common Loon, Pacific Loon, Red-throated Loon and Yellow-billed Loon have also been observed during the winter near Juneau. There appears to be limited nesting by marine bird species within the ACB transportation route, with the majority of the use being feeding.

3.4.6.6 Raptors

A number of raptor species have been observed within the ACB transportation route, including Red-tailed Hawks, American Kestrels, and Bald Eagles. Of these species the most abundant is Bald Eagles, which are present at high densities and are present year round. Nest data collected by the USFWS over the last twenty years indicates that the Alaskan portion of the Taku River and Taku Inlet may contain approximately 50 Bald Eagle nests; although some of these data are more than 10 years old (US FWS 2007b). Raptor surveys conducted along the BC portion of the Taku River found densities of 0.9 nests per linear km of the river (Rescan 1997). Surveys conducted by GLL in March 2007, when nests were easy to observe due to the lack foliage, found 18 nests from Yellow Bluff to Taku Inlet, adjacent to the Taku River mainstem.

3.4.6.7 Breeding Songbirds

During breeding bird surveys conducted by Rescan (1997) a total of 30 bird species were recorded that are not accounted for in other species groups, while the work conducted by GLL in 2007, recorded a total of 43 species. In addition to the species found during the breeding bird surveys in the Taku/Tulsequah area, additional breeding bird surveys from Juneau was used to develop the list of breeding songbirds for the ACB transportation route outlined in Table 3-16. The majority of the species listed in Table 3-16 nest in forested habitats either in shrubby areas or in mature forest habitats.

Table 3-16 Songbird Species in the Study Area

Common Name	Common Name	Common Name
Alder Flycatcher	Hairy Woodpecker	Sapsucker sp.
American Dipper	Hammond's Flycatcher	Savannah Sparrow
American Crow	Harris's Sparrow	Song Sparrow
American Redstart	Hermit Thrush	Spotted Towhee
American Robin	Hoary Redpoll	Spruce Grouse
American Three-toed Woodpecker	Killdeer	Steller's Jay
American Tree Sparrow	Lincoln's Sparrow	Swainson's Thrush
Anna's Hummingbird	MacGillivray's Warbler	Swamp Sparrow
Bank Swallow	Mountain Bluebird	Townsend's Warbler
Belted Kingfisher	Northern Flicker	Tree Swallow
Black-capped Chickadee	Northern Shrike	Varied Thrush
Blackpoll Warbler	Northwestern Crow	Vaux's Swift
Blue Grouse	Orange-crowned Warbler	Violet-green Swallow
Bohemian Waxwing	Flycatcher spp.	Warbling Vireo
Brown Creeper	Pacific-slope Flycatcher	Western Tanager
Chestnut-backed Chickadee	Pine Grosbeak	Western Wood-Pewee
Chipping Sparrow	Pine Siskin	White-crowned Sparrow
Common Raven	Purple Finch	White-tailed Ptarmigan
Common Redpoll	Red Crossbill	White-throated Sparrow
Common Yellowthroat	Red-breasted Nuthatch	White-winged Crossbill

Common Name	Common Name	Common Name
Dark-eyed Junco	Red-breasted Sapsucker	Willow/Alder Flycatcher
Downy Woodpecker	Red-eyed Vireo	Wilson's Warbler
European Starling	Red-winged Blackbird	Winter Wren
Fox Sparrow	Rock Dove	Yellow Warbler
Gadwall	Ruby-crowned Kinglet	Yellow-bellied Flycatcher
Golden-crowned Kinglet	Ruffed Grouse	Yellow-rumped Warbler
Golden-crowned Sparrow	Rufous Hummingbird	
Gray Jay	Rusty Blackbird	

3.4.7 Amphibians and Reptiles

3.4.7.1 Methodology

In addition to reviewing available information from Rescan and others, Gartner Lee conducted field surveys in the spring and summer of 2007 for amphibians and reptiles. These surveys included ground-based assessments at the proposed ACB landing site and along the proposed access road to the ACB landing area.

3.4.7.2 Results

Rescan (1997) recorded amphibians as they were encountered in the field but did not conduct systematic surveys in the area. Based on literature reviews, five amphibians species occur within the Taku River: long-toed salamander (*Ambystoma macrodactlum*), roughskin newt (*Taricha granulosa*), western toad (*Bufo boreas*), Columbia spotted frog (*Rana luteiventris*) and wood frog (*Rana sylvatica*) (Corkran and Thoms 1996, MacDonald 2003). Two species of reptiles, the common garter snake (*Thamnophis sirtalis*) and western terrestrial garter snake (*Thamnophis elegans*) could potentially be found in the area (Gregory and Campbell 1984, MacDonald 2003).

Amphibian and Reptile Species at Risk

The only amphibian species at risk in the area is the western toad, which is listed as a species of Special Concern by COSEWIC (2006b) and there are no listed reptile species expected in the area. None of the amphibian or reptile species expected or known in the Alaska portion of the Taku River are listed in the state of Alaska (US FWS 2005b).

During the work conducted by Rescan (1997), adult western toads were found to be abundant in the Tulsequah area, particularly in the back channels and wetlands along the floodplains of the Tulsequah and Taku Rivers. Western toad was noted in at least 20 locations and sightings included eggs, tadpoles, toadlets, and adults. No details regarding the locations of the breeding areas were provided. During the work conducted by Gartner Lee, adult western toads were found near the proposed ACB landing site and along Maple Ridge, near the proposed road alignment. Western toad eggs were also observed in Big Bull Slough northeast of the ACB landing site.

Western toads are found throughout southeastern Alaska including the Taku River valley (MacDonald 2003). Carstensen *et al.* (2003) found western toad adults and tadpoles during

amphibian surveys conducted near Canyon Island, in a pond in the high-water channel on the eastern side of Canyon Island and in three ponds higher up on the floodplain. They have also been noted in wetlands near the Wright River, Sittakanay River, Sockeye Creek and the upper portion of Taku Inlet (Carstensen *et al.* 2003).

Other Amphibian Species

Surveys conducted by Rescan (Rescan 1997) found Columbia spotted frog, wood frog, and long toed-salamander within the study area. Spotted frog was observed in Shazah Slough, Flannigan Slough and the floodplain of the upper Tulsequah River. Wood frog was observed at the confluence of Twin Glacier Creek and Taku River and at Maple Ridge. A long-toed salamander was observed near Big Bull mine. Surveys conducted by GLL in June of 2007 found spotted frog in the vicinity of the proposed access road and ACB landing area. Columbia spotted frog was found breeding in Big Bull Slough and the wetland complex located along the east side of the Tulsequah River about 4.5 km upstream from the confluence with the Taku River. Adult spotted frog were also observed in a number of areas as incidental sightings during other assessment work. No rough-skinned newts have been observed in the BC portion of the ACB transportation route.

In Alaska, spotted frog tadpoles and adults were found in ponds near Canyon Island and Yehring Creek in the Taku River in 2003 (Carstensen *et al.,* 2003). They have also been reported in several wetlands near Wright River, Sittakanay River, Moose Creek, and Sockeye Creek (Carstensen *et al.,* 2003). Unconfirmed observations reported in Carstensen *et al.* (2003) indicated that wood frogs have been observed near the upper portion of Taku Inlet. Localized populations have also been recorded near Juneau (Carstensen *et al.,* 2003) and on Douglas Island (MacDonald, 2003). Long-toed salamander larvae were observed in a high-water pond near Canyon Island and there are unconfirmed observations in wetlands near Wright River and Sockeye Creek (Carstensen *et al.,* 2003).

There are no records of the rough-skinned newt being found along the ACB transportation route in Alaska, however, the species has been observed in the area around Juneau as well as on nearby Admiralty Island (MacDonald, 2003; Carstensen *et al.,* 2003).

Reptile Species

No reptile species have been observed within the ACB transportation route in either BC or Alaska.

3.4.7.3 Summary

Overall, a wide range of amphibian aquatic and terrestrial habitats is available within and adjacent to the ACB transportation route. Although only a single breeding area was identified for western toad, adult toads were observed in numerous terrestrial habitats on Maple Ridge and Big Bull Slough. Spotted frogs and their breeding areas were common within the wetland aquatic habitats adjacent to the Tulsequah and Taku Rivers including Big Bull Slough. Wood frogs and long-toed salamander newts were also documented in the wetland areas of portions of the ACB

transportation route. Reptiles were not documented, identified nor recorded during any reviews or surveys conducted in this area. Although there is a potential for garter snakes to occur here, their range may be limited by the lack of appropriate over-wintering habitats.

3.5 Human Activities – Canada

The following sections describe the various human activities that occur along the proposed ACB transportation route within Canada. As the Canada/US border somewhat restricts the casual movement of people between the two countries, it is appropriate to discuss those activities that occur within each country separately, although many of these activities occur on both sides of the international boundary and are regulated (or not) in different ways.

3.5.1 Fisheries

3.5.1.1 Commercial Fishery (Drift Net Fishery)

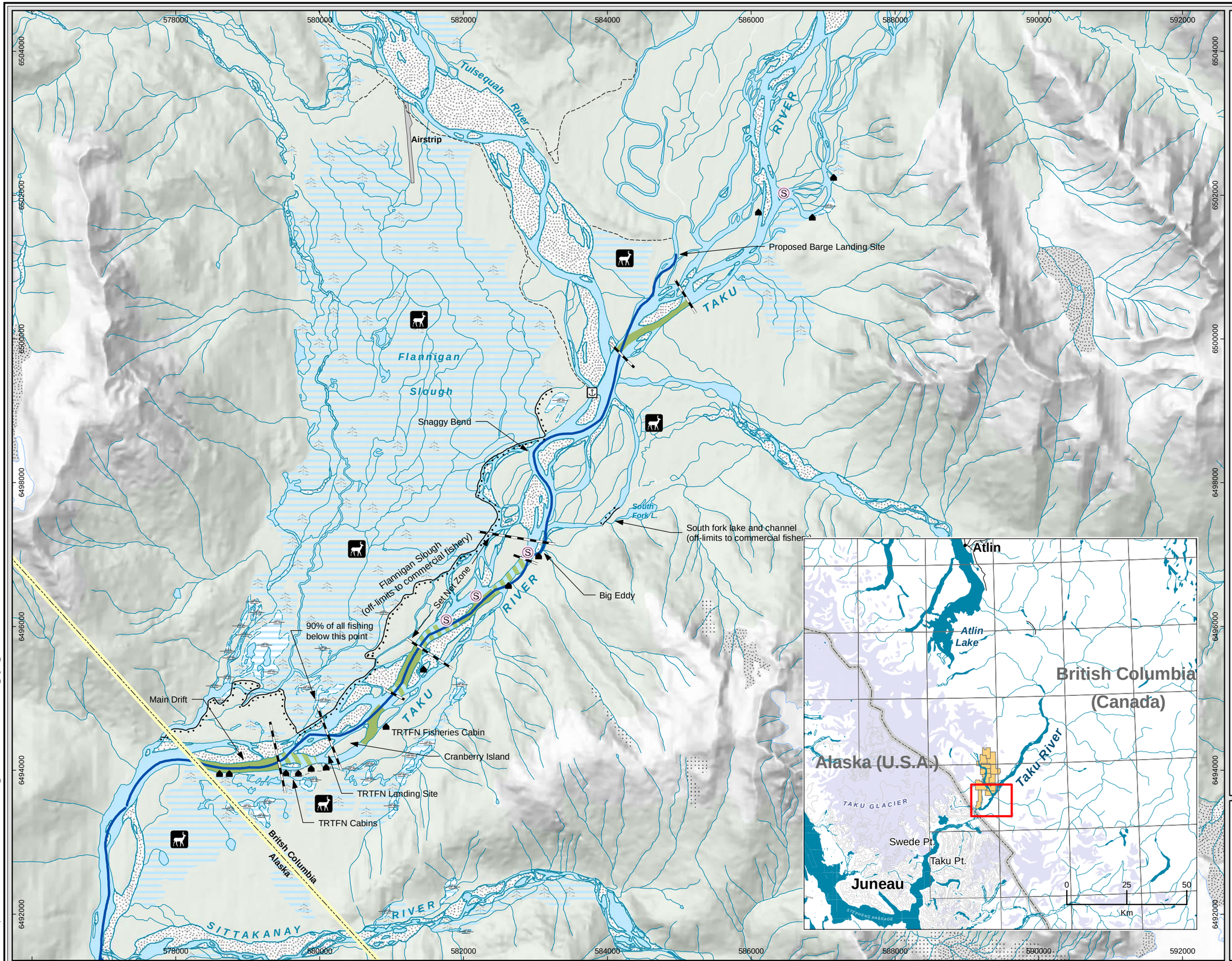
The commercial fishery on the Taku River system was established in 1979. Currently there are sixteen commercial licences available, eight of these are held by the Taku River Tlingit First Nation (TRTFN) and eight are held by non-First Nation Canadian fishermen. Fishing camps are located along the river as shown on Figure 3-11 – five of these are TRTFN camps, and seven are operated by other fishermen. Gear consists of drift and set gill nets.

The Taku River commercial fishing area extends from just upstream of the international border to approximately 18 km further upstream (see Figure 3-11). The fishery in Canada is focused on the mainstem of the river within 2.5 miles of the Canada/US border, where the boats line up and take turns drifting nets down the deepest part of the main channel (see Figure 3-11). The fishermen will use one drift net, sometimes with a set net, or use two set nets. The drift zone may extend a mile further up river during high water, as the boats follow the fish upstream. Set nets are not often used due to the reduced quality of the fish caught. Set nets are set in eddies along the shore, and will be avoided by the ACB route.

The commercial fishing area does not include Flannigan's Slough and South Fork Lake and outlet channel.

Taku Wild Food, a company owned and operated by the TRTFN, operates the landing site at Cranberry Island, supplying ice to the fishing boats and buying some of the total commercial catch. The landing station is located just upstream of the border on Cranberry Island, and it handles commercially caught salmon. Fish are then transported to commercial buyers via air to Atlin, B.C. or by boat to Juneau, Alaska. Marketed products include fresh-frozen, fresh, and smoked salmon.

The commercial fishery usually commences the second or third week of June and continues through September, concentrating almost exclusively on the sockeye salmon run that starts in early June, peaks in July and trails off by mid-September. The sockeye fishery typically opens on the 3rd Sunday of June. There is also a small king (Chinook) salmon fishery (limited to 1400 fish) that



Legend

- Proposed Barge Route
- Boat Takeout
- Individual cabin
- Areas with multiple cabins
- Moose Habitat

Commercial Fisheries

- Drift - General use
- Drift - TRTFN used/identified
- Limits to commercial fishery
- Extent of commonly used river reaches for commercial fishery
- Set Nets

Map Sources/Notes:
- Human impact information digitized from hand-drawn sketches

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UTM Zone 8N, NAD 83

File Name: 70142_Figure_3-10.mxd

Reviewed By:	FP	Prepared By:	MP
Date Issued:	August, 2007	Project Number:	70-142

Redfern Resources Ltd.

Project: Tulsequah Chief Mine
Location: Northwest British Columbia

Human Activities on the Taku River - Canada

Gartner Lee

Figure 3-11
Version 1

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Date Revised: August 28, 2007
Date Plotted: September 4, 2007

opens between late May and early June. This test fishery is conducted to monitor the stock. Coho salmon are caught incidentally; the run starts at the end of July and peaks in September. The pink salmon run coincides with the sockeye run, but there is little market for these fish so if they are caught incidentally, they are not generally kept.

Most of the non-First Nations commercial fishermen will fish from mid-May to late August. Openings run from Sunday at noon for 24 to 96 hours, as determined by Fisheries and Oceans Canada. Many of the commercial fishermen take their catch to Juneau to sell and to re-supply following the close of a week's fishery. Very little fishing, if any, is done during high water, such as spring freshet or a jökulhlaup.

3.5.1.2 Sport Fishing/Charter

There is limited sport fishing along ACB route within Canada. These activities, where they do occur on the Taku River within Canada, are much further upstream and are linked to the wilderness fishing opportunities offered by guide outfitters or fly-in fishing operators based in Atlin or Whitehorse.

3.5.1.3 Personal Use Fisheries

There is minimal personal use fishing on the Canadian side of the border, given the challenge of access to the area. There is likely some incidental impact on other recreation activities, such as rafting trips.

3.5.1.4 Subsistence Use

There is a food fishery carried out by the TRTFN commercial fishermen following closure of the commercial fishery. This fishery is done in conjunction with the commercial fishing, however transporting the fish by air back to Atlin is very costly at this time. There is a larger focus on the coho run and the TRTFN remain active on the river until September. There are no other subsistence fishermen.

3.5.2 Recreation and Tourism

3.5.2.1 Commercial Wilderness Tourism (rafting; canoeing)

Wilderness canoeing, rafting, and kayak trips have been offered on the Taku River by a number of wilderness tourism companies for at least a decade. In 2003, five companies offered trips (Equinox Wilderness Expeditions, Nahanni River Adventures, Rivers Oceans and Mountains (ROAM), River League Wilderness Rafting Expeditions, Canadian River Expeditions). However, in 2006, only one commercial trip was conducted. One other scheduled trip were cancelled, likely due to lack of interest. Nahanni River Adventures and Canadian River Expeditions jointly offered one whitewater canoe trip this past season (2007). Great Expeditions also offers a Taku River raft and kayak trip. ROAM does not offer a scheduled Taku trip but will offer custom trips if requested.

Most commercial trips take up to 10 to 12 clients, although this will vary to some degree. All trips are fly-in trips originating in Atlin, B.C., and begin at the Shesley River, a tributary of the Inklin River. The trip proceeds down the Nakina and Taku rivers, passing the Tulsequah confluence around Day 7 of the 10 to 14 day trip. Each company offers only one or two trips each summer in July and August. Trip costs average $4000/person. All the Canadian groups take out at the confluence of the Tulsequah and Taku Rivers, and are then flown out from the airstrip at the old Tulsequah townsite on the west side of the river. Trips originating in the US continue downstream and complete the journey at the Taku Lodge in Taku Inlet (Alaska) where clients are flown out to Juneau.

3.5.2.2 Commercial Lodges

There are no commercial lodges operating along the ACB route on the Taku River within Canada. Many kilometres upstream of the confluence with the Tulsequah River, Taku Safari runs a base camp lodge for their guided hunting trips (see Section 3.6.3).

3.5.2.3 Recreational Use

Casual recreational use along that portion of the Taku River corridor between the ACB landing site at the confluence of the Tulsequah River and the Canada/US border is very limited, primarily due to the limited access available on the Canadian side of the border, and the access restrictions imposed by the international border itself. While some transboundary travel does occur, it is very limited.

Sightseeing by aircraft does occur as an incidental activity to other wilderness tourism, but is limited. Winter recreation activities, such as snowmobiling and heli-skiing are located closer to the BC towns of Smithers and Atlin. Given the remoteness of the area, such activities are rarely pursued, especially along the Canadian portion of the ACB route. A heli-ski operation has operated in the last few winters and is based across the Tulsequah River near the Canarc minesite.

3.5.3 Big Game Outfitting; Resident Hunting

3.5.3.1 Big Game Outfitting

Taku Safari Inc., based in Atlin, B.C., is the primary guide outfitter in Wildlife Management Unit 6-26, which contains the Nakina, Inklin and Taku watersheds. The hunting area covers an expanse of over 15,500 km^2. They have a base camp lodge on the Taku River well beyond the study area, satellite hunt camps at several locations in the mountains, and a fishing lodge on an unnamed lake. All of these facilities are distant from the study area. Access is via float plane from Atlin to maintain the exclusive wilderness atmosphere for clients. From April until November, guided hunts for grizzly bear, black bear, moose, mountain goat, stone sheep, caribou, and wolf, as well as lake and river fishing are offered. Fishing trips and other incidental recreation opportunities are also offered to clients during this time. Guided hunting activity in higher elevations is focused along the eastern slopes of the Coast Mountain range far removed from the study area, however some bear and moose hunting activity does occur at lower elevations in back channels and sloughs.

Four other guide outfitters are licensed to operate in this wildlife management unit, as of October 2006. These outfitters are based in Smithers, Dease Lake and Telegraph Creek.

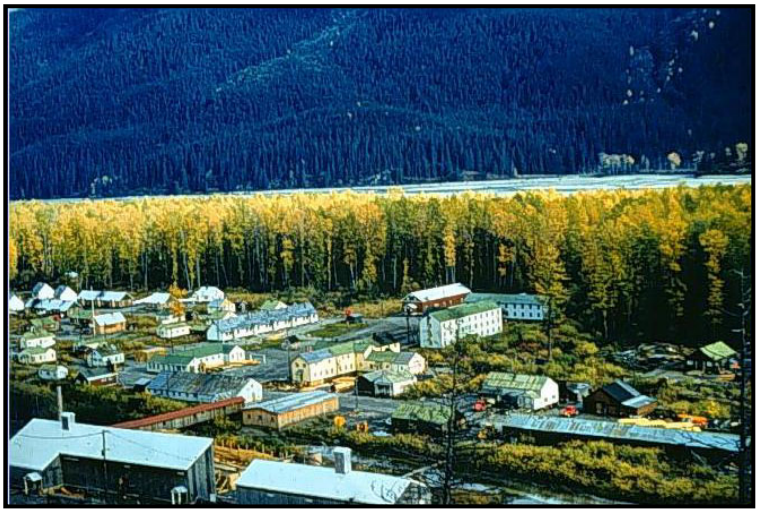
3.5.3.2 Resident Hunting (Moose; Bear)

BC Management Unit 6-26, within which the lower Tulsquah and Taku floodplains are located, is a large area (18,982 km^2), with the Taku/Tulsequah floodplain areas encompassing approximately 0.7% of the management unit area. The area is also relatively inaccessible, so the wildlife harvesting from this area is likely also limited. A discussion of wildlife harvesting, based on data for the entire Management Unit, is included in Section 3.5.5.

3.5.4 Mining

The Tulsequah and Taku valleys have a history of mining exploration dating back to the 1800s. Knowledge of the Tulsequah Chief deposit is reported to date back as far as 1910. In 1929, the Big Bull deposit was discovered, followed by the discovery of the Whitewater deposit on the west side of the Tulsequah River.

Exploration work continued in the area, and in 1937, the Polaris-Taku Mine was brought into production. This mine operated continuously until 1951, producing a total of 231,000 ounces of gold during that time. The work force at the mine varied from 120 to 200. These people lived in the town of Tulsequah, many with their families.



1950s photo of the former Tulsequah townsite located at the Polaris-Taku mine

In 1947, Cominco Ltd. initiated exploration and pre-production work at the Big Bull and Tulsequah Chief deposits, and roads were built to connect the two minesites to the Taku River. In 1951, the Polaris-Taku mine was closed just as the Big Bull and Tulsequah Chief mines were opening. Mining continued successfully here until 1957, producing an average of 482 tonnes per day. When metal prices dropped, the mines were closed and the mill equipment sold.

3.5.4.1 Exploration and Mineral Development

Exploration projects in the area consist of Redfern's Big Bull and Tulsequah Chief Project and Canarc Resource Corporation's New Polaris Project.

In 1981, Redfern commenced exploration in northwest British Columbia and staked a block of claims surrounding Cominco's block of claims over the Tulsequah Chief mine. Eventually an agreement was signed between Redfern and Cominco to continue exploration in this entire area. Work started in 1987 with surface diamond drill holes, and continued each year until 1992 when Redfern purchased Cominco's interest in the property. Advanced mineral exploration at the Tulsequah Chief and Big Bull mines continues to this day with Redfern conducting over 8,000 m of drilling in 2007.

The Polaris-Taku site also has been the site of active and intermittent mineral exploration since the late 1980s. The property is currently held by Canarc Resource Corp. and is in the preliminary exploration phase.

3.5.4.2 Exploration Potential

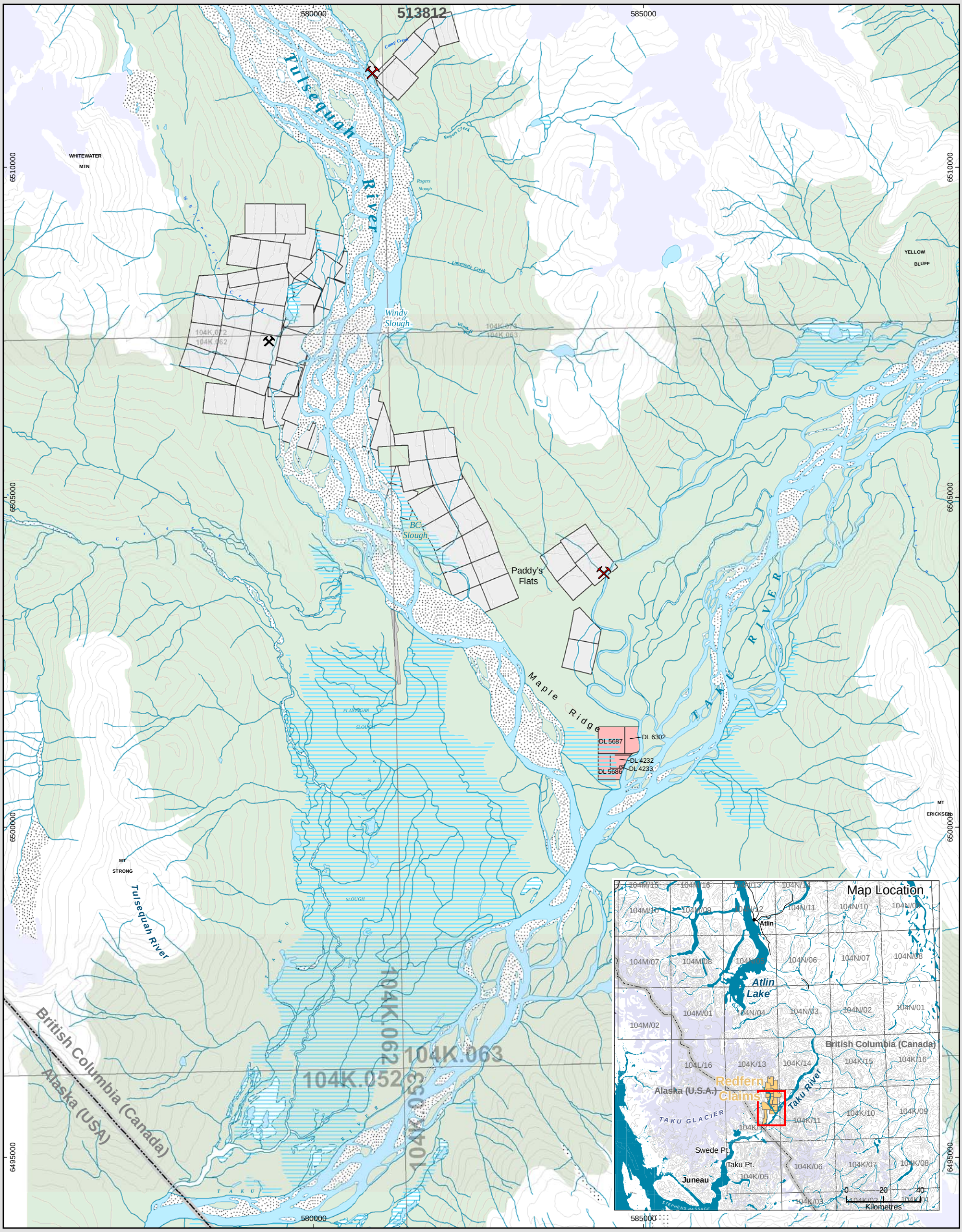
There are a total of 26 mineral occurrences in the study area (lower Taku River in Canada and Tulsequah River watersheds). Of these, four are past producing mines (Tulsequah Chief, Big Bull, Banker and New Polaris), two are prospects and the remainder are mineral showings. Active mineral claims cover most of the Tulsequah River valley and Taku River valley downstream of King Salmon River.

3.5.5 Land Ownership

Land within the study area is largely Crown land. The only privately owned lands are five District Lots owned by Redfern and one other individual. These lots are located at Big Bull Landing (Figure 3-12) near the proposed ACB landing site. There are a number of Crown Grants along the Tulsequah River and in the Big Bull area. These Crown grants are held by Redfern and Canarc Resource Corporation in association with their respective properties.

3.6 Human Activities – Alaska

Existing human activities that may overlap with the proposed ACB transportation system are identified in the following paragraphs. Activities of concern are commercial fisheries, sport fishing, personal use fisheries/subsistence, commercial tourism, dispersed recreation, and the interface with private property owners on the Taku River. Generalized location of human use activities are shown on Figure 3-13.



Map Sources/Notes:
Basedata TRIM (1:20,000)
Exploration road alignment (cartographic representation by Gartner Lee Limited), Wardop Engineering
Mine layout, Wardrop Engineering
All other data, Gartner Lee Limited

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Legend

- Crown Grants
- Titled Land
- Swamp / Marsh
- Sandbar
- Glacier

File Name: 70142_Figure_3-12.mxd
Reviewed By: FKP
Date Issued: August 2007
Prepared By: GS
Project Number: 70142

Redfern Resources Ltd.

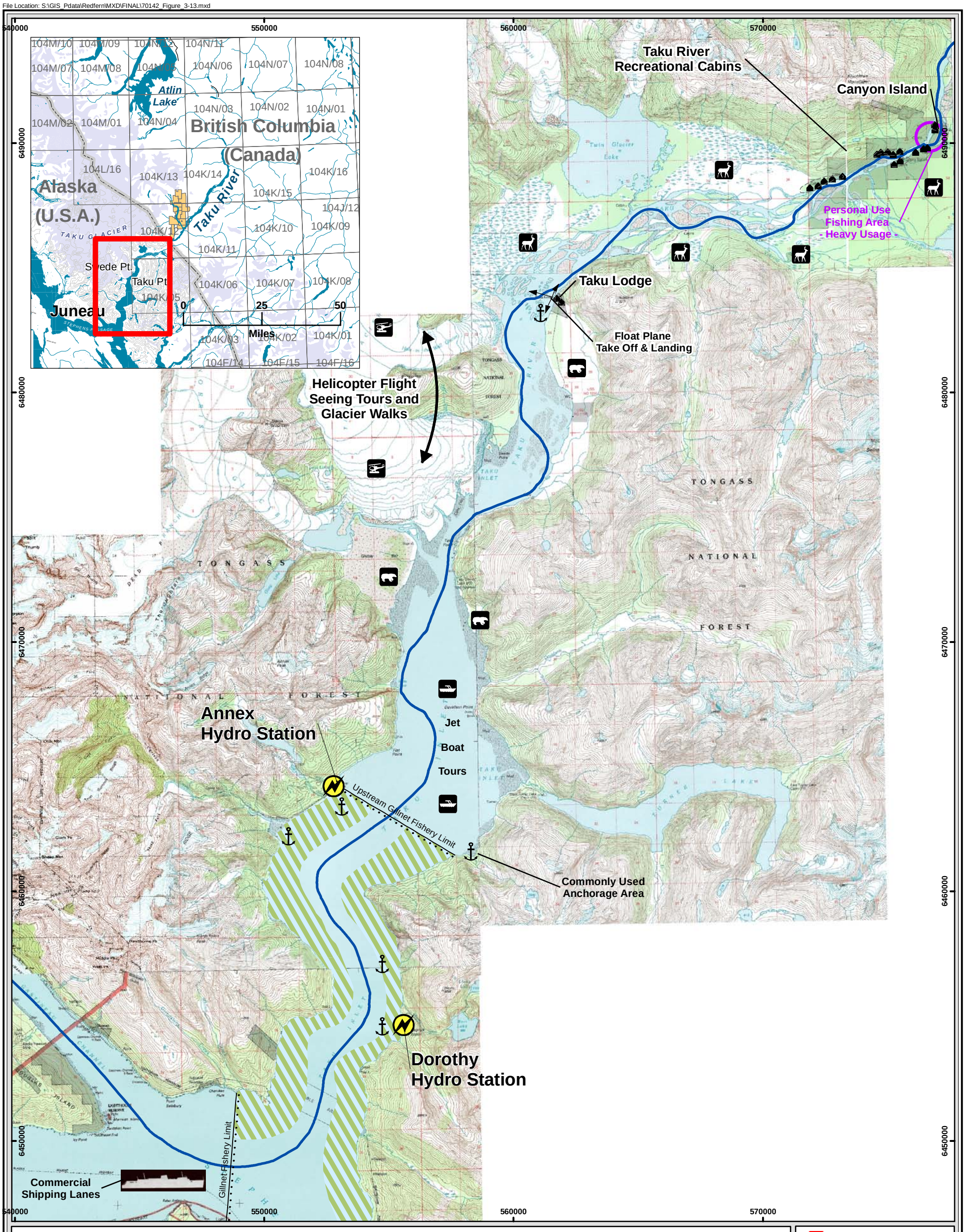
Land Tenure on the Taku & Tulsequah River Area

28 August, 2007

Gartner Lee

Figure 3-12
Version 1

File Location: S:\GIS_Pdata\Redfern\MXD\FINAL\70142_Figure_3-13.mxd



Map Sources/Notes:
- Topographic Images derived from Digital Raster Graphic (DRG) Images produced by the USGS
- Human impact information digitized from hand-drawn sketches

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File Name: 70142_Figure_3-13.mxd
Reviewed By: FP/KW
Date Issued: August 2007
Prepared By: JW
Project Number: 70142

Legend

- Proposed ACB Transportation System Route
- Hydroelectric Station
- Cabins
- Anchorage from Juneau State Land Plan
- Bear Habitat and Hunting
- Moose Habitat and Hunting
- Heavily Used Areas of Gillnet Fishery
- Limits of Commercial Fisheries

Redfern Resources Ltd.

Human Use Activities on the Taku River and Taku Inlet, Alaska

28 August 2007

Gartner Lee

Figure 3-13
Version 1

3.6.1 Fisheries

3.6.1.1 Taku/Snettisham Gillet Fishery (District 11)

The District 11 gillnet area encompasses Section 11-B (Taku Inlet, Port Snettisham, and Stephens Passage north of Midway Island) and Section 11-C (Midway Island south to a line from Point League to Point Hugh). This fishery has traditionally targeted sockeye salmon during the early portion of the season and fall chum and coho salmon later in the season. In recent years, the fishery has also targeted hatchery summer chum and sockeye salmon. Since 2005, a directed Chinook salmon fishery will occur in District 11 when run strength is sufficient. This review will focus on that portion of 11-A involving the ACB route, as shown on Figure 3-13.

Commercial fishing in Taku Inlet is dominated by drift gillnetting for salmon. Gillnetters set curtain-like nets in the water suspended from a float line at the surface and a weighted lead line along the submerged bottom edge. Nets vary in length from 900 to 1,800 feet long. There are two types of gillnets; driftnets that are free floating from boats and set nets that have one end attached to the shoreline. The average boat size is 30 to 40 feet in length.

The Alaskan commercial gillnet fisheries does not occur in the Taku River. The extent of the fishery is limited to Taku Inlet with the upstream extent near Annex Creek (see Figure 3-13). The western limit across Stephens Passage is just west of Bishop Point. At the start of the opening, boats tend to line-up on one of the two boundaries, depending on the current direction, and then, at the time of the opening, begin to drift with the current. Generally, the fishery is more intensive near the sides of the inlet as opposed to the centre of the inlet.

There are approximately 480 limited entry permits in the southeast Alaska drift gillnet fishery of which 80 to 95% are actively fished each year. On average, there are 85 boats that participate in the Taku fishery each year, but this number varies from year to year. The drift gillnet fishery primarily targets sockeye, pink, and summer chum salmon during summer season and on coho and fall chum salmon during fall season. The Chinook salmon fishery in District 11 had been closed since 1975 in order to rebuild Taku River stocks. In February 2005, negotiations with Canada resulted in an agreed upon regime that would allow directed Chinook salmon fishing in District 11 for the first time in 30 years.

The management goals for the 2007 Taku/Snettisham drift gillnet fishery are as follows:

a) provide for sufficient salmon spawning escapements to Taku River, Port Snettisham, and Stephens Passage streams while harvesting those fish in excess of escapement needs;
b) monitor incidental harvest of Chinook salmon to stay within the drift gillnet allocation of 2.9% of non-Alaska hatchery Chinook salmon;
c) manage the fishery consistent with current provisions of the Pacific Salmon Treaty (5 AAC 33.361); and

d) manage the District 11 directed Chinook salmon fishery to harvest large adult Chinook salmon in accordance with the Pacific Salmon Treaty and the District 11 Chinook salmon management plan.

The District 11 gillnet fishery will be managed in accordance with the Pacific Salmon Treaty. Harvest sharing arrangements for Chinook, sockeye, and coho salmon through the 2008 fishing season are specified in the Treaty. Specific management goals for salmon are as follows:

Chinook Salmon The 2007 pre-season forecast of 38,700 large Chinook salmon was insufficient to open the District 11 drift gillnet Chinook salmon fishery at the beginning of May.

Sockeye Salmon The District 11 fishery will be managed through mid-August primarily on the basis of sockeye salmon abundance. Run strength will be evaluated using fishery catch and CPUE data and weekly in-river run size estimates derived from the Taku River fish wheel mark-recapture project operated at Canyon Island. Subsequent openings will be based on in season fishery performance and stock assessment information.

Beginning in mid-August, management of the Taku/Snettisham gillnet fishery will be based on the run strength of coho and fall chum salmon. The Pacific Salmon Treaty requires the U.S. to manage its fisheries to achieve a minimum above-border run size of 38,000 coho salmon. Coho salmon is the primary species managed during the fall season, but area and time restrictions may be necessary to further protect the weaker fall chum salmon returns.

3.6.1.2 Taku/Snettisham Troll Fishery

Trollers primarily target king, coho, and pink salmon. Boat size varies from small skiffs to vessels of 50 feet or more with most ranging between 25 to 40 feet. Trollers catch a relatively low volume of high-quality fish. No directed king salmon troll fishery was planned for District 11 in 2007 due to forecast low returns of large fish.

3.6.2 Sport Charter and Personal Use Fishery

In addition to the commercial salmon harvest, Taku River salmon are also caught in the Juneau area sport fishery and personal use fishery. There are on average 130 personal use permits

issued. Residents are limited to two Chinook per day, and one fish per day with a three fish annual limit for non-residents. The seasonal limit is five sockeye per person, or ten per household. The personal use fishery occurs in July.

There is intensive use of the personal use fishery just downstream of the narrows at Canyon Island. The upper limit of the personal use fishery is the narrow at Canyon Island, and the lower extent is just upstream of Taku Lodge. During this fishery, nets are typically set in eddies, just downstream of the narrow. During the most intensive usage of the personal use fishery, the nets are pervasive in this area and are reported to almost completely block the channel, creating a navigational hazard.

Sport fisheries in the Juneau area harvested significant numbers of Chinook and Coho salmon originating from the Taku River. The percentage of Chinook salmon from the Taku River has ranged from 56 to 93% of the total spring sport catch volume from the Juneau area since 1994, with a ten-year average of 73%. Taku River Chinook account for a significant portion of the total catch from Juneau waters.

In some years, the Taku River contributes in excess of 50% of the coho salmon harvested in the Juneau recreational fishery. Since 1994, Taku River cohos have accounted for between 16 and 66% of the total sport catch in the Juneau area with the average approximately 34%. The Taku River contributes on average 2,669 Chinook and 8,345 Coho to the sport fishery each year.

3.6.3 Fisheries Research

The ADF&G conducts annual ongoing research on the Taku River, which is necessary for active management of the commercial and sport fisheries on the river. Given that the Taku produces the largest runs of Chinook and coho salmon in southeast Alaska, the ongoing study and management of the fishery is of particular importance. The research activities include: 10 to 12 fish counters or ADF&G personnel at two campsites, boat traffic to capture juvenile and adult salmon, juvenile salmon traps set over miles of the lower river and maintained daily from April to early June, juvenile salmon holding net pens and two fish wheels and gillnets at Canyon Island. The fish wheels are set on either bank of the river, approximately 200 m apart and are used for, among other research, Coho stock assessment. The river narrows significantly at Canyon Island and the flow is forced through a deep bedrock channel, which is ideal for a fishwheel (McPherson *et al.*). Facilities for fisheries research in this area have been in place since 1950 (Juneau State Land Plan). In addition, the National Marine Fisheries Service (NMFS) has been issuing permits for operating four fish traps along Taku Inlet near Grizzly Bar (Juneau State Land Plan).

3.6.4 Hunting

3.6.4.1 Mountain Goat

The ADF&G estimates an average of four mountain goats harvested annually by an average of 11 hunters in the mountainous areas above the Taku River. Hunting for mountain goat takes place in August, September, and October, with September as the busiest month. Access to mountain goat hunts begins by floatplane or boat. Ninety percent of goat hunters are residents of Alaska. There are few, if any, guided hunts for mountain goats in this area.

This is a dispersed activity on mountains and will be away from the mainstem of the Taku River

3.6.4.2 Moose

Approximately 45 moose are harvested annually by an average of 82 hunters. Guided hunts for moose in the Alaska Taku River area are nearly nonexistent.

Moose hunting is a dispersed activity and occurs primarily in the sloughs and wetland complex off the Taku River mainstem. Major wetland/slough complexes that are used for moose hunting include the wetlands north of Moose Slough, Sockeye Creek wetlands, Johnson Creek wetland, Yehring Creek wetlands and the wetland complex south hand east of Canyon Island. Boat access of the Taku River is typically used to access these areas.

3.6.4.3 Bear

In Alaska, grizzly bear harvesting within GMU sub-area 1C has varied from one to seven animals from 1985 to 2003 with an average of 4 bears being harvested per year. Seventy percent of the harvest takes place during the spring season while the other 30% takes place in the fall. Bear hunting is a dispersed activity with no specific areas.

As in BC, the proportion that the lower Taku River encompasses of the total sub-area is relatively small (~0.02%), with limited access other than by boat, likely limiting the number of harvested bears from this area.

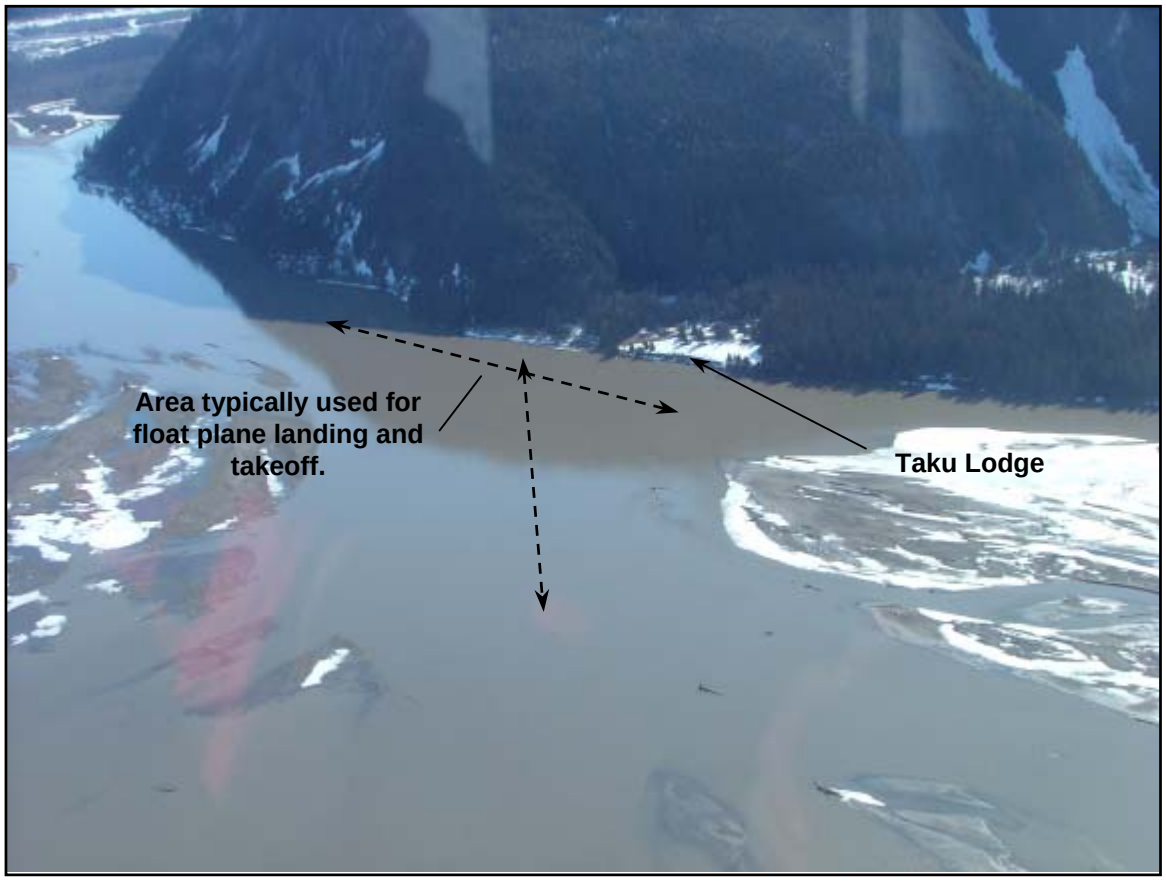
3.6.5 Commercial Tourism

3.6.5.1 Commercial Lodges

The Taku Glacier Lodge is the only commercial lodge located within the study area, and offers flightseeing and salmon bake during the summer season. Overnight lodging is not offered. Approximately 13,000 visitors visit the lodge during the summer season that extends from early May until the end of September. Visitors to the lodge are flown in by floatplanes from Juneau, landing and taking off on the mainstem of the river immediately in front of the lodge (see Figure 3-14). During the height of the tourist season, there are six or seven aircraft landing and taking off approximately every two hours throughout the day as guests are ferried between Juneau and the

lodge. Many of the guests are traveling on cruise ships that visit Juneau as part of the Alaskan tour. The flightseeing component is the most significant economic activity generated by the Taku Glacier Lodge.

Figure 3-14. Taku Lodge and Float Plane Landing Area



3.6.5.2 Commercial Fixed Wing Flightseeing

Air Excursions flies a small amount of on-demand flightseeing tours during the summer. Wings of Alaska offers flightseeing in the Taku area. Wings Airways also provides transfers to Taku Lodge with a flightseeing component. Additional companies that provide flightseeing as a relatively small part of their overall operations include Alaska Seaplanes, Haines Air, and LABORATORY Flying Service.

In addition to their flightseeing tours, Coastal Helicopters Inc. also operates charters to the Taku area. TEMSCO Helicopters Inc. does charter business with the USFS in the Taku area. AK Seaplane Service typically flies to the Taku area twice a year on charter flights.

Over 60,000 visitors participate in some type of flightseeing or glacier landing tour in the Taku River area on a yearly basis. The average price of all air tours was approximately $220.00 per person. Including other charter flights, the approximate retail value of all commercial aircraft activity in the area was approximately $13 million in 2003.

3.6.5.3 Rafting, Canoeing, and Kayaking

There are several wilderness guiding companies that offer rafting, canoeing, and kayaking trips along the Taku River. These river excursions are typically 10 to 14 days in length and cost an average of $3,000 per person. See Section 3.6.2 for further discussion.

3.6.6 Dispersed Recreational Use

Taku Inlet and the Taku River are heavily used for recreation in the summer and some moderate use in the winter months. Recreation activities are generally dispersed and consist of hiking, camping, river rafting, fishing, and hunting. People travel to this area from Juneau by boat on day and overnight trips to view marine mammals and raptors. Winter activities are limited due to the difficulty of accessing the area at this time of year. Cabin owners on the river occasionally snow mobile from their cabins, although there is no overland means of accessing the river at this time.

3.6.7 Mining and Mineral Exploration

There are federal mining claims on the uplands adjacent to Grizzly Bar (subunits 14a1, 14a5, 14a6, 14a46, and 14a60). There are also numerous federal mining claims on the uplands in the Sheep Fork Creek, Carlson Creek, and Annex Creek drainages. State mineral locations are on state tidelands at the mouth of Carlson Creek and the state tidelands between the power plant and Scow Cove.

Base and precious metal mines in the Tulsequah area of British Columbia, 15 miles up the Taku River from the US/Canada border, were serviced by barges from Juneau in the 1950s.

3.6.8 Land Ownership and Private Land Holdings

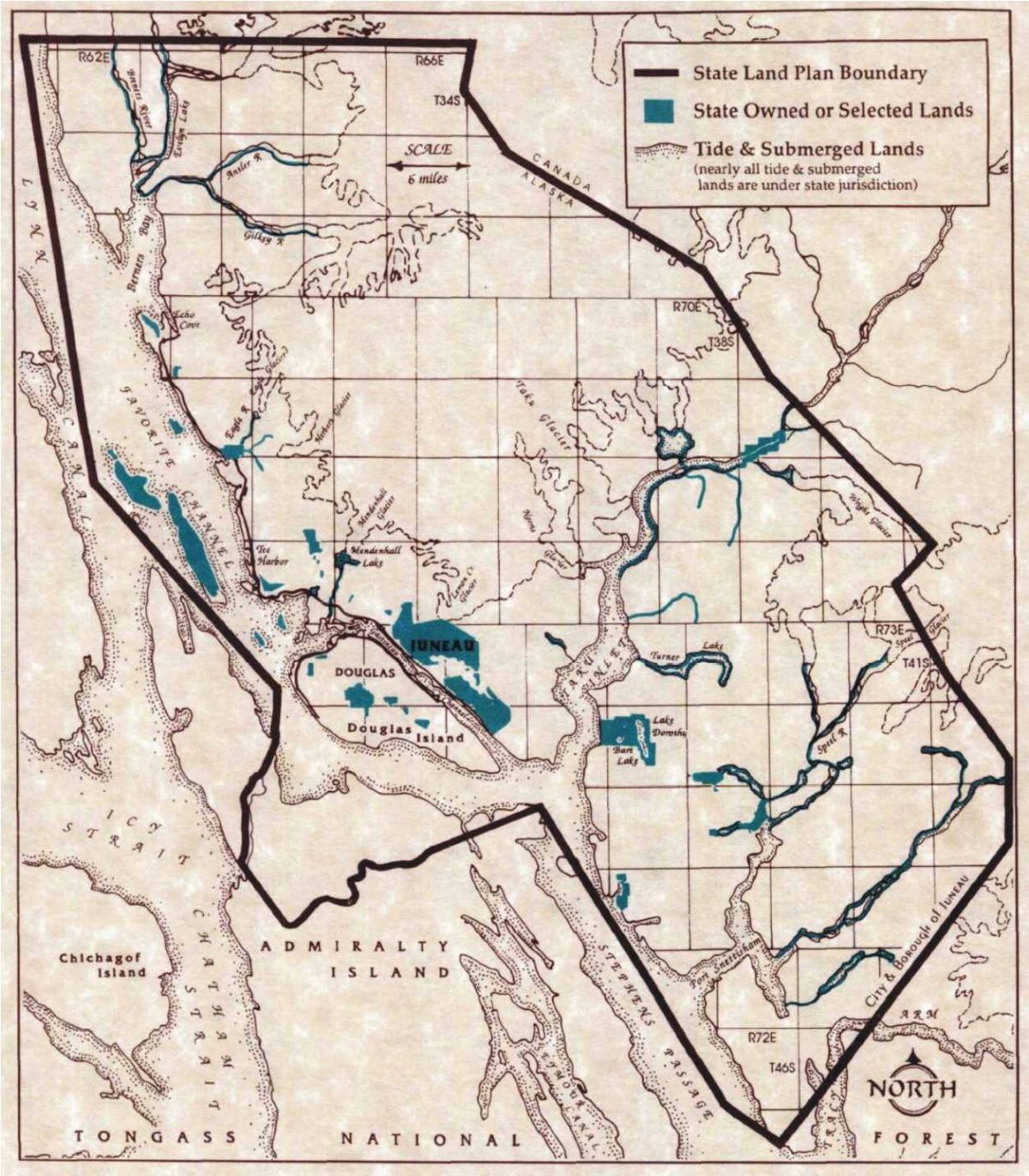
The tidelands, submerged lands and shorelands along the proposed ACB route within Alaska are owned by the State of Alaska. The majority of uplands along the proposed ACB route are owned by the United States and managed by the US Forest Service. The proposed ACB route does not traverse US Forest Service Lands.

There are few private land holders on the lower Taku River. Most private holdings are located between the Taku Glacier Lodge and the Canadian/US border. The majority of private land is located from the area north of the Taku Lodge to the north end of Canyon Island. Generalized landownership in the Taku watershed is illustrated on Figure 3-15.

The Taku River recreation area contains 119 parcels with an approximate property value of $5.4 million. Some type of structure is present on 43 of these parcels. There are 29 parcels owned by the State of Alaska Department of Natural Resources with a total value of $1.8 million, none of which include structures.

The lower Taku River valley area contains 82 parcels with a total property value just over $1 million. There are three parcels that include structures and have a total property value of $587,000. The Taku Glacier Lodge is in this area and has a total value of $560,800.

Figure 3-15. Overview of State Land Ownership in Juneau and Taku River Areas



Note: From Juneau State Land Plan, Alaska Department of Natural Resources, 1993

4. Effects Assessment to Support the Project Approval Certificate Amendment in British Columbia

4.1 Transportation System Project Design and Assessment Approach

The design of the proposed ACB transportation system, both technically and operationally, as described in Volume 1, is integrated with the Environmental Assessment presented herein. Specifically, the environmental assessment approach that has been applied to the Tulsequah Chief Mine's ACB transportation system project is as follows:

1. Identification of issues and potential environmental effects.
2. Modification of system design and operation to avoid potential effects.
3. Where issues and/or potential effects cannot be completely avoided, further modification of system design and operation to reduce potential impacts.
4. Identification and implementation of impact-specific mitigation measures to reduce potential negative effects to acceptable levels.

This process of modifying the project design to avoid or reduce potential effects is referred to as "mitigation by design" and is the most effective, meaningful and robust means for reducing a project's potential negative social and environmental impacts. This "mitigation by design" process has been integrated into the development of the ACB transportation system as described in the Project Description (Volume 1). These "mitigation by design" elements are often overlooked as they are intrinsic to the project, but the following assessment documentation identifies many of these "mitigation by design" elements of the transportation system project. For example, the proposed route avoids many of the significant habitat areas in the Taku River valley, thus potential impacts associated with these habitats are avoided.

It should be recognized that the proposed ACB transportation system presents a viable opportunity to mitigate the single largest potential source of environmental and social impact associated with the Tulsequah Chief Mine - the 160 km Atlin access road. By eliminating the need for the Atlin access road, the associated mitigation measures and monitoring programs required to ensure the Tulsequah Chief Mine does not have a significant negative environmental effect is greatly reduced. This is discussed further in the "Context of Assessment" section provided below.

4.2 Scope of Assessment

For the purposes of the assessment and amendment of the Project Approval Certificate, the project activities associated with this proposed amendment include:

- year-round ACB operation on 11 km of the Taku River between the proposed landing site and the US/Canada border *as the alternative to a 450 kilometre truck haulage route to Skagway, AK via the Atlin access road;*
- construction of an ACB landing and loading facility located near the confluence of the Taku and Tulsequah Rivers; and
- upgrading of 8.5 km of exploration access road to an all-weather haul road between the minesite and the ACB landing site.

4.2.1 Temporal Scope

The temporal scope of the ACB transportation system project is year-round transportation, for the life of the Tulsequah Chief Mine, including construction and decommissioning. The current mine life is expected to be 8 years, plus one year of construction and an assumed one year of decommission/reclamation, for a total 10-year project. The project is to start in early 2008. *On average*, the ACB transits on the Taku River will comprise one round-trip daily, of a single ACB, year-round. The logistics and proposed scheduling of the operations are discussed fully in Volume 1, and incorporate estimated downtime due to poor weather conditions, maintenance and other possible interruptions to shipments.

4.3 Assessment Approach

This environmental assessment represents a focused, strategic assessment of the ACB transportation system as an amendment to the Tulsequah Chief Mine Project Approval Certificate. The assessment is focused only on new and/or changed project elements associated with the transportation system in Canada, including potential effects that may have transboundary implications. The assessment is generally a qualitative assessment, focused on key issues that have been identified through consultation with the public, First Nations, key stakeholders, and regulatory agencies. Specifically, the assessment identified the key issues or concerns, and assesses potential effects associated with those issues. This approach allows regulators and stakeholders to focus on the proposed changes in the mine project (in this case, the transportation system), ultimately leading to a more meaningful outcome and a better project.

4.3.1 Review Process

The Project Approval Certificate M02-01 for the Tulsequah Chief Mine Project requires that if Redfern proposes a change to the Project, that, in the opinion of the Executive Director has the potential for significant adverse effects, Redfern must provide the Executive Director with:

a) a notice of the proposed change; and
b) plans, analysis, records and other information necessary for an effective assessment by the Executive Director of the proposed change.

Redfern requested the amendment to the Certificate M02-01 in a letter on February 23, 2007. A Working Group (WG) has been established for the review of the proposed amendment, and includes representatives from the Taku River Tlingit First Nation, provincial and federal agencies, local government and representatives from the neighbouring jurisdiction (State of Alaska and US government agencies). The Douglas Indian Association was also invited to participate at the request of the Taku River Tlingit. A meeting of the WG was held on May 1, at which time Redfern presented the ACB concept, and the process for reviewing the proposed ACB transportation system was discussed. Subsequently, Redfern provided BCEAO with a draft of Volume 1 – Project Description that was distributed to the Working Group on May 8th for review. Since that time, the following steps have been taken in the process:

Table 4-1. Steps in the BCEAO Review Process (May – August 2008)

Date	Details
May 18	Draft Table of Contents for Volume 2 distributed to WG; comments requested by June 8th
June 20th	BCEAO extends deadline for comments on TOC until June 22
June 22	Redfern provides Issues Identification list for distribution to WG; this follows a meeting with TRTFN to identify issues and concerns
June	Comments on TOC received from: - Dept. Fisheries and Oceans Canada; - BC Ministry of Environment - BC Environmental Assessment Office - State of Alaska, Dept. Natural Resources - US Environmental Protection Agency; - US Dept. of the Interior; - US Coast Guard
June 22	Redfern advised BCEAO that there will be revisions to Volume 1, Project Description and will be providing a final Volume 1 for distribution to WG.
July	TOC revised to reflect input from agencies on Volume 2 TOC.
July –August	Redfern prepares Volume 1 and 2 for distribution to WG

While there are no firm instructions as to how to carry out an amendment under the BC process, BCEAO has indicated that this assessment will mirror a typical EA process, but incorporate flexibility as appropriate. There are other examples of amendments that provide guidance: the Brilliant Dam expansion and Wolverine Coal Mine are two examples of substantial amendments. The rationale for assuming this proposed amendment would be similarly handled (substantial amendment) stems from:

- transboundary interests; and
- public interest in the ACB access.

While the *Canadian Environmental Assessment Act* (CEAA) does not define procedures for amendments to CEAA screenings, it is assumed at this point in time that CEAA will be triggered by

the need for a Fisheries Act Authorization. The BCEAO and CEAA agencies have confirmed that if a federal review were needed, it would be a harmonized process with the BCEAO.

The manner in which BCEAO will address transboundary effects will depend to some degree on the assumption of parallel processes in BC and Alaska. This has, and continues to be the intention of both jurisdictions. BCEAO has indicated that they will defer to the Alaska State review process and findings, to satisfy the need to address potential transboundary effects.

4.3.2 Assessment Methodology

An issues-based approach was used for the assessment of effects associated with the proposed ACB transportation system. Key issues were identified through consultation with stakeholders in British Columbia and Alaska. A one-day workshop was held in Whitehorse with representatives of the Taku River Tlingit First Nation (TRTFN) to identify and properly describe their issues of concern. The assessment methodology involved the following steps:

1. Identification of issues and potential effects.
2. Assessment of opportunities for avoidance (e.g., can the potential effect be avoided through the design of the project).
3. Identification of specific mitigation opportunities if the potential effect cannot be fully avoided.
4. Conclusion as to the significance of any residual adverse effects.

For the most part, there is a wealth of information that exists on the resources of the Taku River, and this assessment relies heavily on this existing information and previous assessment work. Much of the previous work on the Tulsequah Chief Mine did extend from the Tulsequah Chief Minesite southward to the US/Canada boarder. Additional information downstream of the Canada/US boundary was provided by State and US agencies in Juneau. This previous work was then supplemented by literature review, local knowledge and experience of the project team and local residents' professional judgement. Information gaps were identified at an early stage in the assessment, and efforts were made to fill these gaps through field studies carried out during the winter, late spring, and summer seasons.

4.3.3 Context of Assessment

As stated in the introduction, the ACB transportation system is proposed as the preferred alternative over the previously approved Atlin access road. Therefore, the approved Atlin access road represents the fundamental basis from which assessment of potential effects associated with the ACB transportation system is measured against. Table 4-2 through Table 4-5, below, provide a succinct summary of potential effects associated with the Atlin access road, mitigation requirements and a comparison with the proposed ACB transportation system alternative.

Table 4-2. Context for Assessment: Physical Impacts

Access Option	Atlin Road		ACB Transportation System	Net Change in Potential Effect
Potential Impact	**Extent of Potential Effect**	**Scope of Mitigation Required**[1]	**Extent of Potential Effect**	
Footprint Associated with Access Option	■ 160 km of new road – total 370 ha cleared. ■ Upgrading of Atlin Public Highway (not quantified).	■ Reclamation of 160 km of road at mine closure, including revegetation, recontouring of cut and fill zones and removal of stream crossings structures.	■ 9.5 km of additional haul road required (includes 1km spur road to container storage area)- total 25 ha disturbed, including ACB landing site and container storage yard.	■ 92% reduction in footprint and road reclamation requirements. ■ Avoids any requirement for upgrade to Atlin Public Highway directly related to the Project. ■ Avoids any impact to Yukon and Alaskan Highways.
Climate Impacts Associated with Access Option	■ CO_2 emissions.	■ None.		
Noise Impacts Associated with Access Option	■ 2.2 million VKT of wildland potentially affected annually by noise (based on 160 km of new road). ■ 1,190 people in Atlin, Marsh Lake/Whitehorse South and Carcross potentially impacted by 37 additional truck passages daily.[2]	■ Trucks to be equipped with industry standard mufflers. Trucks to stay within Transport Canada guidelines for noise levels.	■ 182,460 VKT of wildland potentially affected by noise annually (based on 12 km of haul road and 11 km of river in Canada). ■ Assume 10 year-round equivalent residents on Canadian portion of Taku River affected by 10-truck equivalent passages daily.[3]	■ 92% reduction in wildland potentially affected by noise annually. ■ 99.8% reduction in potential person-truck noise events daily.
Hydrology	■ 69 stream crossings.[4]	■ Stream crossing structures to be designed to pass flow from 100-year flood event.	■ 6 stream crossings.	■ At least 90% reduction in stream crossings required.
Water Quality	■ Potential for vehicle mishap: 15 million VKT annually.[5]	■ Development and implementation of Spill Prevention and Contingency Plan.	■ Potential for vehicle mishap: 363,300 VKT travelled annually.[6]	■ 98% reduction in potential vehicle mishap or accident opportunities.

1. *Generally as proposed in Project Report, Rescan 1997.*
2. *Noise impacts associated with mine access not described in original environmental assessment. Populations from 2005 Yukon Bureau of Statistics.*
3. *Assume each ACB transit is equivalent to 5 highway trucks.*
4. *From Project Committee Report (BC Environmental Assessment Office 1998), however actual number of stream crossing identified during detailed design is substantially higher.*
5. *Water quality impacts associated with mine access were not described in original environmental assessment. For the purposes of this discussion, it is assumed that access related water quality impacts would be related to a vehicle accident or malfunction. Number of vehicle kilometres travelled is assumed to represent a relative measure of potential for mishap or accident.*
6. *Assume each ACB trip represents three vehicle trips (1 tug, 1 ACB and 1 ancillary/support vessel).*

Table 4-3. Context for Assessment: Biological Impacts

Access Option	Atlin Road		ACB Transportation System	Net Change in Potential Effect
Potential Impact	**Extent of Potential Effect**	**Scope of Mitigation Required[7]**	**Extent of Potential Effect**	
Fish and Fish Habitat – Habitat Loss Associated with Project Access	■ 69 stream crossings.[8] ■ No locations requiring Fisheries Act Authorization for harmful alteration, disruption or disruption of fish habitat.	■ Stream crossings to be constructed in accordance with DFO Guidelines for Stream Crossings. ■ Development and implementation of Fish and Fish Habitat Mitigation and Compensation Plan.	■ 6 stream crossings, none are fish-bearing at crossing locations. ■ Construction and filling of back channel at ACB landing site likely to require Fisheries Act Authorization.	■ At least 90% reduction in stream crossings required. ■ Construction and filling of back channel at ACB landing site required as site is subject to occasional inundation (potential loss of fish habitat, 1 to 2 ha available for fish usage <10% of the year).
Fish and Fish Habitat – Sediment Control Associated with Project Access	■ 160 km of new road. [9]	■ Development and implementation of Fish and Fish Habitat Mitigation and Compensation Plan to minimize sedimentation.	■ 9.5 km of new road (including spur road to Paddy's Flats) plus ACB landing site (<2 ha).	■ 92% reduction road length and potential for increased sedimentation.
Fish and Fish Habitat –Increased Road Access & Fishing Pressure	■ Atlin access road, if uncontrolled, provides road access to Upper Taku River watershed and potentially increases fishing pressure.	■ Road to be controlled access with manned gatehouse. ■ Redfern to implement and enforce no fishing policy for all employees.	■ None.	■ Avoids potential impact to fish associated with road access & angling pressure.
Vegetation	■ 160 km of new road – total 370 ha cleared. ■ Upgrading of Atlin Public Highway (not quantified).	■ Revegetation of road right-of-way after construction. ■ Reclamation of 160 km of road at mine closure, including revegetation, recontouring of cut and fill zones, and restore groundwater flow patterns, where possible.	■ 9.5 km of additional haul road required (inc. spur road to container storage area)- total 25 ha disturbed, including ACB landing site and container storage yard.	■ 92% reduction in vegetation impact and road reclamation requirements. ■ Avoids any requirement for upgrade to Atlin Public Highway.
Wildlife – Habitat Loss or Alteration	■ Total 370 ha of habitat disturbed, including high value habitats.	■ Deactivation and reclamation for the road at mine closure.	■ Total 25 ha disturbed, including ACB landing site and container storage yard.	■ 92% reduction in wildlife habitat disturbed.
Wildlife – Mortality due to Collisions or Maintenance Activities	■ Potential for vehicle collision: 15 million VKT annually.[10] ■ Potential wildlife mortality due to avalanche control on road (not quantified).	■ Monitoring of potential collision areas. ■ Checking for mountain goats in avalanche control areas. ■ Passage was to be created through snow berms in ungulate wintering areas.	■ Potential for road vehicle collision: 175,200 VKT annually.	■ 99% reduction in potential road vehicle collisions. ■ Avoids potential avalanche control related mortalities as no significant avalanche control required for new road to the ACB landing site.

7. Generally as proposed in Project Report, Rescan 1997
8. From Project Committee Report (BC Environmental Assessment Office 1998), however actual number of stream crossing identified during detailed design is substantially higher.
9. Actual length of road with potential for sediment delivery to water bodies is not quantified.
10. Includes increased traffic on public highways.

Access Option	Atlin Road		ACB Transportation System	Net Change in Potential Effect
Potential Impact	**Extent of Potential Effect**	**Scope of Mitigation Required[7]**	**Extent of Potential Effect**	
Wildlife – Avoidance of Road Bordering Habitats	■ Wildlife avoidance is a function of traffic volume, cover and distance from road. ■ 2.2 million VKT of wildland potentially disturbed annually (based on 160 km of new road).[11]	■ Deactivation and reclamation for the road at mine closure. ■ Access and firearms restrictions to reduce avoidance tendencies. ■ Access control to minimize traffic volume ■ Enforcement of wildlife right-of-way policy. ■ Retention of tree screens. ■ Monitoring and modification of road construction. activities in areas of wildlife disturbance concern (see Environmental Supervision Plan).	■ 175,200 VKT of wildland potentially disturbed annually (based on 9.5 km of new road), plus ■ 21,780 VKT annually of wildland adjacent to Taku River between Taku Lodge and ACB landing site potentially disturbed.	■ >91% reduction in potential wildlife habitat avoidance.
Wildlife – Increased Wildlife Harvest	■ Road connectivity provides access for hunters.	■ Implementation of Environmental Follow-up and Monitoring Program. ■ Control road access and provide manned gate. ■ Implement no-firearms and no-hunting policy for all mine employees and contractors. ■ Avoid patch habitats, where possible as per Environmental Supervision Plan.	■ Potential for modest increase in hunting pressure during winter months associated with easier movement following over-snow route of ACB from Taku River residents.	■ Potential impact largely avoided.

11. For the purposes of this discussion, number of vehicle kilometres travelled is assumed to represent a relative measure of potential for wildlife avoidance.

Table 4-4. Context for Assessment: Cultural, Subsistence and Archaeological Impacts

Access Option	Atlin Road		ACB Transportation System	Net Change in Potential Effect
Potential Impact	**Extent of Potential Effect**	**Scope of Mitigation Required[12]**	**Extent of Potential Effect**	
First Nation Camp Sites	■ 7 camp locations along road alignment, however locations likely avoided.	■ Camp sites to be specifically located and road to avoid site.	■ No known camp sites at this time. To be confirmed by Tlingit Land Use Impact Study (TLUIS).	■ Likely complete avoidance of potential conflict with camp sites.
Praying Places	■ Potential noise impact at two sites in vicinity of roadway.	■ Noise management during construction & operations.	■ To be determined through Tlingit Land Use Impact Study (TLUIS).	■ Access change may avoid potential impacts.
Graves	■ Known grave sites will be avoided. ■ Potential for sites associated with Heritage Trail.	■ Archaeological assessment to be completed prior to construction through Heritage Trail area.	■ Preliminary archaeological assessment indicates archaeological sites unlikely associated with ACB landing site access road.	■ Avoids potential impact to grave sites.
Aboriginal Trails	■ Crossing of Telegraph Trail. ■ Crossings of Heritage Trail.	■ Realignment to reduce number of crossings of Heritage Trail. ■ Archaeological assessment to be completed prior to construction through Heritage Trail area.	■ No additional traditional trails know at this time. To be confirmed by Tlingit Land Use Impact Study (TLUIS).	■ Avoids potential impact to traditional trails.
Traplines	■ Road crosses through three trapline areas.	■ Restricted road access prevents impacts to trapline and interference with trapping activities.	■ One trapline area in ACB study area.	■ Reduce number of trapline areas potentially affected from three to one. ■ Total area disturbed reduced by 92%.
Subsistence Resources	■ Potential impacts to wildlife – see Wildlife section of Biological Impacts Section.	■ Implementation of Environmental Follow-up and Monitoring Program. ■ Restrict road access and provide manned gate. ■ Implement no-firearms and no-hunting policy for all mine employees and contractors. ■ Avoid patch habitats, where possible as per Environmental Supervision Plan.	■ Potential for marginal increase in hunting pressure by residents on Taku River (AK) during winter months (snowmobile use along river corridor that would be packed snow). ■ Impacts to be determined through Tlingit Land Use Impact Study (TLUIS).	■ Potential impact to subsistence use avoided, especially in Blue Canyon area.
Commercial and Traditional Fisheries of Taku River	■ None.	■ N/A	■ Potential for momentary disruption of commercial drift net fishery during barge passage on lower portion of Taku River within Canada.	■ Potential impact to commercial and traditional drift net fishery on Canadian portion of Taku River downstream of Tulsequah River.
Other First Nation Lifestyle, Cultural and Economic Impacts	■ TRTFN believe Atlin road would conflict with First Nation lifestyle and identity.	■ Implement socio-economic monitoring plan.	■ Impacts to be determined through Tlingit Land Use Impact Study (TLUIS).	■ Likely greatly reduce potential impacts to culture and lifestyle, but to be determined through TLUIS.

12. Generally as proposed in Project Report, Rescan 1997

Table 4-5. Context for Assessment: Accidents and Malfunctions

Access Option	Atlin Road		ACB Transportation System	Net Change in Potential Effect
Potential Impact	**Extent of Potential Effect**	**Scope of Mitigation Required[13]**	**Extent of Potential Effect**	
Spills (Fuel, Hazardous Materials or Mineral Concentrate)	■ Potential for vehicle mishap: 15 million VKT annually.	■ Development and implementation of spill contingency and prevention plan.	■ Potential for road vehicle mishap: 175,200 VKT travelled annually. ■ Potential for ACB vehicle mishap: 62,700 VKT	■ 99% reduction in potential for road vehicle mishap or accident. ■ Increase in potential for marine mishap or accident, however probability lower for marine mishap than equivalent road traffic. Overall 98% reduction in total VKT.
Accidents Causing Human Injury or Death	■ Potential for vehicle mishap: 15 million VKT annually. ■ Potential for vehicle collision of public roadway: 12.8 million VKT annually.	■ Comply with standard traffic safety regulations and requirements. ■ Maintain roadways and vehicles in safe condition ■ Ensure radio communications on remote segments of roadway.	■ Potential for road vehicle mishap: 175,200 VKT travelled annually. ■ Potential for ACB vehicle mishap: 62,700 VKT travel annually.	■ 99% reduction in potential for road vehicle mishap or accident. ■ Increase in potential for marine mishap or accident, however probability lower for marine mishap than equivalent road traffic. Furthermore, transport personnel work as a team and are not alone ■ Overall 98% reduction in total VKT with significant reduction in health and safety risk for personnel. ■ >99% for potential for public vehicle collision – significant increase in public safety associated with project transportation.

13. Generally as proposed in Project Report, Rescan 1997

4.4 Assessment of Effects to Aquatic Resources

This assessment is based on issues that have been identified through input from consultation with government agencies, First Nations and Redfern Resources and their study team. Many of the concerns are related to the routine and ongoing operation of a tug and/or amphitrac and ACB on the Taku River. This assessment will be broken into two main components: potential physical effects to the Taku River and potential effects related to fish and fish habitat that is either direct or indirect resulting from the physical effects.

4.4.1 Potential Impacts to the Physical Aquatic Environment

The operation of the ACB is described in Volume 1 and includes the different methods that will be used at different times of the year to push or tow the ACB on the Taku River and Taku Inlet. Many of the potential effects to the riverine environment are common to both the Canadian and US portions of the river. Several issues of concern and potential physical effects have been identified along the Taku River including:

- channelization of the Taku River;
- disruption of gravels;
- re-suspension of sediments and bank erosion;
- changes in river ice freeze and thaw patterns due to ACB operations;
- snag relocation; and
- aquatic noise.

4.4.1.1 Channelization

Potential Effect

Concern has been raised that air cushion barging could cause channelization of the Taku River during the open water barging season. The ACB will be predominately towed by tug with support form the amphitrac, when warranted, starting at the mouth of the Taku River and into Canada. For the most part the tug will navigate the thalweg or the deepest part of the Taku River channel – this route is illustrated clearly in Volume 1, Appendix C: Taku River Barging Route Atlas. Channelization refers to straightening and/or ceasing a rivers ability to migrate laterally (i.e., erode banks). This term channelization is usually used in association with construction of training works such as levees or dykes to control flooding. Such works can have a considerable impact on the hydraulic characteristics of a watercourse and associated fish habitat. There are no plans to carryout works that would cause channelization and by following the thalweg there will be minimal disturbance to the river channel itself. There will be times when water depth in the river is quite shallow and propeller wash from the tug could disturb sand and gravels; ongoing river flows and especially freshet and jökulhlaup flows will naturally redistribute those sands, gravels and cobbles on a regular basis.

The ACB is also not expected to have any impact on the river channel as it will be on hover and out of the water except for 2.4 ft of the pliable air skirt. The skirt will not be as deep as the bottom of the

shallow draft tug and in most cases will not be in contact with the substrate of the mainstem Taku River during the open water barging season.

Proposed Mitigation

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential channelization effects.
- Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential channelization effects.
- No dredging or other works will be conducted to channelize the river, therefore the potential effect is not relevant to this project.

Conclusion

- With the implementation of the ACB transportation system as designed and proposed, the potential for channelization effects will be avoided.

4.4.2 Disturbance of Substrates

Potential Effect

As discussed in the section on channelization, the passage of the tug and/or amphitrac and ACB is unlikely to cause any significant disruption of the substrates. Along all or most of the route the ACB will be towed along the thalweg, the deepest part of the river channel. There will likely be areas where the water depth will be close to the draft of the tug and the propeller wash may displace the substrate. This will likely be a short term disruption as freshet flows and jökulhlaups will naturally redistribute the gravels. The project is unlikely to have any significant long-term effect on the substrates of the Taku River.

Proposed Mitigation

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential disturbance of substrates.
- Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential disturbance of substrates.

Conclusion

- With the implementation of the ACB transportation system as designed and proposed, the potential for disturbance of substrates will be avoided and not significant.

4.4.2.1 Re-suspension of Sediments and Bank Erosion

Potential Effect

Tug and ACB operations can cause re-suspension of sediments beneath the tug by the turbulence created by the propeller and in shallow water areas where wake waves agitate fine sediments along the margins of the river or waves cause erosion of river banks. Sediment re-suspension, at significant levels, can cause increased sediment deposition in backwater and secondary channels. The ability of the tug and ACB to have an effect on sediments and erosion along the river banks is directly related to the energy of the waves created and the material composition of the bank. The size of the waves is dictated by many factors including the shape of the vessels' hull, draft, displacement, speed through the water and water depth. The distance the ACB and tug are from the river banks also determines that size of the waves striking the banks. The factors having the greatest effect are vessel speed and distance from shore.

Studies of tug and barge activities on rivers are usually based on more conventional tug sizes typically towing multiple barges. The environmental assessment of increased barge traffic on the Mackenzie River (Imperial Oil Resources Ventures Limited, 2006) required to build the Mackenzie Valley pipeline was based on 147 ft (45 m) tugs with a draft of 3.6 ft (1.1 m) pulling up to six, 250 ft (76 m) long barges that had a draft of 4 ft (1.5 m). The waves generated were as high as 4.2 ft (1.3 m) at the barge but were predicted to be <1 ft (0.3 m) by the time they reached the shore some 400 ft (125 m) from the vessels. In this study the predicted wave energy that would be created by barging was two orders of magnitude less than the estimated threshold for scour of the clay-till material that made up the riverbed and banks of the Mackenzie River.

Similar modelling has been conducted on tug and barge operations on the Mississippi River. Again, these studies are related to larger tugs and barges and the studies where assessing the effects of between 2 and 24 tows per day (Maynord and Keevin, 2005). Studies reported the maximum wave heights of 1 ft (0.3 m) associated with 15 barges (3 wide by 5 long) being towed at 8 mph (US Army Corps of Engineers, 2004). Studies of the effect of sediment re-suspension reported that tow boat traffic contributed only a minor amount of additional sediment to backchannel and other lower velocity areas along the Mississippi River and the effect was generally masked by the large volume of sediment transported by the Mississippi River (US Army Corps of Engineers, 2004). The effect of re-suspension of sediments appears to be largely determined by the type of sediments making up the substrate and banks of the river and the natural sediment load.

Specific details of the wake that will be created by the ACB, amphitrac or shallow draft tug are defined, but some assumptions were presented in Volume 1, Section 3.1.1.3. In support of the assumptions from Volume 1, observations made during the tug and barge operation that took place in the summer of 2007 to move construction equipment up to the contemporary barge landing area, confirmed that the vessels generated a small wake that did not appear to exceed 1 ft (0.3 m). The wake had all but dissipated by the time it reached the riverbank. Due to the highly turbid nature of the Taku River during this operation, it was difficult to see if the barge wake or propeller scour re-introduced sediment into the water column. The tug used had a draft of 5 ft (1.5 m), which is almost

twice the 2.6 ft (0.79 m) draft of the shallow draft tug that will be used to tow the ACB. Based on studies of other systems where larger tugs and barges are used, the re-suspension of sediment and bank erosion are concerns associated with barging. The proposed system that will be used on the Taku River will likely produce much smaller wakes and the forces that will contribute to sediment re-suspension and erosion and the effect of barging will likely cause a negligible to minor increase in bank erosion and sediment re-suspension. However, these effects are very dependent on the types of sediment and bank materials along the Taku River. Specific studies have not been undertaken on the Taku River to identify potential areas of concern. This uncertainty will be addressed through the development of a management plan for the barging operation. Prior to the start of operation, areas of existing erosion will be identified as will back or side channel areas that could be affected by sediment re-suspension and deposition. These sites will be monitored and corrective action taken if effects from barging are reported.

Proposed Mitigation

- Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges.
- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments.
- Implement management strategy to identify and monitor areas that could be affected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.

Conclusion

- With the implementation of the ACB transportation system as designed and the proposed mitigation, the potential for re-suspension of sediments and bank erosion effects associated with this project will be negligible.

4.4.2.2 Effects on Water Quality

Potential Effect

There are two mechanisms by which the barging operation can impact water quality. The first is through an accident or malfunction where the ACB or tow vessel sinks and/or deleterious substances are released into the water. The second is through the re-suspension of sediments and erosion causing increases in turbidity and total suspended solids (TSS) in the water. The effects of and prevention measures for accidents and malfunctions are discussed in Section 4.8

The potential for increased turbidity and TSS is presented in the previous section. These data show that the Taku River is a very turbid river especially during the open water season where TSS is typically 40 to over 100 mg/L. Lowest TSS is found in the winter when the river is frozen. The ACB/tug/amphitrac are not likely to cause significant increases in either turbidity or TSS based on the

information provided above – i.e. slow speeds of barging will not generate large wakes and the barging will be carried out primarily in the thalweg of the river where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug. However, the erodability of sediments along the ACB route has not been studied and there is potential for sediment re-suspension or increased bank erosion so monitoring as described above will be carried out.

Proposed Mitigation

- Develop and implement Spill Prevention and Contingency Plan, complete with requirements for appropriate materials packaging, personnel training, equipment and measures to reduce risk of spills.
- Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges.
- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments.
- Implement management strategy to identify and monitor areas of that could be affected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.

Conclusion

- With the implementation of appropriate spill prevention planning, prevention and response, the risk of water quality effects from malfunctions and accidents is reduced to acceptable levels.
- With the implementation of the ACB transportation system as designed and the proposed mitigation, the potential for re-suspension of sediments and bank erosion effects associated with this project will be negligible.

4.4.2.3 Effects on Ice Formation and Break-up

Potential Effect

In some operations the ACBs have been used as an ice breaker as it can use the air discharging from under the skirt to lift the ice and break it. Every effort will be made to avoid using the ACB as an ice-breaker and to allow the river to freeze-up and break-up under natural conditions. The plan for operating the ACB during the spring thaw and fall freeze-up is designed to minimize any effect to ice formation and break-up.

Ice normally forms from the sides out into and over the main channel. Ice tends to be established on the edges of the river first, landfast on gravel bars and shallows, with the mainstem remaining open and navigable. Once the peripheral ice has become established and strong enough along the margins, the amphitracs will travel on the ice, initially along the margins, using its wheels. Given the ACB and amphitrac's low ground pressures, the weight of these vehicles can be accommodated on thin ice relative to their total payload.

During winter months, there is concern that if a conventional ice road were prepared, ice thickness would increase, changing the river/ice dynamic. Ice roads are built by clearing the snow off the ice surface to encourage ice thickening (removes insulating effect of snow) and even flooding the ice surface to build up the ice thickness. An ice road will not be built and these operations will not be conducted. The ACB will operate over snow with minor compaction of the snow, thereby preserving the insulation function of the snow. Therefore, the ice formation will be allowed and additional thickness will not be created, allowing spring break up to proceed naturally.

During spring break-up, it is anticipated there maybe be a short period when barging is suspended while the ice in the main channel breaks up. As mentioned, the ACB can be used as an ice-breaker so that in emergency situations such as unexpected ice formation while the tug is moving the ACB, the ACB can be used to open a channel to get the tug to moorage.

Proposed Mitigation

- Operation plan avoids ice-breaking and plans to allow the river to freeze up and thaw naturally. A frozen river surface is the preferred operational condition for the Taku River ACB transportation system in winter.
- Ice road building will not be conducted; therefore ice formation will remain natural.

Conclusion

- With the implementation and operation of the ACB transportation system as designed, the potential effects on ice formation and break-up will be negligible.

4.4.2.4 Large Woody Debris

Potential Effect

Large trees and stumps are a common occurrence in the Taku River. Spring freshet and high flows associated with jökulhlaups can deposit large debris in the portion of the channel that will be used by the ACB. When occurring in the travel route, these present a navigation hazard for all river users. As described in Volume 1, a small riverboat will travel ahead of the ACB and tug periodically and after flood events. The operator of this craft will inform the ACB operator of any impediments to navigation. The amphitracs will be equipped with a grapple mounted on a hydraulic arm. This grapple will be used to pick up and move logs or stumps lodged in the navigation channel. This woody debris would be relocated to one side of the channel, as close as practical to the site it was removed from so that it remains part of the hydraulic dynamics of the Taku River.

Proposed Mitigation

- Relocation of hazard snags and logs in the river is a measure to reduce potential for accident or mishap.

- Relocation of large woody debris will be minimized to only those areas that are located in the actual travel route and present a hazard to the safe operation of the transportation system.
- Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel such that the debris continues its role as fish habitat, thereby minimizing the effect.

Conclusion

- With the implementation of the ACB transportation system as designed and proposed mitigation, the potential effects on relocation of large woody debris representing a hazard to the operation will be negligible.

4.4.2.5 Aquatic Noise

Potential Effect

Volume 1, Section 3.1.1.2 provides some details on the noise levels generated by the ACB. As indicated, the ACB and towing vessels will produce noise levels similar to highway rated tractor trailers, approximately 70 dB (decibels) at 100 ft (30 m). In comparison, jet boats at 30 mph (48 kph) create 88 dB, propeller-driven air boats create 80 dB, and float planes taking off create 85 dB. A significant component of underwater noises generated by marine craft come from the propellers and the transmission of the engine noise through the hull. The ACB, like other air cushion vehicles, will not likely generate significant underwater noise levels as the vessel is floating on a 2 m cushion of air with essentially no opportunity for vibrations to resonate into the water. The other vessels operating on the Taku River will produce noises similar to water craft that currently use these waterways. In summer months the ACB operation will be one of many sources of air borne and underwater noises along the Taku River with jet boats and float planes being regular occurrences along the river.

Proposed Mitigation

- The ACB will not contribute additional noise to the underwater environment.
- All equipment associated with the ACB transportation system will be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m).

Conclusion

- With the implementation of the ACB transportation system as proposed, the potential increase in aquatic noise will be negligible.

4.4.3 Assessment of Aquatic Biological Effects

The proposed ACB operations on the Taku River could have a number of potential direct and indirect effects on resources including fish, fish habitat and marine mammals. The indirect effects are the physical effects described above that may subsequently have an impact on the aquatic resources in the study area.

4.4.4 Fish and Fish Habitat

A number of potential effects on fish and fish habitat include:

- direct effects on mainstem spawning and rearing habitat;
- effects on migrating adults and juveniles;
- entrainment of small fish under the ACB in the air cushion;
- indirect effects on food production in the Taku Sand Flats; and
- indirect effects on rearing habitat (moving large woody debris, sedimentation of back channels).

4.4.4.1 Effects on Mainstem Spawning and Rearing

Potential Effect

Barging activity is not expected to cause measurable changes to the mainstem of the Taku River and therefore the potential to impact mainstem spawning and rearing habitat is also limited. Most salmon species do not typically select mid-channel, mainstem areas of large rivers for spawning. Also, the Taku River mainstem typically carries a high load of suspended sediment; salmon are known to avoid these turbid conditions. Studies of Taku River sockeye salmon have found that a portion of the population do use mainstem habitats for spawning. Sockeye typically return to spawn in areas associated with lakes that the juveniles then use for rearing, however, Eiler et al. (1992) reported that 63% of the Taku run returned to “riverine areas.” Of the fish using the main stem, 55% spawned in side-channels, while the rest spawned in small tributaries, the mouths of tributary streams, upland sloughs and in the main-stem in areas usually associated with groundwater upwelling. The study also reported that the majority of juveniles from the riverine spawners migrated to sea in their first year, unlike those that use lakes for rearing that spend one year in freshwater.

The proposed barging operation also includes moving large woody debris (LWD) that becomes lodged in the navigation channel to maintain a clear route for the ACB. Large woody debris such as logs and root wads provide protective cover for juvenile salmonids and moving the LWD could impact habitat for these young fish. As discussed in Section 5.6.1.7, the operational procedure will be to use the grapple mounted on the bow of the amphitrac to move the LWD out of the navigation channel. Generally, the majority of the LWD transported by the Taku River will become lodged in shallow water areas and gravel bars and only a small portion of the LWD in the Taku River will become anchored in the navigation channel. The LWD that does have to be moved will be moved to a wetted portion of the river channel to one side of the ACB route. Above the Taku Lodge the wetted channel width of the Taku River is generally greater than 300 ft (100 m), providing ample space to place LWD in areas

that will not affect navigation but will continue to provide functional fish habitat. During operations a log will be kept recording where LWD is moved from and where it is placed.

Proposed Mitigation – Mainstem Spawning

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding mainstem spawning in side channels and creek mouths.

Proposed Mitigation – Large Woody Debris

- Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel such that the debris continues its role as fish habitat, thereby minimizing the effect.

Conclusion

- With the implementation of the ACB transportation system as designed and the proposed mitigation, the potential effects to mainstem spawning will be avoided and effects to rearing will be negligible.

4.4.4.2 Migrating adults and juveniles

Potential Effects

Concerns have been expressed about the ACB operations potential to impact migrating adult and juvenile salmon. In the case of juvenile salmonids, Meehan and Sniff (1962) and Murphy et al. (1988, 1989 and 1997) have reported on studies conducted in the Taku River. It appears that juveniles migrate downstream from April to November. The studies also suggest that the river edge habitat is an important component of the rearing habitat for juveniles and that declining river flows result in the movement of juveniles from the upper tributaries and reaches of the Taku River to the lower reaches of the Taku River in search of suitable habitat. Meehan and Sniff (1962) reported that peak downstream migration of Chinook, chum, and coho was in the early morning hours (1 am – 5 am). Sockeye showed little difference in activity over the course of a 24 hour day. Chinook, coho and sockeye juveniles spend up to a year in the freshwater environment before migrating out of the Taku River and would be most susceptible to any impacts in the River.

Murphy et al. (1988) reported that juvenile Chinook are more likely to rear in the main river channel along the river margin and in slough areas, mouths of tributaries and in tributaries directly connected to the mainstem. Coho and sockeye were more likely to be found in off channel areas such as ponds and sloughs. Juvenile salmonids were not normally found in water flows in excess of 30 cm/s and Murphy et al. (1989) reported that flows in the Taku River, mid-channel from 30 to 240 cm/s.

Migrating juveniles of all species are unlikely to be affected by the ACB and tug operation during the majority of the route as the vessels will be in mid-channel where juveniles are not found, primarily due to high water velocities. Also, the majority of juvenile salmonids migrate downstream during darkness, when the ACB will not normally be on the river. Barging operations are not likely to have any significant effect on juvenile migration. Given the work that has been done on juvenile salmonids in the lower Taku River, the species at most risk is the Chinook. Chinook juveniles that make use of the edge habitat in the Taku River mainstem are at potential risk from the effects of ACB and tug wake and at locations where the ACB transitions from water to land. These potential effects related to stranding and entrainment in the air flow under the ACB are discussed below.

Barging activities could also affect the upstream migration of adult salmon. Adult Chinook salmon are the earliest arrivals in the Taku, between early May and early June while the spawning runs of the other species do not start until June/July (TRTFN 2003). The timing of the majority of fish migrating into and up the Taku River takes place when there is considerable boat activity on the Taku River between the mouth and Canyon Island. This boat activity is related to in river fishing plus access and activities around the recreational properties located along “Martini Row”. The river channel is generally fairly wide along much of the river and in most areas there are multiple channels. The main channel typically ranges from 100 m to over 200 m wide providing opportunities for fish to avoid the ACB and tug. The ACB/tug combination will be approximately 85 m long, travelling at 5 to 10 knots (2.6 m/s – 5.2 m/s); at 2.6 m/s it will take less than 60 seconds for the ACB to pass a point. If the fish were to be affected by ACB noise and shadows from a distance of 100 m, the total distance of effect would be 285 m, and the duration of the effect would be just over 110 seconds. Given the short duration of the ACB passage past a point that would occur twice a day and the fact that the width of the river provides opportunities for fish to avoid the ACB, it is unlikely that the barging will have an effect that would impact on the populations of salmon in the Taku River.

Proposed Mitigation Measures

No specific measures required, as barge route avoids areas preferred by migrating juveniles (barge in mid-channel where velocities are high).

Conclusion

- Potential for significant adverse effects is unlikely.

4.4.4.3 Entrainment of small fish under the ACB in the air cushion

Potential Effect

Air cushion vehicles are known to spray water and blow other debris around by the air escaping from under the skirt. Concern has been expressed that small fish will be affected by the forces of air on the water and become injured or killed. The likely area for this type of event to occur is where fish are in very shallow water when the ACB passes overhead. This would occur at points where

the ACB enters or leaves the water such as the start and end of the route along the east side of Canyon Island and at the ACB landing spot. The likelihood of this causing even a minor impact on fish populations is minimal. Relative to the entire shore length between Taku River and the ACB landing site (approximately 30 miles of river) and the distribution of juvenile fish along this shoreline, the impact area is very small (ACB width is 88 ft) and the time of exposure is short – in the order of minutes as the ACB passes by. Also, studies of air cushion vehicles have shown that they cause minimal damage to plants and animals that they pass over (Turner, 2003), suggesting that this would be further reduced for fish within the water column. In the water column itself below the barge, there is no change in water pressure as water is incompressible.

While the existing evidence suggests that the potential for small fish, in particular juvenile salmonids, to be damaged by the ACB as it passes over shallow water areas will be insignificant, there are no reports directly related to juvenile salmonids to confirm this assessment. Therefore, a monitoring program will be carried out during the initial months of open water barging to confirm this assessment.

Proposed Mitigation

- Implement a monitoring program during initial months open water barging to confirm there are no significant adverse effects associated with entrainment of small fish under the ACB in the air cushion during the landing process.

Conclusion

- With implementation of the measures outlined above, potential for adverse effects to small fish during ACB landing will not be significant.

4.4.4.4 Stranding of Juveniles

Potential Effects

Juvenile salmonids often utilize river edge habitat for rearing and migration which makes them susceptible to wave action and being washed up on shore and subsequently becoming stranded. In Section 5.6.1.4, evidence was presented to suggest that the waves generated by the ACB and tug will be similar to, or less than, the wake waves generated by the typical jet boats that routinely use the Taku River. The ACB and tug will be travelling in mid-channel, maximizing their distance from shore which means the wave height and energy will be significantly reduced by the time they reach the shore. The other potential effect is associated with the ACB transitioning from the river onto gravel bars. As the ACB approaches the shore, any bow wave creates a surge of water that can also wash juveniles on to shore and become stranded. The bow wave from the ACB is limited while on hover so that the surge of water will be small as the ACB approaches the beach. As with the discussion of potential effects of the forced air under the ACB skirt damaging juveniles, the length of affected shoreline (total 200 ft or 60 m) is very small relative to the overall length of the Taku River. Given the small wave heights and surges that the ACB will create and the wake waves

created by the tug and amphitrac, stranding is not expected to impact to fish populations in the river. Similar conclusions were made of hovercraft activities, involving more traditional fast moving hovercraft on the Kuskokwim and Johnson Rivers (Volpe 2000). To confirm this conclusion, monitoring will be carried out at the landing site and at low gradient beach areas along the route. If significant numbers of fish are being stranded by ACB operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.

Proposed Mitigation

- The ACB and tug will travel in mid-channel, minimizing the wave heights reaching the beach areas and the probability of stranding juveniles.
- Monitoring will be carried out at the landing site and at low gradient beach areas along the route during the first year of operation. If significant numbers of fish are being stranded by ACB operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse effects to juveniles while ACB landing will not be significant.

4.4.4.5 Upgrade of Haul Road

Potential Effects

Only a portion of the haul road between the minesite and the ACB landing site is assessed for this amendment. The original Environmental Assessment Certificate issued in 2002 considered the section of road between the mine and the limestone quarry. Therefore, the following discussion is related to the section of road south of the limestone quarry to the proposed ACB landing site. This section of road is part of the Big Bull mine exploration works that Redfern is undertaking in 2007, however, it will initially be built to temporary exploration road standards and upgraded to handle the haul trucks that will be required to transport materials between the mine and the ACB landing. There are 6 stream crossings as indicated on Figure 5-1 of Volume 1 and all crossings are located upstream of the portion of stream accessible to fish. Construction of the exploration road will include the installation of suitably sized culverts that can accommodate the road upgrades for the haul trucks, therefore, no construction activities are planned at the creek crossings that have the potential to affect downstream fish habitat.

Operational effects can include the discharge of sediment-laden waters into fish bearing waters and spills of deleterious substances.

Proposed Mitigation

- Volume 1 describes the upgrades that will be carried out, including increased number of turn outs, reducing road grades from 10% to 8%, installing truck run-away lanes, etc. Any construction activities that are adjacent to the Tulsequah River riparian zone or within the riparian zone of the streams that are crossed will be carried out with the proper care and attention for the protection of water quality and nearby fish habitat.
- Measures implemented will include having environmental monitors on site, erosion and sediment control, construction will take place under favourable weather conditions, vegetation clearing will be kept to a minimum and grubbing will not take place within the riparian zones. Construction activities required to upgrade the haul road are not expected to have any significant environmental effects on fish or fish habitat.
- Roads will include suitable ditching and culverts to contain and divert surface runoff away from fish bearing waters or stream sections that are immediately upstream of fish barriers.
- Redfern will develop and maintain detailed spill response plans appropriate to the type and quantity of deleterious materials that will be transported along the haul road.

Conclusion

- Construction activities required to upgrade the haul road are not expected to have any significant environmental effects on fish or fish habitat.
- Operations of the haul road are not expected to cause any significant environmental effect.

4.5 Terrestrial Resources Assessment

4.5.1 Assessment Methodology

The Effects Assessment was conducted on a variety of terrestrial ecosystem components using the assessment methods described below. The assessments were carried out for the Construction and Operations phases and included an assessment of the effects and risks of the project on the ecosystem component within a watershed or regional context, where appropriate.

4.5.1.1 Terrain, Soils and Ecosystems Assessment Methods

The following were used to evaluate the potential effects of the proposed ACB transportation system on terrain, soils and ecosystem components:

1. Review of terrain, soils and ecosystem mapping and assessment information to determine the resources that could be affected. Reviewed potential effects of the proposed construction and operating activities and how they may affect those components.

2. During the review, the ecosystem mapping and the field work conducted in 2007 was used in the evaluation. Although the detailed ecosystem and soils mapping is still in draft form, the available information can provide a semi-quantitative assessment.
3. To aid in the evaluation, the ecosystem information was grouped into upland forest, floodplain forest, wetland and estuarine (tide flat) types for assessment.
4. Assessed the potential effects of the proposed ACB landing and road access against available mapping and field information to determine approximate areas of impact.
5. Assessed the potential effects of ACB transportation system on terrain, soils and ecosystem components while operating in non-aquatic modes.

4.5.1.2 Rare Plants and Wildlife Species Assessment Methods

The assessment of effects on rare plants and wildlife species (both Species at Risk and those of management interest) was undertaken using a two-step process. An initial assessment was conducted to determine which species would require more detailed assessment, followed by a detailed effects assessment.

Initial Evaluation Methods

A variety of terrestrial plant and wildlife species were considered for evaluation to determine if the proposed ACB transport amendment for concentrate and mine supplies would affect wildlife habitats or populations. The initial list of species and species groups outlined in the Project Setting chapter included species that are considered to be Species at Risk either by Federal, Provincial/State regulators, as well as species of management interest or concern by regulators, First Nations or the public. This listing was first reviewed using the following criteria to determine if more detailed effects evaluations and measures to reduce effects would be required:

- Is it likely that the species/species group will be found in the land use the area?
- Is there evidence from information sources or the field assessments that suitable habitat for the species/species group exists within or around the study area that could be affected?
- Is there evidence obtained from information sources or during field assessments of the species/species group using the area within or surrounding the study area?
- Is it likely that the habitats important to the species/species group or that the regional populations of the species/species group could be affected by the construction or operations of the proposed ACB transportation system, landing site and road access?

In assessing the effects of construction and operations, the following were considered during the initial evaluation:

- area disturbed or changed directly and/or indirectly during construction and operations;
- noise and displacement during construction and operations;
- timing and duration of construction and operations;

- number of personnel involved in construction and operations; and
- the risk to the species or species group in a watershed or regional context where possible.

The initial evaluation allowed the key issues and effects on species and species groups to be identified quickly and effectively. If the answers to the evaluation questions were "Yes" in all cases, detailed project effects assessments were carried out and measures developed to reduce the effects on those species or species groups. It is recognized that the effects evaluation at this initial stage is more qualitative than quantitative, but it is anticipated that the process used is sufficiently transparent and verifiable given the available information that the conclusions reached are appropriate and minimize risk to the component under evaluation. It is also anticipated that effective monitoring strategies will be developed and implemented in conjunction with regulators, First Nations and the public to ensure that the anticipated effects are verified, with the understanding that operations and procedures would be modified if required.

Detailed Evaluation Methods

Where the initial evaluation indicated that a more detailed evaluation was required, a detailed evaluation of potential project effects was conducted to provide more information regarding the potential effects and to identify potential measures to minimize effects and to identify monitoring measures that would be required to deal with the effect. During the detailed evaluation, the construction and operating activities were further divided into project phases and types of operations to allow evaluation of their effects. Key issues and concerns identified through discussions with First Nations, government regulators and a review of the potential effect of the Taku River ACB transportation system formed the basis for the detailed evaluation.

4.5.2 Terrain and Soils Assessment

4.5.2.1 Evaluation of Effects on Terrain and Soils

Effects of the proposed haul road to the ACB landing on terrain have been addressed through terrain stability mapping completed for the mineral exploration road. Issues related to potentially unstable terrain have been addressed through the field assessments and incorporated into the road design to ensure adverse effects are minimized.

It is not expected that the proposed construction activities related to the haul road to the ACB landing site, or the ACB landing site itself, will affect the soils in those areas. The lack of deep organic soils within the proposed access road and lack of any significant organic soils at the ACB landing site limit the effects of the proposed activities on soils. During operations, the use of accepted soil erosion control measure such as grass seeding, effective water management and ongoing maintenance will ensure that effects on soils are minimal.

4.5.2.2 Planned Measures to Reduce Effects on Terrain and Soils

Terrain stability mapping and field assessments have previously been completed for the mineral exploration road, which will address the proposed haul road to the ACB landing. Monitoring will be completed to ensure that the recommendations outlined in the terrain stability field assessments are followed.

The lack of extensive deep soils along the proposed haul road to the ACB landing site and the lack of soil at the ACB landing site limit the options for soil conservation. During construction activities it will be difficult to stockpile surficial soils for use in future reclamation activities and it is likely more effective to utilize the surficial soils in-situ to provide a substrate for re-vegetation during construction and operations. High precipitation rates in the area also limit the ability to effectively stockpile surficial soils due to erosion and soil leaching so it will be more effective to utilize stripped surficial soil along exposed cutbacks where appropriate. During construction and operations, erosion, sediment and water drainage control will follow the Erosion Control Plan prepared by Wardrop (2007) and the Riparian Management Plan (GLL 2007), which are based on best management practices developed for forest road construction and operations.

4.5.2.3 Summary of Residual Effects on Terrain and Soils

There are no significant effects predicted for terrain and soils resources.

4.5.3 Ecosystems Assessment

4.5.3.1 Evaluation of Effects on Ecosystems

The evaluation of the effects on ecosystems, including rare ecosystems, is provided in more detail in Table 4-6.

Table 4-6. Evaluation of Construction and Operation Activities of the Taku River ACB Transportation System on Ecosystem Resources

Ecosystem Type	Concern or Issue	Potential Effect(s)	Magnitude/Risk of Potential Effect	Measures to Reduce Predicted Effects	Predicted Residual Effects
Upland Forests Including listed ecosystems	Construction of ACB haul road will convert upland forests.	Conversion of a small area to road (~19 ha). No listed ecosystems known to be affected.	Very Low - amount of area converted is much less than 0.1% of available upland forest in lower Taku. Area will be reclaimed upon project completion.	Reclamation Plans.	None.
	Changes in downstream water quality or quantity affecting adjacent upland forest ecosystems during construction and operations.	Change in soil moisture and/or nutrient regime will affect ecosystem.	Very Low - area affected is very small in relation to available area.	Erosion Control Plan. Riparian Management Plan.	None.
Floodplain Forests All are listed ecosystems	Construction of ACB access road and landing area will convert floodplain forests.	Conversion of a small area of listed ecosystems to road and landing (< 1.5 ha).	Very Low - amount of area converted is much less than 0.1% of available floodplain forest in lower Taku. Area will be reclaimed upon project completion.	Reclamation Plans.	None.
	Changes in downstream water quality or quantity affecting adjacent floodplain ecosystems during construction and operations.	Change in soil moisture and/or nutrient regime will affect ecosystem.	Very Low - area affected is very small in relation to available area.	Erosion Control Plan. Riparian Management Plan.	None.
Wetlands Including listed ecosystems	Construction of ACB haul road and landing area will convert wetlands.	None - there is no construction in wetlands.	None - No construction activities in wetlands.	Ensure no construction in wetlands.	None.
	Operations of ACB in wetlands will affect function.	None - there are no planned operations in wetlands.	None - No operations in wetlands.	Ensure no operations in wetlands.	None.
	Changes in downstream water quality or quantity affecting adjacent wetlands during construction and operations.	Change in soil moisture and/or nutrient regime will affect ecosystem.	Very Low- area affected is very small in relation to available area.	Erosion Control Plan. Riparian Management Plan.	None.
Estuarine (tide flats) Including possible listed ecosystems	Operations of ACB in estuary/ tide flats will affect function.	Compaction of substrates or damage to aquatic vegetation.	Very Low - ACB operations planned at high tides, dynamic ecosystem so any effects would be limited.	Operation through area during high tides.	None.

4.5.3.2 Planned Measures to Reduce Effects on Ecosystems

During construction and operations, erosion, sediment and water drainage control will follow the Erosion Control Plan prepared by Wardrop (2007) and the Riparian Management Plan (GLL 2007) to ensure that water quality and quantity are maintained to down slope ecosystems. Ecosystems affected by the construction of the ACB landing area and haul road will be reclaimed according to an accepted reclamation plan.

4.5.3.3 Summary of Residual Effects on Ecosystems

There are no significant residual effects predicted for ecosystem resources.

4.5.4 Rare Plants

4.5.4.1 Initial Evaluation of Effects on Rare Plants

Based on the available information, the initial evaluation outlined in Table 4-7 indicates that there are no expected effects of the proposed ACB transportation system on rare plants and their distribution. The small area that will be affected by the proposed ACB landing site and access road and lack of rare plants in those areas limits the direct effect on rare plants. It is not expected that construction or operation of the proposed haul road or ACB landing site will affect soil moisture, drainage patterns or nutrient levels near those developments so the effects down slope of the developments are also not expected to affect rare plants.

Table 4-7. Initial Evaluation of the Taku River ACB Transportation System on Rare Plant Species

Species or Species Group	Rationale	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Rare Plants	Species at Risk.	Yes - some species found previously in general study area, but no listed species found in ACB landing or road access areas.	Not likely - construction of ACB landing and road access areas will affect a minimum amount of area and no listed species were found; no effects expected by operations.	No - unlikely to be affected by construction or operations.

4.5.4.2 Detailed Evaluation of Effects on Rare Plants

Not required.

4.5.4.3 Planned Measures to Reduce Effects on Rare Plants

Follow accepted soil erosion control and road drainage practices (Wardrop 2007, GLL 2007) during construction and operations to ensure there are no significant effects on any undiscovered rare plants that may be downhill of haul road or adjacent to ACB landing.

4.5.4.4 Summary of Residual Effects on Rare Plants

No significant residual effects are predicted to rare plants.

4.5.5 Terrestrial Mammals

4.5.5.1 Initial Evaluation of Effects on Terrestrial Mammals

The initial evaluation of the effects of the Taku River ACB transportation system on terrestrial mammals is outlined in Table 4-8. Based on the initial evaluation, the following terrestrial mammal species/species groups were determined to require a more detailed evaluation: black bear, grizzly bear, grey wolf and moose.

4.5.5.2 Detailed Evaluation of Effects on Terrestrial Mammals

The detailed evaluation of the effects of the proposed Taku River ACB transportation system on terrestrial mammals is provided in Table 4-9 for the species identified.

4.5.5.3 Planned Measures to Reduce Effects on Terrestrial Mammals

The following measures and plans are proposed to reduce the potential effects of the ACB transportation system on wildlife and wildlife habitats.

- Wildlife Management Plan - provides direction to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs (see Appendix B). Includes the Bear/Human Management Plan (see Appendix B) and outlines general operating expectations and procedures for issues such as avoiding collisions (through speed limits, personnel training etc.), wildlife sightings and incident reporting, etc. Provides framework for adaptive management planning and system for implementing results of monitoring to reduce effects of the project if they become evident.
- Bear/Human Management Plan - provides direction to ensure bear/human interactions are reduced through training, management of garbage; managing personnel movements in high use bear habitats and reporting of incidents.

Table 4-8. Initial Evaluation of the Taku River ACB Transportation System on Terrestrial Mammal Species and Species Groups

Species or Species Group	Rationale	Evidence of Suitable Habitat within Area?	Species Likely Found within Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Keen's Myotis Bats	Species at Risk. Management Interest.	Yes - potential habitat within old mines and in adjacent mature/old and floodplain forests.	Yes - potential habitat is available, however, distribution is not well known (especially Keen's).	No - not in available information, some sampling will be completed in 2007.	Unlikely - construction of ACB landing and road access will affect a minimum amount of habitat; operations not expected to disrupt foraging or movements.	No - unlikely to be affected by construction or operations.
Beaver Muskrat	First Nations and Public Use.	Yes - extensive wetland and backchannel available in Taku and Tulsequah drainages.	Yes - study area is within mapped range and suitable habitat is available.	Yes – observed during previous and current field assessments.	Unlikely - construction and operations outside of observed use areas.	No - unlikely to be affected by construction, include in monitoring program during operations; consideration within spill contingency plan required.
River Otter	First Nations and Public Use.	Yes - suitable river and wetland habitat available, available fish resources for foraging.	Yes- study area is within mapped range and suitable habitat is available.	Yes – observed during previous field assessments.	Unlikely - construction and operations will have minimal disruption of foraging or denning areas.	No - unlikely to be affected by construction, include in monitoring program during operations; consideration within spill contingency plan required.
Black Bear	Bear-People Interactions. First Nations and Public Use.	Yes - known and potential foraging habitat within floodplain habitats, and surrounding forest.	Yes - study area is within mapped range and suitable habitat is available.	Yes – extensive use noted during previous and current field assessments.	Yes - potential for interaction with construction and operation personnel.	Yes - mitigation of bear/human interactions required during construction and operations.

Species or Species Group	Rationale	Evidence of Suitable Habitat within Area?	Species Likely Found within Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Coyote Lynx Red Fox	First Nations and Public Use. Management Interest.	Yes - potential foraging and denning habitats available within and adjacent to ACB route.	Yes - area is within mapped range and suitable habitats are available.	Yes - limited numbers detected.	Unlikely - limited number in area, construction and operations will have minimal disruption of foraging or denning areas.	No - unlikely to be affected by construction or operations.
Dall's Sheep	Species at Risk.	No - habitat types not in areas near ACB route.	No - habitat types not in areas near ACB route.	No - none observed in previous or current field assessments.	Unlikely - construction or operations will not affect habitats used by species.	No - unlikely to be affected by construction or operations.
Fisher	Species at Risk.	Yes - extensive large diameter cottonwood available, some evidence of porcupine (prey species) in area.	Yes - area is within mapped range and extensive suitable habitat is available.	Yes - evidence of limited use within study area.	No - construction of barge landing and road access will affect a minimum amount of cottonwood or prey habitat; operations not expected to disrupt hunting or movements.	No - unlikely to be affected by construction or operations.
Grey Wolf	Management Interest.	Yes - potential foraging and denning habitats available within and adjacent to ACB route.	Yes - area is within mapped range and suitable habitat is available.	Yes - evidence of use observed in all seasons.	Yes - possible increase in foraging opportunities on moose during winter due to snow compaction; possible increase in persecution due to increased human use.	Yes - measures to limit foraging opportunities and human interactions required during construction and operations.
Grizzly Bear	Species at Risk. Bear-People Interactions. First Nations and Public Use.	Yes - known and potential foraging habitat within floodplain, and surrounding forest.	Yes - study area is within mapped range and suitable habitat is available.	Yes - evidence of use within and around study area.	Yes - potential for interaction with construction and operation personnel.	Yes - measures to limit bear/human interactions required during construction and operations.
Hoary Marmot Snowshoe Hare	First Nations Use. Prey Species.	Yes - potential foraging habitats available in floodplain and on steep slopes in lower Taku River.	Possible - study area is within mapped range and suitable habitat is available.	No - no evidence of use at low elevations by these species.	Unlikely - construction and operations will affect a very small amount of habitats used by these species.	No - unlikely to be affected by construction or operations.

Species or Species Group	Rationale	Evidence of Suitable Habitat within Area?	Species Likely Found within Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Marten Mink Short-tailed Weasel	First Nations and Public Use.	Yes - suitable habitat in forested areas.	Yes - study area is within mapped range and suitable habitat is available.	Yes - evidence of use found.	Unlikely - construction and operations will affect a very small amount of riparian or mature/old forested habitat.	No - unlikely to be affected by construction or operations.
Mice Squirrels Voles Shrews	Species at Risk. Prey Species.	Yes - suitable habitat in upland forested areas.	Yes - study area is within mapped range and suitable habitat is available.	Yes - evidence of use found.	No - construction and operations will affect a very small amount of riparian or mature/old forested habitat.	No - unlikely to be affected by construction or operations.
Moose	First Nations and Public Use.	Yes - extensive seasonal, including winter foraging habitat within and adjacent to study area.	Yes - area is within mapped range and extensive suitable habitat is available.	Yes - extensive use documented for all seasons within and adjacent to ACB route. Very high value winter habitat in portions of ACB route.	Yes - possible effects on winter range and seasonal movements due to ACB operation.	Yes - measures required to limit effects due to operations especially during winter.
Mountain Goat	First Nations and Public Use.	Yes - limited amount suitable foraging and security habitat available in lower Taku River and Taku Inlet areas.	Possible - populations in area could utilize the limited habitats.	No – although evidence of use found at higher elevations outside study area.	Unlikely - construction will not affect habitats; operations unlikely to affect habitat use.	No - unlikely to be affected by construction or operations.
Porcupine	Prey Species.	Yes - suitable habitats in upland forested areas.	Yes - area is within mapped range and suitable habitat is available.	Yes - evidence of use found, population might fluctuate.	Unlikely - construction or operations will affect minimal amount of habitats used by species.	No - unlikely to be affected by construction or operations.
Sitka Black-tailed Deer	First Nations and Public Use.	Yes - suitable foraging and snow interception habitat available in mature forest in Taku Inlet.	Yes - lower portion of study area within mapped range and suitable habitat available.	Yes - limited use documented in lower Taku River and Take Inlet.	Unlikely - construction or operations will not affect forested habitats used for important winter range.	No - unlikely to be affected by construction or operations.

Species or Species Group	Rationale	Evidence of Suitable Habitat within Area?	Species Likely Found within Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Stone Sheep	First Nations and Public Use.	No - habitat types not in areas near ACB route.	No - habitat types not in areas near ACB route.	No - none observed in previous or current field assessments.	Unlikely - construction or operations will not affect habitats used by species.	No - unlikely to be affected by construction or operations.
Meadow Jumping Mouse Tundra Shrew	Species at Risk.	No - habitat types not in areas near ACB route.	No - habitat types not in areas near ACB route.	No - none observed in previous or current field assessments.	Unlikely - construction or operations will not affect habitats used by species.	No - unlikely to be affected by construction or operations.
Wolverine	Species at Risk. First Nations and Public Use.	Yes - potential foraging habitat available.	Possible - development area is within mapped range and foraging habitat is available.	Yes - limited use detected in area.	Unlikely - construction or operations will not significantly affect species.	No - unlikely to be affected by construction or operations.
Woodland Caribou	Species at Risk. First Nations and Public Use.	No - habitat types not in areas near ACB route.	No - habitat types not in areas near ACB route.	No - none observed in previous or current field assessments.	Unlikely - construction or operations will not affect habitats used by species.	No - unlikely to be affected by construction or operations.

Table 4-9. Detailed Evaluation of Construction and Operation Activities of the Taku River ACB Transportation System on Terrestrial Mammals

Species	Concern or Issue	Potential Effect(s)	Magnitude/ Risk of Potential Effect	Measures to Reduce Predicted Effects	Predicted Residual Effects
Grizzly Bear Black Bear	Increased mortality of bears due to interactions with humans (including road collisions).	Mortality significantly impacts populations.	High	Bear/Human Management Plan.	None.
	Construction and operations of road and ACB landing area displaces bears from high value foraging habitats.	Displacement from foraging habitats.	Low	Identify high value sites and avoid for construction (done). Monitor habitat use and modify operations, if practical.	None.
Grizzly Bear Black Bear	Operation of ACB transport system on Taku River and Taku Estuary.	Displacement from foraging habitats.	Low to Moderate	Identify high value sites and avoid during operations through timing or distance. Monitor habitat use and modify operations if practical.	None.
Moose	Construction and operations of road and ACB landing area displaces moose from high value foraging habitats.	Displacement from foraging habitats.	Low	Identify high value sites and avoid for construction (done). Monitor habitat use and modify operations if practical.	None.
	Operations along access road Operation of ACB transport system on Taku River.	Displacement from high value foraging habitats.	Low to Moderate	Identify high value sites and avoid during operations through timing or distance. Monitor habitat use and modify operations if practical.	None.
		Increased mortality risk from increased access by wolves/humans along ACB route and access road. Mortality from collisions.	Low to Moderate	Monitor mortalities and modify operations. Monitor habitat use and modify operations if practical.	None.

Species	Concern or Issue	Potential Effect(s)	Magnitude/ Risk of Potential Effect	Measures to Reduce Predicted Effects	Predicted Residual Effects
Grey Wolf	Operations along acess road. Operation of ACB transport system on Taku River.	Displacement from foraging habitats.	Low to Moderate	Identify high value sites and avoid during operations through timing or distance. Monitor habitat use and modify operations.	None.
		Increased mortality risk from increased access by humans along ACB route. Mortality from collisions.	Low to Moderate	Monitor mortalities and modify operations.	None.

4.5.5.4 Summary of Residual Effects on Terrestrial Mammals

There are no significant residual effects predicted for terrestrial mammal species.

4.5.6 Birds

4.5.6.1 Initial Evaluation of Effects on Birds

The initial evaluation of the effects of the Taku River ACB transportation system on bird species groups can be found in Table 4-11. In order to facilitate the initial evaluation, species were grouped into species groups more than for other species, based on their foraging behaviour and habitats, and where they nest. A general description of what species are in the species groups is provided below in Table 4-10.

Table 4-10. Species Group Composition for Bird Species in the Taku River Area

Species Groups	Group Composition
Pelagic Foraging Marine Birds and Waterfowl	Includes sea ducks and marine birds that do not nest within the ACB barge route and generally forage in offshore waters, or offshore of the islands in Southeast Alaska. They may occasionally be found in inshore waters. Examples include: Laysan Albatross, Buller's Shearwater, Steller's Eider.
Nearshore and Freshwater Foraging and Birds and Waterfowl	Includes sea ducks, loons, swans, geese, dabbling ducks, gulls and alcids (e.g. marbled murrelet) that may potentially nest within or adjacent to the ACB route and forage in nearshore or freshwater habitats. Examples include: Mallard, Mew Gull, Surf Scoter.
Shorebirds	Includes both large and small shorebirds that feed in tidal or intertidal areas as well as within wetland or river habitats. May also potentially nest within or adjacent to the ACB route. Examples include: Great Blue Heron, Least Sandpiper, Spotted Sandpiper.
Raptors	Birds of prey, such as owls and hawks, but excluding Bald Eagles, that generally nest in forested upland sites in large stick nests or tree hollows. They likely forage and may also potentially nest within or adjacent to the ACB route. Examples include: Red Tailed Hawk, Northern Goshawk.
Songbirds	Forest songbirds and other species generally found in upland sites. These species generally forage and potentially nest in upland habitats adjacent to the ACB route. Examples include: sparrows, warblers, flycatchers, crows, ravens, swallows, etc.

Although the species groups outlined above include species that may exclusively forage or nest in areas that are outside of the BC portion of the Taku River drainage, they are included in this evaluation to provide regulators with an assessment of species that have obligations under transboundary agreements such as the Migratory Bird Act.

Based on the initial evaluation, the following bird species and species groups were determined to require a more detailed evaluation: bald eagle, nearshore foraging ducks and marine birds, and shorebirds.

4.5.6.2 Detailed Evaluation of Effects on Birds

The detailed evaluation of the effects of the proposed Taku River ACB transportation system on birds is provided in Table 4-12 for the species identified.

Table 4-11. Initial Evaluation of the Taku River ACB Transportation System on Bird Species and Species Groups

Species or Species Group	Rationale	Evidence of Suitable Habitat Within Area?	Species Likely Found in Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Pelagic Foraging Marine Birds and Waterfowl	Species at Risk. Migratory Bird.	No - breeding habitats not within proposed study area, and inshore marine habitats not generally used for foraging.	Unlikely – potential foraging habitat not located in study area.	No - available information does not indicate use in study area.	Not likely - potential impact if oil spill in offshore waters.	No - unlikely to be affected by construction or operations; consider within spill contingency plan.
Nearshore and Freshwater Foraging Birds and Waterfowl	Species at Risk. Migratory Bird.	Yes - Taku Inlet, Taku estuary, Taku River and adjacent wetland complexes provide suitable foraging habitat; wetland complexes adjacent to Taku River provide suitable breeding habitats.	Yes - development area is within known migration routes and suitable foraging and breeding habitats are present.	Yes - numerous species identified using area during various seasons.	Yes - possible disruption of feeding during operations; potential impact if oil spill.	Yes - measures to minimize disruption of important feeding areas required; consideration within spill contingency plan required.
Shorebirds	Species at Risk. Migratory Birds.	Yes - Taku estuary, Taku River and adjacent wetland complexes provide suitable foraging habitat; wetland complexes adjacent to Taku River provide suitable breeding habitats for some species.	Yes - development area is within known migration routes and suitable foraging and breeding habitats are present.	Yes - numerous species identified using area during various seasons.	Yes - possible disruption of feeding during operations; potential impact if oil spill.	Yes - measures to minimize disruption of important feeding areas required; consideration within spill contingency plan required.

Species or Species Group	Rationale	Evidence of Suitable Habitat Within Area?	Species Likely Found in Area?	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Bald Eagle	Management Interest.	Yes – foraging habitat available along the Taku River and Taku Inlet, potential nesting habitat in floodplain forest along Taku River.	Yes – suitable nesting and foraging habitat is present and known to be used.	Yes – birds observed during surveys, use of perch and nest trees evident.	Possible - nest tree within 700 m of proposed ACB landing and several along Taku River within 500 m of ACB route.	Yes - assess potential for disturbance to potential nesting habitat.
Raptor Species Songbirds	Species at Risk. Migratory Birds.	Yes - potential breeding and foraging habitat located in mature/old forest adjacent to proposed ACB transportation route.	Yes – suitable nesting and foraging habitat available.	Yes - detected during breeding bird or incidental surveys.	Not likely - construction of ACB landing and road access will affect a minimum amount of nesting or foraging habitat; operations not expected to disrupt hunting or movements.	No - unlikely to be affected by construction or operations.

Table 4-12. Detailed Evaluation of Construction and Operation Activities of the Taku River ACB Transportation System on Birds

Species or Species Group	Concern or Issue	Potential Effect(s)	Magnitude/ Risk of Potential Effect	Measures to Reduce Potential Effects	Predicted Residual Effects
Bald Eagle	Construction and operations of road and ACB landing area near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts population.	Low to Moderate.	Identify high value sites and avoid for construction (done). Monitor habitat use and populations and modify operations where possible.	None.
	Operation of ACB transport system on Taku River near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts population.	Low to Moderate.	Identify high value sites and avoid during operations through timing or distance where possible (i.e. maintain minimum 200 m from active nests with ACB, where possible. Monitor habitat use and populations and modify operations where possible.	None.
Nearshore and Freshwater Foraging Birds and Waterfowl	Construction and operations of road and ACB landing area near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts populations.	Low to Moderate.	Identify high value sites and avoid for construction (done). Monitor habitat use and populations and modify operations where possible.	None.
	Operation of ACB transport system on Taku River and Taku Inlet near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts populations.	Low to Moderate.	Identify high value sites and avoid during operations through timing and distance where possible. Monitor habitat use and populations and modify operations where possible.	None.

Species or Species Group	Concern or Issue	Potential Effect(s)	Magnitude/ Risk of Potential Effect	Measures to Reduce Potential Effects	Predicted Residual Effects
Shorebirds	Construction and operations of road and ACB landing area near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts populations.	Low to Moderate.	Identify high value sites and avoid for construction (done). Monitor habitat use and populations and modify operations where possible.	None.
	Operation of ACB transport system on Taku River and Taku Inlet near nesting and foraging habitats.	Displacement from nesting and foraging habitats impacts populations.	Low to Moderate.	Identify high value sites and avoid during operations through timing and distance where possible. Monitor habitat use and populations and modify operations where possible.	None.

4.5.6.3 Planned Measures to Reduce Effects on Birds

- An outline of the proposed monitoring Bald Eagle Monitoring and Waterfowl and Shorebird Monitoring is found in Appendix A.

4.5.6.4 Summary of Residual Effects on Birds

There are no significant residual effects predicted for bird species.

4.5.7 Amphibians and Reptiles

4.5.7.1 Initial Evaluation of Effects on Amphibians and Reptiles

Table 4-13. Initial Evaluation of the Taku River ACB Transportation System on Amphibian and Reptile Species

Species	Rationale	Evidence of Species Within Area?	Effects Possible from Construction/Operations?	Detailed Assessment and Measures Required?
Western Toad	Species at Risk.	Yes - observed in ACB landing area and adjacent to ACB landing area, ACB route and haul road.	Unlikely - no known breeding areas will be removed by ACB landing or haul road; limited disruption of migration routes across roads during operations	No - ID breeding habitats; monitor migration across road and ACB landing; consider breeding habitats within oil spill contingency plan.
Other Amphibians	Management Interest.	Yes - breeding and foraging habitats adjacent to ACB landing area, ACB route and haul road.	Unlikely - no known breeding areas will be removed by ACB landing or haul road; limited disruption of migration routes across roads during operations.	None.
Reptiles	Management Interest.	No - no evidence of use and possibly outside known ranges.	Unlikely - no known in area.	None.

4.5.7.2 Detailed Evaluation of Effects on Amphibians and Reptiles

Not required.

4.5.7.3 Planned Measures to Reduce Effects on Amphibians and Reptiles

- No measures are proposed.

4.5.7.4 Summary of Residual Effects on Amphibians and Reptiles

There are no significant residual effects predicted for amphibian and reptile species.

4.6 Human Activities

The potential effects on human activities along the proposed ACB route within Canada are primarily associated with the commercial and subsistence fisheries on the Taku River. The assessment of these potential effects was prepared based on information gathered through interviews with native and non-native fishermen regarding their activities on the river. Additional information was obtained through personal communications with Taku River Tlingit First Nation (TRTFN) staff. Other human activities are quite limited in this area due to the relatively difficult access (by air from Atlin or Whitehorse) or boat (via Alaska), and the presence of the international boundary that limits the casual transit of people across the border.

4.6.1 Commercial Fishery

Potential Effect

The daily transit of the ACB has the potential to temporarily disrupt the drift net fishery that is concentrated just upstream of the Canada/US border. Approximately 80% of the fishery is located within this area. The longest drift is approximately 1 km long, and takes each boat about 8 minutes to complete the drift. The passage of the ACB through this section of the river would take approximately 10 minutes, thus the period of disturbance to the fishing activity would be roughly 10 minutes, twice per day (upstream and downstream transit). During the transit of the ACB, the drift nets would likely need to be pulled from the water for this short period to allow the passage of the ACB.

Proposed Mitigation

- Redfern will prepare a Transportation Communications Plan prior to the commencement of operations. This Plan will include the following elements that are relevant to this activity:
    - a) A schedule of the ACB transits will be posted and communicated to all fisheries regulators, TRTFN, and registered fishermen prior to the commencement of the fishing season.
    - b) Fisheries regulators, TRTFN and fishermen would be notified in advance of any scheduling changes, to the extent practical. The notification of the ACB transit schedule will ensure that all users of the river have prior knowledge of the timing of ACB transits, and can, with little effort, accommodate this disruption.

c) Annual meeting with fisheries regulators, TRTFN and fishermen at the close of the commercial season to review the ACB operations with respect to the drift net fishery.
d) Work collaboratively with the fisheries regulators, TRTFN and fishermen to identify further mitigative measures, as needed and appropriate.

Conclusion

- The length of delay when the ACB passes through the drift net fishing zone will be very short, and result in no measurable impact on the success of the fishery. Annual monitoring, and adaptive measures if needed, will further reduce disruption to this fishery.

4.6.2 Subsistence Fishery

Potential Effect

The subsistence fishery is mostly carried out by the TRTFN that participate in the commercial fishery, usually in the days following the commercial openings, although others participate whenever the opportunity to access the area is available. As for the commercial drift net fishery, the potential effect is associated with the temporary disruption of the activity when the ACB passes by.

Proposed Mitigation

- See Section 4.6.1 Commercial Fishery

Conclusion

- The transit of the ACB will cause a brief disruption of this activity, and result in no measurable change in the success of the subsistence fishery.

4.6.3 Sport and Personal Use Fisheries

These activities are virtually non-existent within the study area, or are incidental to other infrequent recreational use (commercial wilderness tourism). Sport fishing takes place on the upper reaches of the Taku River and its tributaries, distant from the ACB operations. Due to the limited access to the Taku River in Canada, there is very little personal use fishing activity. These activities will not be affected by the proposed ACB transportation system operations.

4.6.4 Recreation and Tourism

Potential Effect

As discussed in Section 3.6.2, commercial river trips are offered on the Taku River, although the level of use has dwindled in recent years. For the past two seasons, only one or two trips were completed. Canadian tour operators complete the trip at the confluence of the Tulsequah River, and fly out from the airstrip located on the west side of the Tulsequah River, near the old Tulsequah townsite. The ACB operations will pose little if any disruption to this activity. There is ample room at the river confluence for the ACB and any other small watercraft on the river. Noise effects associated with operations at the ACB landing site, where loading and unloading operations will be carried out, will be present. Given the low volume of trips using the river and taking off the river in the vicinity of the ACB landing area, any noise and visual effects will be temporary, short duration, and infrequent.

Proposed Mitigation

- None is proposed.

Conclusion

- The potential effects on commercial tourism activities (river trips) will be insignificant.

4.6.5 Big Game Outfitting and Resident Hunting

Potential Effects

Guided outfitting and resident hunting is very limited within the study area as described in Section 3.6.3. Guided hunting activities at higher elevations are focused along the eastern slopes of the Coast Mountains, rather than along lower elevations of the Tulsequah or Taku River valleys. However, some bear and moose hunting activity does occur at lower elevations in back channels and sloughs where there is potential for disruption in hunting activity as a result of intermittent, incremental noise related to the ACB transportation system and haul road from the ACB landing to the minesite.

Due to difficult access, resident hunting is very limited in the study area.

Proposed Mitigation

- No specific mitigation is proposed; refer to Section 4.4.2.5 regarding noise.

Conclusion

- No adverse effects on big game outfitting or resident hunting activities are predicted to be associated with the operation of the ACB transportation system along the Taku River within Canada.

4.7 Heritage Resources

Redfern and the Taku River Tlingit First Nation (TRTFN) signed a Letter of Agreement in 2007 regarding their role and participation in the Tulsequah Chief Mine Project permitting and the assessment related to the proposed ACB transportation alternative. The purpose of this Letter of Agreement is to articulate the means whereby Redfern will support the capacity of the TRTFN to participate effectively in the environmental assessment review process. This will allow the TRTFN to identify and evaluate the potential effects of the proposed ACB operations on their current and traditional uses of the land and resources of the Taku River. This evaluation will include an assessment of potential effects on heritage resources.

At this time, there has been some preliminary identification and field assessment of heritage resources in the vicinity of the proposed ACB landing site at the confluence of the Taku and Tulsequah Rivers. The results of this work, and any further heritage assessment work will be included as an Addendum to this Volume once completed and provided by the TRTFN.

4.8 Accidents and Malfunctions

The conceptualization of the air cushion barging (ACB) system has evolved in an iterative manner with engineering design, transportation logistics and environmental management all given due consideration. As a result, preventative and mitigative measures have been incorporated into the proposed air cushion barging system, and the potential for accidents and malfunctions has been discussed and considered at some length during this process. Protocols will be implemented that are designed to minimize environmental disturbances and hazards to people, aquatic systems and wildlife. Most importantly, all reagents or dangerous goods shipped upstream and all concentrate and dangerous goods shipped downstream will be transported in standard containers designed for marine and riverine use and approved by all the relevant regulatory agencies in both Canada and the United States. In addition, the proposed transportation system will be connected to the larger shipping route from Alaska to the contiguous United States and therefore all shipping containers will be required to meet all standard shipping regulations on that route.

The following sections outline examples of potential accidents and malfunctions, and where appropriate, measures incorporated to prevent or minimize the associated risk.

4.8.1 Spills of Hazardous Materials

Potentially hazardous materials, such as diesel fuel, reagents, and ore concentrate, will be transported in bulk quantities on the ACB system. On average, there will be one round trip between the ACB landing site and Juneau. On a typical outbound ACB load, nine or ten containers of ore concentrate will be shipped, and on a typical inbound barge load, up to 53,000 litres of diesel fuel and 34 tonnes of cement will be transported. Table 4-14 lists a typical ACB load traveling upstream and Table 4-15 lists the process consumables that will be transported by the ACB system and in what containers they will be shipped. Materials will be assembled into standard ISO containers before shipping to site.

Table 4-14. Typical Barge Load to Tulsequah Chief Project

Material	Approximate Weight (tones)
Diesel	47
Cement	34
Process Consumables	21
Misc. Equipment and Supplies	6
Food and Camp Supplies	5
Propane	2
Explosives	2
Process Plant Maintenance Supplies	1.5
Rock Bolts	0.5
Misc. Underground Supplies	0.2

Table 4-15 Process Consumables to be Transported via ACB Transportation System

Material	Delivery Container
Flocculant	25 kg bags
Copper Sulphate ($CuSO_4$)	1,000 kg supersacs
Zinc Sulphate ($ZnSO_4$)	1,000 kg supersacs
Sodium Sulphite ($Na2SO_3$)	1,000 kg supersacs
Methyl Isobutyl Carbinol	Tanker truck or 200 L drums
DF250 (frother)	Tanker truck
Potassium Amyl Xanthate	Pellet form in 1,000 kg drum or 1-tonne tote bags
Sodium Cyanide (NaCN)	Briquette form in 100 kg drums or 1-tonne tote bags
Sodium Metabisulphite ($Na_2S_2O_5$)	Powder form in 1,000 kg fabric bags
Sodium Ethyl Xanthate	Pellet form in 1,000 kg drums
3418A	Liquid in drums
Sulphuric Acid (H_2SO_4)	Tanker truck
Dextrin	100 kg fabric bags or 25-kg bags
Ferric Sulphate (Fe2(SO4)3)	Tanker truck
Lime	Unslaked powder form in 40-tonne trucks

4.8.1.1 Spills on water

All cargo will also be transported in marine-certified containers to prevent leakage or spills into water (see Volume 1. Photos 2-1 and 2-2). Hazardous materials will be handled and transported in accordance with current regulations pertaining to transportation of hazardous goods. The containers will be secured to the deck of the barge to prevent shifting during transit. There will be no transfer of bulk materials from one barge to another during the transfer from river to marine operations; rather the river and marine tugs will exchange barges.

Diesel Spills

Fuel will be transported to site in either ISO tanks or standard fuel tanker truck approved for public transportation systems. These will be secured on the ACB by industry-standard methods. Redfern has committed to joining SEAPRO (Southeastern Alaska Petroleum Resource Organization). SEAPRO has pre-positioned oil spill response teams and equipment maintained in a state of readiness in the event that any member organization has an incident. There is a SEAPRO team located in Juneau, AK. SEAPRO is also classified as an oil spill removal organization for rivers and canals.

Reagent Spills

All reagents or dangerous goods will be transported in keeping with the *Transportation of Dangerous Goods Act* in Canada, and all other relevant legislations. Redfern will establish and implement an Aquatic Spill Contingency Plan that specifically addresses a potential spill of each reagent and the proper response depending on that reagent. In the event that a portion of the transportation system is contracted to an independent operator, Redfern will require that the operator meet all legislated requirements regarding the shipping of dangerous goods.

Concentrate Losses

The ore concentrate will be shipped in sealed containers. Given the weight of these containers and the stability of the barge, loss of a container overboard is considered to be very unlikely. The sealed containers would prevent or minimize spillage of concentrate into the environment, even in the unlikely event that a container became submerged. If the container were to become submerged negative impacts to the environment would be reduced as oxidation of the concentrate would be prevented.

Potential spills of materials at the AML facilities in Juneau will be handled in accordance with AML's current Spill Contingency Plan for their facilities.

4.8.1.2 Spills on Land

Should any spills occur on land between the ACB landing site and the mine-site, the mine's Spill Contingency Plan would be implemented.

The Spill Contingency Plan shall include:

- specific instructions regarding contact information including who to contact, how and when;
- descriptions of the type and amount of contaminants normally in transit on the ACB transportation system;
- the steps to be taken to report, contain, clean-up and dispose of contaminants in the case of a spill;
- the means by which the spill plan is activated;
- the training required and provided to employees in order to respond to a spill; and
- an inventory of and the location of response and clean-up equipment available.

Diesel Spills

Uncontrolled losses to the environment, during a single event, would be limited to the volume of fuel being transported at any one time, or approximately 20,500 L. Depending upon the location of the accident, the spill could report to groundwater and/or surface water directly. Spills of diesel fuel directly into, or adjacent to, surface streams would have an immediate acute and potentially chronic impact to aquatic biota. Recognizing that petroleum products are less dense than water, such a spill may also result in fouling of riparian habitat. The most difficult accident to control would be a spill into a rapid flowing watercourse that would make containment measures difficult and ineffective. Under this situation, several kilometres of stream habitat could be impacted.

Transportation of diesel fuel to the Tulsequah Chief minesite will be using industry standard fuel tanker trucks or ISO tanks. Preventative and mitigation techniques have been developed over many years and have proven effective. In addition to the development of a detailed Spill Contingency Plan, careful road safety (speed limits, etc.), good road maintenance and effective communications will ensure that the potential for accidents during routine transport of diesel fuel to the site is minimized.

Reagent Spills

The most important reagents to consider, with respect to potential accidental spills, are associated with those transported in liquid form, mainly: frother (DF250), sulphuric acid, ferric sulphate ($Fe_2(SO_4)_3$) methyl isobutyl carbinol, 3418 A and flocculant.

The environmental risk associated with accidental spills during transport of liquid reagents is similar to that described for diesel fuel. Sulphuric acid has the greatest potential for impacts to the environment due to the volumes used at site. Sulphuric acid will be transported to site as 93% strength liquid in ISO tankers. Dowfroth 250 (DF25)) (polypropylene glycol) will also be transported in ISO tankers. Both reagents are 100% soluble in water and toxic to aquatic life. Direct loss to surface water would result in impacts to aquatic biota, however the spatial extent of these impacts will be dependent upon flow conditions at the time. Because of their solubility, the duration of impacts would be transient but may extend over several hundreds of metres or kilometres. Acute toxicity would be reduced with transport downstream with increasing dilution. Risks due to dry reagent spills are considered minimal owing to their lack of mobility and ease of recovery.

Concentrate Losses

The potential for losses during transport from the mine to the ACB dock are considered unlikely. Sealed concentrate containers will prevent fugitive dust losses. Should an accident occur during transport, the likelihood of a full-load loss would be very minimal. Direct spillage to a surface watercourse would have the potential for loss of habitat due to deposition of fines of the dense concentrations. However, the bioavailability of the metals in concentrate would be very low. The economic importance of the material would endure adequate and rapid clean-up.

4.8.2 Mechanical Failure of ACB

It is possible that one or more of the four engines on the ACB could fail during operations. The ACB can maintain hover on only two engines, and the likelihood of all four engines failing simultaneously is very remote. The loss of hover on the ACB would mean that the barge would settle onto the surface and float or rest on the pontoon, depending if it is on water or land at the time. As more than one towing vessel (the shallow draft tug and amphitrac, or two amphitracs) will frequently operate together, crews would be able to provide mutual support to manoeuvre the barge into a secure position until the engine(s) could be repaired. No environmental impacts are anticipated.

4.8.3 Mechanical Failure of Amphitrac

It is possible that one or more of the engines could fail during operations. Three engines will be dedicated to powering the screws and metal wheels; one engine will be dedicated to powering the soft tire wheels. It is very unlikely that more than a single engine would fail at one time. If one of the engines powering the screws were to fail, it can still progress on a single engine. If the engine powering the soft tire wheels should fail, a second amphitrac would tow the amphitrac to the minesite where the engine would be repaired. No environmental impacts are anticipated.

4.8.4 Mechanical Failure of Shallow Draft Tug or Marine Tug

While it is possible that either the shallow draft tug or marine tug could experience a mechanical failure during operations, contingency plans will be prepared to deal with this situation. Typically, another tug or suitable vessel will provide assistance to the crippled vessel, and tow it to Juneau where it can be repaired. In the case of the shallow draft tug operating on the river, the amphitracs would provide the needed assistance to tow it out to the Taku Inlet where it would then be towed or escorted to Juneau by a marine tug or other suitable vessel. The barge would be taken off hover, set down on shore until such time that another vessel could rendezvous with the barge and complete the trip. No environmental impacts are anticipated.

4.8.5 Grounding

In the event that the marine tug or shallow-draft tug run aground, the standard procedures will be followed to re-float the tug. This may involve waiting for tidal assist, or commercial towing. While grounding is an inconvenience, it does not usually pose a serious threat to safety. Given that the tugs are most likely to run aground on sand or gravel bars the risk associated with this kind of accident is minimal. In any event, running aground is a standard operational risk and there are no environmental impacts associated with this type of accident.

4.8.6 Capsize of ACB

The ACB is designed to operate safely in *sea state 5*, with wave heights up to 4 m. These conditions may be encountered during severe storms at sea, particularly at the convergence of the Taku Inlet, Gastineau Channel and Stephens Passage. Weather conditions will be continuously monitored, and operations may be postponed in the event that severe storms are forecast for the area. The decision whether or not to proceed will be the responsibility of the tug captain, who is responsible for safety of the crew and vessel when at sea. The ACB is remotely controlled, and can be lowered off hover to provide additional stability if needed. The design is such that it will float on the pontoon, and continue to remain afloat even if there is damage to a portion of the pontoon. As such, it is very improbable that the ACB would capsize or sink.

4.8.7 River Collisions

The Taku River is used for pleasure boating as well as commercial fishing. In order to avoid any collisions with other craft, the ACB, amphitracs and tug boats will be equipped with lights and a fog-horn or noisemaker and will follow all navigational rules and regulations. Only qualified operators will be retained to run the ACB, tug boats and amphitracs. Redfern will have an Emergency Response Plan in place that outlines the steps to take in the case of a collision. In the event that a portion of the transportation system is contracted out, Redfern will require the operator to follow all relevant regulations and legislation regarding emergency preparedness.

4.8.8 Firearms Incidents

The area in which the ACB will be operating is popular amongst hunters and other firearms owners. All dangerous goods containers will be clearly labelled as such, including placards and warning signs. During holidays that are well known for firearms activity, the risk of operating will be assessed and it may be determined that the ACB will not operate during these holidays. Effort will be made to educate the public regarding the cargo carried by the ACB and its potential hazards. Redfern will extend its no-firearms policy to the transportation system so that firearms issues are not associated with the river crew.

4.8.9 Truck Haulage

The most likely environmental impact associated with accidents with respect to truck haulage is addressed in the Section 4.8.1. As stated above, careful road safety (lower speed limits, etc.), good road maintenance and effective communications between drivers will ensure that the potential for accidents during routine transport of diesel fuel to the site is minimized. Each truck will be equipped with a radio and remain in constant communication range of the transport co-ordinator at site so that any accident can be reported quickly and dealt with.

4.8.10 Conclusions

The preceding section outlines how potential for accidents and malfunctions are assessed and the proposed mitigation plans. Development of the ACB transportation system considers environmental management, in conjunction with engineering, throughout the system design and operations planning. Consideration of potential accidents and malfunctions has been integral to designing the transportation system.

The potential environmental effects related to possible accidents consist of spills of hazardous materials, principally diesel fuel, reagents and concentrate. Most of the ore haul route is along or over water bodies, including tributaries to the Tulsequah River and the Taku River itself.

Potential spills directly into a water course would be the most detrimental situation and could result in acute toxicity to aquatic biota. Transportation of hazardous materials such as sulphuric acid and frother are of potential concern because the volumes to transported, their liquid form, solubility and toxicity to aquatic life. The transportation of ore is not considered to pose significant risk as the material will be contained in sealed containers, is insoluble, and would, if released to the environment, have mainly physical impacts on aquatic life.

Redfern will develop a comprehensive spill prevention and contingency plan, prior to commencement of operation of the transportation system, which will be used by Redfern and any transportation system contractors.

4.9 Transboundary Effects

The *Canadian Environmental Assessment Act* (CEAA) requires environmental assessments to consider the transboundary effects of proposed projects. Geographically, this provision indicates that transboundary effects across international boundaries must be considered. The process to be followed by the BCEAO for this amendment will also address the issue of potential transboundary effects. BCEAO has indicated that the parallel review process in Alaska will be reflected in their assessment.

4.9.1 Transboundary Effect Analysis

A transboundary effect is possible where, for example, an animal moves across jurisdictional boundaries (e.g., annual migration pattern) or an activity (e.g., air emissions) caused by the proponent crosses jurisdictional boundaries. The assessment of transboundary effects as they relate to the proposed ACB transportation system has focussed on the following elements:

a) potential transboundary effects associated with spills into water in Canada that may extend into Alaska;
b) potential transboundary effects on fish and fish habitat; and
c) potential transboundary effects on wildlife and wildlife habitat.

Spills into Water

Hazardous Materials

Chapter 4, Section 4.8, describes the potential effects associated with accidents and malfunctions of the project, including spills of hazardous materials into the environment. Of primary concern are spills that could enter the Taku River either directly or indirectly as a result of a rupture to a container holding any of the hazardous substances being transported on the ACB, and then spillage of said substance into the receiving environment. .

Mitigation measures to reduce the potential for adverse effects to the environment will include the following:

a) All hazardous materials will be transported in marine certified containers to prevent leakage and spills into water.
b) All hazardous materials will be handled and transported in accordance with current regulations pertaining to the transportation of hazardous goods in both Canada and Alaska.

c) All hazardous materials on the ACB will be secured appropriately, and in accordance with standard marine procedures and practices for the weather conditions likely to be encountered or are encountered.
d) The ACB will have a bulwark around the deck to prevent leakage in the event that of a spill on deck during transport. Spill clean up kits will be carried on board the ACB and tow vessels.
e) All handling and loading of materials at Big Bull landing site will be carried out on land, not on or near water.
f) There will be no transfer or transhipment of material from one vessel to another while on the river or at sea.
g) During the loading and unloading of the ACB at the Big Bull landing site, these materials will be handled in their containers – there will be no transfer of bulk materials at this site.
h) Materials will be transported by truck to the minesite in their containers, in accordance with Canadian regulations for the transportation of dangerous goods and the equivalent in the US.
i) Appropriate training and supervision will be ensured for all staff involved in handling and transporting hazardous materials.
j) Redfern will implement a comprehensive Spill Prevention and Contingency Plan that includes provisions for prevention and clean up of spills of these materials.

With this level of operational design and appropriate supervision of the handling procedures at the landing site, the risk of spills of hazardous materials entering the Taku River system is low. Consequently, the risk of a transboundary effect on the Taku River and its resources in Alaska is similarly low, but the risk cannot be eliminated entirely.

Diesel

Diesel spills could occur as a result of a rupture to the fuel tanks during transport along the river on the ACB or during truck transport along the haul road to the minesite, or as a result of rupture to the fuel tanks of the ACB and tow vessels, or from the loss of a fuel transport truck overboard.

Mitigation measures proposed to minimize the risk of fuel spill into water include all of the measures mentioned above, as well as:

- Bulk fuel will be transported in industry standard trailer mounted tanks approved for use on public transportation networks. The truck trailers will be secured on the deck of the ACB according to standard marine procedures for shipping fuel.
- There will be no handling or transfer of bulk fuel from water to land or land to water. Refuelling of equipment will be carried out in accordance with standard practices for fuel handling near water and boat refuelling procedures.
- There will be no routine refuelling of equipment while en-route.

- Redfern's Spill Prevention and Contingency Plan will address fuel spills on land, and include specific measures to minimize the risk of fuel entering the water.
- The ACB itself will have double-walled fuel tanks that are non-integral to the hull. This means that if the hull (pontoon) is damaged, there is minimal risk of rupturing the fuel tank.
- Spill response equipment will be carried on board all vessels.
- Redfern will become a member of SEAPRO (Southeast Alaska Petroleum Resource Organization).

With this level of operational design and appropriate supervision of the handling procedures at the landing site, the risk of spills of hazardous materials entering the Taku River system is low. Consequently, the risk of a transboundary effect on the Taku River and its resources in Alaska is similarly low, but the risk cannot be eliminated entirely.

Fish and Fish Habitat

The assessment of effects of the proposed ACB transportation system within the Canadian portion of the study area has concluded that there will be no significant effect on the fish and fish habitat of the Taku River. Further, the proposed ACB operations and activities will not cause a significant increase in sediment levels through re-suspension or bank erosion that would affect the water quality of the Taku River downstream of the international boundary. The ACB operations in the Canadian section of the Taku River will not result in any significant effects that will affect fish stocks or fish production in the U.S. section of the Taku River.

Wildlife and Wildlife Habitat

The assessment of the potential effects of the proposed ACB transportation system on wildlife and wildlife habitats in BC predicts that there will be no significant residual effects, if the planned measures to reduce the anticipated potential effects are implemented. Movements of wildlife from one side of the Canada/US border to the other are assumed to be currently occurring, and it is not expected that the ACB transport system would significantly change movement patterns or populations. Ongoing monitoring of populations such as moose, wolves and bears are proposed, and will provide information to regulators to assess movements and populations over duration of the project.

Conclusions

The assessment of potential transboundary effects is primarily focussed on the risk of spills of hazardous materials during river transport, materials handling at the Big Bull landing site, and truck hauling between the landing site and the minesite. Spills have the potential to enter the water directly or indirectly, with potential downstream consequences.

The assessment of the potential accidents and malfunctions considered a wide range of possible scenarios whereby accidents and malfunctions may result in an adverse environmental effect. The

level of risk for the potential accidents and malfunctions appears to be low, given that current standards for shipping hazardous materials and fuel will be adhered to, and appropriate spill prevention and clean measures will be implemented and enforced.

Assuming that high standards of design and supervision are implemented, the assessment of transboundary effects has concluded that the risk of significant adverse effects resulting from the proposed ACB transportation system operations is low. It is recognized however, that although measures to reduce this risk will be implemented and enforced, the risk cannot be entirely eliminated.

4.10 Cumulative Effects

A cumulative impact assessment is not considered necessary at this time, as there are no other known projects or proposals for projects including mining, forestry or development in the Taku River valley that would overlap with the Transportation System of the Tulsequah Chief Project spatially or temporally.

There are two potential projects of which Redfern Resources is aware: New Polaris and Big Bull. Canarc Resources Corp. owns 100% interest in the New Polaris project, which is located approximately 3 km downstream of the Tulsequah Chief Project on the Tulsequah River. Canarc Resources Corp. has initiated preliminary work on the site and intends to pursue a feasibility study, government permitting and project financing in 2008 (http://www.canarc.net/projects/new_polaris/). However, at this time, Canarc has not submitted any applications to the British Columbia Environmental Assessment Office. Therefore, Redfern, cannot assess the cumulative effects of the proposed Transportation System and the Canarc project.

Currently, Redfern is exploring the Big Bull site, located at the confluence of the Tulsequah and Taku Rivers. If a reserve were to be developed at Big Bull the Tulsequah Chief project life would be extended, which would not be considered a cumulative effect but rather simply an extension of the project.

4.11 Summary of Potential Effects, Mitigation Measures and Conclusions

4.11.1 Summary

The following table provides a summary of:

- potential adverse environmental effects;
- proposed mitigation measures to avoid or minimize potential adverse effects; and
- conclusions regarding any residual effects.

Table 4-16. Summary Potential Effects and Mitigation

Potential Effect	Proposed Mitigation	Conclusion -Residual Effects
Aquatic Effects		
Channelization	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential channelization effects. ■ Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential channelization effects. No dredging or other works will be conducted to channelize the river, therefore the potential effect is not relevant to this project.	Avoided, no measurable effects.
Disturbance of Substrates in Taku River	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential disturbance of substrates in Taku River. ■ Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential disturbance of substrates in Taku River.	Avoided, no measurable effect.
Re-suspension of sediments and bank erosion	■ Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional ACBs. ■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments. ■ Implement management strategy to identify and monitor areas of that could be effected by sediment re-suspension and deposition. Adjust ACB operation (e.g., travel speed) if unacceptable effects are reported.	The potential for re-suspension of sediments and bank erosion effects associated with this project will be negligible.
Effects on Water Quality	■ Develop and implement Spill Prevention and Contingency Plan, complete with requirements for appropriate materials packaging, personnel training, equipment and measures to reduce risk of spills. ■ Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional ACBs. ■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments. ■ Implement management strategy to identify and monitor areas of that could be affected by sediment re-suspension and deposition. Adjust ACB operation (e.g., travel speed) if unacceptable effects are reported.	The risk of water quality effects from accidental spills, while not eliminated, is reduced to acceptable levels. The potential for re-suspension of sediments and bank erosion effects associated with this project will be negligible.
Effects on Ice Formation and Break-up	■ Operation plan avoids ice breaking and plans to allow the river to freeze up and thaw naturally. A frozen river surface is the preferred operational condition for the Taku River ACB transportation system in winter. ■ Ice road building will not be conducted; therefore fall ice formation and spring break-up will not be altered by the ACB operations.	Proposed operations and design of the equipment will minimize potential effects on ice formation and break-up.
Relocation of Large Woody Debris that provide protective cover for juvenile salmonids	■ Relocation of large woody debris will be minimized to only those that are located in the actual travel route and present a hazard to the safe operation of the transportation system. ■ Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel so the debris continues its role as fish habitat. ■ Above the Taku lodge the wetted channel width of the Taku River is generally greater than 100 m, providing lots of room to place LWD in areas that won't affect navigation but will continue to provide functional fish habitat. ■ During operations a log will be kept, recording where LWD is moved from and where it is placed.	Potential effects on juvenile fish habitat will be insignificant as relocation of LWD will continue to provide fish habitat in nearby wetted areas of river channel.
Increased Level of Aquatic Noise	■ The air cushion will minimize the transmission of noise and vibration into the water column so the ACB will not contribute additional noise to the underwater environment. ■ All equipment associated ACB transportation system to be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m).	Aquatic noise will be negligible.
Effects on Mainstem Salmon Spawning and Rearing	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding mainstem spawning in side channels and creek mouths. ■ East channel at Canyon Island used for spawning at mouth of Fish Creek; ACB route will avoid this habitat by travelling out of the water along the gravel bar on east shore of island.	The potential effects to mainstem spawning will be avoided and effects to rearing will be negligible.

Potential Effect	Proposed Mitigation	Conclusion -Residual Effects
Effects on migrating adult and juvenile salmon	■ Specific mitigation not required. ACB route follows mid channel where juveniles are not found primarily due to high water velocities. Also, the majority of juvenile salmonids migrate downstream during darkness, when the ACB will not normally be on the river. ■ Given the short duration of the ACB passage past a point that would occur twice a day and the fact that the width of the river provides opportunities for fish to avoid the ACB it is unlikely that the barging will have an effect that would impact on the adult migration of salmon in the Taku River.	No significant effects on migrating juvenile or adult salmon.
Entrainment of small fish under the ACB in the air cushion	■ Implement a monitoring program during initial months open water barging to confirm there are no significant adverse effects associated with entrainment of small fish under the ACB in the air cushion during the landing process.	Risk to small fish during ACB landing will be minimal.
Stranding of Juveniles	■ Monitoring will be carried out at the landing site and at low gradient beach areas along the route during the first year of operation. If significant numbers of fish are being stranded by ACB operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.	Potential for significant adverse effects to juveniles while ACB landing will not be significant.
Effects resulting from construction activities during upgrade of Haul Road (erosion, sedimentation)	■ Mitigation measures include the use of environmental monitors, erosion and sediment control, construction will take place under favourable weather conditions, vegetation clearing will be kept to a minimum and grubbing will not take place within the riparian zones.	Construction activities required to upgrade the haul road are not expected to have any significant environmental effects on fish or fish habitat.
Effects resulting from operations on Haul Road; (introduction of sediment and deleterious substances into fish bearing waters)	■ Roads will include suitable ditching and culverts to contain and divert surface runoff away from fish bearing waters or streams sections that are immediately upstream of fish barriers. ■ Redfern will develop and maintain detailed spill response plans appropriate to the type and quantity of deleterious materials that will be transported along the haul road.	Operations of the haul road are not expected to cause any significant environmental effect.
Terrestrial Resources		
Increased instability of soils along the proposed haul road	■ The lack of deep organic soils within the proposed haul road and lack of any significant organic soils at the ACB landing site limit the effects of the proposed activities on soils. ■ During construction and operations, erosion, sediment and water drainage control will follow the Erosion Control Plan prepared by Wardrop (2007) and the Riparian Management Plan (GLL 2007), which are based on best management practices developed for forest road construction and operations.	There are no significant residual effects predicted for terrain and soils resources.
Increased stress to terrestrial ecosystems	■ During construction and operations, erosion, sediment and water drainage control will follow the Erosion Control Plan prepared by Wardrop (2007) and the Riparian Management Plan (GLL 2007) to ensure that water quality and quantity are maintained to down slope ecosystems.	There are no significant residual effects predicted for terrestrial ecosystem resources.
Stress on currently undetected rare plant species	■ The small area that will be affected by the proposed ACB landing site and access road, and lack of rare plants in those areas limits the direct effect on rare plants. ■ Accepted soil erosion control and road drainage practices (Wardrop 2007, GLL 2007) will be followed during construction and operations to ensure there are no significant effects on any undiscovered rare plants that may be downhill of haul road or adjacent to ACB landing.	No significant residual effects are predicted to rare plants.
Increased mortality of black/grizzly bears due to interactions with humans	■ Implementation of a Bear/Human Management Plan ■ *No Firearms Policy* for all Redfern employees and contractors will be implemented for ACB crews and personnel ■ Implement Wildlife Right-of-way policy for transportation system operations.	There are no significant residual effects predicted for bears.
Displacement of bears from high value foraging habitats due to construction and operation of the haul road, and ACB operations on the Taku River and Taku Inlet tide flats.	■ ACB route avoids most of the high value foraging habitats identified in preliminary assessments. Further observation and monitoring will refine knowledge of these key habitats, and where appropriate, the route will be adjusted to provide additional distance buffers to minimize disturbance. ■ Monitor habitat use on Taku tidal flats through mapping bear locations and modify routes/timing based on use patterns. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This includes the Bear/Human Management Plan (see below) and outlines general operating expectations and procedures for issues such as avoiding collisions, wildlife sightings and incident reporting, etc. In addition, it provides a framework for modifying operations if warranted. ■ A *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel. ■ Implementation of a Wildlife right-of-way policy for transportation system operations.	There are no significant residual effects predicted for bears.

Potential Effect	Proposed Mitigation	Conclusion -Residual Effects
Displacement of moose from moderate to high value foraging habitats during construction and operation of haul road, and ACB operations	■ The ACB route avoids most of the high value moose foraging habitats identified in preliminary assessments (e.g., sloughs, side channels). Further observation and monitoring will refine knowledge of these key habitats, and where appropriate, the route will be adjusted to provide additional distance buffers to minimize disturbance. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. In addition it provides a framework for modifying operations if warranted.	There are no significant residual effects.
Increased mortality of moose resulting from increased interactions between wolves & humans along ACB route and access road	■ See above measures and: ■ A *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel. ■ Implementation of a Wildlife right-of-way policy for transportation system operations.	There are no significant residual effects.
Displacement of grey wolves from foraging habitat	■ The ACB route avoids most of the high value moose winter range that wolves use for winter foraging. (e.g., sloughs, side channels). Further observation and monitoring will refine knowledge of wolf forage habitats, and where appropriate, the route will be adjusted to provide additional distance buffers if required to minimize disturbance. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. In addition it provides a framework for modifying operations if warranted.	There are no significant residual effects.
Increased grey wolf mortality from increased access by humans along ACB route and road	■ See above measures and: ■ A *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel. ■ Implementation of a Wildlife right-of-way policy for transportation system operations.	There are no significant residual effects.
Reduction/redistribution of bald eagle population due to displacement from nesting or foraging habitat	■ Maintain minimum distance of 200 m from active nest sites with ACB, where possible. ■ Implement *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. In addition it provides framework for modifying operations if warranted. ■ Monitor habitat use and populations and modify operations where possible.	There are no significant residual effects.
Reduction/redistribution of Nearshore and Freshwater Foraging Birds and Waterfowl population due to displacement from nesting or foraging habitat	■ Implement *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. In addition it provides a framework for modifying operations if warranted. ■ Monitor habitat use and populations.	There are no significant residual effects.
Reduction/redistribution of shorebird population due to displacement from nesting or foraging habitat	■ Implement *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. In addition it provides a framework for modifying operations if warranted. ■ Monitor habitat use and populations.	There are no significant residual effects.

Potential Effect	Proposed Mitigation	Conclusion -Residual Effects
Human Activities		
Changes in success of Commercial Fishery resulting from disruption during ACB transits	■ Redfern will prepare a Transportation Communications Plan prior to the commencement of operations. This Plan will include the following elements that are relevant to this activity: ✓ A schedule of the ACB transits will be posted and communicated to all fishermen prior to the commencement of the fishing season. ✓ Fishermen would be notified in advance of any scheduling changes, to the extent practical. The notification of the ACB transit schedule will ensure that all users of the river have prior knowledge of the timing of ACB transits, and can, with little effort, accommodate this disruption. ✓ Annual meeting with the fishermen at the close of the commercial season to review the ACB operations with respect to the drift net fishery; Work collaboratively with the fishermen to identify further mitigative measures, as needed and appropriate.	No measurable impact on the success of the fishery. Annual monitoring, and adaptive measures if needed, will further reduce disruption to this fishery.
Changes in success Subsistence Fishery resulting from disruption during ACB transits	See above mitigation measures.	No measurable change in the success of the subsistence fishery.
Changes in success of Sport and Personal Use Fisheries resulting from disruption during ACB transits	Activities are very limited in the area of ACB operations. No mitigation proposed.	None.
Commercial Recreation and Tourism Effects associated with interference with use	Commercial recreation and tourism activities very limited in area of ACB operations. No specific mitigation proposed.	Effects on commercial tourism activities (river trips) will be insignificant.
Interference with hunting and Big game outfitting activities	Hunting activities very limited in area of ACB operations. Big game outfitting has little overlap (possibly spring hear hunt) in area of ACB operations; No mitigation proposed.	No adverse effects are predicted on these activities.
Accidents and Malfunctions		
Changes in water quality as a result of accidents or spills of hazardous materials that could enter the aquatic environment, causing acute toxicity to aquatic organisms.	■ Redfern will develop a comprehensive Spill Prevention and Contingency Plan, prior to commencement of operations. ■ All cargo will also be transported in marine-certified containers to prevent leakage or spills into water. ■ Hazardous materials will be handled and transported in accordance with current regulations pertaining to transportation of hazardous goods. ■ There will be no transfer or transhipment of material from one vessel to another while on the river or at sea. ■ Fuel will be transported in to site in standard fuel tanker trucks approved for public transportation systems. ■ Redfern has committed to joining SEAPRO (South-eastern Alaska Petroleum Resource Organization). SEAPRO has pre-positioned oil spill response teams and equipment maintained in a state of readiness in the event that any member organization has an accident. ■ Ore concentrate will be shipped in sealed containers. ■ ACB will have bulwark around deck to prevent spills from entering water, if leakages were to occur during transport. ■ Road safety measures (reduced speed limits), good road maintenance and effective communications will ensure that the potential for accidents during routine truck haulage of diesel fuel to the site is minimized.	While the risk of spills into the environment cannot be entirely eliminated, the risks associated with spills is considered to be at an acceptably low level, and one that can be effectively managed by implementing the measures outlined.

Potential Effect	Proposed Mitigation	Conclusion -Residual Effects
Transboundary Effects		
Transboundary effects associated with spills into water in Canada that may extend into Alaska	See above mitigation measures identified for Spills.	
Potential transboundary effects on fish and fish habitat	Assessment of effects on fish and fish habitat on the Taku River concluded that there would be no significant effects. Further, the proposed ACB operations and activities will not cause a significant increase in sediment levels through re-suspension or bank erosion that would affect the water quality of the Taku River downstream of the international boundary. No mitigation proposed.	ACB operations in the Canadian section of the Taku River will not result in any significant effects that will affect fish stocks or fish production in the U.S. section of the Taku River.
Potential transboundary effects on wildlife and wildlife habitat.	Assessment of effects in BC concludes that there will be no significant residual effects, if the planned measures to reduce the anticipated potential effects are implemented. Movements of wildlife from one side of the Canada/US border to the other are assumed to be currently occurring, and it is not expected that the ACB transport system would significantly change movement patterns or populations. Ongoing monitoring of populations such as moose, wolves and bears are proposed, and will provide information to regulators to assess movements and populations over duration of the project.	No significant residual transboundary effects predicted.

4.11.2 Conclusion

In summary, the proposed operation of the ACB transportation system, with the implementation of mitigation measures described above, will not result in significant adverse environmental effects. In the context of comparing the proposed ACB transportation system as an alternative to the previously approved 160 km access road, it is further concluded that the ACB system provides an opportunity to significantly reduce the environmental footprint and potential adverse effects associated with the Tulsequah Chief Mine project. The mitigation measures, monitoring programs, and negligible residual effects outlined above show that the proposed ACB transportation system is an environmentally sustainable access alternative, and presents an opportunity to mitigate the single largest potential source of environmental and social impact associated with the Tulsequah Chief Mine - the 160 km Atlin access road.

5. Supplemental Information for State of Alaska Coastal Zone Consistency Review and State Permits

The proposed ACB transportation system will involve year-round barging in the Taku River using ACBs and tow vessels. On average, one ACB will make a daily round-trip hauling mine supplies and mineral concentrate to and from the Tulsequah Chief Mine in northwestern BC to Juneau. A complete description of the proposed ACB transportation system is provided in Volume 1: Project Description of this documentation set.

This chapter provides a review of the proposed transportation system activities in the State of Alaska regulatory context. This chapter also provides a review of potential issues and opportunities to avoid or minimize potential effects from the Alaskan portion of the proposed transportation system. Conclusions and recommendations drawn from the issues review of the Alaskan portion of the transportation system are presented.

5.1 Scope of Taku River ACB Transportation System

For the purposes of the Coastal Zone Consistency Review and State of Alaska permits, the transportation system activities consist of:

- year-round ACB operation on the Taku River between the US/Canada border and marine shipping lanes in Stephens Passage/Gastineau Channel.

The spatial scope of the proposed transportation system activities in Alaska is illustrated on Map 2. The Alaskan portion of this review focuses on the Taku River drainage from the US/Canada border downstream to the Taku Inlet, and includes Gastineau Channel to the City of Juneau, Alaska.

5.1.1 Temporal Scope

The temporal scope of the ACB transportation system project is year-round transportation for the life of the Tulsequah Chief Mine, including construction and decommissioning. The current mine life is expected to be 8 years, plus one year of construction and an assumed one year of decommission/reclamation, for a total 10-year project. The project is to start in early 2008. *On average*, the ACB transits on the Taku River will comprise one round-trip daily of a single ACB, year-round. The logistics and proposed scheduling of the operations are discussed fully in Volume 1, and incorporate estimated downtime due to poor weather conditions, maintenance and other possible interruptions to shipments.

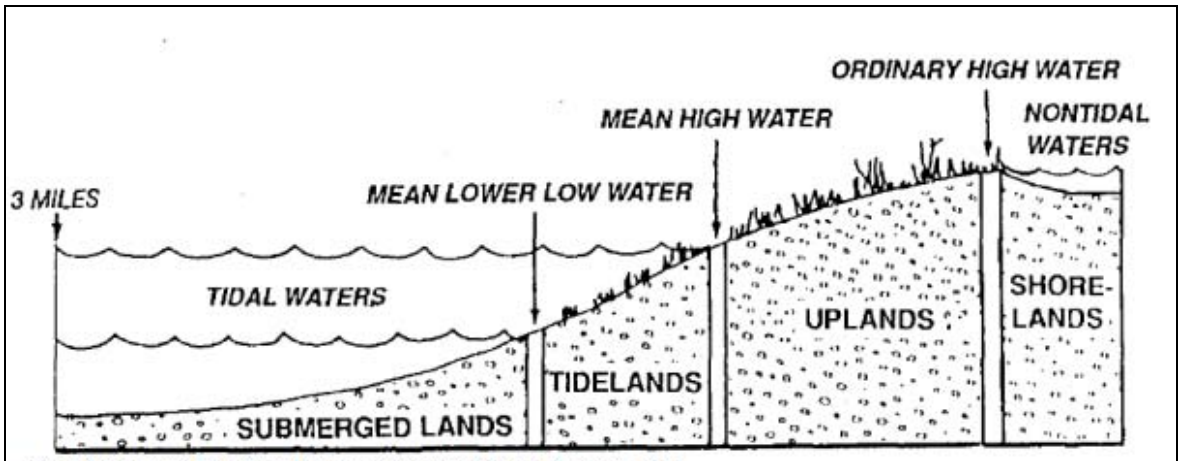
5.2 Land Jurisdiction in Alaska

Land ownership plays a vital role in determining the regulatory regime under which the proposed ACB transportation system will be reviewed and permitted. The proposed activities will occur in the Taku River and Harbour region (Region 14) as defined in the Juneau State Land Plan. Land ownership within this area is comprised of State, federal and private lands. The uplands are predominantly owned by the US Forest Service. The State of Alaska has been allowed to select upland lands within the Tongass National forest for the purpose of community expansion and recreation uses. The State of Alaska has also acquired ownership to tidelands, shorelands, and submerged lands from federal legislation. The proposed ACB route will only traverse State tidelands, shorelands and submerged lands of the Taku River and Taku Inlet (see Volume 1, Appendix C: Taku River Barging Route Atlas).

5.2.1 Land Ownership

The majority of uplands along the proposed ACB transportation route are owned by the United States and managed by the US Forest Service. The proposed ACB route does not traverse US Forest Service Lands. (see Map and Volume 1, Appendix C: Taku River Barging Route Atlas). The proposed ACB route does traverse State of Alaska tidelands, shorelands and submerged lands; definitions of these lands are illustrated on Figure 5-1. The Alaska Department of Natural Resources is the lead agency for project review and permitting.

Figure 5-1. Submerged Lands, Tidelands, Uplands and Shorelands as Described in Juneau State Land Plan



From Juneau State Land Plan, Alaska Department of Natural Resources, 1993

In the Canyon Island area, uplands on either side of the shorelands of the Taku River and the uplands of Canyon Island itself (land use areas 14a25 and 14a28, see Juneau State Land Plan discussion below) are also State or private lands.

5.2.2 Definition of Shorelands, Tidelands and Submerged Lands

Mean High Water for Taku Inlet is 15.4 feet. All lands below 15.4 feet tidal elevation in the Taku Inlet are owned and managed by the State of Alaska. The State of Alaska owns the shorelands of navigable rivers in Alaska. The boundaries of navigable rivers are defined by the location of ordinary high water on the outer most braids of the river. The Taku River is navigable and therefore the boundary between State shorelands and federal/private uplands along the Taku River as it extends upriver from mean high water is ordinary high water.

Ordinary High Water (OHW) is not a fixed boundary; the location of OHW changes based on the conditions of the river. The State defines OHW per 11 AAC 53.900, "*'Ordinary high water' means the mark along the bank or shore up to which the presence and action of the nontidal water are so common and usual, and so long continued in all ordinary years, as to leave a natural line impressed on the bank or shore and indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or other distinctive physical characteristics"*.

5.2.3 Navigable Waters and Lands

State ownership of the beds of navigable waters is an inherent attribute of State sovereignty protected by the United States Constitution (Utah v. United States, 482 U.S. 193 (1987). Title to the beds of navigable waters in Alaska was vested in the newly formed State of Alaska in 1959. In addition, under the Alaska Constitution and the Public Trust Doctrine, all waters in the State are held and managed by the State in trust for the use of the people, regardless of navigability and ownership of the submerged lands.

The physical characteristics and uses of a waterbody used by the State for asserting navigability are based upon legal principles that have been established by the federal courts. These criteria are applied to rivers, lakes, and streams throughout the State and take into account Alaska's geography, economy, customary modes of water-based transportation, and the particular physical characteristics of the water body under consideration.

The federal test for determining navigability was established over a hundred years ago. In the landmark decision of the Daniel Ball, 77 U.S. (19 Wall.) 557, 563, (1870), the Supreme Court declared: *"those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used, or are susceptible of being used, in their ordinary condition, as highways of commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water."*

The waterbody must be usable as a highway for the transportation of people or goods. Interpreting the requirements that navigable waterbodies be used or usable as “highways of commerce”, the courts have ruled that the central theme of title of navigability is that the waterbody be capable of use as a highway which people can use for transporting goods or for travel. Neither the types of goods being transported nor the purpose of travel are important in determining navigability. Transportation on water associated with recognized commercial activities in Alaska, such as mining, timber harvesting, and trapping is, evidence of navigability, the use of water bodies for transportation in connection with natural resources exploration or development, government land management, management of fish and game resources, or scientific research is also evidence of navigability. Travel by local residents or visitors for the purpose of hunting, fishing, and trapping, or as a means of access to an area can be used to establish navigability. The same holds for recreational transportation, including personal travel and professionally guided trips.

To be considered navigable for title purposes, the waterbody must have been navigable in 1959 (when Alaska became a State). Assuming there have been no significant changes in the physical characteristics of the waterbody, a waterbody that is navigable today would be considered legally navigable in 1959 as well.

Commercial navigation on the Taku River existed prior to Alaska statehood. Commercial navigation on the Taku River extends back prior to western contact when the Taku River First Nations people used that river as the primary trade route between the coast and the interior. In more contemporary times, seasonal, routine barging was used in the 1950s to transport mineral concentrate and supplies to and from the Tulsequah Chief and Big Bull mines in British Columbia. In recent years, commercial transportation on various scales occurs on the river to haul supplies to recreational landowners and mineral exploration projects in Canada. Therefore, the Taku River was a navigable waterbody prior in 1959 and continues to be today.

5.2.4 Summary of Land Ownership.

In summary, the entire ACB route and activities in Alaska will occur on the Taku River and Taku Inlet. The Taku River is a navigable waterbody since before Alaska statehood and continues to be navigable today. The ACB transportation system route does not depart from the boundaries of navigable rivers as defined by the State of Alaska. Taku River is determined to be navigable water, and therefore deemed to be State of Alaska owned. Therefore, the proposed Taku River ACB transportation system is subject to the State of Alaska regulatory regime and relevant State regulations and permits.

5.3 Regulatory Review Process

The State of Alaska (Alaska) has determined that the proposed ACB transportation system will require a Title 41 Permit, a land use permit, and must undergo an Alaska Coastal Zone Consistency Review. A Title 41 permit is required for activities in or across streams that might, in general, impact or impede the passage of fish, especially anadromous fish. The land use permit would be needed to address potential effects to State lands.

The Coastal Zone Consistency Review requires the application of specific standards that include the Habitats Standard at 11 AAC 112.300, and the Transportation Routes and Facilities Standard at 11 AAC 112.280. Habitats in coastal areas subject to the program include estuaries, wetlands, tideflats, rivers, streams, lakes, active floodplains, and riparian management areas. These habitats must be managed to avoid, minimize, or mitigate significant adverse impacts to competing uses, water flow, circulation, and drainage patterns. Transportation routes must avoid, minimize, or mitigate disruption in known or reasonably foreseeable wildlife transit.

The Office of Project Management and Permitting (OPMP), State of Alaska, Department of Natural Resources acts as the lead agency for large project permitting and oversees the Alaska Coastal Management program. Land ownership may determine who the lead agency will be during the review process and permit process. The Department of Natural Resources will be the lead Agency for co-ordinating the project and permit review. It will also be responsible for conducting the Coastal Zone Consistency review process, identification of appropriate permits and facilitating the agency consultation process

5.4 Management of Alaska State Land

5.4.1 Juneau State Land Plan

The Juneau State Land Plan directs how the Alaska Department of Natural Resources (DNR) will manage State uplands, tidelands, and submerged lands within the City and Borough of Juneau (CBJ). The Plan determines management intent, land use designations, and management guidelines that apply to all State lands in the planning area.

The role of State land management plans was established by State statute AS 38,04.005. It is the policy of the State of Alaska "…*to establish a balanced combination of land available for both public and private purposes. The choice of land best suited for public and private use shall be determined through the inventory, planning, and classification processes*…"

The Juneau State Land Plan includes areas of high-value fish and wildlife, recreation, mineral resource, and waterfront development areas. It represents Alaska's best effort to reach a fair and responsible accommodation of all interests. The balance struck by the plan can be summed up as ensuring multiple use and reasonable access for resource development while protecting other important resources, uses and values.

More specifically, the Juneau State Land Plan ensures the following:

- Uses that are neither designated nor specifically prohibited may be allowed by DNR if they are consistent with the management intent and guidelines for the Management subunit and unit, and relevant plan guidelines.
- Conflicts with significant fish and wildlife habitat and harvest area and recreation areas are avoided, minimized, or mitigated through plan management intent and guidelines protected from incompatible uses.

The area to be traversed by the ACB transportation system falls within Region 14 of the Juneau State Land Plan, and includes the Taku River, Taku Inlet, and portions of Stephens Passage. Most of the State lands in this region are tidelands, shorelands, and submerged lands with the following exceptions: State-owned uplands along the lower Taku River and Taku Harbour, and State-selected uplands at Dorothy Lake and Bart Lake.

The background description for Region 14 notes that the Taku River has been used historically and currently as a transportation corridor to the sea from northwestern British Columbia. The river is currently used for recreation access and commercial/industrial access to the Taku River watershed in Canada. Stephens Passage supports a large volume of recreational boating use, commercial fisheries, commercial transportation, barging and variety of ships. The marine areas in the entire unit receive heavy seasonal use by boaters from Juneau.

5.4.1.1 Area Wide Land Management Policies

The Juneau State Land Plan provides area-wide land management policies for each of the major resources affected by the Plan. Of these policies, the Fish & Wildlife polices are of most relevance to this project. Where authorizing the use of State lands, the land use must be conducted with appropriate planning and implementation to avoid or minimize significant adverse impacts on fish, wildlife or their habitats. When determining appropriate permit stipulations or measures, the State will apply, in order of priority, the following steps:

1. Avoid anticipated, significant adverse impacts on fish, wildlife or their habitats through design, siting, timing or other management options.
2. When significant adverse impacts cannot be avoided by design, siting, timing or other management options, the adverse impact of the use or development will be minimized.
3. If significant loss of fish or wildlife habitat occurs, the loss will be rectified, the extent feasible and prudent, by repairing or rehabilitating, or restoring the affected area to a functional state.
4. The State will consider requiring replacement with or enhancement of fish and wildlife when steps 1 through 3 cannon avoid substantive or irreversible loss of habitat.

The Plan designates the Taku River (Unit 14A) as Fish and Wildlife Harvest (Hv) areas and Fish and Wildlife Habitat Areas (Ha). When reviewing a proposed use such as the ACB transportation system, consideration is given to measures aimed at protecting the specific type of fish and wildlife harvest that occurs in the designated area. The consistency review will determine that:

a) the proposed navigational use is compatible with the designated fish and wildlife harvest use; or
b) that with appropriate design, siting, and operating stipulations the other designated use can be made compatible and significant impacts to the harvest use avoided; or
c) that the other use is of sufficient importance of lacks a feasible and prudent alternative and it should be allowed within the harvest area consistent with the guidelines of the Plan and ACMP policies.

5.4.1.2 Management Intent

The management intent in the Plan for unit 14A Taku River is as follows: *"This unit will be managed to provide continued recreational use, and to protect the valuable international fishery, important sea lion haulout, other habitats, and harvest values. Management will allow for possible future hydropower facility expansion and additional utility corridors. Also, development of a regional road corridor and mining access with associated tideland and shoreland facilities is generally consistent with the management intent for this unit".*

Use of the waterbody for navigation is intrinsic to the definition of the State land, and therefore the defining land use for the Taku River. This is noted on the Unit 14A land plan maps (see Figure 5-2).

5.4.1.3 Unit 14a – Taku River Management Guidelines

The Plan provides specific Management Guidelines for each Region and Management Units. For the Taku River, some of pertinent management guidelines include:

- *Sea Lions*

  Subunits 14a2 and 14a3 (east shore) may contain a sea lion haulout. Prior to authorizing activities within 3,000 feet of the sea lion haulout in these subunits, DNR will consult with ADF&G and NMFS. If this is an area found to be a haulout, measures will be taken to avoid significant adverse impacts on this haulout.

- *Fisheries Research and Management*

  Unit 14 has and is likely to see additional applications for facilities associated with research and management of the Taku River fisheries that are part of an international treaty agreement with Canada. Authorizing facilities for these purposes is consistent with management intent for unit 14a.

Figure 5-2. Unit 14A Taku River - Land Plan, Inset 1

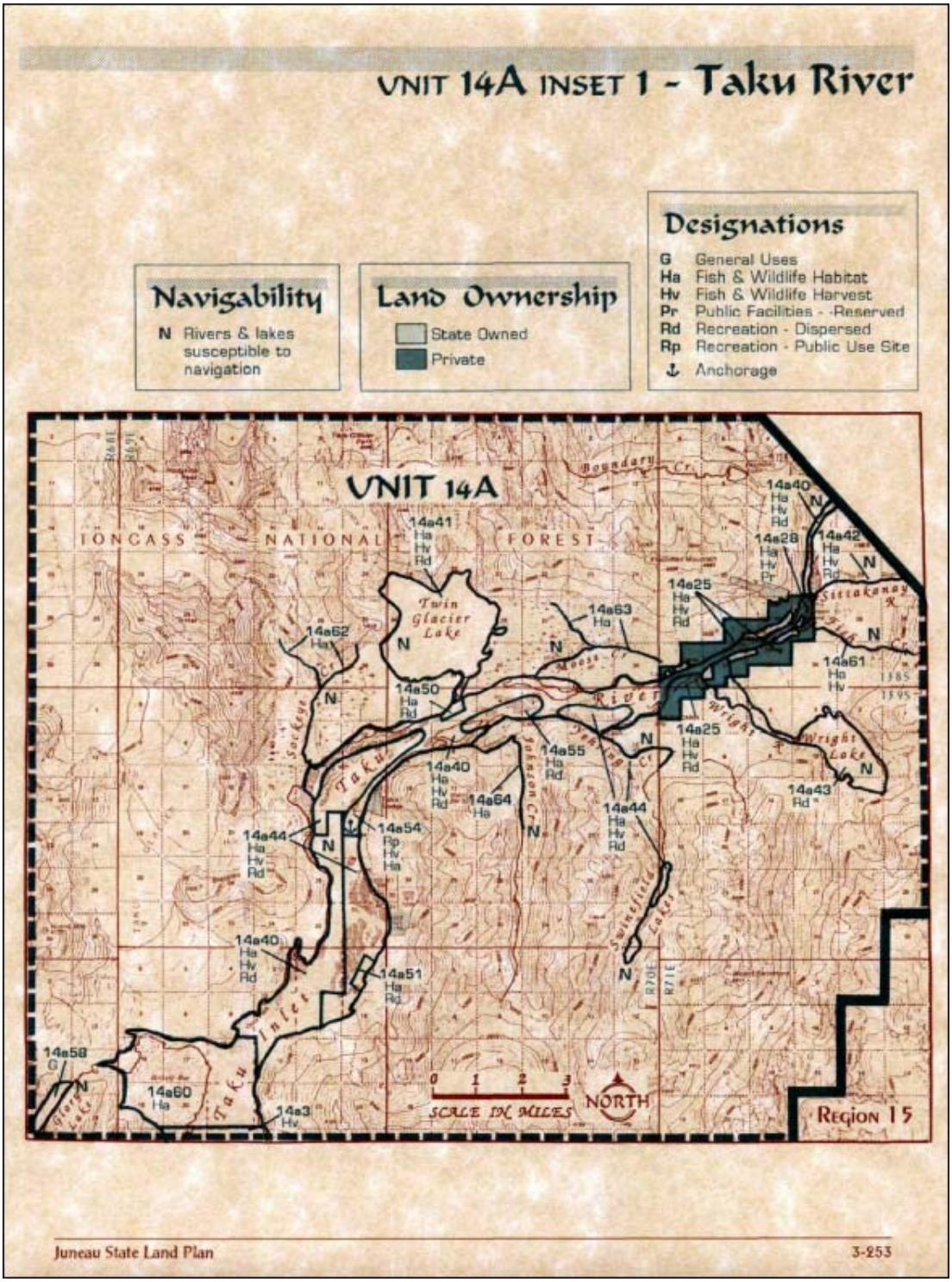
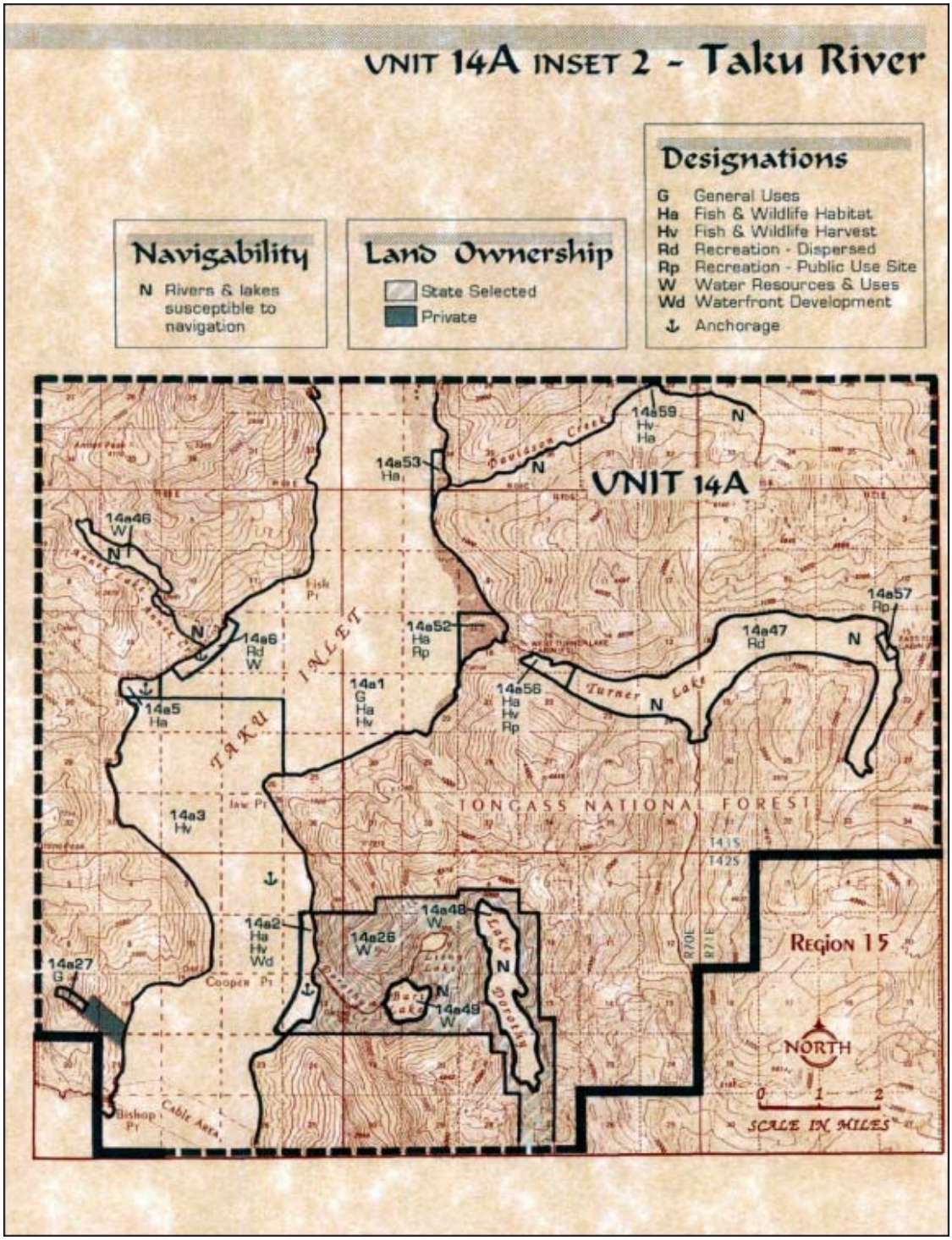


Figure 5-3. Unit 14A Taku River - Land Plan, Inset 2



Note: From Juneau State Land Plan, Alaska Department of Natural Resources, 1993

5.4.1.4 Juneau State Land Plan Summary

The Plan designates the Taku River as a navigable river by virtue of its definition as State land. The proposed ACB transportation system must be consistent with the applicable area-wide land management policies and the specific Unit 14a – Taku River management guidelines.

5.4.2 Alaska Coastal Management Program

The Alaska Legislature enacted the Alaska Coastal Management Act (ACMA) on June 4, 1977. In 1978, Alaska adopted the Standards of the Alaska Coastal Management Program and the guidelines for District Coastal Management Programs. 11 AAC 12 Statewide Standards of the Alaska Coastal Management Program were incorporated into the ACMP in 2006.

The Coastal Zone Consistency Review requires the application of specific standards that include the Habitats Standard at 11 AAC 112.300 and the Transportation Routes and Facilities Standard at 11 AAC 112.280. Habitats in coastal areas that are subject to the program include estuaries, wetlands, tideflats, rivers, streams, lakes, active floodplains, and riparian management areas. These habitats must be managed to avoid, minimize, or mitigate significant adverse impacts to competing uses, water flow, circulation, and drainage patterns. Transportation routes must avoid, minimize, or mitigate disruption in known or reasonably foreseeable wildlife transit. The proposed ACB transportation system does not overlap with any known State of Alaska critical habitat areas, refuges or sanctuaries as shown the Important Habitat Area map (ADF&G 2004).

5.5 Issues Review Methodology

The review of the proposed ACB transportation system focused on key issues identified through consultation with the public, native groups, key stakeholders, and regulatory agencies. Specifically, the review identifies the key issues or concerns and considers potential effects associated with those issues. This approach allows regulators and stakeholders to focus on the key concerns associated with the proposed ACB transportation system, ultimately leading a more meaningful outcome and overall better project.

The design of the ACB transportation system, both technically and operationally, is described in Volume 1. The approach to the review of potential effects of the project is as follows:

1. Identification of issues and potential for project-related effects.
2. Modification of project design and operation to avoid potential effects.
3. Where issues and or potential effects cannot be completely avoided, further modification of the design and operation to minimize potential adverse impacts.
4. Identification and implementation of impact-specific measures to minimize significant adverse effects.

This process of modifying the project design to avoid or reduce potential project effects is referred to as “mitigation by design” and is the most effective, meaningful and robust means for reducing a project’s potential adverse social and environmental impacts. This “mitigation by design” process has been integrated into the development of the ACB transportation system as described in the Volume 1. Mitigation by design is often overlooked during the environmental assessment, as these mitigative measures are integral to the project. For example, the proposed route avoids many of the more sensitive fish and wildlife habitat areas in the Taku River valley, thus potential impacts associated with these habitats are avoided. These mitigative measures are noted in the following review.

5.6 Aquatic Resources Issues Review

This review is based on issues that have been identified through consultation with government agencies, First Nation organizations and Redfern Resources and their study team. Many of the concerns are related to the routine operation of a tug and /or amphitrac and ACB on the Taku River. This review is divided into two main components: potential physical effects to the Taku River, and potential effects to fish and fish habitat, some of which directly or indirectly stem from the physical impacts.

5.6.1 Impacts to the Physical Aquatic Environment

The operation of the ACB is described in Volume 1 and includes the different methods that will be used at different times of the year to move the ACB on the Taku River and Taku Inlet. Many of the potential effects to the riverine environment are common to both the Canadian and US portions of the river. Several issues of concern and potential physical effects have been identified along the Taku River including:

a) channelization of the Taku River;
b) disruption to the sand flats at the mouth of the Taku River;
c) disruption of gravels;
d) re-suspension of sediments and bank erosion;
e) changes in river ice freeze and thaw patterns due to ACB operations;
f) snag relocation; and
g) aquatic noise.

5.6.1.1 Channelization

Issue Review

Concern has been raised that ACB operations could cause channelization of the Taku River during the open water barging season. The ACB will be predominately towed by a shallow draft tug (with support from the amphitrac) starting at the mouth of the Taku River and into Canada. For the most part, the tug will navigate the thalweg or the deepest part of the Taku River channel – this route is illustrated clearly in Volume 1. Appendix C: Taku River Barging Route Atlas. Channelization refers to straightening and/or ceasing a rivers ability to migrate laterally (i.e., erode banks). This term channelization is usually used in association with construction of training works such as levees or dykes to control flooding. Such works can have a considerable impact on the hydraulic characteristics of a watercourse and associated fish habitat. There are no plans to carry out works that would cause channelization and by following the thalweg there will be minimal disturbance to the river channel itself. There will be times when water depth in the river is quite shallow and propeller wash from the tug could disturb sand and gravels, but ongoing river flows and especially freshet and jökulhlaup flows will naturally redistribute those sands, gravels and cobbles on a regular basis.

As well, the ACB is not expected to have any impact on the river channel, as it will be on hover and out of the water except for 2.4 ft of the pliable air skirt. The skirt will not be as deep as the bottom of the shallow draft tug, and in most cases will not be in contact with the substrate of the mainstem Taku River during the open water barging season.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential channelization effects.
- Use of shallow draft tug and the ACB, appropriate for the Taku River, will avoid potential channelization effects.
- No dredging or other works will be conducted to channelize the river; therefore the potential effect is not relevant to this project.

Conclusion

- With the implementation of the ACB system as designed and proposed, the potential for chanellization effects will be avoided.
- The proposed ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding significant adverse impacts to (A) natural water flow; and (B) the active floodplain.

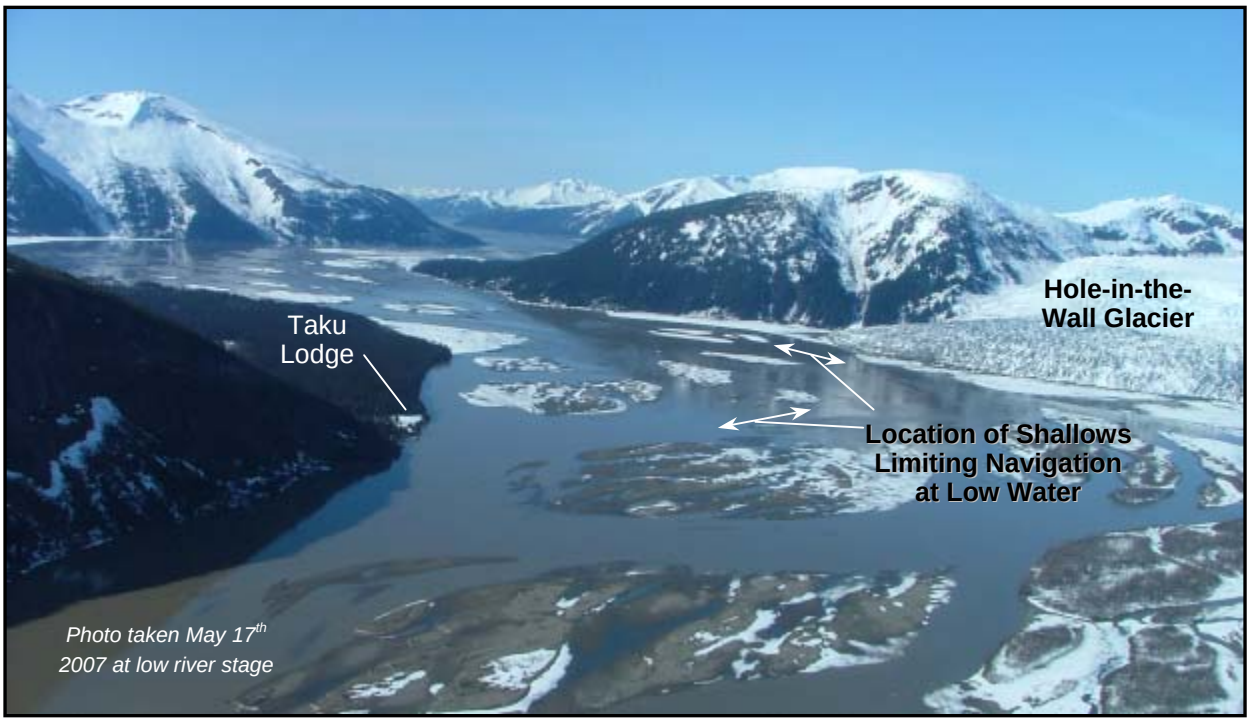
5.6.1.2 Disturbance of the Sand Flats

Issue Review

Analyses of the depth in the Taku River under various flow regimes and tide conditions have been carried out. These analyses, provided in Appendix A of Volume 1, shows that water depth conditions in the Taku River between Taku Inlet and Taku Lodge will be too shallow for the tug to operate in the period immediately after break-up and until the Taku achieves flows in the order of 25,000 cfs (700 m^3/s), and again in the fall as flow levels drop below 25,000 cfs. The shallow areas, or shoals, are limited to two short reaches of the river, one adjacent to Hole-in-the-Wall Glacier, and the other between the glacier and Taku Lodge (Figure 5-4). Each shallow segment is less than ½ mile long.

At flows between 25,000 cfs (700 m^3/s) and 17,500 cfs (500 m^3/s) the tug traverses the sand flat shallows at mean tide levels and higher (8 foot tide, datum at Juneau). Timing the transit through the shallows with the tide is referred to as “tidal assist”. When flows drop below 17,500 cfs or if tide conditions are not favourable, the amphitracs will be used to navigate the ACB through the lower Taku River sand flats. The amphitracs will operate in tandem to move the ACB from the point where it is picked up from the ocean tug to the deep channel just upstream of the Taku Lodge.

Figure 5-4. Location of Lower Taku River Sand Flat Shallow Areas Limiting Navigation at Low Water



Once ice forms in the winter on the sand flats and shelves adjacent to the open channel, the amphitrac and ACB can cross the ice cover surface, circumnavigate the shallow open channels of the sand flats, thereby avoiding potential disruption during winter months. Potential disruption of the sand flat, therefore, only occurs during the transition season between the summer open water season and freeze up along the river. This is typically a period of 45 days in the spring and 80 days in the fall. Tidal assist (e.g., transiting the shallows with a mean tide or higher) can be used to traverse the shallows reaches fully aquatically for approximately 40 days during the transition seasons.

There are two alternatives for navigating the ACB through the shallow reaches of the Lower Taku River during the transition seasons using the amphitracs:

1. The first is to chart out and follow a route that is predominately on dewatered, exposed sands. In this scenario, the amphitrac will operate much the same as the rolligons that are currently used on Alaska's North Slope. The amphitracs on tires would exert a pressure of 2 to 5 psi (pounds per square inch) on the sand flats. The ACB, with its weight supported by air and spread over an area of approximately 18,000 ft^2, will exert a force of 1 psi[14]. The skirt around the ACB will drag on the ground and will leave some marks on the surface of the sand. The force of airflow under the ACB is approximately 45 to 67 mph (20 to 30 m/sec). Studies of other air cushion craft travelling on land report that small rodents and ground nesting birds' eggs were not damaged if passed over by the ACB (Turner 2003). The action of the skirt dragging on the ground in combination with the airflow did blow some dirt and vegetation around. Given the light footprint exerted by the ACB and amphitrac, very little disruption of the sand flats is anticipated beyond temporary compaction and some sand being blown around if the sand is dry.

   The combined amphitrac and ACB will cross the sand flats twice per day, taking a load of concentrate to the ocean going tug and picking up an ACB loaded with supplies for the mine. It is anticipated that this crossing of exposed areas of the sand flats are unlikely to cause significant disruption of sediments. The majority of the areas traversed by the ACB and amphitrac will be inundated at high tide, releasing any modest compaction that might be caused. Only the unvegetated areas of the sand flats would be traversed in this fashion, and vegetated areas would be avoided.

2. The second option is to select a predominantly aquatic route for the ACB/amphitrac to travel over. The amphitracs will have a draft of 14 inches and will be able to move the ACB through most, if not all, of this section in a fully aquatic mode without disrupting the sediments. The two amphitracs would work in tandem to move the ACB along wetted channels. There would be negligible disturbance to areas 3 ft or more deep. At depths of 2.4 ft m or less, the ACB/amphitrac combination would disturb sand flat sediments. This shallow water season would extend from ice break up to mid May. During this time the disturbance to sediments would likely be minor and short lived as the higher flows and sediment loads that begin around

14. By comparison a human footprint exerts 5 to 10 psi.

mid-May would overwhelm any effects created by the ACB/amphitrac. This disruption may also happen again in the low flow period before freeze up. Again, if there was any physical effect on the substrate, it would likely be negated by the action of ice on the sand flats once the river freezes.

It is likely that both scenarios will become integrated into the standard operating procedures on the Taku River. The passage over exposed tidal areas of the sand flats would be used when barging takes place at low tides, and at higher tides an aquatic route would be used. Although the performance of rolligons in soft ground environments in Alaska is well known, their use on the Taku River sand flats is new. Therefore, prior to routine use of the ACB/amphitrac combination on the lower Taku River, trials with the amphitracs will be made at low flow and various low tides to select the least disruptive operating procedure for specific flow/tide combinations. The recent bathymetric data collected for this assessment (Volume 1, appendix A) will be used as a basis of selecting route options. Environmental monitors will participate in the trials and observations will be recorded for each of the routes tested. Once operation of the ACB begins, additional environmental observations will be collected to assess the effect of the ACB and the effectiveness of the amphitrac at following the selected route(s).

Measures to Avoid or Minimize Potential Adverse Effects

- Use ACB and shallow draft equipment suitable for the Taku River.
- Travel in the deepest channel through of the lower Taku River sand flats during the open water season, thereby avoiding potential disturbance to sand flat.
- Use of ACB and amphitrac during winter to travel across ice covered sand flats and ice shelves, avoiding the shallow reaches lower Taku River sand flats, thereby avoiding potential disturbance to sand flat.
- Use tidal assist (a rising tide, mean tide or higher) when possible during the transition season to traverse the shallow portions of the sand flats fully aquatically, thereby avoiding potential disturbance to sand flat.
- Conduct trials with environmental monitors prior to routine usage of the ACB/amphitrac in the transition season to select which operating method (as outlined above) minimizes disturbance to the sand flats during the low water transition season.

Conclusion

- Any residual effects from the ACB/amphitrac passage through the sand flat shallows will be reversed by normal water flows in the river and are not inconsistent with the natural environment and naturally occurring amounts of disturbance in the tidal flats area.
- As the area of potential disturbance is very small within the context of the Taku River sand flats, the temporal extent is short and the effect is reversible, the potential disturbance effect is determined to be not significant.

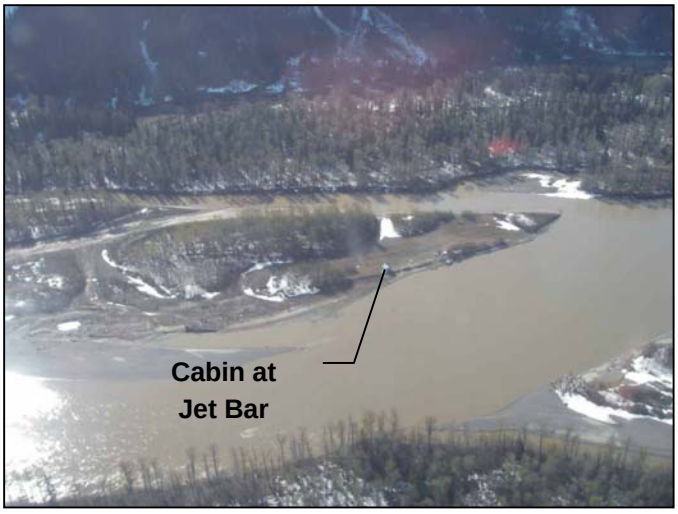
- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding and minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (4) tideflats, by avoiding significant adverse impacts to (A) adequate water flow and natural drainage patterns.

5.6.1.3 Disturbance of Substrates Upstream of Taku Lodge

Issue Review

As discussed in the section on channelization, the passage of the tug and/or amphitrac and ACB is unlikely to cause any significant disruption of the substrates. Along all or most of the route the ACB will be towed along the thalweg, the deepest part of the river channel. There will likely be areas where the water depth will be close to the draft of the tug and the propeller wash may displace the substrate. This will likely be a short-term disruption as freshet flows and jökulhlaups will naturally redistribute the gravels. The project is unlikely to have any significant long-term effect on the substrates of the Taku River. Figure 5-5 illustrates the effect that flooding has on natural erosion and sedimentation in the Taku River.

Figure 5-5. Low and High Water in Taku River: Photos Taken May (left) and June (right) 2007, just upstream of Cranberry Island



Measures to Avoid or Minimize Potential Adverse Effects

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential disturbance of substrates upstream of Taku Lodge.
- Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential disturbance of substrates upstream of Taku Lodge.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding significant adverse impacts to (A) natural water flow; and (B) the active floodplain.

5.6.1.4 Re-suspension of Sediments and Bank Erosion

Issue Review

Tug and ACB operations can cause re-suspension of sediments beneath the tug by the turbulence created by the propeller and in shallow water areas were wake waves agitate fine sediments along the margins of the river or waves cause erosion of river banks. Sediment re-suspension, at significant levels, can cause increased sediment deposition in backwater and secondary channels. The ability of tug and ACB to have an effect on sediments and erosion along the riverbanks is directly related to the energy of the waves created and the material composition of the bank. The size of the waves is dictated by many factors including the shape of the vessels hull, draft, displacement, speed through the water and water depth. The distance the ACB and tug are from the riverbanks also determines that size of the waves striking the banks. The factors having the greatest effect are vessel speed and distance from shore.

Studies of tug and barge activities on rivers are usually based on more conventional tug sizes typically towing multiple barges. The environmental assessment of increased barge traffic on the Mackenzie River (Imperial Oil Resources Ventures Limited 2006) required to build the Mackenzie Valley pipeline was based on 147 ft (45 m) tugs with a draft of 3.6 ft (1.1 m) pulling up to six, 250 ft (76 m) long barges that had a draft of 4 ft (1.5 m). The waves generated were as high as 4.2 ft (1.3 m) at the barge but were predicted to be <1 ft (0.3 m) by the time they reached the shore some 400 ft (125 m) from the vessels. In this study the predicted wave energy that would be created by barging was two orders of magnitude less than the estimated threshold for scour of the clay-till material that made up the riverbed and banks of the Mackenzie River.

Similar modelling has been conducted on tug and barge operations on the Mississippi River. Again, these studies are related to larger tugs and barges and the studies assessed the effects of between 2 and 24 tows per day (Maynord and Keevin 2005). Studies reported the maximum wave

heights of 1 ft (0.3 m) associated with 15 barges (3 wide by 5 long) being towed at 8 mph (US Corps of Engineers 2004). Studies of the effect of sediment re-suspension reported that tow boat traffic contributed only a minor amount of additional sediment to backchannel and other lower velocity areas along the Mississippi River and the effect was generally masked by the large volume of sediment transported by the Mississippi River (US Corps of Engineers 2004). The effect of re-suspension of sediments appears to be largely determined by the type of sediments making up the substrate and banks of the river and the natural sediment load.

Specific details of the wake that will be created by the ACB, amphitrac or shallow draft tug are defined, but some assumptions were presented in Volume 1, Section 3.1.1.3. In support of the assumptions from Volume 1, observations made during the tug and barge operation that took place in July of 2007 to move construction equipment up to the Tulsequah Minesite, the vessels generated a small wake, that did not appear to exceed 1 ft (0.3 m). The wake had all but dissipated by the time it reached the riverbank. Because of the highly turbid nature of the Taku River during this operation it was difficult to see if the barge wake or propeller scour re-introduced sediment into the water column. The tug used had a draft of 5 ft (1.5 m), which is almost twice the 2.6 ft (0.79 m) draft of the shallow draft tug that will be used to tow the ACB. Based on studies of other systems where larger tugs and barges are used, the re-suspension of sediment and bank erosion are concerns associated with barging. The proposed system that will be used on the Taku River will likely produce much smaller wakes and the forces that will contribute to sediment re-suspension and erosion and the effect of barging will likely cause a negligible to minor increase in bank erosion and sediment re-suspension. However, these effects are very dependent on the types of sediment and bank materials along the Taku River. Specific studies have not been undertaken on the Taku River to identify potential areas of concern. This uncertainty will be addressed through the development of a management plan for the barging operation. Prior to the start of operation areas of existing erosion will be identified as will back or side channel areas that could be effected by sediment re-suspension and deposition. These sites will be monitored and corrective action taken if effects from barging are reported. The project description already identifies that towing speeds will be reduced when passing through the area known as Martini Row as a measure to protect docks and banks in that area.

Measures to Avoid or Minimize Potential Adverse Effects

- Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges.
- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments.
- Implement management strategy to identify and monitor areas of that could be effected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding and minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; (B) the active floodplain; and (C) natural vegetation within the riparian management area.

5.6.1.5 Effects on Water Quality

Issue Review

There are two mechanisms by which the barging operation can impact water quality. The first is through an accident or malfunction where the ACB or tow vessel sinks and/or deleterious substances are released into the water. The second is through the re-suspension of sediments and erosion causing increases in turbidity and total suspended solids (TSS) in the water. The effects and prevention measures for accidents and malfunctions are discussed in Section 4.8.

The potential for increased turbidity and TSS is presented in the previous section. These data show that the Taku River is a very turbid river especially during the open water season where TSS is typically 40 to over 100 mg/L. Lowest TSS is found in the winter when the river is frozen. The ACB/tug/amphitrac are not likely to cause significant increases in either turbidity or TSS based on the information provided above – i.e. slow speeds of barging will not generate large wakes and the barging will be carried out primarily in the thalweg of the river where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug. However, the erodability of sediments along the ACB route has not been studied and there is potential for sediment re-suspension or increased bank erosion so monitoring as described above will be carried out.

Measures to Avoid or Minimize Potential Adverse Effects

- Develop and implement Spill Prevention and Contingency Plan, complete with requirements for appropriate materials packaging, personnel training, equipment and measures to reduce risk of spills.
- Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges.
- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments.
- Implement management strategy to identify and monitor areas of that could be effected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.

Conclusion

- Taku River is very turbid during the open water season when the ACB will be travelling aquatically. Therefore, with implementation of the measures outlined above, potential turbidly and TSS related water quality effect are determined to be not significant.
- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding and minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; (B) the active floodplain; and (C) natural vegetation within the riparian management area.

5.6.1.6 Effects on Ice Formation and Break-up

Issue Review

In some applications, the ACBs have been used as an icebreaker as it can use the air discharging from under the skirt to lift the ice and break it. Every effort will be made to avoid using the ACB as an icebreaker and to allow the river to freeze up and break-up under natural conditions. The plan for operating the ACB during the spring thaw and fall freeze up is designed to minimize any effect to ice formation and break-up.

Ice normally forms from the sides out into and over the main channel. Ice tends to be established on the edges of the river first, landfast on gravel bars and shallows, which the mainstem remains open and navigable. Once the peripheral ice has become established and strong enough along the margins, the amphitracs will travel on the ice, initially along the margins, using its wheels. Given the ACB and amphitriac's low ground pressures, the weight of these vehicles can be accommodated on thin ice relative to their total payload.

During winter months, there is concern that if a conventional ice road were prepared, ice thickness would increase, changing the river/ice dynamic. Ice roads are built by clearing the snow off the ice surface to encourage ice thickening (removes insulating effect of snow) and even flooding the ice surface to build up the ice thickness. An ice road will not be built and these operations will not be conducted. The ACB will operate over snow with minor compaction of the snow, thereby preserving the insulation function of the snow. Therefore, the ice formation will be allowed and additional thickness will not be created, allowing spring break-up to proceed naturally.

Once ice reaches sufficient thickness, the ACB will travel up the west side of Canyon Island. It is known that the main channel on the west side of Canyon Island is one of the first areas on the Taku River to freeze. On the east side of the island, inflows and perhaps groundwater influences at the mouth of Fish Creek maintains a section of open water throughout most of the winter. Barging will avoid this section of open water during the winter months.

During spring break-up, it is anticipated there maybe be a short period when barging is suspended while the ice in the main channel breaks up. Once the main navigation channel is clear of ice, barging will resume. The amphitracs will be continue to be used to navigate the sand flats if required and the shallow draft tug will be used from the Taku Lodge to the Tulsequah River. As mentioned, the ACB can be used as an icebreaker so that in emergency situations such as unexpected ice formation while the tug is moving the ACB, the ACB can be used to open a channel to get the tug to moorage.

Measures to Avoid or Minimize Potential Adverse Effects

- Operation plan avoids ice breaking and plans to allow the river to freeze up and thaw naturally. A frozen river surface is the preferred operational condition for the Taku River ACB transportation system in winter.
- During winter months, the preferred route will be over the west channel at Canyon Island, thereby avoiding potential impacts to the high value fish habitat associated with open water areas in the east channel and the mouth of Fish Creek.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; and (B) the active floodplain.

5.6.1.7 Large Woody Debris

Issue Review

Large trees and stumps are a common occurrence in the Taku River. Spring freshet and high flows associated with jökulhlaups can deposit large debris in the portion of the channel that will be used by the ACB. When occurring in the travel route, these present a navigation hazard for all river users. As described in Volume 1, a small riverboat will travel ahead of the ACB and tug periodically and after flood events. The operator of this craft will inform the ACB operator of any impediments to navigation. The amphitracs will be equipped with a grapple mounted on a hydraulic arm. This grapple will be used to pick up and move logs or stumps lodged in the navigation channel. This woody debris would be relocated to one side of the channel, as close as practical to the site it was removed from so that it remains part of the hydraulic dynamics of the Taku River.

Measures to Avoid or Minimize Potential Adverse Effects

- Relocation of hazard snags and logs in the river is a measure to reduce potential for accident or mishap.
- Relocation of large woody debris will be restricted to debris located in the actual travel route that present a hazard to the safe operation of the transportation system.
- Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel such the debris continues its role as fish habitat, thereby minimizing the effect.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; and (B) the active floodplain.

5.6.1.8 Aquatic Noise

Issue Review

Volume 1, Section 3.1.1.2 provides some details on the noise levels generated by the ACB. As indicated the ACB and towing vessels will produce noise levels similar to highway rated tractor-trailers, approximately 70 dB (decibels) at 100 ft (30 m). In comparison jet boats at 30 mph (48 kph) create 88 dB, jet skis create 80 dB and floatplanes taking off create 85 dB. A significant component of underwater noises generated by marine craft come from the propellers and the transmission of the engine noise through the hull. The ACB, like other air cushion vehicles will not likely generate significant underwater noise levels as the vessel is floating on a 2 m cushion of air and basically no opportunity for vibrations to resonate into the water. The other vessels operating in Taku Inlet and River will produce noises similar to watercraft that currently use these waterways. In summer months the ACB operation will be one of many sources of air borne and underwater noises along the Taku River with jet boats, jet skis and float planes being regular occurrences along the river.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB will not contribute additional noise to the underwater environment.
- All equipment associated ACB transportation system to be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m).

Conclusion

- With implementation of the measures outlined above, potential increase in aquatic noise will be insignificant.

5.7 Aquatic Biological Issues Review

The proposed ACB operations on the Taku River could have a number of potential direct and indirect effects on aquatic resources including fish, fish habitat and marine mammals. Indirect effects on these resources are attributable to the physical effects described above.

5.7.1 Fish and Fish Habitat

A number of potential effects on fish and fish habitat include:

a) direct effects on mainstem spawning and rearing habitat;
b) effects on migrating adults and juveniles;
c) entrainment of small fish under the ACB in the air cushion;
d) indirect effects on food production in the Taku Sand Flats; and
e) indirect effects on rearing habitat (moving large woody debris, sedimentation of back channels).

5.7.1.1 Effects on Mainstem Spawning and Rearing

Issue Review

Barging activity is not expected to cause measurable changes to the mainstem of the Taku River and therefore the potential to impact mainstem spawning and rearing habitat is also limited. Most salmon species do not typically select mid channel, mainstem areas of large rivers for spawning. Also, the Taku River mainstem, typically carries a high load of suspended sediment so that the water is very turbid which is the type of condition that salmon are known to avoid. Studies of Taku River sockeye salmon have found that a portion of the population uses mainstem habitats for spawning. Sockeye typically return to spawn in areas associated with lakes that the juveniles then use for rearing, however, Eiler et al. (1992) reported that 63% of the Taku run returned to “riverine areas”. Of the fish using the main stem, 55% spawned in side-channels, while the rest spawned in small tributaries, the mouths of tributary streams, upland sloughs and in the main-stem in areas usually associated with groundwater upwelling. The study also reported that the majority of

juveniles from the riverine spawners migrated to sea in their first year, unlike those that use lakes for rearing that spend one year in freshwater.

During the open water season the ACB will be towed around the east side of Canyon Island to avoid conflict with the fish counting wheels and local heavy boat traffic traveling through the bottleneck. The east channel includes the mouth of Fish Creek, an area that is known to support spawning sockeye and coho salmon. Chum, Chinook and steelhead have not been noted to spawn in this location (Pers Comm. Jim Andel, Alaska Department of Fish and Game). There are two proposed approaches for barging through this area:

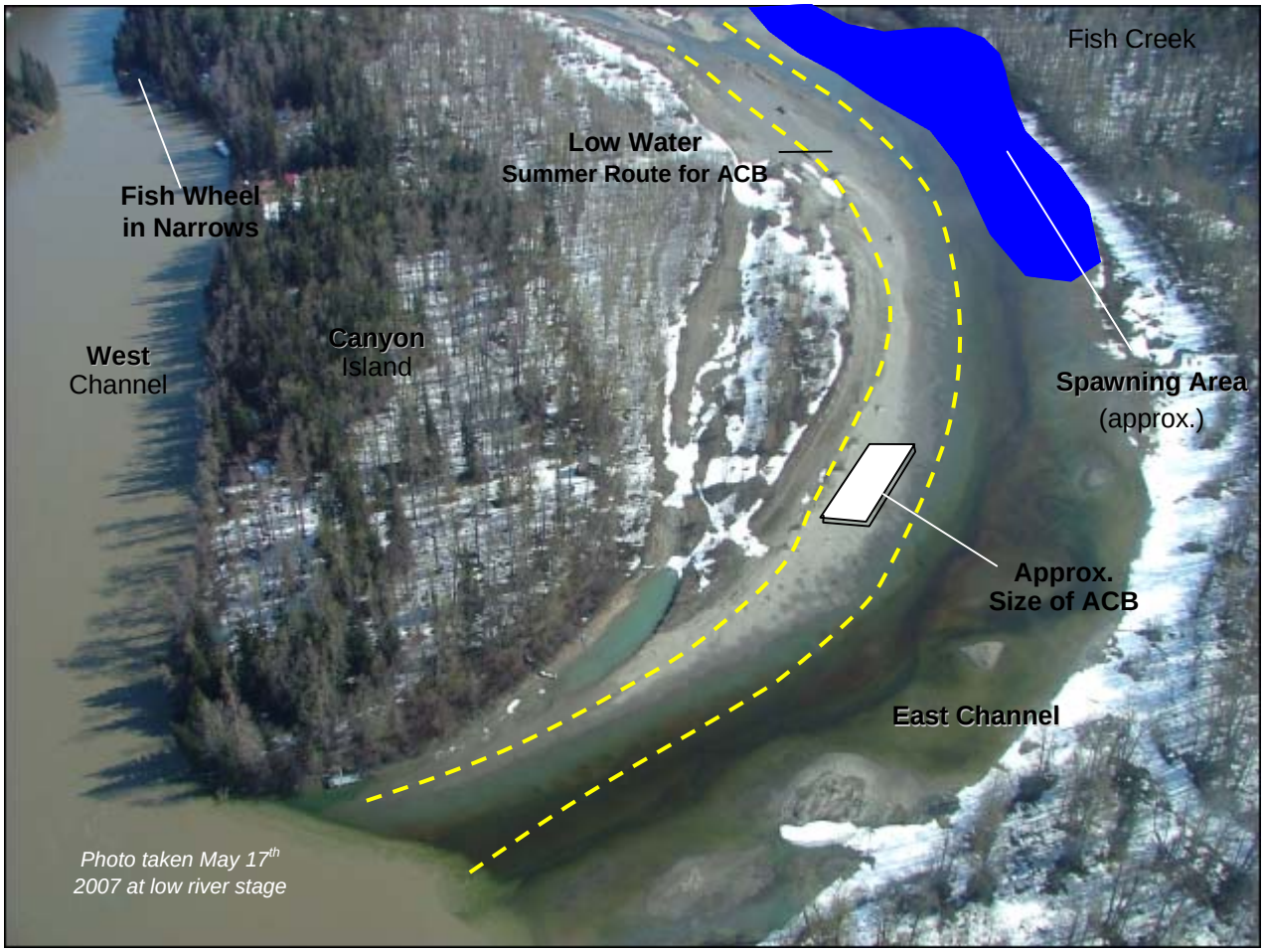
1. During high water when the entire channel is full, the tug will tow the ACB through the channel, as there will be sufficient depth to avoid disturbance to the spawners.
2. As water levels drop, the amphitrac will be used to pull the ACB over the gravel beach area on the east shore of Canyon Island (see Figure 5-6).

Therefore, at low water levels there will be no barging activity in the wetted portion of the channel so that rearing and spawning salmon habitat will not be disturbed. The ground pressure of the amphitrac and ACB is very low (between 1 and 5 psi) so that no compaction of the material on the gravel beach is expected but if there is any, the high flow conditions during freshet or jökulhlaup will likely redistribute the substrate and undo any compaction.

The proposed routes around Canyon Island should not affect incubating eggs. In the early fall the ACB will be taking the overland route adjacent to the east side of Canyon Island and will avoid known spawning areas at the outlet of Fish Creek and the channel downstream of the outlet. Barging operations along the east side of Canyon Island will be monitored during the late summer and fall and corrective action taken if impacts to spawning habitat occur.

The proposed barging operation also includes moving large woody debris (LWD) that becomes lodged in the navigation channel to maintain a clear route for the ACB. Large woody debris such as logs and root wads provide protective cover for juvenile salmonids and moving the LWD could impact habitat for these young fish. As discussed in Section 5.6.1.7, the operational procedure will be to use the grapple mounted on the bow of the amphitrac to move the LWD out of the navigation channel. Generally, the majority of the LWD transported by the Taku River will become lodged in shallow water areas and gravel bars and only a small portion of the LWD in the Taku River will become anchored in the navigation channel. The LWD that does have to be moved will be moved to a wetted portion of the river channel to one side of the ACB route. Above the Taku lodge the wetted channel width of the Taku River is generally greater than 300 ft (100 m), providing lots of room to place LWD in areas that will not affect navigation but will continue to provide functional fish habitat. During operations a log will be kept recording where LWD is moved from and where it is placed.

Figure 5-6. View of East Channel at Canyon Island and ACB Low Water Route Overland Route



Measures to Avoid or Minimize Potential Adverse Effects – Mainstem Spawning

- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding mainstem spawning is side channels and creek mouths.

Measures to Avoid or Minimize Potential Adverse Effects – Canyon Island East Channel Spawning

- Use shallow draft tug to tow ACB during high water in the east channel only when water levels in channel are greater than 3 ft to avoid potential disturbance of spawning.
- At low water levels during open water season, use amphitrac to tow ACB on dry gravel bar and avoid potential impact to spawning.

- Use west channel in winter once it is frozen to avoid potential for impacts to spawning and over-wintering in east channel.
- Engage environmental monitor to observe this area in late summer and fall and implement corrective action if spawning impacts occur.
- Use of low ground pressure equipment (amphitrac and ACB) will avoid compaction or rutting of gravels.

Measures to Avoid or Minimize Potential Adverse Effects – Large Woody Debris

- Relocation of hazard snags and logs in the river is a measure to reduce potential for accident or mishap.
- Relocation of large woody debris will be restricted to debris located in the actual travel route that present a hazard to the safe operation of the transportation system.
- Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel so the debris continues its role as fish habitat.

Conclusion

- Any residual effects from the ACB/amphitrac passage over the gravel bar on the east side of Canyon Island will be reversed by normal water flows in the river. These effects are not inconsistent with the natural environment and naturally occurring amounts of disturbance in this stretch of the river.
- With implementation of the measures outlined above, potential for significant adverse effects to mainstem spawning and rearing will be avoided.
- The proposed ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; and (B) the active floodplain.

5.7.1.2 Indirect Effect from Physical Effects on the Lower Taku River Section (Sand Flats)

Issue Review

In Section 5.6.1.2 it was concluded that there might be minor physical effects to the sand flats during the transition season (early spring and fall) when water flows in the Taku River drop below 25,000 cfs (700 m^3/s). The potential effects of disturbance to the sand flats include compaction from the amphitrac wheels, and disturbance from the ACB skirt that could disturb benthic organisms and eulachon eggs. If the ACB route follows dewatered sand bars, the effects are likely to be minor, as these intertidal areas would not support eulachon eggs. The effect on benthic organisms would be minor due to the light footprint of the amphitrac and ACB, both less than the pressure exerted by a human footprint.

If a more aquatic route is used, there is the potential to affect eulachon spawning and egg survival as well as benthic organisms. The effect would be related to any sections of the route where the amphitrac or ACB skirt drags on the bottom. It is unlikely that this drag will have a noticeable effect on benthic organisms, as the ACB route would only disturb a small fraction of the sand flats. During the spring low flow period, the spawning run of eulachon will be present in the lower Taku River starting in late April or early May. From early May until hatching, eulachon eggs will be incubating in the lower Taku River. Any effect would be short lived as typical flow levels in the Taku River begin increasing above 17,500 cfs (500 m^3/s) in early May and are normally exceeding 25,000 cfs (700 m^3/s) by mid to late May. The effect of using an aquatic route through the sand flats on eulachon spawners is uncertain. Potential effects could be mitigated by using an aquatic route during higher tides when water depth would protect spawning eulachon and eulachon eggs. Also, ACB operations on the river will be generally carried out during daylight hours. Eulachon generally spawn at night so barging should have little effect on spawning activity. Once flows exceed 25,000 cfs (700 m^3/s) the operations should not have any effect on eulachon eggs regardless of tide levels.

The selection of the appropriate route for the ACB and amphitac over the sand flats during eulachon migration and spawning periods will minimize any impact on the eulachon population. As described in section 1.2.2, initial tests will be made to select the most appropriate route and tide level combinations and the effects will be monitored during the barging operation. Corrective action will be taken if it is found if barging is having a significant effect on eulachon spawning and incubating eggs.

Measures to Avoid or Minimize Potential Adverse Effects

- Proposed route avoids eulachon spawning areas as identified on Juneau State Land Plan: Areas 14a44 and 14a55 by staying in mainstem channel.
- Use of ACB and shallow draft equipment is suitable for the shallow section of the Taku River. Travel in the deepest channel through of the lower Taku River sand flats during the open water season would avoid potential disturbance to sand flat.
- Use of ACB and amphitrac during winter to travel across ice covered sand flats and ice shelves, avoiding the shallow reaches lower Taku River sand flats, thereby avoiding potential disturbance to sand flat.
- Use tidal assist (a rising tide, mean tide or higher) when possible during the transition seasons to traverse the shallow portions of the sand flats fully aquatically, thereby avoiding potential disturbance to sand flat.
- Conduct trials with environmental monitors prior to routine usage of the ACB/amphitrac in the transition season to identify preferred operating procedure (as outlined above) to minimize disturbance to the sand flats during the low water transition seasons.

Conclusion

- Although there is some potential that traversing the sand flat shallows during low water flows may affect benthic organisms, it is unlikely that the ACB skirt drag will have a noticeable effect on benthic organisms as the ACB route would only disturb a small fraction of the sand flats and only for a very short temporal extent.
- With the implementation of the measures outlined above, and given the limited area of potential habitat relative to the total sand flats area utilized by the eulachon, the limited temporal extent of disturbance and potential effects to eulachon eggs are minimized to well below levels of significance.
- The proposed ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding and minimizing alteration in surface and groundwater drainage patterns.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (4) tideflats, by avoiding significant adverse impacts to (A) adequate water flow and natural drainage patterns.

5.7.1.3 Migrating Adults and Juveniles

Issue Review

Concerns have been expressed about the potential for ACB operations to impact migrating adult and juvenile salmon. In the case of juvenile salmonids, Meehan and Sniff (1962) and Murphy et al. (1988, 1989 and 1997) have reported on studies conducted in the Taku River. It appears that juveniles migrate downstream from April to November. The studies also suggest that the river edge habitat is an important component of the rearing habitat for juveniles and that declining river flows result in the movement of juveniles from the upper tributaries and reaches of the Taku River to the lower reaches of the Taku River in search of suitable habitat. Meehan and Sniff (1962) reported that peak downstream migration of Chinook, chum, and coho was in the early morning hours (1 am – 5 am). Sockeye showed little difference in activity over the course of a 24-hour day. Chinook, coho and sockeye juveniles spend up to a year in the freshwater environment before migrating out of the Taku River and would be most susceptible to any impacts in the River.

Murphy et al. (1988) reported that juvenile Chinook are more likely to rear in the main river channel along the river margin and in slough areas, mouth of tributaries and in tributaries directly connected to the mainstem. Coho and sockeye were more likely to be found in off channel areas such as ponds and sloughs. Juvenile salmonids were not normally found in water flows in excess of 30 cm/s and Murphy et al. (1989) reported that flows in the Taku River, mid-channel from 30 to 240 cm/s.

Migrating juveniles of all species are unlikely to be affected by the ACB and tug operation during the majority of the route as the vessels will be in mid-channel where juveniles are not found primarily due to high water velocities. Also, the majority of juvenile salmonids migrate downstream during darkness, when the ACB will not normally be on the river; barging operations are not likely to have any significant effect on juvenile migration. Given the work that has been done on juvenile salmonids in the lower Taku River the species at most risk is the Chinook. Chinook juveniles that

make use of the edge habitat in the Taku River mainstem are at potential risk from the effects of ACB and tug wake and at locations where the ACB transitions from water to land. These potential effects related to stranding and entrainment in the airflow under the ACB are discussed below.

Barging activities could also effect the upstream migration of adult salmon. Adult Chinook salmon are the earliest arrivals in the Taku, between early May and early June while the spawning runs of the other species do not start until June/July (TRTFN 2003). The timing of the majority of fish migrating into and up the Taku River takes place when there is considerable boat activity on the Taku River between the mouth and Canyon Island. This boat activity is related to in river fishing plus access and activities around the recreational properties located along “Martini Row”. The river channel is generally fairly wide along much of the river and in most areas there are multiple channels. The main channel typically ranges from 100 m to over 200 m wide providing opportunities for fish to avoid the ACB and tug. The ACB/tug combination will be approximately 85 m long, travelling at 5 to 10 knots (2.6 m/s – 5.2 m/s); at 2.6 m/s it will take less than 60 seconds for the ACB to pass a point. If the fish were to be affected by ACB noise and shadows from a distance of 100 m, the total distance of effect would be 285 m and the duration of the effect would be just over 110 seconds. Given the short duration of the ACB passage past a point that would occur twice a day and the fact that the width of the river provides opportunities for fish to avoid the ACB it is unlikely that the barging will have an effect that would impact on the populations of salmon in the Taku River. It is also expected that the effect of barging would be less noticeable downstream of Canyon Island due to the level of boat activity associated with fishing and recreation in the Martini Row area that coincides with the upstream migration.

Measures to Avoid or Minimize Potential Adverse Effects

- No specific measures required; effects are likely to be insignificant.

Conclusion

- Potential for significant adverse effects is unlikely.

5.7.1.4 Entrainment of small fish under the ACB in the air cushion

Issue Review

Air cushion vehicles are known to spray water and blow other debris around by the air escaping from under the skirt. Concern has been expressed that small fish will be affected by the forces of air on the water and become injured or killed. The likely area for this type of event to occur is where fish are in very shallow water when the ACB floats by. This would occur at points where the ACB enters or leaves the water such as the route along the east side of Canyon Island. The likelihood of this causing even a minor impact on fish populations is minimal. Relative to the entire shoreline along the Taku River (approx. 15.5 miles from the border to Taku Lodge), and the distribution of juvenile fish along this shoreline, the impact area is very small (ACB width is 88 ft) and the time of exposure is short – in the order of minutes as the ACB passes by. Also, studies of air cushion

vessels and vehicles have shown that they cause minimal damage to plants and animals that they pass over (Turner 2003), suggesting that this would be further reduced for fish within the water column. In the water column itself below the ACB, there is no change in water pressure as water is incompressible.

While the existing evidence suggests that the potential for small fish, in particular juvenile salmonids, to be damaged by the ACB as it passes over shallow water areas will be insignificant, there are no reports directly related to juvenile salmonids to confirm this assessment. Therefore, a monitoring program will be carried out during the initial months of open water barging to confirm this assessment.

Measures to Avoid or Minimize Potential Adverse Effects

- Implement a monitoring program during initial months of open water operations to confirm there are no significant adverse effects associated with entrainment of small fish under the air cushion as the ACB crosses from water to gravel bars.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse effects resulting from juvenile fish trapped beneath the air cushion will not be significant.

5.7.1.5 Stranding of Juveniles

Issue Review

Juvenile salmonids often utilize river edge habitat for rearing and migration which makes them susceptible to wave action and being washed up on shore and subsequently becoming stranded. In Section 5.6.1.4 evidence was presented to suggest that the waves generated by the ACB and tug will be similar to or less than the wake generated by the jet boats that typically use the Taku River. The ACB will be travelling in mid-channel, maximizing the distance from shore so that wave height and energy will have attenuated by the time waves reach the shore. The other potential effect is associated with the ACB transitioning from the river onto gravel bars. As the ACB approaches the shore, any bow wave crates a surge of water that can also wash juveniles on to shore and become stranded. The bow wave from the ACB is limited while on hover so that the surge of water will be small as the ACB approaches the beach. As with the discussion of potential effects of the forced air under the ACB skirt damaging juveniles, the length of affected shoreline (total 200 ft or 60 m) is very small relative to the overall length of the Taku River. Given the small wave heights and surges that the ACB will create and the wake waves created by the tug and amphitrac, stranding is not expected to impact to fish populations in the river. Similar conclusions were made of hovercraft activities, involving more traditional fast moving hovercraft on the Kuskokwim and Johnson Rivers (Volpe 2000). To confirm this conclusion monitoring will be carried out at the landing site and at low gradient beach areas along the route. If significant numbers of fish are being stranded by ACB

operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB will travel in mid-channel, minimizing the wave energy by the time it reaches the beach areas, and the potential for stranding juveniles.
- Monitoring will be carried out at the landing site and at low gradient beach areas along the route during the first year of operation. If significant numbers of fish are being stranded by ACB operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse effects to juveniles while ACB landing will not be significant.

5.7.2 Marine Mammals

Issue Review

The marine mammals that are reported to be present in the study area include stellar sea lions and harbour seals. It appears that no detailed studies of marine mammals that use the Taku Inlet area have been done, but Humpback whales and killer whales are also known to be in the vicinity and are identified in the Juneau State Land Plan. The Humpback whales are also a tourism attraction in this area. The ACB operations between Juneau and the head of the Taku Inlet could disturb marine mammals from both above and below water noise generated by the marine tug and ACB. The noise from the marine tug will be similar to existing marine traffic, representing only a small portion of the total vessel traffic travelling to and from Juneau through Stephens Passage and Taku Inlet, and is only expected to have an incremental impact on marine mammals in the area. Based on information about other air cushion vehicles described above, and studies by Richardson et al. (1995) that reported gray whales were less responsive to large military hovercraft when they were on hover than when they were floating on the water with the engines running. The ACB will not generate significant underwater noise levels and should contribute similar or less underwater noise than the marine tug.

Stellar sea lions are listed on both the *Endangered Species Act* and the *Marine Mammal Protection Act*. Under the *Endangered Species Act* the Stellar Sea Lion Recovery Plan identified critical habitat as haulout areas and adjacent waters and beaches occupied by more than 200 animals. The recovery plans require that activities stay at least 3,000 ft from haulouts to provide an adequate buffer. While no haul out areas located in the study area supports more than 200 animals, the Juneau State Land Plan identifies the haul out sites as areas of concern. The ACB route will maintain a 3,000 ft buffer from the haulouts thereby minimizing any effect on sea lions using these haul outs.

Harbour seals have been observed on the ice edge at the mouth and lower reaches of the Taku River during aerial surveys carried out by Gartner Lee and the US Fish and Wildlife Service. US Fish and Wildlife observed approximately 120 animals in February 2007 (D. Grooves, pers. Comm.. 2007) and Gartner Lee recorded approximately 150 animals in March and 30 in May of 2007. Harbour seals are known to habituate relatively easily to human activity and are not likely to be affected by the passage of the ACB and tow vessels in the lower Taku River and Taku Inlet.

Measures to Avoid or Minimize Potential Adverse Effects

- Use of ACB reduces underwater noise associated with barging activity by reducing mechanical transmission of noise to the water column.
- Slow speed of travel will be not exceed the vessel speed limits implemented in Glacier Bay National Park to prevent harassment and disturbance of humpback whales.
- Maintain 3,000 foot distance from known sea line haul-out at Dorothy.
- Implement Wildlife right-of-way policy for transportation system operations.
- Avoid areas where marine mammals are observed to congregate.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to marine mammals will be avoided.
- The proposed ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (2) by avoiding disruption or reasonably foreseeable wildlife transit.

5.8 Terrestrial Resources Issues Review

5.8.1 Methodology

In assessing the effects of operations in Alaska, the following were the key factors considered during the initial screening:

a) noise and displacement of wildlife during operations; and
b) proximity, timing and duration of operations, particularly with respect to high value habitats.

The initial screening of effects allowed the key issues and effects on species and species groups to be identified quickly and effectively. The initial screening is described in detail in Section 4.6.5. If the initial screening questions were answered “Yes” in all cases, a detailed review of potential effects was carried out, and mitigation measures developed to reduce these effects. It is acknowledged that the evaluation at this initial stage is more qualitative than quantitative.

Nonetheless, the process followed is sufficiently transparent, and that the conclusions reached are appropriate and minimize risk of significant impact. Effective monitoring strategies will be developed and implemented, where warranted, to ensure that the predicted effects are verified, and with the understanding that operations and procedures would be modified, if warranted and practical.

5.8.1.1 Detailed Evaluation Methods

Where the initial screening indicated that a more detailed evaluation was required, a detailed evaluation of potential project effects was conducted and mitigative measures and monitoring measures were identified to address the effect. Key issues and concerns identified through discussions with First Nations, government regulators. A detailed review of the potential effects of the proposed ACB operations formed the basis for this evaluation.

5.8.2 Terrestrial Mammals Issues Review

Based on the initial screening (refer to Section 4.5.5), the following terrestrial mammal species/species groups were determined to require a more detailed evaluation: **black bear, grizzly bear, grey wolf and moose**. The detailed evaluation of the effects of the ACB transportation system on terrestrial mammals is provided in Section 4.5.5, Table 4-9 for the species identified.

5.8.2.1 Grizzly and Black Bears

Issue Review

Grizzly and black bears can potentially be displaced from foraging habitat due to disturbance associated with ACB operations on the Taku River and tide flats. This is categorized as a low to moderate risk, given the distance from the ACB route (mainstem of river), slow traveling speed, and temporary nature of the disturbance. A preliminary identification of high value habitat areas indicates that the vegetated tidal flats, and wetlands and river edges are prime foraging habitat for bears.

Measures to Avoid or Minimize Potential Adverse Effects

- ACB route avoids most of the high value foraging habitats identified in preliminary assessments. Further observation and monitoring will refine knowledge of these key habitats, and where appropriate, the route will be adjusted to provide additional distance buffers if required to minimize disturbance.
- Monitor habitat use on Taku tidal flats through mapping bear locations and modify routes/timing based on use patterns.
- Implement the *Wildlife Management Plan* - provides direction to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs (see Appendix B). The monitoring will include a Bear/Human Management Plan and

outline general operating expectations and procedures for reporting wildlife sightings and incidents, etc. Provides framework for modifying operations if warranted.

- *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel.
- Implement Wildlife right-of-way policy for transportation system operations.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to black and grizzly bears will be avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.8.2.2 Moose

Issue Review

ACB operations during the open water season have the potential to displace moose from high value forage habitats along the river corridor. Winter operations have the potential to indirectly increase moose mortality due to easier access by wolves and/or humans along the ACB winter route.

Measures to Avoid or Minimize Potential Adverse Effects

- ACB route avoids most of the high value foraging habitats identified in preliminary assessments (e.g., sloughs, side channels). Further observation and monitoring will refine knowledge of these key habitats, and where appropriate, the route will be adjusted to provide additional distance buffers, if required, to minimize disturbance.
- Implement monitoring of winter movements and locations of moose and grey wolves before and during the ACB operations. This would be done using aerial and ground snow track surveys and plotting locations of moose/wolves along the Taku River.
- *Wildlife Management Plan* - provides direction to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. The plan outlines general operating expectations and procedures for issues such as avoiding collisions (winter operations) reporting wildlife sightings and incident reporting, etc. Provides framework for modifying operations if warranted.
- *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel.
- Implement Wildlife right-of-way policy for transportation system operations.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to moose will be avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.8.2.3 Grey Wolves

Issue Review

Winter operations of the ACB have the potential to displace wolves from prime winter foraging habitat (moose winter range along river corridor). There is also potential for increased mortality risk resulting from increased human access into the area in winter.

Measures to Avoid or Minimize Potential Adverse Effects

- ACB route avoids most of the high value moose winter range that wolves use for winter foraging. (e.g., sloughs, side channels, river edge). Further observation and monitoring will refine knowledge of wolf forage habitats, and where appropriate, the route will be adjusted to provide additional distance buffers, if required, to minimize disturbance.
- *Wildlife Management Plan* - provides direction to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. The Plan will outline general operating expectations and procedures for issues such as reporting wildlife sightings and incident reporting. The Plan will provide a framework for modifying operations if warranted.
- *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel.
- Implement Wildlife right-of-way policy for transportation system operations.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to wolves will be avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.8.3 Birds Issues

The initial screening of the effects of ACB operations on bird species groups can be found in Section 4.5.6. Based on the initial screening, the following bird species and species groups were determined to require a more detailed evaluation: Bald Eagles, Nearshore and Freshwater Foraging Birds, Waterfowl, and Shorebirds.

5.8.3.1 Bald Eagle

Issue Review

The operation of the ACB system has the potential to displace nesting eagles from nesting and foraging habitats, impacting populations. Nests have been identified through surveys, though were not active at the time of observation.

Measures to Avoid or Minimize Potential Adverse Effects

- Identify high value sites and avoid during operations through distance or timing, to extent possible.
- Maintain minimum distance of 200 m from active nest sites with ACB, where possible.
- Monitor habitat/nest use to determine if the ACB operations are affecting nest use. This monitoring would involve obtaining accurate nest location information during the late winter when nests are readily visible using aerial surveys. The nests would be checked for occupancy during the late spring-early summer using ground surveys.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to bald eagles can be largely avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.8.3.2 Nearshore and Freshwater Foraging Birds and Waterfowl

Issue Review

ACB operations have the potential to displace these birds form nesting and foraging habitats with resulting impacts to populations.

Measures to Avoid or Minimize Potential Adverse Effects

- High value habitats will be identified and avoided to the extent possible during operations through distance and timing. ACB route mostly follows the deeper channels, and avoids nearshore areas favoured by marine foraging birds and waterfowl.
- Habitat use and populations will be monitored, and operations modified where practical and warranted.

Conclusion

- With implementation of the measures outlined above, particularly the avoidance of nearshore areas along the river, potential for significant adverse impacts to nearshore foraging marine birds and ducks can be largely avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.8.3.3 Shorebirds

Issue Review

Operation of the ACB system has the potential to displace shorebirds from nesting and foraging habitats, impacting populations.

Measures to Avoid or Minimize Potential Adverse Effects

- High value habitats will be identified and avoided during operations through distance and timing, where practical.
- Monitoring of habitat use and populations and modify operations where practical. Mapping of high use areas would allow the identification of preferred route(s), and may provide opportunities to modify routes or timing to reduce disturbance effects.

Conclusion

- With implementation of the measures outlined above, potential for significant adverse impacts to shorebirds can be largely avoided.
- The proposed ACB operations, with implementation of mitigation measures outlined above, is consistent with the Area Wide Land Management Policies for Fish and Wildlife Habitat as described in the Juneau State Land Plan.
- The proposed ACB operations are consistent with 11 AAC 112.300. Habitats Standard.

5.9 Human Activities Issues Review

The Alaska Public Trust Doctrine guarantees the public right to engage in such things as navigation, commerce, fishing and other uses. The Taku River has been used historically and currently as a transportation corridor to the sea from northwestern British Columbia. It is currently used for recreation access and is proposed for future access to mineralized areas in Canada (Juneau State Land Plan, Chapter 3 – Policies). It is a recognized navigable water body and is governed by the State of Alaska land management provisions. These include the provisions in the Juneau State Land Plan that designates the Taku River (Unit 14A) as Fish and Wildlife Harvest (Hv) area. When reviewing a proposed use such as the ACB transportation system, consideration is given to measures aimed at protecting the specific type of fish and wildlife harvest that occurs in the designated area. It is understood that navigation is a deemed use of the Taku River, Taku Inlet and Gastineau Channel, and that the review will determine that:

a) the proposed navigational use is compatible with the designated fish and wildlife harvest use; or

b) that with appropriate design, siting, and operating stipulations the other designated use can be made compatible and significant impacts to the harvest use avoided; or

c) that the other use is of sufficient importance of lacks a feasible and prudent alternative and it should be allowed within the harvest area consistent with the guidelines of the Plan and ACMP policies.

This section reviews the potential effects on fish and wildlife harvesting activities and draws conclusions as to the compatibility with the proposed ACB transportation system. Further, this section reviews potential effects on other activities and identifies measures to avoid or minimize adverse effects.

Concerns related to the routine operation of the ACB on the Taku River and Taku Inlet have been identified through discussions with various user groups, including the Taku River Recreation Association, commercial tourism operators in the area, commercial fishing organizations, environmental organizations and individual members of the public. Few concerns were identified for the marine operations in Gastineau Channel, as this is a recognized marine shipping channel that is used heavily by a variety of ships and watercraft operating in and out of Juneau. The primary areas of concern relate to activities in Taku Inlet, and along the Taku River corridor within Alaska.

5.9.1 Potential Effects on Human Activities

Activities that have the potential to be affected by the proposed ACB transportation system in Alaska include the following:

- commercial gillnet and seine net fisheries located in Taku Inlet;
- troll fishery;
- personal use fishery (Canyon Island);
- sport charter fishery (dispersed);
- fisheries research (Canyon Island fish wheels; minnow trapping);
- hunting;
- commercial tourism (Taku Lodge; jet boat tours; flightseeing tours; river rafting);
- dispersed recreation (boating, fishing, camping);
- enjoyment of recreational properties along Taku River; and
- mining and mineral exploration.

Recreational properties are located along the Taku River, approximately within a 3-mile (5 km) section downstream of Canyon Island. Most of these properties include cabins and houses, and are concentrated along the northwest shoreline of the river. There are a few properties along the opposite shore, including Canyon Island itself. Discussions with property owners identified several additional issues, namely:

- increased noise from the ACB operating in proximity to residences;
- increased wake causing shoreline erosion an potential damage to docks and property;
- damage to docks and wharves from possible collisions with the ACB;
- visual effects associated with operations; and
- interference with small boat traffic in this area.

5.9.1.1 Commercial Gillnet and Seine net Fishery

Issue Review

Commercial fishing in Taku Inlet is dominated by the drift gillnet fishery. On average, 85 boats participate annually in this fishery, although this number varies considerably during the season, and from year to year. The fishing season usually starts as early as the beginning of May and continues more or less continuously until the end of September. Within this period, openings start Sunday at noon, and typically extend until Wednesday at noon. The Chinook harvest may or may not be declared open, depending on the strength of the returning run.

The concern related to the potential disruption to the fishery caused by the daily passage of the ACB enroute to and from Juneau. Depending on the number of boats and location of the fishing fleet, the ACB and fish boats will need to avoid each other to prevent nets from being tangled or damaged. Net damage or entanglement would result in downtime for fishermen and potential reduction in the catch as a result of pulling the nets from the water. When the fleet is more

concentrated over an area in the Inlet, such as often occurs at the start of the opening (Sunday) there is greater potential for interference with passing watercraft, including the ACB. Once the fleet is more dispersed throughout the Inlet, the potential for interference with nets is reduced.

Most of Juneau's commercial traffic, including marine barging, passes through the fishery area. This demonstrates that the uses co-exist, and are generally compatible.

Measures Proposed to Avoid or Minimize Potential Adverse Effects

- The route followed by the ACB will generally keep to the middle of the Inlet to avoid interference with the fleet (the fleet tends to fish closer to the edges of the channel and Inlet as shown on Figure 3-12).
- Redfern will develop a *Transportation Communication Plan* that will, at minimum, include the following:
  - schedule of ACB transits throughout the open water season to be communicated to fishing fleet in advance of seasonal openings;
  - advance notification of any changes to the schedule, to the extent practical;
  - direct communication with commercial fishing organizations prior to the start of the commercial fishing season, and again at the close of the season to identify particular issues that may arise;
  - radio communication on the tug operating on a common marine frequency;
  - equipping the barge and tug with standard marine lighting to ensure visibility; and
  - to the extent practical, arrange ACB scheduling to avoid being in the area where the fleet is concentrated at Sunday noon (start of openings).
- Compensate for net damage caused by fault of the ACB operator.

Conclusion

- The measures outlined above will avoid the potential interference and disturbance to the gillnet fishery. Operational experience, combined with regular communication with the fishermen will further refine measures as required. Navigation of the proposed ACB through the areas used by the commercial fishing fleet in Taku Inlet (and Gastineau Channel) is not predicted to result in incompatibility with the designated harvesting activity.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (1) offshore areas, by avoiding and minimizing significant adverse impacts to competing uses such as commercial, recreational or subsistence fishing, to the extent that those uses are determined to be in competition with the proposed uses.

5.9.1.2 Personal Use Fishery

Issue Review

The Alaska personal use fishery on the Taku River is concentrated at the downstream end of Canyon Island, where nets are set in eddies in the west channel, downstream of the fish wheels. During the month of July, there may be up to 100 boats that fish this location. This activity occurs primarily on weekends, when many nets are concentrated in this narrow channel. Reportedly, these set nets can effectively block navigation with the nets extending almost across the entire width of the channel.

The concern that was identified during this review relates to the potential disruption and damage to nets and fishing activity that would occur if the ACB route followed the west channel during the times that the personal use fishery is active. Redfern suggests that, in collaboration with Alaska Dept. of Fish and Game, protocols be developed that ensure navigability of the both channels at Canyon Island for all users of the river.

Given the fact that the width of the west channel at its narrowest point will not accommodate the width of the ACB with adequate room for manoeuvrability (partially due to the fish wheel set at this location), the route will follow the east side of Canyon Island during the open water season. Figure 5-6 illustrates the approximate route that will be followed by the ACB at Canyon Island.

Measures to Avoid or Minimize Potential Adverse Effects

- Use of the east channel during the open water season will largely avoid potential interference with the Personal Use Fishery.
- Redfern will develop a Transportation Communication Plan that will, at minimum, include the following elements:
  - schedule of ACB transits throughout the open water season to be communicated to the public, via the Alaska Dept. of Fish and Game and through public advertising;
  - advance public notification of any changes to the schedule, to the extent practical; and
  - direct communication Alaska Dept. of Fish and Game prior to the start of the personal use fishery, and again at the close of the season to identify particular issues that may arise and identify means to avoid or minimize conflicts with this fishery and navigation.

Conclusion

- The ACB will avoid direct interference with the personal use fishery by using the east side of Canyon Island to navigate up and downstream the river in the location. The Transportation Communication Plan will assist in further avoid potential disturbance to the personal use fishery in this area.

- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (1) offshore areas, by avoiding and minimizing significant adverse impacts to competing uses such as commercial, recreational or subsistence fishing, to the extent that those uses are determined to be in competition with the proposed uses.

5.9.1.3 Sport Fishery

Issue Review

Sport fisheries in the Juneau area harvest significant numbers of Chinook and Coho salmon originating from the Taku River. Taku River Chinook account for a significant portion of the total catch from Juneau waters. The sport fishery is a dispersed, low-density activity that occurs near the shore when done from smaller boats, or from the shore itself.

Again, the potential effect relates to disruption or interference with this relatively dispersed fishing activity resulting from the daily transit of the ACB.

Measures to Avoid or Minimize Potential Adverse Effects

- Potential for interference with this fishery is limited, as the ACB will remain in the deeper waters of the Taku Inlet.
- The ACB will be equipped with lights and horn for warning any small craft of its position. Rules of navigation are generally that smaller power craft must give way to larger power craft, (and sail has the right of way over power). There will be ample opportunity in the expanse of Taku Inlet to accommodate the proposed ACB operations.

Conclusion

- Given the large expanse of the Taku Inlet, the dispersed nature of the sport fishing activity, and the regular and generally predictable round trip schedule of the ACB through Taku Inlet, the effects of the ACB operations on sport fishing activities will be negligible.
- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (1) offshore areas, by avoiding and minimizing significant adverse impacts to competing uses such as commercial, recreational or subsistence fishing, to the extent that those uses are determined to be in competition with the proposed uses.

5.9.1.4 Fisheries Research

Issue Review

In accordance with the US/Canada Pacific Salmon Treaty, the Alaska Department of Fish and Game and NOAA conduct fisheries research and management on the Taku River, including salmon stock identification, stock assessment and analyses of fisheries that occur along this transboundary river (Juneau State Land Plan). Of particular importance are the two fish wheels and

gillnets at Canyon Island. The fish wheels are set on either bank of the river, approximately 200 m apart, used for stock assessment. Concerns have been expressed regarding the potential effect of ACB operations on the ongoing research activities along the Taku, and in particular the possible interference with or damage to the fish wheels at Canyon Island.

Measures to Avoid or Minimize Potential Adverse Effects

- ACB route during open water season will avoid using the west channel at Canyon Island, and follow the east channel (when sufficient channel depth) or cross gravel bar along east side of Canyon Island.
- ACB operations typically will follow main channel of Taku River, avoiding research activites such as fish trapping, that occur close to shore.
- Implement Transportation Communications Plan and involve ADF&G in reporting any interference to research activities during each open water barging season.

Conclusion

- The potential interference with fisheries research on the Taku River, and particularly at Canyon Island, will be largely avoided. Use of east channel to move ACB up and down river at Canyon Island during this season will avoid boat congestion and fish wheels located in west channel.
- The ACB operations are not inconsistent with the existing fisheries research activities on the Taku River.

5.9.1.5 Hunting

Issue Review

Hunting for mountain goats, moose and black bear occurs within the Taku River valley and at higher elevations above the river. Hunting activity is very dispersed, and is primarily carried out by resident Alaskan hunters; there is very little guided hunting in this area. Moose hunting occurs in the fall season, mostly in the sloughs off the mainstem of the river, such as in Moose Creek Slough. Roughly 80 hunters harvest 45 moose in a season. Bear hunting is primarily carried out in the spring, and some later in the fall, and is concentrated along the lower elevations of the valley.

The concerns related to hunting stem from the potential disturbance to wildlife resulting from noise as the ACB transits the river, during the hunting seasons for moose, in particular.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB route avoids direct interference with hunting activity along the Taku River. The areas typically used for moose hunting do not include the mainstem of the Taku River, and hunting of mountain goats occurs at higher elevations above the valley floor, and would be unaffected by the ACB operations. Bear hunting is very limited, occurs mostly at lower elevations accessible

from the river, and disturbance would be limited to the temporary noise generated by the ACB as it passes by on the river.

- Noise generated by the ACB equipment (ACB and amphitrac/shallow draft tug) will be temporary, as it passes by on the river. The ACB engines will be muffled and enclosed to minimize noise. The noise generated by the ACB and the Amphitrac will be approximately 70 dB at 100 ft, roughly equivalent to a truck or boat passing by.

Conclusion

- The effects of the ACB operations on hunting activities along the Taku River valley are anticipated to be negligible. The activity therefore is compatible with wildlife harvesting.

5.9.1.6 Commercial Tourism

Issue Review

The Taku Glacier Lodge is the only commercial lodge located within the study area, offering flightseeing and a salmon bake during the summer season. Approximately 13,000 visitors visit the lodge during the summer season that extends from early May until the end of September. Visitors to the lodge are flown in by floatplanes from Juneau, landing and taking off on the mainstem of the river immediately in front of the lodge. During the height of the tourist season, there are six or seven aircraft landing and taking off approximately every two hours throughout the day as guests are ferried between Juneau and the lodge.

Potential effects of the ACB operations relate to the potential interference with the incoming and outgoing aircraft that shuttle tourists to and from the lodge. Discussions with Wings Airway and the Taku Lodge owners and operators indicate that it will be possible to accommodate the ACB operations through appropriate scheduling, daily communications during the tourist season, and when necessary, by exercising courtesy and giving the right-of-way to approaching aircraft.

Measures to Avoid or Minimize Potential Adverse Effects

- The landing and takeoff area is shown on Figure 3-13. The time required to land or take-off is very short, and therefore either the ACB or aircraft can delay their activity momentarily to allow the other to complete the transit. This disruption to either the ACB travel or the aircraft will be relatively short (e.g., <5 min.), thereby minimizing and avoiding the potential effect.
- The ACB/amphitrac and shallow draft tug will all be equipped with radios and will monitoring the aircraft frequency in this area, allowing direct communications between the barge and aircraft to co-ordinate activities.
- The ACB and tug/amphitrac will be equipped with standard marine lighting to ensure visibility.
- A Transportation Communication Plan will be developed based on discussions with the lodge operators to co-ordinate schedules to minimize disruption to the incoming and outgoing flights. This may include routine or seasonal meetings to review the success of the co-ordination and communication.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding blockage of existing or traditional access.

5.9.1.7 Flightseeing Tours; Commercial Rafting and Canoeing; Jet boat tours

Issue Review

Flightseeing tours comprise a large part of the commercial tourism activity that operates within the Taku valley and surrounding glaciers and mountains. Jet boats also ferry tourists around to view the spectacular Taku River and surrounding glaciers. There is very limited number of wilderness river trips conducted on the Taku River, and the majority of these complete the trip in Canada. Those that do continue into Alaska mostly take off the river at the Taku Lodge where the guests are then flown out to Juneau. There was little concern raised regarding the potential effects on any of these commercial tourism activities associated with the ACB operations in Alaska. No potential effects were noted.

Measures to Avoid or Minimize Potential Adverse Effects

- Redfern will undertake to ensure that the ACB and towing vessels are maintained in good condition and repair, and will make best efforts to maintain a tidy, clean and generally acceptable appearance of the vessels at all times.

Conclusion

- The transit of the ACB will be observed by tourists on flightseeing trips in the area, and occasionally by tourists completing a wilderness river trip on the Taku River. The temporary transit of the ACB may be considered as a curiosity by some tourists, or as an unwelcome visual, noisy, temporary disruption amongst the multitude of other activities that are commonplace on the Taku River such as jet boats, helicopters, and turboprop floatplanes, and other watercraft. Therefore, the proposed activity is not inconsistent with these existing activities.

5.9.1.8 Dispersed Recreation

Issue Review

Many residents of Juneau travel to the Taku Inlet and Taku River on day trips to participate in boating, sightseeing, hiking, fishing etc. These activities comprise a good portion of the small craft traffic volume that is present throughout the open water season, and in particular the summer season, between Juneau and the Taku Inlet. The ACB will generally remain in the deeper river channel(s) and the middle of the Taku Inlet. Small craft tend to remain closer to the shore of

exposed areas such as the Inlet, where winds and waves can pose safety issues for smaller craft. The ACB is relatively large and should be clearly visible to other river users. Travel speed will be slow, and the smaller craft will have no difficulty in avoiding the approaching ACB. Minimal interference with the ACB operations is anticipated.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB will be equipped with lights and horns to warn small craft in the area of its approach.

Conclusion

- Potential effects of interference with small craft operating in the Alaskan portion of the Taku River and Taku Inlet are anticipated to be negligible; standard safety measures and navigational procedures will be adopted to minimize encounters with small craft.

5.9.1.9 Recreational Properties - Wake

Issue Review

The ACB operations on the Taku River will likely produce much smaller wakes and the forces that will contribute to erosion will likely cause a negligible to minor increase in bank erosion. Volume 1, Project Description has identified that towing speeds will be reduced when passing through this stretch of river as a measure to protect docks and banks. For further discussion of this issue, see Section 5.6.1.4. Wake wave monitoring stations will be set up in the Martini Row area and perhaps other areas of the Taku River system in order to ascertain the actual size of any wake waves that are being created by the ACB operations.

Measures to Avoid or Minimize Potential Adverse Effects

- Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges.
- The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments.
- Monitor wake waves in vicinity of Martini Row using wave height-monitoring equipments. Adjust barge operation (e.g., travel speed) if unacceptable wakes are reported.

Conclusion

- The proposed Taku River ACB transportation system is consistent with 11 AAC 112.280. Transportation Routes and Facilities Standard (1) by avoiding and minimizing alteration in surface and groundwater drainage patterns.

- The transportation system is consistent with 11 AAC 112.300. Habitats Standard (8) rivers, by avoiding and minimizing significant adverse impacts to (A) natural water flow; (B) the active floodplain; and (C) natural vegetation within the riparian management area.

5.9.1.10 Recreational Properties - Noise

Issue Review

The ACB and towing vessels will produce noise levels similar to highway rated tractor-trailers, approximately 70 dB (decibels) at 30 m (100 ft). In comparison, jet boats at 48 kph (30 mph) create 88 dB, propeller-driven air boats create 80 dB, and floatplanes taking off create 85 dB. The ACB operating in Taku Inlet and on the river will produce noise levels similar to watercraft that currently use these waterways. In summer months, the ACB operation will be one of many sources of ambient noise along the Taku River with jet boats, jet skis and float planes generating considerable background traffic noise.

Noise generated by the ACB and tow vessels will be temporary, as it passes by on the river. The ACB engines will be muffled and enclosed to minimize noise. The effect will be temporary as the ACB passes by, and will take approximately thirty minutes travelling upstream at 5 knots to transit the 3 mile stretch of the river, and about half that time travelling downstream at approximately 10 knots.

Measures to Avoid or Minimize Potential Adverse Effects

- All equipment associated ACB transportation system to be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m).
- Engines on all equipment to be enclosed to reduce sound transmission.

Conclusion

- The noise effects will be incremental to the background airborne noise generated by jet boats, floatplanes and other small craft frequenting the area during the summer season. The incremental noise generated by the ACB system will be temporary, lasting approximately 30 minutes for the entire stretch of river to be navigated. These effects are not significant.

5.9.1.11 Property Damage - Docks, Wharves or Watercraft- resulting from ACB Collision

Issue Review

Concerns have been expressed regarding the potential of the ACB to damage docks and wharves, as well as any boats anchored to these structures as the ACB travels through this stretch of the river.

Measures to Avoid or Minimize Potential Adverse Effects

- Navigation of the ACB and the towing vessels will be under the control of experienced crew, familiar with the river and obstacles along the route.
- The ACB will be moved by a shallow draft tug (with or without support from amphitrac) that has adequate power to maintain control over the ACB at all times.
- By utilizing the east channel route during summer months, the higher velocity flow through Canyon Island narrows is avoided, thereby avoiding the reach of river that presents more navigational challenges.
- Speeds through this section will be further reduced, if wanted, to avoid collision with structures along the riverbanks.
- In the event of a mishap that results in damage to structures, the ACB operator will compensate the property owner for any damages attributable to the ACB operations.

Conclusion

- The above noted measures will avoid damage to any structures along the riverbanks, including docks, wharves, and boats, floatplanes that may be anchored to the structures. In the event of property damage, compensation will be provided to the owner.

5.9.1.12 Recreational Properties - Visual Effects

Issue Review

Some property owners may consider the transit of the ACB as visual impairment of the surrounding viewscape. However, given recent (2007) barging experience on the river, many property owners may find the ACB a source of interest. Respect for the right to hold a wide variety of personal opinions on aesthetics is a strong Alaskan attribute.

Measures to Avoid or Minimize Potential Adverse Effects

- Redfern will undertake to ensure that the ACB and towing vessels are maintained in good condition and repair, and will make best efforts to maintain a tidy, clean and generally acceptable appearance of the vessels at all times.

Conclusion

- The temporary transit of the ACB and ancillary towing vessels will result in a visual disturbance for a short period of time. Efforts to ensure that the appearance and condition of the vessels is maintained properly will provide some measure of relief to those that may find the ACB operations visually undesirable.

5.9.1.13 Recreational Properties - Interference with Small Craft

Issue Review

Access to and from the recreational properties along the Taku River is primarily by boat, although floatplanes are also used from time to time. The small boat traffic in this area can be considerable at times, particularly on weekends and during the height of the summer season. Potential interference with small craft in this area during the transit of the ACB has been identified as a source of concern to property owners. Figure 5-7 illustrates the ACB travelling through this section of river.

Measures to Avoid or Minimize Potential Adverse Effects

- The ACB will be equipped with horns and lights, and a pilot vessel to notify any craft in the area of the approach of the ACB. During periods of heavy traffic, boat traffic will be warned of the pending approach of the ACB by being accompanied by a small pilot boat.
- A Transportation Communication Plan will be developed to provide, amongst other things, a schedule of transits of the ACB prior to the start of the boating season. The schedule will be posted and communicated to the Taku River Recreation Association, and the public. Changes to the schedule will also be communicated in advance, to the extent practical. Annual or seasonal meetings with the Taku River Recreation Association is proposed to review the success of the Communications Plan and identify opportunities for improvement for all parties.
- The speed of the ACB may be slowed through this stretch of river to allow additional opportunity for small craft to move out of the way of the approaching barge.
- All users of the river will apply navigational rules and courtesies at all times.

Conclusion

- The measures described above will reduce avoid interference with small craft. Standard safety measures and navigational procedures will be applied to minimize encounters with small craft.

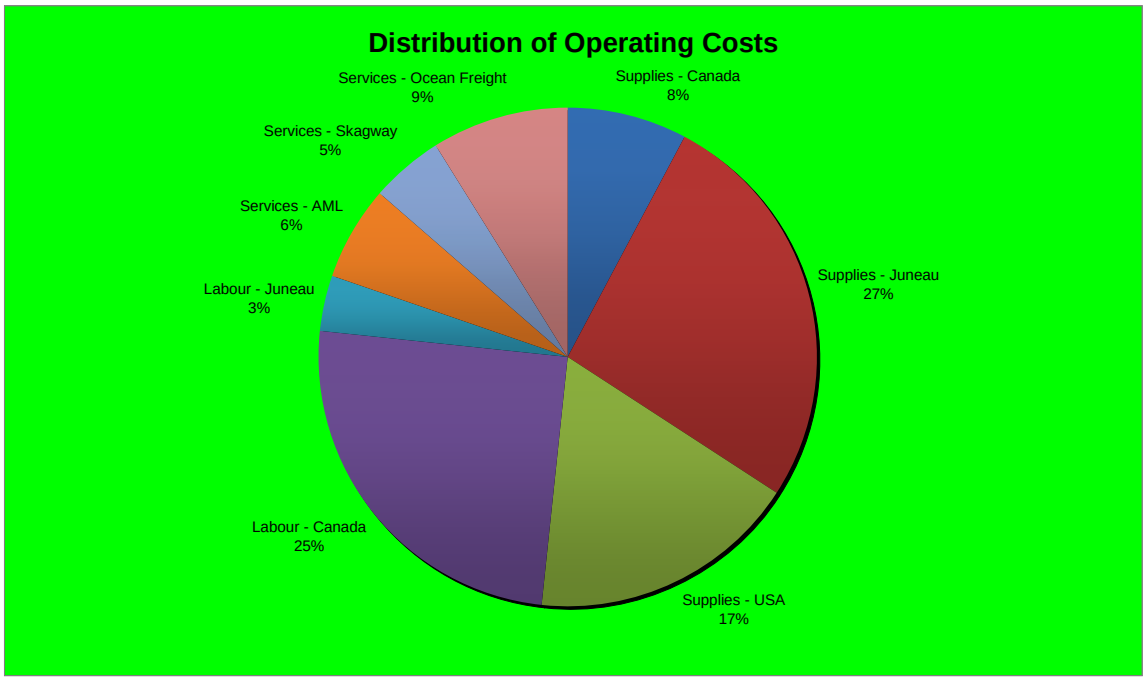
Figure 5-7. Illustration of ACB near Canyon Island

5.10 Economic Benefits

The proposed ACB transportation system will have economic effects in Alaska that are associated with the operation of the barge system, the purchase of supplies and services, including the handling of materials in Juneau and Skagway, Alaska. For example, it is anticipated that approximately half the crew that will be hired to operate the ACB transportation system will be based out of Juneau, Alaska. In addition, a large proportion (approximately 44%) of supplies destined for the mine will originate in the United States, some of which will be purchased directly in Alaska (eg. fuel) and all of which would be handled through the existing port facilities in Juneau. Many services required for the ACB system would also be supplied from Alaska, including regular maintenance of the barging fleet, communications, etc.

The proposed ACB transportation system will result in a redistribution of some of the economic benefits attributable to the Tulsequah Chief Mine project from British Columbia to Alaska. Figure 5.8 below illustrates the distribution of operating costs associated with the proposed ACB transportation system in Canadian and Alaskan/US jurisdictions.
Insert Figure showing Distribution of Costs

Figure 5-8. Distribution of Operating Costs



5.11 Summary and Conclusions

5.11.1 Summary

The following table provides a summary of:

- Issues identified;
- Proposed measures to avoid or minimize potential adverse effects associated with those issues; and
- The consistency of the proposed ACB transportation system with respect to the Juneau State Land Plan and the ACMP Statewide Standards (11 AAC 112) relevant to those issues.

Table 5-1. Summary and Conclusions of Issues and Proposed Measures to Avoid or Minimize Potential Adverse Effects

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Aquatic Resources			
Channelization	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential channelization effects. ■ Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential channelization effects. ■ No dredging or other works will be conducted to channelize the river; therefore the potential effect is not relevant to this project.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Disturbance of the Sand Flats	■ Use of ACB and shallow draft equipment suitable for the Taku River and travel in the deepest channel through of the lower Taku River sand flats during the open water season, thereby avoiding potential disturbance to sand flat. ■ During winter travel, ACB will travel across ice covered sand flats and ice shelves, avoiding the shallow reaches lower Taku River sand flats, thereby avoiding potential disturbance to sand flat substrate. ■ Use tidal assist (a rising tide, mean tide or higher) when possible during the transition season to traverse the shallow portions of the sand flats fully aquatically, thereby avoiding potential disturbance to sand flat. ■ Prior to routine usage of the ACB, Environmental monitors will observe in the transition season to identify preferred operating practices and route adjustments if needed (as outlined above) to minimize disturbance to the sand flats during the low water transition season.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Disturbance of Substrates in Taku River	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding potential disturbance of substrates in Taku River. ■ Use of shallow draft equipment and the ACB, as appropriate for the Taku River, will avoid potential disturbance of substrates in Taku River.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Re-suspension of sediments and bank erosion	■ Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional river barges. ■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments. ■ Implement management strategy to identify and monitor areas that could be affected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Effects on Water Quality	■ Develop and implement Spill Prevention and Contingency Plan, complete with requirements for appropriate materials packaging, personnel training, equipment and measures to reduce risk of spills. ■ Use of the ACB and shallow draft tug will minimize wake and potential bank erosion, thereby minimizing disturbance of sediments and reduction in water quality. ■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments. ■ Implement management strategy to identify and monitor areas of that could be affected by sediment re-suspension and deposition. Adjust barge operation (e.g., travel speed) if unacceptable effects are reported.	N/A	YES 11 AAC 112.280 11 AAC 112.300

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Effects on Ice Formation and Break-up	■ Operation plan avoids ice breaking and plans to allow the river to freeze up and thaw naturally. A frozen river surface is the preferred operational condition for the Taku River ACB transportation system in winter. ■ Ice road building will not be conducted; therefore fall ice formation and spring break-up will not be altered by the ACB operations. ■ During winter months, the preferred route will be over the west channel at Canyon Island, thereby avoiding potential impacts to the high value fish habitat associated with open leads in the east channel near the mouth of Fish Creek.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Relocation of Large Woody Debris that provide protective cover for juvenile salmonids	■ Relocation of large woody debris will be minimized to only those that are located in the actual travel route and present a hazard to the safe operation of the transportation system. ■ Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel so the debris continues its role as fish habitat. ■ Above the Taku Lodge the wetted channel width of the Taku River is generally greater than 100 m, providing lots of room to place LWD in areas that won't affect navigation but will continue to provide functional fish habitat. ■ During operations a log will record where LWD is moved from and where it is placed.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.280 11 AAC 112.300
Increased Level of Aquatic Noise	■ The air cushion will minimize the transmission of noise and vibration into the water column so the ACB will not contribute additional noise to the underwater environment. ■ Use of ACB reduces underwater noise associated with barging activity by reducing mechanical transmission of noise to the water column. ■ All equipment associated ACB transportation system to be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m).	N/A	N/A
Effects on Mainstem Salmon Spawning and Rearing	■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River for the majority of the route, thereby avoiding mainstem spawning in side channels and creek mouths. ■ East channel at Canyon Island used for spawning at mouth of Fish Creek; barge route will avoid this habitat by travelling out of the water along the gravel bar on east shore of island. ■ ACB will use west channel at Canyon Island in winter once frozen to avoid potential impacts to spawning and over-wintering in east channel. ■ Engage environmental monitor to observe this area in later summer and fall and implement corrective action if spawning impacts occur. ■ Use of low ground pressure equipment (amphitrac and ACB) will avoid compaction or rutting of gravels ■ Large woody debris will be relocated as close as possible to its original location and remain in the wetted channel such the debris continues its role as fish habitat, thereby minimizing the effect.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.280
Disruption of benthic organisms and eulachon eggs through disturbance of sand flats	■ Proposed route avoids eulachon spawning areas as identified on Juneau State Land Plan: Areas 14a44 and 14a55 by staying in mainstem channel. ■ Use of ACB and shallow draft equipment suitable for the Taku River and travel in the deepest channel through of the lower Taku River sand flats during the open water season, thereby avoiding potential disturbance to sand flat. ■ Use of ACB and amphitrac during winter to travel across ice covered sand flats and ice shelves, avoiding the shallow reaches lower Taku River sand flats, thereby avoiding potential disturbance to sand flat. ■ Use tidal assist (a rising tide, mean tide or higher) when possible during the transition season to traverse the shallow portions of the sand flats fully aquatically, thereby avoiding potential disturbance to sand flat. ■ Prior to routine usage of the ACB, environmental monitors to monitor operations during the transition season to select which operating method (as outlined above) minimizes disturbance to the sand flats during the low water transition season.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300 11 AAC 112.280

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Effects on migrating adult and juvenile salmon	■ Specific mitigation not required. Barge route follows mid channel where juveniles are not found primarily due to high water velocities. Also, the majority of juvenile salmonids migrate downstream during darkness, when the ACB will not normally be on the river. ■ Given the short duration of the ACB passage past a point that would occur twice a day and the fact that the width of the river provides opportunities for fish to avoid the ACB it is unlikely that the barging will have an effect that would impact on the adult migration of salmon in the Taku River.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300 11 AAC 112.280
Entrainment of small fish under the ACB in the air cushion	■ Implement a monitoring program during initial months of open water operations to confirm there are no significant adverse effects associated with entrainment of small fish under the ACB in the air cushion during the landing process.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300 11 AAC 112.280
Stranding of Juveniles	■ Monitoring will be carried out at low gradient beach areas along the route during the first year of operation. If significant numbers of fish are being stranded by ACB operations, measures will be taken to reduce stranding such as reducing speeds when adjacent to identified stranding sites.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300 11 AAC 112.280
Disruption to marine mammals due to aquatic noise	■ Use of ACB reduces underwater noise associated with barging activity by reducing mechanical transmission of noise to the water column. ■ Implement Wildlife right-of-way policy for transportation system operations. ■ Avoid areas where marine mammals are observed to congregate.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES (if applicable)
Disruption to sea lion haul outs	■ Maintain 3,000 distance from known sea line haul-out at Dorothy. ■ Implement Wildlife right-of-way policy for transportation system operations. ■ Avoid areas where marine mammals are observed to congregate.	YES Area Wide Land Management Policies Fish and Wildlife Habitat YES Region 14A Guidelines for Sea Lions	YES 11 AAC 112.300
Terrestrial Resources			
Displacement of Bears from high value foraging habitats due to ACB operation on the Taku River and Taku Inlet tide fats.	■ ACB route avoids most of the high value foraging habitats identified in preliminary assessments. Further observation and monitoring will refine knowledge of these key habitats, and where appropriate, the route will be adjusted to provide additional buffer distance to minimize disturbance. ■ Monitor habitat use on Taku tidal flats through mapping bear locations and modify routes/timing based on use patterns. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This includes the Bear/Human Management Plan and outlines general operating expectations and procedures for issues such as wildlife sightings and incident reporting, etc. Provides framework for modifying operations if warranted. ■ A *No Firearms Policy for* all Redfern employees will be implemented for ACB crews and personnel. ■ Implement Wildlife right-of-way policy for all aspects of operations.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Displacement of Moose from moderate to high value foraging habitats due to ACB operations	■ The ACB route follows the deeper channel of the river and avoids most of the high value foraging habitats identified in preliminary assessments (e.g., sloughs, side channels). Further observation and monitoring will refine knowledge of these key habitats, and if appropriate, the route will be adjusted to provide additional distance buffers to minimize disturbance. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This Plan will outline general operating expectations and procedures for issues such as wildlife sightings and incident reporting, and will provide a framework for modifying operations if warranted.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Increased mortality of Moose from increased winter access by wolves along ACB route	■ See above measures and: ■ *No Firearms Policy* for all Redfern employees will be implemented for ACB crews and personnel. ■ Implement Wildlife right-of-way policy for transportation system operations.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Displacement of Grey Wolf from prime winter foraging habitat (moose winter range along river corridor).	■ ACB route avoids most of the high value moose winter range that wolves use for winter foraging. (e.g., sloughs, side channels). Further observation and monitoring will refine knowledge of wolf forage habitats, and where appropriate, the route will be adjusted to provide additional buffer distance to minimize disturbance. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This Plan will outline general operating expectations and procedures for issues such as wildlife sightings and incident reporting, and will provide a framework for modifying operations if warranted.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Increased Grey Wolf mortality during winter operations (ACB route utilized by wildlife to travel over snow)	■ See above measures and: ■ A *No Firearms Policy will* be implemented for ACB crews and Redfern personnel. ■ Implement Wildlife right-of-way policy for transportation system operations.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Reduction/Redistribution of Bald Eagle population due to displacement from nesting or foraging habitat	■ Maintain minimum distance of 200 m from active nest sites with ACB, where possible. ■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This Plan will outline general operating expectations and procedures for issues such as wildlife sightings and incident reporting, and will provide a framework for modifying operations if warranted. ■ Monitor habitat/nest use to determine if the ACB operations are affecting nest use.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Reduction/Redistribution of Nearshore and Freshwater Foraging Birds and Waterfowl population due to displacement from nesting or foraging habitat	■ Implement *Wildlife Management Plan* - provides direction to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. ■ High value habitats will be identified and avoided to the extent possible during operations through distance and timing. ACB route mostly follows the deeper channels, and avoids nearshore areas favoured by marine birds and waterfowl. ■ Habitat use will be monitored, and operations modified where practical and warranted.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Reduction/Redistribution of Shorebird population due to displacement from nesting or foraging habitat	■ Implement the *Wildlife Management Plan* that outlines methods to minimize impacts to wildlife habitat and populations through best management practices and establishment of monitoring programs. This Plan will outline general operating expectations and procedures for issues such as wildlife sightings and incident reporting, and will provide a framework for modifying operations if warranted. ■ High value sites will be identified and avoided during operations through distance and timing, where practical. ■ Habitat use will be monitored, and operations modified where practical and warranted.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Human Activities			
Changes in success of the Commercial Gillnet and Seine net Fishery resulting from possible disruption of activity during ACB operations.	■ Avoidance of majority of fishing fleet as route followed by the ACB will generally keep to the middle of the Inlet (the fleet tends to fish closer to the edges of the channel and Inlet as shown on Figure 3-12). ■ Redfern will develop a *Transportation Communication Plan* that will, at minimum, include the following: - Schedule of ACB transits throughout the open water season to be communicated to fishing fleet in advance of seasonal openings - Advance notification of any changes to the schedule, to the extent practical - Direct communication with commercial fishing organizations prior to the start of the commercial fishing season, and again at the close of the season to identify particular issues that may arise - Radio communication on the tug operating on a common frequency. - Equipping the barge and tug with standard marine lighting to ensure visibility - To the extent practical, arrange ACB scheduling to avoid being in the area where the fleet is concentrated at Sunday noon (start of openings). ■ Compensate for net damage caused by fault of the ACB operator.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Disruption to Personal Use Fishery concentrated at west channel and downstream end of Canyon Island	■ Avoid west channel at Canyon Island will minimize conflict with personal use fishery. ■ Redfern will develop a Transportation Communication Plan that will include the following elements: - ACB operations schedule during the open water season to be communicated to the public, via the Alaska Dept. of Fish and Game and through public advertising. - Advance public notification of any changes to the schedule, to the extent practical ■ Direct communication Alaska Dept. of Fish and Game prior to the start of the personal use fishery, and again at the close of the season to identify issues and further measures to reduce conflicts between this fishery and navigation at Canyon Island.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300
Disruption or interference with the Sport Charter Fishery	■ Potential for interference with this fishery is limited, as the ACB will remain in the deeper waters of the Taku Inlet. Sport charter fishing and shore based sport fishing is very dispersed, generally occurring closer to shore in more sheltered waters of the Inlet. ■ The ACB will be equipped with lights and horn for warning any small craft of its approach. Rules of navigation would apply to all craft. There will be ample opportunity in the expanse of Taku Inlet to accommodate the proposed ACB operations.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES 11 AAC 112.300

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Interference with hunting	■ The ACB route avoids direct interference with hunting activity along the Taku River. The areas typically used for moose hunting do not include the mainstem of the Taku River, and hunting of mountain goats occurs at higher elevations above the valley floor, and would be unaffected by the ACB operations. Bear hunting is very limited, occurs mostly at lower elevations accessible from the river, and disturbance would be limited to the temporary noise generated by the ACB as it passes by on the river. ■ Noise generated by the ACB equipment (ACB and amphitrac/shallow draft tug) will be temporary, as it passes by on the river. The ACB engines will be muffled and enclosed to minimize noise. The noise generated by the ACB and the Amphitrac will be approximately 70 dB at 100 ft, roughly equivalent to a truck or boat passing by.	YES Area Wide Land Management Policies Fish and Wildlife Habitat	YES (if applicable) 11 AAC 112.300
Interference with aircraft at Taku Lodge	■ The landing and takeoff time required for an aircraft is very short, and therefore either ACB or aircraft can, through direct radio contact, allow the other to complete its transit. This disruption to either the ACB travel or the aircraft will be relatively short (e.g., <5 min.), thereby minimizing and avoiding the potential effect on either aircraft or ACB operations. ■ The barging equipment will be equipped with radios and will monitoring the aircraft frequency in this area, allowing communications between the barge and aircraft to co-ordinate activates. ■ ACB and tug/amphitrac will be equipped with standard marine lighting to ensure visibility ■ A Transportation Communication Plan will be developed based on discussions with the lodge operators to co-ordinate schedules in order to avoid and minimize disruption to the incoming and outgoing flights. This may include routine or seasonal meetings to review the success of the co-ordination and communication.	N/A	YES 11 AAC 112.280
Issues Raised by Cabin Owners on Taku River			
Increased erosion of banks or increased sedimentation due to wake action, resulting in damage to property	■ Use of the ACB and shallow draft tug will minimize wake and potential bank erosion. ACBs produce very little wake as compared to conventional barges. ■ The ACB and associated river equipment will travel in the thalweg (deepest portion) of the Taku River where fine sediments will not generally accumulate to be re-suspended by the propeller wash from the tug, thereby avoiding potential re-suspension of sediments. ■ Monitor wake waves in vicinity of Martini Row using wave height monitoring equipments. Adjust barge operation (e.g., travel speed) if unacceptable wakes are reported.	N/A	YES 11 AAC 112.280 11 AAC 112.300
Increased noise	■ All equipment associated ACB transportation system to be kept in good working order and equipped with industry standard mufflers to reduce noise levels to 70 dB at 100 ft (30 m). ■ Engines on all equipment to be enclosed to reduce sound transmission.	N/A	N/A
Damage to Docks, Wharves or Watercraft resulting from ACB Impact	■ Navigation of the ACB and the towing vessels will be under the control of experienced crew, familiar with the river and obstacles along the route. ■ The ACB will be moved by a shallow draft tug (with or without support from amphitrac) that has adequate power to maintain control over the ACB at all times. ■ Speeds through this section will be further reduced, if wanted, to minimize risk of collision with riverbanks, docks or other structures and vessels anchored in this area. ■ In the event of a mishap that results in damage to structures, Redfern will compensate the property owner for any damages attributable to the ACB operations.	N/A	N/A
Negative aesthetic impact of the ACB for recreational properties	■ Redfern will ensure that the ACB and towing vessels are maintained in good condition and repair, and will make best efforts to maintain a tidy, clean and generally acceptable appearance of the vessels at all times.	N/A	N/A

Issue	Proposed measures to avoid or minimize potential adverse effects	With Implementation of Measures, Proposed ACB Transportation System Is:	
		Compatible with Management Intent and Guidelines of Juneau State Land Plan	Consistent With ACMP Statewide Standards (Applicable Standard Identified)
Interference with small craft on the Taku River	■ The ACB will be equipped with lights and horns to warn small craft in the area of its approach.	N/A	N/A
Disruption of Fisheries Research Activities on the Taku River, particularly at Canyon Island	■ ACB route during open water season will avoid using the west channel at Canyon Island, and follow the east channel (when sufficient channel depth) or cross gravel bar along east side of Canyon Island. ■ ACB operations typically will follow main channel of Taku River, avoiding research activites such as fish trapping, that occur close to shore ■ Implement Transportation Communications Plan and involve ADF&G in reporting any interference to research activities during each open water barging season.	YES Consistent with Management Guidelines for Unit 14 related to Fisheries Research and Management	YES 11 AAC 112.300

5.11.2 Conclusion

In summary, the proposed operation of the ACB transportation system is not inconsistent with the navigational uses on the Taku River that have been existed before, and formally recognized since Alaska gained Statehood. The operations and activities related to the ACB transportation system in Alaska have been found to be consistent with the Management Intent and Management Guidelines as set out in the Juneau State Land Plan, to the extent that these intents and guidelines apply to this project. Furthermore, these operations and activities have also been found to be consistent with the management intent of Unit 14, ACMP as set out in the relevant and applicable standards.

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Appendix A

Environmental Management Program Outline

Appendix A

Environmental Management Program Outline

1. Environmental Management Program

The environmental assessment identifies many operational measures to mitigate the potential effects of year-round ACB operations on the Taku River, and the construction activities that will be required to initiate the ACB transportation system. As there is limited information on the performance characteristics of the amphitrac, there is some uncertainty associated with the assessment of the ACB operations as proposed. In order to address the uncertainty of the assessment and to ensure that the operational measures are followed and effective, Redfern will develop an environmental management program as part of the operational plan for the ACB transportation system.

An Environmental Management Program provides a logical identification of issues and comprehensive guidance to manage potential environmental impacts. The approach considers how resources will be allocated, who is responsible for planning, implementation and monitoring of environmental management activities related to the construction and operation of a project. This Program will include elements of an environmental management system that includes the collection and reporting of information on a timely basis so that it can be used to evaluate environmental performance, and identify where improvements are required to address unanticipated effects, or to reduce known environmental effects.

The Environmental Management Program is composed of several Environmental Management Plans (EMPs). EMPs are focused on specific project phases, components or environmental effects and provide detailed information on the measures, including best management practices and other mitigation measures, emergency response plans and environmental monitoring. It is likely that many of the EMPs identified here will be similar to those that are also currently under development as part of the broader permitting of the mine. The following is an initial concept for the EMPs related to the ACB transportation system.

1.1 Haul Road and ACB Landing Construction and Maintenance

The only new land-based facilities that will be required for the transportation system will be the ACB landing and loading area and the upgrade of the exploration road between the landing site and the limestone quarry. The roadwork will be an upgrade from exploration road to haul road as

described in Volume 1. The following provides an initial list of the components of the construction management plan:

1.1.1 Aquatic Resource Protection

Sediment and Erosion Control Plan

- Management of stormwater and meltwater.
- Ditching and culverts directed away from natural waterbodies.

Riparian Area Management Plan

- Minimize riparian clearing.
- Compensation plan for loss of riparian vegetation at ACB landing.

Water quality Monitoring during Construction and Operations

- Monitoring program of water quality during construction and operation, including monitoring the effectiveness of the riparian compensation plan.

1.1.2 Terrestrial Resource Protection

During construction and operations, erosion, sediment and water drainage control will follow the Erosion Control Plan prepared by Wardrop (2007) and the Riparian Management Plan (GLL 2007) to ensure that water quality and quantity are maintained to down slope ecosystems.

Wildlife Management Plan

The Wildlife Management Plan will prescribe methods to minimize impacts to wildlife habitat through best management practices and establishment of specific monitoring programs. The WMP includes the Bear/Human Management Plan, and outlines general operating expectations and procedures for issues such as avoiding collisions, wildlife sightings and incident reporting, etc. In addition, it will provide a framework for modifying operations if warranted. The following specific monitoring programs have also been identified:

Bald Eagle Nest Monitoring

- Monitoring of nest occupancy could be undertaken to determine if significant change occurs after ACB operations begin. This monitoring would involve obtaining accurate nest location information during the late winter when nests are readily visible using aerial surveys. These nests would be checked for occupancy during the late spring/early summer using boat or ground surveys. Any detection of a significant change would warrant further investigation into possible reasons for the change.

Waterfowl and Shorebird Monitoring

- Monitoring of foraging behaviour in relation to the ACB movements in the Taku River and Taku Inlet could be undertaken to determine potential effects of the ACB on bird foraging.

1.2 Route Selection and Testing

The bathymetry of the Taku River presented in Appendix A of Volume 1 indicates shallow water areas that may be impassable under certain river flow and tide conditions. If necessary, additional bathymetric data in those areas will be conducted to better chart out potential routes. Once the route(s) are identified, testing with the amphitrac/ACB and shallow draft tug/ACB combinations would be carried out. During these early river trials, Environmental Monitors would observe and report on:

- evidence of disruption to channel sediments;
- effects to beach areas where the ACB leaves the water and travels overland; and
- behavioural responses by wildlife.

After river trials are complete, the route(s) with the least impact will be charted and used for the initial ACB operations. As identified in the plans below, records will be kept during operations to determine if the preferred route is effective, and at the end of each open water season the operation will be reviewed and recommendations for the next season will be prepared.

1.3 Winter Barging

Specific attention will be paid to:

- the movement of the ACB and amphitrac onto the ice;
- avoiding open water areas to minimize the potential for the ACB to initiate ice break-up; and
- avoiding the formation of thicker than normal ice through the compaction of snow; any thickening of the ice could delay spring break-up.

Information collected during the winter barging will be summarized and evaluated and recommendations made for the next winter's barging operation.

1.4 Summer (open water season) Barging

Specific attention will be paid to:

- ensuring sufficient distance is maintained between ACB route and sea lion haul out areas;
- monitoring of bank and gravel bar conditions along the gravel bar traversed on the east side of Canyon Island;
- monitoring of salmon spawning activity in the channel east of Canyon Island; and
- monitor wake waves in vicinity of Martini Row using wave height monitoring equipments. Adjust ACB operation (e.g., travel speed) if unacceptable wakes are reported.

Information collected during the summer barging will be summarized and evaluated and recommendations made for the next summer's barging operation.

1.5 Spring and Fall Barging

Specific attention will be paid to:

- determining the appropriate time to convert from using an ice route to an aquatic/land route in the spring break-up period;
- monitoring of river ice conditions to determine the appropriate time to convert from aquatic to ice routes during the transition period at freeze-up;
- monitoring for disturbance of the sand flats including evidence of effects on spawning eulachon;
- monitoring for disturbance of substrates in the shallowest stretches of the route when river discharge drops below 700 m3/s; and
- monitoring fish use of the channel on the east side of Canyon Island and the interaction between the ACB and fish activity.

Information collected during the spring and fall barging will be summarized and evaluated and recommendations made for the next season.

1.6 Transportation Communications Plan

Regular communication about the ACB operations will be an important component of the overall ACB operations, and will provide a means to minimize potential interference with other activities on the river and in Taku Inlet. The Plan would include the following elements:

- A schedule of the ACB transits will be posted and communicated to First Nations, regulators, and all fishermen prior to the commencement of the fishing season.
- Fishermen would be notified in advance of any scheduling changes, to the extent practical. The notification of the ACB transit schedule will ensure that all users of the river have prior knowledge of the timing of ACB transits, and can, with little effort, accommodate this disruption.

- Annual meeting with the fishermen at the close of the commercial season to review the ACB operations with respect to the drift net fishery;
- Work collaboratively with fishermen to identify further mitigative measures, as needed and appropriate.
- Work collaboratively with ADF&G in reporting any interference to research activities during each open water barging season.
- Discussions with the Taku Lodge operators to co-ordinate schedules in order to avoid and minimize disruption to the incoming and outgoing flights. This may include routine or seasonal meetings to review the success of the co-ordination and communication.

1.7 Fuel, Chemicals and Materials Storage and Handling

All federal, provincial, and state regulations will be followed for the transportation of the types of materials that will be carried on the ACB. A detailed materials handling protocol will be developed for the ACB operation. The plan will focus on appropriate handling and storage of materials at the ACB landing site. For the most part, fuel, chemicals and other materials will only be stored for a short time at the ACB landing site but due to the proximity to the Taku and Tulsequah Rivers, additional precautions will be taken.

1.8 Spill Prevention and Contingency Plan

A spill prevention and emergency response plan for the transportation program will build on the overall plan for mine operations. The plan will address the unique needs of responding to a spill or emergency on the Taku River. The Spill Contingency Plan will include:

- specific instructions regarding contact information including who to contact, how, and when;
- descriptions of the type and amount of contaminants normally in transit on the ACB transportation system;
- the steps to be taken to report, contain, clean-up and dispose of contaminants in the case of a spill;
- the means by which the spill plan is activated;
- the training required and provided to employees in order to respond to a spill;
- appropriate training of ACB crews, loading and unloading operators, etc.
- an inventory of and the location of response and clean-up equipment available;
- containment equipment such as absorbent booms;
- effective communication between all involved in the operation; and
- role of lead boats.

1.9 Health and Safety Management Plans

This section will be an extension of the overall health and safety plan to address the unique aspects of the barging operations on the Taku River.