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Final Report

Comprehensive Renewable Energy Feasibility Study for Sealaska Corporation

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Executive Summary

Comprehensive Renewable Energy Feasibility Study
for Sealaska Corporation

Purpose

The purpose of this project was to conduct a comprehensive feasibility study to determine the potential sustainability of wind and/or small hydroelectric power plants on Southeast Alaska native village lands. The long-term objective is to supply all or a portion of the villages' electricity from local, renewable energy sources in order to reduce costs, provide local employment, and reduce power outages. An additional objective was for the villages to gain an understanding of the requirements, costs, and benefits of developing and operating wind or small hydroelectric power plants.

Background

Sealaska was formed as the Regional Native Corporation for Southeast Alaska under the Alaska Native Claims Settlement Act (ANCSA), passed by Congress in 1971. It includes 12 village/urban corporations in SE Alaska and represents nearly 17,000 shareholders, approximately half of who live in Southeast Alaska. Most villages are isolated from any central electric transmission and use diesel-electric systems for power generation. For diesel powered plants, the cost of electricity is $0.30 – 0.35¢ per kWh, <u>after</u> deducting subsidies from the State of Alaska. This makes the villages prime candidates for deploying renewable energy sources.

Scope of work for this project

Wind energy: Prescreening of potential sites; field surveys by a wildlife biologist, meteorologist, and wind power development specialist to select best potential sites; installation of anemometry, and analysis of wind data to determine if the wind is sufficient for economic viability of a wind power station. If one or more sites were identified that appeared to be economically viable, a business plan would be prepared.

Small hydro: Analysis of past and current studies of the potential small hydro sites to determine if changing conditions such as technology improvements or materials cost changes, indicate that one or more projects may now be economic. Includes preliminary analyses of environmental, permitting, and economic considerations.

Project Team

The project team consisted of very experience personnel in their respective areas of expertise. This report is based on their collective work and reports. The team members:

Sealaska Corporation: Project Coordinator – Michele Metz, Assistant Lands Manager, Natural Resources Department
Technical Coordinator and wind energy consultant: Springtyme Company L.L.C.,
Bob Lynette

Wildlife: Northwest Wildlife Consultants, Inc., Karen Kronner
Meteorologist: John Wade Wind Consultants, John Wade
Anemometry Installation: Met Tower Services, Mike Sailor, Chris Sailor, Jeff Baker
Micro/Small Hydroelectric Power: Alaska Power & Telephone, Larry Coupe
US Department of Energy: Larry Flowers (DOE Monitor)

Project Work

Wind Energy

Database - A database was assembled for all of the candidate sites in SE Alaska, including location, demographics, electricity supply and demand, existing and planned transmission interties with central generation, topographical maps, macro wind data, and contact personnel.

Pre-field work analyses – Twenty-three sites were analyzed to eliminate sites that were not likely candidates. Criteria used were: (1) macro wind data from weather stations and airports, (2) probability of viable winds based on topography, (3) schedule for bringing intertie to candidate sites, and (4) wildlife information that might preclude deploying wind turbines. Additionally, communications with the Alaska State Energy office and tribal members at the villages were conducted to ensure that all parties were working together and to gather anecdotal information. Five villages were selected for site visits.

Meetings with cognizant personnel and field analyses – Field trips were conducted at the five candidate villages that were deemed most likely to have viable wind resources. Meetings were held with local village and utility leaders and the requirements, costs, and benefits of having local renewable energy facilities were discussed. The potential sites were looked over and GPS readings taken. Two sites were selected based on their needs and the probability of having viable wind resources – Hoonah and Yakutat.

Hoonah: No wind resource data was available at Hoonah, but its location – with a 1,410 ft. ridge above the village made for an attractive site. Additionally, AT&T Wireless owns a 100 ft. Rohn tower on the ridge that provided an inexpensive way of installing anemometry at the site. The anemometry was installed in March 2005, and the first data successfully retrieved in September 2005. A report was prepared by meteorologist John Wade that contains the details of the measured wind resources and preliminary energy production projections. (Attachment A to this report.)

Yakutat: There was one existing anemometer tower that was not well sited and for which only scattered, unreliable data was available. Two additional sites were identified and instrumented with 30-meter NRG towers and anemometry. Additionally, the original site was retrofitted with modern NRG anemometry. Yakutat Power, the local utility, provided help with personnel and equipment. Data was also collated from an analog wind speed instrument used by the local airport. Data was collected for more than 12 months from the three NRG stations. An off-site reference station was identified and used to project long-term wind resource characteristics at the two stations. A report was prepared by meteorologist John Wade that contains the details of the measured wind resources and energy production projections. (Attachment B to this report.) A preliminary financial analysis of a hypothetical wind power station was prepared and used to gauge the economic viability of installation of a multi-megawatt wind power station.

Small Hydroelectric

The study focused on the communities associated with Sealaska Corporation that use diesel-electric for electricity and have a potential for hydroelectric power generation[1]. Most of them have had at least an assessment of hydroelectric potential, and a few have had feasibility studies of potential hydroelectric projects. The communities, their existing utilities, and identified potential hydroelectric projects are shown in the following table.

Sealaska-Affiliated Communities with Hydroelectric Potential

Community	Existing Utility	Potential Hydroelectric Projects
Angoon	Inside Passage Electric Cooperative (IPEC)(1)	Thayer Creek
Hoonah	IPEC	• Gartina Creek • Water Supply Creek
Hydaburg	Alaska Power & Telephone	Reynolds Creek
Kake	IPEC	Cathedral Falls Creek
Klukwan	IPEC	Walker Lake
Yakutat	Yakutat Power	Chicago Harbor

(1) Previously known as Tlingit-Haida Regional Electric Association

Findings and Conclusions

Wind Energy

Although there are several known windy spots in SE Alaska (e.g., Skagway), we were not able to identify any isolated Native American villages that utilize diesel-electric power generation that have commercially viable wind resources. The two sites that were judged to have the best potential were Yakutat and Hoonah, but as shown below, neither site has commercially viable wind resources.

Hoonah - The average wind resources measured on the 1,417 ft elevation ridge above the village were very low, with a six-month average of 3.9 mps (8.7 mph) at 60 meters above ground level. The annual average wind speed is estimated at 4 mps (9 mph). Using today's commercial utility-grade wind turbines' performance and costs, yields an annual capacity factor of less than 10%

[1] The complete study is contained in Attachment C to this report.

and a cost of energy of approximately 26¢ per kWh. Hoonah is not a commercially viable site for wind powered energy generation without very substantial grant funding.

Yakutat - The average wind resources measured at three sites were very marginal, with an annual average of 4.0 mps (9 mph) at 60 meters above ground level. The best site had an annual average of 4.2 mps (9.4 mph) at 60 meters. Using today's commercial utility-grade wind turbines' performance and costs yields an annual net capacity factor of approximately 12% and a cost of energy of approximately 19¢ per kWh. Unless grant funds were available, the Yakutat site is not commercially viable for wind power at this time.

The following tables show the necessary grant funding and low-cost financing that would be required to justify wind power projects at Hoonah and Yakutat. A fixed charge rate of 9% represents 5% financing, since 4% of the rate is required to amortize the plant. Conventional financing is represented by a 14% fixed charge rate.

Impact of Low-cost financing and/or Grant Funds Applied to Hoonah

Fixed charge rate	Cost of Energy ($/kWh)					
	No Grant Financing	With Grant (% of total capital cost)				
		10%	20%	30%	40%	50%
9%	0.26	0.23	0.21	0.19	0.17	0.15
10%	0.27	0.25	0.23	0.20	0.18	0.16
11%	0.29	0.27	0.24	0.22	0.19	0.16
12%	0.31	0.28	0.26	0.23	0.20	0.17
13%	0.33	0.30	0.27	0.24	0.21	0.18
14%	0.35	0.32	0.29	0.26	0.22	0.19

Impact of Low-cost financing and/or Grant Funds Applied to Yakutat

Fixed charge rate	Cost of Energy ($/kWh)					
	No Grant Financing	With Grant (% of total capital cost)				
		10%	20%	30%	40%	50%
9%	0.19	0.17	0.16	0.14	0.13	0.11
10%	0.20	0.19	0.17	0.15	0.13	0.12
11%	0.22	0.20	0.18	0.16	0.14	0.12
12%	0.23	0.21	0.19	0.17	0.15	0.13
13%	0.25	0.22	0.20	0.18	0.16	0.14
14%	0.26	0.24	0.21	0.19	0.17	0.14

Small Hydroelectric Power

None of the sites examined are financially viable without substantial grant funding. The following table contains a summary of the feasibility of new hydroelectric projects that could serve the communities.

Community	Project	Construction Cost ($2003)	Economic Feasibility	Environmental Feasibility
Angoon	Thayer Creek (1,000 kW)	$8,700,000	Low	Moderate
Hoonah	Gartina Creek (600 kW) Water Supply Creek (600 kW)	$3,750,000 $3,330,000	Moderate Moderate	Moderate High
Hydaburg	Reynolds Creek (5,000 kW)	$9,400,000	Low	High
Kake	Cathedral Falls Creek (800 kW)	$5,300,000	Moderate	Moderate
Klukwan	Walker Lake (1,900 kW)	$9,400,000	Low	Unknown
Yakutat	Chicago Harbor (1,400 kW)	$9,300,000	Moderate	Unknown

Interconnection to another utility is possible for most of these communities, and may be a viable alternative to either diesel or hydroelectric generation. The possible transmission interconnections to the communities are summarized in the following table.

Interconnection Potential Summary

Community	Interconnection Potential
Angoon	Low
Hoonah	Moderate
Hydaburg	High
Kake	Moderate
Klukwan	High
Yakutat	Very low

Combining the most important factors for the feasibility of new hydro facilities yields the following table.

Community	Project	Economic Feasibility	Environmental Feasibility	Interconnection Potential	Required Grant (% of Cost)
Angoon	Thayer Creek	Low	Moderate	Low	80%
Hoonah	Gartina Creek	Moderate	Moderate	Moderate	45%
	Water Supply Cr.	Moderate	High	Moderate	40%
Hydaburg	Reynolds Creek	Low	High	High	100%
Kake	Cathedral Falls Cr.	Moderate	Moderate	Moderate	55%
Klukwan	Walker Lake	Low	Unknown	High	80%
Yakutat	Chicago Harbor	Moderate	Unknown	Very low	55%

(red)	Negative factor
(yellow)	Neutral factor
(green)	Positive Factor

Hoonah, Kake, and Yakutat appear to have the best potential for new hydro facilities. However, it should be noted that very little work has been done on the Yakutat site, and further fieldwork may result in changes to the assessment.

This final report was prepared by Springtyme Company L.L.C. (Bob Lynette) and is based on the team's collective field trip reports, meteorological data, analyses, and discussion/meeting notes with team members and others as cited herein.

1.0 Project Overview

1.1 Project Purpose and Long-Term Objectives

The objective of this project is to determine if there is a potential for wind energy and/or small hydroelectric energy projects within one or more tribal villages in SE Alaska. The long-term objective is to supply all or a portion of village electricity from local, renewable energy sources in order to reduce costs, provide local employment, and reduce power outages. A business plan will be prepared if one or more of the sites has economically viable renewable resources.

This final report was prepared by Springtyme Company L.L.C. (Bob Lynette) and is based on the team's collective work.

1.2 Background

1.2.1 Sealaska Corporation and Candidate Sites

Sealaska was formed as the Regional Native Corporation for Southeast Alaska under the Alaska Native Claims Settlement Act (ANCSA), passed by Congress in 1971. Headquartered in Juneau, Alaska, it is the largest private property owner in Southeast Alaska. Sealaska includes 12 village/urban corporations and represents nearly 17,500 shareholders, approximately half of whom live in Southeast Alaska. The economies of rural Southeast Alaska communities are built on a complex mix of employment and income from government, the timber industry, the seafood industry, income from transfer payments (payments from governments to individuals), community service organizations, and other sources of income for residents. The early part of this study (prescreening sites) included all native corporations, native landholdings near villages, and other sites that Sealaska believed could be acquired by Sealaska.

Location, Size, and Power Generation – Figure 1 shows the location of Sealaska's landholdings, village corporations and towns. The smaller villages are isolated in forested lands and are reachable only by floatplane, boat or barges. Table 1 summarizes the power generation facilities in SE Alaska and Table 1A summarizes the early information for all of the sites that were analyzed in order to identify sites that might be attractive for renewable energy applications. Twenty-three sites were prescreened.

1.2.2 Project Team

Sealaska Corporation: Project Coordinator – Michele Metz, Assistant Lands Manager, Natural Resources Department
Technical Coordinator and wind energy consultant: Springtyme Company L.L.C., Bob Lynette
Wildlife: Northwest Wildlife Consultants, Inc., Karen Kronner
Meteorologist: John Wade Wind Consultants, John Wade
Anemometry Installation: Met Tower Services, Mike Sailor, Chris Sailor, Jeff Baker
Micro/Small Hydroelectric Power: Alaska Power & Telephone, Larry Coupe
US Department of Energy: Larry Flowers (DOE Monitor)

Figure 1: Location of the Sealaska Land Holdings and ANCSA Ownership

Table 1, Existing Resources

Project Name / Location	Fuel Type	Installed Capacity
Alaska Electric Light & Power Company		
Annex Creek	Hydroelectric	3,600 KW
Auke Bay	Diesel Gas Turbine	2,500 KW 24,300 KW
Gold Creek	Hydroelectric Diesel	1,800 KW 7,300 KW
Lemon Creek	Diesel Gas Turbine	22,500 KW 35,000 KW
Salmon Creek No. I	Hydroelectric	5,000 KW
Alaska Power Administration		
Snettisham / Crater Lake	Hydroelectric	78,210 kW
Alaska Power & Telephone Company		
Dewey Lake / Skagway	Hydroelectric	975 KW
Goat Lake / Skagway	Hydroelectric	4,000 KW
Diesel / Skagway	(proposed)	3,365 KW
Black Bear/ Craig	Hydroelectric	4,500 KW
Diesel / Craig	Diesel	3,320 KW
Haines	Diesel	5,770 KW
Hydaburg	Diesel	1,001 KW
Hopis	Diesel	150 KW
Ketchikan Public Utilities		
S. W. Bailey	Diesel	13,450 KW
Beaver Falls	Hydroelectric	7,300 KW
Ketchikan Lakes	Hydroelectric	4,200 KW
Swan Lake/Revillagigedo Island (State-Owned)	Hydroelectric	22,500 KW
Totem Bight / Ketchikan	Diesel	2,000 KW
Metlakatla Power & Light		
Purple Lake	Hydroelectric	3,900 KW
Centennial	Diesel	3,300 KW
Chester Lake	Hydroelectric	1,000 KW
Petersburg Municipal Power & Light		
Mind Slough	Hydroelectric	2,200 KW
Petersburg Generation Plant	Diesel	7,650 KW
Tyee (State Owned)	Hydroelectric	20,000 KW
City and Borough of Sitka		
Blue Lake	Hydroelectric	6,000 KW
Green Lake	Hydroelectric	18,000 KW
Indian River	Diesel	7,500 KW
Thorne Bay		
Thorne Bay Plant	Diesel	1,235 kW
Tlingit-Haida Regional Electric Authority		
5 Small Plants (17 units) Diesel	Diesel	6,067 kW
Wrangell Electric Department		
Wrangell Municipal Plant	Diesel	8,350 kW

[1] Southeast Alaska Electric Intertie System Plan Report #97-01, Acres International Corporation, January 1, 1998

Table 1A, Summary of all Sites

Community	Popula-tion	Location	Current Utility	Primary Generation	Identified Potential
Angoon	572	Admiralty Island	T-HREA	Diesel	Hydro, intertie
Craig	1,397	Prince of Wales Island	AP&T	Hydro	Hydro, intertie
Elfin Cove	32	Chichagof Island	ECEU	Diesel	Hydro
Gustavus	429	Near Glacier Bay	GEC	Diesel	Hydro
Haines	1,811	Lynn Canal	AP&T	Hydro	Hydro, intertie
Hoonah	860	Chichagof Island	T-HREA	Diesel	Hydro, intertie
Hydaburg	382	Prince of Wales Island	AP&T	Diesel	Hydro, intertie
Hyder	97	Portland Canal	TP&L	Diesel	
Juneau	30,903	Mainland	AEL&P	Hydro	Hydro, intertie
Kake	710	Kupreanof Island	T-HREA	Diesel	Hydro, intertie
Kasaan	39	Prince of Wales Island	AP&T	Hydro	
Ketchikan	14,070	Revillagigedo Island	KPU	Hydro	Intertie
Klawock	854	Prince of Wales Island	AP&T	Hydro	Hydro, intertie
Klukwan	139	Near Haines	T-HREA	Diesel	Hydro, intertie
Metlakatla	1,375	Annette Island	MP&L	Hydro	Intertie
Pelican	163	Chichagof Island	PUC	Hydro, diesel	
Petersburg	3,224	Mitkof Island	PMP&L	Hydro	Intertie
Saxman	431	Near Ketchikan	KPU	Hydro	Hydro
Sitka	8,835	Baranof Island	Sitka	Hydro	Intertie
Skagway	862	Lynn Canal	AP&T	Hydro	Hydro, intertie
Tenakee Sp.	104	Chichagof Island	TSEU	Diesel	Intertie
Wrangell	2,308	Wrangell Island	WML&P	Hydro	Intertie
Yakutat	808	Mainland	Yakutat	Diesel	Hydro

These locations were specifically included in the DOE Statement of Work.

1.2.2 Power Generation and Transmission Situation in SE Alaska

SE Alaska settlements and commercial activities are spread over a large and varied area. The primary sources of electricity are hydropower and diesel generators. Hydropower supplies approximately 700,000 MWh annually, and diesel supplies approximately 120,000 MWh. Increases in demand are projected at approximately 5% annually, with much lower increases projected for the small villages. The cost of energy for diesel varies from 18¢ per kWh to 28¢ per kWh, depending on fuel prices. The cost of energy for hydroelectric for existing plants is approximately 65 – 6.5¢ per kWh, and generation costs from new plants are expected to cost approximately 10-11¢ per kWh. None of these costs include transmission and distribution costs.

A number of the generation facilities are tied to several communities over transmission interties. Figure 2 shows the existing and projected transmission interties. Governmental agencies and communities would like to expand the interties to reach more outlying communities. The expanded intertie system would cost over $330 million and take approximately 25 years to complete, assuming that current plans and schedules are met.

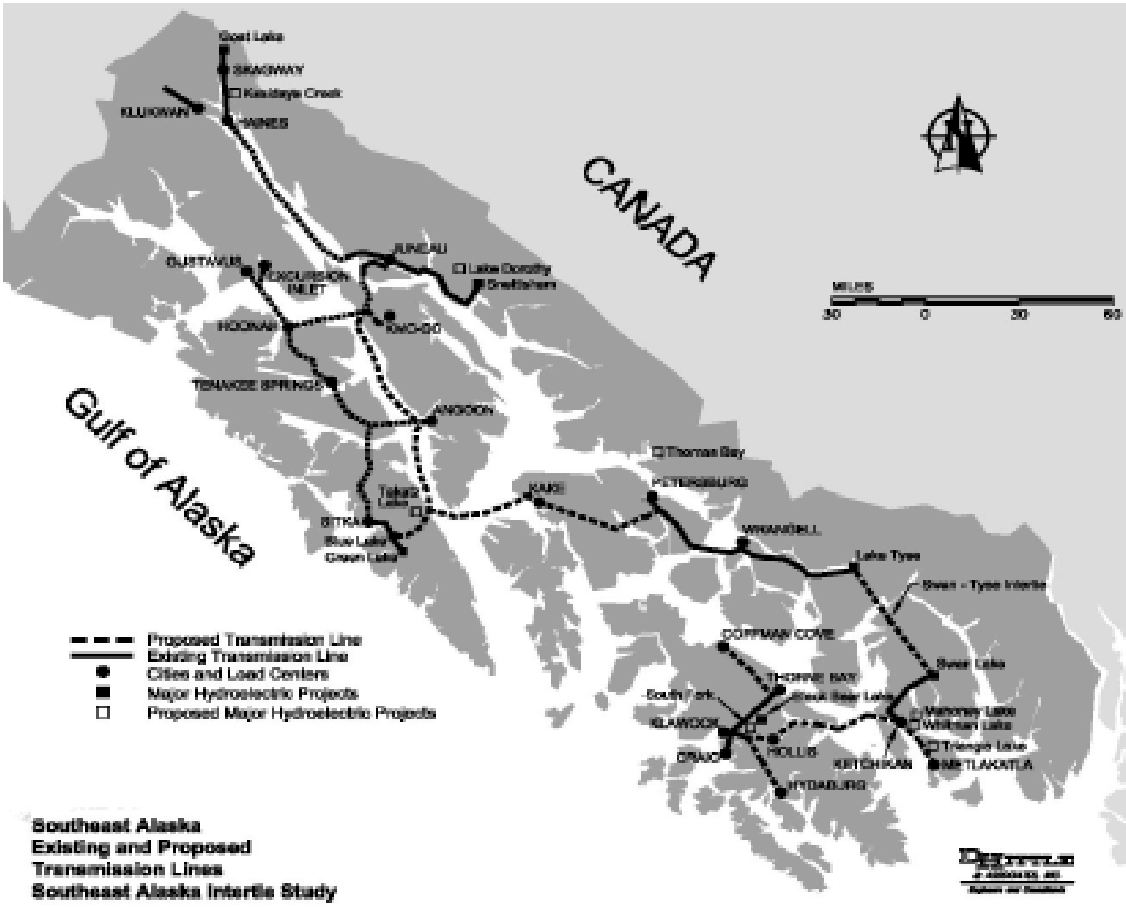


Figure 2, Existing and Proposed Transmission Interties

Some of these interties are currently being built, others are planned, and some may not be authorized.

1.2.3 Wind Energy Feasibility Study

The project work consisted of:

1. Creation of a database of all potential sites, including demographics, current power supply generation plants, planned new generation or intertie facilities, interests of the local communities, probability of viable wind energy resources based on macro information and anecdotal information, environmentally sensitive areas/wildlife, and the logistics of installing anemometry and wind turbines.

2. Analyses of the candidate sites to identify those with the best potential for wind energy generation.

3. Field surveys to the most promising sites.

4. Training for tribal members about wind energy - wind resource measurement, wind power plant characteristics, impacts, costs, and benefits.

5. Installation of anemometry and measurement of the wind resources at two of the sites.

6. Analysis of the wind resource data to determine wind speeds, wind directions, turbulence intensity, potential array losses, and energy generation to help determine the viability of wind power for the reservation.

7. Analysis of the economic viability of a wind power station at the sites.

8. If the analyses yield positive results, and Sealaska approves, preparation of a business plan that discusses the development considerations, costs, and potential funding sources for proceeding with a wind power project.

1.2.4 Micro/Small Hydroelectric Power Feasibility Study

The purpose of this study was to update previous studies on hydroelectric projects for the communities that currently rely on diesel generation for most of their power supply. The communities considered are those for which Sealaska Corporation is designated as the Regional Corporation.

The project work consisted of:

1. Collect previous feasibility reports

2. Review the previous reports and evaluate whether new technology or construction methods could result in cost savings.

3. Update the economic assessments.

4. Conduct a preliminary environmental assessment to determine if there are major issues that would likely preclude development.

5. Conduct a regulatory assessment to determine and describe the regulatory processes that would need to be completed.

6. Preparation of a final report for inclusion in this project report.

2.0 Wind Energy Pre-development Activities and Results

This section describes the activities associated with determining the viability of developing and operating one or more wind power stations on Native American lands in SE Alaska.

2.1 Identification of Anemometry Sites and Equipment Installation

An extensive database was assembled for all of the candidate sites in SE Alaska, including location, demographics, topographical maps, electricity supply type and load, existing and planned transmission interties with more central generation, planned hydroelectric plants, macro wind data, and contact personnel. Section 1 contained the list of the potential sites and their locations.

Pre-field work analyses – The 23 sites in the database were analyzed to eliminate sites that were not likely candidates. Twelve of the sites were eliminated at the onset because they use hydropower for all or a major portion of their power generation. To further narrow the search, discussions were held via email and telecoms with the Alaska Energy Authority, Sealaska, tribal members, village staff, public and private power companies and wildlife agency personnel. This provided an understanding of the conditions at the remaining sites. Criteria used to evaluate the remaining sites were: (1) schedule if any, for bringing a transmission intertie to candidate sites, (2) current and projected population and commercial activities (e.g., contracting fish processing plants, expanded activities due to tourism), (3) topography and logistics for installing wind turbines, (4) interests within the villages/towns for installing and operating a wind power facility, (5) wildlife information that might preclude deploying wind turbines, (6) macro wind data from weather stations and airports, (7) the probability of viable winds based on topography, and (8) anecdotal information. Based on these criteria, five villages were selected for site visits. Table 2 contains the results of these analyses.

Meetings with cognizant personnel and field analyses – A field trip was conducted to these sites during July 8 through July 18, 2003. The team consisted of Bob Lynette - technical manager, John Wade - meteorologist, Karen Kronner – wildlife biologist, and Larry Flowers - DOE monitor and an expert in wind-diesel hybrid energy systems. Meetings were held with local village and utility leaders and the requirements, costs, and benefits of having local renewable energy facilities were discussed. The vegetation and topography for potential anemometer towers were noted and GPS readings were taken. Several of the sites did not have enough room for wind power applications without posing a noise and/or safety problem, and the vegetation at several of the sites indicated insufficient wind resources.

Following is a summary of the sites and subsequent actions.

Angoon

Angoon, a Tlingit community, is situated in the Chatham Strait, which is a north-south oriented stretch of water in South East Alaska's inside passage. It is the only permanent settlement on Admiralty Island, located on the southwest coast at Kootznahoo Inlet. Angoon is 55 miles southwest of Juneau and 41 miles northeast of Sitka. Its coordinates are 57.50333° N

Table 2, Selection Results for Identifying Potential Sites

Community	Population	Location	Primary Generation	Decision Criteria
Angoon	572	Admiralty Island	Diesel	
Craig	1,397	Prince of Wales Island	Hydro, diesel	
Elfin Cove	32	Chichagof Island	Diesel	
Gustavus	429	Near Glacier Bay	Diesel	
Haines	1,811	Lynn Canal	Hydro	
Hoonah	860	Chichagof Island	Diesel	
Hydaburg	382	Prince of Wales Island	Diesel	
Hyder	97	Portland Canal	Diesel	
Juneau	30,903	Mainland	Hydro	
Kake	710	Kupreanof Island	Diesel	
Kasaan	39	Prince of Wales Island	Hydro	
Ketchikan	14,070	Revillagigedo Island	Hydro	
Klawock	854	Prince of Wales Island	Hydro	
Klukwan	139	Near Haines	Diesel	
Metlakatla	1,375	Annette Island	Hydro	
Pelican	163	Chichagof Island	Hydro, diesel	
Petersburg	3,224	Mitkof Island	Hydro	
Saxman	431	Near Ketchikan	Hydro	
Sitka	8,835	Baranof Island	Hydro	
Skagway	862	Lynn Canal	Hydro	
Tenakee Springs	104	Chichagof Island	Diesel	
Wrangell	2,308	Wrangell Island	Hydro	
Yakutat	808	Mainland	Diesel	

These locations were specifically included in the DOE SOW.
Eliminated - does not use diesel as primary generation source.
Eliminated - hydropower or intertie expected within next 10 years.
Eliminated - low population or extremely difficult logistics.
Eliminated - very low probability of sufficient wind resources.
Selected for site visit.

Latitude and -134.58389° W Longitude. (Sec. 25, T050S, R067E, Copper River Meridian.) The area encompasses 22.5 square miles of land and 16.1 square miles of water. A photo of the area is shown in Figure 3 and a map in Figure 4. Three possible locations for meteorological towers were examined, but there was no evidence of sufficient wind in this area, other than at Danger Reef. The potential met tower sites are shown by a red marker in Figure 4. If a met tower were to be placed at Danger Reef, it would be sited as shown on the map in Figure 4. But upon further evaluation, it was decided that the Danger Reef area is inappropriate because accessibility is difficult, there are potential wildlife conflicts, and it is upwind of a seaplane landing area.

Angoon was dropped from further consideration for a Windpower station.

Figure 3, Aerial Picture of Angoon

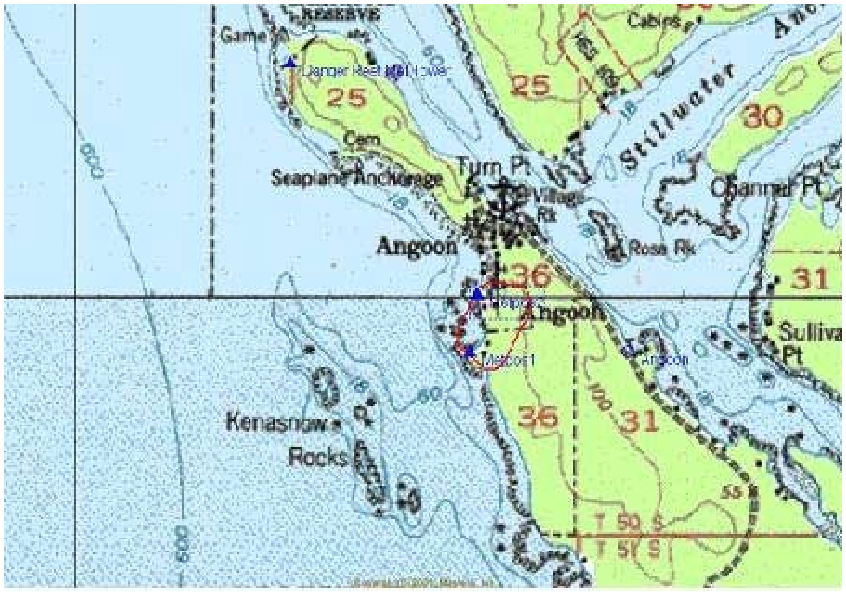


Figure 4, Map of Angoon with Potential Met Tower Sites

Gustavus

Gustavus lies on the north shore of Icy Passage at the mouth of the Salmon River, 48 air miles northwest of Juneau in the St. Elias Mountains. It lies at the entrance to Glacier Bay National Park and Preserve, adjacent to Parkland. Its coordinates are 58.41333° North Latitude and -135.73694° West Longitude. Gustavus has a seasonal economy; the lodge and park, located northwest of Gustavus, attract a number of tourists and recreation enthusiasts during summer months. Some commercial fishing occurs; 32 residents hold commercial fishing permits. An aerial view showing the location of Gustavus is shown in Figure 5. Glacier Bay is the series of inlets to the N-NW of Gustavus.

Gustavus has a State-owned airport with jet capability. Air traffic is relatively high during peak summer months, and several cruise ships include the Bay in their itinerary. Vegitative signs were discouraging as were discussions with residents. It was decided that there was little chance of viable winds, and permitting would be a major problem due to the airplane traffic. Further, it was subsequently learned that there was little chance of obtaining tribal ownership nearby. This site was dropped from further consideration.

Figure 5, Gustavus, Looking North

Tenakee Springs

Tenakee Springs is located on the east side of Chichagof Island, on the north shore of Tenakee Inlet and has an ideal NW-SE orientation. Southeast winds are predominant in this area. It lies 45 miles southwest of Juneau, and 50 miles northeast of Sitka at approximately 57.78083° N

Latitude and -135.21889° W Longitude. The area encompasses 13.8 square miles of land and 5.3 square miles of water. Tenakee Springs is primarily a retirement community, though commercial fishing is an important source of income. Eighteen residents hold commercial fishing permits. While fish processing had historically been a mainstay of its economy, tourism is becoming increasingly important. The City and Store are the only local employers.

Figure 6 shows the village looking to the north.

Figure 6, Tenakee Springs Looking North

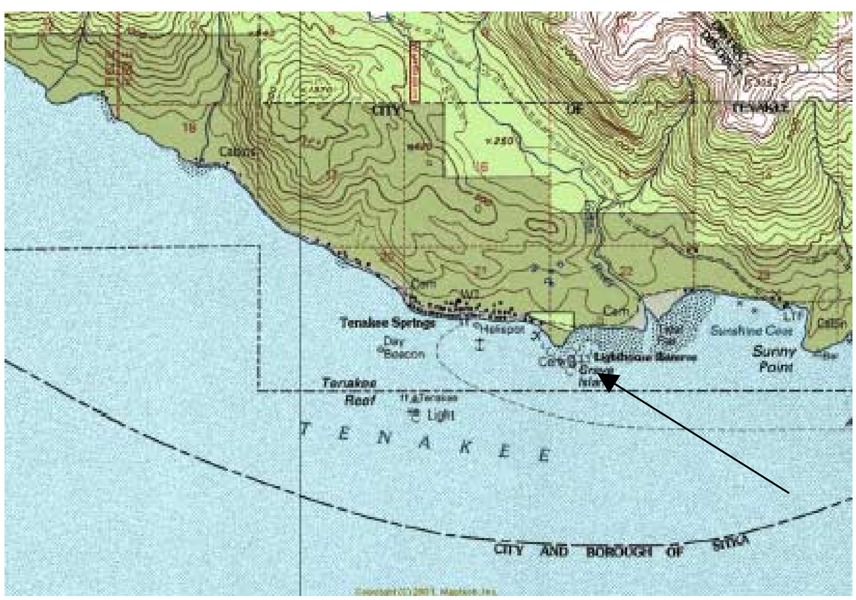


Figure 7, Tenakee Springs Topographical Map

This area, with the exception of the point north of Grave Island, does not have any evidence of a good wind resource (see arrow in Figure 7). However there is no room for turbines at this location. Tenakee Springs was dropped from further consideration.

Hoonah

Hoonah is a Tlingit community located on the northeast shore of Chichagof Island, 40 air miles west of Juneau. It coordinates are 58.11° N Latitude and -135.44361° W Longitude. The area encompasses 6.6 square miles of land and 2.1 square miles of water. Hoonah is located in Icy Straight which is oriented SE-NW, an ideal orientation for the prevailing winds. Fishing, logging and local government are mainstays of the economy. One hundred and seventeen residents hold commercial fishing permits. Sealaska Timber Corporation employs 130 area residents through subcontracts and the Huna Totem Corp. owns a sort yard and timber transfer facility. The City and School District are significant public-sector employers. Subsistence activities are important component of the lifestyle. Salmon, halibut, shellfish, deer, waterfowl and berries are harvested. Figure 8 shows the village looking NE. Note the ridge above the village.

Hoonah has a diesel generation capacity of 2,445 kW and the load is approximately 4,500 MWh per year.

Figure 8, Hoonah Village Looking NE

The project team met with the Hoonah Mayor and staff, looked at the vegetation, terrain, and identified three potential sites:

- An “in-town” site that was strongly endorsed by the mayor,

- A site near a landfill about 1/3rd of the way up the ridge, and
- A site at the top of the ridge (White Alice site)

The "in-town" site was marked and GPS readings taken. This site was subsequently rejected by the City Council. The landfill site is a relatively low saddleback west of Spasky Bay. It is not well oriented with respect to the prevailing winds and the airport just to the west in the center of Spasky Pass, indicates light winds from a variety of wind directions. This site was rejected because of the low winds. The third site – White Alice is on a 1,410 ft. ridge above the village, and hence became the favored site. Figure 9 shows why the ridge appeared attractive. Figure 10 shows the topography and the locations for the "in-town" and White Alice sites.

Figure 9, Ridge above Hoonah

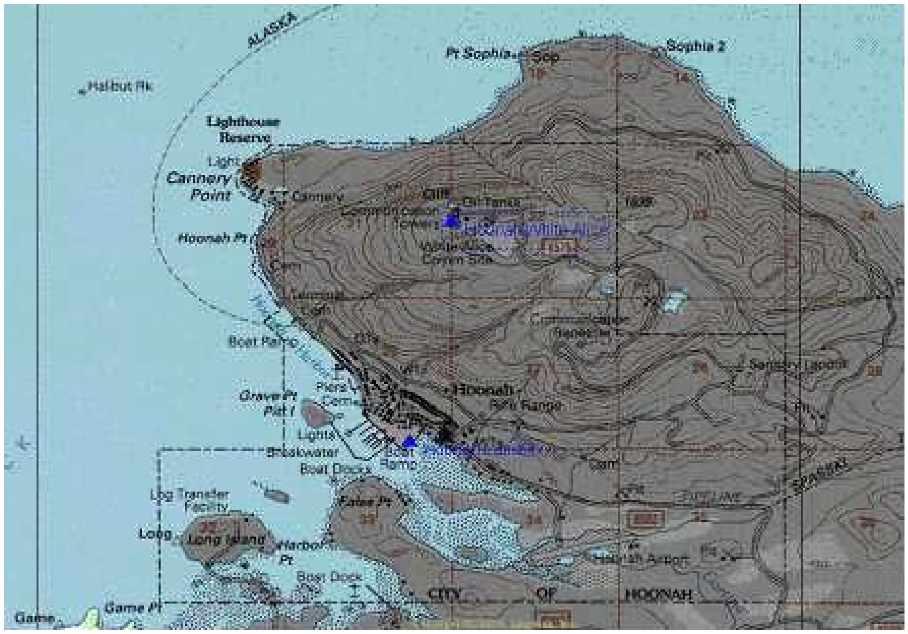


Figure 10, Hoonah Topography and Potential Anemometry Sites (in Blue)

An existing 100-foot Rohn tower was located at the top of the ridge – owned by AT&T Wireless. They agreed to install our anemometry on the tower, but gaining their permission required more than 16 months of coordination, with the need to provide electrical and mechanical drawings and loads. The anemometry was finally installed in March 2005, and the first data successfully retrieved in September 2005. A report was prepared by meteorologist John Wade that contains the details of the measured wind resources and preliminary energy production projections. (Attachment A to this report.) The results and the implications for developing wind power at Hoonah are discussed later in this section.

Yakutat

Yakutat is isolated among the lowlands along the Gulf of Alaska, 225 miles northwest of Juneau and 220 miles southeast of Cordova. It is at the mouth of Yakutat Bay, one of the few refuges for vessels along this stretch of coast. The Hubbard and Malaspina Glaciers are nearby. It coordinates are 59.54694° N Latitude and -139.72722° W Longitude. The area encompasses 7,650.5 sq. miles of land and 1,808.8 sq. miles of water. Yakutat's economy is dependent on fishing, fish processing and government. One hundred and sixty residents hold commercial fishing permits. A cold storage plant is the major private employer. Recreational fishing opportunities, both saltwater and freshwater fishing in the Situk River, are world-class. Alaska Airlines provides daily jet service to Yakutat. Snows come early – in November, and leave in May. Figure 11 shows an aerial view of Yakutat. As can be seen, Yakutat is surrounded to the north, east, and south by high mountains. Yakutat Power operates 2,880 kW of diesel generators and has an annual load of approximately 6,000 MWh.

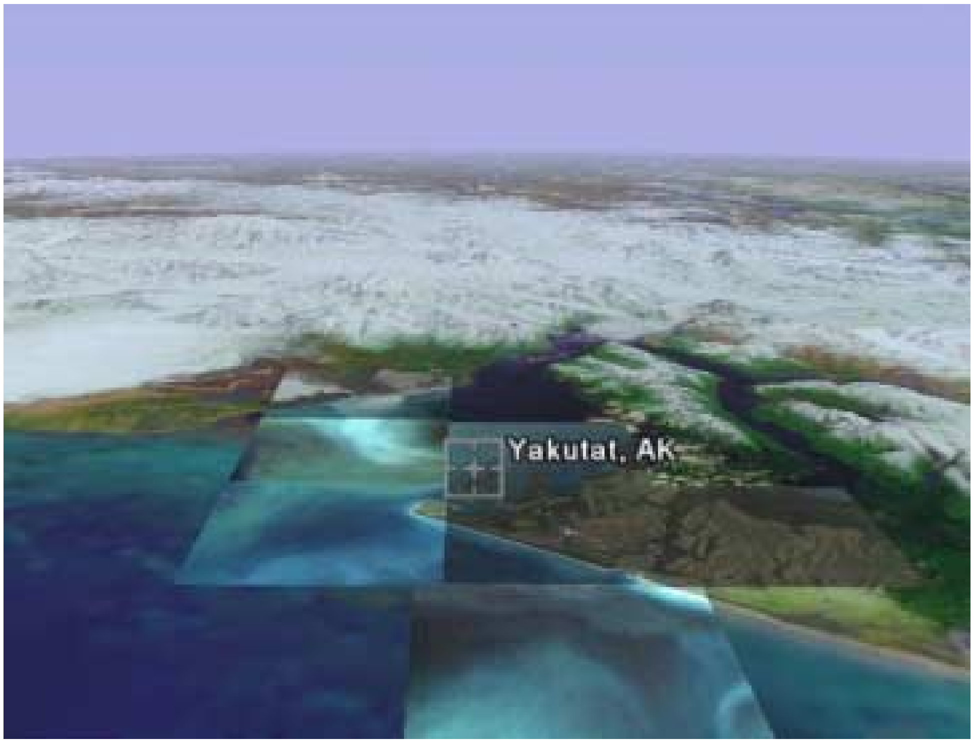


Figure 11, Aerial View of Yakutat Looking North

There were two sources of existing wind data at Yakutat. The Alaska Energy Commission has had a met tower on the beach northwest of the airport and the National Oceanic and Atmospheric Administration maintains an automatic met station shown as YakNOAA on the map below. In addition, twice a day data is collected by Rawindsonde balloons of winds at various heights up to nearly 20 kilometers above the earth. An energy rose is presented for winds just over 2,000 feet above the surface of Yakutat. Figure 12 shows that the strongest winds are coming off the mountains to the east and flowing offshore toward low pressure in the Gulf of Alaska. On shore winds from the ocean do not appear to be significant. Our meteorologist believed that the wind coming down Disenchantment Bay into Yakutat Bay from the northeast could be fairly strong winds on the tribal lands on the Phipps Peninsula. Yakutat was strongly recommended by the Alaska Power Authority as one of the more promising sites for wind energy.

The team flew into Yakutat on July 17, 2003. After reviewing potential sites, discussions with Yakutat Power (Scott Newlun), Alaska Energy Commission personnel (current person is Reuben Loewen), and other cognizant personnel, it was decided that two new 30-meter met towers should be installed and the existing met tower retrofitted with modern equipment. All three towers would have two levels of anemometry so we could measure the wind shear. The sites were flagged and GPS readings taken to assist with the subsequent installation.

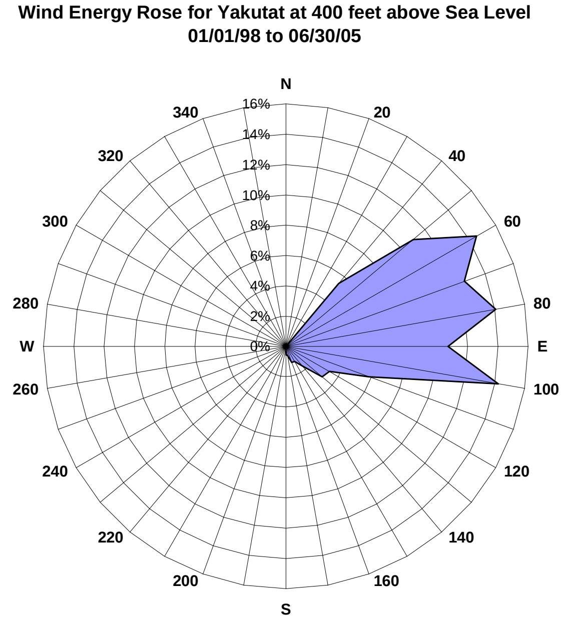


Figure 12, Distribution of Energy Producing Winds 400 feet above the Surface at Yakutat

The installation of the met towers at Yakutat was completed in July 2004. Figures 13 shows the locations and pictures of the installations. Earlier coordination by our wildlife biologist Karen Kronner, revealed that there might be a species of plant – the Moonwart Fern, that was becoming a candidate for "Threatened" status under the Endangered Species Act. Our crew searched the area prior to erecting the met tower at the beach location and identified the plant, marked its perimeter, and avoided the area. (Figures 14 and 15) We also used bird diverters on the guy wires and installed signs informing villagers and others about the anemometry. (Figure 16) Unfortunately, one of the data loggers was destroyed by gunfire before we could have the signs made up and installed. We replaced the data logger and there were no further incidents. Data collection was nearly 100% at all three sites during the remaining data collection period.

Figure 13, Locations of New and Existing Met Towers

Figure 14, Avoiding the Moonwart Fern

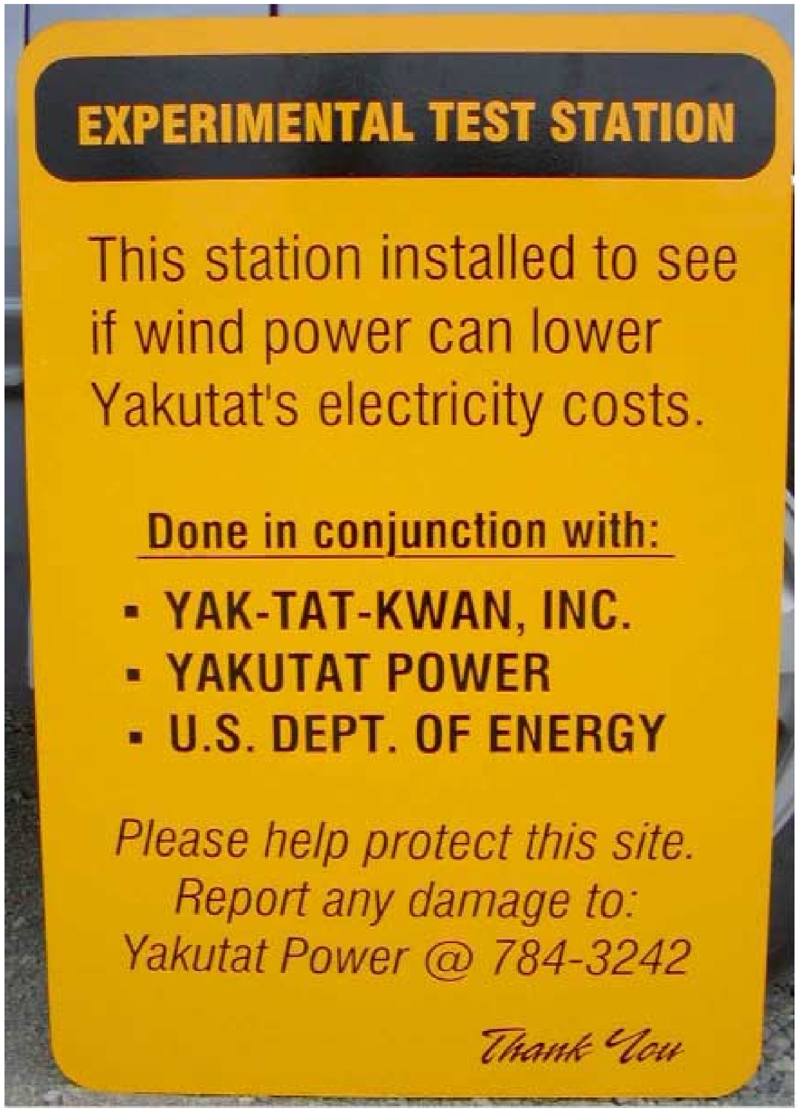


Figure 15, Signs Placed at Sites

A report was prepared by meteorologist John Wade that contains the details of the measured wind resources and energy production projections. (Attachment B to this report.) The results and the implications for developing wind power at Yakutat are discussed later in this section.

2.3 Description of the Anemometry

Hoonah – The anemometry is mounted on a Rohn tower owned by AT&T Wireless. The tower is instrumented at 20 and 30 meters. Sensors used for measuring wind speed are Maximum 40 cup anemometers with protective terminal boots. Wind direction is measured with a 200P-wind direction sensor. The tower is well grounded. All sensors are connected to the logger with shielded 20-gauge cable.

The Maximum cup anemometer on each revolution generates two sine wave cycles that are linearly proportional to the wind speed. Anemometer voltage varies between 0.5 and 6 volts VAC. The transfer constant to convert the Maximum 40P output to wind speed is a multiplier of 1.711 with a 0.78 mph offset.

The site is equipped with a NRG Symphonie Data Logger with a non-volatile industry standard FLASH Multi Media Card (MMC). The card is mailed to John Wade to be read from a USB port. A 5-watt photovoltaic panel powers the sensors and loggers. A terminal reader is supplied to program the logger on-site and view data. NRG supplies software for converting data on the FLASH cards to engineering units, QA/QC programs, and standard statistical summaries.

2.4 Wildlife considerations

Karen Kronner of Northwest Wildlife Consultants, Inc. provided the wildlife expertise for the team. Her complete report is contained in Appendix C.

Efforts were made from the onset of the program to locate the anemometry (and possible future wind turbines) in areas that would minimize potential avian impacts. Several sources were used to obtain existing information on the avian use or other wildlife of the villages and nearby surrounding area. Agency biologists, wildlife professionals with experience in the area, and local bird enthusiasts typically have the local knowledge and experience with birds inhabiting and migrating through the local environment.

Based on these pre-field reviews, it became apparent that bald eagles (nesting or foraging concentrations), migrating birds (all groups), wintering waterfowl, nesting goshawks, and bats could be the biological resources to consider when selecting sites for wind turbine siting. In addition, guy wires on meteorological towers in some areas may be problematic if large concentrations of birds are nearby (potential avian collision with the wires in flight paths).

Based on agency comment and a review of the USFWS Threatened and Endangered System database, there are no known federal or state threatened or endangered wildlife species commonly found in the areas being investigated for Sealaska Corporation. Bald eagles are protected under the Bald Eagle Protection Act. Alaska Species of Special Concern potentially occurring as breeders or migrants in southeast Alaska are American peregrine falcon and the northern (Queen Charlotte) goshawk. In southeast Alaska the peregrine falcon nests on cliffs along rivers or near lakes and the goshawk nests in old growth and mature forests. Large concentrations of shorebirds migrate along the coast. Table 3 summarizes the information from local SE Alaska wildlife personnel. The following provides site-specific documentation of the potential biological (avian or other) concerns noted during the July 2003 field trip for the locations selected for studying the wind resources with met towers. The complete report (Appendix C) includes comments on those sites that were not selected for further wind resource analyses.

Hoonah – White Alice site.

The habitat is coniferous forest (hemlock) with periodic openings created by timber harvest and other human disturbances. Some openings are approximately six to seven acres are

Table 3, Pre-field Notes Provided to NWC from Area Specialists

Location	Notes from USFWS Mike Jacobson	Bird notes from R. Day, ABR
Angoon	Area has bald eagle nests. Mitchell Bay is premier spot in SE AK for waterfowl, gulls, and shorebirds because there is dense schooling of fish to feed on.	Complex shorelines and protected waters suggest that this area may be important to wintering seabirds and waterfowl.
Hoonah	Bald eagles abundant. Good roads, active logging.	Nearby Icy Strait is important foraging area for seabirds in summer, substantial number of wintering waterfowl (and probably seabirds) in Port Frederick.
Tenakee Springs	Waterbirds in bays, good eagle population. Good wind potential.	Simple shoreline by town suggests that the area may not be important for wintering seabirds or waterfowl.
Yakutat	Major bird migration of all birds (they move along the coast). Wind probably good.	Major bird migration zone for along-coast movements. Kittlitz's Murrelets are in the bay, but unknown whether they fly in airspace where the windfarm will be.

currently shrubby habitat consisting of alder and young hemlock. Existing communication towers in the openings could provide supporting structure to place anemometry equipment, eliminating the need to do additional habitat clearing and eliminating the guy wire concern (see above). If the site has potential for wind turbine(s) it is possible they could be placed in areas that are already disturbed. Passerine breeding activity and migration and bat activity could be higher than at the landfill site. Low flying water birds may be at risk for collision with the turbines. If the site has sufficient wind for turbine(s), more site-specific data will be gathered from local expertise or by conducting focused studies.

Yakutat

Met Tower A (Point)

This location needs minimal vegetation clearing for placement of the met tower. Wind turbine(s) would require removal and control of low shrubs. Habitat alteration does not appear to be a concern at this site because the vegetation type is extensive and no unique features were noted. In general, the elevation of the point combined with the proximity of the land to the opening of the bay suggests birds of all groups may fly closer to the ground here compared to the beach met tower site where they are expected to be more dispersed. Birds orienting with the shoreline during local and long distance movements will be traveling over this point and along the beach. See other comments below from other individuals.

Met Tower B (Beach)

This wide, flat sandy beach is sparsely vegetated. It may serve as a resting spot for migrating shorebirds depending on the water levels (percent of exposed foraging flats) and weather extremes. However, shorebirds typically concentrate at other locations. There did not appear to be any unique landform except the beach itself that would indicate higher use by birds. Gulls of various species are known to rest on the beach. Approximately 2,000 gulls have been observed resting on the flat beach on one day. Bald eagles nest nearby but no nest locations were available from the resources contacted. See other notes below from other individuals.

Agency Comments

U.S. Fish and Wildlife Service

Mike Jacobson, *USFWS*, was contacted on August 7 after the July field trip. He was briefed on the results of the field trip. It was explained that if a wind site is located, there may be 1-5 turbines but we would need to test the wind for a year. He did not have any special concerns for each location although was pleased that we would mark the guy wires so they would be more visible to birds.

Hoonah

Based on the species of wintering waterfowl near the selected Hoonah met tower location at the fill site, he did not expect waterfowl to be a concern for the met tower. He would like to see the turbine specifications when available but noted that waterfowl may not be a concern but would need to look at it closer if we decide to go forward. He was pleased that we had selected a disturbed site so other issues such as habitat impacts, etc. would be eliminated. He noted that the wintering ducks are mostly open water diving ducks and not shallow water ducks that may rest and forage on the grassy shoreline. He encouraged NWC to check with the local birders for additional local avian use information.

Yakutat

He was pleased that the team attempted to locate sites away from prominent points that migrating birds may concentrate near while moving into the bay or along the coastline. Bald eagle nesting and flight paths during nesting or concentrated roosting would be issues that need to consider for micro-siting wind turbines. When asked about gulls, he noted that they are protected under the Migratory Bird Treaty Act but some species have been increasing in SE AK and may not be too much of a concern. Others are somewhat unique regionally so their nest sites and concentrated use patterns may need to be reviewed.

2.5 Wind Resource Measurement, Analysis, and Results

The wind resource data was analyzed by John Wade, principal of John Wade Wind Consultants. The following information was taken and edited by the author from Mr. Wade’s final report, which is included as Appendix A and B of this report.

2.5.1 Data Collection, Data Recovery, and Analysis Criteria
Data is sent by email to Mr. Wade's office in Portland, Oregon. The Portland Oregon office is equipped with NRG data collection software and stores binary and ASCI data files for further analysis. The averaging interval of the data logger is 10-minutes, but the data analysis uses hourly data. The raw data remains in 10-minute intervals.

Data analysis consists of spreadsheets for computing the standard analyses routines for wind energy projects, including, diurnal wind speed patterns, monthly time series, speed frequency distributions, wind roses, turbulence, shear, and expected power output calculations at anemometer height and wind turbine hub heights.

2.5.2 Climatology
A climatological analysis is an important part of the wind resource validation study. Typically a wind resource assessment is conducted for a period of only one to two years prior to installing wind turbines. A general rule is that a year of data is sufficient to estimate the mean annual wind speed to within ±10% at the 90% confidence level. This means that the annual energy output may be off by 20 to 25%. To increase the confidence in the relatively short record of data at the candidate site, data at a nearby long-term reference site can be analyzed.

The approach in the climatological analysis is to select a nearby reference station with a long-term record that would provide information on annual and seasonal variation in the wind resource. A typical approach is to multiply the long-term site mean wind speed by the ratio of the candidate site to the long-term site.

2.5.3 Data Analysis and Results
Hoonah – Hoonah is tree covered and has very complex terrain. While it is only 45 miles east of the Gulf of Alaska, it is sheltered from storms in the Gulf by mountains to west and southwest that are up to 3,000 feet high. The proximity to the ocean moderates the temperatures and results in a mean annual temperature of about 45 degrees Fahrenheit with a range from the mid 20's to the high 50's.

Winds statistics for Juneau indicate very little seasonal variation being equally weak in every month. Strongest gusts occur in the winter months. Table 4 contains the White Alice location information and ancillary information.

Table 4, White Alice Site

Site Name: White Alice Site 5074 **Latitude**: 58° 7' 37.61'' N **Longitude:** 135° 25' 55.16" W **Map Datum:** WGS 84 **Elevation**: 1417 feet. **Terrain:** East-west ridgeline on island; **Roughness**: Sitka Spruce and Western Red Cedar. **Prevailing Wind Direction:** NE **Magnetic Declination**: 26.5 degrees East **Tower Height**: 30 meters **Sensor Levels**: 30 and 21 meters **Logger**: 5074

The annual air density for this area assuming a 60 meter hub height turbine, an average elevation of 430 meters and an annual temperature of 6 degrees Centigrade is 1.19 kg/m^3.

Data recovery was over 100% for the entire period of record from late April 2005 through the late September 2005 for the three sites.

Climatology **-** Typically a wind resource assessment is conducted for a period of only one to two years prior to installing wind turbines. A general rule is that a year of data is sufficient to estimate the mean annual wind speed to within ±10% at the 90% confidence level. This means that the annual energy output may be off by 20 to 25%. To increase the confidence in the relatively short record of data at the candidate site, data at a nearby long-term reference site can be analyzed.

The approach in the climatological analysis is to select a nearby reference station with a long-term record that would provide information on annual and seasonal variation in the wind resource. Table 5 shows that the winds during the sampling period at Juneau were generally lower (13%) than normal and the average for a six-month period sampled is about 97% of the annual wind speed.

Data Analysis **-** Table 6 and Figures 16 and 17summarize the important statistics measured to date. In addition to measured average speed, wind direction, temperature and extreme wind speed, other statistics derived measurements such as shear, turbulence, and 60-meter wind speeds. The data was corrected for departures from normal for each month and the six-month period was normalized to a year.

Table 6 shows that even winds extrapolated to 60 meters using the very high shear values measured at this site are not strong. The high shear and turbulence intensity do not mean that this site is one of the most turbulent sites on earth, they merely reflect the low wind speeds and the large impact that tree induced friction has at low wind speeds. The higher winds at night show a mountain to sea wind flow phenomena. The six-month wind speed at Hoonah, extrapolated to 60 meters hub height was 3.9 meters per second (8.7 mph). Using Juneau as a base, the wind speed for a full year is projected to be 4 meters per second, or approximately 9 miles per hour.

Conclusions and Recommendations - Although less than a year of data has been collected, the mean annual wind speed has been corrected to an annual value using a nearby long-term site. Based on the data collected so far, a modern wind turbine like a GE 1500 kW machine would achieve a Gross Capacity Factor of less than 10% and a Net Capacity Factor of 9%, which makes cost effective wind energy development in this area very unlikely.

Table 5, Wind Statistics for the Juneau Airport

Month	Climo Avg V	2005	Departure	Comments
Jan	7.7			
Feb	8			
Mar	8.1			
Apr	8.4	6.5	-23%	9 days only
May	8.1	6	-26%	
Jun	7.8	5.9	-24%	
Jul	7.5	7.3	-3%	
Aug	7.3	6.9	-5%	
Sep	7.9	8	1%	7 days only
Oct	9.2			
Nov	8.5			
Dec	8.8			
Ann	**8.1**	**7.8**	**-13%**	
% of Annual		**96.7%**		

Table 6, Statistics for the first six months at Hoonah site

month	100' v	99'v	70' V	Max 100'	TI	Shear	V60	CF	Count	Data Recovery
Apr	4.3	3.2	2.3	26.4	0.43	0.67	3.6	0.05	223	100%
May	4.8	4.6	3.0	29	0.40	0.66	4.1	0.09	744	100%
Jun	4.2	3.5	2.3	29	0.42	0.67	3.6	0.07	720	100%
Jul	4.6	4.7	2.6	25.6	0.41	0.68	3.3	0.05	744	100%
Aug	5.0	4.6	2.5	36.7	0.41	0.66	3.5	0.08	744	100%
Sep	6.5	6.9	3.8	31.6	0.40	0.74	4.9	0.17	181	100%
Mean	**4.9**	**4.6**	**2.8**	**36.7**	**0.41**	**0.68**	**3.9**	**0.08**	**3356**	**100%**

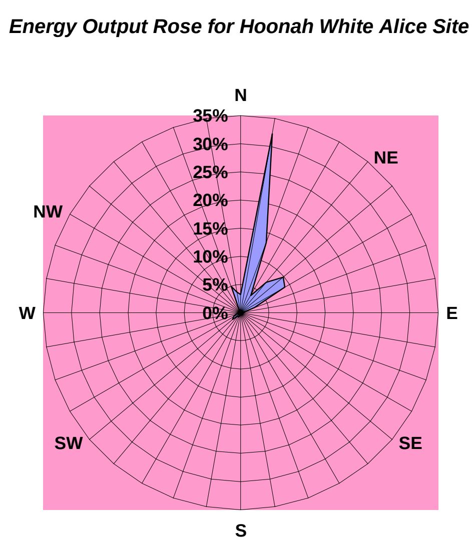


Figure 16, Energy Output Rose for the Hoonah Site

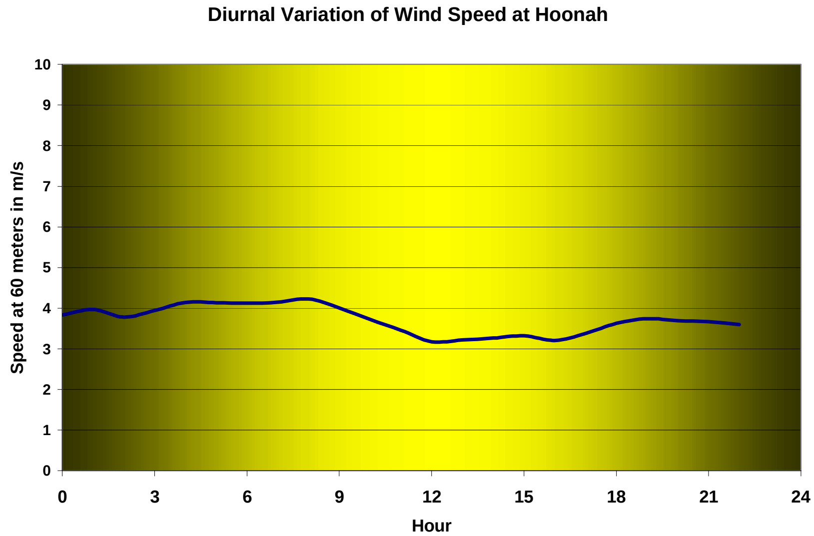


Figure 17, Diurnal Variation of Wind Speed at Hoonah

Yakutat -
Yakutat is surrounded on three sides by water: to the north by Yakutat Bay, to the west the Pacific Ocean and to the northeast by Russell Fiord. To the north and northeast, are the peaks of the St. Elias Range, which rise to heights of between 14,000 and 20,000 feet. This higher terrain means that southeasterly flow circulating around the Aleutian Low is a barrier that first slows the onshore winds and then lifts them dropping abundant precipitation in the Yakutat area. Figure 11 shows a three dimensional view of the area. From this view it is clear that the only direction the winds can come from are the east though SSW; all other directions are blocked by higher terrain. (See Figure 12 for the wind direction at 400 feet.)

Table 7 contains the three Yakutat met tower location information and ancillary information. Refer to Figure 13 for a map of the three met tower locations.

Data recovery was over 99% for two of the sites and 92% for the Ocean Cape site. The annual air density for this area assuming a 60-meter hub height turbine, an average elevation of 10 meters and an annual temperature of 3.3 degrees Centigrade is 1.26 kg/m^3.

Climatology **-** As discussed previously, the approach in the climatological analysis is to select a nearby reference station with a long-term record that would provide information on annual and seasonal variation in the wind resource. For this report the Yakutat upper air data was used because it was thought to provide a climatology unaffected by population and development growth in the area or changes in measurement equipment. Data near the surface (400 foot) was used to determine a correction for seasonality and interannual variation. Table 8 shows that while there were some significant departures from normal during the year, on average the winds during the measurement period were normal.

Table 7, Site Description for Yakutat Sites

Site Name: A Ocean Cape Site 002 **Latitude**: 59° 32.502' N **Longitude:** 139° 51.738' W **Map Datum:** WGS 84 **Elevation**: 40 feet. **Terrain:** Small escarpment on coastal headland. **Roughness**: Spruce and Red Cedar. **Prevailing Wind Direction:** SE – SW **Magnetic Declination**: 25 degrees East **Tower Height**: 30 meters **Sensor Levels**: 30 and 20 meters **Logger**: 4410

Site Name: B YakMet Beach 001 **Latitude**: 59° 32.881' N **Longitude:** 139° 48.525' W **Elevation**: 6 feet. **Terrain:** Gradually sloping beach **Roughness**: Spruce and Cedar **Prevailing Wind Direction:** East -Southeast **Magnetic Declination**: 25 degrees East **Tower Height**: 30 meters **Sensor Levels**: 30 and 20 meters **Logger:** 4409

Site Name: C YakCoast Guard 003 **Latitude**: 59° 32.881' N **Longitude:** 139° 48.525' W **Elevation**: 20 feet. **Terrain:** Gradually sloping beach **Roughness**: Spruce and Cedar **Prevailing Wind Direction:** Southeast -Southwest **Magnetic Declination**: 25 degrees East **Tower Height**: 30 meters **Sensor Levels**: 30 and 20 meters **Logger:** 4408

Table 8, Upper Air Data at 400 feet

				400 foot data									
year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Mean
1998	2.7	4.1	2.6	4.5	4.8	3.2	3.6	4.6	3.7	3.2	2.1	3.9	3.8
1999	2.5	3.3	3.5	4.8	4.0	3.5	3.6	4.5	5.7	5.5	3.7	6.8	4.3
2000	3.4	2.9	3.9	3.8	3.8	3.6	3.0	3.8	4.5	3.6	4.8	4.8	3.8
2001	5.4	3.0	4.6	3.7	4.3	2.9	3.7	2.5	4.3	3.6	4.2	3.0	3.7
2002	4.7	3.7	5.1	3.2	3.3	3.9	3.7	3.7	3.6	4.8	5.6	2.6	4.0
2003	3.4	3.7	4.2	3.0	3.3	3.3	3.1	3.4	3.4	3.9	3.0	3.5	3.4
2004	3.9	4.7	4.3	4.3	2.9	3.1	2.9	2.8	4.1	4.3	3.9	5.2	3.8
2005	3.5	4.9	4.8	3.4	3.1	2.7	2.9						3.8
Mean	**3.7**	**3.8**	**4.1**	**3.8**	**3.7**	**3.3**	**3.3**	**3.6**	**4.2**	**4.1**	**3.9**	**4.3**	**3.8**
Period of Measurement													
2004							2.9	2.8	4.1	4.3	3.9	5.2	
2005	3.5	4.9	4.8	3.4	3.1	2.7	2.9						
Mean for Measurement Period	3.5	4.9	4.8	3.4	3.1	2.7	2.898	2.8	4.1	4.3	3.9	5.2	**3.8**
Departure from Normal	**-6%**	**30%**	**16%**	**-11%**	**-15%**	**-18%**	**-12%**	**-22%**	**-2%**	**4%**	**0%**	**23%**	**0%**

Tables 9 - 11 and Figures 18 - 20 summarize the important statistics measured to date. Despite the low average wind speed, the extreme wind speeds are very high. All three locations have similar mean annual wind speeds at 30 meters. The vertical wind variation is large at all but the

Beach site, which is very close to the bay. Based on the roughness near the met towers, the shear at all three sites should be closer to 0.26. Using a shear value of 0.26 to extrapolate to 60 meters the annual Gross Capacity Factor should be close to 12%.

The turbulence intensity is high at all three sites. The wind roses show that there is no wind flow from the north down the bay and no onshore flow from the west. The diurnal variation of wind speed shows very little amplitude even in the summer months when thermal effects in the lower 48 states create large diurnal variations (see Figure 21). In the summer the peak is later in the day then in the spring or fall. Winter characteristically is a season of little diurnal variation and it is true at Yakutat.

Conclusions and Recommendations – The average of all three sites was 4 mps (9 mph), and the best site (Ocean Cape) was 4.22 mps (9.4 mph). A modern wind turbine such as the GE 1500 kW machine would achieve a Gross Capacity Factor (GCF) of approximately 14% at the Ocean Cape, and a Net Capacity Factor of approximately 12%, which makes cost effective wind energy development in this area very unlikely without major grant funding.

Table 9, Statistics for Met A Ocean Cape site

mon	30m V	Max Gust	Red 30m V	20m V	Temp	Shear	60m V m/s	80m V m/s	Count	Recovery Rate
Jul-04	6.05	38.5	6.60	6.32	57.6	0.058	2.99	3.22	216	100%
Aug-04	5.73	41.9	6.28	5.81	59.6	0.157	2.99	4.98	744	100%
Sep-04	9.23	60.6	9.72	9.17	50.9	0.100	4.69	6.02	717	100%
Oct-04	9.24	58.9	9.72	8.38	48.4	0.415	5.36	5.86	215	29%
Nov-04	9.09	62.5	9.63	8.43	37.6	0.419	5.22	6.41	657	91%
Dec-04	10.32	58.9	10.76	9.55	34.9	0.360	5.77	5.03	738	99%
Jan-05	7.42	59.8	7.97	6.75	32.3	0.455	4.46	5.11	731	98%
Feb-05	9.31	54.6	9.77	8.43	32.9	0.431	5.44	6.14	671	100%
Mar-05	8.56	52.1	9.03	7.95	38.4	0.332	4.86	5.40	742	100%
Apr-05	7.17	52.1	7.76	6.91	43.2	0.304	4.02	4.47	720	100%
May-05	6.57	45.2	6.91	5.82	51.7	0.599	4.27	5.26	744	100%
Jun-05	6.96	27.3	7.32	6.97	56.5	0.165	3.43	3.61	720	100%
Jul-05	6.86	28.2	7.07	6.61	58.9	0.286	3.51	3.75	277	100%
Average	**7.88**	**62.5**	**8.35**	**7.47**	**46.4**	**0.31**	**4.38**	**5.02**	**7892**	**92%**
Expected Annual Wind Speed m/s	**3.52**						**4.22**	**4.55**		
Expected Annual Gross Capacity Factor at 60 meters							**13%**			

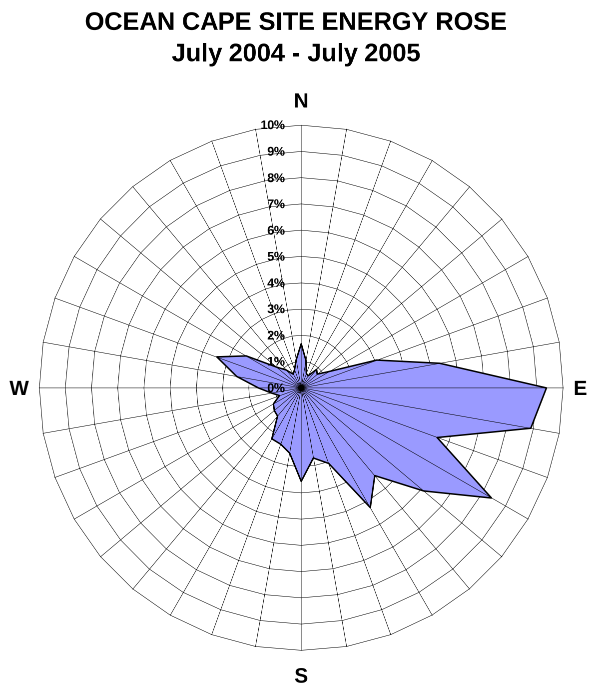


Figure 18, Energy Rose for Ocean Cape Site 1.

Table 10, Statistics for Met B Beach site

Month	30m V	Max Gust	TI	Red 30m V	20m V	Shear	60m V m/s	80m V m/s	Count	Data Recovery Rate
Jul-04	6.3	35.9	0.139	6.51	6.35	0.004	2.9	2.9	175	100%
Aug-04	4.5	41.0	0.156	4.89	4.66	0.047	2.1	2.1	744	100%
Sep-04	7.4	51.3	0.161	7.45	7.34	0.060	3.5	3.6	718	100%
Oct-04	7.9	55.5	0.145	7.82	7.81	0.062	3.7	3.8	737	99%
Nov-04	8.9	51.3	0.156	8.64	8.50	0.106	4.3	4.5	720	100%
Dec-04	8.6	45.2	0.165	8.42	8.22	0.128	4.2	4.4	744	100%
Jan-05	6.2	44.4	0.140	6.04	6.00	0.137	3.1	3.2	744	100%
Feb-05	8.4	52.9	0.146	8.50	8.47	0.073	4.0	4.1	672	100%
Mar-05	8.8	42.7	0.151	8.61	8.60	0.098	4.2	4.4	739	99%
Apr-05	6.8	44.4	0.136	6.51	6.39	0.146	3.5	3.7	718	100%
May-05	5.6	41.9	0.173	5.40	5.55	-0.085	2.6	2.7	744	100%
Jun-05	5.6	25.6	0.186	5.30	5.51	-0.089	2.6	2.7	720	100%
Jul-05	5.4	26.4	0.175	5.07	5.23	-0.078	2.6	2.6	279	100%
Mean	6.9	55.5	0.16	6.86	6.82	0.05	3.33	3.45	8454	99.8%
Expected Annual Wind Speed m/s	3.10						3.71	4.00		
Expected Annual Gross Capacity Factor at 60 meters							12%			

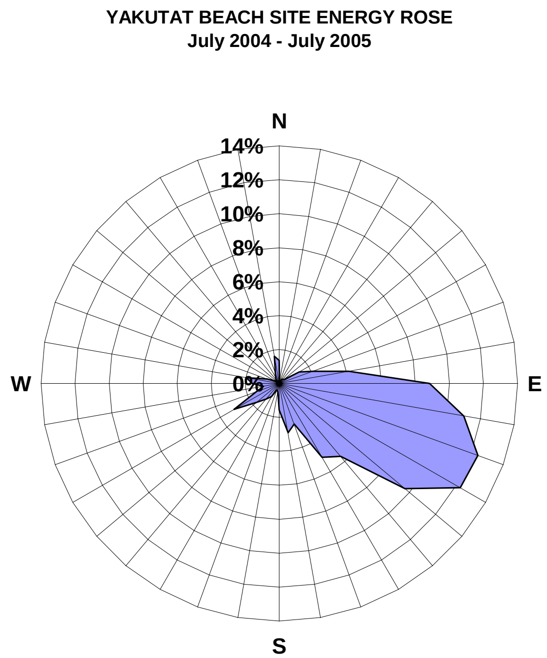


Figure 19, Energy Rose for Beach Site 2

Table 11, Statistics for Met C Coast Guard Site

mon	30m V	Max Gust	TI	Red 30m V	20m V	Temp	Shear	60m V m/s	80m V m/s	Count	Recovery Rate
Jul-04	6.1	38.5	0.200	5.8	5.7	57.1	0.169	3.2	3.5	198	100%
Aug-04	5.2	40.1	0.140	4.8	4.4	58.7	0.426	3.3	3.9	742	100%
Sep-04	8.6	60.6	0.151	8.1	7.2	49.4	0.472	5.2	6.1	719	100%
Oct-04	7.7	58.9	0.184	7.2	6.1	42.2	0.572	5.1	6.1	742	100%
Nov-04	8.9	65.7	0.154	8.4	7.3	36.7	0.615	5.7	6.8	718	100%
Dec-04	9.7	53.8	0.122	9.1	8.2	33.4	0.564	5.9	6.9	713	96%
Jan-05	7.1	54.6	0.147	6.3	5.4	28.9	0.655	5.0	6.2	725	97%
Feb-05	9.0	59.8	0.167	8.3	7.3	31.7	0.592	5.8	6.8	658	98%
Mar-05	8.4	50.4	0.195	8.1	7.1	37.6	0.472	5.1	5.9	734	99%
Apr-05	6.3	50.4	0.188	5.9	5.3	41.9	0.481	4.0	4.8	720	100%
May-05	5.6	17.0	0.071	5.2	4.8	48.0	0.648	4.0	5.4	744	100%
Jun-05	7.0	25.6	0.105	6.1	5.7	54.4	0.735	5.0	6.6	720	100%
Jul-05	6.4	27.3	0.102	5.6	5.0	57.5	0.830	4.9	6.6	325	100%
Mean	**7.7**	**65.7**	**0.165**	**7.2**	**6.4**	**41.8**	**0.502**	**4.8**	**5.7**	**2837**	**99.1%**
Expected Annual Wind Speed m/s	**3.44**							**4.12**	**4.45**		
Expected Annual Gross Capacity Factor at 60 meters								**12%**			

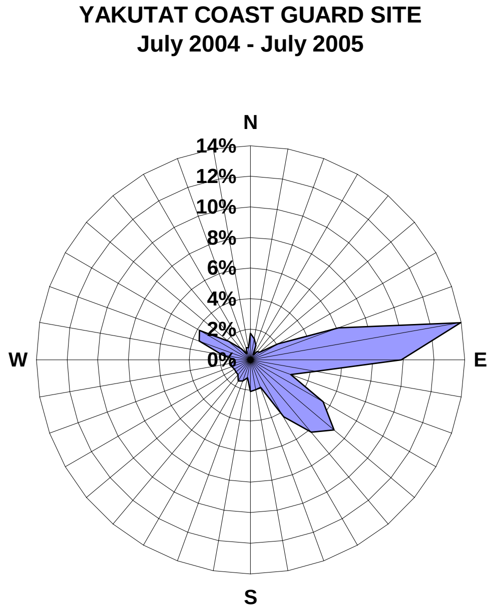


Figure 20, Energy Rose for Coast Guard Site 3

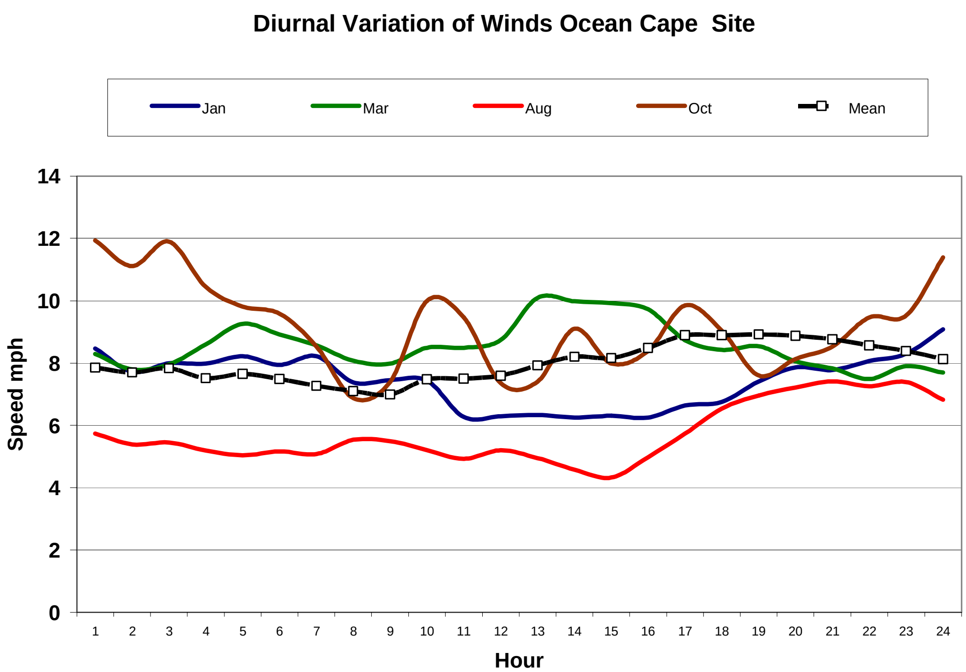


Figure 21, Diurinal Variation of Winds at the Ocean Cape Site

2.6 Transmission Considerations

There are two transmission considerations associated with this project:

- The cost of transmission lines from a new project to the existing electrical infrastructure, and

- The SE Alaska intertie and how plans for extending the intertie might impact new project decisions.

The costs of transmission for all of the projects covered in this report are included in the economic analyses contained herein.

The existing and proposed SE Alaska intertie were discussed in Section 1.2.2 and shown in Figure 2. Referring to Figure 2, the Intertie to the Greens Creek Mine has recently been completed, and there is an ongoing effort to get the estimated $26 million required to construct the intertie to Hoonah. Yakutat is very isolated from the intertie and there is little chance that they can get electrical energy from outside sources. There is a reasonably good chance that Hydaburg and Klukwan will eventually be connected to the intertie, and Kake has a lower probability of being connected to the intertie.

2.7 Economic Analysis for a Potential Wind Power Station at Hoonah and/or Yakutat

Both Hoonah and Yakutat are isolated from any central grid. In order to ensure grid stability, a wind power station should be sized such that it never exceeds 30% of the load. Hoonah has a nameplate capacity of 2,455 kW and Yakutat has a capacity of 2,880 kW. Using 30% of the load and assuming that the peak load is approximately 80% of the nameplate capacity yields a maximum wind turbine rating of approximately 585 kW at Hoonah and 690 kW at Yakutat. If the wind turbine has a somewhat higher rating, it can be derated to meet this criteria. A Vestas 680 kW wind turbine was chosen for economic modeling.

There are two methods generally used to determine the economic viability of a wind power project:

1. A Cost-of-Energy (COE) model used to derive an approximate cost of generation, and

2. A more complex economic model that reflects the approach used by developers and financial institutions to finance commercial projects.

Because the wind resource results were significantly below the wind speeds generally required to achieve financial viability, the first method was chosen, since it provides results that puts the project is an easy to understand perspective.

It should be noted that the capital costs for wind turbines delivered to a US market has increased significantly during the past two years due to the weakening of the US dollar and dramatic increases in the cost for steel in 2004. (Steel is used for most wind turbine components, but the major cost increase impact is for the wind turbine towers whose cost is directly proportional to the price of steel.) The numbers used herein reflect prices in late 2005.

2.7.1 Cost-of-Energy Calculation

The simplified Cost-of-Energy (COE) model is:

$$\text{Cost of Energy} = \frac{((\text{fixed charge rate x capital cost}) + \text{annual O\&M (inc. schd. replacements/overhauls)})}{\text{annual net energy generation}}$$

Tables 12 and 13 show the results for values that represent the most likely costs and financing terms for a commercial project with no grants and today's (December 2005) costs for financing a project. The fixed charge rate is based on a blend of equity (12% return) and debt (8% return) financing, assuming 50% equity and 50% debt. The cost for the wind turbine ($950,000/MW) is the minimum current cost for "bankable"[2] wind turbines. The balance-of-station costs (engineering, roads, control/storage building, wind turbine foundations, monitoring and control systems, one-time installation fee by land owner, and electrical infrastructure) have a range of $230,000 - $280,000 per installed MW for plants rated at 10 – 100 MW. A value of $280,000 per MW was used for this calculation since it is a "one-off" installation and sophisticated controls will be required to integrate the wind turbine to the grid. Approximately $150,000 will also be required at both locations to install the transmission lines from the wind turbine to the utility interconnect. In addition, barging the crane in and out and delivering the wind turbine and 60-meter steel tower is estimated to cost $110,000. These costs are included in the balance-of-station costs. An installation fee of $5,000 per wind turbine, which would be paid to the land owner was also applied to the balance-of-station number, which reflects typical current values.

Table 12, Cost-of-Energy Calculation for Hoonah

Item	Value
Turbine rating	680 kW
Project life (years)	25
Fixed charge rate	0.14
Wind turbine cost	$ 646,000
Balance-of-station cost	$ 450,400
Soft costs	$ 50,000
Total Capital Cost	$ 1,146,400
Annualized amortization (FCR x Capital Cost)	($166,799.37)
Annual operation & maintenance (inc. major repl.)	$ (20,000)
Total annualized cost	$ (186,799)
Annual net kWh	536,110
Cost of energy (COE) before royalty payments	**$ (0.35)**

[2] "Bankable" wind turbines are from well-established manufacturers with good reputations for delivering on time and carry warranties that satisfy financing entities.

Table 13, Cost of Energy Calculation for Yakutat

Item	Value
Turbine rating	680 kW
Project life (years)	25
Fixed charge rate	0.14
Wind turbine cost	$ 646,000
Balance-of-station cost	$ 450,400
Soft costs	$ 50,000
Total Capital Cost	$ 1,146,400
Annualized amortization (FCR x Capital Cost)	($166,799)
Annual operation & maintenance (inc. major repl.)	$ (20,000)
Total annualized cost	$ (186,799)
Annual net kWh	714,816
Cost of energy (COE) before royalty payments	**$ (0.26)**

The annual cost of energy is approximately 35¢ per kWh for Hoonah and 26¢ per kWh for Yakutat. These values are clearly too high to justify a wind turbine project without very significant grants or low-cost financing. Table 14 shows a simplified maximum cost-of-energy that could justify a commercial project.

Table 14, Maximum Cost-of-Energy to Justify a Commercial Project

Item	$/kWh	Notes
Energy value to utility	0.14	Approximate value per Yakutat Power.
Internalize tax credit[3]	0.019	Assumes tribe does not own project for first 10 years.
Total	**0.159**	"Break-even" for project

In viewing the "acceptable" cost of energy of 0.14¢ per kWh, it must be understood that both utilities have sunken costs in their existing diesel generation facilities, and the demand for electricity is not increasing significantly. This means that new generation facilities must come close to the marginal cost of diesel fuel, which is approximately 0.13 – 0.15¢ per kWh today. Tables 15 and 16 show the impact of low-cost financing and partial grants on the projected cost of energy. The possible combinations that could enable the project to be "financiable" are shaded. A low fixed charge rate of 9% was used because this represents 4% annual depreciation plus 5% debt and equity financing – the lowest reasonable rate. For Hoonah, it would require a grant of at least 50% of the project cost and financing of 5 – 7% to make a viable project. The likelihood of obtaining either of these conditions in the near future is considered remote.

[3] There is currently a federal 1.9¢ per kWh production tax credit (PTC) for producing energy from wind powered generation facilities available to the owner(s) of the facilities for the first ten years that the facility is in operation. The PTC expires on December 31, 2007, but observers believe that it will be renewed.

Table 15, Impact of Low-cost financing and/or Grant Funds Applied to Hoonah

Fixed charge rate	Cost of Energy ($/kWh)					
	No Grant Financing	With Grant (% of total capital cost)				
		10%	20%	30%	40%	50%
9%	0.26	0.23	0.21	0.19	0.17	0.15
10%	0.27	0.25	0.23	0.20	0.18	0.16
11%	0.29	0.27	0.24	0.22	0.19	0.16
12%	0.31	0.28	0.26	0.23	0.20	0.17
13%	0.33	0.30	0.27	0.24	0.21	0.18
14%	0.35	0.32	0.29	0.26	0.22	0.19

Table 16, Impact of Low-cost financing and/or Grant Funds Applied to Yakutat

Fixed charge rate	Cost of Energy ($/kWh)					
	No Grant Financing	With Grant (% of total capital cost)				
		10%	20%	30%	40%	50%
9%	0.19	0.17	0.16	0.14	0.13	0.11
10%	0.20	0.19	0.17	0.15	0.13	0.12
11%	0.22	0.20	0.18	0.16	0.14	0.12
12%	0.23	0.21	0.19	0.17	0.15	0.13
13%	0.25	0.22	0.20	0.18	0.16	0.14
14%	0.26	0.24	0.21	0.19	0.17	0.14

For Yakutat, a grant of $300,000 - $400,000 plus low cost (5%) financing would be required. This also seems unlikely. It should be noted that in both locations the financial feasibility of the projects is the best projected case, since it assumed that there were no curtailments of the wind turbine's output to ensure grid stability when the load is low and the wind turbine is operating at rated capacity (680 kW).

Another alternative – installing a smaller wind turbine that does not require a crane was examined. Two 50 kW wind turbines would supply approximately 1.9% of the load at Yakutat. This is not a sensible alternative.

2.7.2 Potential Benefits to the Tribe

Based on the previous financial discussion, there is little possibility of financing this project without substantial low-cost financing and/or outright grant funds. However, in the event that a path is found to finance a project, (via low-cost financing and/or grant funds), this section provides a picture of the potential benefits to the Tribe.

To provide all the financial benefits available, it is assumed that the project would be owned by an entity other than the local tribe during the first ten years of operation, when the federal production tax credit would likely be available. During this time, the local tribe would receive royalties from the project to pay for the use of their land. Table 17 shows the potential income to the Tribe, assuming a royalty rate of 4% of the net production income from the project. This is the maximum rate considered likely from a wind project with the wind resources measured to date. Using this rate yields an annual income of approximately $4,000.

In addition to this income, the project would be structured to revert to the Tribe after ten years. The income stream available to the Tribe from the project ownership is estimated to be 5 % of the project's income, or approximately $5,000[4]. Taken together with the royalty payments, there is an income stream after the first ten years of operation of a maximum of approximately $9,000 per year.

Table 17, Potential Income from Land-Lease Royalties - Yakutat

Annual net energy (kWh)	714,816
Revenue at $0.14/kWh	$ 100,074
Royalty at 4% of revenue	$ 4,003

2.7.3 Discussion of Results

The wind resources at both Hoonah and Yakutat were disappointing and make it very difficult to finance a wind power station at either location. Although the outcomes were negative, the wind resource data can be used by meteorologists to refine the macro wind models for this region.

2.7.4 Wind Energy – Lessons Learned

1. There are few, if any isolated villages in SE Alaska that are suitable for wind energy projects. This is attributed to several factors:
    - The macro winds are not nearly as high as they are in the more northern parts of Alaska
    - The villages are situated on the coastlines, whereas the higher winds are found in the mountains, which generally are not accessible.
    - Villages are generally established in areas that are away from strong winds.
2. Each village has many factions and officials and tribal members do not always agree with each other. Extreme care must be taken to fully explain these types of projects to all parties very early in the process. This is difficult because of the logistics, but is a necessity.
3. The agreement did not anticipate the difficulty of obtaining permits to erect the anemometry. More time needs to be allotted for communications – both programmatic and technical.
4. Although sometimes useful, anecdotal information is generally optimistic. This is attributed to the natural tendency to remember very windy days, but not remember calm days.

[4] The reader is reminded that the original rate-of-return of 12% for equity investors included the PTC, which will no longer be available after operating the project for ten years.

3.0 Hydroelectric Pre-development Activities and Results

The purpose of this study was to update previous studies on hydroelectric projects for the communities that currently rely on diesel generation for most of their power supply. The communities considered are those for which Sealaska Corporation is designated as the Regional Corporation. Section 2.1.4 described the activities associated with this project. The primary objective was to determine if economic conditions and technological changes have made potential projects more attractive. The purpose of this section is to document the performance of those activities and to present the results. Much of this section is taken from Alaska Power & Telephone's report. The entire AT&P report, carried out by Mr. Larry Coupe of Alaska Power & Telephone, is contained in Appendix D of this report.

3.1 Background

Southeast Alaska is blessed with high rates of precipitation and mountainous terrain, which makes for outstanding hydroelectric generation potential. Over the years, many communities have sought to develop some of the hydroelectric potential to meet the electric loads of their citizens and businesses. Those communities that have managed to develop hydroelectric projects generally have relatively low power rates, whereas the communities without hydroelectric generation rely almost exclusively on diesel generators and have comparatively high power rates. Because of the rugged terrain and generally long distances between communities, transmission interconnections are few.

Sealaska communities can be categorized by their power supply as follows:

<u>Locally interconnected communities</u>

Many of the larger communities in Southeast Alaska are locally interconnected to smaller communities or to each other, and these larger communities generate most of their electricity from hydroelectric projects. They are served by municipal or investor-owned electric utilities, which can be expected to continue development of additional hydroelectric projects to meet load growth. The Table 18 lists these larger communities, their interconnected smaller communities, their serving utilities, their existing hydroelectric projects, and previously identified potential hydroelectric projects.

<u>Isolated Communities</u>

The remaining communities in Southeast Alaska are electrically isolated, and rely primarily on diesel power for electricity generation. This study focused on the communities that are associated with Sealaska Corporation. Nearly all of them have had at least an assessment of hydroelectric potential, and a few have had feasibility studies of potential hydroelectric projects. These communities, their existing utilities, and identified potential hydroelectric projects are shown in Table 19.

Table 18, Larger Interconnected Communities

Larger Communities	Interconnected Smaller Communities	Electric Utility	Existing Hydroelectric Projects	Potential Hydroelectric Projects
Juneau	Douglas, Auke Bay	Alaska Electric Light & Power (AELP)	Snettisham Annex – Salmon Gold Creek	Lake Dorothy
Ketchikan	Saxman	Ketchikan Public Utilities (KPU)	Swan Lake Beaver Falls – Lake Silvis Ketchikan Lakes	Whitman Lake Mahoney Lake (1)
Sitka		Sitka Electric Department	Blue Lake Green Lake	Takatz Lake Lake Diana Medvejie Lake
Haines – Skagway		Alaska Power & Telephone	Goat Lake Dewey Lakes Lutak	Kasidaya Creek Dayebas Creek Connelly Lake
Petersburg – Wrangell		Petersburg Municipal Power & Light Wrangell Municipal Power & Light	Tyee Lake Blind Slough	Scenery Lake Swan Lake
Metlakatla	Annette	Metlakatla Power & Light	Purple Lake Chester Lake	
Craig – Klawock - Kasaan		Alaska Power & Telephone	Black Bear Lake	South Fork

(1) Mahoney Lake is a proposed development by Ketchikan Electric Company, which is a joint venture of Alaska Power & Telephone and Cape Fox Corporation.

Table 19, Isolated Communities

Community	Existing Utility	Potential Hydroelectric Projects
Angoon	Inside Passage Electric Cooperative (IPEC) (1)	Thayer Creek
Hoonah	IPEC	Gartina Creek Water Supply Creek
Hydaburg	Alaska Power & Telephone	Reynolds Creek
Kake	IPEC	Cathedral Falls Creek
Klukwan	IPEC	Walker Lake
Yakutat	Yakutat Power	Chicago Harbor

The hydroelectric potential of these six communities are discussed further in the following sections of this report.

Development of a hydroelectric project is possible whenever there is sufficient head and flow. However, from a practical sense, development can be constrained by economics and/or environmental issues.

3.2 Economic Analysis Method

Economic analysis of a potential hydroelectric project involves comparison of the cost of power from the proposed project to that of the most likely alternative source of power. For the purposes of this report, continuation of the current source of power (diesel generation) is considered to be the most likely alternative for all of the communities considered in this report. Devising a definitive method of comparing diesel generation to hydro generation is problematic because hydro has a high initial cost, long life, and relatively low operating cost, whereas diesel has a low initial cost, relatively short life, and relatively high operating cost. Thus, for an economic analysis to be fair, it must extend for a long period of time (the life of a hydro project is generally considered to be at least 50 years). The three main factors affecting an economic analysis are load growth, financing terms, and diesel fuel costs, and all of those can be very volatile, even in the short term. The economic analysis method used for this study is outlined below.

Load Growth

Load growth in a community or interconnected system is important in analyzing a hydro project only if the potential project energy cannot always be used to meet load. For the six communities considered by this study, load growth is considered in the analyses only for Angoon, Hydaburg, and Yakutat. In Hoonah and Kake, the potential projects are small compared to the load, and thus all or nearly all of the generation can be used. For Klukwan, the potential hydro project would feed into a larger interconnected system that has sufficient hydro generation for many years; accordingly there is little need for the project and little value in engaging in a speculative long-term load growth forecast.

For Angoon, Hydaburg, and Yakutat, load growth has been projected from current loads at a rate of 1.5% per year for 10 years, at 1.0% for an additional 10 years, and then at 0.5%. This would reflect a modest rise in population in those communities or a modest increase in usage per customer.

Generation

The potential generation of each project has been based on the results of previous studies for those projects where Mr. Coupe was directly involved in the work (Thayer Creek near Angoon, Gartina Creek and Water Supply Creek near Hoonah, and Reynolds Creek near Hydaburg). For the other projects, generation has been calculated using a computer model of a run-of-river operation, with streamflows based on factoring of USGS gage records of nearby streams.

Hydro Capital Costs

The basic construction cost for each project was determined by varying methods. For those projects where Mr. Coupe was directly involved in the previous work (Thayer Creek near Angoon, Gartina Creek and Water Supply Creek near Hoonah, and Reynolds Creek near Hydaburg), the cost estimates were updated based on increases in the Consumer Price Index between the date of the previous cost estimate and 2003. For the Cathedral Falls and Walker Lake sites, where previous studies were at least 20 years old, the cost estimates were based on new unit prices applied to the estimates from the previous study. For some items, new estimates were also calculated to reflect proposed changes in the project arrangement. For the Chicago Harbor site where no previous applicable study existed, the cost estimate is entirely original.

Engineering and contingency allowances were estimated based on judgment regarding the complexities of the various sites and the thoroughness of the underlying studies. Contingencies allowances vary between 13% and 30%, and engineering costs vary between 12% and 27%.

The investment cost (i.e., the construction cost plus engineering and contingencies) was then escalated to the estimated earliest possible bid date for the project, which is a function of the current status of the permitting and design and the estimated complexity of the environmental issues. Escalation was calculated at 2.5% per year, which is comparable to the inflation rate for the past several years.

The escalated investment costs were then converted to capital costs by adding in amounts for interest during construction and financing costs. For simplicity, interest during construction was calculated as 55% of the interest rate of the construction financing times the duration of the construction period in years. Financing costs were estimated to be zero, which assumes the projects are financed with grants and loans secured from government sources rather than commercial lenders.

Many recent hydro projects in Southeast Alaska have been partially funded to various degrees with grants from the federal and/or state government. For illustrative purposes, we have considered for each project grant funding at levels of 0%, 25%, 50%, 75%, and 100%.

Hydro Annual Costs

Annual costs for a hydro project consist of debt service and various operating costs. Debt service has been based on the various assumed levels of grant funding, and loan funding of the balance with an interest rate of 5.5% and a term of 30 years. These loan terms are similar to terms of recent loans by the Alaska Industrial Development and Export Authority (AIDEA) and the Rural Utility Service (RUS).

Annual operating costs for a hydro project include labor for operation, maintenance, and administration; parts and supplies; interim replacement of major components; insurance; taxes (if any); land use fees (if any), and environmental mitigation. For most of these small projects, there may be little additional labor cost, as the existing diesel plant personnel will be able to operate the hydro units. There may be some additional transportation costs because the hydro projects are typically located some distance from the communities. For these two items, the costs have been estimated by judgment. The total of the other operating costs have been estimated by the following formula:

Operating cost ($1000, 2003) = $45*MW^{0.55}$, where MW is the generating capacity

The operating costs are assumed to increase at the general rate of inflation (2.5% per year).

Diesel Annual Costs

Diesel annual costs include the costs for fuel, consumable parts and supplies, and interim overhauls and replacements. The biggest portion of the cost is the fuel cost, which has been based on values for fuel price and diesel efficiencies listed in AEA's 2003 Statistical Report of the Power Cost Equalization Program.

Consumable parts and supplies have been assumed to cost 6.4 mills/kWh, and overhauls and replacement cost on the average 5.3 mills/kWh. Note that all of these costs are at a 2003 cost level, and will vary from year to year. These operating costs are assumed to increase at the assumed general rate of inflation (2.5% per year), except for the price of diesel fuel, which is assumed to increase at a rate of 3.5% per year, reflecting its relative scarcity and recent trends.

Cost Comparison

For each of the hydro projects, the economic feasibility has been evaluated by calculating the cumulative discounted net benefits over a typical 50-year life. The net benefit in any one year is the annual cost of the diesel alternative minus the annual cost of the hydro alternative; the benefits may be negative if the hydro project is more costly than continuing with diesel generation. The annual net benefits in each year is calculated, and then discounted back to 2003 using a discount rate of 5.5% (discounting accounts for the lesser real value of future amounts). The cumulative discounted net benefits for each year are then calculated as the sum of the discounted net benefit from the first year of operation to the year in question. As noted above, five levels of grant funding have been assumed, resulting in five discounted net benefit streams for each project, which were then plotted over time. For the purposes of this evaluation, we have used a 10-year time frame for crossover to positive cumulative discounted net benefits as an indication of project economic and financial feasibility.

3.3 Results

3.3.1 Angoon

Existing Power Supply

IPEC currently supplies electric power to Angoon, which is generated at a plant in town with three diesel generators. The power plant capacity is 1,260 kW, and the cost of power to Angoon citizens in 2003 was 14.54 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 18.21 ¢/kWh). Power is distributed by an overhead system. Peak loads have been about 425 kW, and the annual electrical energy requirement has been about 2,000 MWh. There has been little to no load growth recently because of the stagnant economy in Angoon.

Earlier Studies - Hydroelectric power for Angoon has been the subject of numerous studies, including:

- Preliminary Appraisal Report on the Hydroelectric Potential for the Villages of Angoon, Craig, Hoonah, Hydaburg, Kake, Kasaan, Klawock, Klukwan, Pelican, and Yakutat; September 1977 by R. W. Retherford Associates.
- Thayer Creek Project, A Reconnaissance Report; October 1979 by Harza Engineering
- Angoon Tidal Power & Comparative Analysis; February 1981 by Harza Engineering
- Angoon Water Supply Alternatives; July 1981 by Trick, Nyman, & Hayes
- A Comparative Economic Analysis of Electric Energy Alternatives for Angoon, Alaska; February 1984 by Acres International
- Angoon Hydro Study; August 1989 by Polarconsult Alaska, Inc.
- Angoon Hydroelectric Project, Feasibility Evaluation Report; March 2000 by HDR Alaska.

<u>Thayer Creek</u>

Most of the previous analyses have focused on developing the hydroelectric potential of Thayer Creek, which drains a large lake (Thayer Lake) at about El 365, and flows in a westerly direction to Chatham Strait. The stream gradient is rather gentle for about 6 miles, but 1.7 miles from the mouth at about El 260, the stream begins a series of rapids and falls, including one falls about 0.4 miles from the mouth that is a barrier to upstream movement of anadromous fish. This combination of naturally regulated flows, high stream gradient, and paucity of anadromous fish habitat makes Thayer Creek a good site for hydroelectric development. The main impediments are the length of transmission line (about 7 miles) and wilderness designation of the area. Thayer Creek is in the area reserved to Kootznoowoo, Inc. for hydroelectric development, but that development is still subject to environmental protection stipulations by the Forest Service and possibly litigation by environmental organizations.

Potential Generation

According to prior analyses, the estimated potential generation of the Thayer Creek Project is about 8,400 MWh if not limited by load and about 2,000 MWh with current loads (about 99% of the Angoon requirements). An alternative arrangement would provide about 7,700 MWh if not limited by load and about 2,000 MWh with current loads.

Environmental Assessment

The major environmental issues are likely to be:

- Development of a hydroelectric project in a National Monument and wilderness area. Even though the right to develop the project is unquestionable, the issue will undoubtedly be raised, as hydro development in wilderness areas is anathema to many environmental organizations.
- Visibility of the corridor for the transmission line, and possibly of the surge tank and penstock.

- Instream flows in the bypassed reach of stream between the diversion dam and the powerhouse.

  The environmental feasibility of either arrangement is judged to be moderate.

Economic Assessment

The estimated construction costs are shown in Table 20, adjusted to a 2003 cost level. Also shown are the estimated annual operating costs. The earliest possible on-line date is estimated to be 2010, considering the current status of the development effort and the likely environmental opposition to the project. The results of the economic analysis are shown in Figure 22. As can be seen from Figure 22, the Thayer Creek Project appears to be economical only if approximately 80% of its cost can be funded with grants (i.e. $7,000,000 in grants). The Thayer Creek Project is judged to have a low potential for economic and financial feasibility.

Development of the Thayer Creek Project could be viewed as an alternative to construction of the Angoon branch of the Southeast Intertie. If viewed in that context, the economics are much more favorable, since the Angoon branch of the Southeast Intertie is likely to be much more expensive than the Thayer Creek Project. Note that 80% federal funding has been authorized for construction of the Southeast Intertie, the same rate as required for economic feasibility for the Thayer Creek Project.

Regulatory Assessment

On January 23, 2001 the Federal Energy Regulatory Commission (FERC) ruled that it did not have jurisdiction over the Thayer Creek Project because it cannot license projects located in National Monuments within the national Forest System. The effect of this ruling is that the primary federal permitting authority will be the Forest Service, presumably by a Special Use Permit. The Forest Service acknowledges Kootznoowoo's rights to develop the project, but they may be strict in their prescriptions to protect the "water, fishery, wildlife, recreational, and scenic values of Admiralty Island". They may also require an Environmental Impact Statement (EIS) rather than the less comprehensive Environmental Assessment (EA) that FERC would normally require for this size project.

Other permits that would likely be required include

- Wetlands Permit from the Corps of Engineers
- Water rights from the Alaska Department of Natural Resources (ADNR)
- Section 401 Water Quality Certification from the Alaska Department of Environmental Quality (ADEQ)
- Coastal Zone Management Consistency Determination by the Alaska Division of Governmental Coordination (ADGC). As noted earlier, the State of Alaska has recently transferred much of the responsibility for hydroelectric project review from ADFG to ADNR.

Other Potential Hydroelectric Developments

Other potential hydroelectric developments in the Angoon area that have been considered in the past include:

- Development of a small hydroelectric facility in conjunction with a water supply and hatchery development on Favorite Bay Creek south of Angoon.
- Development of a tidal power station on Kootznahoo Inlet at Turn Point, where tidal currents are very strong.
- Development of a small hydroelectric facility in conjunction with a water supply development of two lakes and an unnamed creek approximately 2 miles north of Angoon in the area reserved for hydroelectric development.

Table 20, Thayer Creek Hydroelectric Project (Angoon)
Summary of Project Costs

			Project Arrangement		
CONSTRUCTION COST (1999 Cost Level)			HDR		Modified HDR
FERC					
Account	Description		Amount		Amount
330	Land and Land Rights	$	-	$	-
330.5	Mobilization and Logistics	$	741,000	$	741,000
331	Structures and Improvements	$	543,000	$	543,000
332	Reservoirs, Dams, and Waterways	$	1,587,000	$	1,453,000
333	Turbines and Generators	$	715,000	$	715,000
334	Accessory Electrical Equipment	$	366,000	$	366,000
335	Miscellaneous Mechanical Equipment	$	110,000	$	110,000
336	Roads and Bridges	$	789,000	$	773,000
353	Substation Equipment and Structures	$	48,000	$	48,000
355	Transmission Line	$	1,173,000	$	1,173,000
SUBTOTAL		$	6,072,000	$	5,922,000
	Contingencies	$	800,000	$	780,000
TOTAL DIRECT CONSTRUCTION COST		$	6,872,000	$	6,702,000
	Permitting and Engineering	$	1,228,000	$	1,198,000
TOTAL INVESTMENT COST (1999 Cost Level)		$	8,100,000	$	7,900,000
	Escalation			$	800,000
TOTAL INVESTMENT COST (2003 Cost Level)				$	8,700,000

			Project Arrangement		
			HDR		Modified HDR
	Cost level		1999		2003
OPERATING COSTS			Amount		Amount
	Incremental Labor	$	25,000	$	35,000
	Transportation	$	5,000	$	10,000
	Other Operating Costs (1)	$	55,000	$	45,000
TOTAL OPERATING COSTS		$	85,000	$	90,000
	Escalation	$	9,000	$	-
TOTAL OPERATING COSTS (2003 Cost Level)		$	94,000	$	90,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

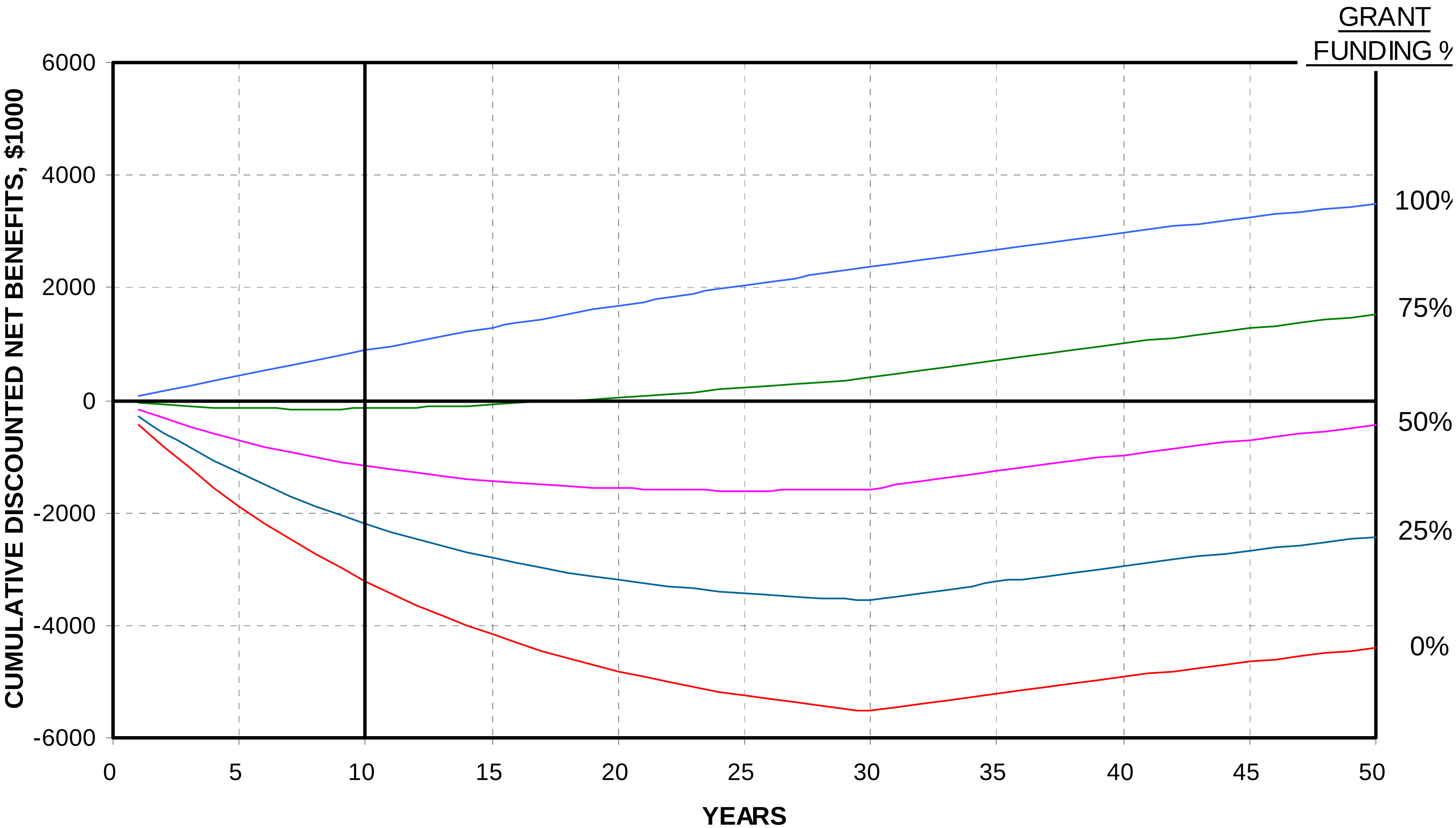


Figure 22, Thayer Creek Project (Angoon) Economics Summary

With regard to the tidal development, a conventional large-scale development involving closure of the inlet at Turn Point is technically possible, but would only be economically feasible if were connected to much larger loads than Angoon. It would more than likely be unacceptable from an environmental standpoint however. A small tidal current generator installation may be possible, but that technology is untested at this time. UEK Corporation, a manufacturer of tidal current generators, has indicated they have done some preliminary work on a tidal development at Turn Point.

With regard to the water supply developments, concurrent hydroelectric generation is frequently feasible and should be considered if a new water supply system is developed. The development of the two lakes and unnamed stream north of Angoon is intriguing because it could be developed as a first phase of the Thayer Creek development if funds cannot be secured for the entire project.

Interconnection Potential by the Southeast Intertie

The 1998 Acres report on the Southeast Intertie included an interconnection to Angoon in the third phase, which is the 2015-2020 time frame. Phase III was to include interconnection of Sitka, Tenakee Springs, Angoon, Hoonah, Greens Creek, and Juneau, and was estimated to cost $173.8 million. It is important to note that the interconnection of Angoon is shown as a side branch rather than on the main intertie. Furthermore, if AEL&P is successful in interconnecting Hoonah, Greens Creek, and Juneau, there may be less incentive for completion of the link between Hoonah and Tenakee Springs/Angoon/Sitka as envisaged by the Acres report. Thus, it is very possible that interconnection of Angoon may be delayed well beyond the 2015-2020 time frame.

Development of a hydroelectric project to serve Angoon could also delay interconnection. If the interconnection were to occur, it would allow marketing of any excess energy to the interconnected utilities.

3.3.2 Hoonah

Existing Power Supply

IPEC currently supplies electric power to Hoonah, which is generated at a plant in town with diesel generators. The power plant capacity is 2,455 kW, and the cost of power to Hoonah citizens in 2003 was 14.54 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 18.21 ¢/kWh). Power is distributed by an overhead system. The annual electrical usage has been about 4,500 MWh. There has been little to no load growth recently, but the Point Sophia development may add significantly to the loads as it enters operation.

Hydroelectric Potential

Hydroelectric potential in the Hoonah area has been the subject of at least three studies, as follows:

- Preliminary Appraisal Report on the Hydroelectric Potential for the Villages of Angoon, Craig, Hoonah, Hydaburg, Kake, Kasaan, Klawock, Klukwan, Pelican, and Yakutat; September 1977 by R. W. Retherford Associates.
- Gartina Creek Project, A Reconnaissance Report; October 1979 by Harza Engineering Company
- Reconnaissance of Three Potential Hydroelectric Sites Near Hoonah, Alaska; June 2002 by HydroWest Group, LLC. (HydroWest Group was a wholly-owned subsidiary of Alaska Power & Telephone, and the author of the current study was the principal author of the Hoonah study)

Game Creek

Game Creek flows into Port Frederick near Hoonah, and was initially considered by Retherford as a potential hydroelectric site because of its relatively large size and the good topography for developing a storage project. However, Retherford dropped consideration of Game Creek when it was determined to be a major anadromous fish stream. Because of the probable environmental impacts, Game Creek has not been reviewed for the current study.

Gartina Creek

Project Arrangements of Previous Studies

Retherford considered Gartina Creek as a hydroelectric site because of the existence of a moderate height waterfall. Retherford suggested a run-of-river project at Gartina Falls, with a 20-foot-high concrete dam at the head of the falls, a short penstock, and a powerhouse at the base of the falls with a capacity of 750 kW and an annual generation of 2.1 GWh.

Harza conducted a more detailed study in 1979 for the Gartina Falls site, and selected an arrangement quite similar to Retherford. It included a 27-foot-high concrete dam about 150 feet upstream of the head of the falls, a 210-foot-long, 57-inch diameter penstock, and a 2-unit 450-kW power plant at the base of the falls, with provisions for adding two additional units in the future.

HydroWest proposed a similar arrangement for the Gartina Falls site, but with a few significant differences:

- The diversion dam was proposed to have a concrete core wall and grouted rockfill slopes, and would be about 15 feet high and located at the head of the falls.
- The intake structure includes a means for sluicing sediment past the diversion dam.
- The powerhouse would be located about 150 below the falls to allow more economical access and to provide greater protection from rockfalls.
- The powerhouse would contain a single impulse-type turbine rated at 600 kW.
- The tailrace would include a diffuser structure to prevent fish from entering the tailrace.

HydroWest estimated the construction cost would be $3.75 million and the annual generation would be 1.88 GWh. Note that the City of Hoonah began collecting streamflow data just upstream of Gartina Falls in spring 2003 as the first step in a more serious consideration of developing the site. The HydroWest study was conducted by Larry Coupe, and is considered to be a reasonable evaluation of the site potential.

Potential Generation

The potential generation of the Gartina Falls Project was estimated by HydroWest to be about 1,900 MWh per year, which is approximately 40% of the current Hoonah load. HydroWest did not estimate the amount of that potential generation that would actually be usable, but there should be little problem absorbing all or nearly all of the potential generation into the Hoonah system, particularly if the Pt Sophia development increases loads substantially.

Environmental Assessment

Potential environmental issues with the Gartina Falls Project are considered to be:

- Loss of anadromous fish habitat between the base of the falls and the powerhouse, including deep pools at the base of the falls.
- Diminished aesthetic value of Gartina Falls.
- Disruption of brown bear feeding patterns due to the powerhouse location.

Only the first of these potential issues is considered to be significant. The project is judged to have a moderate potential for environmental feasibility.

Economic Assessment

The estimated construction annual operating costs of the Gartina Falls Project as described above are shown in Table 21. The construction costs are based on a review and adjustment of the HydroWest cost estimate to a 2003 cost level. The earliest possible on-line date is estimated to be 2008, considering the current status of the development effort.

The results of the economic analysis for the Gartina Falls Project are shown in Figure 23. As can be seen from Figure 23, the Gartina Falls Project appears to be economical if approximately 45%

of its cost can be funded with grants (i.e. $1,700,000 in grants). This indicates a moderate potential for economic and financial feasibility.

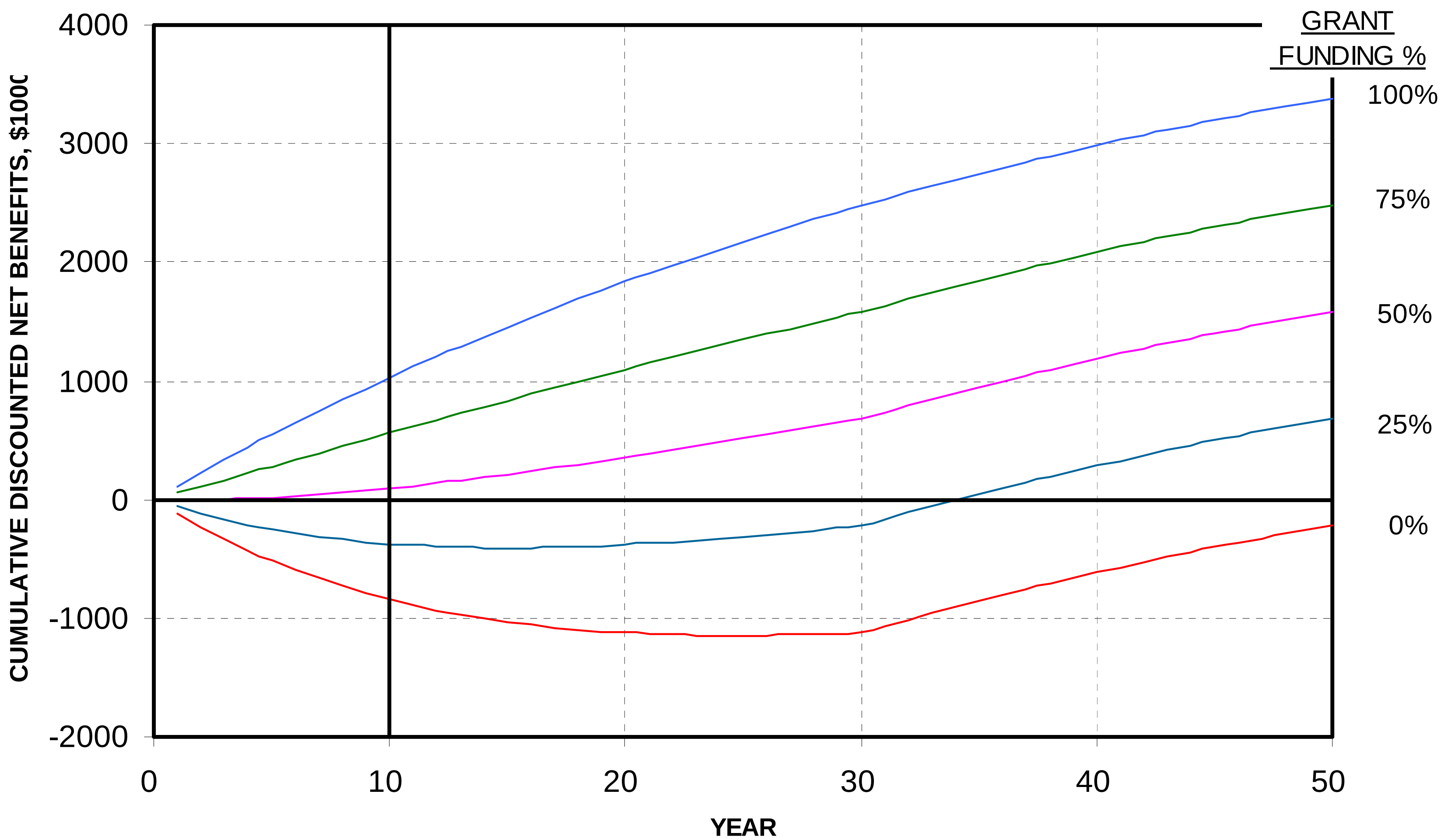
Table 21, Gartina Falls and Water Supply Creek Hydro Projects (Hoonah)
Summary of Project Costs

		Project Arrangement	
CONSTRUCTION COST (2002 Cost Level)		Gartina Falls	Water Supply Creek
FERC Account	Description	Amount	Amount
330	Land and Land Rights	$ -	$ -
330.5	Mobilization and Logistics	$ 76,000	$ 67,000
331	Structures and Improvements	$ 330,000	$ 178,000
332	Reservoirs, Dams, and Waterways	$ 836,000	$ 814,000
333	Turbines and Generators	$ 325,000	$ 299,000
334	Accessory Electrical Equipment	$ 215,000	$ 215,000
335	Miscellaneous Mechanical Equipment	$ 75,000	$ 75,000
336	Roads and Bridges	$ 73,000	$ 61,000
353	Substation Equipment and Structures	$ 100,000	$ 100,000
355	Transmission Line	$ 280,000	$ 287,000
SUBTOTAL		$ 2,310,000	$ 2,096,000
	Contingencies	$ 578,000	$ 524,000
TOTAL DIRECT CONSTRUCTION COST		$ 2,888,000	$ 2,620,000
	Permitting and Engineering	$ 775,000	$ 625,000
TOTAL INVESTMENT COST (2002 Cost Level)		$ 3,663,000	$ 3,245,000
	Escalation (Approx. 2.3%)	$ 87,000	$ 75,000
TOTAL INVESTMENT COST (2003 Cost Level)		$ 3,750,000	$ 3,320,000

		Project Arrangement	
		Gartina Falls	Water Supply Creek
OPERATING COSTS (2002 Cost Level)		Amount	Amount
	Incremental Labor	$ -	$ -
	Transportation	$ -	$ -
	Other Operating Costs (1)	$34,000	$34,000
TOTAL OPERATING COSTS (2002 Cost Level)		$ 34,000	$ 34,000
	Escalation (Approx. 2.3%)	$ 1,000	$ 1,000
TOTAL OPERATING COSTS (2003 Cost Level)		$ 35,000	$ 35,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

Figure 23, Gartina Falls Project (Hoonah) Economics Study



Regulatory Assessment

In December 1998, Alaska Power & Telephone filed a Declaration of Intention with FERC on behalf of Sealaska Corp. to determine whether FERC had jurisdiction over a proposed development at the Gartina Falls site. On August 16, 2001, FERC issued a notice that it did not have jurisdiction. ADFG and NMFS requested rehearing on the basis of a possible impact to anadromous fish, but on November 21, 2001 FERC affirmed that FERC licensing is not required.

As noted earlier, the State of Alaska will assume regulatory authority over hydroelectric project of 5 MW capacity or less once they develop an adequate program. It is reasonable to assume that the State will apply its regulatory process to all small projects, even those like Gartina Falls where FERC does not have jurisdiction. It is not clear how complicated the state process will be, and therefore there could by some advantage to proceeding with the project permitting under the current process for non-jurisdictional projects. The South Fork Project currently being developed on Prince of Wales Island by Alaska Power & Telephone can be considered a model for the regulatory process for a project that is non-jurisdictional. For South Fork, the following permits have been required:

- Wetlands Permit from the Corps of Engineers
- Water rights from the Alaska Department of Natural Resources (ADNR)
- Section 401 Water Quality Certification from the Alaska Department of Environmental Conservation (ADEC)
- Coastal Zone Management Consistency Determination (ADNR). Only part of the transmission line would be in the Hoonah coastal zone, which may limit the complexity of that consistency determination.

Based on AP&T's experience with the South Fork Project, obtaining the necessary permits for construction would probably require 18 to 24 months once a definite project arrangement is developed, assuming one summer season of field studies is necessary.

Water Supply Creek

Project Arrangements of Previous Studies

HydroWest also considered a hydroelectric development on a tributary of Gartina Creek, referred to in their study as Water Supply Creek. Water Supply Creek flows north and northeast into Gartina Creek a few hundred feet above Gartina Falls. About 2,500 feet above that confluence, the City of Hoonah diverts water for a municipal water supply. The land is entirely Sealaska Corporation land. The arrangement proposed by HydroWest includes the following:

- A concrete and rockfill diversion dam at about El 800 that raises the water surface about 8 feet. An intake structure would be located on the east abutment.
- A power conduit consisting of 4,000 feet of 24-inch diameter HDPE pipe and 1,500 feet of 20-inch diameter steel pipe. The power conduit would be located adjacent to an existing logging road for much of its length.
- A powerhouse located just below the existing water supply diversion. The powerhouse would have a single 600-kW generating unit. The power plant would discharge back to the pond behind the water supply diversion dam.
- A transmission line about 4.1 miles long to connect to the existing IPEC system near the airport. Note that if both the Gartina Falls and Water Supply Creek projects are developed, the cost of most of the transmission line would be shared.
- An access road about 1,300 feet long from the end of existing logging road to the diversion structure.

The construction cost for the HydroWest arrangement was estimated to be $3.1 million. Note that the City of Hoonah began collecting streamflow data just upstream of the water supply diversion in spring 2003 as the first step in a more serious consideration of developing the site.

Potential Generation

The potential generation of the Water Supply Creek Project was estimated by HydroWest to be about 1,800 MWh per year, which is approximately 40% of the current Hoonah load. HydroWest did not estimate the amount of that potential generation that would actually be usable. There should be little problem absorbing all or nearly all of the potential generation into the Hoonah system.

Environmental Assessment

There are no issues known at this time that would prevent the development of the Water Supply Creek project. If subsequent surveys determine that there is a significant population of resident fish in the creek between the diversion and the powerhouse, then some regulatory agencies want to impose an instream flow requirement, which would seriously jeopardize the project’s feasibility. The project is judged to have a high potential for environmental feasibility.

Economic Assessment

The estimated construction and annual operating costs of the Water Supply Creek Project as described above are shown in Table 22 and the results of the economic analysis are shown in Figure 24.

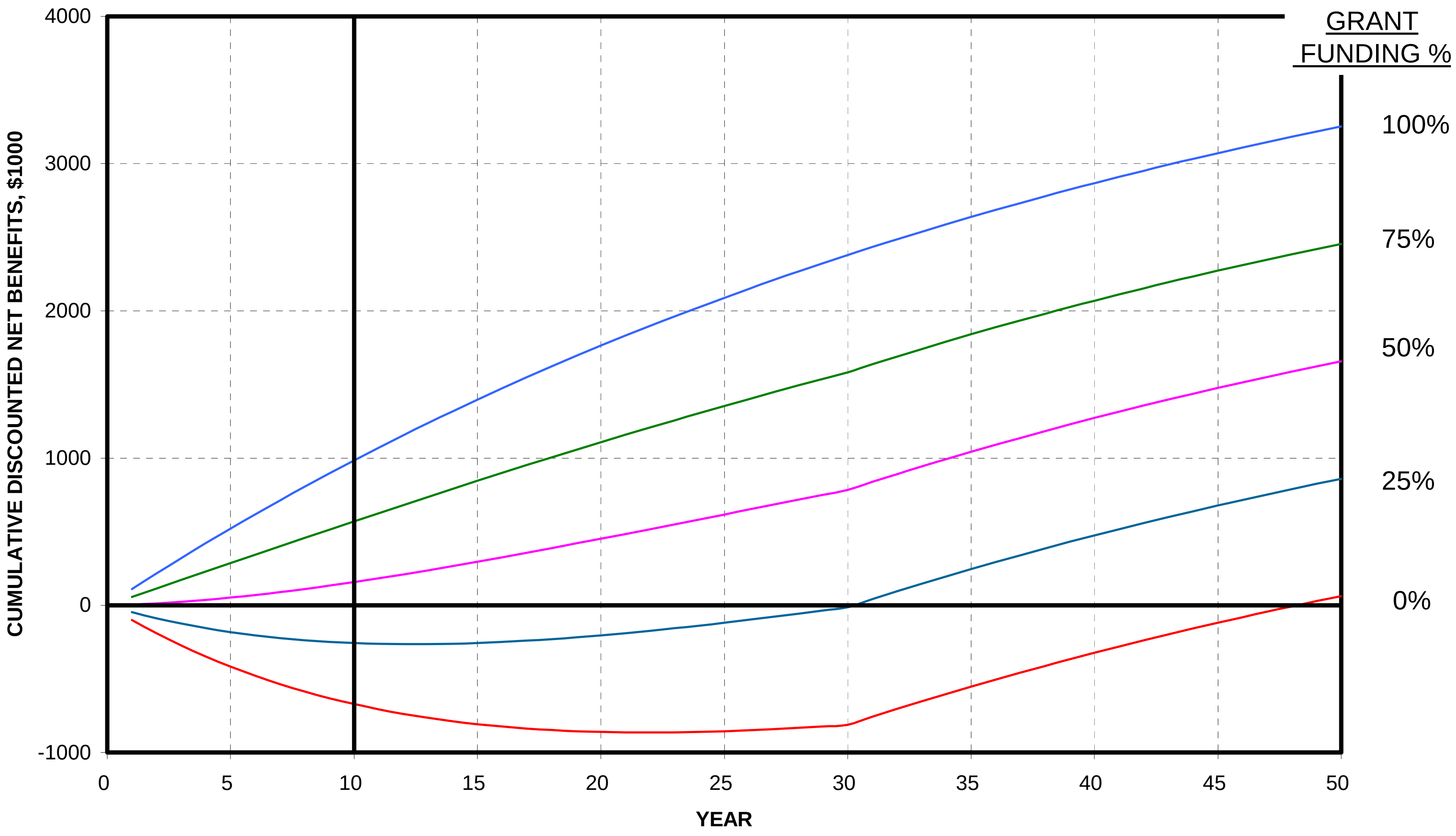
Table 22, Gartina Falls and Water Supply Creek Hydro Projects (Hoonah) Summary of Project Costs

		Project Arrangement	
CONSTRUCTION COST (2002 Cost Level)		Gartina Falls	Water Supply Creek
FERC Account	Description	Amount	Amount
330	Land and Land Rights	$ -	$ -
330.5	Mobilization and Logistics	$ 76,000	$ 67,000
331	Structures and Improvements	$ 330,000	$ 178,000
332	Reservoirs, Dams, and Waterways	$ 836,000	$ 814,000
333	Turbines and Generators	$ 325,000	$ 299,000
334	Accessory Electrical Equipment	$ 215,000	$ 215,000
335	Miscellaneous Mechanical Equipment	$ 75,000	$ 75,000
336	Roads and Bridges	$ 73,000	$ 61,000
353	Substation Equipment and Structures	$ 100,000	$ 100,000
355	Transmission Line	$ 280,000	$ 287,000
SUBTOTAL		$ 2,310,000	$ 2,096,000
	Contingencies	$ 578,000	$ 524,000
TOTAL DIRECT CONSTRUCTION COST		$ 2,888,000	$ 2,620,000
	Permitting and Engineering	$ 775,000	$ 625,000
TOTAL INVESTMENT COST (2002 Cost Level)		$ 3,663,000	$ 3,245,000
	Escalation (Approx. 2.3%)	$ 87,000	$ 75,000
TOTAL INVESTMENT COST (2003 Cost Level)		$ 3,750,000	$ 3,320,000

		Project Arrangement	
OPERATING COSTS (2002 Cost Level)		Gartina Falls Amount	Water Supply Creek Amount
	Incremental Labor	$ -	$ -
	Transportation	$ -	$ -
	Other Operating Costs (1)	$34,000	$34,000
TOTAL OPERATING COSTS (2002 Cost Level)		$ 34,000	$ 34,000
	Escalation (Approx. 2.3%)	$ 1,000	$ 1,000
TOTAL OPERATING COSTS (2003 Cost Level)		$ 35,000	$ 35,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

Figure 24, Water Supply Creek Project (Hoonah) Economics Summary



As can be seen from Figure 24, the Water Supply Creek Project appears to be economical if approximately 40% of its cost can be funded with grants (i.e. $1,300,000 in grants). This indicates a moderate potential for economic feasibility.

<u>Joint Development</u>

The HydroWest study concluded that only one of the two projects should be developed, as there was insufficient load in Hoonah to justify both. That conclusion did not take into consideration the Point Sophia development, which is expected to add considerable load. It is quite possible that development of both projects can be justified when the Point Sophia load is considered, but more detailed study of the timing of the loads and generation would be required. Joint development would decrease the construction cost somewhat, and if the projects were developed sequentially, could provide construction employment for a number of Hoonah residents for 3 - 4 years.

Interconnection Potential

Alaska Electric Light & Power (AELP), the utility serving Juneau, has proposed to construct an intertie between Juneau and Hoonah through Greens Creek. AELP is also proposing to develop the Lake Dorothy Hydroelectric Project, which would produce the power needed to supply the Greens Creek mine and Hoonah. In 2003, D. Hittle & Associates evaluated the feasibility of such an intertie. That report determined that the cost of power to Hoonah would be about 9.6 ¢/kWh in 2007, based on the following key assumptions:

- The construction cost of the intertie ($37.1) million would be funded by grants.
- The interconnection to Hoonah would be complete in 2007.
- The allocated operating costs of the intertie would be about $61,000 in 2007, including operation and maintenance, administrative and general, and reserves and replacement fund expenses.
- The busbar cost of power from Lake Dorothy would be about 8.5 ¢/kWh in 2007.

It is impossible at this time to determine whether these assumptions are realistic. If they are, then the interconnection would provide power to Hoonah at a rate that is substantially cheaper than diesel generation. However, the following circumstances should be noted:

- Power from Lake Dorothy may not be firm in the long term, as AEL&P's first priority may be to supply Juneau loads.
- Hoonah's loads are small compared to the Greens Creek mine loads, but the cost of the line from Greens Creek to Hoonah is relatively high. Thus, there is less economic incentive for the Greens Creek-to-Hoonah segment than there is for the Juneau-to-Greens Creek segment. If funding is difficult to obtain, the Greens Creek-to-Hoonah segment could be sacrificed.
- Hoonah's cost of power with the intertie could go up substantially when the Greens Creek mine ceases operation, since Hoonah would need to pay the O&M cost for the entire intertie.
- If the Hoonah hydroelectric projects were evaluated on the same basis (i.e. 100% grant funding), then their cost of power would be even less than the intertie.

- Construction of the Hoonah hydroelectric projects does not necessarily preclude the construction of the intertie.
- Development of the projects could be viewed as an alternative to construction of the Greens Creek-Hoonah link of the Southeast Intertie. If viewed in that context, the economics of the hydro projects are highly favorable. However, there would still be a need for a substantial amount of diesel generation in Hoonah.

3.3.3 Hydaburg

Existing Power Supply

AP&T currently supplies electric power to Hydaburg, which is generated at a plant in town with diesel generators. The power plant capacity is 1,085 kW, and the cost of power to Hydaburg citizens in 2003 was 13.49 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 4.81 ¢/kWh). Power is distributed by an overhead system. The annual energy requirement has been about 1,500 MWh.

AP&T has started construction of a transmission line linking Hydaburg to the Craig/Klawock system. Once that line is complete (expected to be in 2005), the Hydaburg loads will be served primarily by AP&T's hydroelectric projects (Black Bear Lake and the soon-to-be-constructed South Fork project). The existing Hydaburg diesel plant will be kept in reserve for use in the event the transmission line needs repair.

Hydroelectric Potential

General

In October 2000, Haida Corporation, the village corporation for Hydaburg, received a FERC license to construct and operate the Reynolds Creek Hydroelectric Project, located approximately 8 miles east of Hydaburg. As currently planned and licensed, the Reynolds Creek Project will be constructed in two phases. The first phase is planned for a capacity of 1.5 MW, and the second phase will add 3.5 MW. The intent of the first phase was to supply the local Hydaburg loads, and the second phase would be to supply load growth on the remainder of Prince of Wales Island.

Because of the imminent interconnection of Hydaburg, and because growth on Prince of Wales Island has leveled off dramatically in the last few years, there will be no need for the energy from the Reynolds Creek Project for several years at least. Therefore, Hydaburg is attempting to obtain a legislative remedy to avoid losing the FERC license (which typically requires completion of construction within a few years of the license issuance).

Note that Larry Coupe worked on the licensing of the Reynolds Creek Project while employed by HDR Engineering, consultant for Haida Corporation.

Potential Modifications to the Project Arrangement

Assuming that Haida Corporation is successful in preserving its FERC license, and assuming that load growth picks up on Prince of Wales Island, then the Reynolds Creek Project is the next logical addition to the Prince of Wales hydro system. However, it may be more economical to develop the entire 5 MW capacity at once rather than the two-phased arrangement as licensed.

That change should not require an extensive revision of the license, since the FERC environmental analysis evaluated the effects of the entire project. Constructing the entire 5 MW capacity could be accomplished with a single generating unit, which would decrease the cost somewhat.

Environmental Assessment

The major environmental issues of the Reynolds Creek Project as evaluated in the FERC licensing are the potential impacts to:

- Arctic grayling in Lake Mellen.
- Resident fish in the bypassed reach between Lake Mellen and the powerhouse.
- Anadromous fish in the stream reach below the powerhouse (the powerhouse is located at the anadromous barrier).

Mitigation measures for these potentials impacts included in the license are as follows:

- Restrictions on use of Lake Mellen for storage to preserve grayling spawning in tributary streams.
- Screens at the power intake to prevent grayling from being entrained in the diversion to the power plant.
- Instream flow requirements for the bypassed reach (10 cfs).
- Instream flow requirements for the anadromous reach (varying from 25 to 50 cfs).
- Restrictions on rate of change of flow by the power plant (also known as the ramping rate).

The Reynolds Creek Project is judged to have a high potential for environmental feasibility because the issues have all been resolved through the FERC licensing process, and there is the potential for reducing economic impact of the environmental mitigation measures.

Potential Generation

HDR calculated the potential generation of the Reynolds Creek Project to be 11,500 MWh with the 1500 kW Stage I development, and 23,500 MWh with the both the Stage I and Stage II developments. Changes in the instream flow requirements may change the values somewhat, but 23,000 MWh is considered to be a reasonable estimate of the generation if Reynolds Creek Project is constructed in a single phase, as described above.

Economic Assessment

The estimated construction and annual operating costs of the Reynolds Creek Project as described above are shown in Table 23 and the results of the economic analysis is shown in Figure 25. The construction costs are based on a review and adjustment of the HDR cost estimate to a 2003 cost level, and to eliminate the staged construction, as described above. The economic analysis is based on an on-line date of 2015, which assumes Haida Corporation receives a 12-year extension to the required start of construction. Delaying the construction is necessary because of the current low loads on Prince of Wales Island.

Haida Corporation has been allocated approximately $4,000,000 in federal grant funds to help defray the cost of construction. Even with that amount of grant funding, the Reynolds Creek Project will not be economical if there is little load to be served.

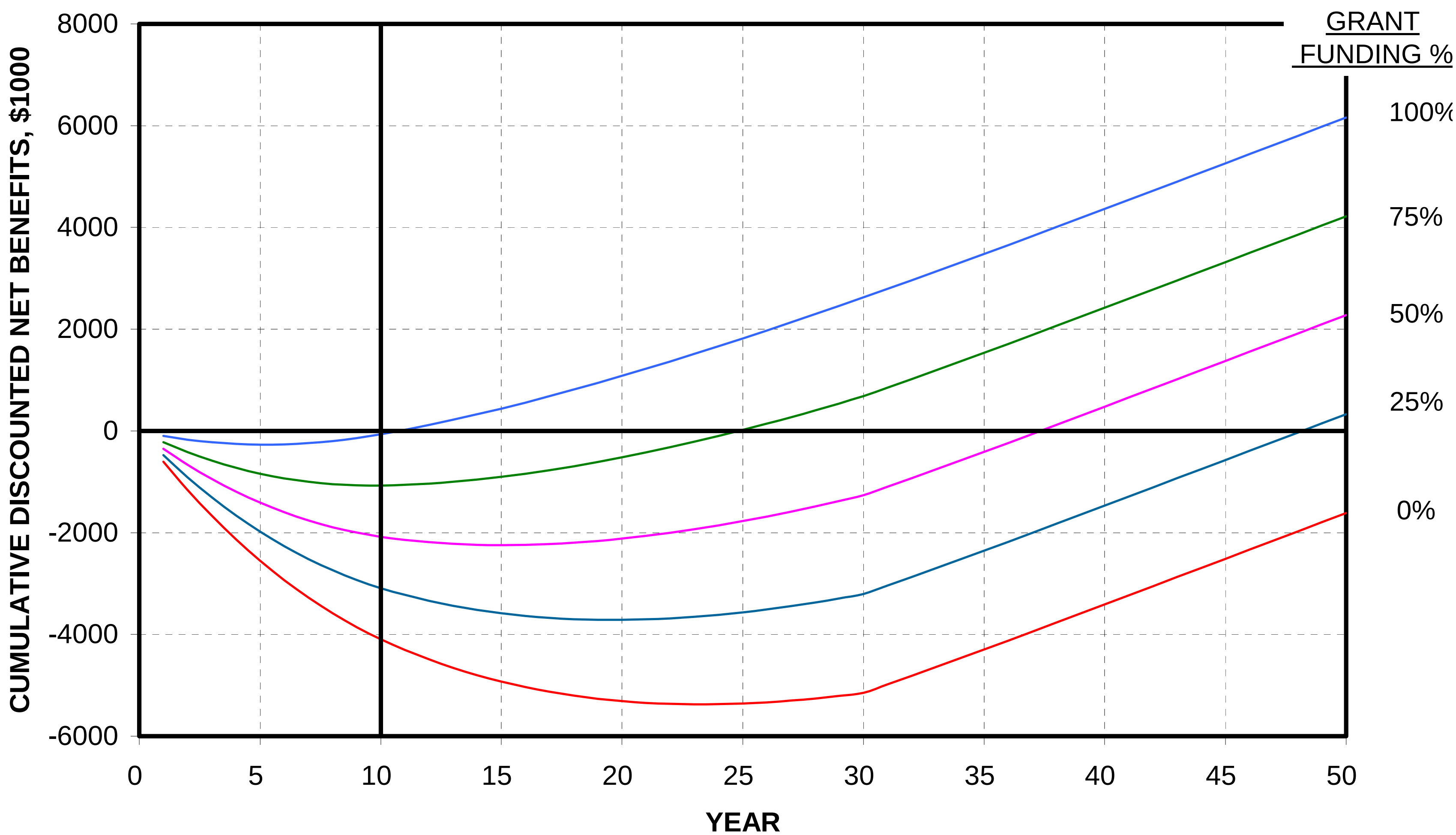
Table 23, Reynolds Creek Hydro Project (Hydaburg) Summary of Project Costs

		Project Arrangement	
		HDR Stage I	Revised
CONSTRUCTION COST (Cost Level 1999)		(1500 kW)	(5000 kW)
FERC			
Account	Description	Amount	Amount
330	Land and Land Rights	$ -	$ -
330.5	Mobilization and Logistics	$ 500,000	$ 500,000
331	Structures and Improvements	$ 400,000	$ 570,000
332	Reservoirs, Dams, and Waterways	$ 827,000	$ 827,000
333	Turbines and Generators	$ 1,100,000	$ 1,500,000
334	Accessory Electrical Equipment	$ 15,000	$ 315,000
335	Miscellaneous Mechanical Equipment	$ 20,000	$ 50,000
336	Roads and Bridges	$ 200,000	$ 200,000
353	Substation Equipment and Structures	$ 72,000	$ 202,000
355	Transmission Line	$ 2,045,000	$ 2,045,000
SUBTOTAL		$ 5,179,000	$ 6,209,000
	Contingencies	$ 817,000	$ 943,000
TOTAL DIRECT CONSTRUCTION COST		$ 5,996,000	$ 7,152,000
	Permitting and Engineering	$ 1,400,000	$ 1,400,000
TOTAL INVESTMENT COST (1999 Cost Level		$ 7,396,000	$ 8,552,000
	Escalation (Approx. 10.4%)	$ 804,000	$ 848,000
TOTAL INVESTMENT COST (2003 Cost Level		$ 8,200,000	$ 9,400,000

		Project Arrangement	
		HDR Stage I	Revised
		(1500 kW)	(5000 kW)
	Cost level	2003	2003
OPERATING COSTS		Amount	Amount
	Incremental Labor		$ 36,000
	Transportation		$ 18,000
	Other Operating Costs (1)		$ 109,000
TOTAL OPERATING COSTS (2003 Cost Level)		$ -	$ 163,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental miti

Figure 25, Reynolds Creek Project (Hydaburg) Economic Summary



As can be seen from Figure 25, the Reynolds Creek Project appears to be economical only if 100% of its cost can be funded with grants, or if there is substantial load growth on Prince of Wales Island, such as from a new industrial development. Thus, the Reynolds Creek Project is judged to have a low potential for economic and financial feasibility.

Regulatory Assessment

The Reynolds Creek Project has already received a FERC license and various state permits. If Haida Corporation proceeds with the project in the future, it could elect for regulation by the State rather than FERC in accordance with the Energy Act of 2000, which transfers regulatory authority from FERC to the State for project of 5 MW capacity or less. Should Haida Corporation wish to try to modify any of the license conditions, it could also be either under FERC regulation or State regulation, assuming the amendment process is started after the State institutes its regulatory program.

Interconnection Potential

As noted earlier, Hydaburg will soon be interconnected to the Alaska Power & Telephone's system on Prince of Wales Island. Also, the 1998 Acres update study for the Southeast Intertie suggested that a link between Ketchikan and Prince of Wales Island should occur in the 2025 time frame. If this link were constructed, it would hydro projects on Prince of Wales Island to generate to meet loads in the interconnected Southeast system. The construction cost was estimated to be about $39 million in 1996 dollars.

Project will not be economical if there is little load to be served. AP&T's interconnected load on Prince of Wales Island (including the planned interconnections to Hydaburg and Hollis) is currently about 26.0 GWh. AP&T's hydroelectric generation capability from the Black Bear Lake Project and the planned South Fork Project is about 30 GWh. Load growth has been very limited in the last few years, however, for purposes of this economic analysis, load growth has been forecast as follows:

As can be seen from Figure 25, the Reynolds Creek Project appears to be economical only if 100% of its cost can be funded with grants, or if there is substantial load growth on Prince of Wales Island, such as from a new industrial development. Thus, the Reynolds Creek Project is judged to have a low potential for economic and financial feasibility.

3.3.4 Kake

Existing Power Supply

IPEC currently supplies electric power to Kake, which is generated at a plant in town with diesel generators. The power plant capacity is 2,585 kW, and the cost of power to Kake citizens in 2003 was 14.54 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 18.21 ¢/kWh). Power is distributed by an overhead system. The annual electrical energy requirement has been about 4,200 MWh.

Hydroelectric Potential

Hydroelectric potential in the Kake area has been the subject of at least two studies, as follows:

- Preliminary Appraisal Report on the Hydroelectric Potential for the Villages of Angoon, Craig, Hoonah, Hydaburg, Kake, Kasaan, Klawock, Klukwan, Pelican, and Yakutat; September 1977 by R. W. Retherford Associates.
- Cathedral Falls Project, A Reconnaissance Report; October 1979 by Harza Engineering Company

Gunnock Creek

Project Arrangements of Previous Studies

Gunnock Creek flows through Kake into Keku Strait, and has a drainage area of about 11.5 sq. miles. Retherford considered Gunnock Creek as a potential hydroelectric site, and developed a project arrangement with two dams, 14,500 acre-foot storage reservoir, 2800-foot long pipeline, and 1800 kW power plant. On the basis of the Retherford study, the Alaska Power Authority contracted with Harza Engineering to study the Gunnock Creek site. Harza's initial studies of the site concluded that the cost of the Gunnock Creek project would be much higher than estimated by Retherford. The Gunnock Creek site was then dropped in favor of the Cathedral Falls site, which had also been identified by Retherford.

Potential Modifications of Previous Project Arrangements

Harza's evaluation of the Gunnock Creek development as proposed by Retherford undoubtedly holds true today. However, we understand that the Corps of Engineers will include an outlet in the new water supply dam that could be used for the addition of a generating plant, but they are not planning on pursuing power development as part of the dam. Much of the water available at the dam is piped downstream for the hatchery, and therefore the greatest generation would be obtained if a power plant were constructed near the hatchery that would make use of the additional head and flow. Assuming a hydraulic capacity of 60 cfs and a generating head of 125 feet, the capacity of a power plant at the hatchery would be about 500 kW.

Salmon are reported to spawn in Gunnock Creek as far upstream as the water supply dam. Development of the power plant at the hatchery could have a detrimental impact on natural spawning and rearing in Gunnock Creek if the diversion rate is greater than the current hatchery withdrawal. Also, the hatchery may not be agreeable to a power plant since it could result in a colder water supply to the hatchery. Consequently, the most practicable use of Gunnock Creek for generation is likely to be a small generator at the water supply dam, discharging to the stream directly below the dam. The capacity would be quite small (perhaps 25-50 kW), but the installation cost should be small as well. The feasibility of such an installation has not been evaluated herein because it will depend to a great degree on the arrangement of the facilities in the dam, and that information is not currently available. Once the details of the dam design are known, we recommend a detailed feasibility study, as there is likely to be a high potential for it being cost-effective.

Cathedral Falls Creek

Project Arrangements of Previous Studies

Cathedral Falls Creek flows into Hamilton Bay about 10 miles south of Kake. Retherford considered Cathedral Falls Creek as a hydroelectric site because of the existence of a moderate height waterfall. Retherford suggested a project with a 70-foot-high concrete dam, a 2000-foot long penstock, and a powerhouse at the base of the falls with a capacity of around 2000 kW. However, Retherford did not prepare a cost estimate of cost of power analysis, as they focused on the Gunnock Creek site.

Harza's arrangement for the Cathedral Falls site included a 27-foot-high concrete dam at the head of the falls, a 210-foot-long, a 9-foot-diameter tunnel 360 feet long, a 78-inch diameter penstock 470 feet long, and a 2-unit 750-kW power plant at the base of the falls. Harza estimated the construction cost to be $7.1 million. Harza's plan provided for future expansion of the powerhouse to include 2 additional generating units for an ultimate capacity of 1,500 kW.

Potential Modifications of Previous Project Arrangement

The following modifications to the Harza project arrangement are likely to result in a more economical project:

- Minimize the height of the diversion dam.
- Construct the dam with a concrete core wall and grouted rockfill rather than all concrete. Incorporate a sluice gate for removing accumulated sediment.
- Construct the tunnel and penstock with a microtunnel boring machine, and decrease the diameter to 4 feet.
- Utilize Ossberger-type generating units in the power plant to allow more efficient use of the available flow.

The generating capacity of this modified arrangement would be 1,000 kW, with no future expansion potential. The intake would probably need to be screened if there are resident fish above the falls. Likewise, a screened tailrace would probably be needed to protect anadromous fish below the falls. The drainage basin above the falls appears to be relatively flat, but the stream appears to be somewhat incised. Harza indicated storage could not be developed at the damsite, however, they did not indicate if storage could be develop elsewhere in the basin. One intriguing possibility is to develop a reservoir in the Goose March area on Slo Duc Creek, with a diversion from Cathedral Falls Creek. Water from Cathedral Falls Creek and Slo Duc Creek could be stored during high flow periods, then released to Cathedral Falls Creek for generation, possibly through a second power plant. This concept has not been reviewed in detail, as the available topographic mapping is not sufficiently detailed. If development of the Cathedral Falls site is pursued, we recommend that this storage option be explored in more detail.

Potential Generation

Harza estimated the annual generation with their arrangement to be about 3.45 GWh. With the revised arrangement as described above, the average annual energy potential is estimated to be 3,300 MWh, assuming no requirement for instream flows in the bypassed reach.

Environmental Assessment

Anadromous fish utilize Cathedral Falls Creek extensively below the fall. Because the project will operate in a run-of-river mode and return flow at the base of the falls, impacts to the anadromous fish population would be insignificant. However, it is reasonable to expect regulatory agency concern for the anadromous population and adoption of several measures to ensure minimal impact. The measures could include:

- Screened tailrace design
- Immediate release of flow at the diversion site whenever the power plant trips offline.
- Rate-of-change restrictions on the power plant discharge.

The Harza report does not indicate if there are resident fish in Cathedral Falls Creek above the falls. Based on the topography, it is reasonable to expect the stream to be capable of supporting a sizable resident population. Screening of the power intakes is likely to be required to prevent losses to any resident population.

It is unknown whether there are significant aesthetic or cultural issues that would be associated with diminishing flow over the falls.

There do not appear to be any environmental issues that would prevent development of a run-of-river project at Cathedral Falls, but a moderate amount of environmental mitigation would be required. Therefore, the Cathedral Falls Project is judged to have a moderate potential for environmental feasibility.

Economic Assessment

The estimated construction annual operating costs of the Cathedral Falls Project as described above are shown in Table 24 and results of the economic analysis are shown in Figure 26. The construction costs are based on a review and adjustment of the Harza cost estimate. The earliest possible on-line date is estimated to be 2009, considering the current status of the development effort. As can be seen from Figure 26, the Cathedral Falls Project appears to be economical if approximately 55% of its cost can be funded with grants (i.e. grants totaling about $2,900,000 would be required). This indicates a moderate potential for economic and financial feasibility.

Regulatory Assessment

Some or all of the land occupied by the Cathedral Falls site is in the Tongass National Forest. In other states, occupying US land automatically results in jurisdiction by the Federal Energy Regulatory Commission. However, the State of Alaska will begin regulation of small hydro projects in the state once it develops and receives approval of its own regulatory program. The state has just begun developing its program, so it is too early to tell how complicated or expensive it will be.

Interconnection Potential

The 1998 Acres update study for the Southeast Intertie suggested that the link between Petersburg and Kake should occur in the 2011 to 2015 time frame. The transmission link would allow sale of surplus power from the Tyee Lake hydro project to IPEC to serve Kake loads. The construction cost was estimated to be about $19.7 million in 1996 dollars.

In 2003, D. Hittle & Associates evaluated the feasibility of the Petersburg-Kake transmission line. Their report concluded that the cost of power to Kake would be about 9.6 ¢/kWh in 2007, based on the following key assumptions:

- The construction cost of the intertie ($23.1 million) would be funded entirely by grants.
- The interconnection to Kake would be complete in 2007.
- The operating costs of the intertie would be about $255,000 in 2007, including operation and maintenance, administrative and general, and reserves and replacement fund expenses.
- The busbar cost of power from the Tyee Lake Project would be about 4.0 ¢/kWh in 2007.

It is impossible at this time to determine whether these assumptions are realistic. If they are, then the interconnection would provide power to Kake at a rate that is substantially cheaper than diesel generation. However, the following circumstances should be noted:

- Power from Tyee Lake may not be firm in the long term, as the first priority will be to supply Petersburg & Wrangell loads, and then Ketchikan loads as a second priority.
- The preferred route of the transmission line is overland and away from the coast. However, there is a separate proposal to construct a road linking Kake to Petersburg that would follow the coastline. If the road were constructed, there would be some environmental incentive to route the transmission line along the road, even though that might not be the most economical route. This interface with the road complicates and probably delays the transmission line development.
- If the Cathedral Falls hydro project was evaluated on the same basis (i.e. 100% grant funding), then their cost of power would be even less than the intertie.
- Construction of the Cathedral Falls hydro project would not necessarily preclude the construction of the intertie.
- Development of the project could be viewed as an alternative to construction of the Petersburg-Kake link of the Southeast Intertie. If viewed in that context, the economics of the hydro projects are highly favorable. However, there would still be a need for a substantial amount of diesel generation in Kake.

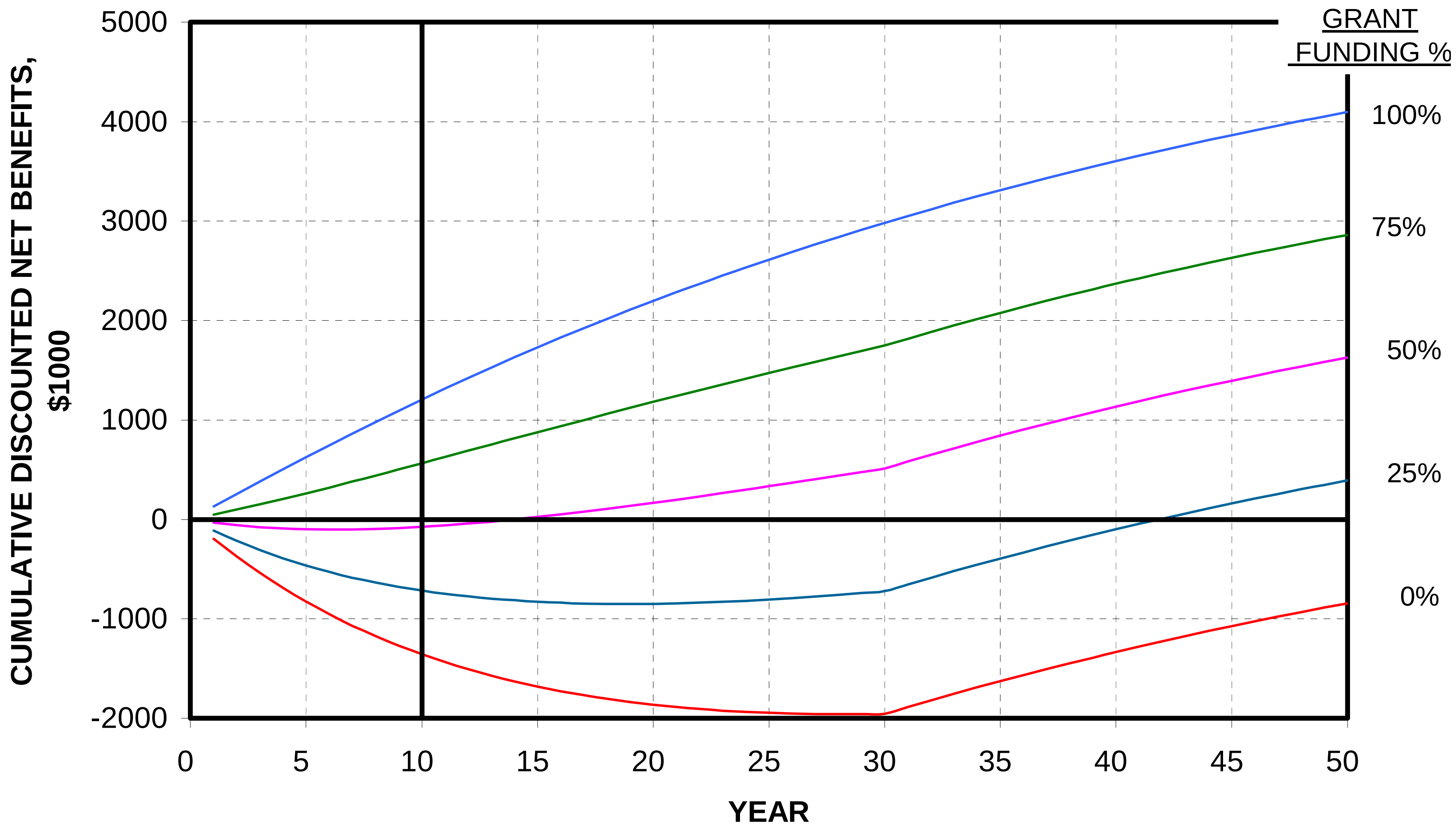
Table 24, Cathedral Falls Hydroelectric Project (Kake) Summary of Project Costs

			Project Arrangement		
CONSTRUCTION COST			Harza		Modified Harza
	Cost level		1979		2003
FERC					
Account	Description		Amount		Amount
330	Land and Land Rights	$	17,000	$	-
330.5	Mobilization and Logistics	$	500,000	$	126,000
331	Structures and Improvements	$	126,000	$	204,000
332	Reservoirs, Dams, and Waterways	$	2,800,000	$	1,500,000
333	Turbines and Generators	$	320,000	$	600,000
334	Accessory Electrical Equipment	$	-	$	295,000
335	Miscellaneous Mechanical Equipment	$	82,000	$	70,000
336	Roads and Bridges	$	444,000	$	90,000
353	Substation Equipment and Structures	$	-	$	65,000
355	Poles and Fixtures	$	497,000	$	720,000
SUBTOTAL		$	4,786,000	$	3,670,000
	Contingencies	$	1,197,000	$	918,000
TOTAL DIRECT CONSTRUCTION COST		$	5,983,000	$	4,588,000
	Permitting and Engineering	$	1,117,000	$	712,000
TOTAL CONSTRUCTION COST		$	7,100,000	$	5,300,000

		Project Arrangement		
		Harza		Modified Harza
Cost level		1979		2003
OPERATING COSTS		Amount		Amount
Incremental Labor			$	-
Transportation			$	10,000
Other Operating Costs (1)	$	40,000	$	40,000
TOTAL OPERATING COSTS	$	40,000	$	50,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

Figure 26, Cathedral Falls Project (Kake) Economics Summary



3.3.5 Klukwan/Chilkat Valley

Existing Power Supply

IPEC currently supplies electric power to Klukwan and the Chilkat Valley. Most of the generation is from hydro, which is purchased from an independent developer. The cost of power to Klukwan residents in 2003 was 14.54 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 18.21 ¢/kWh). For Chilkat Valley residents, the 2003 cost of power was 16.29 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 18.21 ¢/kWh). The annual energy requirement for Klukwan and the Chilkat Valley has been about 1,600 MWh.

Interconnection Potential

AP&T is planning construction of a transmission line linking IPEC's Chilkat Valley system and Klukwan to the Haines/Skagway system. Once that line is complete (expected to be in 2006), the Klukwan loads will be served primarily by hydroelectric projects (AP&T's Goat Lake and the soon-to-be-constructed Kasidaya Creek projects, and the Lutak Hydro project near Haines). The existing Klukwan diesel plant will be kept in reserve for use in the event the transmission line needs repair.

Hydroelectric Potential

Previous Studies

In 1988, Ott Water Engineers conducted a reconnaissance-level feasibility study of a Walker Lake hydroelectric project for the Alaska Power Authority. Walker Lake is located 8 miles west of Klukwan at about El 1180. It has a surface area of about 120 acres. It's depth is unknown, but based on the area topography it is probably fairly shallow. The outlet stream, Walker Creek, flows into the Little Salmon River, which then flows into the Tsirku River at about El 250.

Ott considered five alternative configurations for the Walker Lake project, three of which were for supplying power to Klukwan only, and two of which were for supplying power to Klukwan and Haines. Because Klukwan will be interconnected the Haines-Skagway system soon, any future development of the Walker Lake site would be as a regional resource. Only one of the five alternatives studied by Ott showed any potential for feasibility (designated Alternative 3B by Ott). Coincidentally it is the alternative with the greatest generation potential, and therefore the one most suited for development as a regional resource. Accordingly, this study has concentrated on that one alternative, as described below.

Alternative 3B included the following major features:

- A diversion dam on the Little Salmon River at about El 1250 feet.
- A 5,900-foot long 18-inch diameter buried HDPE pipeline from the Salmon River diversion to Walker Lake
- Two small rockfill dams on Walker Lake to provide storage. One of the dams would include an intake structure.
- A 9,700-foot long 30-inch diameter low-pressure buried steel pipeline from Walker Lake along the hillside to a point above the powerhouse.
- A 2,200-foot long 30-inch diameter exposed steel penstock from the end of the low-pressure pipeline to the powerhouse.

- A powerhouse containing a single generating unit with a capacity of 1900 kW. The generating unit would have a 3-jet impulse turbine, operating under a gross head of about 780 feet and a maximum discharge of 37 cfs. A field trip report included in Ott's report seems to indicate the powerhouse location is near the existing bridge over the Little Salmon River, however the estimated gross head at the site seems to indicate the powerhouse location is a bit farther upstream.
- A 20-mile long 34.5 kV transmission line linking the powerhouse to Klukwan and Haines.
- A switchyard at the powerhouse and a substation in Klukwan.

The construction cost was estimated to be about $10.8 million.

Potential Modifications of Previous Project Arrangements

The Ott report did not include any drawings showing the locations of the various structures; therefore it is difficult to reliably evaluate alternatives. Nevertheless, there do appear to be some modifications that could lessen the cost:

- Instead of diverting the flow of the Little Salmon River in a separate pipeline to Walker Lake, the diversion pipeline could join directly to the larger pipeline from Walker Lake to the powerhouse. This would shorten the length from 5900 feet to about 4900 feet.
- Use a siphon intake at the lake rather than a dam (this may not be practical if the lake is shallow near the intake site). AP&T has used siphon intakes at both its Black Bear Lake and Goat Lake projects with good success.
- Use of HDPE instead of steel for the low-pressure pipe from Walker Lake.

The transmission line would only need to be 8 miles long from the powerhouse to Klukwan, as the Klukwan-Haines link will be in existence soon. For purposes of this report, we have assumed the line would be buried construction since it will pass through or near the Chilkat Bald Eagle Preserve.

Potential Generation

The energy potential of the Walker Lake site was estimated by Ott to be 5,430 MWh for Alternative 3B. Generation would be similar with the suggested modifications.

Environmental Assessment

Ott did not address environmental issues, other than to indicate that the overhead transmission line they proposed might not be allowed. The revised project as described above would bypass all of Walker Creek and about two miles of the Little Salmon River. If there are significant fish resources in either of those streams, then development of the Walker Lake site would be difficult. The ADNR Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes indicates that the Little Salmon River has fish in its lower reach, but not in the bypassed reach. However, fish surveys would be necessary to determine the actual extent of fish usage. Because of the lack of any specific information, the environmental feasibility is considered to be unknown.

Economic Assessment

The estimated construction and annual operating costs of the Walker Lake Project as described above are shown in Table 25. The construction costs are based on a review and adjustment of the Ott cost estimate to a 2003 cost level. Note that it appears Ott was quite conservative in its estimate. The earliest possible on-line date is estimated to be 2010 considering the current status of the development effort. However, unless loads grow at an unexpectedly high rate, the interconnected system will have sufficient hydro generation until at least 2020. Because additional hydro generation will not be needed any time soon, an economic analysis has not been conducted for this study, and the economic feasibility is considered to be low.

Regulatory Assessment

The land occupied by the Walker Lake site is in the Haines State Forest Resource Management Area. It is unlikely that the Federal Energy Regulatory Commission (FERC) would currently have jurisdiction.   As noted earlier, the State of Alaska will assume regulatory authority over hydroelectric project of 5 MW capacity or less once they develop an adequate program. It is reasonable to assume that the State will apply its regulatory process to all small projects, even those like Walker Lake where FERC would ordinarily not have jurisdiction.

Table 25, Walker Lake Hydro Project (Klukwan) Summary of Project Costs

CONSTRUCTION COST		Project Arrangement OTT	Modified OTT
	Cost level	1988	2003
FERC Account	Description	Amount	Amount
330	Land and Land Rights	$ -	$ -
330.5	Mobilization and Logistics	$ 193,000	$ 180,000
331	Structures and Improvements	$ 304,000	$ 256,000
332	Reservoirs, Dams, and Waterways	$ 3,093,000	$ 2,572,000
333	Turbines and Generators	$ 920,000	$ 610,000
334	Accessory Electrical Equipment	$ 420,000	$ 295,000
335	Miscellaneous Mechanical Equipment	$ 40,000	$ 60,000
336	Roads and Bridges	$ 603,000	$ 648,000
353	Substation Equipment and Structures	$ 205,000	$ 90,000
355	Poles and Fixtures	$ 787,000	$ -
356	Conductors and Devices	$ 715,000	$ -
358	Underground Conductor & Devices		$ 1,921,000
359	Line Clearing, Mob. And Demob	$ 60,000	$ 60,000
SUBTOTAL		$ 7,340,000	$ 6,692,000
	Contingencies	$ 1,835,000	$ 1,673,000
TOTAL DIRECT CONSTRUCTION COST		$ 9,175,000	$ 8,365,000
	Permitting and Engineering	$ 1,625,000	$ 1,035,000
TOTAL CONSTRUCTION COST)		$ 10,800,000	$ 9,400,000

		Project Arrangement OTT	Modified OTT
OPERATING COSTS (2003 Cost Level)		Amount	Amount
	Incremental Labor	NOT SHOWN IN REPORT	$ -
	Transportation		$ 16,000
	Other Operating Costs (1)		$ 64,000
TOTAL OPERATING COSTS (2003 Cost Level)			$ 80,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

3.3.6 Yakutat

Existing Power Supply

Yakutat Power, a division of the City and Borough of Yakutat, generates and distributes all power in Yakutat. All generation is by diesel engines, with a combined capacity of 2,880 kW. Peak loads are about 1,500 kW, and annual generation is about 7 GWh. Much of the load is from supplying power to two fish processing plants. The cost of power to Yakutat citizens in 2003 was 20.35 ¢/kWh for up to 500 kWh per month (after PCE subsidy of 8.98 ¢/kWh.)

Hydroelectric Potential

The only previous studies of the hydroelectric potential in the Yakutat area was Retherford (1977), which considered only a tidal development at Ankau, a complex of bays about 3 miles west of town. Retherford concluded that a tidal development would not be economical because of the relatively low tide range in Yakutat (about 13 feet maximum).

Information on Yakutat produced by the Alaska Department of Community and Economic Development indicated that Yakutat was interested in exploring the hydroelectric potential of the Chicago Harbor area about 15 miles north of town. In a conversation, Mr. Scott Newlun, Yakutat's Power Manager, indicated they were interested in any generation method that could replace the current diesel generation. A tidal development at Ankau is still under consideration, and some work is being done in that regard by Arctic Pacific Enterprises.

Ankau Tidal Development

The Ankau area would appear to lend itself to any of three types of tidal development:

- A conventional tidal development, where the Ankau channel is closed by a dike and power plant. The turbines would be reversible so generation would occur both on filling and draining of the Ankau basin, but it would be intermittent and variable.
- A two-basin tidal development, where the Ankau/Kardy Lake basin is divided into two pools by a number of dikes, with a power plant located between the two pools. During high tide periods, water would flow from the Gulf of Alaska into the Kardy Lake pool through a sluiceway constructed on the southwest side of the lake; the sluiceway gates would close on the receding tide once the Kardy Lake water level rose to sea level. As the water level in Kardy Lake rises, water would flow through the power plant into the Ankau basin, generating power. Once the water level in the Ankau basin rises above the sea level, a sluiceway in the Ankau channel would open to drain it. With this type of development, a continuous generation pattern can be obtained although it would vary somewhat throughout the day and from day to day. However, the generation would be less than with the conventional development, and the cost would be higher because of the greater number of structures. Preliminary calculations indicate the average output from tidal energy would be around 250 kW, generating about 2.2 GWh per year. The runoff into the Kardy Lake basin would provide some additional generation, perhaps 0.5-1.0 GWh per year.
- A tidal current development, where a number of turbines are anchored in the Ankau channel to make use of the energy of the moving water. This type of development

would cause the least impact to the Ankau basin, but would also have the least generation.

Because of the low tide range, power from any conventional tidal development will be very expensive unless substantially subsidized. A tidal current development may be the most practicable, although the generating equipment for such an application is still experimental, and environmental impacts are largely unknown. ADNR's Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes indicates that the Ankau-Kardy Lake system is utilized by anadromous fish. It may be very difficult to obtain the necessary permits for any project that could have negative impacts to anadromous fish.

Conventional Hydroelectric Projects

No previous studies have located small conventional hydroelectric projects near Yakutat, although an Alaska Energy Authority database indicates some analysis of a 300 MW development on the Alsek River. For the current study, a search was made using USGS topographic maps to look for sites that might have hydroelectric potential, generally focusing on the Chicago Harbor area, as that area was identified by Yakutat Power as having potential. Two sites were located, as discussed below. Note that neither of these sites has been visited and the USGS maps have a 100' contour interval, therefore the analyses should be viewed with caution.

Chicago Harbor - An unnamed stream drains the western slopes of Mt Tebenkof and flows into Yakutat Bay at Chicago Harbor, approximately 15 miles north of Yakutat. A relatively broad basin occurs at about the 500' elevation, and the stream below that basin is quite steep. It is impossible to tell from the mapping if there is storage potential in the basin, therefore a run-of-river project has been assumed. The drainage area is estimated to be 4.2 square miles.

The selected project arrangement includes the following features:

- A low diversion dam at about El 450.
- A 36-inch diameter low pressure pipeline about 3400 feet long traversing the hillside from the diversion dam to the west.
- A 30-inch diameter high-pressure penstock about 1200 feet long dropping down the hillside from the end of the low-pressure pipeline to the power plant.
- A power plant near the mouth of the creek, containing a single impulse turbine and generator rated 1400 kW at a flow of 50 cfs and a net head of 410 feet.
- A boat ramp for construction and operation access.
- An access road about 1.6 miles long from the boat ramp to the power plant and diversion dam.
- A transmission line consisting of 12.5 miles of submarine cable from the power plant to the Sawmill Cove northeast of Yakutat, and 2.5 miles of overhead line from Sawmill Cove to Yakutat.
-

The hydraulic capacity of the project is estimated to be 50 cfs, which would be exceeded about 20% of the time, based on factoring of flow records for the Situk River. Note that actual flows may be greater than estimated for the subject stream because its drainage basin is relatively higher in elevation than the Situk River. On the other hand, the subject stream may be flashier than estimated, because the Situk River drainage includes a large lake and many ponds, which tend to even out the flows. Installation of a stream gage and developing more detailed topographic mapping would be important first steps in evaluating this site.

Lake Redfield - Lake Redfield is a lake located about 9 miles northeast of Yakutat and about 4.5 miles south of Chicago Harbor. The lake has a surface area of about 800 acres, and the surface is at about El 150. The surrounding area is quite flat and very marshy. The outlet stream from the lake flows through a series of ponds for about 4,000 feet before dropping to Yakutat Bay. The USGS map indicates the last 600 feet of stream drops 100 feet, which could make for a small hydroelectric site. The site is particularly appealing because of the possibility of utilizing and/or developing storage at the lake.

Because of the wide contour spacing and flat terrain, it is not possible to accurately determine the drainage area or storage potential. For this study, the drainage area has been estimated to be 7 square miles, which would provide an average flow of about 60 cfs. Good regulation of the stream flow could be accomplished with storage of about 15,000 acre-feet, which could be gained by raising the lake level about 15 feet. If the plant were sized to provide a generating capacity of 1,500 kW, the hydraulic capacity would be about 180 cfs. For purposes of this assessment, the following components have been assumed:

- An earthfill storage dam 500 feet long and 25 feet high.
- A 60-inch diameter low pressure pipeline about 2000 feet long parallel the stream from the dam to the west.
- A 48-inch diameter penstock about 200 feet long dropping down the hillside from the end of the low-pressure pipeline to the power plant.
- A power plant near the mouth of the creek, containing two generating units, each rated 750 kW at a flow of 90 cfs and a net head of 125 feet.
- A boat ramp for construction and operation access.
- An access road about 0.5 miles long from the boat ramp to the power plant and diversion dam.

No transmission line would be required if developed in conjunction with the Chicago Harbor project, as the submarine cable from that project could be conveniently brought ashore in the Lake Redfield area.

<u>Potential Generation</u>

The potential annual generation of the Chicago Harbor site is estimated to be 7,500 MWh, however not all of that generation is likely to be usable, as some of it would occur when loads are low. For purposes of this study, it has been assumed that 60%, or 4,500 MWh would be usable.

The potential annual generation of the Lake Redfield site is estimated on a preliminary basis to be about 3,700 MWh. If the Lake Redfield site was developed as described above, all of the generation would be usable because of the ability to store excess water in the lake.

Environmental Assessment

The topographic maps indicate the land occupied by both projects is in the Tongass National Forest. ADNR's Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes does not indicate anadromous fish usage of the Chicago Harbor stream. If there is a barrier falls near the mouth of the stream, then fish usage may not be an issue. If the anadromous barrier is further upstream, then it may be necessary to move the power plant upstream to the barrier to minimize impacts to fish. Such a move would decrease the generating head and power output. Resident fish populations are often found upstream of barriers falls, and can also be problematic.

Scott Newlun, manager of Yakutat Power has indicated that there is a fairly large run of salmon in the Lake Redfield stream. The ADNR catalog does not show anadromous usage of the outlet stream, but it does indicate Lake Redfield is connected to the Situk River system. If that is the case, then development of Lake Redfield would be very difficult and/or uneconomic.

Economic Assessment

A combined development of the Chicago Harbor and Lake Redfield sites would be able to provide for all or nearly all of the generation requirements of Yakutat. However because of the probable environmental impacts from developing Lake Redfield, we have conducted an economic analysis of only the Chicago Harbor site. The estimated construction and annual operating costs are shown in Table 26 and the results of the analysis are shown in Figure 27. The construction costs are based on the USGS mapping and recent cost estimates for other projects in Southeast Alaska. The earliest possible on-line date is estimated to be 2010 considering the current status of the development effort. As can be seen from Figure 27, the Chicago Harbor Project appears to be economical if approximately 55% of its cost can be funded with grants (i.e. $5,100,000 in grants). This indicates a moderate potential for economic and financial feasibility.

Regulatory Assessment

Some or all of the land occupied by the Cathedral Falls site is in the Tongass National Forest. In other states, occupying US land automatically results in jurisdiction by the Federal Energy Regulatory Commission. However, as described in Section I.C.1, the State of Alaska will begin regulation of small hydro projects in the state once it develops and receives approval of its own regulatory program. The state has just begun developing its program, so it is too early to tell how complicated or expensive it will be.

Interconnection Potential

Because of its extreme isolation, Yakutat is unlikely to be electrically interconnected to any other community in the foreseeable future.

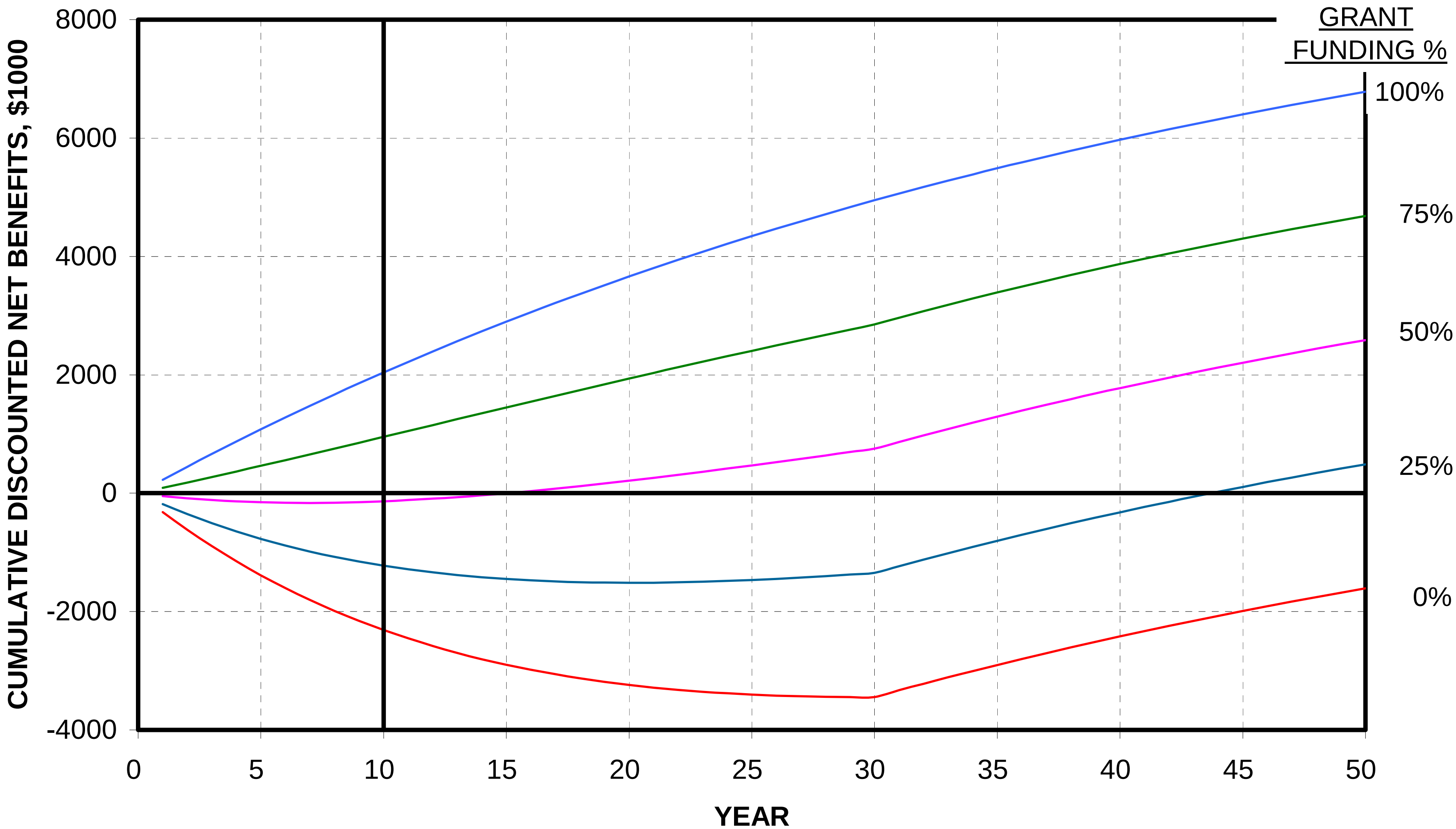
Table 26, Chicago Harbor Hydroelectric Project (Yakutat) Summary of Project Costs

CONSTRUCTION COST (2003 Cost Level) FERC Account	Description		Amount
330	Land and Land Rights	$	-
330.5	Mobilization and Logistics	$	300,000
331	Structures and Improvements	$	180,000
332	Reservoirs, Dams, and Waterways	$	1,060,000
333	Turbines and Generators	$	680,000
334	Accessory Electrical Equipment	$	260,000
335	Miscellaneous Mechanical Equipment	$	110,000
336	Roads and Bridges	$	470,000
353	Substation Equipment and Structures	$	140,000
355	Overhead Transmission Line	$	380,000
358	Submarine Transmission Line	$	2,810,000
SUBTOTAL		$	6,390,000
	Contingencies	$	1,920,000
TOTAL DIRECT CONSTRUCTION COST		$	8,310,000
	Permitting and Engineering	$	990,000
TOTAL CONSTRUCTION COST (2003 Cost Level)		$	9,300,000

OPERATING COSTS (2003 Cost Level)			Amount
	Incremental Labor	$	30,000
	Transportation	$	25,000
	Other Operating Costs (1)	$	55,000
TOTAL OPERATING COSTS (2003 Cost Level)		$	110,000

(1) Includes administration, insurance, taxes, land use feed, interima replacements, and environmental mitigation.

Figure 27, Chicago Harbor Project (Yakutat) Economics Summary



3.3.7 Hydro – Summary of Study

Table 27 contains a summary of the costs and economic an environmental feasibility of new hydroelectric projects that could serve the communities.

Table 27, Summary of New Hydro Power Plants Feasibility

Community	Project	Construction Cost ($2003)	Economic Feasibility	Environmental Feasibility
Angoon	Thayer Creek (1,000 kW)	$8,700,000	Low	Moderate
Hoonah	Gartina Creek (600 kW) Water Supply Creek (600 kW)	$3,750,000 $3,330,000	Moderate Moderate	Moderate High
Hydaburg	Reynolds Creek (5,000 kW)	$9,400,000	Low	High
Kake	Cathedral Falls Creek (800 kW)	$5,300,000	Moderate	Moderate
Klukwan	Walker Lake (1,900 kW)	$9,400,000	Low	Unknown
Yakutat	Chicago Harbor (1,400 kW)	$9,300,000	Moderate	Unknown

Interconnection to another utility is possible for most of these communities, and may be a viable alternative to either diesel or hydroelectric generation. The possible transmission interconnections to the communities are summarized in Table 28.

Table 28, Interconnection Potential Summary

Community	Interconnection Potential
Angoon	Low
Hoonah	Moderate
Hydaburg	High
Kake	Moderate
Klukwan	High
Yakutat	Very low

Combining the most important factors for the feasibility and interconnect probabilities for new hydro facilities yields the results shown in Table 29.

Table 29, Combined Feasibility for Potential Hydro Projects

Community	Project	Economic Feasibility	Environmental Feasibility	Interconnection Potential	Required Grant (% of Cost)
Angoon	Thayer Creek	Low	Moderate	Low	80%
Hoonah	Gartina Creek	Moderate	Moderate	Moderate	45%
	Water Supply Cr.	Moderate	High	Moderate	40%
Hydaburg	Reynolds Creek	Low	High	High	100%
Kake	Cathedral Falls Cr.	Moderate	Moderate	Moderate	55%
Klukwan	Walker Lake	Low	Unknown	High	80%
Yakutat	Chicago Harbor	Moderate	Unknown	Very low	55%

Negative factor (red)
Neutral factor (yellow)
Positive Factor (green)

Hoonah, Kake, and Yakutat appear to have the best potential for new hydro facilities. However, it should be noted that very little work has been done on the Yakutat site, and further field work may result in changes to the assessment.

Appendix A, Final Meteorological Report for Hoonah

(Provided under separate cover)

Appendix B, Final Meteorological Report for Yakutat

(Provided under separate cover)

Appendix C, Southeast Alaska Native Villages Renewable Energy Feasibility Study Wildlife Field Review

(Provided under separate cover)

Appendix D, Evaluation of the Hydroelectric Potential Near Selected Sealaska Communities

(Provided under separate cover)