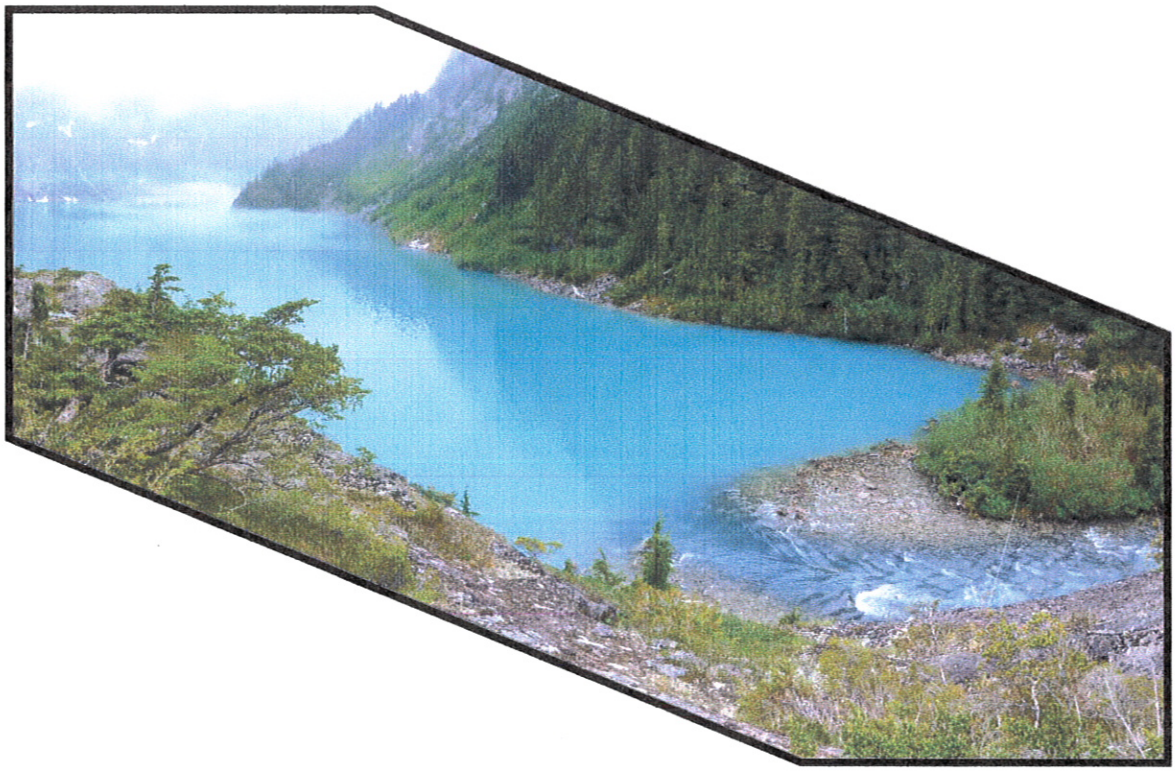
Takatz Lake Hydroelectric Development
Appraisal Study Report



Submitted to:

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SECTION 1 – EXECUTIVE SUMMARY

1.1 Background

Takatz Lake represents one of the best hydroelectric development sites on Baranof Island, with a lake perched at El. 905 ft about a mile from tidewater. The Project was studied extensively by the Alaska Power Administration (APA) in the 1960's. The site has not been developed mainly due to its remote location, about 18 miles from Sitka on the eastern shore of Baranof Island.

In September, 2008, the City and Borough of Sitka (the City) obtained a Federal Energy Regulatory Commission (FERC) preliminary permit (FERC No. P-13234) to study the possible development of Takatz Lake as a hydroelectric generation project. Since 2009, the City has completed a series of site surveys, hydrological analyses, environmental studies, and engineering assessments in and around Takatz Lake and along the electrical transmission corridor to Sitka. This Appraisal Study Report provides a summary of the historical studies conducted, our evaluation of alternatives for developing the dam and powerplant site, and a concept level cost estimate for our preferred development alternative.

1.2 Objectives

The objectives of the Appraisal Study were to 1) develop, based on technical feasibility, a number of development alternatives for the power generating facilities of the Project; i.e., the dam, power conduit and powerhouse and 2) select a Preferred Alternative based on a combination of technical feasibility, energy generation and cost. In addition, we evaluated environmental factors to determine which might affect issuance of necessary licenses and permits, or which might affect project operations and/or economics.

A key element of the Appraisal Study was an examination of whether a phased development of the project is feasible. Construction in phases could reduce initial capital costs while still allowing full development of the site, when electric loads increases merit this. This study sought to confirm that a phased development of the Takatz Lake Project would be technically feasible and cost effective, compared to alternatives previously developed for the Takatz site.

1.3 Hydrology, Environmental Studies and Constraints

With the new stream gage at the outlet of Takatz Lake, the City was able to significantly improve the hydrologic record for Takatz Lake. Prior studies relied on an 18 year record based only on estimated data for sites away from the lake outlet. The improved record spans 28 years including 5 years of actual gage data at the lake outlet. The estimated average outflow from Takatz Lake is 169 cfs based on this 28 year record.

A synopsis of the environmental studies is included at Section 4 and the historical reports are available as an appendix to this report. The upper reaches of Takatz Creek are free of salmonid species, due to a barrier falls 0.73 stream miles (SM) from the mouth of the creek. Takatz Lake does not have a native fish population due to the heavy sediment load in the lake and a lack of habitat and food. Dolly Varden have been observed in the middle reaches of Takatz Creek, below

the lake, where tributaries contribute additional inflow. This area also provides habitat for wildlife and birds. Redirecting flow from Takatz Lake through a power tunnel to a powerhouse at tidewater would reduce flow in these middle reaches. Additional environmental studies have been recommended to gain a better understanding of contribution flows along Takatz Creek.

Recreational and aesthetic resources would be impacted by the development of the Takatz Project in an otherwise undisturbed remote area. Local communities (Sitka, Baranof Warm Springs) and some area businesses have voiced opposition to the Project, mainly related to the electric transmission line route across the island and the possible future road from Sitka to the Baranof Hot Springs area.

The 2008 Tongass National Forest Land and Resource Management Plan (Forest Plan) and the Roadless Rule may continue to restrict certain types of development associated with a hydropower project, such as roads. However, a transportation utility system (TUS) Land Use Designation (LUD) overlay does exist for a potential power transmission and proposed state road corridor across Baranof Island. The proposed Takatz transmission line is situated within this corridor over part of its length. Also, the 2005 Federal Highway SAFETEA-LU Act (Public Law 109-59) established a similar transportation corridor across the island. Limits within the TUS LUD have not been clarified by the Forest Service, U.S. Departement of Agriculture (Forest Service), and will require consultation.

The transmission line has been the source of most major environmental concerns because of its potential inconsistency with the Forest Plan restrictions. Public opposition has centered more on transmission than on generation facilities.

Construction and operation of the generating facilities, while challenging and costly due to remoteness and terrain, could have reduced environmental impacts relative to other locations in southeast Alaska. This is based on the following findings from several years of environmental study:

- Takatz Lake and Takatz Creek upstream of the lake support no fish populations;
- Takatz Creek above a barrier falls near tidewater harbors no anadromous fish populations;
- Salmon populations in Takatz Bay should not be significantly impacted;
- There are no potentially-affected threatened or endangered species in the Project area;
- No significant cultural resources were found within the proposed footprint of the generation and proximal transmission facilities.

It is expected, however, that more environmental issues will arise as field surveys extend beyond the rather limited areas examined up to the time of this report. It is already known that there are wetlands in the area, and that certain Project features, as designed, are not consistent with the scenic integrity objectives of the Forest Plan Land Use Designations.

1.4 Project Development Alternatives

This study examined three main alternatives for development of the Takatz site, see Table 1-1. These include:

- Alternative 1: The "1968 plan of development" which is slightly modified from the APA's 1968 recommended plan of development. In Alternative 1 we eliminated the surface penstock and surge chambers which were proposed in 1968 and we modified the tunnel alignments.
- Alternative 2: A phased development of the Project which sought to reduce the initial capital cost of the project. This option includes the Phase 1 development of a lake tap, tunnel, powerhouse, and site support facilities, with no dam constructed. Phase 2 of this alternative would include the future addition of a dam to increase the average generation and greatly expand the project's storage capacity.
- Alternative 3: A single-stage development similar to the 1968 APA plan, with a lower main dam, to avoid construction of the saddle dam initially proposed.

All alternatives include a two-unit powerhouse with a nominal hydraulic capacity of 450 cfs, a dock in Takatz Bay with an 800-ft access road to the powerhouse site, support facilities in the powerhouse area, and an 18-mile long, primarily overhead transmission line to Sitka.

1.5 Power Operations Studies

The power operations studies estimated both the required reservoir storage capacity of the Takatz Project and the likely energy generation of each development alternative, using the updated hydrology. Comparisons to the storage volume, reserve energy and annual rule curves of the City's Blue Lake and Green Lake Projects show that each of the three alternatives would provide sufficient storage to effectively regulate inflows to Takatz Lake. Average annual generation from the project would range from 87,500 MWH to 102,600 MWH per year, depending on the alternative selected. The very large reservoir storage volumes possible with the 1968 APA Plan and the Phase 2 development would allow the Takatz Project to provide significant carry-over energy storage for use during dry years or system emergencies.

1.6 Construction Cost Estimates

The Takatz site's remote location will make it a challenging project to develop. The high elevations, lack of road access, avalanche risk, and extreme terrain along the transmission line route all combine to make the transmission line construction a costly element of the project.

This study included a contractor's style cost estimate with development of mobilization plans, staging, crew types, and a preliminary construction schedule to estimate the overall cost of construction. Our estimates indicate that the project's total construction cost may range from $298 million to $436 million (2014$), depending on the development plan selected, with a cost per kW of installed capacity ranging from $11,900 to $14,880 per kW.

1.7 Recommended Development Plan

Major statistics for the three alternatives examined in this study are shown in Table 1-1. This table shows that the Phased development of the Takatz site offers the best combination of reduced initial investment, adequate reservoir storage and annual energy generation. Phase 1 of this development would include a lake tap intake, approximately 5,700 feet of tunnel, a 25 MW powerhouse, and an

18 mile transmission line from the Project to the City of Sitka. This initial development would provide 70,200 MWH of firm energy with an average annual energy of 87,500 MWH. The total project cost for this Phase 1 development is estimated at $298 million.

The initial Phase 1 construction would increase the City's installed hydropower capacity by 75% (from 33 MW to 58 MW) with a 57% increase in average annual energy generation, increasing the system's hydro generation from 156,000 MWH to 243,000 MWh per year. Phase 2 of this development alternative would increase energy generation by a modest 7% to 93,840 MWH but would greatly increase the project's carry-over energy storage. This long-term storage capability may have significant future value to the City of Sitka or to a regional electric system.

The Southeast Alaska Power Agency (SEAPA) transmission system currently ties the Ketchikan/Saxman area to Wrangell and Petersburg. A transmission extension to the Kake area is in the permitting stage. Completion of the transmission extension to Kake will bring an interconnection opportunity for the Takatz Project. Kake is approximately 40 miles east of Takatz Bay. An interconnection to Kake would require 35 miles of submarine cable plus a short length of overhead line and associated termination facilities at each end.

1.8 Future Studies

Development of the Takatz Project will require a series of site investigations for geotechnical conditions at the intake area, dam site, tunnel alignments, powerhouse area, and along the transmission line. The transmission line portion of the project will also require further studies by meteorologists and avalanche specialists to evaluate and refine wind/ice design criteria and to define specific avalanche locations/risk. The meteorologist and avalanche specialists would recommend appropriate mitigation measures that can be incorporated into the transmission line design.

Additional environmental and engineering studies will likely be required as part of a FERC license application process and to confirm the optimum arrangement and design of the Project elements. Both engineering and environmental studies should be completed according to a timeline based on the FERC licensing process and the final design/procurement/construction program.

In early 2015 the City of Sitka will complete the Blue Lake Expansion Project, boosting Sitka's average annual hydro energy generation to 156 million MWH, vs. a current annual system load of about 120 million MWH. Thus, development of the Takatz Project is not an urgent priority for the City. It likely will require a period of years before the City's system energy demand sufficiently exceeds the available hydro energy by a large enough margin to merit development of the Takatz Project.

A comprehensive electrical load analysis and load development plan will be needed to ensure that a sufficient demand for power is present when the Taktaz Project is ultimately completed. The isolated nature of Sitka's electric grid makes this a particular challenge. A regional intertie to the Ketchikan area may greatly facilitate the City's ability to market the project's energy and may ultimately provide the impetus for development of the Takatz Lake Hydroelectric Project.

Table 1-1 Takatz Project Development Alternatives

(Summary of Project Characteristics, Annual Energy Generation, & Estimated Costs)

Alternative:	No. 1	No. 2	No. 2	No. 2	No. 3
Basic Project Plan Description:	**1968 APA**	**Phase 1 only**	**Phase 2 only**	**Phases 1&2**	**Single-Stage**
Intake Type (Invert Elev, mllw[1])	Conv (880)	Lake Tap (717)	NA	Lake Tap (717)	Conv (860)
Main Dam Crest El. (ft mllw)	1040	None	990	990	990
Lake Minimum WSEl (mllw)	900	747	747	747	890
Lake Maximum WSEl (mllw)	1040	905	990	990	990
Active Storage (ac-feet)	80,910	52,970	44,605	97,575	50,643
Main Dam Max WSEl (mllw):	1040	NA	990	990	990
Saddle Dam Max WSEl (mllw):	1040	NA	NA	NA	NA
Installed Gen. Capacity (MW):	29.3	25.0	4.2	29.2	27.8
Annual Energy Firm (MWH):	94,354	70,221	19,406	89,627	79,277
Annual Energy Avg (MWH):	102,558	87,548	6,292	93,840	98,691
Est. Total Construction Cost[2,3] ($M):	$372	$254	$81	$309	$307
Est. Other Project Costs[4] ($M)	$64	$44	$15	$54	$54
Est. Total Project Cost[2,3] ($M):	$436	$298	$96	$363	$361
Installed Cost per kW, $	$14,880	$11,920	$24,000	$12,430	$12,980
Capital Cost per firm annual MWH, $	$4,620	$4,240	$4,950	$4,050	$4,550

Notes:

1. Mean Lower Low Water (mllw) is Southeast Alaska datum.
2. Includes state and local sales taxes (if applicable), equipment markups, Contractors overhead and profit, and construction bonding and construction loan financing.
3. Does not include interest costs during construction, legal services, land acquisition or easement costs. Costs are based upon concept level design, and should be considered accurate to within -20% to +30%.
4. Includes geotechnical investigations (for both transmission line and hydro projects), all design engineering services, environmental studies and permitting services (for both transmission line and hydro projects), FERC licensing services, bid and construction management services, and Owner's administration needs. Does not include cost of mitigation and enhancements possibly required by the FERC license.