City and Borough of Sitka

100 Lincoln Street • Sitka, Alaska 99835

MEMORANDUM

To: Mayor Paxton and Assembly Members

From: Hugh Bevan, Interim Municipal Administrator

Date: December 16, 2019

Subject: Availability and Uses of Sitka's Excess Hydro Generation Capacity

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In 2015 Sitka completed a major renovation of the Blue Lake power generation system that included raising Blue Lake dam by 83 feet, a reconstruction of the tunnels that move the water, a totally new hydro power plant, and complete upgrade of the Fish Valve power plant. At Jarvis Street a very large, diesel fired, backup turbine generator was purchased and installed.

In a normal water year Sitka has excess hydrogeneration capacity. However, as the town grows and additional electric loads, such as the new SEARHC medical campus come on line, the excess capacity will diminish. The management of the excess capacity is one of Sitka's most important strategic concerns because when the excess is consumed, the town will be faced with very expensive options to add additional generation capacity. Both Blue Lake and Green Lake are now constructed and optimized to their maximum capacity.

In Sitka, only a certain amount of water flows into Blue Lake and Green Lake every year, and that can vary considerably from year to year. The higher the elevation of the lake, related to the power plant, the more energy we can extract for each gallon of water that runs through the tubine-generators.

The Blue Lake expansion did not add more water to the project, it allowed us to use the same amount of water at a much higher head pressure, thus producing more energy for each gallon of water.

During the next decade, Sitka is well advised to begin implementing the extensive planning for additional power generation capacity, or the City could be faced with supplementing the system with expensive diesel fired generation.

Takatz Lake on the eastern side of Baranof Island has been extensively studied as a possible new power source for the town. However, cost estimates to bring Takatz on line are approximately half a billion dollars. This amount is financially out of reach for Sitka unless a major new electric load is identified that can pay for and justify such a huge investment..

Solar and Wind have both been studied and found to be not economically or technically viable options. I recently heard an intriguing idea of exploring nearby areas for a possible geothermal site that could be developed for electric power production. Sitka may want to pursue that idea.

In a normal water year the surface of Blue Lake reaches its lowest level in late spring. (Green Lake behaves the same). With increasing spring rainfall and some snow melt, the lake rises and eventually begins to spill over the dam in the fall. The spill continues until mid-winter when rainfall and snow melt from the mountains diminishes. The lake level then begins to fall until it reaches its minimum the following spring. The amount of water that spills over the dams annually represents Sitka's excess generation capacity.

If the lake level over the course of a year is plotted on a graph, it resembles an ocean swell, rising and falling in a wave pattern. The breakeven wave pattern is called the Rule Curve. This curve represents the maximum amount of water that can be removed from the lakes in a normal water year and still have them recover to spill elevation during the following water year.

If the weather is dry for an extended period and the town draws the lake level below the Rule Curve, the lake may not re-fill and over time it is possible to lose control of the reservoirs in this manner. Management of Sitka's reservoirs is one of the major keys to preserving a reliable electrical system.

As the lake level lowers over the winter and spring more gallons of water are used to produce the same amount of power because the hydrogeneration machines are less efficient at lower lake levels. (less head pressure at the powerhouse).

In mid October 2019 we formed the Electric Department Working Group that consists of two expert consultants who have previously managed Sitka's electric system and three key City staff. The Group spent two months evaluating several decades of hydrologic data and running a computer model that estimates the future generation capacity of the two lakes.

I believe it is critical that this evaluation of remaining capacity be completed every year or two,going into the future, and that it is thoroughly understood before large, additional electric loads are added to the system.

The computer model estimates the amount of time water will spill over the dams each year based upon key assumptions. After much debate the Working Group settled on these assumptions:

- The electric load from Sitka's present population and industry will grow at an annual rate of 0.67%.

- An 80% exceedance value of water inflow was used to evaluate the hydro generation capacity. Using an 80% exceedance gives us an 80% confidence level that the reservoirs will refill each water year.

- Sitka's base electrical generation requirement is 132, 245 MWh per year beginning in 2025, which is the base year for our modeling.

- The new SEARHC medical campus will come on line in 2025 and use an additional 10,000 MWh of energy per year.

- SEARHC could also use an additional 20,000 MWh for building(s) heat.

Based upon these assumptions and the 80% confidence level the following projections are made:

• No SEARHC expansion	25 years until existing hydro capacity is consumed
• 10,000 MWh/year SEARHC load	18 years until existing hydro capacity consumed
• 30,000 MWh/year SEARHC load	10 years until existing hydro capacity is consumed

This analysis led us to the conclusion that an additional 20,000 MWh for SEARHC heating load, could only be provided in the form of interruptible energy supply.

An interruptible heating system is based on a primary oil boiler with a secondary electric boiler. The electric boiler provides a substantial amount of the system's heat, but it can be turned off remotely, or limited, by the City Electric Department when demand on the entire system requires it, i.e. we can "shed" the interruptible service when the power is needed by full rate paying customers, or during equipment failure periods.

There is a provision in the City Code that provides an incentive power rate for entities who are willing to operate on interruptible status. SEARHC is interested in exploring this option.

At the moment there are five interruptible systems: Sitka High School, Blatchley Middle School, Baranof Elementary and Keet Gooshi Heen schools, and the City / State Building. These formerly oil heated buildings were retrofitted with additional electric boilers that accomplished three goals: the facilities achieve a savings by buying electric energy at a rate that is cheaper than buying equivalent heat as fuel oil, and second, the Electric Department receives revenue for the sale of excess energy that would have

otherwise simply spilled over the dams. A third consideration is the reduction in local use of fuel oil and reduction of air pollution.

The Working Group has concluded that our position going into negotiations for a Power Sales Agreement with SEARHC will be:

- Commit to a perpetual supply of about 10,000 MWh of annual energy at the General Service – Public Authority Rate, which is currently $0.1470 per kWh this equates to about $1.5 million per year in new revenue to the Electric Fund.

- Negotiate an interruptible rate for building heat that is supplemental to the SEARHC oil heating systems. If negotiations are successful, additional income will be realized. However, over time as full rate paying customers come on line the available, interruptible power for SEARHC will decline.

- Negotiate the improvements to the electrical distribution system that will be required to furnish the level of reliability that SEARHC requires.

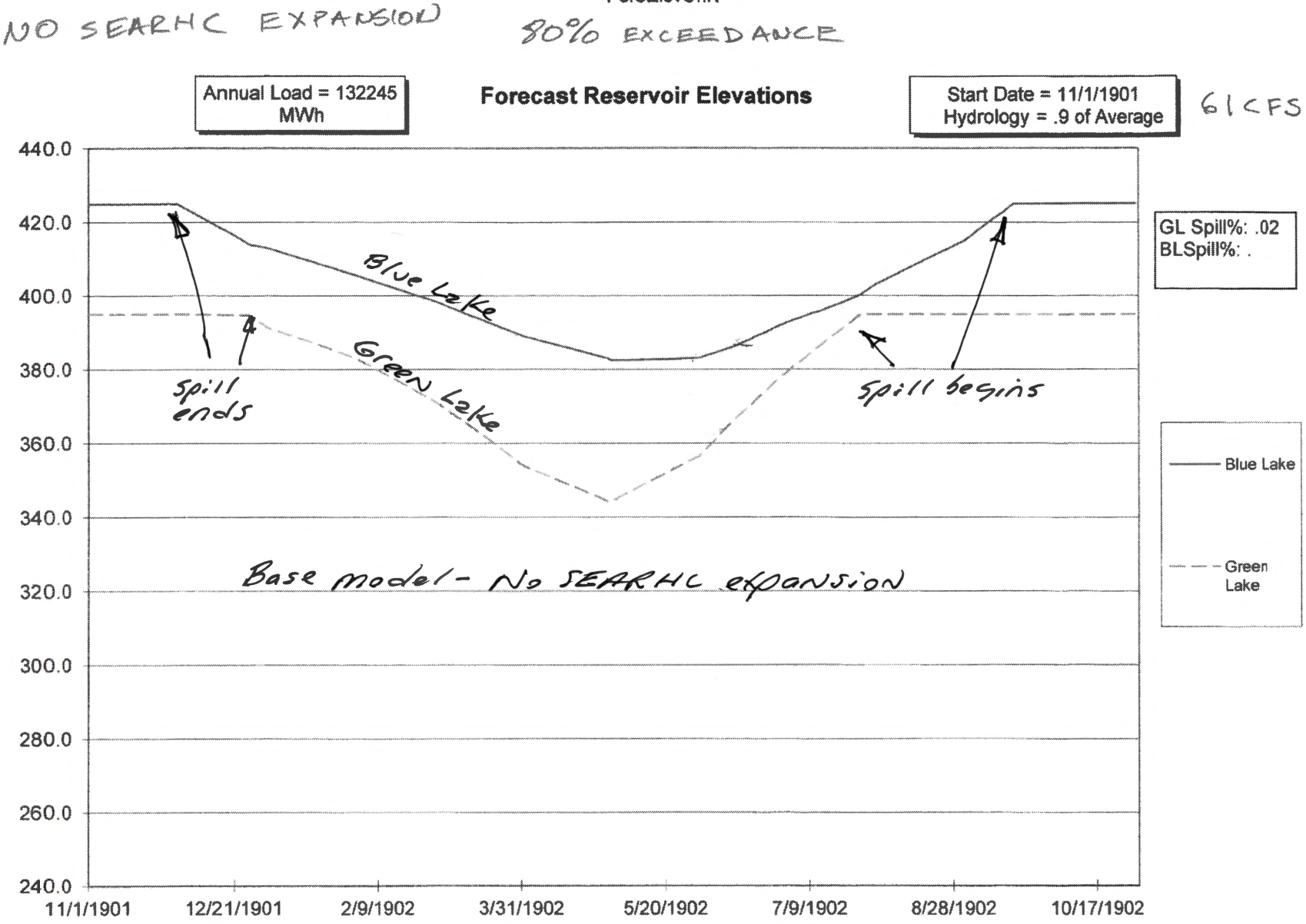
I want to thank Interim Utility Director Jeff Wheeler and Deputy Generation System Manager Erin Clay of the Electric Department for their help with this report. And, Dean Orbison P.E. and Robert Dryden P.E. provided essential technical input.

As I said earlier in the report, I highly recommend this type of analysis is done regularly by the Department going forward into the future.

BASED ON D HIDDLE 2025 LOAD OF 132,245 MWh/yr

NO SEARHC EXPANSION

80% EXCEEDANCE



61 CFS SPILL

TOTAL 80% EXCEEDANCE INFLOW 684 CFS

BASED ON D HIDDLE 2025 LOAD OF 132,245 MWh/YR

10,000 MWh/YR SEARHC EXPANSION

80% EXCEEDANCE

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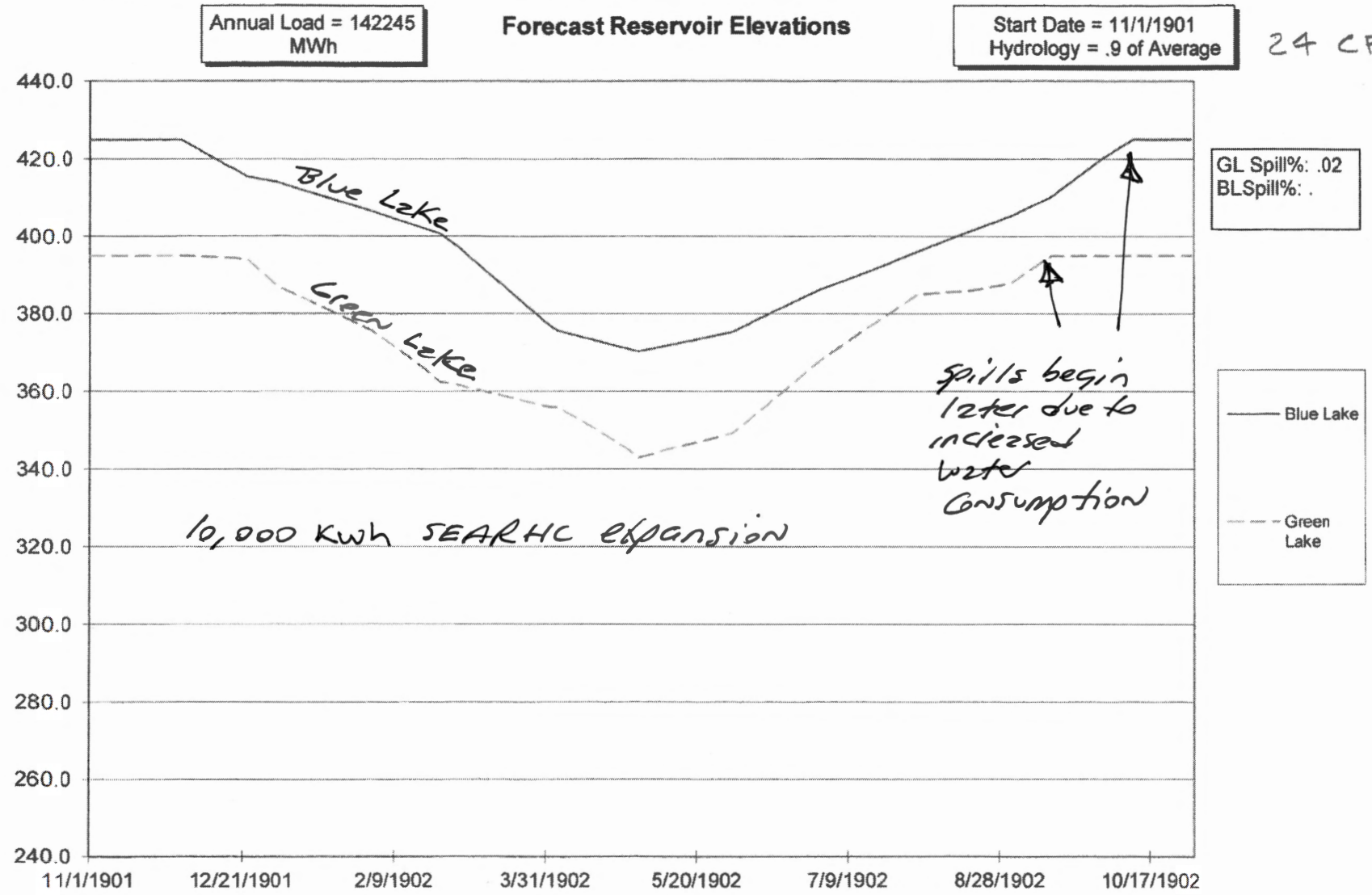

TOTAL 80% EXCEEDANCE INFLOW

684 CFS