

Comprehensive Electrical Load Analysis and Load Development Plan

FINAL REPORT

June 28, 2018

Prepared for
City and Borough of Sitka Electric Department
Sitka, Alaska

by



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City and Borough of Sitka
Comprehensive Electrical Load Analysis and Load Development Plan
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Final Report

Section 1 Introduction and Overview

Background

D. Hittle & Associates (DHA) was retained by the City and Borough of Sitka (CBS) Electric Department to provide a Comprehensive Electrical Load Analysis and Load Development Plan (the “Load Analysis”). The Load Analysis is a follow-on study to the Takatz Lake Hydroelectric Development Appraisal Study dated October 2014¹ (the “Appraisal Study”). A series of mapping, environmental and engineering feasibility studies were undertaken in the 2009 to 2015 time frame to help define the impacts, technical feasibility and cost of the Takatz Lake Project.

In 2013 the CBS commissioned the Appraisal Study to review the appropriate reservoir storage capacity, hydraulic capacity, installed megawatts and number of generating units for the Takatz Lake development. A basic goal of the Appraisal Study was to determine what reservoir storage capacity and generating capability was most appropriate at Takatz Lake to both develop its hydrologic resource and to augment the CBS’s hydro generation resources.

The Appraisal Study noted that, *“beginning in 2014, Sitka’s electric loads will be served by a fundamentally different set of generation resources compared to the City’s 1960’s electric system. The current generating resources include: the Green Lake hydro plant (16 MW capacity); a recently expanded Blue Lake hydro project (15.9 MW capacity to be on-line in 2014); and 27 MW of back-up diesel generators owned by the City.”*

The Appraisal Study further noted that, *“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.”*

Among other recommendations, the Appraisal Study indicated that, *“A comprehensive electrical load analysis and load development plan will be needed to ensure that a sufficient demand for power is present when the Takatz Project is ultimately completed. The isolated nature of Sitka’s*

¹ *Takatz Lake Hydroelectric Development Appraisal Study Report*, prepared for the City and Borough of Sitka, by Currents Consulting, Seattle, Washington, October 2014.

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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."

In August 2017 the CBS retained DHA to conduct the Load Analysis. This report summarizes the analytical methods, assumptions and results of the Load Analysis.

Introduction

The Load Analysis has evaluated and forecasted the number of retail electric customers and energy requirements on an annual basis for each of the CBS's customer classes. An additional component of the forecast involved the evaluation of the loadings on electric feeders and substation facilities. The McDowell Group of Juneau, Alaska assisted DHA in the preparation of the load forecast.

The CBS electric system is electrically isolated from any other electric systems and provides all functions of electric service to its customers including all necessary power generation. As such, the load forecast has been prepared as part of the Electric Department's planning process to determine the need for future generation and other system developments that would be dependent on the electric needs of the community.

The Electric Department completed a major expansion of the Blue Lake hydroelectric project in 2015. To support the cost of this development as well as pay for other increases in the cost of electric service, electric rates have been increased over a multi-year period. The most recent rate adjustment became effective October 1, 2017. With higher costs of electricity, consumers could potentially be expected to reduce energy consumption. Historical energy consumption data for the Electric Department in recent years does not conclusively indicate that consumption has been affected by the cost of electricity. Further, the 2017 forecast does not explicitly acknowledge the price of electricity in the forecast of future energy needs. As more electricity consumption information becomes available in the near future, the Electric Department may want to evaluate further the impact of electricity prices on consumer demands.

Previous electric forecasts for the Electric Department have estimated significant increases in electricity needs due to increases in electric space heating in the community. This was prompted by the relatively high costs of heating oil that was experienced in the early 2000s. The high price of fuel oil compared to the cost of electricity provided an economic incentive for residential customers and public buildings to convert to electric heat. Many of the communities in Southeast Alaska with hydroelectric generation as the primary source of power supply experienced this same situation up until about 2012. Since 2012, the rate of conversions to electric heat in Southeast Alaska seems to have declined noticeably.

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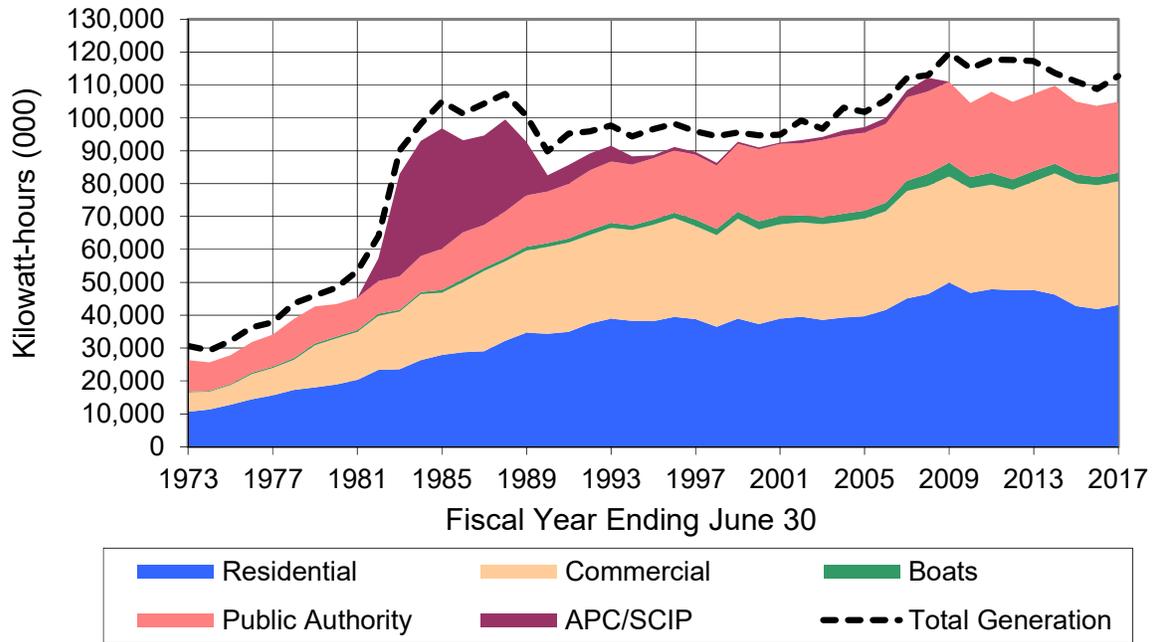
Over the past ten years, 2008 through 2017², the Electric Department's total annual energy sales and energy requirements have declined about 4.6% and 0.2%, respectively. Between 2008 and 2014 energy sales increased slightly and a fairly noticeable decline in sales occurred between 2014 and 2015. The total number of electric accounts has increased from 5,174 in 2008 to 5,357 in 2017, representing an average annual increase of 0.4%. Annual energy consumption per customer has decreased since 2008 for residential customers and has increased for general service customers. The decrease in electricity consumption per residential customer is believed to be primarily due to the warmer than average winters the past three years, however, residential energy consumption has probably also decreased as a result of improved efficiencies in lighting and home appliances.

In the year ended June 30, 2017, the Electric Department's total energy requirements were 112,740 MWh, an increase of 7.1 % over the requirements in 2016, however, as mentioned previously, a decrease of 0.2% since 2008. Peak demand for the electric system was 22.16 MW in 2017. The annual peak demand typically occurs in the winter and is affected by periods of colder weather. The all-time annual system peak demand was 23.93 MW occurring in January 2012.

Total energy sales by customer class for the years 1973 through 2017 are shown in Figure 1. As can be seen in Figure 1, a significant amount of energy was sold to the Alaska Pulp Company (APC) between 1982 and 1990. The historical number of electric accounts, annual energy sales by customer classification, total system energy requirements and annual energy losses for the same period are shown in tables following the text of this report.

² All references to annual totals are for years ending June 30, based on the CBS's fiscal year.

Figure 1
City and Borough of Sitka
Historical (1973-2017) Energy Sales by Customer Class and Total Generation



Analytical Methodology

The number of customers and total energy sales have been forecasted for each of the Electric Department’s customer classifications on an annual basis for the 50-year period 2018 through 2067. Three alternative growth scenarios: medium, high, and low were developed. Although the forecast primarily focused on each customer class as a whole, the expected power needs of certain large customers were reviewed through discussions with these customers and other information generally available through various State agencies and other sources.

Discussions conducted with certain large power users indicated that some changes in electricity use may be coming in the future, however, the extent and timing of these changes are not certain. As such, the forecast does not explicitly include incremental adjustments for changes to the loads of large power users. Rather, the adjustments in power needs that might be forthcoming are assumed to be acknowledged in the forecast of the general service and public authority classes.

The Load Analysis has been developed using an energy demand model that independently projects customers and energy consumption for each of the Electric Department’s electric customer classifications for each year of a 50-year forecast period. The most significant variables affecting the number of residential customers in Sitka were considered to be population and the previous year’s number of customers. Similarly, the number of general service and public authority customers appears to be closely related to the number of residential customers when compared to the other variables evaluated.

It should be noted that detailed energy sales data for the electric system that we were able to obtain from the CBS is incomplete for the period 2009 through 2014. A transition to a new accounting system during this period contributed to a difference in the way sales data was retained. Overall it appears that annual sales and revenue data is reasonably complete, however, there are some anomalies that leave gaps in the presentation of historical trends.

Additional information regarding the methodology used in the forecast is provided in the sections discussing the forecast of the number of customers and the energy consumption per customer.

Report Format

An overview of Sitka's economy and other factors related to electric energy needs in the community are provided in Section 2. The forecast of the number of energy customers, electric consumption per customer, total electric sales and total energy requirements are presented in Section 3 of the report. Section 3 also provides a discussion of monthly energy generation in Sitka. The results of the system analysis are provided in Section 4.

The assessment of loads and resources is provided in Section 5. An analysis of the costs of resource alternatives is provided in Section 6.

The results of the forecast of total energy requirements are summarized in Table 8 and Figure 14.

The detailed annual presentation of historical and forecasted numbers of customers and energy sales by customer class are provided in the tables following the main body of the report. The detailed results of the load analysis are provided in Appendix 1.

Section 2 Certain Factors Affecting Electric Energy Needs in Sitka

Overview of Sitka's Economy

Sitka has a well-diversified economy, with total employment of 6,416 in 2016, including 4,443 wage and salary jobs and 1,973 self-employed workers, according to the Bureau of Economic Analysis.³ The community's economic base includes commercial fishing and seafood processing, health care, tourism, federal government (including the U.S. Coast Guard and U.S. Forest Service), and education. The larger basic industry employers in Sitka include Southeast Alaska Regional Health Consortium (SEARHC), USCG Air Station Sitka, U.S. Forest Service Sitka Ranger District, the community's three large seafood processors (Silver Bay Seafoods, Sitka Sound Seafoods, and Seafood Producers Cooperative), Sitka Pioneer Home, and Mt. Edgecumbe High School. Sitka is home to 545 commercial fisheries permit holders.

Sitka residents earned a total of \$552 million in personal income in 2016. Total annual personal income in Sitka has been relatively stable over the past five years, ranging from \$544 million in 2012 to \$582 million in 2015. In 2016, per capita personal income was \$62,537, 12 percent above the state-wide per capita income of \$55,646.

The Sitka economy has also been stable or increasing in terms of wage and salary employment. Alaska Department of Labor and Workforce Development (ADOLWD) data shows annual average employment increasing 11 percent from 3,825 in 1997 to 4,228 in 2016.⁴ As shown in the chart below, over this period average employment by the federal government has decreased 46 percent, but other categories of employment have increased or remained stable, including local government⁵ (33 percent increase), state government (5 percent increase), and private ownership (12 percent increase). It should be noted that the decline shown in 2016 is largely due to a seafood processor starting to properly separate jobs at the company into their actual place of work rather than all in Sitka. From 2015 to 2016, average annual employment decreased by only 38 (rather than 338) after taking this into consideration.⁶

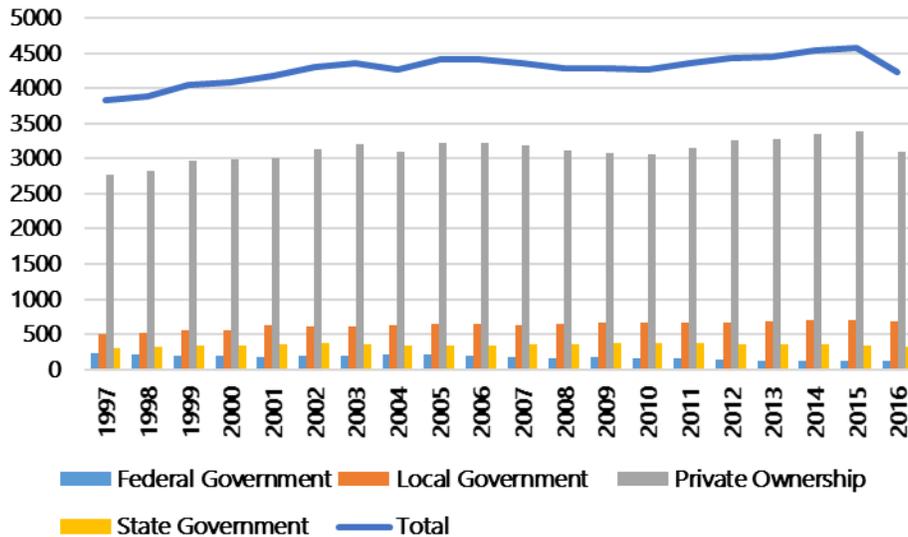
³ <https://bea.gov/>

⁴ <http://live.laborstats.alaska.gov/qcew/>

⁵ Local government includes borough, municipal and tribal government employment.

⁶ This information is according to the Sitka Economic Development Association, through contact with officials at the Alaska Department of Commerce, Community, and Economic Development.

Figure 2
City and Borough of Sitka
Average Annual Employment
Total and by Industry Type, 1997-2016



Sitka’s economy has a significant seasonal component, with peak summer employment (in July and August) typically about 40 percent higher than the winter low point. Seafood processing accounts for much of the seasonality. In 2016, seafood processing employment ranged from a low of 144 (in January) to a high of about 800 (in July). The visitor industry is also seasonal, with employment in the Leisure and Hospitality sector ranging from 379 in January to 627 in June. Other key components of Sitka’s economic base, including health care and federal government (USCG and USFS) providing steady year-round employment.

Seafood Processing

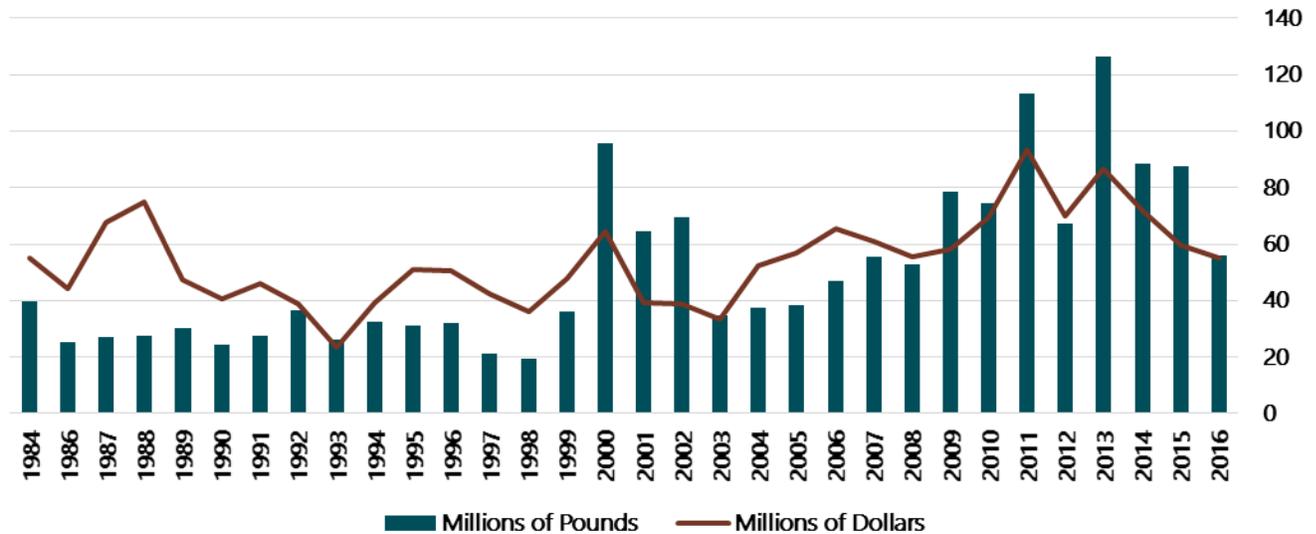
The City and Borough of Sitka is home to Alaska’s fifth largest seafood port by value of seafood products produced. Over the 2015/2016 period, Sitka averaged \$121 million in annual first wholesale value (the value of seafood products sold by Sitka-based processors).⁷ This number is down slightly from the annual average in 2013/2014 (\$129 million), in line with moderate declines seen around the state.⁸ Over the past few years Alaska’s seafood industry has been negatively impacted by a strong U.S. dollar, which decreases the competitiveness of Alaska seafood in export and domestic markets.

⁷ McDowell Group, 2017. The Economic Value of Alaska’s Seafood Industry. Prepared for the Alaska Seafood Marketing Institute.

⁸ McDowell Group, 2015. The Economic Value of Alaska’s Seafood Industry. Prepared for the Alaska Seafood Marketing Institute.

Despite moderate declines in first wholesale value in recent years, the long-term trajectory shows increasing commercial fishery landing volumes and values in Sitka.⁹ In 2015/2016, the value of landings averaged \$57.3 million annually, up 16 percent from an average of \$49.6 million (\$ 2016) in 1984/1985.

Figure 3
Commercial Fishery Landings in Sitka, Volume and Value (1984-2016)



Notes: Landings presented in round (live) weight. Value data presented in inflation-adjusted 2016 dollars. Source: National Oceanic and Atmospheric Administration, Office of Science and Technology. <https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/index>

Pink salmon made up almost a third (31 percent) of landings, by volume, in Sitka from 2006 to 2017.¹⁰ Other top species by landings volume over this period include herring (28%) and chum salmon (24%). Other species made up 5 percent or less of total landings from 2006 through 2017.

Pink salmon landings are highly variable, due to distinct even-year and odd-year populations. A forecast released in November 2017 by the Alaska Department of Fish and Game predicts pink salmon harvests in 2018 in line with the 1960-2016 average.¹¹ Forecasts for years beyond 2018 are not available.

Chum salmon harvests in Sitka are heavily influenced by the efforts of local hatcheries. By 2020, a new remote release site for chum salmon, Crawfish Inlet, will be in full production and is estimated to increase by roughly 50 percent chum salmon production from hatcheries in the Sitka

⁹ These data reflect the value of landings in Sitka to commercial fishermen, and don't include added value by processors.

¹⁰ COAR data obtained by request from Alaska Department of Fish and Game

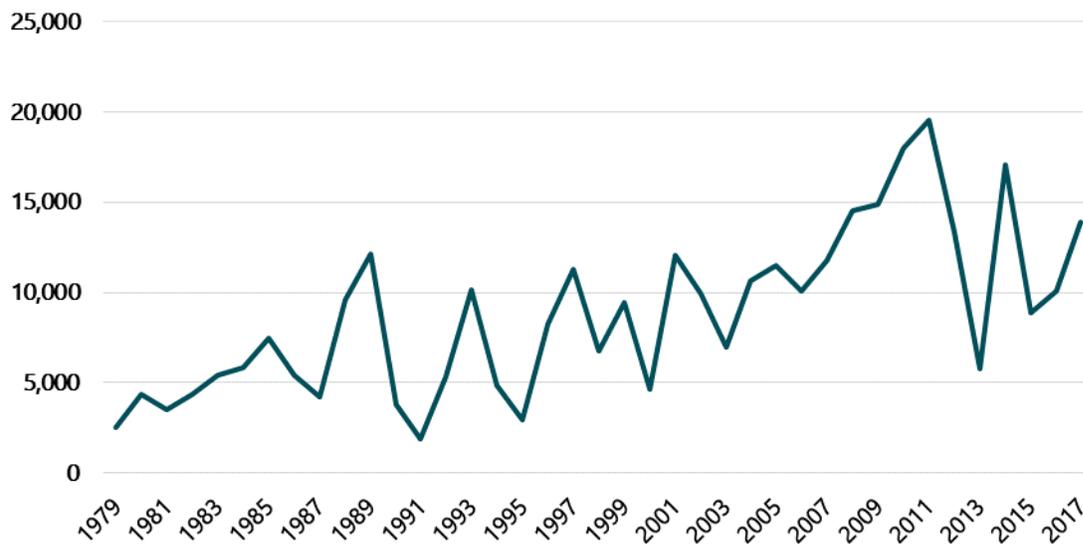
¹¹

http://www.adfg.alaska.gov/static/fishing/PDFs/commercial/southeast/2018_se_pink_salmon_harvest_forecast.pdf

area.¹² Coho and Chinook salmon are also released by Sitka area hatcheries, though at much smaller scales.

Herring populations around Sitka are subject to significant fluctuations but considered healthy and managed for long term sustained yield. Sitka sac roe harvests have trended upwards since the 1980s, as shown in the chart below.

Figure 4
Sitka Seine Sac Roe Harvest (1979-2017)
(Tons)



Source: <http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareasoutheast.herring#harvest>

Shore based processors in Sitka include Sitka Sound Seafoods, Silver Bay Seafoods, Seafood Producers Cooperative, Sitka Salmon Shares, and other smaller operations.¹³ These processors turn raw fish and shellfish into a myriad of products for sale directly to consumers, to retailers, and to other seafood processors, among other outlets. Most of the seafood products sold by Sitka-based processors are frozen, including over 90 percent of salmon products.¹⁴ Electricity consumption by Sitka’s seafood processing sector peaks in months when key species are harvested and delivered, with a bump in late spring for herring and a larger bump in late summer and early fall for salmon.

While no specific forecasts or predictions are available for the long-term health of Alaska’s fisheries or Sitka’s seafood industry, the state’s proven track record of sustainable management

¹² Interview with Northern Southeast Regional Aquaculture Association.

¹³ A new processor is currently getting ramped up in Sitka’s industrial park, Northline Seafoods, but it is unknown how much fish the company will process on land in Sitka. Northline Seafoods will reportedly be processing whole salmon frozen on site in Bristol Bay and shipped by barge to Sitka.

¹⁴ COAR data obtained by request from Alaska Department of Fish and Game

suggests long term stability in seafood harvests. As discussed above, recent trends with regard to the three top species processed in Sitka – pink salmon, chum salmon, and herring – suggest steady or increasing landings but also significant variability due to environmental and biological factors.

Alaska's seafood industry competes with wild and farmed fisheries from around the world. Alaska's seafood marketing is conducted by a partnership between the seafood industry and state government known as the Alaska Seafood Marketing Institute (ASMI). ASMI has a global reach and aggressive programs to differentiate Alaska's products and market the state's pristine environment and the value of wild caught seafood. Other relevant trends include investment by the state's processors, including processors in Sitka, to increase utilization rates and develop new products based on previously discarded waste streams such as fish heads. Even without increases in seafood harvest volumes, growth in the value of Alaska's seafood products is possible through these and other efforts.

Other Issues Affecting Electric Loads

Seafood Processors

Telephone interviews were conducted with the seafood processors in Sitka to determine if any changes were forthcoming or planned that might affect electricity needs. None of the seafood processors contacted indicated that they are planning major upgrades or changes that they anticipate will increase demand. On the contrary, there seems to be interest in reducing consumption through efficiency measures. On the plus side, there is a new, albeit small, processor starting up in Sitka. The operation is in the industrial park area.

Another positive, or stabilizing note, for processing electricity demand is the fact that the local hatchery, NSRAA, has substantially increased their chum salmon releases in recent years through a new release site at Crawfish Inlet. Not all of these salmon end up harvested and not all that are harvested are processed in Sitka but, it will result in additional processing in the Sitka area. The new releases represent a roughly 40% increase in chum releases and will be in full production by 2020.

It is difficult to predict processing activity, but it appears that a roughly stable level of electricity consumption by the seafood processors can be expected.

Health Care

The main hospital in Sitka, run by SEARHC, is located on Japonski Island. SEARHC has indicated that it has outgrown its current facility and that it intends to significantly expand its campus in the next five to ten years. SEARHC has informed the Electric Department that based on conceptual plans for the new campus, the electric loads for the SEARHC campus could increase by approximately 5 MW. Half of this estimated load, 2.5 MW, is expected to be firm load while the other half is estimated to be interruptible. The estimated magnitude and timing of

the new facility load is very preliminary at this time and as such, should be regarded with a high level of uncertainty.

Cruise Ship Shore Power and Visitor Industry

Discussions with a representative of the cruise industry in Juneau indicated that there isn't a likelihood that more cruise lines and ships will convert to be able to plug into shore power anytime soon. Princess plugs in regularly in Juneau, but is the only cruise line to do that. The new cruise berths Juneau has built have the ability to supply power but that hasn't been used yet and probably won't anytime soon. It is indicated that the reason this isn't more of a trend is that there has been significant investment recently to retrofit ships to meet new environmental requirements leading to a focus of on-board solutions to power and other needs.

A representative of the Westmark indicated that there were no significant plans to expand or change their operations in ways that would affect electricity consumption. Incremental improvements in efficiency are a goal as opportunities arise. It was noted that Westmark Sitka updated the lighting in all of the hotel hallways about 18 months ago, along with the same in other commercial buildings Westmark owns around Sitka. Westmark indicated that a change to electric boilers was not under consideration. Westmark also noted that they didn't see any changes of note coming in the visitor industry.

US Coast Guard

At the time information for the load analysis was initially being obtained, an official of the United States Coast Guard (USCG) in Sitka indicated that there is a goal to provide incremental improvements in efficiency of energy use as opportunities arise. It was also indicated that the Electric Department has been working with the USCG to collect some data and explore the costs and benefits of installing interruptible parallel electric boilers.

The USCG has recently indicated that it is planning to bring a new cutter to its base in Sitka. Preliminary estimates based upon the existing USCG electric service requirements are that with the new cutter, electric loads could increase approximately 250 KW. Based on the preliminary assumption that this would be a continuous load, the overall impact would be to add 2,190 MWh annually to the CBS electric system.

Industrial Park

Current anchor tenants at Sitka's Gary Paxton Industrial Park (GPIP) include Silver Bay Seafoods, Northern Southeast Regional Aquaculture Association (NSRAA), CBS utilities, Fortress of the Bears, and Northline Seafoods. Silver Bay Seafoods is by far the largest operation in the area. As of December 2017, NSRAA is proposing to lease an adjacent lot to add a facility that will allow water recycling in the event of a disruption in their water supply.

GPIP sees regular turnover of businesses at other lots in the park. A couple leases are currently used only for storage. Sitka Economic Development Association (SEDA) – which manages the

park under contract with the city – regularly terminates inactive leases and offers vacant lots for lease or purchase. A new multi-purpose, drive down dock was near completion as of the writing of this report. According to SEDA’s website, the deep water dock is designed to stimulate business creation and expansion in Sitka’s marine support sector, as well as facilitate additional freight service to Sitka.

Cannabis Production

As of December 2017, two marijuana cultivation facilities – one, roughly 1,800 square feet and the other, roughly 1,250 square feet – are in operation in Sitka. Both facilities have expansions pending state approval that would roughly double the square footage of each operation. One of the facilities has also proposed the addition of another cultivation facility in the industrial park area, but that proposal is currently stalled.

Two additional marijuana cultivation businesses have received state licenses in recent months and are considered “active – pending inspection” by the state’s Alcohol and Marijuana Control Office. A proposed facility on Sawmill Creek road, if constructed, would be the largest in Sitka at 7,500 square feet.

The two operating cultivation facilities described above are combination facilities that include cultivation and retail sales operations. Another retail operation is currently operating in Sitka, bringing the total to three active retail marijuana stores.

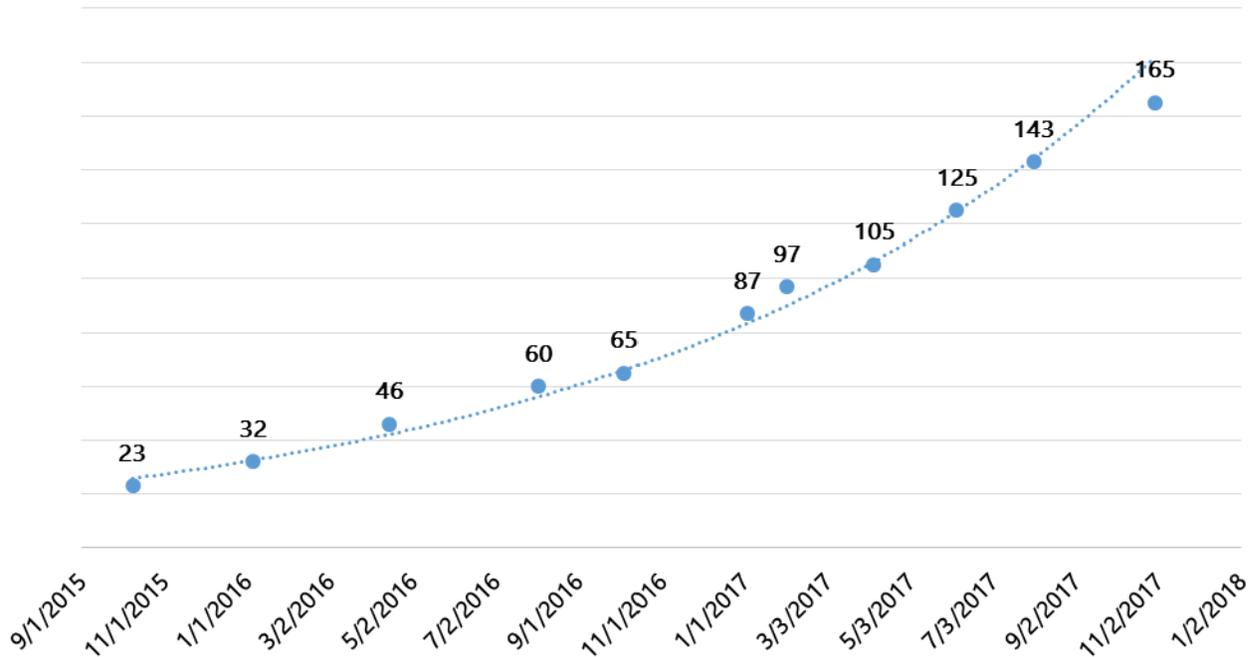
Electric Vehicles

As of August 2017, at least 39 fully electric vehicles, 37 Nissan Leafs and two Chevrolet Bolts, were registered to addresses in Sitka. Registration data was obtained from the Alaska Division of Motor Vehicles for these two specific electric vehicle models as well as any Tesla vehicles. No Teslas were registered in Sitka at the time. It was not possible to obtain data for all electric vehicle models. However, anecdotally, Nissan Leafs are considered by far the dominant electric vehicle model in Alaska.

Information provided by Alaska Electric Light and Power (AEL&P), Juneau’s electric utility, shows a steady rate of adoption of Nissan Leafs in Juneau from 23 vehicles in October 2015 to 165 in October 2017. Leaf ownership rates as of August 2017 were nearly identical in Sitka (one vehicle per 238 residents) and Juneau (one vehicle per 227 residents). According to a presentation by AEL&P to the Juneau Chamber of Commerce, the average electric vehicle in Juneau uses about 300 kWh per month (10 kWh per day).

The number of Nissan Leaf electric vehicles registered in Juneau over the past three years are shown in the following chart. The rate of increase in electric vehicles appears to be exponential, however, AEL&P indicates that some slowing in the number of vehicles is being seen more recently.

Figure 5
Nissan Leaf Electric Vehicles Registered in Juneau, 2015-2017



Source: Alaska Electric Light & Power, from Alaska Division of Motor Vehicles data.

Based on the increase seen in this chart, AEL&P has projected a reasonable number of electric vehicles in Juneau over the next few years to be about 1,100, representing about 5% of the total number of passenger vehicles presently in Juneau. Using a similar assumption of 5% of total passenger vehicles estimated at about 4,850 in Sitka, the total number of electric vehicles in Sitka could reach about 250. This would result in a total estimated electrical load of about 900,000 kWh annually¹⁵ for the recharging of electric vehicle batteries. Additional electric vehicles, such as buses and municipal service vehicles, could be employed in Sitka at some point.

Electric vehicles are being promoted in communities in the Pacific Northwest where hydroelectric power is the primary source of electric energy. As such, the implementation of electric vehicles is expected to increase as is the availability of new electric vehicle options. A significant issue with newer electric vehicles is the move towards faster recharging times. AEL&P indicates that the typical recharging load of a Nissan Leaf is about 6 kW. Faster charging vehicles may draw as much as 20 kW. The need for faster charging may not be an issue in Southeast Alaska where the length of available roads are much lower than elsewhere.

¹⁵ Calculated as 300 kWh per month for 250 vehicles. The estimated monthly recharging loads for electric vehicles in Sitka are assumed to be similar to the average recharging loads experienced in Juneau.

Heat Pumps

The use of electric heat pumps for space heating has been increasing in recent years. Heat pumps offer a lower cost alternative to other forms of electric and oil-fueled space heating. The Electric Department indicates that contractors in Sitka estimate the average number of residential heat pumps installed in Sitka has been about 100-120 per year in recent years. Of these, it is estimated that about 70% of the heat pump installations are being made in homes with oil-fueled space heating. It is also noted that as State and city rebate programs are being phased out, the number of residential heat pump installations is declining. It has been indicated, however, that commercial heat pump installations have been increasing as residential installations are declining.

Estimating the electricity use for heat pumps is difficult due to the variables involved. However, estimating about 6,100 kWh¹⁶ per year for an individual residential heat pump load, the total load on the electric system would be 610,000 kWh per year for 100 residential heat pumps. This estimated load for 100 heat pumps represents 0.5% of the total forecasted load for the CBS electric system in 2018.

¹⁶ Based on a 12,000 BTU heat pump with an assumed 1.5 kW average load operating 80% of the time for seven months per year. Certain information regarding heat pump electrical requirements can be found at <http://www.heatpumpshalifax.ca/how-much-will-my-power-bill-increase-after-installing-a-heat-pump/>.

Section 3

Forecast of Customers and Energy Sales

Customer Account Forecast

The Electric Department classifies its customers as residential, boat, general service, and public authority. The number of customers for each customer classification have been forecasted. A portion of the sales to public authority customers is classified as non-bill. There are also three customers to which power is sold on an interruptible basis. In the past, there have been other customer classifications including public safety, the Sawmill Cove Industrial Park (SCIP) and as previously mentioned, APC. At the present time, those customers located at the industrial park are classified as individual general service customers.

The historical number of these customer accounts are shown in Table 14. Following is a description of the methods used in projecting the number of customer accounts.

Population Projections

The forecasted number of residential customers is based primarily on the relationship between population and the number of electric customers, with acknowledgement of recent trends in the number of electric customers served. Population projections for the CBS are periodically developed by the State of Alaska Department of Labor and Workforce Development (DOL). DOL's last detailed long-term projection was published in April 2016 and the results were presented in the report, *Alaska Population Projections: 2015-2045*. This latest DOL forecast projects the total state population to increase at an average annual rate of 0.66%.

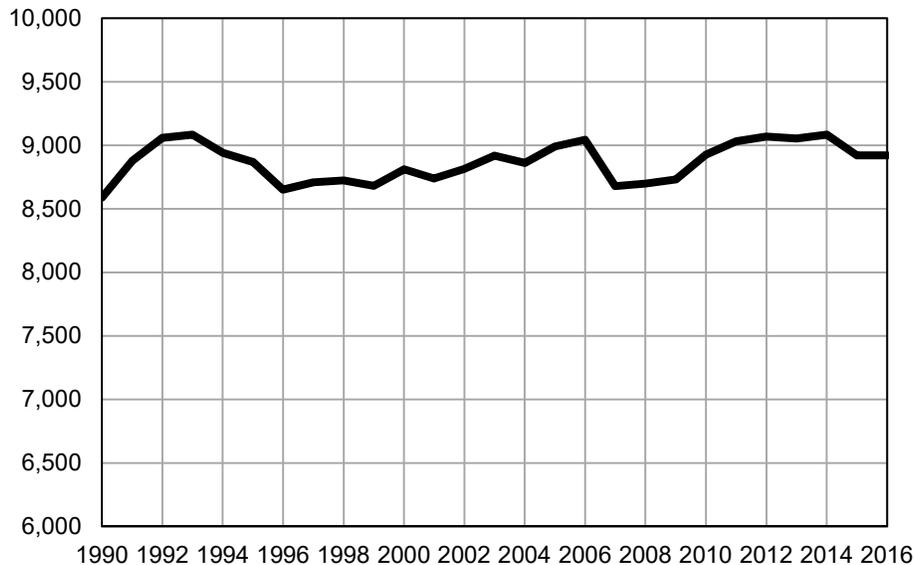
DOL projected each borough/census area population separately based on unique mortality, fertility and migration rates. The migration into and out of Alaska's boroughs and census areas are noted to represent a highly unstable component of population change. Although certain areas in the state are expected to have positive levels of net-migration throughout the projection period, with the exception of Haines, Skagway and Wrangell, the boroughs and census areas in Southeast Alaska are projected to experience negative net-migration strong enough to limit population growth.

The population in 2016 as estimated by DOL¹⁷ was 8,920 for the CBS. The population since 1990 in the CBS is shown in Figure 6. In 1993, the population of Sitka was nearly 9,000. Following closure of the pulp mill, the population declined to approximately 8,700 in 1997 before stabilizing and beginning a slight increase. Between 1997 and 2006, the population increased at an average annual rate of approximately 0.4%. The population decreased in 2007

¹⁷ 2016 Population by Borough/Census Area and Economic Region, Alaska Department of Labor and Workforce Development, Research and Analysis Department. <http://live.laborstats.alaska.gov/pop/>

as a result of the closure of the Sheldon Jackson College. As can be seen in Figure 6, the CBS population has remained relatively constant ranging between 8,700 and about 9,000 over the past 27 years.

Figure 6
City and Borough of Sitka
Historical (1990 - 2016) Population



In its latest projections, the DOL is projecting that the population in the CBS will decline over the period 2015 through 2045. The birth rate, death rate and net-migration was projected separately for age and gender groups. The population in the CBS is projected by DOL to decrease to 8,081 in 2045 representing an average annual decrease of 0.34% between 2016 and 2045. In the past, DOL included low, medium and high projections in its population projections. The 2015 population projections include only a single case. The projections provide a specific population value every five years.

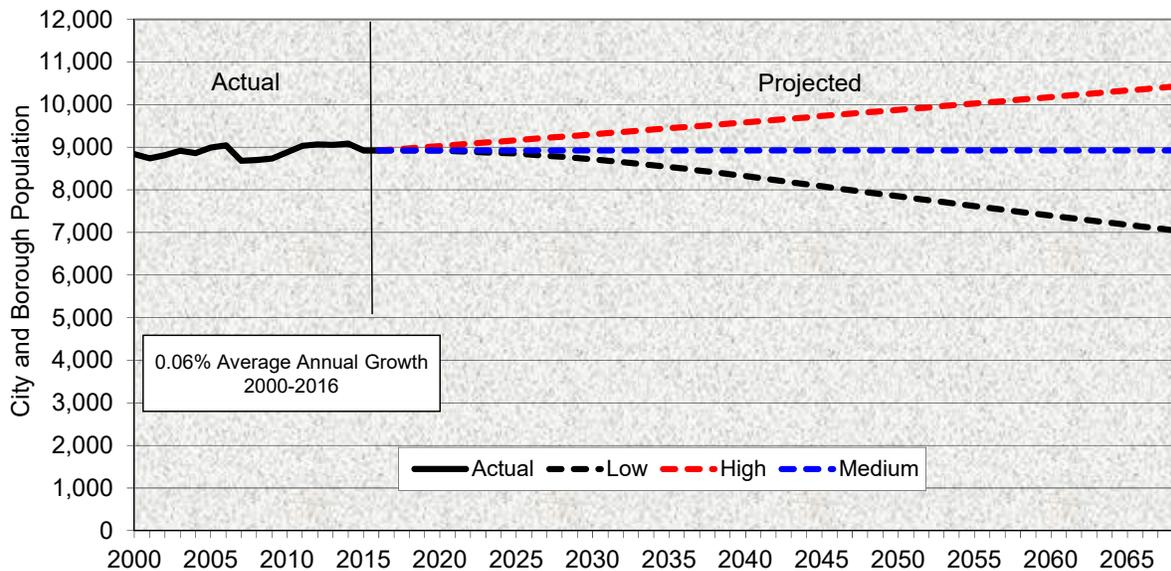
For the purpose of the electric load forecast it has been necessary to define a population projection to serve as the basis for the number of future electric consumers. We have established an annual population projection through 2067 by extrapolating the five year specific values provided by DOL to establish the “Low Case” population projection. The reason for identifying this projection as the Low Case is that the DOL projections don’t seem to take economic considerations into account. While lower oil prices have some drag on state employment, fisheries, tourism, and federal employment appear to be flat or increasing in Sitka. Without a pessimistic view of Sitka’s economic future it is hard to see a significant decline in population.

Further, migration assumptions are quite difficult to make on small geographic scales, as DOL admits in the most recent report on their projections. It is hard to imagine a steady, significant decline in Sitka’s population given the diversified economy and very high quality of life there. Add to that the fact that more and more work is location neutral.

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In addition to the Low Case based on the DOL projections, a Medium Case has been presented with no change in population. A High Case has been established assuming 0.3% average annual growth in population. This rate of population growth is approximately the average annual rate of growth experienced in the CBS over the ten year period, 2007 through 2016. The projected populations for each growth case are shown in the following figure. The DOL population projections in five year increments are shown in Table 1 (Low Case).

Figure 7
City and Borough of Sitka
Actual and Projected Population



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Table 1
Forecasted Population Used in Load Forecast
City and Borough of Sitka

	Forecasted Population		
	Medium	Low	High
2016 (Estimated Actual)	8,920	8,920	8,920
2017	8,920	8,920	8,947
2020	8,920	8,920	9,028
2025	8,920	8,851	9,164
2030	8,920	8,718	9,302
2035	8,920	8,538	9,442
2040	8,920	8,324	9,585
2045	8,920	8,081	9,730
2067	8,920	7,093	10,392
Average Annual Growth Rates			
2016 - 2020	0.00%	0.00%	0.30%
2020 - 2025	0.00%	-0.16%	0.30%
2025 - 2030	0.00%	-0.30%	0.30%
2030 - 2035	0.00%	-0.42%	0.30%
2035 - 2040	0.00%	-0.51%	0.30%
2040 - 2045	0.00%	-0.59%	0.30%
2040 - 2067	0.00%	-0.59%	0.30%
2016 - 2045	0.00%	-0.34%	0.30%
2016 - 2067	0.00%	-0.45%	0.30%

Residential Accounts

The number of residential accounts has been projected based on the calculated relationship between customers served, population and recent trends in the number of residential accounts served. For the most part, the number of persons per residential account is relatively consistent but does show a trend to fewer persons per account. This would be consistent with the trend towards fewer persons per household. The historical relationship between population and residential accounts is shown in Table 2.

Table 2
City and Borough of Sitka
Persons per Residential Electric Account

	Population	Residential Accounts	Person per Account
2003	8,918	3,484	2.56
2004	8,860	3,473	2.55
2005	8,990	3,488	2.58
2006	9,043	3,524	2.57
2007	8,678	3,584	2.42
2008	8,698	3,621	2.40
2009	8,730	3,651	2.39
2010	8,881	3,671	2.42
2011	9,030	3,672	2.46
2012	9,068	3,662	2.48
2013	9,053	3,728	2.43
2014	9,084	3,598	2.52
2015	8,920	3,638	2.45
2016	8,920	3,679	2.42
2017	8,920	3,703	2.41

A regression analysis of the historical trend in the number of residential accounts was conducted, however it was determined that basing the number of accounts on the recently experienced number of persons per residential account would be a more reasonable assumption. If, as DOL projects, the population decreases in each community, the number of residential units would probably not increase quite as much as would have been experienced with increasing population. As such, the number of persons per residential account might tend to drop slightly but could reasonably be expected to remain about the same as currently experienced.

For the purpose of the load forecast, it has been assumed that the number of persons per residential account for the Medium Case will remain at the 2017 level through 2018 and would decrease 0.1% per year thereafter.

Boat Accounts

Boat accounts in Sitka are for boats moored in community marinas. Although there may be no real connection, the number of boat accounts appears to be reasonably related to the number of residential accounts. On average over the past ten years, there have been 4.75 residential accounts per harbor account. Over the past ten years, the number of boat accounts has increased 0.86% per year on average. The number of boat accounts increased noticeably between 2016 and 2017 which resulted in a reduction to 4.58 residential accounts per boat account in 2017.

For the load forecast it has been assumed that the number of residential accounts per boat account will be the same in 2018 as in 2017 and will decrease by 0.1% per year thereafter. This

means that the number of boat accounts will increase slightly faster than the number of residential accounts.

General Service Accounts

The number of general service accounts has been projected based on the number of these accounts relative to the number of residential accounts. The number of residential accounts per general service account has been decreasing 0.9% per year on average over the past 19 years and 0.3% per year on average over the past ten years and was 5.68 residential customers per general service customer in 2017. The number of general service accounts has increased 0.6% per year on average over the ten year period, 2008 through 2017.

For the purpose of the load forecast, it has been assumed that the number of general service accounts are directly related to the number of residential accounts. The ratio of residential accounts to general service accounts is assumed to continue to decrease in the future at an average rate of 0.5% per year for the Medium Case.

Although all of the general service customers are included in the same class for this forecast, it is noted that some of the general service customers are considerably larger than others. The number of larger general service accounts appear to remain relatively stable. Among the new general service accounts projected in the forecast, the ratio of larger and smaller general service customers would be expected to remain similar to what is experienced at the present time. There are two general service rate classes.

Public Authority Accounts

The number of public authority accounts has increased 0.5% per year on average over the ten year period, 2008 through 2017. Similar to the number of general service accounts, the number of public authority accounts has been projected based on the number of these accounts relative to the number of residential accounts. The number of residential accounts per public authority account has been decreasing 0.2% per year on average over the past ten years and was 19.09 residential customers per general service customer in 2017.

For the purpose of the load forecast, it has been assumed that the number of public authority accounts are directly related to the number of residential accounts. The ratio of residential accounts to public authority accounts is assumed to continue to decrease in the future at an average rate of 0.7% per year through 2020 and at 0.4% per year thereafter, for the Medium Case.

Total Forecasted Number of Accounts

In 2017, the Electric Department provided electric service to 3,703 residential customers, 808 boat customers, 652 general service customers, 194 public authority customers and 3 interruptible customers.

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The forecasted number of customer accounts, by customer classification are shown in Table 9 for the medium, high and low growth scenarios. Since the number of residential customers is projected relative to forecasted population and recent trends in the number of customers served, there is a projected decrease in the number of customers served for the low growth scenario and a slight increase for the medium and high growth scenarios. The projected number of customers for the Medium Case are summarized in Table 4. As can be seen in Table 4, the total number of customer accounts served by the Electric Department is projected to increase at an average annual rate of 0.2% per year. A more detailed presentation of the forecasted number of customer accounts is shown in Table 17.

Table 3
Forecasted Total Number of Customer Accounts
(Medium Case)

Forecast Year	Customer Classification					Total
	Residential	General Service	Boats	Public Authority	Interruptible	
2017 (Actual)	3,703	652	808	194	3	5,360
2020	3,714	664	813	199	6	5,396
2025	3,733	684	821	204	6	5,448
2030	3,751	705	829	209	6	5,500
2035	3,770	726	838	214	6	5,554
2037	3,778	735	841	216	6	5,576
2067	3,893	881	893	251	6	5,924
Average Annual Growth Rates						
2017-2020	0.1%	0.6%	0.2%	0.9%	26.0%	0.2%
2020-2025	0.1%	0.6%	0.2%	0.5%	0.0%	0.2%
2025-2030	0.1%	0.6%	0.2%	0.5%	0.0%	0.2%
2030-2035	0.1%	0.6%	0.2%	0.5%	0.0%	0.2%
2035-2067	0.1%	0.6%	0.2%	0.5%	0.0%	0.2%
2017-2037	0.1%	0.6%	0.2%	0.5%	3.5%	0.2%
2017-2067	0.1%	0.6%	0.2%	0.5%	1.4%	0.2%

Energy Consumption per Customer

Establishing a relationship between energy consumption per customer and variables such as weather conditions, the price of electricity, and the price of heating oil, was attempted. Energy consumption is affected by these variables, as well as others, but based on the experience in recent years, a consistent relationship is difficult to obtain. Total annual energy consumption per residential customer decreased in recent years while winter temperatures in Southeast Alaska have generally been higher than average. At the same time, the price of heating oil has decreased reducing the demand for conversion to electric space heating.

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General Service energy consumption is affected somewhat by weather conditions but is impacted to a greater degree by economic activity in the area. DOL indicated in January 2017¹⁸ that employment in Southeast Alaska dropped about 1.4% between 2015 and 2016 and was expected to decline 1.7% in 2017. Much of the decrease in employment is expected in government jobs. Seafood processing was projected to increase slightly in 2017 and construction jobs were projected by DOL to decline somewhat in 2017.

Tourism, fishing and seafood processing continue to do well in Southeast Alaska¹⁹. For the purpose of the load forecast it is assumed that these industries will continue to operate reasonably consistently through the forecast period. Establishing a good relationship between energy consumption and variables such as weather conditions, per capita income, inflation and others, was not possible.

Residential energy consumption decreased 0.8% per year on average between 2008 and 2017 but increased by 3.0% between 2016 and 2017. Residential energy consumption over the past ten years is summarized in the following table.

Table 4
Residential Energy Consumption 2008-2017
(Kilowatt-hours)

Year	Energy Sales (kWh)	Annual Change
2008	46,396,181	
2009	49,925,862	7.6%
2010	46,775,688	-6.3%
2011	47,901,502	2.4%
2012	47,583,037	-0.7%
2013	47,628,760	0.1%
2014	46,273,202	-2.8%
2015	42,757,624	-7.6%
2016	41,849,249	-2.1%
2017	43,117,499	3.0%
Compound Annual Growth Rate		
2008-2013	0.5%	
2013-2017	-2.0%	
2008-2017	-0.8%	

¹⁸ Alaska Economic Trends, January 2017.

¹⁹ Alaska Economic Trends, August 2017 and January 2017.

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General Service energy consumption has remained relatively constant over the past four years but increased 0.9% per year on average between 2008 and 2017. The following table shows the total energy sales to general service customers.

**Table 5
 General Service Energy Consumption 2008-2017**

Year	Energy Sales (kWh)	Annual Change
2008	32,026,170	
2009	31,421,023	-1.9%
2010	30,932,153	-1.6%
2011	30,932,153	0.0%
2012	30,486,914	-1.4%
2013	32,043,016	5.1%
2014	34,799,581	8.6%
2015	35,090,537	0.8%
2016	34,615,848	-1.4%
2017	34,745,934	0.4%
Compound Annual Growth Rate		
2008-2013	0.0%	
2013-2017	1.6%	
2008-2017	0.9%	

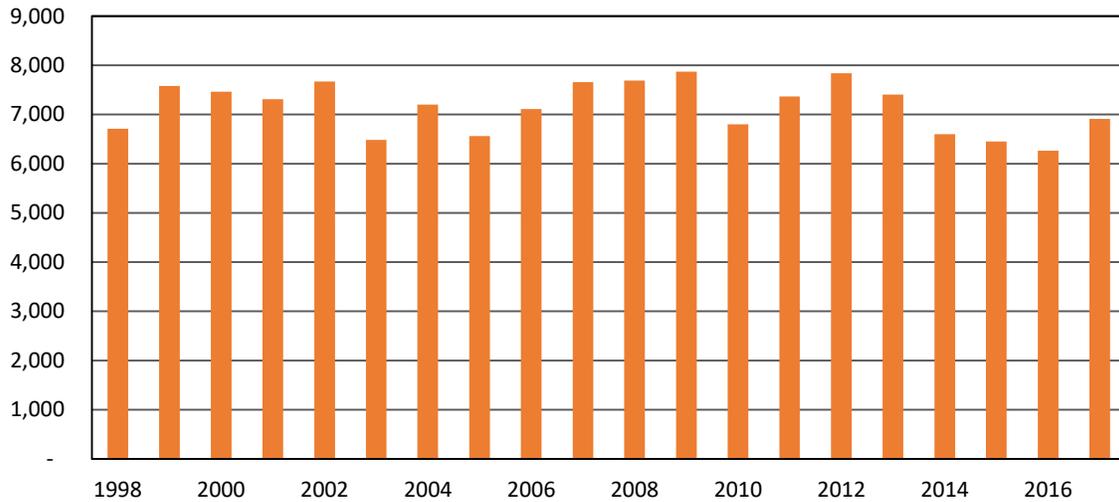
Energy consumption per customer for each customer class has been evaluated. A regression analysis was performed to determine the relationship between energy consumption, weather and the price of heating oil. For the purpose of the load forecast, the impact of weather conditions is represented by the relationship between energy consumption and heating degree days (HDD). HDD are calculated as the summation of the differences in the daily mean temperature relative to 65 degrees Fahrenheit over a period of time. When the mean temperature is more than 65 degrees it does not factor into the HDD. The HDD for many locations around the United States are calculated by the National Oceanic and Atmospheric Administration (NOAA).

On NOAA’s National Centers for Environmental Information website²⁰ the monthly HDD, along with other weather information, for the past eleven years for the Sitka airport has been obtained. The summation of the monthly data indicates that temperatures had been generally warmer during the three year period, 2014-2016 resulting in lower HDD during those years. Average temperatures were somewhat lower in 2017 compared to 2016 and HDD increased in 2017 as a result.

²⁰ <https://www.ncdc.noaa.gov/cdo-web/search>

The following figure shows the annual HDD for Sitka for the twenty year period, 1998 through 2017. The average annual HDD over the twenty years was 7,147. The long-term average for the Sitka airport, as provided by NOAA, is 7,191. Although the average annual HDD over the period shown on the charts is representative of the long-term average, it is clear that the HDD were significantly below average during the three year period, 2014 through 2016.

Figure 8
Annual Summation of Sitka Monthly HDD ¹



¹ Data for Sitka airport station for fiscal years ending June 30.

Over the past twenty years, the average annual energy consumption per residential customer has not changed much, although there are changes from year to year. The impact of warmer than average temperatures on energy consumption appears to be more noticeable in recent years potentially as a result of higher uses of electric space heat. The following chart shows the average energy consumption per residential customer over the past twenty years.

Figure 9
Average Annual Energy Consumption per Residential Customer
(Kilowatt-hours)

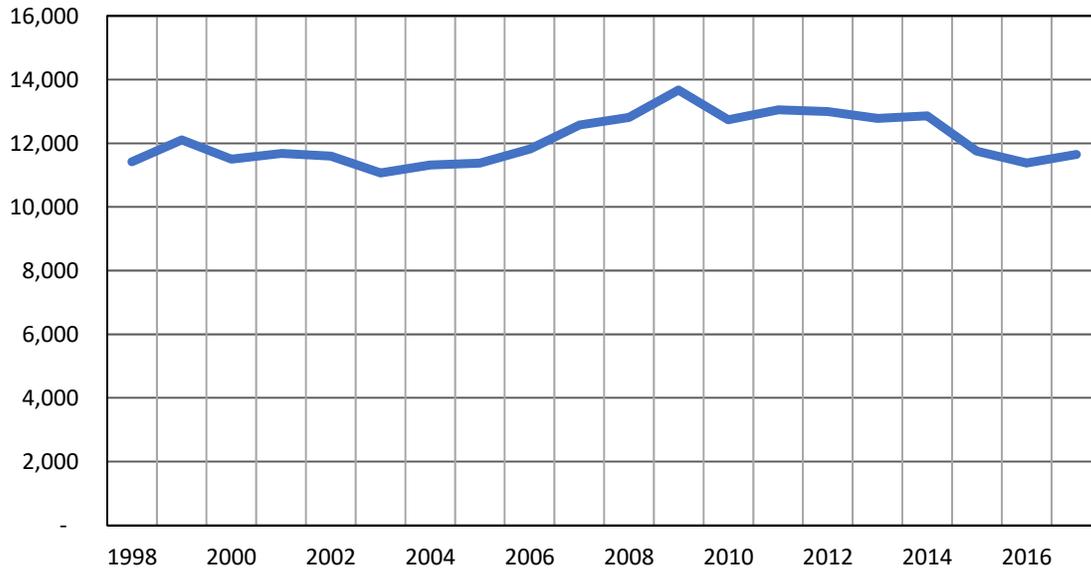
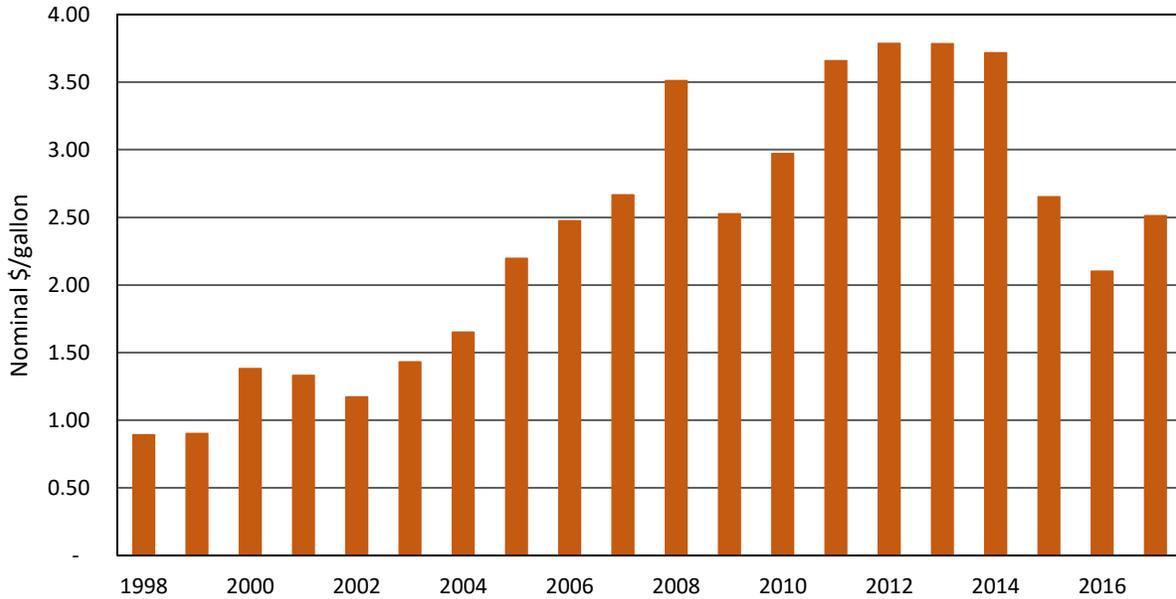


Figure 9 shows that the average energy consumption per residential customer increased between 2003 and 2009 and generally declined between 2009 and 2016 with a slight increase in 2017. Between 2003 and 2009 the HDD generally increased as well. HDD generally decreased between 2009 and 2016. Comparing the energy consumption per residential customer to the HDD chart would indicate that the drop in HDD beginning in 2014 was a factor in the drop in energy consumption in 2015 and 2016.

Another factor affecting energy consumption is the price of heating oil. As heating oil prices increased in the mid-2000s, there was an increasing incentive to use electricity for space heat on either a permanent or a temporary basis. The average price of heating oil on a national basis is shown in the following figure.

Figure 10
Annual Price of Heating Oil
(Nominal \$/gallon) ¹

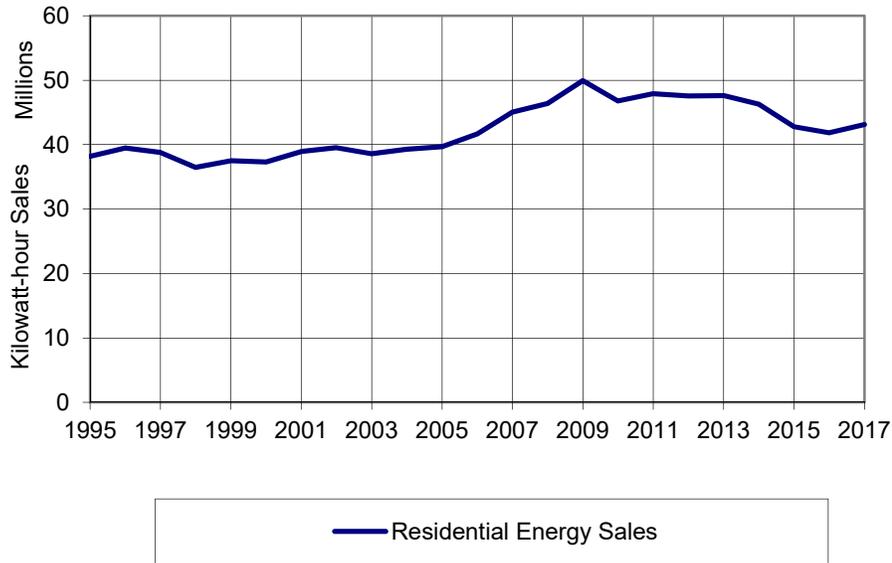


¹ National average. Source: US Energy Information Administration.
<http://www.eia.gov/forecasts/steo/realprices/>

The increasing price of fuel between 2003 and 2008 along with favorable electric rates potentially encouraged more residents to use electricity for space heat. The drop in oil prices in 2015 most likely added to the decrease in energy consumption already noted to be a result of warmer temperatures.

The price of electricity relative to the price of heating oil has an impact on electricity use if consumers have the ability to use different energy sources for space heating. Further, changes in the price of electricity from year to year can have an impact on consumer use of electricity as well. Large changes in the price of electricity over a relatively short period of time acts as an incentive to adjust energy consumption. The recent rate increases in Sitka are too new to evaluate this “price elasticity” impact on electricity use in detail. The following figure shows total energy sales to residential customers in Sitka over the past twenty years. Electricity rates remained relatively constant throughout this period, however, they did increase relatively recently.

Figure 11
City and Borough of Sitka
Total Residential Energy Sales



The regression analysis that was conducted to determine if a good relationship between annual energy consumption by customer class, HDD and oil prices, for the most part, did not indicate that the relationships were sufficiently strong to base the forecast of future consumption on the results of the regression analysis. It was deemed important, however, to base the forecast on future assumptions of HDD. To accomplish this, the relationship of energy consumption per customer per HDD was evaluated and used to project future energy consumption, primarily for residential customers.

For the Medium Case of the load forecast it has been assumed that the HDD will remain somewhat below average in 2018 and will return to the long-term average in 2019 and will remain at that level each year thereafter. For the High Case, the HDD is assumed to be at the level experienced in 2013 (7,408) beginning in 2019 and remain at this level each year thereafter. For the Low Case, the HDD is assumed to be at the average of the past five years (6,727) for each year beginning in 2019.

The price of oil is projected by the US Energy Information Administration to increase about 8% in 2018 as compared to the price in 2017, which is still considerably below the high prices experienced between 2011 and 2014. Oil prices are assumed to increase 3.0% each year after 2018 based on a projection for Southeast Alaska provided by the Alaska Energy Authority.

The forecasted energy consumption per customer by customer class is shown in Table 14.

Residential Energy Consumption

Residential energy consumption per customer in 2015, 2016 and 2017 was affected by the higher than normal winter temperatures. The assumption of a return to normal temperatures would increase residential energy consumption. Based on historical experience it is also anticipated that if weather conditions were to remain relatively constant, average annual energy consumption per customer would increase from year to year. The availability of LED lighting and other energy conservation products would lower the average increase than previously experienced, however.

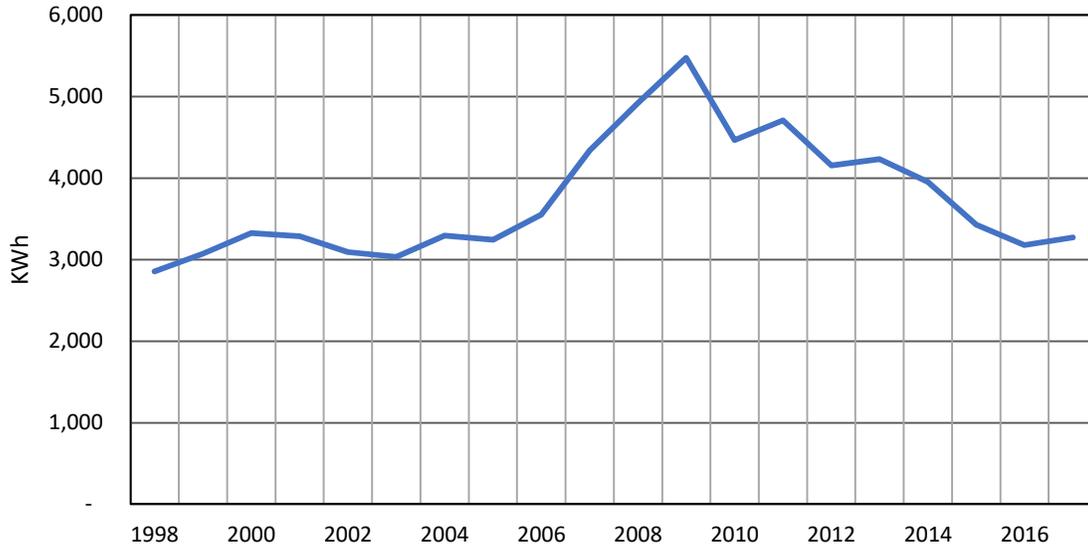
Assuming that the HDD in Sitka returns to the long-term average in 2019, the average annual energy consumption per residential customer for the Medium Case is forecasted to increase from 11,644 kWh in 2017 to 11,900 kWh in 2018 and 12,130 kWh in 2019. After 2019, the energy per customer is assumed to increase 0.5% per year.

For the High Case, the average annual energy consumption per residential customer is forecasted to be 12,657 kWh in 2019. After 2019, the annual energy per customer is assumed to increase 0.5% per year through 2023 and at 0.6% per year thereafter. For the Low Case, the energy consumption per customer is assumed to remain at 11,510 per year beginning in 2019.

Boat Customer Energy Consumption

Energy consumption per boat customer has decreased fairly significantly over the past ten years. Similar to residential customers, the average energy per boat customer decreased even further in the past three years due to the warmer than average temperatures. A slight increase in energy consumption per customer was noted in 2017. The regression analysis conducted for boat energy consumption per customer found a reasonable correlation between energy consumption, HDD and the price of oil. The following chart shows the average annual energy consumption per boat customer the past twenty years.

Figure 12
Average Annual Energy Consumption per Boat Customer
(KWh)



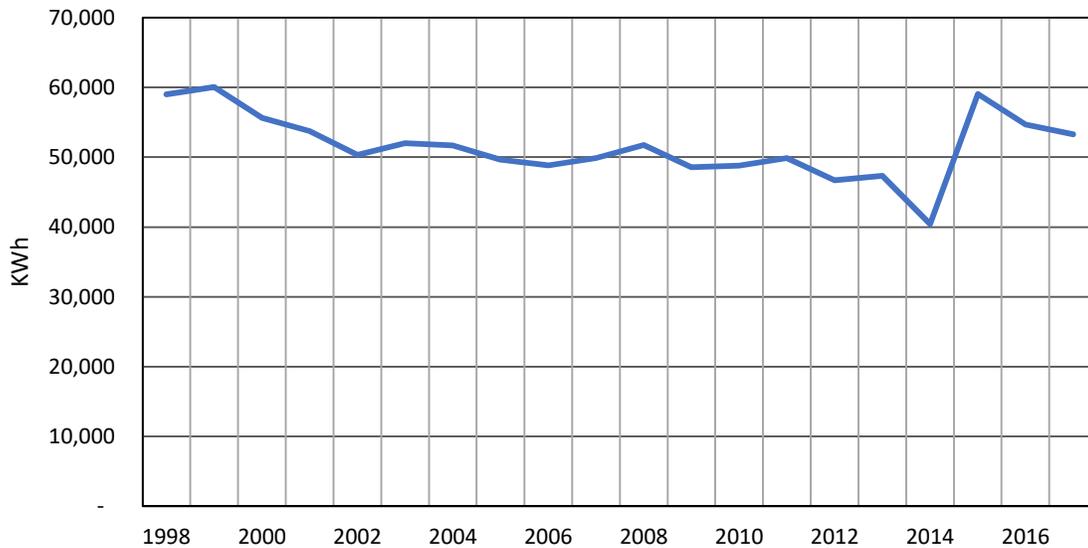
Assuming that the HDD in Sitka returns to the long-term average in 2019, the average annual energy consumption per boat customer for the Medium Case is forecasted to increase from 3,272 kWh in 2017 to 3,822 kWh in 2018 and 3,912 kWh in 2019. After 2019, the energy per boat customer is assumed to increase 0.5% per year.

For the High Case, the average annual energy consumption per boat customer is forecasted to be 4,098 kWh in 2019. For the Low Case, the energy consumption per boat customer is assumed to be 3,313 per year in 2019. After 2019, the annual energy per boat customer for the High and Low Cases is assumed to increase 0.5% per year.

General Service Energy Consumption

Energy consumption by general service customers is affected by a number of variables primarily related to the business activity the customer is involved in. Overall, the energy use by general service customers in Sitka has remained relatively constant over the past twenty years and has shown an increase in recent years²¹. The following chart shows the average annual energy consumption per general service customer the past twenty years.

Figure 13
Average Annual Energy Consumption per General Service Customer ¹
(KWh)



¹ Energy consumption data for 2014 and 2015 appears to be inconsistent. Actual energy consumption in these two years is probably the average of the low and high values shown on the chart.

It is assumed that general service energy consumption per customer will increase slightly over the next five years in response to the assumption of a return to cooler average temperatures. Assuming that the HDD in Sitka returns to the long-term average in 2019, the average annual energy consumption per general service customer for the Medium Case is forecasted to increase from 53,291 kWh in 2017 to 54,068 kWh in 2019. After 2019, the annual energy per general service customer is assumed to increase 0.2% per year through 2023 and at 0.3% per year thereafter.

For the High Case, the average annual energy consumption per general service customer is forecasted to be 55,727 kWh in 2019. After 2019, the energy per general service customer is

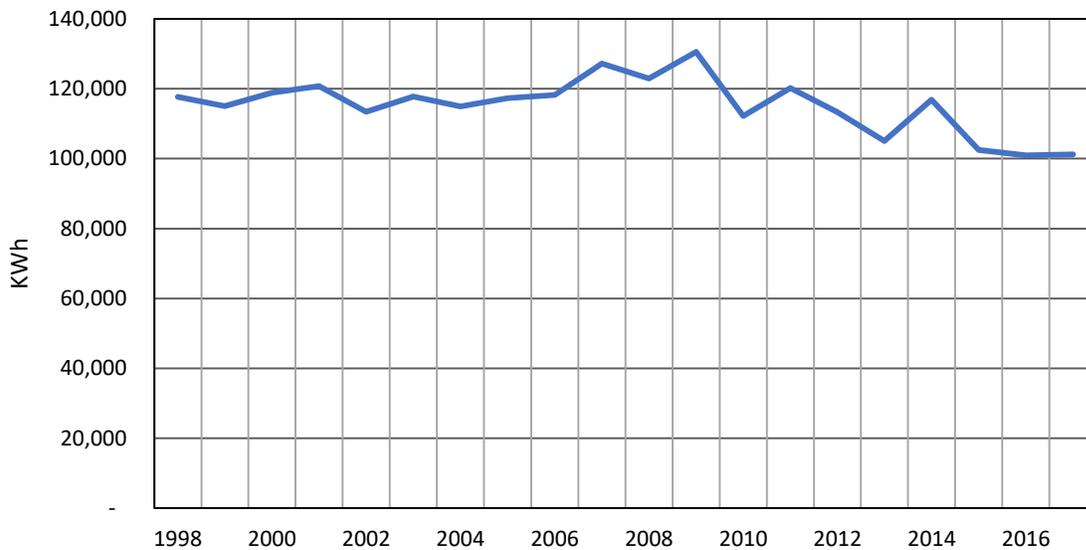
²¹ The number of general service customer accounts and energy sales in 2014 and 2015, as provided by the CBS, appears to be inconsistent.

assumed to increase 0.3% per year. For the Low Case, the energy consumption per general service customer is assumed to be 50,455 kWh in 2019. After 2019, the average annual energy consumption per general service customer for the Low Case is assumed to remain constant through 2023 and decrease at 0.05% per year thereafter.

Public Authority Energy Consumption

Average annual energy consumption per public authority customer has remained fairly consistent over the past twenty years but has declined noticeably between 2009 and 2017. Energy consumption per public authority customer in 2017 was 22.5% lower than it was in 2009. It is also noted that energy consumption per public authority customer remained constant over the most recent three year period, 2015 through 2017. The following chart shows the average annual energy consumption per public authority customer over the past twenty years.

Figure 14
Average Annual Energy Consumption per Public Authority Customer (KWh)



It is assumed that public authority energy consumption per customer will increase somewhat over the next few years in response to the assumption of a return to cooler average temperatures. Assuming that the HDD in Sitka returns to the long-term average in 2019, the average annual energy consumption per public authority customer for the Medium Case is forecasted to increase from 101,251 kWh in 2017 to 104,579 kWh in 2019. After 2019, the annual energy per public authority customer is assumed to increase 0.2% per year through 2023 and at 0.3% per year thereafter.

For the High Case, the average annual energy consumption per public authority customer is forecasted to be 109,224 kWh in 2019. After 2019, the energy per public authority customer is assumed to increase 0.3% per year. For the Low Case, the average energy consumption per public authority customer is assumed to be 98,991 kWh in 2019. After 2019, the annual energy

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consumption per public authority customer for the Low Case is assumed to increase 0.1% per year.

Base consumption amounts and assumed changes in consumption in the future are shown in Table 3. Forecasted energy consumption per customer for each customer class through the forecast period is shown in Table 17.

**Table 6
Annual Energy Consumption per Customer Account and
Assumed Future Changes in Consumption**

	Customer Classification			
	Residential	General Service	Boats	Public Authority
Annual kWh per Customer:				
Actual 2017	11,644	53,291	3,272	101,251
Assumed Average Annual Change:				
Medium Case				
2017-2020	1.8%	0.8%	6.7%	1.4%
2020-2025	0.5%	0.2%	0.8%	0.2%
2025-2030	0.5%	0.3%	0.9%	0.3%
2030-2035	0.5%	0.3%	1.0%	0.3%
2017-2037	0.7%	0.4%	1.8%	0.4%
2035-2067	0.4%	0.2%	1.4%	0.2%
High Case				
2017-2020	3.0%	1.6%	8.1%	2.7%
2020-2025	0.5%	0.3%	0.9%	0.3%
2025-2030	0.6%	0.3%	1.0%	0.3%
2030-2035	0.6%	0.3%	1.1%	0.3%
2017-2037	0.5%	0.3%	1.4%	0.3%
2035-2067	0.7%	0.4%	1.6%	0.4%
Low Case				
2017-2020	-0.3%	-1.8%	4.3%	-0.7%
2020-2025	0.4%	0.0%	0.7%	0.1%
2025-2030	0.3%	0.0%	0.7%	0.1%
2030-2035	0.3%	0.0%	0.8%	0.1%
2017-2037	0.2%	0.0%	0.9%	0.0%
2035-2067	0.2%	-0.2%	1.1%	0.0%

Interruptible Energy Sales

The CBS has established an interruptible energy sales program to sell hydroelectric generation to government buildings, and potentially industrial facilities, to supplant the use of fuel oil for space and water heating. At the present time, the Electric Department has three interruptible energy customers, all public buildings, which in total purchased 2,847 MWh in 2017. Two additional

schools are expected to be installing electric boilers and will begin purchasing interruptible energy in 2018. In total, it is assumed that these two new interruptible customers will purchase 1,400 MWh of energy annually.

For the purpose of the load forecast, it is assumed for the Medium Case that one more interruptible customer will begin taking service in 2020 and add an additional 1,400 MWh annually to the total energy sold to interruptible customers. For the High Case, two more interruptible customers are assumed to be on-line by 2025, one in 2022 and one in 2024, which would add 2,800 MWh annually in total to the total energy requirement of the system. The Low Case includes the two new loads in 2018 but does not include any other new interruptible loads.

Additional Loads of Electric Vehicles and Heat Pumps

As previously indicated in Section 2, additional electric vehicle and heat pump loads should be anticipated in Sitka. For the purpose of the forecast, it is assumed that 30 additional electric vehicles would be registered in Sitka in each of the next ten years. This would result in about 340 total electric vehicles at the end of ten years which may be an overly aggressive assumption of new electric vehicles but is provided here as an example. At current estimates for recharging loads, this number of vehicles would add 108 MWh per year total load to the CBS system, representing approximately 0.09% of the total CBS electric system load in 2018. By the end of the assumed ten year electric vehicle expansion period, it would be estimated that the total new electric vehicle recharging load would be 1,080 MWh per year.

For the purpose of the load forecast it is assumed that 100 new residential heat pumps will be installed in Sitka per year for each of the next ten years. The estimated load of the heat pumps is 6,000 kWh per year per unit resulting in a total load of 600 MWh per year for the CBS electric system. This estimated annual load for 100 heat pumps would represent 0.5% of the total forecasted CBS electric system load in 2018.

Total Energy Sales

Based on the forecasted number of customers and the projected electricity use per customer account, total annual energy sales have been forecasted. The results of the forecast for each of the customer classes and for each year of the forecast period are shown in Table 18 and are summarized for selected years in Table 7. As can be seen in Table 7, total energy sales are forecasted to be 114,016 MWh in 2020 for the medium growth scenario. This amount is approximately 11,019 MWh more than was sold in 2017, representing an increase of 10.7%.

Much of the increase between actual sales in 2017 and forecasted sales in 2020 is due to the assumption of a return to long-term average winter temperatures and annual HDD. In addition, the increased power sales to three new interruptible loads are included in the Medium Case. Interruptible energy sales were 2,847 MWh in 2017 and are forecasted to be 5,650 MWh in

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2020. Interruptible energy sales are only made if surplus hydroelectric energy is available. It can be expected that interruptible sales will vary from year to year and will potentially increase if fuel oil prices increase substantially.

Alternative high and low forecasts of the load are also included. The total forecasted energy sales for each year of the forecast period for the high and Low Cases are also shown in Table 18 and are summarized in Table 7. The High Case assumes that winter temperatures and HDD will be slightly higher than the long-term average while the Low Case assumes that winter temperatures and HDD will remain near the average level experienced the past five years.

**Table 7
Forecasted Total Retail Energy Sales ¹**

	Total Energy Sales (MWh)		
	Medium	High	Low
2017 (Actual)	102,997	102,997	102,997
2020	114,016	119,594	105,134
2025	121,554	133,993	109,832
2030	127,295	143,688	111,708
2035	131,764	151,047	111,713
2037	133,632	154,086	111,570
2067	157,266	208,943	104,317
Average Annual Growth Rates			
2017-2020	3.4%	5.1%	0.7%
2020-2025	1.3%	2.3%	0.9%
2025-2030	0.9%	1.4%	0.3%
2030-2035	0.7%	1.0%	0.0%
2035-2067	0.6%	0.6%	0.6%
2017-2037	1.3%	2.0%	0.4%
2017-2067	0.9%	1.4%	0.0%

¹ Includes interruptible energy sales. Excludes non-bill public authority energy sales.

Total Energy Requirements

The total energy requirements are the sum of total energy sales, non-billed public authority energy sales and energy losses. Non-billed public authority use was 1,769 MWh in 2017. Annual energy losses experienced by the electric system in the years 2008 through 2017 have varied between 2.6% and 10.8% of total energy requirements, averaging 6.7%. The significant variance in losses from year to year is probably caused more by variances in generation and sales accounting than anything else. Over the past five years energy losses have averaged 6.5% which would indicate lower losses more recently. It is not known if the decrease noted in recent years is due to accounting changes or other factors. For the purpose of the load forecast, energy losses

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are assumed to be 6.7%, 6.9% and 6.5% of total energy requirements for the medium, high and low load growth scenarios.

Forecasted total energy requirements are shown in Table 18 and are summarized in Table 8. Historical and forecasted energy requirements are shown in Figure 15 with average annual growth rates over the periods 1998–2017 and 2018–2037 indicated also.

Table 8
Forecasted Total Energy Requirements

	Total Energy Requirements (MWh)		
	Medium	High	Low
2017 (Actual)	112,740	112,740	112,740
2020	124,090	130,450	114,220
2025	132,240	146,050	119,270
2030	138,480	156,600	121,290
2035	143,350	164,650	121,310
2037	145,380	167,970	121,160
2067	171,140	227,960	112,990
Average Annual Growth Rates			
2017-2020	3.3%	5.0%	0.4%
2020-2025	1.3%	2.3%	0.9%
2025-2030	0.9%	1.4%	0.3%
2030-2035	0.7%	1.0%	0.0%
2035-2067	0.6%	1.0%	-0.2%
2017-2037	1.3%	2.0%	0.4%
2017-2067	0.8%	1.4%	0.0%

Figure 15
Historical and Projected Total Energy Requirements (1997-2067)

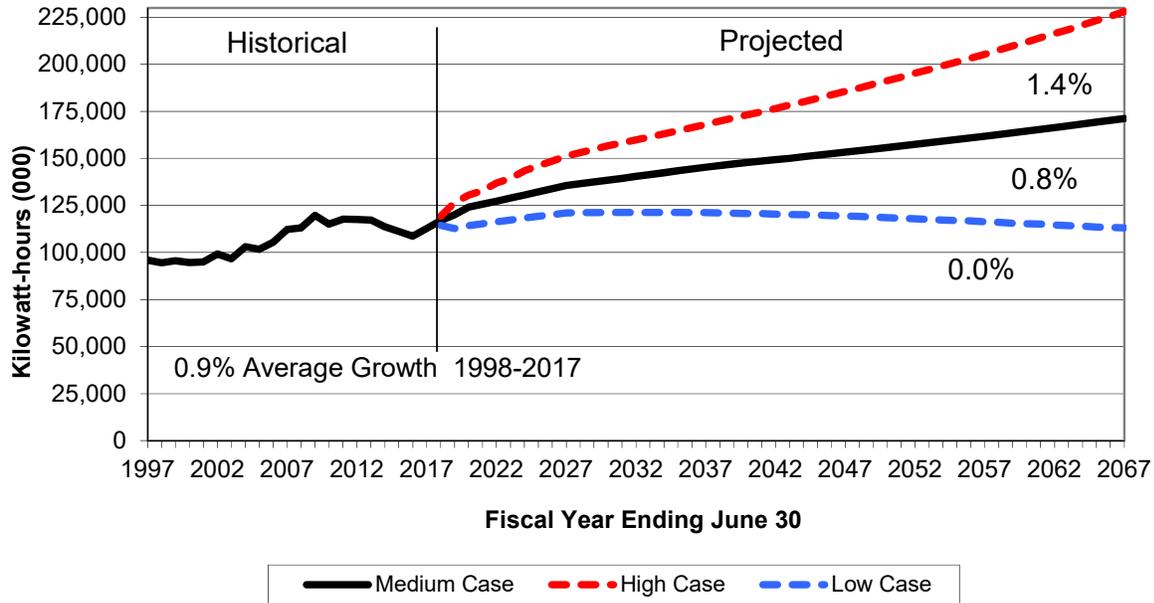


Figure 15 shows that average annual load growth experienced by the CBS system was 0.9% over the period 1998 through 2017. Between 2003 and 2009, average annual load growth was significantly higher which would correspond to the period of time with increasing HDD and higher fuel prices each year (see Figure 8 and Figure 10). The results of the forecast indicate average annual load growth over the next 50 years of 0.8% for the medium growth scenario, 1.4% average annual load growth for the high scenario, and 0.0% average increase in loads for the low growth scenario.

Peak Demand

Peak demand of the CBS electric system has been forecasted based on the forecast of total energy requirements and a range of annual load factors. The load factor is the ratio of peak demand to average demand. Over the past ten years, the CBS annual load factor has averaged approximately 60% ranging between 55.9% in 2012 and 62.5% in 2016. Typically in Sitka, a lower load factor will be incurred in a year with a colder winter and indicates the need for more power needed during the cold period. If more electric space heating is used in the community it would be expected that the average load factor would decline somewhat.

In any given year in the future, the load factor can't be predicted primarily because of its dependence on weather conditions. For the purposes of the peak demand forecast, the annual load factor has been assumed to range between 56% and 63%. Based on this assumption, the peak demand is forecasted to be within a range tied to the forecasted energy requirements in each year. In 2018 for example, the peak demand is forecasted to be between 21,200 KW and 23,800

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KW for the Medium Case. The forecasted peak demand in 2018 would be slightly higher for the High Case and slightly lower for the Low Case.

The forecasted range of peak demand for each year and each growth scenario is shown in Table 19 and is summarized in the following table.

**Table 9
Forecasted Range of Peak Demand (kW)**

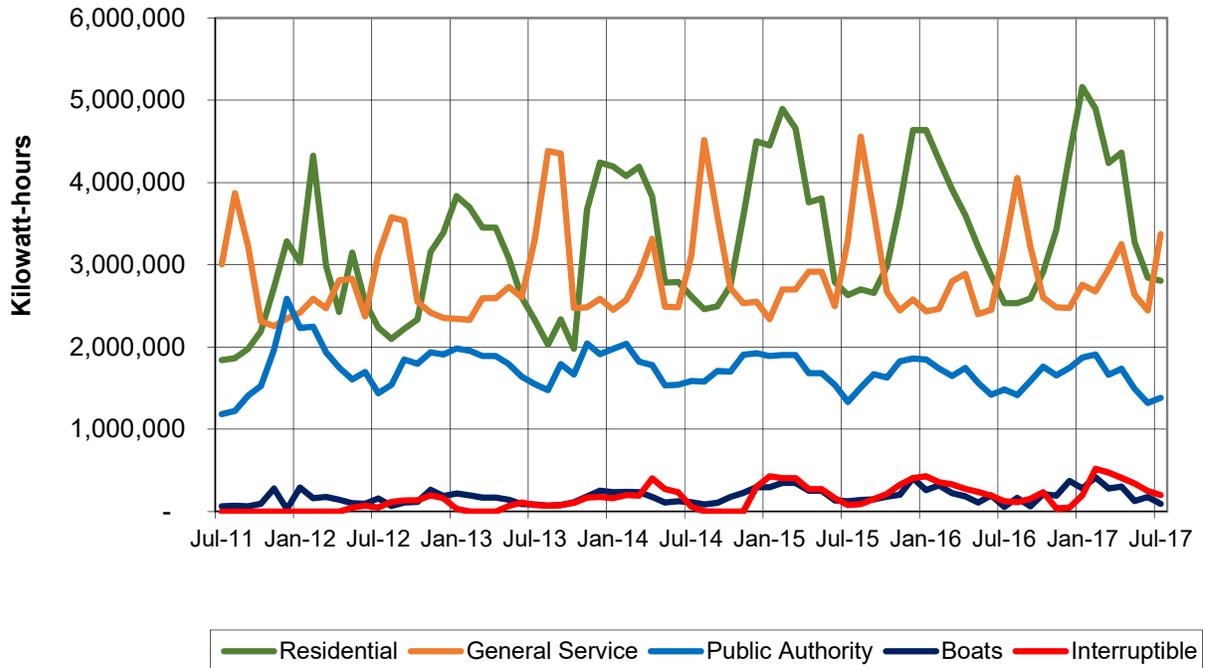
	Medium Case		High Case		Low Case	
	Low	High	Low	High	Low	High
2017 (Actual)	22,160	22,160	22,160	22,160	22,160	22,160
2020	22,500	25,300	23,600	26,600	20,700	23,300
2025	24,000	27,000	26,500	29,800	21,600	24,300
2030	25,100	28,200	28,400	31,900	22,000	24,700
2035	26,000	29,200	29,800	33,600	22,000	24,700
2037	26,300	29,600	30,400	34,200	22,000	24,700
2067	31,000	34,900	41,300	46,500	20,500	23,000
Average Annual Growth Rates						
2017-2020	0.5%	4.5%	2.1%	6.3%	-2.2%	1.7%
2020-2025	1.3%	1.3%	2.3%	2.3%	0.9%	0.8%
2025-2030	0.9%	0.9%	1.4%	1.4%	0.4%	0.3%
2030-2035	0.7%	0.7%	1.0%	1.0%	0.0%	0.0%
2035-2067	0.5%	0.5%	1.0%	1.0%	-0.2%	-0.2%
2017-2037	0.9%	1.5%	1.6%	2.2%	0.0%	0.5%
2017-2067	0.7%	0.9%	1.3%	1.5%	-0.2%	0.1%

Monthly Loads

The total energy sales throughout the year have shown a significant seasonal shape. Typically, the peak in sales occurs in either December, January or February. A summer peak usually occurs in August when the seafood processors are in full operation. The actual monthly energy sales as experienced the past six years²² by customer class are shown in the following figure.

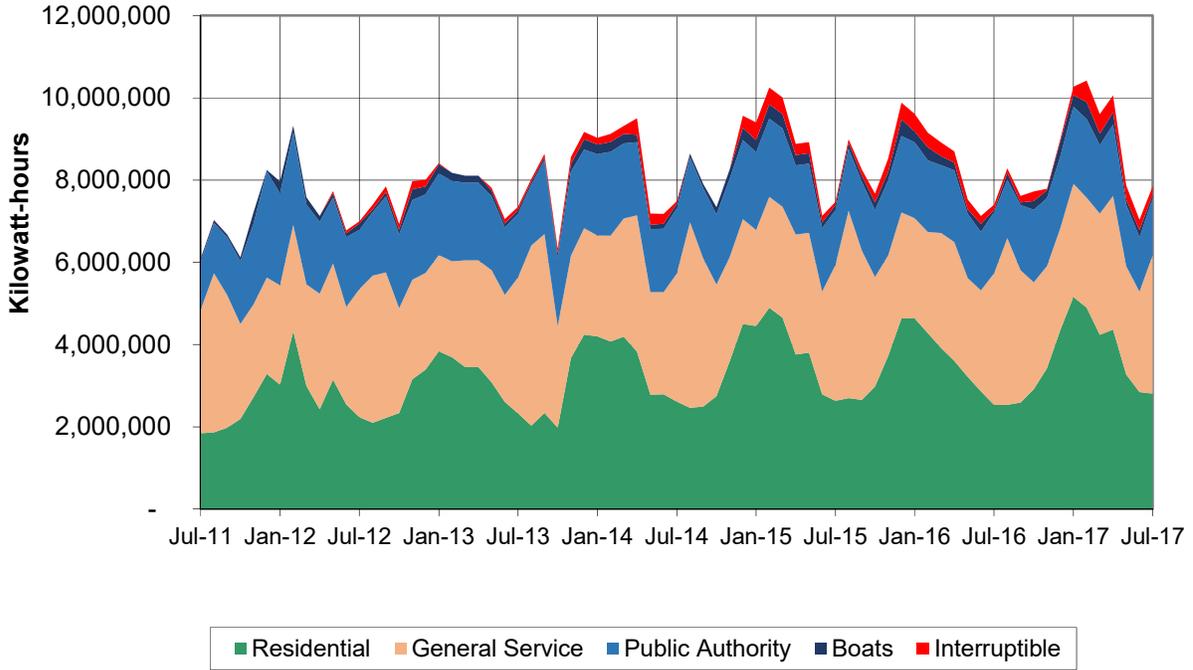
²² Monthly energy sales data as provided appears to have some inconsistencies and is not available prior to July 2011. Some adjustment was made to the sales data in a few of the months to address obvious problems.

Figure 16
City and Borough of Sitka
Actual Monthly Retail Energy Sales
(2012-2017)



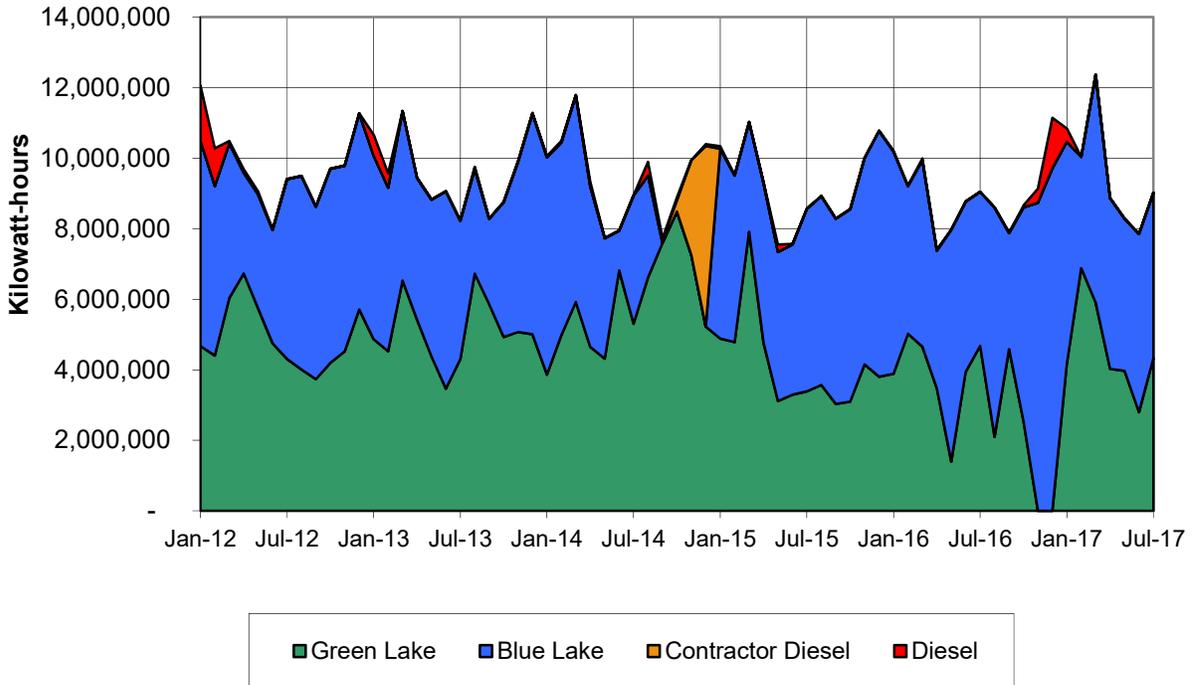
As can be seen in the previous figure the annual peaks of the residential and public authority customer classes can be clearly seen in the winter while the general service class peak is in the summer. On a cumulative basis the monthly energy sales for the same period is shown in the following figure.

Figure 17
City and Borough of Sitka
Actual Monthly Retail Energy Sales – Cumulative
(2012-2017)



Energy sales are usually reported when meter reading is conducted. As such, energy sales, as reported, tend to lag actual generation by approximately two to three weeks. Monthly energy sales shown in the previous figure do not include public authority non-billed use nor does it include energy losses. Monthly energy generation for the 2012 through 2017 period is shown in the following figure.

Figure 18
City and Borough of Sitka
Actual Monthly Energy Generation - Cumulative



Based on the monthly energy generation over the past six years, 2012 through 2017, the average generation in each month relative to the annual total has been derived and is shown in the following table. The use of monthly generation for the past six years only (rather than a longer period) may not reflect the long-term average of monthly power needs but should capture the more recent “shape” of the annual load profile. The percentages shown in the table can be used to present the forecasted annual energy sales in the future on a monthly basis.

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Table 10
City and Borough of Sitka
Average Energy Generation on a Monthly Basis
Based on Actual 2012-2017

January	8.7%
February	8.1%
March	9.0%
April	7.7%
May	6.7%
June	6.6%
July	7.1%
August	9.2%
September	8.0%
October	8.7%
November	9.6%
December	10.6%
Total	100.0%

Section 4 Generation Resources to Supply Loads

Generation Resources to Supply Load

As indicated in Section 9 of the Appraisal Study, *“The City electric system currently operates using rule curves based on average inflow conditions. Weather and precipitation patterns are highly variable in the Sitka region. Therefore it is reasonable for Sitka to use the current lake levels, historic electric load data, and average historical reservoir inflows for real-time planning of the reservoir regulation. This is especially true given the City’s weekly update of the reservoir level forecasts.”*

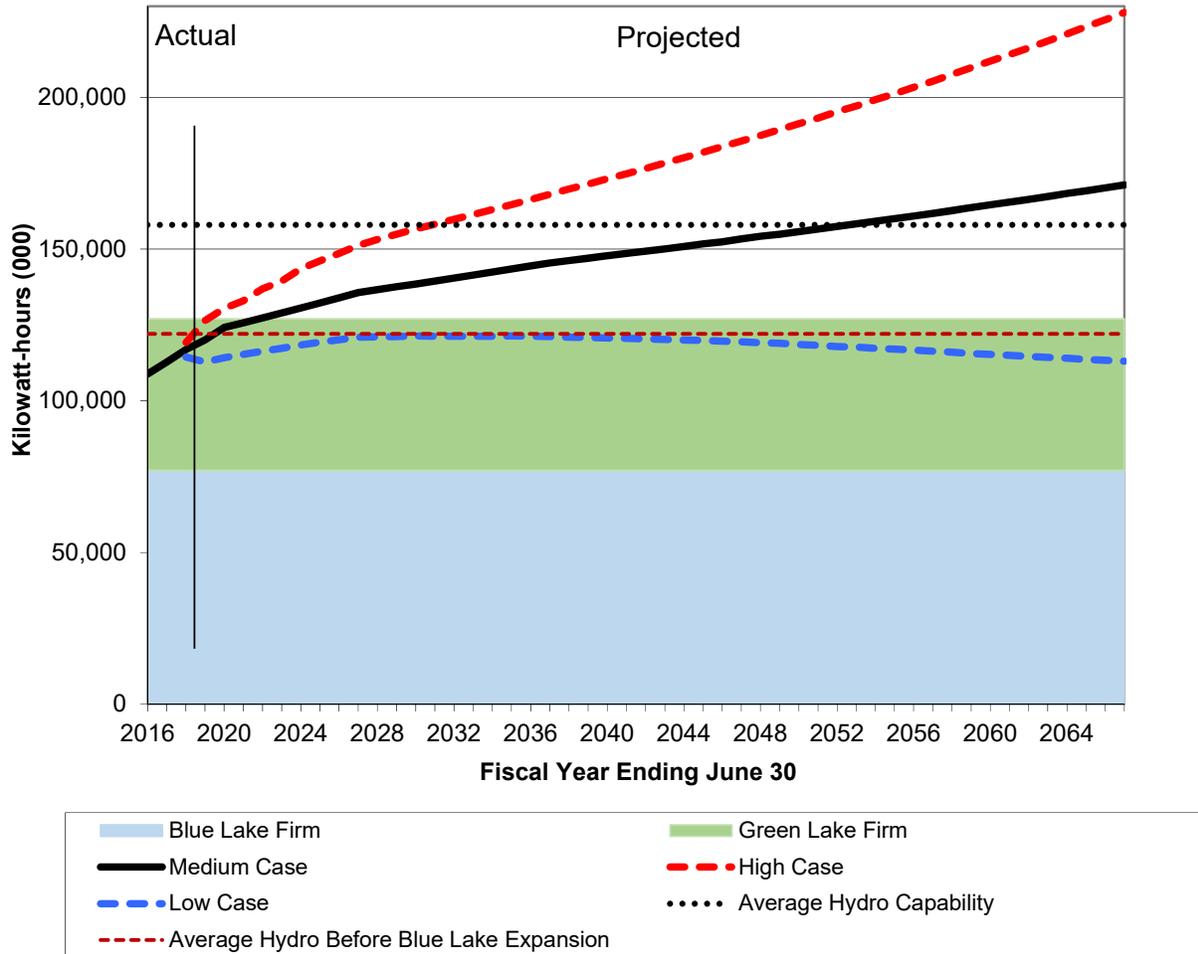
“If inflows are below average, lake levels drop below the rule curves, leading the City to stop the interruptible energy sales and ask customers to reduce their electricity consumption. When lake levels fall far below the rule curves (10 to 20 ft), then the City often elects to operate its diesel generators to limit further drawdowns of the lakes. On a weekly basis, the City uses its operations modeling tools to forecast future lake levels. Based on whether the predicted lake levels rise above or fall below the rule curve, the City adjusts its use of interruptible power and public requests for use of electric heat.”

Historically and at the present time, the electric loads in Sitka are essentially fully supplied by the hydroelectric generating plants owned and operated by the CBS. Diesel generation is used only as needed to supply power when the hydroelectric plants are down for maintenance or due to low water conditions. The total capacity of the hydroelectric system is estimated to range between 22 MW in the summer and 32 MW in the winter. The firm annual energy generation capability of the hydroelectric projects is 127,000 MWh in total, 77,000 MWh for the Blue Lake project and 50,000 MWh for the Green Lake project.

The firm annual energy generation capability is the estimated amount of energy that can be generated with low annual precipitation. With average precipitation, the energy generation capability of the hydroelectric projects would be greater. The annual energy generation capability of the hydroelectric projects with average precipitation is 158,000 MWh in total, 96,000 MWh for the Blue Lake project and 62,000 MWh for the Green Lake project.

Based on these estimates of annual hydroelectric energy generation capability the extent to which existing hydroelectric generation can supply the projected loads for the electric system can be determined. The following figure shows the estimated annual hydroelectric generation with existing resources and the projected Low, Medium and High Case forecast of loads. The average energy generation capability of the hydroelectric system before the expansion of the Blue Lake project is also shown.

Figure 19
City and Borough of Sitka
Forecasted Loads and Annual Hydroelectric Energy Generation Capability
(MWh)



As shown in the figure above, the total firm hydroelectric energy generation capability of the CBS system would be insufficient to meet the energy needs of the system beginning in 2020 if loads increase at the level projected for the High Case. For the Medium Case, the firm capability of the hydroelectric system is sufficient to supply loads through 2023. For the Low Case, the firm hydroelectric energy generation capability is sufficient to supply the loads through 2067.

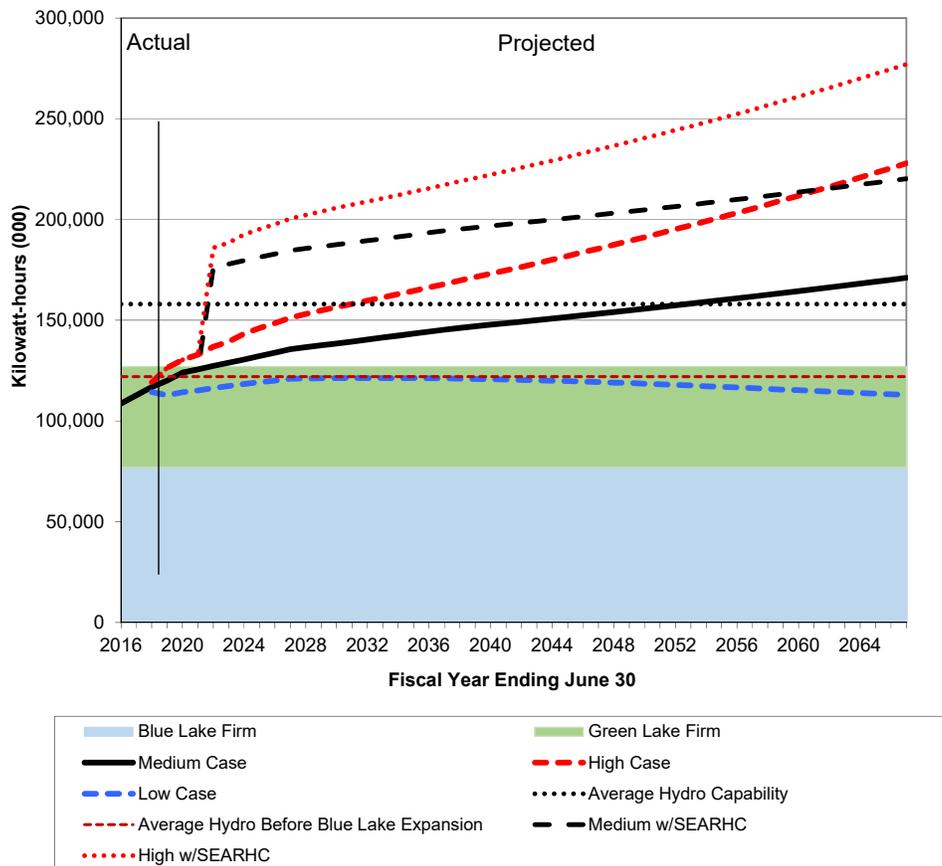
The average energy generation capability of the two existing hydroelectric resources in total is represented on the figure above as the dotted black line. For the High Case the average annual energy generation capability of the hydroelectric resources is sufficient to supply the load until approximately 2033. Average hydroelectric resources are sufficient to supply the loads in the Medium Case until 2054.

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In years with low precipitation where loads may exceed the generation capability of the hydroelectric system, diesel generation would be used to supply the difference. It is important to note that in some years the average hydroelectric energy generation capability will be exceeded. If loads are not large enough to use this energy, water will be spilled at the hydro projects or if possible, will be stored in the reservoirs.

As previously indicated, the USCG and SEARHC have indicated that both entities expect to expand their respective facilities in the next five to ten years which will require significant amounts of power. With a new cutter in Sitka, the USCG could potentially increase its load by an estimated 250 KW and the expansion of the SEARHC campus, based on preliminary estimates, could add a 5.0 MW load, half firm and half interruptible load. Based on these estimates, the annual increase in the USCG load is estimated to be 2,190 MWh while the estimated increase in the SEARHC load is 43,800 MWh. Assuming the new loads are installed in 2022, the impacts of the estimated additional loads on the overall power needs of the CBS system are shown in the following chart. The estimated magnitude and timing of these new loads are very preliminary at this time and as such, should be regarded with a high level of uncertainty.

Figure 20
City and Borough of Sitka
Forecasted Loads and Annual Hydroelectric Energy Generation Capability with
Impact of Increased USCG and SEARHC Loads
(MWh)



Implementation of Takatz Lake Project

The Appraisal Study has defined three main options for development of the Takatz Lake project. All of the options involve the construction of a dam, however, Option 2 provides for a phased project with Phase 1 including a lake tap. Phase 2 of Option 2 would provide for the addition of a dam at a later date.

Based on a detailed analysis of the local hydrology and conceptual designs for the three options as conducted for the Appraisal Study, the operating characteristics of the Takatz Lake project in its three configurations have been estimated. These characteristics, defined in Table 1-1 of the Appraisal Study, are summarized as follows:

Table 11
Takatz Lake Hydroelectric Project
Summary of Project Characteristics for Optional Configurations²³

	Option 1	Option 2			Option 3
	1968 APA	Phase 1	Phase 2	Phases 1&2	Single-Stage
Basic Project Plan					
Active Storage (acre-feet)	80,910	52,970	44,605	97,575	50,643
Installed Capacity (MW)	29.3	25.0	4.2	29.2	27.8
Annual Firm Energy (MWh)	94,354	70,221	19,406	89,627	79,277
Annual Average Energy (MWh)	102,558	87,548	6,292	93,840	98,691

As the option with the lowest estimated construction cost and the lowest estimated installed cost per kilowatt, Option 2 - Phase 1 is the recommended option for the Takatz Lake project as defined in the Appraisal Study. Phase 2, which involves construction of a dam on Takatz Lake, could be undertaken at a later date if desired. Option 2 - Phase 1 would provide an estimated 70,221 MWh of energy generation in years with low precipitation conditions. Average annual energy generation for Option 2 – Phase 1 is estimated to be 87,548 MWh.

The possible timing of the installation of the Takatz Lake project was discussed in the Appraisal Study. The estimated loads of the CBS system are projected to increase gradually over time and a new large generating resource would potentially be very much underused if it were installed “too early” in an isolated system like that of the CBS. Delaying installation, however, would potentially increase the amount of diesel generation needed to supply the total loads. The Appraisal Study discussed a conceptual approach for determining how to more fully utilize the Takatz Lake project in the early years of operation.

²³ Table 1-1, Appraisal Study.

Section 9 of the Appraisal Study states that, *“The reservoir regulation strategy and manipulations of electric heat loads in the electric system is aimed at maximizing hydro generation and limiting the risk of diesel generation. It is reasonable and straightforward approach to reservoir regulation in this system. A future three-reservoir system could easily be operated using this same strategy, provided the Takatz Project is developed with a reservoir storage capacity of at least 48,676 ac-ft (the volume required for the mass balance rule curve).”*

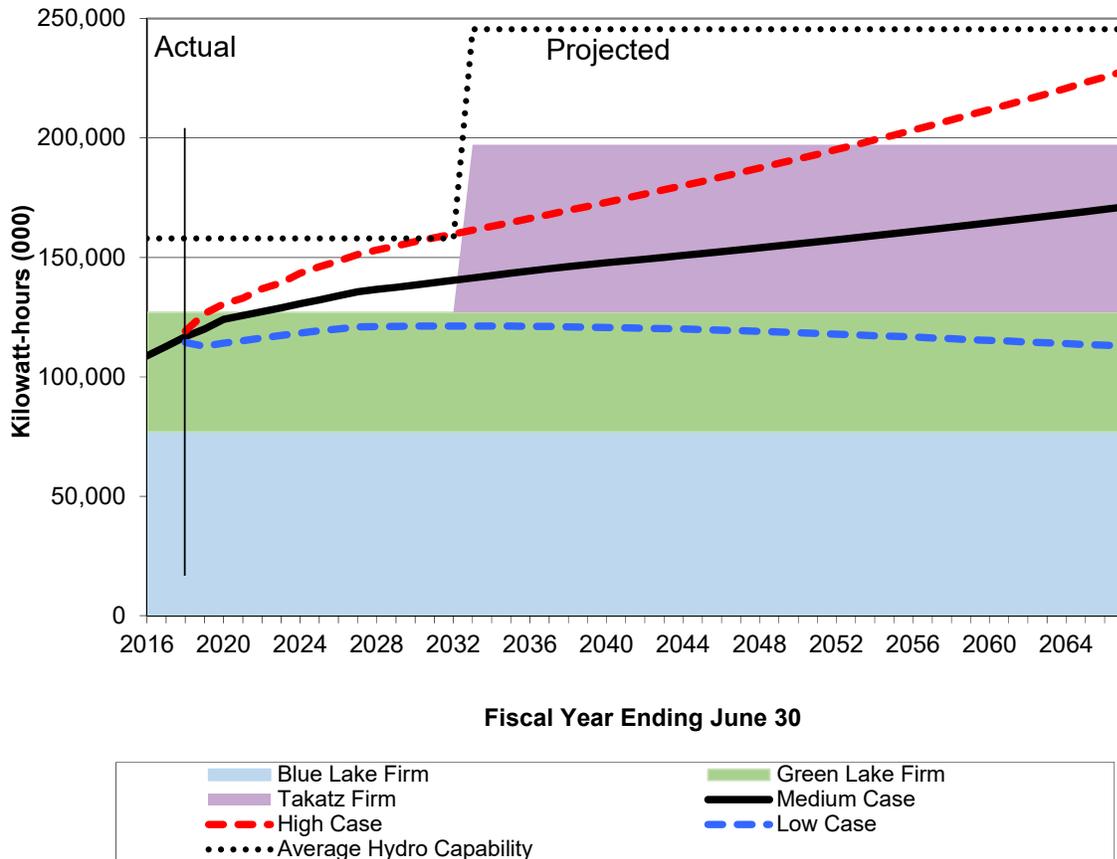
“Future reservoir regulation strategies for the Sitka system will depend on several factors including:

- *How close the average available hydro generation is to the annual system load,*
- *How large the interruptible loads are, relative to the annual system load.*

In the early years after Takatz is constructed Sitka’s average available hydro generation will easily exceed the system load. Thus, in the early years of operation there will be “built-in” reserves for dry year generation and for outages of the Green Lake or Blue Lake projects. During this time the maximum use of interruptible loads should be pursued by the City. Frankly, to maximize generation benefits, the City might pursue expansion of its interruptible load program until the expected annual interruptible load is about one third to one half of the expected Takatz annual output. If this goal were achieved, the Takatz Project could be effectively used as soon as it is completed.”

For the purpose of showing the comparative magnitude of the Takatz Lake project, it is assumed that the Takatz Lake project would be installed at the time in which the high growth case is projected to exceed the average annual energy generation capability of the Blue Lake and Green Lake projects. As shown in Figure 19, this would occur in 2033. Figure 21 shows the inclusion of the Takatz Lake project in the overall hydroelectric generation capability of the CBS system.

Figure 21
City and Borough of Sitka
Forecasted Loads and Annual Hydroelectric Energy Generation Capability
With Takatz Lake Project
(MWh)



As shown in Figure 21, if the Takatz Lake project were to come on-line in 2033, its annual energy generation capability would be about 50% utilized if low precipitation occurred and the loads were increasing at the projected high rate of growth. If loads were increasing at the medium load growth rate, a smaller amount of the Takatz Lake output would be utilized.

The amount of diesel generation needed to supply the full load in 2033 without the Takatz Lake project would be 34,392 MWh for the High Case in a low precipitation year. For the Medium Case the amount of diesel generation needed would be 14,409 MWh. These amounts of diesel generation are shown on Figure 21 as the difference between the total of Blue Lake and Green Lake firm energy and the respective High and Medium Case lines in 2033.

Transmission and Distribution Infrastructure to Support Loads

Overview

As part of the Load Analysis, a detailed system analysis was conducted to evaluate feeder and substation loadings for alternative load growth scenarios. The CBS electric system was modeled using a software product called EasyPower. In the past the Electric Department has retained consultants to use EasyPower to evaluate the loadings on various components of the electric system. We were provided with a data file containing a model of the existing electric system. Although reasonably current, the data file/model needed to be updated to properly reflect the arrangement, characteristics and loadings of the existing electric system. The data file/model was updated with the input and coordination from the Electric Department staff and the system as it is currently configured was modeled with a “base case” run using EasyPower.

The model shows the Blue Lake hydroelectric generators, the Green Lake hydroelectric generators and Jarvis diesel generators all connected and available for use to supply system load. Normal conditions indicate power is generated at the hydroelectric facilities and transmitted over the 69-kV transmission line to the Marine Street substation through the Blue Lake tie located at the Jarvis Street power plant.

At the Marine Street substation, power is distributed to feeders 1210, 1220, 1230, 1240 and 1250 through a single 20 MVA, 69-kV to 12.47-kV transformer. Each feeder is modeled for the loads it serves. Feeders 1310 and 1330 are fed from a single 7.5 MVA transformer located at the Jarvis Street substation and each of these feeders is modeled for the loads it serves. A tap at the 69-kV line near the Blue Lake powerhouse provides power to a 7.5 MVA transformer at the Sawmill Creek substation.

Several alternative cases were run to determine the impact of additional loads on the feeder and transformer loadings. The alternative scenarios are summarized as follows:

1. Base Case - The system model as provided by the Electric Department including updated current loads and load location.
2. 5% load increase - All loads were globally increased 5% over the current loads.
3. 10% load increase - All loads were globally increased 10% over the current loads.
4. Japonski Island increase - Loads were added per the Japonski Island Electrical Master Plan. Specifically:
 - a. The load of the SEARHC hospital was increased by 2 MW
 - b. The Coast Guard load was increased by 0.5 MW
 - c. The State pool load was increased by 0.75 MW
 - d. The Sitka airport load was increased 0.25 MW
 - e. A general increase of 0.81 MW was added for the following:
 - i. A float plane facility (0.2 MW)
 - ii. An RV Parking area at Ceiling Cove (0.15 MW)
 - iii. Alice Loop subdivision (0.06 MW)
 - iv. Condominiums (0.1 MW)
 - v. Filling the lagoon (0.3 MW)

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- f. 2 MW of additional load was added for the industrial park at the Sawmill Cove tap of the 69-kV transmission line. The existing model had a 1.1 MW load in that area with no specific location or details other than a connection to the 69-kV transmission line.

Note that for the purpose of the load increase cases (Items, 2, 3 and 4, above), it is assumed that the loads are increased by the assumed amount over the current system loads. No timing of these increases is specified because the increases are shown only as an example. If a particular year were to be stated for the increases, the model would need to be adjusted to reflect expected changes in the electric system that might be implemented by that time. It is noted however, that an overall 5% increase over current loads (Run 2) would be experienced in 2019 for the Medium Case and a 10% overall increase in current loads (Run 3) would be experienced in 2020 for the Medium Case. For comparison, loads are projected to be 25% higher in 2033 than they currently are with the Medium Case forecast.

Results

**Table 12
CBS Electric System
Summary of System Analysis**

Run #	Feeder 1210		Feeder 1220		Feeder 1230		Feeder 1240		Feeder 1250		Total Marine St		Feeder 1310		Feeder 1330		Total Jarvis St.	
	(MW)	(A)	(MW)	(A)	(MW)	(A)	(MW)	(A)	(MW)	(A)								
1	6.33	293	5.26	244	4.30	199	1.12	52	3.28	152	20.29	939	2.00	93	3.84	178	5.84	270
2	6.58	305	5.47	253	4.47	207	1.16	54	3.41	158	21.09	976	2.06	95	3.95	183	6.01	278
3	6.83	316	5.68	263	4.64	215	1.21	56	3.54	164	21.90	1,014	2.16	100	4.13	191	6.29	291
4	6.09	282	5.06	234	5.17	239	1.07	50	6.24	289	23.63	1,094	1.94	90	3.72	172	5.66	262

From the table above, it can be seen that the Marine Street substation transformer bank is loaded to capacity (20 MW) in the Base Case (Run #1). For each of the subsequent runs it is further overloaded and a new second transformer bank needs to be added. With the addition of a new transformer bank, express feeders could be installed to tie into existing feeders 1210 through 1250 to transfer existing loads off individual feeders and the existing transformer bank. This would allow certain feeders to pick up increased load growth in their respective areas. In addition, a feeder tie could be installed between 1220, 1230 or 1240 and 1310 for increased loadings and reliability.

For Run 4 the added Japonski Island additions create an overload condition on the conductors between Switch 125 and 126 along with the conductors to the SEARHC hospital. Both feeders would require replacement of the existing underground #2 AWG conductors with 200A rated #4/0 AWG conductors. As an alternative to relieve the overloading on Japonski Island an express feeder from the new transformer could be installed for added capacity and reliability to the island.

A detailed printout of the EasyPower model for the Japonski Island increase case, Run #4, is provided in Appendix B.

Section 5 Economic Analysis

Introduction and Analysis

A projection of the cost of power to supply the overall power requirements of the CBS electric system has been developed for the existing system and for the system with the Takatz Lake project included.

The Appraisal Study estimated the construction cost of the Takatz Lake project, Option 2 – Phase 1, to be \$254 million (2014 costs). This cost is indicated to include all costs of construction, equipment markups, contractor’s overhead and profit and applicable sales taxes. The cost does not include interest during construction, legal services, land acquisition or easement costs. Adding estimated costs for permitting, FERC licensing, design, construction management and owner’s administration costs of \$44 million, brings the total project cost to \$298 million (2014 costs). Adjusted to 2018 cost levels²⁴, the estimated total project cost would be \$325 million.

In the past, the CBS has financed new hydroelectric project construction with a combination of grants, as available, and new debt. Typical debt funding for municipal infrastructure projects would be obtained with tax-exempt revenue bonds. For the purpose of this analysis, it is assumed that the Takatz Lake project costs would be 100% financed with tax-exempt revenue bonds with the following factors:

- 5.0% Interest rate
- 30 year repayment period
- 1.5% cost of issuance
- Debt service reserve fund equal to one year’s level debt service

Based on these financing assumptions, if the Takatz Lake project were to be funded in 2018, the estimated bond issue size would be \$353.5 million. Annual debt service on this bond issuance amount would be \$23.0 million assuming a 30-year repayment period and level annual debt service. If the project were to be funded in the future, the total project cost would be higher due to inflation in construction costs.

The estimated operations and maintenance (O&M) costs for the Takatz Lake project, as provided in the Appraisal Study²⁵, are \$706,000 per year (2014 costs). The annual cost of equipment and structures major maintenance, as estimated in the Appraisal Study, is estimated to be between \$1.8 million and \$2.25 million. This amount is indicated to be representative of the levelized cost of major maintenance over the life of the project. Adjusted to 2018 cost levels, the

²⁴ Based on indicated increase in construction costs for Total Hydraulic Plant as provided by Handy-Whitman index from January 2014 to July 2017 of 6.97%, plus 2% assumed increase from July 2017 to July 2018.

²⁵ Table 12-1, page 163, Appraisal Study.

estimated annual costs of the Takatz Lake project and the estimated annual cost of power from the project (assuming full utilization of the energy generation) are shown in the following table:

Table 13
Takatz Lake Hydroelectric Project
Estimated Annual Costs and Cost of Power
(2018 Costs)

Annual Costs (\$000)	
Debt service	\$ 23,000
O&M	760
Major maintenance	2,160
Total Annual Costs	\$ 25,920
Average Annual Energy (MWh)	87,548
Cost of Power (\$/MWh)	\$ 296.07
Cost of Power (¢/kWh)	29.6

Although O&M costs and major maintenance costs would increase annually with inflation, annual debt service would remain constant over time. The annual debt service, however, would be established at the time the project is actually constructed and would reflect inflation in construction costs from 2018 to that date. It should also be noted that the unit cost of power shown in the previous table has been calculated assuming full utilization of the Takatz Lake project generation. The effective unit cost of power in any given year would need to acknowledge the actual amount of generation used in that year.

For the CBS electric system in its current configuration any power not supplied by the two hydroelectric projects is supplied with diesel generation. The amount of diesel generation needed will increase in the future as loads increase absent additional hydroelectric generation. The unit cost of diesel energy generation is estimated to increase each year with increases in fuel costs and inflation in diesel O&M expenses. For the purpose of this analysis, the following assumptions related to diesel generation have been made:

- Fuel price (2018 \$/gallon) \$3.00
- Fuel use (kWh/gallon) 10.0
- Diesel O&M (2018 ¢/kWh) 6.0

Based on these assumptions, the unit cost of diesel generation in 2018 would be 36.0 cents per kWh. Assuming 3.0% annual increase in fuel prices and 2.5% annual inflation in O&M costs, the unit cost of diesel generation in 2033 would be 55.4 cents per kWh.

As shown in Figure 21, the estimated amount of diesel generation needed in 2033 to supply the remaining total load requirement without the Takatz Lake project in a low water year is 34,392 MWh for the high growth case. At the estimated cost of diesel generation of 55.4 cents per kWh in 2033 as described above, the total cost of diesel generation in 2033 would be \$19.1 million for 34,392 MWh of generation. Note that this estimated cost of diesel generation does not include any provision for the capital component of diesel generators. The capital cost of diesel generators may or may not need to be included depending on whether or not the diesel units would need to be installed for backup to the hydroelectric generation system.

The total cost of diesel generation would be saved if the Takatz Lake project were to come on-line in 2033, however, at that time the annual cost of the Takatz Lake project would need to be incurred.

Conclusions

The Load Analysis indicates a need for additional generation in the future for both the Medium and High Cases. With the variability in precipitation from year to year, however, it cannot be stated precisely when a new hydroelectric facility should be developed. This variability is exhibited in Figures 19 and 21 by noting the difference in the firm energy generation of the hydroelectric projects as compared to the average annual energy generation. The CBS will need to regularly monitor changes in power requirements in the community in the future to determine if and when development of the Takatz Lake Project should begin.

From a cost perspective, the cost of diesel generation needed in the future will potentially be very significant in years with low precipitation, particularly if loads increase in accordance with the High Case forecast. With inflation in fuel and diesel O&M costs, the cost of diesel generation could become by far the most significant cost component of the CBS electric system. The cost of diesel generation would be expected to fluctuate from year to year depending on precipitation levels and the subsequent generation from the hydroelectric projects.

If the Takatz Lake Project were to be developed and funded by debt, the annual costs of the project consisting primarily of debt service would remain essentially constant. This would be a high cost, however, that would be incurred every year regardless of precipitation. Electric rates would need to be adjusted to include the costs of the new project.

As a cost comparison, Total Expenditures for the Electric Fund indicated in the CBS fiscal year 2018 budget are \$17.7 million²⁶. This amount includes \$8.5 million in budgeted debt payments. As shown in Table 13, above, the estimated annual cost of the Takatz Lake Project at current 2018 cost levels is \$25.9 million. If the Takatz Lake Project were to be developed, the timing would need to be carefully determined to assure that the costs of the project do not totally overwhelm the costs of the CBS electric system.

²⁶ http://www.cityofsitka.com/government/departments/finance/documents/ElectricFund_000.pdf

APPENDIX A

Detailed Analytical Tables

Table 14	Historical Number of Customer Accounts and Usage per Customer
Table 15	Historical Energy Sales, Total Requirements and Losses
Table 16	Historical Peak Loads and Loadfactor
Table 17	Forecasted Number of Customer Accounts and Usage per Customer
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Table 14

City and Borough of Sitka

Historical Number of Customer Accounts and Usage Per Customer Account

Number of Accounts											Average Usage per Customer Account (kWh)						
Fiscal Year	Residential	General Service	Res/Comm Ratio	Boats	Public Authority	Public Safety	Inter-ruptible	Total	Annual % Change	Residential	General Service	Boats	Public Authority	Public Safety	Inter-ruptible	Total	
1998	3,193	472	6.76	662	156	3	-	4,483	1.4%	11,425	59,022	2,853	117,698	60,246	-	18,909	
1999	3,218	506	6.36	690	171	1	-	4,585	2.3%	12,104	60,045	3,074	115,032	137,400	-	19,905	
2000	3,243	516	6.28	757	172	1	-	4,688	2.2%	11,508	55,633	3,326	118,849	137,960	-	19,011	
2001	3,333	534	6.24	747	170	1	-	4,784	2.0%	11,681	53,727	3,286	120,730	152,680	-	18,970	
2002	3,409	570	5.98	699	179	1	-	4,857	1.5%	11,596	50,357	3,092	113,360	145,600	-	18,701	
2003	3,484	560	6.22	685	185	1	-	4,914	1.2%	11,070	52,006	3,036	117,753	260,367	-	18,685	
2004	3,473	563	6.17	746	192	1	-	4,974	1.2%	11,317	51,690	3,297	114,935	178,659	-	18,719	
2005	3,488	597	5.84	754	189	-	-	5,028	1.1%	11,379	49,677	3,245	117,341	-	-	18,690	
2006	3,524	614	5.74	728	189	-	-	5,055	0.5%	11,811	48,830	3,550	118,234	-	-	19,097	
2007	3,584	620	5.78	723	184	-	2	5,111	1.1%	12,575	49,885	4,339	127,205	-	911,457	20,063	
2008	3,621	619	5.85	748	186	-	2	5,174	1.2%	12,813	51,739	4,923	122,901	-	426,060	20,287	
2009	3,651	647	5.64	771	188	-	2	5,257	1.6%	13,675	48,564	5,475	130,588	-	444,584	20,947	
2010	3,671	634	5.79	772	201	-	2	5,278	0.4%	12,742	48,789	4,465	112,210	-	444,584	19,649	
2011	3,672	620	5.92	769	205	-	2	5,266	-0.2%	13,045	49,891	4,707	120,179	-	444,584	20,336	
2012	3,662	653	5.61	774	201	-	2	5,290	0.5%	12,994	46,687	4,153	113,326	-	29,760	19,672	
2013	3,728	677	5.51	760	217	-	2	5,382	1.7%	12,776	47,331	4,234	105,071	-	528,292	19,638	
2014	3,598	861	4.18	754	196	-	2	5,409	0.5%	12,861	40,418	3,953	116,887	-	1,054,340	19,775	
2015	3,638	594	6.12	770	205	-	3	5,207	-3.7%	11,753	59,075	3,426	102,477	-	952,941	19,492	
2016	3,679	633	5.81	785	196	-	3	5,293	1.7%	11,375	54,685	3,178	100,961	-	1,020,199	18,656	
2017	3,703	652	5.68	808	194	-	3	5,357	1.2%	11,644	53,291	3,272	101,251	-	948,961	18,695	
													-22.5%				
Compound Annual Growth Rates (Unless Marked Average):										Average							
1973-2017	2.1%	2.5%	-0.4%	3.9%	3.7%			2.4%	2.5%	1.1%	1.5%	1.8%	-1.9%			0.6%	
1973-1993	3.6%	3.4%	0.1%	7.0%	7.1%			4.0%	4.1%	3.0%	4.4%	2.8%	-3.8%			1.9%	
1993-2003	1.7%	2.8%	-1.1%	1.5%	1.7%			1.8%	1.4%	-1.7%	-2.2%	1.7%	0.7%			-1.0%	
2003-2012	0.6%	1.7%	-1.1%	1.4%	0.9%			0.8%	0.9%	1.8%	-1.2%	3.5%	-0.4%			0.6%	
2013-2017	0.2%	0.0%	0.3%	0.9%	-0.7%			0.3%	0.3%	-2.2%	2.7%	-4.7%	-2.2%			-1.0%	
2003-2017	0.4%	1.1%	-0.6%	1.2%	0.3%			0.6%	0.7%	0.4%	0.2%	0.5%	-1.1%			0.0%	

Table 15
City and Borough of Sitka
Historical Energy Sales, Total Requirements and Losses
(kilowatt-hours)

Fiscal Year	Residential	General Service	Boats	Public Authority	Public Safety	Total Retail	Annual % Change	APC/SCIP	Interruptible Sales	Total Sales	PA - Nonbill	Losses	Total Requirements	Loss %
1998	36,481,297	27,858,302	1,888,963	18,360,839	180,737	84,770,138	-3.6%	789,265	-	85,559,403	911,692	8,940,267	94,499,670	9.5%
1999	38,950,365	30,382,830	2,121,381	19,670,460	137,400	91,262,436	7.7%	629,585	-	91,892,021	988,605	3,635,201	95,527,222	3.8%
2000	37,321,128	28,706,403	2,517,425	20,441,975	137,960	89,124,891	-2.3%	506,274	-	89,631,165	1,480,197	4,998,244	94,629,409	5.3%
2001	38,932,335	28,690,283	2,454,601	20,524,065	152,680	90,753,964	1.8%	399,516	-	91,153,480	1,493,985	3,761,159	94,914,639	4.0%
2002	39,530,730	28,703,289	2,161,435	20,291,474	145,600	90,832,528	0.1%	969,844	-	91,802,372	1,577,104	7,402,134	99,204,506	7.5%
2003	38,569,146	29,123,395	2,079,515	21,784,389	260,367	91,816,812	1.1%	914,387	-	92,731,199	1,723,933	3,925,133	96,656,332	4.1%
2004	39,303,610	29,101,299	2,459,212	22,067,517	178,659	93,110,297	1.4%	1,524,713	-	94,635,010	1,723,855	8,412,968	103,047,978	8.2%
2005	39,690,807	29,657,231	2,446,827	22,177,417	-	93,972,282	0.9%	1,702,168	-	95,674,450	1,500,000	6,032,518	101,706,968	5.9%
2006	41,623,109	29,981,828	2,584,622	22,346,191	-	96,535,750	2.7%	1,871,596	-	98,407,346	1,597,586	7,000,409	105,407,755	6.6%
2007	45,069,093	30,928,679	3,137,092	23,405,628	-	102,540,492	6.2%	2,203,633	1,746,960	106,491,085	1,934,921	5,690,243	112,181,328	5.1%
2008	46,396,181	32,026,170	3,682,664	22,859,652	-	104,964,667	2.4%	4,189,777	852,120	110,006,564	2,195,316	2,994,411	113,000,975	2.6%
2009	49,925,862	31,421,023	4,221,524	24,550,555	-	110,118,964	4.9%	-	852,120	110,971,084	-	8,717,916	119,689,000	7.3%
2010	46,775,688	30,932,153	3,446,996	22,554,209	-	103,709,046	-5.8%	-	852,120	104,561,166	-	10,468,834	115,030,000	9.1%
2011	47,901,502	30,932,153	3,619,949	24,636,619	-	107,090,223	3.3%	-	852,120	107,942,343	-	9,735,657	117,678,000	8.3%
2012	47,583,037	30,486,914	3,214,648	22,778,544	-	104,063,143	-2.8%	-	52,080	104,115,223	746,066	12,737,156	117,598,445	10.8%
2013	47,628,760	32,043,016	3,217,737	22,800,432	-	105,689,945	1.6%	-	968,536	106,658,481	669,197	9,891,890	117,219,568	8.4%
2014	46,273,202	34,799,581	2,980,418	22,909,862	-	106,963,063	1.2%	-	2,020,818	108,983,881	762,172	3,863,056	113,609,109	3.4%
2015	42,757,624	35,090,537	2,638,209	21,007,870	-	101,494,240	-5.1%	-	2,382,353	103,876,594	1,051,498	6,189,575	111,117,666	5.6%
2016	41,849,249	34,615,848	2,495,118	19,788,270	-	98,748,485	-2.7%	-	3,060,597	101,809,082	1,813,977	5,107,981	108,731,040	4.7%
2017	43,117,499	34,745,934	2,644,120	19,642,781	-	100,150,334	1.4%	-	2,846,884	102,997,217	1,768,911	7,973,716	112,739,844	7.1%
Compound Annual Growth Rates (Unless Marked Average):						Average						Average		
1973-1993	6.7%	8.0%	9.9%	3.0%		6.1%	6.2%			6.4%		2.8%	6.0%	9.9%
1993-2003	-0.1%	0.5%	3.2%	2.3%		0.7%	1.0%			0.3%		-6.3%	-0.1%	6.9%
2003-2012	2.4%	0.5%	5.0%	0.5%		1.4%	1.4%	35.6%		1.3%		14.0%	2.2%	6.8%
2012-2017	-2.0%	2.6%	-3.8%	-2.9%		-0.8%	-1.1%			-0.2%		-8.9%	-0.8%	6.7%
2003-2017	0.8%	1.3%	1.7%	-0.7%		0.6%	0.7%			0.8%		5.2%	1.1%	6.5%
2008-2017	-0.8%	0.9%	-3.6%	-1.7%		-0.5%	-0.2%			-0.7%		11.5%	0.0%	6.7%

Table 16
City and Borough of Sitka
Historical Peak Loads and Load Factor
(kilowatts)

Fiscal Year	System Peak Demand (KW)	Total Generation (Average kW)	System Loadfactor
1998	17,527	10,788	61.5%
1999	17,732	10,905	61.5%
2000	17,664	10,773	61.0%
2001	17,582	10,835	61.6%
2002	18,113	11,325	62.5%
2003	17,544	11,034	62.9%
2004	19,834	11,731	59.1%
2005	19,100	11,610	60.8%
2006	20,770	12,033	57.9%
2007	20,480	12,806	62.5%
2008	22,240	12,864	57.8%
2009	21,500	13,663	63.5%
2010	20,640	13,131	63.6%
2011	23,550	13,434	57.0%
2012	23,930	13,388	55.9%
2013	21,020	13,381	63.7%
2014	22,080	12,969	58.7%
2015	21,650	12,685	58.6%
2016	19,790	12,378	62.5%
2017	22,160	12,870	58.1%
Average Annual Change			Average
2003-2008	4.9%	3.1%	60.2%
2008-2017	0.0%	0.0%	60.0%
2003-2017	1.7%	1.1%	60.2%

Table 17
City and Borough of Sitka
2017 Electric Load Forecast
 Forecasted Number of Customer Accounts and Usage Per Customer Account

MEDIUM CASE

Number of Accounts									Average Usage per Customer Account (kWh)					
Fiscal Year	Residential	General Service	Res/GenS Ratio	Boats	Public Authority	Inter-ruptible	Total	% Change	Residential	General Service	Boats	Public Authority	Inter-ruptible	Total
2017 (Act)	3,703	652	5.68	808	194	3	5,360		11,644	53,291	3,272	101,251	948,961	19,216
2018	3,707	656	5.65	810	196	5	5,374	0.3%	11,900	53,200	3,822	102,900	948,961	19,822
2019	3,710	660	5.62	811	197	5	5,383	0.2%	12,130	54,068	3,923	104,579	948,961	20,197
2020	3,714	664	5.59	813	199	6	5,396	0.2%	12,277	54,558	3,997	105,526	948,961	20,705
2021	3,718	668	5.57	815	200	6	5,407	0.2%	12,338	54,667	4,042	105,737	948,961	20,804
2022	3,722	672	5.54	816	201	6	5,417	0.2%	12,400	54,776	4,089	105,948	948,961	20,906
2023	3,725	676	5.51	818	202	6	5,427	0.2%	12,462	54,886	4,137	106,160	948,961	21,007
2024	3,729	680	5.48	819	203	6	5,437	0.2%	12,524	55,050	4,186	106,479	948,961	21,121
2025	3,733	684	5.46	821	204	6	5,448	0.2%	12,587	55,215	4,237	106,798	948,961	21,233
2026	3,736	688	5.43	823	205	6	5,458	0.2%	12,650	55,381	4,290	107,119	948,961	21,346
2027	3,740	692	5.40	824	206	6	5,468	0.2%	12,713	55,547	4,344	107,440	948,961	21,462
2028	3,744	697	5.37	826	207	6	5,480	0.2%	12,777	55,714	4,400	107,762	948,961	21,581
2029	3,748	701	5.35	828	208	6	5,491	0.2%	12,840	55,881	4,457	108,086	948,961	21,695
2030	3,751	705	5.32	829	209	6	5,500	0.2%	12,905	56,049	4,516	108,410	948,961	21,814
2031	3,755	709	5.30	831	210	6	5,511	0.2%	12,969	56,217	4,577	108,735	948,961	21,929
2032	3,759	714	5.26	833	211	6	5,523	0.2%	13,034	56,385	4,640	109,061	948,961	22,051
2033	3,763	718	5.24	834	212	6	5,533	0.2%	13,099	56,555	4,704	109,388	948,961	22,171
2034	3,767	722	5.22	836	213	6	5,544	0.2%	13,165	56,724	4,771	109,717	948,961	22,287
2035	3,770	726	5.19	838	214	6	5,554	0.2%	13,231	56,894	4,839	110,046	948,961	22,407
2036	3,774	731	5.16	839	215	6	5,565	0.2%	13,297	57,065	4,910	110,376	948,961	22,534
2037	3,778	735	5.14	841	216	6	5,576	0.2%	13,363	57,236	4,982	110,707	948,961	22,653
2038	3,782	740	5.11	843	217	6	5,588	0.2%	13,397	57,294	5,057	110,818	948,961	22,733
2039	3,785	744	5.09	844	219	6	5,598	0.2%	13,430	57,351	5,134	110,929	948,961	22,827
2040	3,789	749	5.06	846	220	6	5,610	0.2%	13,464	57,408	5,214	111,039	948,961	22,907
2041	3,793	753	5.04	848	221	6	5,621	0.2%	13,497	57,466	5,296	111,150	948,961	22,982
2042	3,797	758	5.01	849	222	6	5,632	0.2%	13,531	57,523	5,380	111,262	948,961	23,066
2043	3,801	762	4.99	851	223	6	5,643	0.2%	13,565	57,581	5,467	111,373	948,961	23,141
2044	3,804	767	4.96	853	224	6	5,654	0.2%	13,599	57,638	5,556	111,484	948,961	23,224
2045	3,808	772	4.93	855	225	6	5,666	0.2%	13,633	57,696	5,648	111,596	948,961	23,306
2046	3,812	776	4.91	856	226	6	5,676	0.2%	13,667	57,753	5,743	111,707	948,961	23,385
2047	3,816	781	4.89	858	228	6	5,689	0.2%	13,701	57,811	5,841	111,819	948,961	23,483
2048	3,820	786	4.86	860	229	6	5,701	0.2%	13,735	57,869	5,941	111,931	948,961	23,567
2049	3,823	790	4.84	861	230	6	5,710	0.2%	13,770	57,927	6,045	112,043	948,961	23,649
2050	3,827	795	4.81	863	231	6	5,722	0.2%	13,804	57,985	6,151	112,155	948,961	23,733
2051	3,831	800	4.79	865	232	6	5,734	0.2%	13,839	58,043	6,261	112,267	948,961	23,817
2052	3,835	805	4.76	867	233	6	5,746	0.2%	13,873	58,101	6,375	112,379	948,961	23,902
2053	3,839	810	4.74	868	234	6	5,757	0.2%	13,908	58,159	6,491	112,492	948,961	23,991
2054	3,843	815	4.72	870	236	6	5,770	0.2%	13,943	58,217	6,611	112,604	948,961	24,092
2055	3,846	819	4.70	872	237	6	5,780	0.2%	13,977	58,275	6,735	112,717	948,961	24,175
2056	3,850	824	4.67	874	238	6	5,792	0.2%	14,012	58,334	6,863	112,829	948,961	24,262
2057	3,854	829	4.65	875	239	6	5,803	0.2%	14,047	58,392	6,994	112,942	948,961	24,352
2058	3,858	834	4.63	877	240	6	5,815	0.2%	14,083	58,450	7,129	113,055	948,961	24,440
2059	3,862	839	4.60	879	242	6	5,828	0.2%	14,118	58,509	7,268	113,168	948,961	24,544
2060	3,866	844	4.58	881	243	6	5,840	0.2%	14,153	58,567	7,412	113,281	948,961	24,634
2061	3,870	850	4.55	882	244	6	5,852	0.2%	14,188	58,626	7,559	113,395	948,961	24,732
2062	3,874	855	4.53	884	245	6	5,864	0.2%	14,224	58,684	7,712	113,508	948,961	24,823
2063	3,877	860	4.51	886	246	6	5,875	0.2%	14,259	58,743	7,868	113,622	948,961	24,916
2064	3,881	865	4.49	888	248	6	5,888	0.2%	14,295	58,802	8,030	113,735	948,961	25,023
2065	3,885	870	4.47	889	249	6	5,899	0.2%	14,331	58,861	8,196	113,849	948,961	25,119
2066	3,889	875	4.44	891	250	6	5,911	0.2%	14,367	58,920	8,367	113,963	948,961	25,212
2067	3,893	881	4.42	893	251	6	5,924	0.2%	14,403	58,978	8,544	114,077	948,961	25,312

Compound Annual Growth Rates (Unless Marked Average):									Average				
(2017-20)	0.1%	0.6%	-0.5%	0.2%	0.9%	26.0%	0.2%	0.2%	1.8%	0.8%	6.9%	1.4%	0.0%
(2020-25)	0.1%	0.6%	-0.5%	0.2%	0.5%	0.0%	0.2%	0.2%	0.5%	0.2%	1.2%	0.2%	0.0%
(2025-30)	0.1%	0.6%	-0.5%	0.2%	0.5%	0.0%	0.2%	0.2%	0.5%	0.3%	1.3%	0.3%	0.0%
(2030-35)	0.1%	0.6%	-0.5%	0.2%	0.5%	0.0%	0.2%	0.2%	0.5%	0.3%	1.4%	0.3%	0.0%
(2035-67)	0.1%	0.6%	-0.5%	0.2%	0.5%	0.0%	0.2%	0.2%	0.3%	0.1%	1.8%	0.1%	0.0%
(2017-37)	0.1%	0.6%	-0.5%	0.2%	0.5%	3.5%	0.2%	0.2%	0.7%	0.4%	2.1%	0.4%	0.0%
(2017-67)	0.1%	0.6%	-0.5%	0.2%	0.5%	1.4%	0.2%	0.2%	0.4%	0.2%	1.9%	0.2%	0.0%

Table 17
City and Borough of Sitka
2017 Electric Load Forecast
 Forecasted Number of Customer Accounts and Usage Per Customer Account

HIGH CASE

Fiscal Year	Number of Accounts								Average usage per Customer Account (kWh)					
	Residential	General Service	Res/GenS Ratio	Boats	Public Authority	Inter-ruptible	Total	% Change	Residential	General Service	Boats	Public Authority	Inter-ruptible	Total
2017 (Act)	3,703	652	5.68	808	194	3	5,360		11,644	53,291	3,272	101,251	948,961	19,216
2018	3,733	661	5.65	816	197	5	5,418	1.1%	12,070	53,250	3,881	104,370	948,961	19,978
2019	3,751	667	5.62	822	199	5	5,450	0.6%	12,657	55,727	4,105	109,224	948,960	20,920
2020	3,770	674	5.59	828	202	6	5,486	0.7%	12,720	55,894	4,149	109,552	948,960	21,300
2021	3,789	682	5.56	833	204	6	5,520	0.6%	12,783	56,062	4,194	109,881	948,960	21,421
2022	3,808	690	5.52	839	206	7	5,556	0.7%	12,847	56,230	4,241	110,210	948,960	21,787
2023	3,827	699	5.47	845	208	7	5,591	0.6%	12,912	56,398	4,289	110,541	948,960	21,910
2024	3,846	707	5.44	851	210	8	5,627	0.6%	12,989	56,568	4,338	110,873	948,960	22,281
2025	3,866	716	5.40	857	212	8	5,664	0.7%	13,067	56,737	4,389	111,205	948,960	22,410
2026	3,885	724	5.37	863	214	8	5,699	0.6%	13,145	56,908	4,442	111,539	948,960	22,535
2027	3,904	733	5.33	869	216	8	5,735	0.6%	13,224	57,078	4,496	111,873	948,960	22,666
2028	3,924	742	5.29	875	219	8	5,773	0.7%	13,304	57,249	4,552	112,209	948,960	22,812
2029	3,944	751	5.25	882	221	8	5,811	0.7%	13,383	57,421	4,609	112,546	948,960	22,940
2030	3,963	760	5.21	888	223	8	5,847	0.6%	13,464	57,593	4,668	112,883	948,960	23,072
2031	3,979	767	5.19	892	225	8	5,876	0.5%	13,545	57,766	4,729	113,222	948,960	23,205
2032	3,995	774	5.16	896	227	8	5,905	0.5%	13,626	57,940	4,792	113,562	948,960	23,338
2033	4,011	781	5.14	901	229	8	5,935	0.5%	13,708	58,113	4,856	113,902	948,960	23,468
2034	4,027	788	5.11	905	231	8	5,964	0.5%	13,790	58,288	4,923	114,244	948,960	23,603
2035	4,043	795	5.09	910	233	8	5,994	0.5%	13,873	58,463	4,991	114,587	948,960	23,735
2036	4,060	802	5.06	915	235	8	6,025	0.5%	13,956	58,638	5,062	114,930	948,960	23,865
2037	4,076	809	5.04	919	237	8	6,054	0.5%	14,040	58,814	5,134	115,275	948,960	24,002
2038	4,092	817	5.01	924	240	8	6,086	0.5%	14,110	58,990	5,209	115,621	948,960	24,147
2039	4,109	824	4.99	929	242	8	6,117	0.5%	14,180	59,167	5,286	115,968	948,960	24,270
2040	4,125	832	4.96	933	244	8	6,147	0.5%	14,251	59,345	5,366	116,316	948,960	24,404
2041	4,142	839	4.94	938	246	8	6,178	0.5%	14,322	59,523	5,448	116,665	948,960	24,528
2042	4,158	847	4.91	942	248	8	6,208	0.5%	14,394	59,701	5,532	117,015	948,960	24,664
2043	4,175	854	4.89	947	251	8	6,240	0.5%	14,466	59,881	5,619	117,366	948,960	24,804
2044	4,191	862	4.86	952	253	8	6,271	0.5%	14,538	60,060	5,708	117,718	948,960	24,938
2045	4,208	870	4.84	957	255	8	6,303	0.5%	14,611	60,240	5,800	118,071	948,960	25,070
2046	4,225	878	4.81	961	258	8	6,335	0.5%	14,684	60,421	5,895	118,425	948,960	25,221
2047	4,242	886	4.79	966	260	8	6,367	0.5%	14,757	60,602	5,993	118,781	948,960	25,355
2048	4,259	894	4.76	971	262	8	6,399	0.5%	14,831	60,784	6,093	119,137	948,960	25,489
2049	4,276	902	4.74	976	265	8	6,432	0.5%	14,905	60,966	6,197	119,494	948,960	25,639
2050	4,293	910	4.72	981	267	8	6,464	0.5%	14,980	61,149	6,303	119,853	948,960	25,775
2051	4,310	918	4.69	986	269	8	6,496	0.5%	15,055	61,333	6,413	120,212	948,960	25,911
2052	4,328	927	4.67	991	272	8	6,531	0.5%	15,130	61,517	6,527	120,573	948,960	26,067
2053	4,345	935	4.65	996	274	8	6,563	0.5%	15,206	61,701	6,643	120,935	948,960	26,205
2054	4,362	943	4.63	1,001	277	8	6,596	0.5%	15,282	61,886	6,763	121,298	948,960	26,358
2055	4,380	952	4.60	1,006	279	8	6,630	0.5%	15,358	62,072	6,887	121,661	948,960	26,502
2056	4,397	960	4.58	1,011	282	8	6,663	0.5%	15,435	62,258	7,015	122,026	948,960	26,656
2057	4,415	969	4.56	1,016	284	8	6,697	0.5%	15,512	62,445	7,146	122,392	948,960	26,801
2058	4,433	978	4.53	1,021	287	8	6,732	0.5%	15,590	62,632	7,281	122,760	948,960	26,961
2059	4,450	987	4.51	1,026	290	8	6,766	0.5%	15,668	62,820	7,420	123,128	948,960	27,124
2060	4,468	996	4.49	1,031	292	8	6,799	0.5%	15,746	63,009	7,564	123,497	948,960	27,271
2061	4,486	1,005	4.46	1,036	295	8	6,834	0.5%	15,825	63,198	7,711	123,868	948,960	27,434
2062	4,504	1,014	4.44	1,042	297	8	6,869	0.5%	15,904	63,387	7,864	124,239	948,960	27,580
2063	4,522	1,023	4.42	1,047	300	8	6,904	0.5%	15,983	63,578	8,020	124,612	948,960	27,745
2064	4,540	1,032	4.40	1,052	303	8	6,939	0.5%	16,063	63,768	8,182	124,986	948,960	27,910
2065	4,558	1,042	4.37	1,057	306	8	6,975	0.5%	16,144	63,960	8,348	125,361	948,960	28,081
2066	4,577	1,051	4.35	1,063	308	8	7,011	0.5%	16,224	64,152	8,519	125,737	948,960	28,230
2067	4,595	1,061	4.33	1,068	311	8	7,047	0.5%	16,305	64,344	8,696	126,114	948,960	28,403
Compound Annual Growth Rates (Unless Marked Average):									Average					
(2017-20)	0.6%	1.1%	-0.5%	0.8%	1.4%	26.0%	0.8%	0.8%	3.0%	1.6%	8.2%	2.7%	0.0%	
(2020-25)	0.5%	1.2%	-0.7%	0.7%	1.0%	5.9%	0.6%	0.6%	0.5%	0.3%	1.1%	0.3%	0.0%	
(2025-30)	0.5%	1.2%	-0.7%	0.7%	1.0%	0.0%	0.6%	0.6%	0.6%	0.3%	1.2%	0.3%	0.0%	
(2030-35)	0.4%	0.9%	-0.5%	0.5%	0.9%	0.0%	0.5%	0.5%	0.6%	0.3%	1.3%	0.3%	0.0%	
(2035-67)	0.4%	0.9%	-0.5%	0.5%	0.9%	0.0%	0.5%	0.5%	0.5%	0.3%	1.7%	0.3%	0.0%	
(2017-37)	0.5%	1.1%	-0.6%	0.6%	1.0%	5.0%	0.6%	0.6%	0.9%	0.5%	2.3%	0.7%	0.0%	
(2017-67)	0.4%	1.0%	-0.5%	0.6%	0.9%	2.0%	0.5%	0.5%	0.7%	0.4%	2.0%	0.4%	0.0%	

Table 17
City and Borough of Sitka
2017 Electric Load Forecast
Forecasted Number of Customer Accounts and Usage Per Customer Account

LOW CASE

Fiscal Year	Number of Accounts								Average usage per Customer Account (kWh)					
	Residential	General Service	Res/GenS Ratio	Boats	Public Authority	Interprt. Industr.	Total	% Change	Residential	General Service	Boats	Public Authority	Inter-ruptible	Total
2017 (Act)	3,703	652	5.78	808	194	3	5,360		11,644	53,291	3,272	101,251	948,961	19,216
2018	3,707	656	5.65	820	196	5	5,390	0.6%	11,730	51,750	3,763	101,430	948,960	19,351
2019	3,710	660	5.62	831	197	5	5,409	0.4%	11,482	50,455	3,693	98,991	948,960	18,927
2020	3,714	664	5.59	841	199	5	5,429	0.4%	11,528	50,455	3,726	99,090	948,960	18,930
2021	3,712	665	5.58	850	199	5	5,437	0.1%	11,574	50,455	3,759	99,189	948,960	19,010
2022	3,710	666	5.57	858	200	5	5,445	0.1%	11,621	50,455	3,794	99,288	948,960	19,051
2023	3,708	667	5.56	865	200	5	5,451	0.1%	11,667	50,455	3,829	99,388	948,960	19,081
2024	3,706	668	5.55	872	201	5	5,458	0.1%	11,702	50,430	3,865	99,487	948,960	19,115
2025	3,704	669	5.54	878	201	5	5,463	0.1%	11,737	50,405	3,901	99,587	948,960	19,110
2026	3,696	669	5.52	883	201	5	5,460	-0.1%	11,772	50,380	3,939	99,686	948,960	19,164
2027	3,689	669	5.51	887	202	5	5,458	0.0%	11,808	50,354	3,977	99,786	948,960	19,208
2028	3,681	669	5.50	891	202	5	5,454	-0.1%	11,843	50,329	4,016	99,886	948,960	19,239
2029	3,674	669	5.49	894	202	5	5,449	-0.1%	11,879	50,304	4,056	99,986	948,960	19,271
2030	3,667	669	5.48	897	202	5	5,445	-0.1%	11,914	50,279	4,097	100,086	948,960	19,270
2031	3,655	668	5.47	899	202	5	5,434	-0.2%	11,950	50,254	4,139	100,186	948,960	19,340
2032	3,643	667	5.46	901	202	5	5,423	-0.2%	11,986	50,229	4,181	100,286	948,960	19,377
2033	3,632	666	5.45	903	202	5	5,413	-0.2%	12,022	50,204	4,225	100,386	948,960	19,413
2034	3,620	665	5.44	904	202	5	5,401	-0.2%	12,058	50,178	4,270	100,487	948,960	19,453
2035	3,609	665	5.43	905	202	5	5,391	-0.2%	12,094	50,153	4,315	100,587	948,960	19,498
2036	3,594	663	5.42	906	202	5	5,375	-0.3%	12,130	50,128	4,362	100,688	948,960	19,537
2037	3,580	662	5.41	906	202	5	5,360	-0.3%	12,167	50,103	4,410	100,788	948,960	19,584
2038	3,565	666	5.35	907	199	6	5,348	-0.2%	12,191	50,078	4,459	100,788	948,960	19,597
2039	3,550	669	5.31	908	197	6	5,335	-0.2%	12,216	50,053	4,509	100,788	948,960	19,624
2040	3,536	672	5.26	910	195	6	5,324	-0.2%	12,240	50,028	4,560	100,788	948,960	19,646
2041	3,519	674	5.22	912	194	6	5,310	-0.3%	12,264	50,003	4,612	100,788	948,960	19,682
2042	3,501	676	5.18	914	192	6	5,294	-0.3%	12,289	49,978	4,666	100,788	948,960	19,705
2043	3,484	678	5.14	916	190	6	5,279	-0.3%	12,314	49,953	4,720	100,788	948,960	19,727
2044	3,467	679	5.11	918	189	6	5,264	-0.3%	12,338	49,928	4,776	100,788	948,960	19,758
2045	3,450	680	5.07	920	188	6	5,249	-0.3%	12,363	49,903	4,833	100,788	948,960	19,790
2046	3,433	681	5.04	922	186	6	5,233	-0.3%	12,388	49,878	4,891	100,788	948,960	19,806
2047	3,416	681	5.02	923	185	6	5,216	-0.3%	12,412	49,853	4,951	100,788	948,960	19,836
2048	3,399	681	4.99	924	183	6	5,198	-0.3%	12,437	49,828	5,012	100,788	948,960	19,850
2049	3,383	681	4.97	925	182	6	5,182	-0.3%	12,462	49,803	5,075	100,788	948,960	19,879
2050	3,366	680	4.95	926	180	6	5,163	-0.4%	12,487	49,779	5,138	100,788	948,960	19,888
2051	3,350	679	4.93	926	179	6	5,145	-0.3%	12,512	49,754	5,204	100,788	948,960	19,914
2052	3,333	678	4.92	926	177	6	5,125	-0.4%	12,537	49,729	5,270	100,788	948,960	19,926
2053	3,317	677	4.90	926	176	6	5,107	-0.4%	12,562	49,704	5,339	100,788	948,960	19,953
2054	3,300	676	4.88	926	174	6	5,087	-0.4%	12,587	49,679	5,408	100,788	948,960	19,966
2055	3,284	675	4.87	926	173	6	5,069	-0.4%	12,612	49,654	5,480	100,788	948,960	19,993
2056	3,268	673	4.86	925	172	6	5,049	-0.4%	12,638	49,629	5,553	100,788	948,960	20,018
2057	3,252	671	4.85	924	170	6	5,028	-0.4%	12,663	49,605	5,627	100,788	948,960	20,028
2058	3,236	669	4.84	923	169	6	5,008	-0.4%	12,688	49,580	5,703	100,788	948,960	20,053
2059	3,220	667	4.83	922	167	6	4,987	-0.4%	12,714	49,555	5,781	100,788	948,960	20,063
2060	3,204	665	4.82	921	166	6	4,967	-0.4%	12,739	49,530	5,861	100,788	948,960	20,089
2061	3,189	663	4.81	920	165	6	4,948	-0.4%	12,764	49,505	5,943	100,788	948,960	20,115
2062	3,173	661	4.80	918	163	6	4,926	-0.4%	12,790	49,481	6,026	100,788	948,960	20,128
2063	3,157	659	4.79	916	162	6	4,905	-0.4%	12,816	49,456	6,111	100,788	948,960	20,159
2064	3,142	657	4.78	914	161	6	4,885	-0.4%	12,841	49,431	6,198	100,788	948,960	20,188
2065	3,126	655	4.77	912	159	6	4,863	-0.5%	12,867	49,407	6,287	100,788	948,960	20,203
2066	3,111	653	4.76	910	158	6	4,843	-0.4%	12,893	49,382	6,379	100,788	948,960	20,233
2067	3,096	651	4.76	908	157	6	4,823	-0.4%	12,918	49,357	6,472	100,788	948,960	20,263
Compound Annual Growth Rates (Unless Marked Average):									Average					
(2017-20)	0.1%	0.6%	-1.1%	1.3%	0.9%	18.6%	0.4%	0.4%	-0.3%	-1.8%	4.4%	-0.7%	0.0%	
(2020-25)	-0.1%	0.2%	-0.2%	0.9%	0.2%	0.0%	0.1%	0.1%	0.4%	0.0%	0.9%	0.1%	0.0%	
(2025-30)	-0.2%	0.0%	-0.2%	0.4%	0.1%	0.0%	-0.1%	-0.1%	0.3%	0.0%	1.0%	0.1%	0.0%	
(2030-35)	-0.3%	-0.1%	-0.2%	0.2%	0.0%	0.0%	-0.2%	-0.2%	0.3%	0.0%	1.0%	0.1%	0.0%	
(2035-67)	-0.5%	-0.1%	-0.4%	0.0%	-0.8%	0.6%	-0.3%	-0.3%	0.2%	0.0%	1.3%	0.0%	0.0%	

Table 18
City and Borough of Sitka
2017 Electric Load Forecast
Forecasted Energy Sales, Total Requirements, Losses and Peak Demand
(kilowatt-hours)

MEDIUM CASE

Fiscal Year	Residential	General Service	Boats	Public Authority	Interruptible Sales	Added Heat Pumps & Elec. Vehs.	Total Sales	Annual % Change	Public Authority Nonbill	Losses	Total Requirements	Loss %
2017 (Act)	43,117,499	34,745,934	2,644,120	19,642,781	2,846,884	-	102,997,217		1,768,911	7,973,716	112,739,844	7.1%
2018	44,113,300	34,899,200	3,095,700	20,168,400	4,248,484	858,400	107,383,484	4.3%	1,816,200	7,711,354	116,911,038	6.7%
2019	45,003,600	35,684,800	3,181,900	20,602,000	4,248,484	1,576,400	110,297,184	2.7%	1,855,200	7,920,591	120,072,974	6.7%
2020	45,596,200	36,226,200	3,249,500	20,999,600	5,650,084	2,294,400	114,015,984	3.4%	1,891,000	8,187,643	124,094,627	6.7%
2021	45,873,600	36,517,400	3,294,400	21,147,400	5,650,084	3,012,400	115,495,284	1.3%	1,904,300	8,293,874	125,693,457	6.7%
2022	46,152,500	36,809,500	3,336,500	21,295,600	5,650,084	3,730,400	116,974,584	1.3%	1,917,600	8,400,104	127,292,288	6.7%
2023	46,420,700	37,102,700	3,384,000	21,444,400	5,650,084	4,448,400	118,450,284	1.3%	1,931,000	8,506,076	128,887,360	6.7%
2024	46,702,900	37,434,200	3,428,600	21,615,200	5,650,084	5,166,400	119,997,384	1.3%	1,946,400	8,617,175	130,560,959	6.7%
2025	46,986,700	37,767,300	3,478,800	21,786,800	5,650,084	5,884,400	121,554,084	1.3%	1,961,900	8,728,964	132,244,948	6.7%
2026	47,259,600	38,102,100	3,530,500	21,959,300	5,650,084	6,602,400	123,103,984	1.3%	1,977,400	8,840,265	133,921,648	6.7%
2027	47,546,800	38,438,600	3,579,400	22,132,600	5,650,084	7,324,000	124,671,484	1.3%	1,993,000	8,952,829	135,617,313	6.7%
2028	47,835,600	38,832,500	3,634,100	22,306,800	5,650,084	7,324,000	125,583,084	0.7%	2,008,700	9,018,292	136,610,076	6.7%
2029	48,126,200	39,172,600	3,690,400	22,481,800	5,650,084	7,324,000	126,445,084	0.7%	2,024,500	9,080,194	137,549,777	6.7%
2030	48,405,500	39,514,300	3,743,800	22,657,600	5,650,084	7,324,000	127,295,284	0.7%	2,040,300	9,141,248	138,476,831	6.7%
2031	48,699,400	39,857,700	3,803,400	22,834,400	5,650,084	7,324,000	128,168,984	0.7%	2,056,200	9,203,989	139,429,173	6.7%
2032	48,995,000	40,259,200	3,864,800	23,011,900	5,650,084	7,324,000	129,104,984	0.7%	2,072,200	9,271,205	140,448,388	6.7%
2033	49,292,400	40,606,200	3,923,300	23,190,300	5,650,084	7,324,000	129,986,284	0.7%	2,088,300	9,334,492	141,409,076	6.7%
2034	49,591,500	40,954,900	3,988,300	23,369,600	5,650,084	7,324,000	130,878,384	0.7%	2,104,400	9,398,555	142,381,338	6.7%
2035	49,879,200	41,305,300	4,055,200	23,549,800	5,650,084	7,324,000	131,763,584	0.7%	2,120,600	9,462,122	143,346,306	6.7%
2036	50,181,800	41,714,600	4,119,300	23,730,800	5,650,084	7,324,000	132,720,584	0.7%	2,136,900	9,530,846	144,388,329	6.7%
2037	50,486,100	42,068,700	4,190,200	23,912,700	5,650,084	7,324,000	133,631,784	0.7%	2,153,300	9,596,280	145,381,364	6.7%
2038	50,665,900	42,397,200	4,263,300	24,047,400	5,650,084	7,324,000	134,347,884	0.5%	2,165,400	9,647,704	146,160,988	6.7%
2039	50,832,900	42,669,000	4,333,400	24,293,300	5,650,084	7,324,000	135,102,684	0.6%	2,187,500	9,701,908	146,992,091	6.7%
2040	51,013,800	42,998,700	4,410,900	24,428,700	5,650,084	7,324,000	135,826,184	0.5%	2,199,700	9,753,863	147,779,747	6.7%
2041	51,195,300	43,271,600	4,490,700	24,564,300	5,650,084	7,324,000	136,495,984	0.5%	2,211,900	9,801,962	148,509,846	6.7%
2042	51,377,500	43,602,500	4,567,500	24,700,100	5,650,084	7,324,000	137,221,684	0.5%	2,224,100	9,854,076	149,299,859	6.7%
2043	51,560,200	43,876,400	4,652,100	24,836,200	5,650,084	7,324,000	137,898,984	0.5%	2,236,400	9,902,714	150,038,097	6.7%
2044	51,729,900	44,208,400	4,739,300	24,972,500	5,650,084	7,324,000	138,624,184	0.5%	2,248,700	9,954,791	150,827,675	6.7%
2045	51,913,700	44,541,100	4,829,100	25,109,000	5,650,084	7,324,000	139,366,984	0.5%	2,261,000	10,008,133	151,636,116	6.7%
2046	52,098,200	44,816,700	4,915,900	25,245,900	5,650,084	7,324,000	140,050,784	0.5%	2,273,300	10,057,237	152,381,321	6.7%
2047	52,283,200	45,150,600	5,011,200	25,494,700	5,650,084	7,324,000	140,913,784	0.6%	2,295,700	10,119,211	153,328,694	6.7%
2048	52,468,900	45,485,100	5,109,400	25,632,200	5,650,084	7,324,000	141,669,684	0.5%	2,308,100	10,173,493	154,151,276	6.7%
2049	52,641,300	45,762,200	5,204,500	25,769,800	5,650,084	7,324,000	142,351,884	0.5%	2,320,500	10,222,483	154,894,866	6.7%
2050	52,828,200	46,097,900	5,308,700	25,907,800	5,650,084	7,324,000	143,116,684	0.5%	2,332,900	10,277,404	155,726,987	6.7%
2051	53,015,600	46,434,200	5,416,100	26,045,900	5,650,084	7,324,000	143,885,884	0.5%	2,345,300	10,332,641	156,563,825	6.7%
2052	53,203,600	46,771,200	5,526,800	26,184,400	5,650,084	7,324,000	144,660,084	0.5%	2,357,800	10,388,238	157,406,121	6.7%
2053	53,392,300	47,108,700	5,634,400	26,323,000	5,650,084	7,324,000	145,432,484	0.5%	2,370,300	10,443,705	158,246,488	6.7%
2054	53,581,500	47,446,900	5,751,900	26,574,600	5,650,084	7,324,000	146,328,984	0.6%	2,393,000	10,508,083	159,230,067	6.7%
2055	53,757,400	47,727,500	5,873,000	26,713,900	5,650,084	7,324,000	147,045,884	0.5%	2,405,500	10,559,565	160,010,949	6.7%
2056	53,947,800	48,066,900	5,997,800	26,853,400	5,650,084	7,324,000	147,839,984	0.5%	2,418,100	10,616,590	160,874,674	6.7%
2057	54,138,900	48,406,900	6,119,600	26,993,200	5,650,084	7,324,000	148,632,684	0.5%	2,430,700	10,673,515	161,736,899	6.7%
2058	54,330,600	48,747,600	6,252,100	27,133,300	5,650,084	7,324,000	149,437,684	0.5%	2,443,300	10,731,323	162,612,307	6.7%
2059	54,522,900	49,088,900	6,388,800	27,386,700	5,650,084	7,324,000	150,361,384	0.6%	2,466,100	10,797,656	163,625,139	6.7%
2060	54,715,800	49,430,800	6,529,700	27,527,400	5,650,084	7,324,000	151,177,784	0.5%	2,478,800	10,856,282	164,512,866	6.7%
2061	54,909,300	49,832,000	6,667,400	27,668,300	5,650,084	7,324,000	152,051,084	0.6%	2,491,500	10,918,995	165,461,579	6.7%
2062	55,103,500	50,175,200	6,817,000	27,809,500	5,650,084	7,324,000	152,879,284	0.5%	2,504,200	10,978,469	166,361,953	6.7%
2063	55,284,100	50,519,100	6,971,300	27,950,900	5,650,084	7,324,000	153,699,484	0.5%	2,516,900	11,037,369	167,253,753	6.7%
2064	55,479,400	50,863,600	7,130,400	28,206,300	5,650,084	7,324,000	154,653,784	0.6%	2,539,900	11,105,899	168,299,582	6.7%
2065	55,675,500	51,208,800	7,286,200	28,348,400	5,650,084	7,324,000	155,492,984	0.5%	2,552,700	11,166,163	169,211,846	6.7%
2066	55,872,100	51,554,600	7,455,200	28,490,700	5,650,084	7,324,000	156,346,684	0.5%	2,565,500	11,227,468	170,139,652	6.7%
2067	56,069,400	51,960,000	7,629,500	28,633,300	5,650,084	7,324,000	157,266,284	0.6%	2,578,300	11,293,506	171,138,089	6.7%
Compound Annual Growth Rates (Unless Marked Average):								Average		Average		
(2017-20)	1.9%	1.4%	7.1%	2.3%	25.7%		3.4%	3.4%	2.2%	0.9%	3.3%	6.7%
(2020-25)	0.6%	0.8%	1.4%	0.7%	0.0%	20.7%	1.3%	1.3%	0.7%	1.3%	1.3%	6.7%
(2025-30)	0.6%	0.9%	1.5%	0.8%	0.0%	4.5%	0.9%	0.9%	0.8%	0.9%	0.9%	6.7%
(2030-35)	0.6%	0.9%	1.6%	0.8%	0.0%	0.0%	0.7%	0.7%	0.8%	0.7%	0.7%	6.7%
(2035-67)	0.4%	0.7%	2.0%	0.6%	0.0%	0.0%	0.6%	0.6%	0.6%	0.6%	0.6%	6.7%
(2017-37)	0.8%	1.0%	2.3%	1.0%	3.5%		1.3%	1.3%	1.0%	0.9%	1.3%	6.7%
(2017-67)	0.5%	0.8%	2.1%	0.8%	1.4%		0.9%	0.9%	0.8%	0.7%	0.8%	6.7%

Table 18
City and Borough of Sitka
2017 Electric Load Forecast
Forecasted Energy Sales, Total Requirements, Losses and Peak Demand
(kilowatt-hours)

HIGH CASE

Fiscal Year	Residential	General Service	Boats	Public Authority	Interruptible Sales	Added Heat Pumps & Elec. Vehs.	Total Sales	Annual % Change	PA - Nonbill	Losses	Total Requirements	Loss %
2017 (Act)	43,117,499	34,745,934	2,644,120	19,642,781	2,846,884	-	102,997,217		1,768,911	7,973,716	112,739,844	7.1%
2018	45,057,300	35,198,300	3,166,700	20,560,900	4,248,484	1,030,080	109,261,764	6.1%	1,851,600	8,097,811	119,211,174	6.9%
2019	47,474,800	37,169,700	3,374,200	21,735,600	4,248,484	1,891,680	115,894,464	6.1%	1,957,400	8,589,386	126,441,249	6.9%
2020	47,953,800	37,672,500	3,435,300	22,129,500	5,650,084	2,753,280	119,594,464	3.2%	1,992,900	8,863,607	130,450,970	6.9%
2021	48,436,500	38,234,000	3,493,700	22,415,600	5,650,084	3,614,880	121,844,764	1.9%	2,018,700	9,030,385	132,893,849	6.9%
2022	48,922,800	38,798,500	3,558,000	22,703,300	7,051,684	4,476,480	125,510,764	3.0%	2,044,600	9,302,087	136,857,450	6.9%
2023	49,412,700	39,422,500	3,624,100	22,992,500	7,051,684	5,338,080	127,841,564	1.9%	2,070,600	9,474,831	139,386,995	6.9%
2024	49,956,000	39,993,300	3,691,900	23,283,200	8,453,284	6,199,680	131,577,364	2.9%	2,096,800	9,751,706	143,425,869	6.9%
2025	50,517,100	40,623,900	3,761,600	23,575,500	8,453,284	7,061,280	133,992,664	1.8%	2,123,100	9,930,713	146,046,477	6.9%
2026	51,069,900	41,201,000	3,833,300	23,869,300	8,453,284	7,922,880	136,349,664	1.8%	2,149,600	10,105,399	148,604,663	6.9%
2027	51,627,600	41,838,400	3,906,900	24,164,600	8,453,284	8,788,800	138,779,584	1.8%	2,176,200	10,285,490	151,241,274	6.9%
2028	52,203,400	42,479,100	3,982,600	24,573,800	8,453,284	8,788,800	140,480,984	1.2%	2,213,100	10,411,587	153,105,671	6.9%
2029	52,784,300	43,123,300	4,065,100	24,872,600	8,453,284	8,788,800	142,087,384	1.1%	2,240,000	10,530,644	154,858,027	6.9%
2030	53,356,800	43,771,100	4,145,200	25,173,000	8,453,284	8,788,800	143,688,184	1.1%	2,267,100	10,649,285	156,604,569	6.9%
2031	53,893,700	44,306,700	4,218,200	25,474,900	8,453,284	8,788,800	145,135,584	1.0%	2,294,300	10,756,558	158,186,441	6.9%
2032	54,435,100	44,845,200	4,293,300	25,778,500	8,453,284	8,788,800	146,594,184	1.0%	2,321,600	10,864,660	159,780,444	6.9%
2033	54,981,000	45,386,600	4,375,400	26,083,600	8,453,284	8,788,800	148,068,684	1.0%	2,349,100	10,973,941	161,391,725	6.9%
2034	55,531,500	45,930,700	4,455,000	26,390,400	8,453,284	8,788,800	149,549,684	1.0%	2,376,700	11,083,704	163,010,087	6.9%
2035	56,086,700	46,477,800	4,542,000	26,698,700	8,453,284	8,788,800	151,047,284	1.0%	2,404,500	11,194,697	164,646,480	6.9%
2036	56,660,400	47,027,700	4,631,500	27,008,700	8,453,284	8,788,800	152,570,384	1.0%	2,432,400	11,307,579	166,310,363	6.9%
2037	57,225,000	47,580,400	4,718,500	27,320,200	8,453,284	8,788,800	154,086,184	1.0%	2,460,500	11,419,921	167,966,605	6.9%
2038	57,736,900	48,195,100	4,813,400	27,749,100	8,453,284	8,788,800	155,736,584	1.1%	2,499,100	11,542,239	169,777,922	6.9%
2039	58,266,700	48,753,900	4,911,000	28,064,200	8,453,284	8,788,800	157,237,884	1.0%	2,527,500	11,653,506	171,418,889	6.9%
2040	58,786,000	49,374,900	5,006,300	28,381,100	8,453,284	8,788,800	158,790,384	1.0%	2,556,000	11,768,568	173,114,951	6.9%
2041	59,323,400	49,939,700	5,109,800	28,699,500	8,453,284	8,788,800	160,314,484	1.0%	2,584,700	11,881,525	174,780,708	6.9%
2042	59,850,400	50,567,100	5,211,000	29,019,700	8,453,284	8,788,800	161,890,284	1.0%	2,613,500	11,998,313	176,502,097	6.9%
2043	60,395,500	51,138,000	5,320,800	29,458,800	8,453,284	8,788,800	163,555,184	1.0%	2,653,000	12,121,705	178,329,889	6.9%
2044	60,930,100	51,771,900	5,434,000	29,782,600	8,453,284	8,788,800	165,160,684	1.0%	2,682,200	12,240,695	180,083,579	6.9%
2045	61,483,200	52,409,100	5,550,600	30,108,100	8,453,284	8,788,800	166,793,084	1.0%	2,711,500	12,361,679	181,866,262	6.9%
2046	62,040,200	53,049,700	5,665,000	30,553,700	8,453,284	8,788,800	168,550,684	1.1%	2,751,600	12,491,941	183,794,225	6.9%
2047	62,601,300	53,693,700	5,788,800	30,882,900	8,453,284	8,788,800	170,208,784	1.0%	2,781,200	12,614,829	185,604,813	6.9%
2048	63,166,400	54,341,000	5,916,400	31,213,900	8,453,284	8,788,800	171,879,784	1.0%	2,811,000	12,738,674	187,429,457	6.9%
2049	63,735,600	54,991,800	6,048,000	31,666,000	8,453,284	8,788,800	173,683,484	1.0%	2,851,700	12,872,353	189,407,536	6.9%
2050	64,309,000	55,645,900	6,183,700	32,000,700	8,453,284	8,788,800	175,381,384	1.0%	2,881,800	12,998,191	191,261,374	6.9%
2051	64,886,500	56,303,500	6,323,600	32,337,100	8,453,284	8,788,800	177,092,784	1.0%	2,912,100	13,125,029	193,129,913	6.9%
2052	65,483,200	57,026,100	6,467,900	32,795,900	8,453,284	8,788,800	179,015,184	1.1%	2,953,400	13,267,506	195,236,089	6.9%
2053	66,069,100	57,690,800	6,616,700	33,136,100	8,453,284	8,788,800	180,754,784	1.0%	2,984,000	13,396,434	197,135,218	6.9%
2054	66,659,300	58,359,000	6,770,100	33,599,400	8,453,284	8,788,800	182,629,884	1.0%	3,025,700	13,535,405	199,190,989	6.9%
2055	67,269,000	59,092,700	6,928,400	33,943,500	8,453,284	8,788,800	184,475,684	1.0%	3,056,700	13,672,204	201,204,588	6.9%
2056	67,867,800	59,788,000	7,091,700	34,411,400	8,453,284	8,788,800	186,380,984	1.0%	3,098,800	13,813,413	203,293,197	6.9%
2057	68,486,300	60,509,300	7,260,100	34,759,500	8,453,284	8,788,800	188,257,284	1.0%	3,130,100	13,952,473	205,339,857	6.9%
2058	69,109,400	61,254,600	7,433,900	35,232,000	8,453,284	8,788,800	190,271,984	1.1%	3,172,600	14,101,790	207,546,374	6.9%
2059	69,721,300	62,003,700	7,613,100	35,707,100	8,453,284	8,788,800	192,287,284	1.1%	3,215,400	14,251,152	209,753,836	6.9%
2060	70,353,300	62,756,800	7,798,100	36,061,200	8,453,284	8,788,800	194,211,484	1.0%	3,247,300	14,393,762	211,852,546	6.9%
2061	70,989,900	63,513,800	7,989,000	36,541,000	8,453,284	8,788,800	196,275,784	1.1%	3,290,500	14,546,755	214,113,039	6.9%
2062	71,631,100	64,274,900	8,193,800	36,899,100	8,453,284	8,788,800	198,240,984	1.0%	3,322,700	14,692,404	216,256,087	6.9%
2063	72,277,000	65,039,900	8,397,200	37,383,600	8,453,284	8,788,800	200,339,784	1.1%	3,366,300	14,847,954	218,554,037	6.9%
2064	72,927,500	65,808,900	8,607,100	37,870,700	8,453,284	8,788,800	202,456,284	1.1%	3,410,200	15,004,816	220,871,299	6.9%
2065	73,582,700	66,646,000	8,823,800	38,360,400	8,453,284	8,788,800	204,654,984	1.1%	3,454,300	15,167,770	223,277,054	6.9%
2066	74,258,900	67,423,300	9,055,900	38,727,000	8,453,284	8,788,800	206,707,184	1.0%	3,487,300	15,319,866	225,514,350	6.9%
2067	74,923,700	68,269,000	9,286,900	39,221,500	8,453,284	8,788,800	208,943,184	1.1%	3,531,800	15,485,585	227,960,569	6.9%
Compound Annual Growth Rates (Unless Marked Average):								Average		Average		
(2017-20)	3.6%	2.7%	9.1%	4.1%	25.7%		5.1%	5.1%	4.1%	3.6%	5.0%	6.9%
(2020-25)	1.0%	1.5%	1.8%	1.3%	8.4%	20.7%	2.3%	2.3%	1.3%	2.3%	2.3%	6.9%
(2025-30)	1.1%	1.5%	2.0%	1.3%	0.0%	4.5%	1.4%	1.4%	1.3%	1.4%	1.4%	6.9%
(2030-35)	1.0%	1.2%	1.8%	1.2%	0.0%	0.0%	1.0%	1.0%	1.2%	1.0%	1.0%	6.9%
(2035-67)	0.9%	1.2%	2.2%	1.2%	0.0%	0.0%	1.0%	1.0%	1.2%	1.0%	1.0%	6.9%
(2017-37)	1.4%	1.6%	2.9%	1.7%	5.6%		2.0%	2.0%	1.7%	1.8%	2.0%	6.9%
(2017-67)	1.1%	1.4%	2.5%	1.4%	2.2%		1.4%	1.4%	1.4%	1.3%	1.4%	6.9%

Table 18
City and Borough of Sitka
2017 Electric Load Forecast
Forecasted Energy Sales, Total Requirements, Losses and Peak Demand
(kilowatt-hours)

LOW CASE

Fiscal Year	Residential	General Service	Boats	Public Authority	Interruptible Sales	Added Heat Pumps & Elec. Vehs.	Total Sales	Annual % Change	PA - Nonbill	Losses	Total Requirements	Loss %
2017 (Act)	43,117,499	34,745,934	2,644,120	19,642,781	2,846,884	-	102,997,217		1,768,911	7,973,716	112,739,844	7.1%
2018	43,483,100	33,948,000	3,085,600	19,880,300	3,898,084	772,560	105,067,644	2.0%	1,790,300	7,545,051	114,402,994	6.7%
2019	42,599,200	33,300,500	3,069,100	19,501,300	3,898,084	1,418,760	103,786,944	-1.2%	1,756,200	7,215,135	112,758,279	6.5%
2020	42,815,700	33,502,300	3,133,600	19,719,000	3,898,084	2,064,960	105,133,644	1.3%	1,775,800	7,308,756	114,218,200	6.5%
2021	42,963,900	33,552,800	3,195,600	19,738,700	3,898,084	2,711,160	106,060,244	0.9%	1,777,600	7,373,172	115,211,016	6.5%
2022	43,112,500	33,603,200	3,255,000	19,857,700	3,898,084	3,357,360	107,083,844	1.0%	1,788,300	7,444,331	116,316,475	6.5%
2023	43,261,600	33,653,700	3,311,800	19,877,600	3,898,084	4,003,560	108,006,344	0.9%	1,790,100	7,508,462	117,304,906	6.5%
2024	43,368,000	33,687,300	3,369,800	19,996,900	3,898,084	4,649,760	108,969,844	0.9%	1,800,800	7,575,444	118,346,087	6.5%
2025	43,474,600	33,720,800	3,425,200	20,016,900	3,898,084	5,295,960	109,831,544	0.8%	1,802,600	7,635,348	119,269,492	6.5%
2026	43,510,800	33,704,000	3,477,700	20,036,900	3,898,084	5,942,160	110,569,644	0.7%	1,804,400	7,686,660	120,060,703	6.5%
2027	43,558,700	33,687,100	3,527,400	20,156,800	3,898,084	6,591,600	111,419,684	0.8%	1,815,200	7,745,753	120,980,637	6.5%
2028	43,594,700	33,670,300	3,578,100	20,176,900	3,898,084	6,591,600	111,509,684	0.1%	1,817,000	7,752,010	121,078,694	6.5%
2029	43,642,300	33,653,400	3,625,900	20,197,100	3,898,084	6,591,600	111,608,384	0.1%	1,818,800	7,758,872	121,186,055	6.5%
2030	43,689,800	33,636,600	3,674,800	20,217,300	3,898,084	6,591,600	111,708,184	0.1%	1,820,600	7,765,810	121,294,593	6.5%
2031	43,677,500	33,569,500	3,720,600	20,237,500	3,898,084	6,591,600	111,694,784	0.0%	1,822,400	7,764,878	121,282,062	6.5%
2032	43,664,700	33,502,500	3,767,400	20,257,700	3,898,084	6,591,600	111,681,984	0.0%	1,824,200	7,763,988	121,270,172	6.5%
2033	43,663,400	33,435,600	3,815,200	20,278,000	3,898,084	6,591,600	111,681,884	0.0%	1,826,000	7,763,981	121,271,865	6.5%
2034	43,649,700	33,368,700	3,859,900	20,298,300	3,898,084	6,591,600	111,666,284	0.0%	1,827,800	7,762,897	121,256,980	6.5%
2035	43,647,600	33,352,000	3,905,500	20,318,600	3,898,084	6,591,600	111,713,384	0.0%	1,829,600	7,765,810	121,309,155	6.5%
2036	43,596,600	33,235,100	3,952,100	20,338,900	3,898,084	6,591,600	111,612,384	-0.1%	1,831,400	7,759,150	121,202,933	6.5%
2037	43,557,100	33,168,300	3,995,400	20,359,200	3,898,084	6,591,600	111,569,684	0.0%	1,833,200	7,756,181	121,159,065	6.5%
2038	43,461,300	33,352,100	4,044,200	20,056,900	3,898,084	6,591,600	111,404,184	-0.1%	1,806,000	7,744,676	120,954,859	6.5%
2039	43,365,000	33,485,600	4,094,000	19,855,300	3,898,084	6,591,600	111,289,584	-0.1%	1,787,800	7,736,709	120,814,093	6.5%
2040	43,280,400	33,618,900	4,149,500	19,653,700	3,898,084	6,591,600	111,192,184	-0.1%	1,769,600	7,729,938	120,691,721	6.5%
2041	43,158,500	33,702,100	4,206,300	19,552,900	3,898,084	6,591,600	111,109,484	-0.1%	1,760,500	7,724,189	120,594,172	6.5%
2042	43,023,600	33,785,200	4,264,300	19,351,400	3,898,084	6,591,600	110,914,184	-0.2%	1,742,400	7,710,612	120,367,195	6.5%
2043	42,900,300	33,868,200	4,323,700	19,149,800	3,898,084	6,591,600	110,731,684	-0.2%	1,724,200	7,697,925	120,153,808	6.5%
2044	42,776,400	33,901,200	4,384,400	19,049,000	3,898,084	6,591,600	110,600,684	-0.1%	1,715,100	7,688,818	120,004,601	6.5%
2045	42,651,700	33,934,200	4,446,400	18,948,200	3,898,084	6,591,600	110,470,184	-0.1%	1,706,000	7,679,745	119,855,929	6.5%
2046	42,526,500	33,967,100	4,509,900	18,746,600	3,898,084	6,591,600	110,239,784	-0.2%	1,687,800	7,663,728	119,591,312	6.5%
2047	42,400,500	33,950,100	4,569,900	18,645,800	3,898,084	6,591,600	110,055,984	-0.2%	1,678,700	7,650,951	119,385,634	6.5%
2048	42,273,900	33,933,100	4,631,300	18,444,300	3,898,084	6,591,600	109,772,284	-0.3%	1,660,600	7,631,228	119,064,112	6.5%
2049	42,159,000	33,916,100	4,694,000	18,343,500	3,898,084	6,591,600	109,602,284	-0.2%	1,651,500	7,619,410	118,873,194	6.5%
2050	42,031,100	33,849,400	4,758,200	18,141,900	3,898,084	6,591,600	109,270,284	-0.3%	1,633,300	7,596,330	118,499,913	6.5%
2051	41,914,900	33,782,700	4,818,600	18,041,100	3,898,084	6,591,600	109,046,984	-0.2%	1,624,200	7,580,806	118,251,990	6.5%
2052	41,785,600	33,716,100	4,880,400	17,839,500	3,898,084	6,591,600	108,711,284	-0.3%	1,606,100	7,557,469	117,874,853	6.5%
2053	41,668,200	33,649,500	4,943,600	17,738,700	3,898,084	6,591,600	108,489,684	-0.2%	1,597,000	7,542,064	117,628,747	6.5%
2054	41,537,600	33,583,000	5,008,200	17,537,200	3,898,084	6,591,600	108,155,684	-0.3%	1,578,900	7,518,844	117,253,428	6.5%
2055	41,418,800	33,516,600	5,074,200	17,436,400	3,898,084	6,591,600	107,935,684	-0.2%	1,569,800	7,503,550	117,009,034	6.5%
2056	41,299,500	33,400,600	5,136,200	17,335,600	3,898,084	6,591,600	107,661,584	-0.3%	1,560,700	7,484,495	116,706,779	6.5%
2057	41,179,500	33,284,700	5,199,500	17,134,000	3,898,084	6,591,600	107,287,384	-0.3%	1,542,600	7,458,481	116,288,465	6.5%
2058	41,058,800	33,168,900	5,264,300	17,033,200	3,898,084	6,591,600	107,014,884	-0.3%	1,533,500	7,439,537	115,987,921	6.5%
2059	40,937,500	33,053,200	5,330,500	16,831,600	3,898,084	6,591,600	106,642,484	-0.3%	1,515,300	7,413,649	115,571,432	6.5%
2060	40,815,600	32,937,600	5,398,100	16,730,900	3,898,084	6,591,600	106,371,884	-0.3%	1,506,200	7,394,837	115,272,920	6.5%
2061	40,705,700	32,822,100	5,467,200	16,630,100	3,898,084	6,591,600	106,114,784	-0.2%	1,497,100	7,376,964	114,988,847	6.5%
2062	40,582,500	32,706,700	5,531,900	16,428,500	3,898,084	6,591,600	105,739,284	-0.4%	1,479,000	7,350,859	114,569,143	6.5%
2063	40,458,600	32,591,500	5,597,900	16,327,700	3,898,084	6,591,600	105,465,384	-0.3%	1,469,900	7,331,818	114,267,102	6.5%
2064	40,346,900	32,476,300	5,665,300	16,226,900	3,898,084	6,591,600	105,205,084	-0.2%	1,460,800	7,313,722	113,979,606	6.5%
2065	40,221,800	32,361,300	5,734,200	16,025,300	3,898,084	6,591,600	104,832,284	-0.4%	1,442,700	7,287,806	113,562,789	6.5%
2066	40,108,800	32,246,300	5,804,500	15,924,600	3,898,084	6,591,600	104,573,884	-0.2%	1,433,600	7,269,842	113,277,326	6.5%
2067	39,995,300	32,131,500	5,876,300	15,823,800	3,898,084	6,591,600	104,316,584	-0.2%	1,424,500	7,251,955	112,993,039	6.5%
Compound Annual Growth Rates (Unless Marked Average):								Average				
(2017-20)	-0.2%	-1.2%	5.8%	0.1%	11.0%		0.7%	0.7%	0.1%	-2.9%	0.4%	6.6%
(2020-25)	0.3%	0.1%	1.8%	0.3%	0.0%	20.7%	0.9%	0.9%	0.3%	0.9%	0.9%	6.5%
(2025-30)	0.1%	0.0%	1.4%	0.2%	0.0%	4.5%	0.3%	0.3%	0.2%	0.3%	0.3%	6.5%
(2030-35)	0.0%	-0.2%	1.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	6.5%
(2035-67)	-0.3%	-0.1%	1.2%	-0.8%	0.0%	0.0%	-0.2%	-0.2%	-0.8%	-0.2%	-0.2%	6.5%
(2017-37)	0.1%	-0.2%	2.1%	0.2%	1.6%		0.4%	0.4%	0.2%	-0.1%	0.4%	6.5%
(2017-67)	-0.2%	-0.2%	1.6%	-0.4%	0.6%		0.0%	0.0%	-0.4%	-0.2%	0.0%	6.5%

Table 19
City and Borough of Sitka
Forecasted Peak Loads
(kilowatts)

Fiscal Year	Medium Case		High Case		Low Case	
	Low	High	Low	High	Low	High
2017 (Act)	22,160	22,160	22,160	22,160	22,160	22,160
2018	21,200	23,800	21,600	24,300	20,700	23,300
2019	21,800	24,500	22,900	25,800	20,400	23,000
2020	22,500	25,300	23,600	26,600	20,700	23,300
2021	22,800	25,600	24,100	27,100	20,900	23,500
2022	23,100	25,900	24,800	27,900	21,100	23,700
2023	23,400	26,300	25,300	28,400	21,300	23,900
2024	23,700	26,600	26,000	29,200	21,400	24,100
2025	24,000	27,000	26,500	29,800	21,600	24,300
2026	24,300	27,300	26,900	30,300	21,800	24,500
2027	24,600	27,600	27,400	30,800	21,900	24,700
2028	24,800	27,800	27,700	31,200	21,900	24,700
2029	24,900	28,000	28,100	31,600	22,000	24,700
2030	25,100	28,200	28,400	31,900	22,000	24,700
2031	25,300	28,400	28,700	32,200	22,000	24,700
2032	25,400	28,600	29,000	32,600	22,000	24,700
2033	25,600	28,800	29,200	32,900	22,000	24,700
2034	25,800	29,000	29,500	33,200	22,000	24,700
2035	26,000	29,200	29,800	33,600	22,000	24,700
2036	26,200	29,400	30,100	33,900	22,000	24,700
2037	26,300	29,600	30,400	34,200	22,000	24,700
2038	26,500	29,800	30,800	34,600	21,900	24,700
2039	26,600	30,000	31,100	34,900	21,900	24,600
2040	26,800	30,100	31,400	35,300	21,900	24,600
2041	26,900	30,300	31,700	35,600	21,900	24,600
2042	27,100	30,400	32,000	36,000	21,800	24,500
2043	27,200	30,600	32,300	36,400	21,800	24,500
2044	27,300	30,700	32,600	36,700	21,700	24,500
2045	27,500	30,900	33,000	37,100	21,700	24,400
2046	27,600	31,100	33,300	37,500	21,700	24,400
2047	27,800	31,300	33,600	37,800	21,600	24,300
2048	27,900	31,400	34,000	38,200	21,600	24,300
2049	28,100	31,600	34,300	38,600	21,500	24,200
2050	28,200	31,700	34,700	39,000	21,500	24,200
2051	28,400	31,900	35,000	39,400	21,400	24,100
2052	28,500	32,100	35,400	39,800	21,400	24,000
2053	28,700	32,300	35,700	40,200	21,300	24,000
2054	28,900	32,500	36,100	40,600	21,200	23,900
2055	29,000	32,600	36,500	41,000	21,200	23,900
2056	29,200	32,800	36,800	41,400	21,100	23,800
2057	29,300	33,000	37,200	41,900	21,100	23,700
2058	29,500	33,100	37,600	42,300	21,000	23,600
2059	29,600	33,400	38,000	42,800	20,900	23,600
2060	29,800	33,500	38,400	43,200	20,900	23,500
2061	30,000	33,700	38,800	43,600	20,800	23,400
2062	30,100	33,900	39,200	44,100	20,800	23,400
2063	30,300	34,100	39,600	44,600	20,700	23,300
2064	30,500	34,300	40,000	45,000	20,700	23,200
2065	30,700	34,500	40,500	45,500	20,600	23,100
2066	30,800	34,700	40,900	46,000	20,500	23,100
2067	31,000	34,900	41,300	46,500	20,500	23,000
Compound Annual Growth Rates (Unless Marked Average):						
					Average	Average
(2017-20)	0.5%	4.5%	2.1%	6.3%	-2.2%	1.7%
(2020-25)	1.3%	1.3%	2.3%	2.3%	0.9%	0.8%
(2025-30)	0.9%	0.9%	1.4%	1.4%	0.4%	0.3%
(2030-35)	0.7%	0.7%	1.0%	1.0%	0.0%	0.0%
(2035-67)	0.5%	0.5%	1.0%	1.0%	-0.2%	-0.2%
(2017-37)	0.9%	1.5%	1.6%	2.2%	0.0%	0.5%
(2017-67)	0.7%	0.9%	1.3%	1.5%	-0.2%	0.1%

City and Borough of Sitka
Comprehensive Electrical Load Analysis and
Load Development Plan

APPENDIX B

EasyPower Output

Japonski Island Load Increase Case (Run #4)

Power Flow Summary Report

EasyPower 10.0.0.458 12/14/2017 3:06:40 PM S:\...\Sitka Peak 2017 Japonski..dez
 EasyPower LLC.
 Comments : Japonski Addition

Mismatch Report

Iteration	MW Mismatch		MVAR Mismatch		
	Number	Bus Name	pu	Bus Name	pu
0	BUS-BL_GEN4_CUB		0.00273	BUS-BL_GEN4_CUB	0.00918
1	BUS-BL_GEN4_CUB		0.00084	BUS-BL_GEN3_CUB	0.00036
2	BUS-BL_GEN4_CUB		0.00005	BUS-BL_GEN3_CUB	0.00001
3	BUS-BL_GEN4_CUB		0.00000	BUS-BL_GEN3_CUB	0.00000
4	BUS-BL_GEN4_CUB		0.00000	BUS-BL_GEN3_CUB	0.00000

Generation Summary Report

Generator			Scheduled			Limits		Solution							
Name	Type	Rated MVA	MW	MVAR	Vpu	MVAR Min	MVAR Max	MW	MVAR	MVA	PF	Vpu	Deg	Eq'pu	Deg
GEN-1	Sw	10.300			1.020			10.466	5.217	11.694	0.895	1.020	0.00	1.207	13.64
GEN-2	PQG	10.300	4.500	2.000				4.500	2.000	4.924	0.914	1.019	-0.03	1.085	6.46
HG-BLUE-G3	PQG	9.511	8.000	3.250				8.000	3.250	8.635	0.926	1.005	-0.14	1.118	10.64
HG-BLUE-G4	PQG	9.511	8.000	3.250				8.000	3.250	8.635	0.926	1.005	-0.14	1.118	10.64
HG-FVU	PQG	1.806	1.000	0.000				1.000	0.000	1.000	1.000	1.020	5.27	1.041	14.78

Load Summary Report

Bus		Solution							
Name	Base kV	kV	Vpu	Deg	MW	MVAR	MVA	PF	
52-J7 IN	12.470	12.127	0.973	-7.39	0.000	0.000	0.000	0.000	
210S	12.470	12.055	0.967	-10.94	1.930	0.484	1.990	0.970	
210S2	12.470	11.930	0.957	-11.83	1.899	0.476	1.958	0.970	
220S	12.470	12.244	0.982	-9.71	2.921	0.732	3.011	0.970	
220S_A	12.470	12.244	0.982	-9.71	0.000	0.000	0.000	0.000	
230S	12.470	12.242	0.982	-9.74	0.000	0.000	0.000	0.000	
250S	12.470	12.220	0.980	-9.93	0.000	0.000	0.000	0.000	
330S	12.470	11.880	0.953	-10.44	0.000	0.000	0.000	0.000	
1210 BOX TAP	12.470	12.290	0.986	-9.42	1.990	0.499	2.052	0.970	
1220 BOX TAP	12.470	12.290	0.986	-9.42	0.000	0.000	0.000	0.000	
1230 BOX TAP	12.470	12.290	0.986	-9.42	1.422	0.356	1.466	0.970	
1240 BOX TAP	12.470	12.291	0.986	-9.42	0.569	0.143	0.586	0.970	
1250 BOX TAP	12.470	12.290	0.986	-9.42	0.474	0.119	0.489	0.970	
1260 BOX TAP	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000	
1330 END	12.470	11.821	0.948	-10.86	0.891	0.223	0.919	0.970	
AIRPORT	12.470	12.113	0.971	-9.83	0.929	0.233	0.958	0.970	
AQUATIC	12.470	12.122	0.972	-10.07	1.404	0.174	1.415	0.992	
BL-T1	69.000	69.325	1.005	-3.64	0.000	0.000	0.000	0.000	
BL-T2	69.000	69.325	1.005	-3.64	0.000	0.000	0.000	0.000	
BLUE LAKE TIE	69.000	68.277	0.990	-4.68	0.000	0.000	0.000	0.000	
BOILERS - FUTURE	12.470	12.141	0.974	-10.05	0.000	0.000	0.000	0.000	
BUS-0475	12.470	12.575	1.008	1.91	0.000	0.000	0.000	0.000	
BUS-0505	12.470	12.538	1.005	-0.14	0.000	0.000	0.000	0.000	
BUS-BL-01	12.470	12.536	1.005	-0.14	0.000	0.000	0.000	0.000	
BUS-BL-02	12.470	12.536	1.005	-0.14	0.000	0.000	0.000	0.000	
BUS-BL_GEN3_CUB	12.470	12.537	1.005	-0.14	0.000	0.000	0.000	0.000	
BUS-BL_GEN4_CUB	12.470	12.538	1.005	-0.14	0.000	0.000	0.000	0.000	
BUS-FVU-06	12.470	12.634	1.013	2.33	0.000	0.000	0.000	0.000	
BUS-FVU-HV	12.470	12.634	1.013	2.34	0.000	0.000	0.000	0.000	
BUS-FVU-HV_O	12.470	12.634	1.013	2.34	0.000	0.000	0.000	0.000	
BUS-FVU_BKR	4.160	4.243	1.020	5.26	0.000	0.000	0.000	0.000	
BUS-FVU_TERMINALS	4.160	4.244	1.020	5.27	0.000	0.000	0.000	0.000	
BUS-TIE-H	12.470	12.124	0.972	-7.41	0.000	0.000	0.000	0.000	
BUS-TIE-L	12.470	11.950	0.958	-9.97	0.000	0.000	0.000	0.000	
BUS-XF-BL-T1	12.470	12.529	1.005	-0.16	0.000	0.000	0.000	0.000	

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Load Summary Report (continued)

Bus		Solution						
Name	Base kV	kV	Vpu	Deg	MW	MVAR	MVA	PF
BUS-XF-BL-T2	12.470	12.528	1.005	-0.17	0.000	0.000	0.000	0.000
BYPASS1	69.000	69.325	1.005	-3.64	0.000	0.000	0.000	0.000
BYPASS2	69.000	69.325	1.005	-3.64	0.000	0.000	0.000	0.000
CNTLRM SWGR	12.470	12.127	0.973	-7.39	0.000	0.000	0.000	0.000
D5 SWGR	12.470	12.039	0.965	-4.68	0.000	0.000	0.000	0.000
DT 102	12.470	12.039	0.965	-4.68	0.000	0.000	0.000	0.000
DT 104	12.470	12.039	0.965	-4.68	0.000	0.000	0.000	0.000
DUMMY	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1210	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1220	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1230	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1240	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1250	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1260	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
FDR 1310	12.470	11.947	0.958	-9.99	0.000	0.000	0.000	0.000
FDR 1330	12.470	11.947	0.958	-9.99	0.000	0.000	0.000	0.000
G1	6.900	7.038	1.020	0.00	0.000	0.000	0.000	0.000
G1-SWGR-IN	6.900	7.037	1.020	-0.01	0.000	0.000	0.000	0.000
G1-SWGR-OUT	6.900	7.037	1.020	-0.01	0.000	0.000	0.000	0.000
G2	6.900	7.033	1.019	-0.03	0.000	0.000	0.000	0.000
G2-SWGR-IN	6.900	7.033	1.019	-0.04	0.000	0.000	0.000	0.000
G2-SWGR-OUT	6.900	7.033	1.019	-0.04	0.000	0.000	0.000	0.000
GRD-XFMR-OUT	12.470	11.947	0.958	-9.99	0.000	0.000	0.000	0.000
HIGH SCHOOL	12.470	11.891	0.954	-10.50	0.921	0.049	0.923	0.999
INDUSTRIAL	12.470	11.886	0.953	-10.41	2.697	0.676	2.780	0.970
JARV SWGR BUS	12.470	11.947	0.958	-9.99	0.000	0.000	0.000	0.000
KAAGWAANTAAN	12.470	12.269	0.984	-9.57	0.000	0.000	0.000	0.000
LAKE ST	12.470	11.904	0.955	-10.36	0.000	0.000	0.000	0.000
LAKE_TRANS	12.470	12.253	0.983	-9.67	0.000	0.000	0.000	0.000
MARINE ST	69.000	68.067	0.986	-4.90	0.000	0.000	0.000	0.000
MARINE ST SWGR	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
MARINE ST TIE	69.000	68.277	0.990	-4.68	0.000	0.000	0.000	0.000
MT EDGE COMB	12.470	12.107	0.971	-10.08	0.463	0.116	0.477	0.970
NODE	12.470	11.946	0.958	-9.99	0.000	0.000	0.000	0.000
NODE 101	12.470	12.227	0.981	-9.74	0.000	0.000	0.000	0.000
NODE 101A	12.470	12.288	0.985	-9.43	0.000	0.000	0.000	0.000
NODE 101B	12.470	12.259	0.983	-9.57	0.000	0.000	0.000	0.000
NODE 108	12.470	11.904	0.955	-10.36	0.000	0.000	0.000	0.000
NODE 149	12.470	11.930	0.957	-11.83	0.000	0.000	0.000	0.000
NODE 153	12.470	11.931	0.957	-11.83	0.000	0.000	0.000	0.000
NODE 201	12.470	12.265	0.984	-9.59	0.000	0.000	0.000	0.000
NODE 201A	12.470	12.288	0.985	-9.44	0.000	0.000	0.000	0.000
NODE 204	12.470	12.244	0.982	-9.71	0.000	0.000	0.000	0.000
NODE 206	12.470	12.244	0.982	-9.71	0.000	0.000	0.000	0.000
NODE 210	12.470	12.239	0.981	-9.79	0.000	0.000	0.000	0.000
NODE 301	12.470	12.269	0.984	-9.57	0.000	0.000	0.000	0.000
NODE 304	12.470	12.256	0.983	-9.66	1.887	0.473	1.946	0.970
NODE 322	12.470	12.282	0.985	-9.48	0.473	0.119	0.488	0.970
NODE 401	12.470	12.286	0.985	-9.46	0.000	0.000	0.000	0.000
NODE1	12.470	12.288	0.985	-9.44	0.000	0.000	0.000	0.000
NODE_A	12.470	11.945	0.958	-10.00	0.000	0.000	0.000	0.000
OUT-TIE	12.470	12.127	0.972	-7.39	0.000	0.000	0.000	0.000
PARALLEL SWITCH	12.470	12.039	0.965	-4.68	0.000	0.000	0.000	0.000
ROUNDAABOUT	69.000	68.102	0.987	-4.86	0.000	0.000	0.000	0.000
SEARCH HOSP	12.470	12.062	0.967	-10.11	3.208	0.804	3.307	0.970
SEWARD AVE	12.470	12.083	0.969	-10.10	0.461	0.116	0.476	0.970

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Load Summary Report (continued)

Bus		Solution						
Name	Base kV	kV	Vpu	Deg	MW	MVAR	MVA	PF
SMCV_TAP	69.000	69.300	1.004	-3.67	2.813	1.362	3.125	0.900
SW-121	12.470	11.909	0.955	-10.31	0.992	0.249	1.023	0.970
SW-123	12.470	12.218	0.980	-9.90	1.972	0.494	2.033	0.970
SW-125	12.470	12.176	0.976	-10.01	0.000	0.000	0.000	0.000
SW-126	12.470	12.141	0.974	-10.05	0.000	0.000	0.000	0.000
SW-127	12.470	12.282	0.985	-9.48	0.000	0.000	0.000	0.000
SW-130	12.470	12.232	0.981	-9.77	0.763	0.191	0.787	0.970
SWGR INCOMING	12.470	12.291	0.986	-9.42	0.000	0.000	0.000	0.000
T1-H	69.000	70.318	1.019	-2.81	0.000	0.000	0.000	0.000
T1-L	12.470	12.129	0.973	-7.39	0.000	0.000	0.000	0.000
T1-L_A	6.900	7.030	1.019	-0.06	0.000	0.000	0.000	0.000
T2-H	69.000	68.277	0.990	-4.68	0.000	0.000	0.000	0.000
T2-L	12.470	12.039	0.965	-4.68	0.000	0.000	0.000	0.000
TIE BUS	69.000	68.277	0.990	-4.68	0.000	0.000	0.000	0.000
TOWN HATCHERY	12.470	12.282	0.985	-9.48	0.000	0.000	0.000	0.000
TRANS	12.470	12.197	0.978	-9.83	0.000	0.000	0.000	0.000
YARD XFMR H	69.000	68.067	0.986	-4.90	0.000	0.000	0.000	0.000
YARD XFMR L	12.470	12.292	0.986	-9.42	0.000	0.000	0.000	0.000

System Summary Report

Total	MW	MVAR	MVA	PF
Generation in System	31.966	13.717	34.784	0.919
Load in System	31.080	8.087	32.114	0.968
Shunt Load in System	-0.000	-0.000		
Losses in System	0.886	5.630		
Check of Balance	0.000	-0.000		

Transformer Tap Report

Transformer Name	Connection		Base kV		Tap kV		LTC Description							
	From Bus Name	To Bus Name	From	To	From	To	Type	LTC	LTC Type	Control Side	LTC Side	Control Value pu	Limits Min kV	Limits Max kV
BUS-TIE	BUS-TIE-H	BUS-TIE-L	12.470	12.470	12.470	12.470	2Wnd	No						
T1	TIE BUS	T1-L	69.000	12.470	69.000	12.470	2Wnd	No						
T1_A	T1-H	T1-L_A	69.000	6.900	70.725	6.900	2Wnd	No						
T1_MARINE	YARD XFMR H	YARD XFMR L	69.000	12.470	69.000	12.800	2Wnd	No						
T2	T2-H	T2-L	69.000	12.470	70.725	12.470	2Wnd	No						
XF-BL-T1	BL-T1	BUS-XF-BL-T1	69.000	12.470	70.725	12.470	2Wnd	No						
XF-BL-T2	BL-T2	BUS-XF-BL-T2	69.000	12.470	70.725	12.470	2Wnd	No						
XF-BL_T4	BUS-0605	BUS-0475	12.470	12.470	12.470	12.470	2Wnd	No						
XF-FV-01	BUS-FVU-HV	BUS-FVU_BKR	12.470	4.160	12.470	4.160	2Wnd	No						

Voltage Violation Report

Limits (MAX: 1.05, Min: 0.95)

Bus Name	Base kV	Vpu	kV
1330 END	12.470	0.948	11.821

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Line Overload Report

Overload Threshold = 0.00 %

Line				Load			
From Bus Name	To Bus Name	Branch Name	Rated Amps	Load Amps	Loaded%	OverLoaded%	Comment
52-J7 IN	CNTL RM SWGR	BWY-3	1000.0	273.5	27.4%	-72.6%	
210S	210S2	TX-1210S2	600.0	94.7	15.8%	-84.2%	
210S2	NODE 149	TX-149	230.0	0.1	0.1%	-99.9%	
220S	NODE 204	C-_1_C	480.0	0.4	0.1%	-99.9%	
220S	220S_A	C-_1_E	480.0	96.0	20.0%	-80.0%	
220S_A	SW-123	TX-208	600.0	96.1	16.0%	-84.0%	
230S	SW-130	C-101_Q	295.0	82.6	28.0%	-72.0%	
250S	SW-125	C-SEA	350.0	270.4	77.3%	-22.7%	
330S	1330 END	TX-1310_E	600.0	44.9	7.5%	-92.5%	
1210 BOX TAP	NODE 101A	C-101_A	480.0	189.8	39.5%	-60.5%	
1220 BOX TAP	NODE 201A	C-_1_A	480.0	237.8	49.5%	-50.5%	
1230 BOX TAP	NODE 301	TX-1210S_C	600.0	174.0	29.0%	-71.0%	
1240 BOX TAP	NODE 401	TX-121SW	600.0	22.9	3.8%	-96.2%	
1250 BOX TAP	NODE1	C-101_R	480.0	270.4	56.3%	-43.7%	
AQUATIC	MT EDGEComb	C-126 GREEN_A	150.0	45.3	30.2%	-69.8%	
BL-T1	BL-T2	CBL-DUMMY_0471	1360.0	103.7	7.6%	-92.4%	
BLUE LAKE TIE	TIE BUS	C-20	675.0	255.3	37.8%	-62.2%	
BLUE LAKE TIE	SMCV_TAP	TL-JAR-BL	530.0	255.3	48.2%	-51.8%	
BUS-BL-01	BUS-BL_GEN4_CUB	CBL-HGBL2	1090.0	397.6	36.5%	-63.5%	
BUS-BL-01	BUS-XF-BL-T1	CBL-T152T1-P	790.0	417.4	52.8%	-47.2%	
BUS-BL-01	BUS-BL_GEN3_CUB	CBL-HGBL1	1090.0	397.7	36.5%	-63.5%	
BUS-BL-02	BUS-0505	CBL-524T4-P1	545.0	45.4	8.3%	-91.7%	
BUS-BL-02	BUS-BL-01	CBL-BL-52-TIE	1200.0	378.2	31.5%	-68.5%	
BUS-FVU-06	BUS-0475	BL-FV	300.0	45.4	15.1%	-84.9%	
BUS-FVU-HV	BUS-FVU-HV_O	BL-FV_B	300.0	45.4	15.1%	-84.9%	
BUS-FVU-HV_O	BUS-FVU-06	BL-FV_A	300.0	45.4	15.1%	-84.9%	
BUS-FVU_BKR	BUS-FVU_TERMINAL	TEMP3	280.0	136.0	48.6%	-51.4%	
BUS-TIE-L	JARV SWGR BUS	C-22	395.0	273.5	69.3%	-30.7%	
BUS-XF-BL-T2	BUS-BL-02	CBL-T252T1-P	790.0	418.6	53.0%	-47.0%	
BYPASS1	BYPASS2	CBL-DUMMY_0471_A	1360.0	103.7	7.6%	-92.4%	
BYPASS2	T1-H	TL-GL-BL	530.0	133.8	25.2%	-74.8%	
CNTL RM SWGR	OUT-TIE	C-2_D	675.0	273.5	40.5%	-59.5%	
D5 SWGR	DT 104	C-16	1070.0	0.0	0.0%	-100.0%	
DT 104	PARALLEL SWITCH	C-8	675.0	0.1	0.0%	-100.0%	
DUMMY	MARINE ST SWGR	BWY-2	2000.0	1110.5	55.5%	-44.5%	
FDR 1210	1210 BOX TAP	C-101_M	480.0	286.1	59.6%	-40.4%	
FDR 1220	1220 BOX TAP	C-_1	480.0	237.8	49.5%	-50.5%	
FDR 1230	1230 BOX TAP	C-_1_F	480.0	242.9	50.6%	-49.4%	
FDR 1240	1240 BOX TAP	C-_1_G	480.0	50.5	10.5%	-89.5%	
FDR 1250	1250 BOX TAP	C-_1_H	480.0	293.3	61.1%	-38.9%	
FDR 1260	1260 BOX TAP	C-_1_J	480.0	0.0	0.0%	-100.0%	
FDR 1310	NODE	C-_1_J	480.0	93.9	19.6%	-80.4%	
FDR 1330	NODE_A	C-_1_K	480.0	179.9	37.5%	-62.5%	
G1-SWGR-OUT	G1	C-3_C	585.0	959.3	164.0%	64.0% VIOLATION	
G2-SWGR-OUT	G2	C-3_E	585.0	404.2	69.1%	-30.9%	
INDUSTRIAL	330S	TX-1310_D	600.0	44.9	7.5%	-92.5%	
JARV SWGR BUS	FDR 1310	C-7	675.0	93.9	13.9%	-86.1%	
JARV SWGR BUS	FDR 1330	C-7_B	480.0	179.9	37.5%	-62.5%	
JARV SWGR BUS	GRD-XFMR-OUT	C-7_C	675.0	0.0	0.0%	-100.0%	
LAKE_TRANS	230S	C-101_O	480.0	82.4	17.2%	-82.8%	
MARINE ST	ROUNDAABOUT	TL-JAR-MARINE	530.0	206.0	38.9%	-61.1%	
MARINE ST SWGR	FDR 1230	BWY-1_J	1000.0	242.9	24.3%	-75.7%	
MARINE ST SWGR	FDR 1220	BWY-1_H	1000.0	237.8	23.8%	-76.2%	
MARINE ST SWGR	FDR 1240	BWY-1_J	1000.0	50.5	5.0%	-95.0%	
MARINE ST SWGR	FDR 1260	BWY-1_L	1000.0	0.0	0.0%	-100.0%	
MARINE ST SWGR	FDR 1250	BWY-1_K	1000.0	293.3	29.3%	-70.7%	

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Line Overload Report (continued)

Overload Threshold = 0.00 %

Line				Load			
From Bus Name	To Bus Name	Branch Name	Rated Amps	Load Amps	Loaded%	OverLoaded%	Comment
MARINE ST SWGR	FDR 1210	BWY-1_G	1000.0	286.1	28.6%	-71.4%	
MARINE ST TIE	T2-H	C-20_A	675.0	205.9	30.5%	-69.5%	
MT EDGECOMB	SEWARD AVE	C-126 GREEN_B	150.0	22.6	15.1%	-84.9%	
NODE	SW-121	TX-1310	600.0	93.9	15.7%	-84.3%	
NODE 101	210S	TX-1210S	600.0	190.0	31.7%	-68.3%	
NODE 101A	NODE 101B	TX-1210S_A	340.0	189.8	55.8%	-44.2%	
NODE 101B	NODE 101	C-101_N	480.0	189.8	39.5%	-60.5%	
NODE 108	HIGHSCHOOL	TX-1310_C	600.0	44.8	7.5%	-92.5%	
NODE 108	LAKE ST	TX-1310_B	600.0	0.0	0.0%	-100.0%	
NODE 149	NODE 153	TX-153	180.0	0.0	0.0%	-100.0%	
NODE 201	220S	C-_1_B	480.0	237.8	49.5%	-50.5%	
NODE 201A	NODE 201	TX-1210S_B	600.0	237.8	39.6%	-60.4%	
NODE 204	NODE 206	C-_1_D	480.0	0.1	0.0%	-100.0%	
NODE 210	250S	TX-121SW_F	600.0	270.4	45.1%	-54.9%	
NODE 301	KAAGWAANTAAN	TX-1210S_E	600.0	0.0	0.0%	-100.0%	
NODE 301	NODE 304	TX-1210S_D	600.0	174.0	29.0%	-71.0%	
NODE 304	LAKE_TRANS	C-101_P	570.0	82.4	14.5%	-85.5%	
NODE 322	SW-127	TX-121SW_C	340.0	0.0	0.0%	-100.0%	
NODE 322	TOWN HATCHERY	TX-121SW_D	340.0	0.0	0.0%	-100.0%	
NODE 401	NODE 322	TX-121SW_B	340.0	22.9	6.7%	-93.3%	
NODE1	NODE 210	TX-121SW_E	600.0	270.4	45.1%	-54.9%	
NODE_A	INDUSTRIAL	TX-1310_F	600.0	179.9	30.0%	-70.0%	
OUT-TIE	BUS-TIE-H	C-21	395.0	273.5	69.2%	-30.8%	
ROUNDABOUT	MARINE ST TIE	TL-JAR-ROUND	530.0	206.0	38.9%	-61.1%	
SMCV_TAP	BYPASS1	TL-JAR-BL_A	530.0	280.8	53.0%	-47.0%	
SW-121	NODE 108	TX-1310_A	600.0	44.8	7.5%	-92.5%	
SW-125	SW-126	C-101_J	150.0	270.5	180.3%	80.3% VIOLATION	
SW-126	SEARCH HOSP	C-126 ORANGE	150.0	158.2	105.5%	5.5% VIOLATION	
SW-126	BOILERS - FUTURE	C-126 YELLOW	150.0	0.3	0.2%	-99.8%	
SW-126	AQUATIC	C-126 GREEN	150.0	112.5	75.0%	-25.0%	
T1-L	52-J7 IN	C-1	480.0	273.5	57.0%	-43.0%	
T1-L_A	G2-SWGR-IN	C-1_D	585.0	404.3	69.1%	-30.9%	
T1-L_A	G1-SWGR-IN	C-1_A	585.0	959.3	164.0%	64.0% VIOLATION	
T2-L	DT 102	C-15	1350.0	0.2	0.0%	-100.0%	
TRANS	SW-130	TX-121SW_H	180.0	45.5	25.3%	-74.7%	
TRANS	AIRPORT	C-101_E	145.0	45.5	31.4%	-68.6%	
YARD XFMR L	SWGR INCOMING	C-1_B	1755.0	1110.5	63.3%	-36.7%	

Transformer Overload Report

Overload Threshold = 0.00 %

Transformer				Load			
Name	From Bus Name	To Bus Name	Rated Amps	Load Amps	Loaded%	OverLoaded%	Comment
BUS-TIE	BUS-TIE-H	BUS-TIE-L	434.1	273.5	63.0%	-37.0%	
T1	TIE BUS	T1-L	578.7	273.5	47.3%	-52.7%	
T1_A	T1-H	T1-L_A	1874.3	1363.3	72.7%	-27.3%	
T1_MARINE	YARD XFMR H	YARD XFMR L	1037.1	1110.5	107.1%	7.1% VIOLATION	
T2	T2-H	T2-L	926.0	0.2	0.0%	-100.0%	
XF-BL-T1	BL-T1	BUS-XF-BL-T1	740.8	417.5	56.4%	-43.6%	
XF-BL-T2	BL-T2	BUS-XF-BL-T2	740.8	418.6	56.5%	-43.5%	
XF-BL_T4	BUS-0505	BUS-0475	69.4	45.4	65.3%	-34.7%	
XF-FV-01	BUS-FVU-HV	BUS-FVU_BKR	208.2	136.0	65.4%	-34.6%	

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Branch Losses Report

From Bus		To Bus		Losses	
Name	Base kV	Name	Base kV	MW	MVAR
52-J7 IN	12.470	CNTL RM SWGR	12.470	0.000	0.000
210S	12.470	210S2	12.470	0.012	0.033
210S2	12.470	NODE 149	12.470	0.000	0.002
220S	12.470	NODE 204	12.470	0.000	0.005
220S	12.470	220S_A	12.470	0.000	0.000
220S_A	12.470	SW-123	12.470	0.003	0.007
230S	12.470	SW-130	12.470	0.001	0.004
250S	12.470	SW-125	12.470	0.018	0.005
330S	12.470	1330 END	12.470	0.003	0.006
1210 BOX TAP	12.470	NODE 101A	12.470	0.000	0.000
1220 BOX TAP	12.470	NODE 201A	12.470	0.001	0.000
1230 BOX TAP	12.470	NODE 301	12.470	0.004	0.011
1240 BOX TAP	12.470	NODE 401	12.470	0.000	0.000
1250 BOX TAP	12.470	NODE1	12.470	0.001	0.001
AQUATIC	12.470	MT EDGECOMB	12.470	0.001	0.003
BL-T1	69.000	BL-T2	69.000	0.000	0.000
BL-T1	69.000	BUS-XF-BL-T1	12.470	0.032	0.586
BL-T2	69.000	BUS-XF-BL-T2	12.470	0.032	0.586
BLUE LAKE TIE	69.000	SMCV_TAP	69.000	0.253	0.523
BLUE LAKE TIE	69.000	TIE BUS	69.000	0.000	0.001
BUS-0505	12.470	BUS-0475	12.470	0.006	0.035
BUS-BL-01	12.470	BUS-XF-BL-T1	12.470	0.004	0.000
BUS-BL-01	12.470	BUS-BL_GEN4_CUB	12.470	0.001	0.001
BUS-BL-01	12.470	BUS-BL_GEN3_CUB	12.470	0.000	0.000
BUS-BL-02	12.470	BUS-0505	12.470	0.000	0.003
BUS-BL-02	12.470	BUS-BL-01	12.470	0.000	0.000
BUS-FVU-06	12.470	BUS-0475	12.470	0.005	0.005
BUS-FVU-HV	12.470	BUS-FVU_BKR	4.160	0.008	0.051
BUS-FVU-HV	12.470	BUS-FVU-HV_O	12.470	0.000	0.000
BUS-FVU-HV_O	12.470	BUS-FVU-06	12.470	0.000	0.000
BUS-FVU_BKR	4.160	BUS-FVU_TERMINAL	4.160	0.000	0.000
BUS-TIE-H	12.470	BUS-TIE-L	12.470	0.018	0.268
BUS-TIE-L	12.470	JARV SWGR BUS	12.470	0.001	0.001
BUS-XF-BL-T2	12.470	BUS-BL-02	12.470	0.004	0.000
BYPASS1	69.000	BYPASS2	69.000	0.000	0.000
BYPASS2	69.000	T1-H	69.000	0.120	0.072
CNTL RM SWGR	12.470	OUT-TIE	12.470	0.000	0.000
D5 SWGR	12.470	DT 104	12.470	0.000	0.003
DT 104	12.470	PARALLEL SWITCH	12.470	0.000	0.000
DUMMY	12.470	MARINE ST SWGR	12.470	0.000	0.000
FDR 1210	12.470	1210 BOX TAP	12.470	0.000	0.000
FDR 1220	12.470	1220 BOX TAP	12.470	0.000	0.000
FDR 1230	12.470	1230 BOX TAP	12.470	0.000	0.000
FDR 1240	12.470	1240 BOX TAP	12.470	0.000	0.000
FDR 1250	12.470	1250 BOX TAP	12.470	0.000	0.000
FDR 1260	12.470	1260 BOX TAP	12.470	0.000	0.000
FDR 1310	12.470	NODE	12.470	0.000	0.001
FDR 1330	12.470	NODE_A	12.470	0.000	0.000
G1-SWGR-OUT	6.900	G1	6.900	0.001	0.002
G2-SWGR-OUT	6.900	G2	6.900	0.000	0.001
INDUSTRIAL	12.470	330S	12.470	0.000	0.000
JARV SWGR BUS	12.470	FDR 1330	12.470	0.000	0.000
JARV SWGR BUS	12.470	FDR 1310	12.470	0.000	0.000
JARV SWGR BUS	12.470	GRD-XFMR-OUT	12.470	0.000	0.000
LAKE_TRANS	12.470	230S	12.470	0.001	0.012
MARINE ST	69.000	ROUNDAABOUT	69.000	0.007	0.013

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Branch Losses Report (continued)

From Bus		To Bus		Losses	
Name	Base kV	Name	Base kV	MW	MVAR
MARINE ST SWGR	12.470	FDR 1220	12.470	0.000	0.000
MARINE ST SWGR	12.470	FDR 1250	12.470	0.000	0.000
MARINE ST SWGR	12.470	FDR 1260	12.470	0.000	0.000
MARINE ST SWGR	12.470	FDR 1230	12.470	0.000	0.000
MARINE ST SWGR	12.470	FDR 1240	12.470	0.000	0.000
MARINE ST SWGR	12.470	FDR 1210	12.470	0.000	0.000
MARINE ST TIE	69.000	T2-H	69.000	0.000	0.001
MT EDGECOMB	12.470	SEWARD AVE	12.470	0.001	0.012
NODE	12.470	SW-121	12.470	0.004	0.011
NODE 101	12.470	210S	12.470	0.033	0.094
NODE 101A	12.470	NODE 101B	12.470	0.007	0.011
NODE 101B	12.470	NODE 101	12.470	0.007	0.002
NODE 108	12.470	LAKE ST	12.470	0.000	0.000
NODE 108	12.470	HIGHSCHOOL	12.470	0.001	0.002
NODE 149	12.470	NODE 153	12.470	0.000	0.001
NODE 201	12.470	220S	12.470	0.006	0.003
NODE 201A	12.470	NODE 201	12.470	0.006	0.015
NODE 204	12.470	NODE 206	12.470	0.000	0.003
NODE 210	12.470	250S	12.470	0.006	0.015
NODE 301	12.470	KAAGWAANTAAN	12.470	0.000	0.000
NODE 301	12.470	NODE 304	12.470	0.002	0.006
NODE 304	12.470	LAKE_TRANS	12.470	0.000	0.004
NODE 322	12.470	TOWN HATCHERY	12.470	0.000	0.000
NODE 322	12.470	SW-127	12.470	0.000	0.000
NODE 401	12.470	NODE 322	12.470	0.000	0.000
NODE1	12.470	NODE 210	12.470	0.015	0.039
NODE_A	12.470	INDUSTRIAL	12.470	0.011	0.030
OUT-TIE	12.470	BUS-TIE-H	12.470	0.001	0.001
ROUNDAABOUT	69.000	MARINE ST TIE	69.000	0.035	0.063
SMCV_TAP	69.000	BYPASS1	69.000	0.007	0.014
SW-121	12.470	NODE 108	12.470	0.000	0.001
SW-125	12.470	SW-126	12.470	0.016	0.005
SW-126	12.470	SEARCH HOSP	12.470	0.020	0.003
SW-126	12.470	BOILERS - FUTURE	12.470	0.000	0.006
SW-126	12.470	AQUATIC	12.470	0.003	0.000
T1-H	69.000	T1-L_A	6.900	0.040	0.883
T1-L	12.470	52-J7 IN	12.470	0.000	0.000
T1-L_A	6.900	G2-SWGR-IN	6.900	0.001	0.002
T1-L_A	6.900	G1-SWGR-IN	6.900	0.006	0.014
T2-H	69.000	T2-L	12.470	0.000	0.000
T2-L	12.470	DT 102	12.470	0.000	0.001
TIE BUS	69.000	T1-L	12.470	0.017	0.291
TRANS	12.470	AIRPORT	12.470	0.006	0.010
TRANS	12.470	SW-130	12.470	0.003	0.001
YARD XFMR H	69.000	YARD XFMR L	12.470	0.090	1.995
YARD XFMR L	12.470	SWGR INCOMING	12.470	0.001	0.001
Total System Losses				0.886	5.630

Voltage Drop Report

From Bus		To Bus		Drop
Name	Base kV	Name	Base kV	%
52-J7 IN	12.470	CNTL RM SWGR	12.470	0.0%
210S	12.470	210S2	12.470	1.0%
210S2	12.470	NODE 149	12.470	-0.0%
220S	12.470	NODE 204	12.470	-0.0%

Power Flow Summary Report

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 EasyPower LLC.
 Comments : Japonski Addition

Voltage Drop Report (continued)

From Bus		To Bus		Drop
Name	Base kV	Name	Base kV	%
220S	12.470	220S_A	12.470	0.0%
220S_A	12.470	SW-123	12.470	0.2%
230S	12.470	SW-130	12.470	0.1%
250S	12.470	SW-125	12.470	0.4%
330S	12.470	1330 END	12.470	0.5%
1210 BOX TAP	12.470	NODE 101A	12.470	0.0%
1220 BOX TAP	12.470	NODE 201A	12.470	0.0%
1230 BOX TAP	12.470	NODE 301	12.470	0.2%
1240 BOX TAP	12.470	NODE 401	12.470	0.0%
1250 BOX TAP	12.470	NODE1	12.470	0.0%
AQUATIC	12.470	MT EDGECOMB	12.470	0.1%
BL-T1	69.000	BUS-XF-BL-T1	12.470	-0.0%
BL-T1	69.000	BL-T2	69.000	-0.0%
BL-T2	69.000	BUS-XF-BL-T2	12.470	0.0%
BLUE LAKE TIE	69.000	TIE BUS	69.000	0.0%
BLUE LAKE TIE	69.000	SMCV_TAP	69.000	-1.5%
BUS-0505	12.470	BUS-0475	12.470	-0.3%
BUS-BL-01	12.470	BUS-BL_GEN3_CUB	12.470	-0.0%
BUS-BL-01	12.470	BUS-BL_GEN4_CUB	12.470	-0.0%
BUS-BL-01	12.470	BUS-XF-BL-T1	12.470	0.1%
BUS-BL-02	12.470	BUS-0505	12.470	-0.0%
BUS-BL-02	12.470	BUS-BL-01	12.470	-0.0%
BUS-FVU-06	12.470	BUS-0475	12.470	0.5%
BUS-FVU-HV	12.470	BUS-FVU_BKR	4.160	-0.7%
BUS-FVU-HV	12.470	BUS-FVU-HV_O	12.470	0.0%
BUS-FVU-HV_O	12.470	BUS-FVU-06	12.470	0.0%
BUS-FVU_BKR	4.160	BUS-FVU_TERMINAL	4.160	-0.0%
BUS-TIE-H	12.470	BUS-TIE-L	12.470	1.4%
BUS-TIE-L	12.470	JARV SWGR BUS	12.470	0.0%
BUS-XF-BL-T2	12.470	BUS-BL-02	12.470	-0.1%
BYPASS1	69.000	BYPASS2	69.000	-0.0%
BYPASS2	69.000	T1-H	69.000	-1.4%
CNTLRM SWGR	12.470	OUT-TIE	12.470	0.0%
D5 SWGR	12.470	DT 104	12.470	0.0%
DT 104	12.470	PARALLEL SWITCH	12.470	0.0%
DUMMY	12.470	MARINE ST SWGR	12.470	0.0%
FDR 1210	12.470	1210 BOX TAP	12.470	0.0%
FDR 1220	12.470	1220 BOX TAP	12.470	0.0%
FDR 1230	12.470	1230 BOX TAP	12.470	0.0%
FDR 1240	12.470	1240 BOX TAP	12.470	0.0%
FDR 1250	12.470	1250 BOX TAP	12.470	0.0%
FDR 1260	12.470	1260 BOX TAP	12.470	-0.0%
FDR 1310	12.470	NODE	12.470	0.0%
FDR 1330	12.470	NODE_A	12.470	0.0%
G1-SWGR-OUT	6.900	G1	6.900	-0.0%
G2-SWGR-OUT	6.900	G2	6.900	-0.0%
INDUSTRIAL	12.470	330S	12.470	0.0%
JARV SWGR BUS	12.470	FDR 1310	12.470	0.0%
JARV SWGR BUS	12.470	FDR 1330	12.470	0.0%
JARV SWGR BUS	12.470	GRD-XFMR-OUT	12.470	-0.0%
LAKE_TRANS	12.470	230S	12.470	0.1%
MARINE ST	69.000	ROUNDABOUT	69.000	-0.1%
MARINE ST SWGR	12.470	FDR 1210	12.470	0.0%
MARINE ST SWGR	12.470	FDR 1220	12.470	0.0%
MARINE ST SWGR	12.470	FDR 1230	12.470	0.0%
MARINE ST SWGR	12.470	FDR 1240	12.470	0.0%

Power Flow Summary Report

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 EasyPower LLC.
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Voltage Drop Report (continued)

From Bus		To Bus		Drop
Name	Base kV	Name	Base kV	%
MARINE ST SWGR	12.470	FDR 1250	12.470	0.0%
MARINE ST SWGR	12.470	FDR 1260	12.470	-0.0%
MARINE ST TIE	69.000	T2-H	69.000	-0.0%
MT EDGECOMB	12.470	SEWARD AVE	12.470	0.2%
NODE	12.470	SW-121	12.470	0.3%
NODE 101	12.470	210S	12.470	1.4%
NODE 101A	12.470	NODE 101B	12.470	0.2%
NODE 101B	12.470	NODE 101	12.470	0.3%
NODE 108	12.470	LAKE ST	12.470	-0.0%
NODE 108	12.470	HIGHSCHOOL	12.470	0.1%
NODE 149	12.470	NODE 153	12.470	-0.0%
NODE 201	12.470	220S	12.470	0.2%
NODE 201A	12.470	NODE 201	12.470	0.2%
NODE 204	12.470	NODE 206	12.470	-0.0%
NODE 210	12.470	250S	12.470	0.1%
NODE 301	12.470	NODE 304	12.470	0.1%
NODE 301	12.470	KAAGWAANTAAN	12.470	-0.0%
NODE 304	12.470	LAKE_TRANS	12.470	0.0%
NODE 322	12.470	SW-127	12.470	-0.0%
NODE 322	12.470	TOWN HATCHERY	12.470	-0.0%
NODE 401	12.470	NODE 322	12.470	0.0%
NODE1	12.470	NODE 210	12.470	0.4%
NODE_A	12.470	INDUSTRIAL	12.470	0.5%
OUT-TIE	12.470	BUS-TIE-H	12.470	0.0%
ROUNDAABOUT	69.000	MARINE ST TIE	69.000	-0.3%
SMCV_TAP	69.000	BYPASS1	69.000	-0.0%
SW-121	12.470	NODE 108	12.470	0.0%
SW-125	12.470	SW-126	12.470	0.3%
SW-126	12.470	SEARCH HOSP	12.470	0.6%
SW-126	12.470	BOILERS - FUTURE	12.470	-0.0%
SW-126	12.470	AQUATIC	12.470	0.1%
T1-H	69.000	T1-L_A	6.900	0.0%
T1-L	12.470	52-J7 IN	12.470	0.0%
T1-L_A	6.900	G1-SWGR-IN	6.900	-0.1%
T1-L_A	6.900	G2-SWGR-IN	6.900	-0.0%
T2-H	69.000	T2-L	12.470	2.4%
T2-L	12.470	DT 102	12.470	-0.0%
TIE BUS	69.000	T1-L	12.470	1.7%
TRANS	12.470	AIRPORT	12.470	0.7%
TRANS	12.470	SW-130	12.470	-0.3%
YARD XFMR H	69.000	YARD XFMR L	12.470	0.1%
YARD XFMR L	12.470	SWGR INCOMING	12.470	0.0%