Energy Options Analysis Project

Final Report

Bear River Band of Rohnerville Rancheria

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Executive Summary

This Bear River Band of Rohnerville Rancheria (BRB) Energy Options Analysis Project provides a rigorous and comprehensive near-term renewable energy implementation plan that aligns with the BRB's long term strategic vision of "zero net annual utility energy consumption." Final recommendations were arrived at by following four key project phases:

1. A gas and electricity load assessment was conducted for all existing buildings using historic consumption data, and projected loads of new or anticipated buildings using building designs.
2. A renewable energy resource assessment was conducted that estimated the gross generation potential of solar and wind, constrained to areas that could potentially be developed. Other renewable generation technologies were not considered feasible to meet the loads of the BRB.
3. Demand-side efficiency and fuel switching opportunities were identified that can reduce electrical and gas consumption. These opportunities were not integrated into the load assessment in order to provide a conservative implementation plan, but are recommended to be pursued in order to cost-optimize projects during a feasibility assessment.
4. A strategic vision advisory committee was organized and consulted when iterating on the viability of possible projects.

These project phases resulted in finalizing the following three solar PV projects for the near term, which also lay the foundation for a future community-scale or multiple-facility microgrid for added resiliency:

- Additional solar PV on the hillside south of the Tish-Non Community Center. Through a NEM2A utility account this would offset up to 100% of the existing electrical demand at the Wastewater Treatment Plant and Family Entertainment Center. It is also recommended that the BRB consider including the already planned solar PV for the Recreation Center in this NEM2A account.
- Solar plus battery storage microgrid at the Pump & Play fuel station. This would offset up to 17% of the facility's demand, and offer resilience during grid outages that will sustain the critical services that this fueling station provides to the community. This can be implemented in a phased approach if there are funding constraints.
- Solar PV at the Casino. This would offset up to 56% of the existing electrical demand of the Casino. This can be implemented in a phased approach if there are funding constraints.

These projects fall within the design constraints of the strategic advisory committee while transitioning an estimated 36% of the total existing electricity load of these facilities to local renewable generation. Furthermore, while BRB pursues funding for a feasibility assessment of these projects, it is recommended that the BRB begin the following tasks immediately:

- Implement the demand-side efficiency and fuel switching recommendations
- Initiate the interconnection process with PG&E, and submit a NEM interconnection pre-application report request.

List of Acronyms[1]

kilowatt (kW) - a measure of 1,000 watts of electrical power.

kilowatt hours (kWh) - a measure of electrical energy equivalent to a power consumption of 1,000 watts for 1 hour. A customer is charged by the utility based on the number of kilowatt hours of energy consumed.

Therm - a unit of measurement for the amount of natural gas consumed. It is a unit of heat energy equal to 100000 British thermal units (Btu). It is approximately the energy equivalent of burning 100 cubic feet – often referred to as 1 CCF – of natural gas

Net metering (also known as net energy metering or NEM) is a solar incentive that allows you to store energy in the electric grid. When your solar panels produce more electricity than you need, that energy is sent to the grid in exchange for credits.

[1] https://en.wikipedia.org/wiki/

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Project Overview

This Bear River Band of Rohnerville Rancheria (BRB) Energy Options Analysis provides a detailed assessment of energy solutions and a comprehensive implementation plan for moving toward development of energy sufficiency in alignment with the BRB's strategic vision of "zero net annual utility energy consumption." The objective of this effort is a comprehensive analysis resulting in a thorough understanding of BRB's energy resources and loads, including current and projected future energy consumption. This analysis encompasses "demand-side" options that reduce energy consumption, and local commercially viable and renewable "supply-side" options. The identified opportunities were reviewed by a tribal advisory committee to ensure options are in alignment with the BRB's strategic vision of energy self-sufficiency for the tribal community.

Background

The Bear River Tribe was originally established in 1910 as a home for homeless, landless Native American Indians. In 1958 Rohnerville Rancheria was one of 34 California tribes that was terminated by an act of congress known as the Rancheria Act. In December of 1983, the Bear River Band of Rohnerville Rancheria, along with sixteen (16) other California Tribes, regained their federal recognition status by a class action lawsuit known as the Tillie-Hardwick case. The United States granted Federal recognition to the Tribe as a result of the lawsuit, but it did not provide the Tribe with compensation for the land, resources, rights and heritage/culture that was taken from them. Tribal Chairpersons lobbied Congress to get funds set-aside for three years for the Tribe.

In 2009, the Tribe's Environmental and Natural Resources department implemented a Wind Turbine pilot project to test the feasibility of the wind power around the Tribe's core Reservation lands. This led to the installation of a 10kW wind turbine that has since been successfully operated and maintained by the Tribe's Environmental and Natural Resources department. The wind project was further studied by the Tribe in partnership with Humboldt State University (HSU) who conducted a technical and economic feasibility analysis for the development of wind energy resources on the Rancheria. In 2014, the Tribe contracted with TWN Wind Power to assess wind resources feasibility to achieve the community's goals of self-sufficiency and sustainability. TWN examined how small-scale distributed wind energy generation projects would benefit the Tribal community and provided an assessment of the average annual wind speeds on the Reservation and advised on which areas to consider for future distributed wind energy projects.

In 2014, the Tribe developed an Energy Development Plan facilitated and documented for the Department of Energy (DOE), Office of Indian Energy (IE) through Sandia National Laboratories by Indigenous Collaboration. That Plan contains the Bear River Tribes Energy vision. The Bear River Tribe's subsequent vision and mission are as follows:

> *"The vision of the Bear River Band of Rohnerville Rancheria is shaping a secure healthy future by responsibly exercising sovereignty, investing in our people, refining and evolving as a tribal organization, preserving and revitalizing our culture while serving the best interests of all people."*

> *"The mission of Bear River Band of Rohnerville Rancheria is to promote balance between quality of life, self-sufficiency, sustainability and cultural awareness for Bear River."*

In 2015 the Tribe contracted with JLM Energy to install 400 solar panels and 20 small wind turbines. This project offsets energy usage of the Tish Non Community Center. The max output of the solar panels is 100kw per day and the max output for the wind turbines is 35kw per day. In 2016 Tribal Council hired Redwood Energy to develop a Renewable Energy Sovereignty Master Plan for the Tribe. This Plan included a detailed energy audit, and an initial general high-level energy assessment which this analysis leverages and builds upon.

Project Approach

The overall project goal is to develop an analysis of renewable energy options that focus on the BRB's strategic vision of zero net annual utility energy consumption, and are in alignment with the BRB's Energy Development Strategic Plan. This will be achieved through a collaborative partnership between the Bear River Band and selected Consultant. BRB will oversee the project, engage with tribal stakeholders, and assist the selected Consultant with obtaining all information needed to complete the technical tasks of the project. The Consultant will be responsible for completing the technical work on this project.

In alignment with BRB's Energy Development Strategic Plan, the project team will:

- Expand on past energy assessments by developing current and future load profiles (demand and energy) of residential and commercial properties.
- Leverage and expand on recently identified demand-side reduction strategies by identifying additional behind-the-meter demand-side management opportunities.
- Leverage past renewable energy resource assessments using currently available data as well as available reputable resource assessment tools.
- Assist with the development of a tribal advisory committee that will guide the development of the identified energy options that best meet BRB's strategic vision.
- Assess the status of existing infrastructure on both sides of the utility meter regarding readiness for future renewable energy production development.
- Develop an implementation plan that packages this work into a comprehensive and actionable guide the Tribe can use to pursue future renewable energy development. This plan will consider microgrid design opportunities in addition to other potential energy options.

Project Tasks

The work identified above was carried out in the following set of tasks and are described in this report:

- Subtask 2.1: Building Load Assessment (Load Profiles)
- Subtask 2.2: Renewable Energy Resource Assessment
- Subtask 2.3: Demand-Side Management Opportunities
- Subtask 2.4: Existing Infrastructure and Renewable Energy Production Readiness Assessment
- Subtask 2.5: Formation of the Strategic Vision Advisory Committee
- Subtask 2.6: Energy Options Implementation Plan

Subtask 2.1: Building Load Assessment

A summary of activities and results from Task 2.1 Building Load Assessment are presented below. For additional details refer to the technical memo in Appendix A.

The purpose of the energy analysis work was to assess the electric and heating loads for the existing and planned residential and commercial properties in order to develop a future projected load profile for the Rancheria. The load profiles for both the individual properties and for the overall combined projected Rancheria load were used to identify the demand-side management opportunities that can optimize the Tribes energy use.

The analysis work was divided into the following subtasks:

- Review past energy assessment work.
- Review the estimated modelled energy use for residential properties.
- Perform an energy assessment of the existing commercial properties.
- Develop estimated load profiles for planned projects.
- Develop a projected combined load profile based on the results from the commercial, residential, and planned facilities analyses.
- Perform an assessment of the heating load for properties with available data.

Past Energy Assessments

A review of the 2016 Renewable Energy Sovereignty Master Plan developed by Redwood Energy and Freshwater Environmental Services provided background information on the Rancheria energy assessment work. The summary of their work is included in the technical memo.

Estimated Energy Use from Residential Homes

In the Redwood Energy assessment project, the homes were modelled to estimate residential energy consumption. The energy use presented in their baseline audit report was a total combined residential load of 279,298 kWh. Given how recent this work was done, SERC did not re-assess the home.

Energy Assessment of the Existing Commercial Properties

SERC analyzed the interval and billing history data sets to assess the energy consumption from the large commercial accounts. Graphs of the average hourly and peak demand load profile and average monthly energy use were developed for the existing commercial properties

The results of the energy assessment showed a total annual average energy use of 4,649,129 kWh for all commercial facilities with a total peak demand of 906 kW if all facilities were using peak power simultaneously). As shown, the Casino and Hotel together account for the largest portion (71%) of the total energy use and have a combined peak power demand of 592 kW.

Table 1: Energy Use (kWh) and Peak Demand (kW) for Existing Commercial Loads

Facility	*Energy Use 2015*	*Energy Use 2016*	*Energy Use *2017*	*Average Energy Use*	*% of Total*	*Peak Demand*
Casino	2,297,488	2,271,445	2,251,274	2,273,402	48.9%	381
Hotel	1,050,768	1,026,652	1,056,911	1,044,777	22.5%	211
Pump & Play	363,080	355,530	336,339	351,650	7.6%	56
Tish Non Community Center		263,968	281,818	272,893	5.9%	52
Recreation Center			271,765	271,765	5.8%	67
Waste Water Treatment Plant			174,662	174,662	3.8%	48
Human Resources & Accounting	76,701	82,219	71,502	76,808	1.7%	19
WUSA Singley Hill	62,547	72,135	73,305	69,329	1.5%	43
Billboard	57,779	54,298	51,145	54,407	1.2%	11
Tobacco Traders & Coffee Co.	52,736	52,725	50,204	51,888	1.1%	13
Gaming Office	6,332	7,308	9,005	7,548	0.2%	5
* the last 12 months of data			**Totals**	**4,649,129**	100%	**906**

Estimated Energy Use from Planned Projects

At the time of this task, the Tribe was in the process of significantly expanding its infrastructure with six new projects slated for construction. The planned projects and their expected completion dates included were:

- Recreation Center Phase 3 – Pool (December 2019)
- Bear River Youth Development Center (December 2018)
- Bear River Health and Wellness Center (December 2019)
- Family Entertainment Center (February 2019)
- Two Softball Fields (December 2018)
- Air Conditioning System - Tish Non Community Center (expected June 2018)

SERC acquired and reviewed available electrical plans and documentation for these new projects and used this information to estimate anticipated electricity load profiles for each. The total energy use estimated for the new projects was estimated to be approximately 2,248,000 kWh per year with a total estimated demand of 790 kW.

Total Projected Load

The projected load for the Rancheria was determined by combining the existing annual energy use for the commercial properties, the modeled energy use for the residential properties, and the estimated energy use from the new planned projects. The energy usage and peak loads for each of these three categories are presented in the table below and result in a projected load of 7,176,427 kWh with a peak demand of 1,728 kW for 2020.

Table 2: Total Projected Annual Energy Use (kWh) and Peak Demand (kW)

Category	*Projected Annual Energy Use - 2020*	*% Total*	*Peak Demand*	*% Total*
Commercial	4,649,129	65%	906	52%
Planned Projects	2,248,000	31%	790	46%
Residential	279,298	4%	32	2%
Total Projected	**7,176,427**	**100%**	**1,728**	**100%**

Heating Load Assessment

In their 2016 energy auditing work, Redwood Energy quantified the gas usage for the existing residential and commercial properties and provided a detailed list of recommended product replacements for converting gas-fired appliances (e.g. heaters, gas grills, ovens, etc.) to electrical appliances. Given the past recommendations for home improvements, the residential properties were not re-assessed at this time. Gas consumption for the planned projects was also not evaluated.

Based on utility data files, the annual and a 3-year average consumption for the facilities are shown in Table 3 resulting in a total average annual usage of 75,753 therms.

Table 3: Gas Usage (Therms) from Large Commercial Facilities

Facility	*2015*	*2016*	**2017*	*Average*	*% Total*
Hotel	40,052	41,057	41,611	40,907	54%
Casino	21,754	27,320	29,591	26,222	35%
Tish Non Community Center	4,755	6,723	7,118	6,199	8%
Recreation Center			2,426	2,426	3%
			Totals	**75,753**	**100%**

Subtask 2.2: Renewable Energy Resource Assessment

A summary of activities and results from Task 2.2 Renewable Energy Resource Assessment are presented below. For additional details refer to the technical memo in Appendix B.

The purpose of the resource assessment work was to identify the locations available for on-site renewable energy systems and to estimate the amount of annual energy that could be generated from these new systems.

The assessment work focused on two on-site renewable energy resources: solar and wind. The following tasks were performed and are presented as sections in this memo:

- Solar Energy
  - overview of the Tish-Non Community Center (TNCC) renewable energy and storage system to evaluate system performance
  - identification of potential solar system locations and quantifying available land
  - sizing of PV systems and estimating on-site solar energy generation using *PV Watts*
- Wind Energy
  - overview of past wind studies
  - identification of potential wind turbine locations
  - estimation of the number of turbines
  - estimation of on-site wind power and energy production

Solar Energy

In 2015, a solar PV and wind energy system was installed at the Tish-Non Community Center. The system consists of a 100 kW (DC) solar ground mount PV system, 20 small wind turbines (4.8 kW total) and a 30 kW battery energy storage system that is connected to the community centers main service panel. The system was installed to reduce the centers demand charges, provide emergency backup power, and reduce the high electric utility bill. The project team analyzed operational data for 2017 and results showed that the energy generated from the renewable energy system is approximately 24% of the total building's annual electrical load.

SERC engineers surveyed the Rancheria property using Google Earth and identified 7 sites near the TNCC that are suitable for new solar systems are shown in Figure 1 and an additional four sites on and around the Casino as shown in Figure 2.

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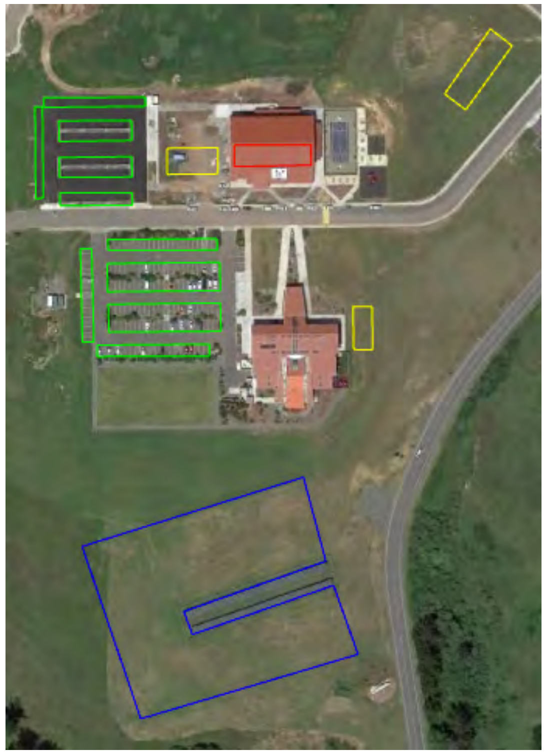

Figure 1: Locations for Potential PV Systems near the Community Center

Figure 2: Locations for Potential PV Systems near the Casino

The area and size of the PV systems were estimated for each location. These estimates were then used in an on-line application known as *PV Watts Calculator* to estimate the potential on-site energy production for the various ground-mounted, rooftop and car canopy locations.

Table 4: Estimated Annual Energy Production (kWh) for Potential PV Systems

Site	*Location*	*PV Size (kWDC)*	*Orientation (°)*	*Tilt (°)*	*Estimated Annual Energy Production (kWh)*
TNCC Hillside	southside	744	160	30	1,013,564
TNCC Parking Lot	E-W islands	560	180	7	704,915
	N-S islands	68	270	7	80,882
Rec Center Parking Lot	E-W islands	297	180	7	373,857
	N-S islands	42	270	7	49,956
Pump & Play	dispensing canopy	48	130	7	59,037
Bear River Drive	top of hillside	103	130	30	132,058
Casino Parking Lot	west lot	145	130	7	178,340
	north lot angled	310	160	7	388,456
	north lot	996	180	7	1,253,741
	east lot	166	115	7	201,407
Rec Center	rooftop	86	180	20	116,122
Casino	rooftop	116	130	30	148,725
Youth Center	rooftop	175	270	10	41,579
	Totals	**3,681**			**4,742,638**

The total potential PV system capacity if all sites were developed is 3.681 MW_DC. This would result in an estimated annual energy production of 4,710 MWh. Based on the results from the recent Load Profile Assessment work, this amount of generation could potential offset approximately 62% of the total projected energy use for 2020 (7.176 MWh).

Wind Energy

A number of past wind resource studies and projects have been done with the most recent one by Humboldt State University in 2016. A student engineering project conducted an electricity production and 20 year cost estimate for three different turbine options using both the NREL wind speed data and the Bergey 10kW production data. The study recommends a 100kW turbine at a tower height of 36.6m. It recommends locating the turbines on the west area of the Rancheria near the waste water treatment plant as shown in Figure 3.

The location of the decommissioned Bergey 10kW turbine significantly impacted hotel customers due to noise levels. Therefore this location is not considered as an option even though there is a utility point of connection for this location.

Figure 3: Proposed Location and Past Location for Wind Turbine Installation

Estimating the potential number of turbines assumes the Northern Power Systems NPS 100C 100kW turbine with a 24m rotor. This is the turbine make and model recommended by the HSU study. The spacing between turbine towers assumes a minimum distance of 3D along a row, and 5D between rows, where "D" is the turbine rotor diameter. [2]

Furthermore, a noise level analysis was done by the HSU study. This study estimated the 60dBAa noise level of the 100kW turbine at a wind speed of 7 m/s occurring a distance of roughly 100ft from the tower. It is assumed that a tower will not be located closer than 100ft to any regularly occupied space such as the waste water treatment plant.

With the above assumptions, it is estimated that a maximum of three turbines could be installed at the Rancheria. Historic wind speed data was obtained then translated into a daily time series of estimated average instantaneous power output using the power curve for the Northern 100kW turbine.

An efficiency reduction of 90% is assumed for the collective output of all three turbines. This is caused by the reduction in available wind energy due to the proximity of the towers to each other. The efficiency reduction value was derived using an educated guess on where the proposed tower layout lies on the 2x2 tower spacing efficiency curve in Figure 6.28 of Masters, 2004.[2]

The resulting estimated annual energy output for the 3 Northern 100kW turbines is shown in Table 5. The minimum values were calculated as the minimum of the results calculated from the Bergey 10kW turbine and the NREL wind data. Similarly, the average is that of the two sets of results, and the maximum also that of the two sets of results. Also shown is the estimated single highest peak power output for the year.

Table 5: Estimated Performance from three Northern 100kW wind turbines

Parameter	***Minimum***	***Average***	***Maximum***
Peak Power Output (kW)	128	149	249
Annual Energy Production (MWh)	203	368	533

[2] See Gilbert M. Masters. 2004. "Renewable and Efficient Electric Power Systems". John Wiley and Sons, Inc., Hoboken, New Jersey. ISBN 0-471-28060-7.

Subtask 2.3: Demand Side Management Opportunities

A summary of activities and results from Task 2.3 Demand Side Management Opportunities are presented below. For additional details refer to the technical memo in Appendix C.

The purpose of this task was to review previous work to leverage and identify demand-side management opportunities with a focus on optimizing the load profile of the Bear River Band of Rohnerville Rancheria (BRB) in the context of significant on-site renewable generation.

The following work tasks were performed:

- Review of the recent energy audit work and associated recommendations
- Identification of specific equipment from the audit report that may provide near-term cost-effective energy savings or fuel-switching opportunities
- High-level energy analysis for possible near-term HVAC retrofits

Review of Redwood Energy's Audit Report

SERC reviewed the *Baseline Energy Audit Report with Recommended Improvements and Cost Analysis* report within the 2016 Redwood Energy (RE) and Freshwater Environmental Services Renewable Energy Sovereignty Master Plan. This audit report provided a detailed list of recommended product replacements for upgrading electrical appliances to more efficient models and converting gas-fired appliances (e.g. HVAC units, heaters, gas grills, ovens, etc.) to electrical appliances. Conversion to all electric appliances, known as fuel-switching, is part of BRB's strategic vision to achieve zero net annual utility energy consumption and includes replacing gas burning space and water heaters with heat pumps.

Two keys points taken from the reports summary are provided below. Refer to the report for a complete list of recommendations for all audited facilities.

- The Bear River Casino building accounts for approximately 80% of the entire energy consumption at the Rancheria
- The internal Casino slot machines and uninterrupted power supply (UPS) battery back-ups make up approximately 70% of the Casino's energy load

In general, SERC has found that the Redwood Energy site audit was thorough and their general strategy to reduce energy usage by upgrading to more efficient equipment makes sense.

Energy Analysis of Near-term Casino Retrofits

During the review of the RE report, SERC identified two categories from the recommended retrofits that could have an impact on the electrical load in the near term: 1) large loads that may have replacement options with significant higher efficiencies and 2) fuel switching opportunities of gas-fired equipment that is near end of life.

From the audit report, the Casino HVAC systems and uninterruptible power supplies (UPS) for the slot machines stand out as potential energy-saving and fuel-switching opportunities. It is anticipated that any reduction in energy use by implementing these retrofits will have only a small effect on the extremely large electrical load at the Casino and that additional retrofits will be required to provide any significant reduction in the facility's load. Below is a high-level energy analysis to replace three HVAC systems at the Casino. At the time of this memo, SERC did not have enough information available to analyze the slot machine UPSs at the Casino and Pump & Play Station.

Energy Analysis Results for HVAC Retrofits

The estimated annual energy use for the existing equipment and for the best (most efficient) replacement products available on the market were analyzed. Results show that replacing the 30 ton chiller would reduce the annual energy use by approximately 29,811 kWh. However, fuel switching the RTUs to new all-electric heat pumps would increase the usage an additional 23,871 kWh per year for the 18 ton unit and 28,444 kWh for the 25 ton unit. If all three retrofits were implemented, the total annual energy use would increase by 22,504 kWh.

The average annual load at the Casino over the past three years is 2,269,589 kWh. The percent change in load decreases by approximately 2% for the cooling mode and increases by 3% in the heating mode, resulting in an overall increase in the Casino load of 1%.

Although the electrical energy use at the Casino would increase by 1%, the retrofits would reduce the consumption of natural gas at the Casino by 16,313 therms. Eliminating this amount of natural gas would prevent 86.5 metric tons of greenhouse gas emissions from entering the environment.

Subtask 2.4: Renewable Energy Integration Readiness

A summary of activities and results from Task 2.4 Renewable Energy Integration Readiness are presented below. For additional details refer to the technical memo in Appendix D.

The purpose of the infrastructure and renewable energy production assessment work was to determine the readiness for integrating renewable energy systems into the existing and planned electrical infrastructure.

Expanding on the previous load profile and energy resource work, the following infrastructure assessment subtasks were performed and their outcomes presented:

- Request and review utility and site electrical infrastructure documentation
- Review the potential renewable energy systems presented in Task 2.2
- Identify options for the electrical point of interconnection (POI) for each RE system based on the size of the energy system and the electrical infrastructure
- Obtain feedback from the Strategic Vision Advisory Committee
- Summarize the readiness for integrating renewable energy systems

The available electrical infrastructure documentation was referenced to identify the possible electrical points of interconnections (POI) for the PV and wind energy systems. The size of the RE system and the specifications and available capacity of the nearby switchgear were analyzed to determine if the RE system can tie into the existing electrical infrastructure. If the RE system size exceeds the existing infrastructure capacity, a new utility generating account is proposed. The limitations and requirements for establishing a new generating account will be investigated in upcoming project tasks.

The point of interconnection (POI) options for each of the renewable energy systems is summarized below. Additional infrastructure documentation along with a site visit will be required to further evaluate the options presented or identify more appropriate locations for integrating the renewable energy systems.

Tish-Non Community Center - the most appropriate POI for the hillside PV and/or solar carport system(s) is at the utility distribution line on Keisner Road. A new generating account with the utility should be established.

Recreation Center - the two possible POI's for a rooftop and/or solar carport PV system(s) along with a possible battery energy storage system are:

- The spare breakers on the main switchboard (MSB SE-1). If upsized to 600A total, the circuits could handle up to 492 kW of renewable energy.

- The spare breakers on the new switchboard (SWBD SE-2). The circuits could handle up to 246 kW of renewable energy.

Pump & Play - the most likely POI for the dispensing canopy PV system is at the station's main service panel. Further investigation is needed to determine whether panel upgrades are required.

Bear River Drive - the exact POI for a ground-mounted PV system is unknown. One possibility may be to connect the system to the previously-installed wind turbine electrical service panel. Further research is required.

Casino - the most appropriate location for connecting the solar carport PV and possible battery energy storage system will depend on the amount of PV installed, the available capacity, limitations of the Casino's electrical system, and the desire to include a BESS to reduce peak demand. The three POI options are:

- connect to the utility distribution line and establish a new generating account.
- connect to the Casino's electrical infrastructure. Equipment upgrades may be needed to handle a large amount of renewable energy.
- connect to both locations if installed PV capacity exceeds the Casino's available capacity and Casino equipment upgrades are not possible or not cost-effective.

Wind Energy System - setting up a new generating account may be the best option for this system.

Subtask 2.5: Strategic Vision Advisory Committee

A summary of activities and results from Task 2.5 Strategic Advisory Committee are presented below. For meeting minutes, refer to the appendices of the Energy Options Implementation Plan in Appendix D.

The purpose of this task was to recruit tribal members and/or employees to form an advisory committee that would provide input and conduct a design review of the preliminary energy system designs. In addition, the Committee, or a selected number of, were to review the Energy Options Implementation Plan and Comprehensive Report.

The Tribes participation into the development of the renewable energy systems was through key tribal members of the Environmental and Natural Resources Department and Facilities Management and from the newly-formed Strategic Vision Advisory Committee. Two design review meetings were held with the tribal members and/or the advisory committee to solicit feedback on the system location, design, and to identify any potential issues with the system.

The initial meeting was with the director of Environmental and Natural Resources, where he provided brief comments on the designs and notified the project team that two new infrastructure projects were planned. The second review meeting was with the advisory committee with additional feedback provided by the facilities director.

Tribal members provided comments on each system and indicated whether the project team should move forward and evaluate the system as a potential energy option. As noted in the meeting notes, most of the comments made expressed concern over the location and the aesthetics of the photovoltaic systems. During the review meetings, the Tribe also provided project updates on the status of planned facilities and notified the project team that a new renewable energy system was to be installed at the Recreation Center.

Subtask 2.6: Energy Options Implementation Plan

A summary of activities and results from the Energy Options Plan are presented below. For the complete report, refer to Appendix E.

In the development of the Energy Options Implementation Plan, the design team focused on energy systems that can be implemented in the near term. The approach taken was to design and propose renewable energy systems based on reliable and proven technologies that will:

- generate clean, renewable energy to reduce utility energy imports
- provide energy savings over the life the project and reduce the greenhouse gas (GHG) emissions
- serve as the core energy generators if a community scale or multiple-facility microgrid is implemented

A total of eight preliminary renewable energy systems were identified. This energy plan presents the engineering design work starting with the design review process of the preliminary energy systems through the performance and cost analyses of the selected energy options.

Energy Options

In the final design review meeting, the project team and key tribal members from the Department of Environmental and Natural Resources screened the modified preliminary systems and identified the following prospective energy options.

> Energy Option 1 - TNCC Hillside PV System -a 400-kWDC ground-mounted system connected to the utility grid that would offset energy use at the Wastewater Treatment Plant and Family Entertainment Center.
>
> Energy Option 2 - Pump & Play Microgrid - a 48-kWDC PV with a battery energy storage system connected behind the meter that is capable of islanding and supplying facility loads during grid outages.
>
> Energy Option 3 - Casino PV and Carport Systems - a large generation system that includes a combination of a rooftop PV system and multiple solar carports that is connected to the casino or utility grid to offset the substantial amount of energy use at the Casino.

The three options include a large grid-tied aggregated PV system at the TNCC, a building level microgrid at the gas station, and a group of PV and carport systems at the Casino. The prospective energy options would operate under net metering agreements described in the previous section, offsetting the retail cost of a customer's energy use.

Net Energy Metering Program

The renewable energy systems will connect either directly to a buildings electrical system or to the utility grid via a new electrical service. To be eligible for net metering, the energy systems must be sized no larger than to offset the annual consumption for the facilities they serve. The project team evaluated utility meter data and calculated the average annual energy use for all commercial facilities to ensure the proposed PV systems were properly sized. If the facility load changes or if additional facilities are to be added to the aggregated system, the generation - load balance calculations should be revisited.

Net energy metering (NEM) allows customers who generate their own energy ("customer-generators") to serve their energy needs directly onsite and to receive a financial credit on their electric bills for any surplus energy fed back to their utility[3]." The TNCC PV system is a NEM account. Customers can submit a NEM Interconnection Pre-Application

Net Energy Metering Aggregation (NEM2A) allows a single customer with multiple meters on the same property, or on adjacent or contiguous properties, to use renewable generation (e.g. solar panels) to serve the aggregated load behind all eligible meters and receive the benefits of Net Energy Metering (NEM2).

Energy Option Performance and Cost Summary

The performance and costs were analyzed for each renewable energy system. System performance was estimated using the System Advisor Model (SAM). Developed by the National Renewable Energy Laboratory (NREL), SAM provides an estimate of the annual energy generation based on PV array size, orientation, tilt, and regional weather data.

The performance summary results for the prospective energy options is shown in Table 6 below.

Table 6: Energy Options Performance Summary

#	*Option*	*PV Size (kWDC)*	*Annual Energy Production (kWh)*	*Annual Energy Use (kWh) and Facility Served*	*% of Load Met*	*25 Year GHG Emission Reductions (MT CO2e)*
1	TNCC PV System	400	562,973	168,000 WWTP 332,000 FEC	100%	267
2	Pump & Play Microgrid	48	59,039	351,650	17%	28
3	Casino PV Systems	900	1,160,096	2,273,402	51%	551
	All Energy Options	1348	1,782,108	4,981,586	36%	847

[3] Source: https://www.cpuc.ca.gov/General.aspx?id=3800

The facilities served include the Wastewater Treatment Plant and Family Entertainment Center for option 1, the gas station for option 2, and the Casino for option 3. The total annual energy use value for the All Energy Options line is the current annual energy consumption from the all commercial facilities[4].

The total greenhouse gas (GHG) emission reductions for the life of the systems (25 years) is estimated at 847 metric tons of carbon dioxide equivalent (MT CO_2e) [5]. The Tribe currently purchases electricity through the Redwood Coast Energy Authority (RCEA) Community Choice Energy program. REpower is the standard electricity service level offered by RCEA and is provided at a lower cost and has a higher mix of renewables than PG&E.

The cost analysis results for the prospective energy options is shown in Table 7 below.

Table 7: Energy Options Cost Analysis Results

#	*Option*	*PV Size (kWDC)*	*Installed Cost ($)*	*Annual Energy Savings (year1)*	*100% Grant Funded NPV*	*50% Grant 50% Loan NPV*
1	TNCC PV System	400	$1,200,000	$63,242	$1,257,979	$633,477
2	Pump & Play Microgrid	48	$144,000	$5,920	$115,493	$40,553
3	Casino PV Systems	900	$3,281,250	$146,091	$2,260,930	$553,306
	All Energy Options	1348	$4,625,250	$215,253	$3,634,402	$1,227,336

4 This value is the total annual average energy use for all commercial facilities of 4,649,129 kWh based on the data from 2015-2017 as reported in the Load Profile Assessment task plus the recent estimated energy use of 332,457 kWh per year at the Family Entertainment Center.

5 These data were calculated using greenhouse gas emissions factors provided by Redwood Coast Energy Authority that have not yet been verified by an authorized third party. They are based on RCEA's 2018 power portfolio and exclude biogenic emissions associated with the biomass power in the portfolio, which is consistent with reporting protocols used by the California Air Resources Board and the Intergovernmental Panel on Climate Change.

Conclusion and Recommendations

The culminating outcome of the Bear River Band Energy Options Analysis Project was to develop an Energy Options Implementation Plan that packages the project work into a comprehensive and actionable guide the Tribe can use to pursue future renewable energy development. The project conclusions and recommendations presented below are those of the Implementation Plan.

Key tribal members and the newly-formed Strategic Vision Advisory Committee participated in the development of the renewable energy systems by providing valuable feedback during the design review process. These comments, along with additional input, were used to modify the designs in preparation for final screening. In the final design review step, the project team and members of the Department of Environmental and Natural Resources screened the modified preliminary systems and selected the top three energy options. These projects were selected based on a set of criteria that included the system size, type of system, likelihood of implementation, and the projects' ability to move the Tribe closer to its goal of zero net annual utility energy consumption.

The prospective energy options would operate under net metering agreements, offsetting the retail cost of energy use. This approach likely provides the greatest economic benefit. A summary of the top energy options are provided below.

Option 1 – TNCC Hillside Photovoltaic System

This project is a 400-kWDC PV system operating under a net energy metering aggregated account. The generated energy would offset 100% of the demand at the Wastewater Treatment Plant and Family Entertainment Center, providing significant cost savings throughout the life of the project.

Option 2 – Pump & Play Microgrid

This microgrid project includes a 48-kWDC photovoltaic system that can offset 17% of the gas station demand providing modest cost savings. With the addition of a battery energy storage system and microgrid controller, the system would provide additional backup power and resiliency for critical services provided at the gas station.

Option 3 – Casino PV and Carport System

This project would involve the installation of up to 900 kW of PV capacity from multiple photovoltaic energy systems. If fully implemented, the system could offset 56% of the energy use at the Casino, providing significant cost savings over the life of the project.

At a total installed cost of $4.6M, the implementation of these three energy options would offset 36% of the annual energy use from all commercial facilities on the Rancheria. This amount of self-generation results in an annual net revenue stream with a first-year savings of $215k. The combined NPV for all options is between $1.2M and $3.6M, depending on whether 50% or 100% of the projects' costs are covered by grant funding, respectively.

The energy options can provide substantial energy cost savings and move the Tribe closer to their vision of zero net annual utility energy consumption. The energy options also lay the foundation for a future community-scale or multiple-facility microgrid. Given the location for the electric points of interconnection for the two large PV systems, it would be possible to install a microgrid on either or both sides of Singley Hill Road. The TNCC PV system could be the core renewable energy generator for a west-side microgrid, and the Casino PV system could serve an east-side microgrid. However, even though these systems offer a possibility for expansion, the criticality of the facilities served and the cost and complexity associated with installing and operating a microgrid should be carefully considered.

Recommendations

The following recommendations are provided to assist the Tribe to move the implementation plan forward into a feasibility analysis stage and beyond.

1. Consider expanding the size of Energy Option1 - TNCC Hillside Photovoltaic System by including the photovoltaic system planned for the Recreation Center and making the Recreation Center another aggregate load in the NEM2A aggregate system.
2. Pursue funding. A list of potential grant funding opportunities can be found in Appendix A. If only partial funding is available, reduce the project scope and move forward with implementation in a phased approach.
3. Submit a NEM interconnection pre-application report request to PG&E to obtain information on the available capacity of the distribution line for the points of interconnections identified for each energy option.
4. Conduct a detailed feasibility study for the three energy options. The study should estimate annual energy production based on the final PV system size to ensure production does not exceed aggregate annual loads. It should also estimate cost savings and system costs based on the results of the PG&E pre-application report for the identified point of interconnection.
5. Start the interconnection process with PG&E by submitting an interconnection request. The engineering review part of the process will identify any utility system upgrades required and cost responsibilities.

Note that if a phased approach is taken for the aggregate TNCC Hillside PV System and/or Casino PV and Solar Carport System, the electrical infrastructure (i.e. conductors, utility transformer, etc.) should be sized for the full build-out capacity of the energy option.

A phased approach at the Pump & Play location would initially involve the installation of the photovoltaic system. If upgrades to the main electrical panel are required, it is recommended to design and size the new panel to accommodate a possible future microgrid. If the conversion to renewable energy resiliency is deemed valuable, seek additional funding and install the battery energy storage system, microgrid controller, and the necessary switchgear to implement a building microgrid.

Additional Energy Planning and Efficiency Recommendations

These additional recommendations are to assist the Tribe in reaching their energy goals.

- Verify the performance of the TNCC PV-battery system to ensure the system is operating properly, specifically the battery energy storage system. Estimate the cost savings and effectiveness of the battery system in reducing peak demand charges.
- Pursue energy efficiency opportunities for existing Tribal facilities utilizing existing energy efficiency programs and services offered by PG&E and the Redwood Coast Energy Authority. Refer to the Demand Side Management Opportunities Technical Memo for details on identified opportunities.
- Continue to involve the Strategic Vision Advisory Committee, Tribal leadership and the Tribal community throughout the energy system implementation process.
- Verify proper operation of the HVAC system at the Recreation Center. Improper operation of the ventilation system can cause an excessive number of air changes per hour, resulting in higher energy use and costs.

Lessons Learned

A key lesson learned in the Energy Options Analysis Project is the value of the Strategic Vision Advisory Committee. Composed of tribal members and employees, the Committee provided valuable input to the project team during the development of the proposed energy options.

The feedback provided during the design review phase allowed the project team to focus their analysis on locations where a renewable energy system had a good chance for implementation and to modify the designs of these systems to address the expressed concerns from the Tribe.

The formation of the Strategic Vision Advisory Committee was a good first step in involving and empowering tribal members in the development of the Tribes energy plan. A few comments are provided in an effort to improve the effectiveness of the Committee:

- *Retain the Committee lead as a key point of contact for consultants hired to implement projects.*

  Project coordination and the communication of information improved greatly throughout the project. A leader with some technical energy background and familiarity with the status of the planned projects is useful.

- *Form the committee at the onset of the project and notify the project consultants of any existing or planned projects that could affect the energy development work*

  The Rancheria has and continues to experience a period of rapid growth with the recent opening of the Family Entertainment Center (May 2019) and four additional infrastructure projects planned for future installation. In addition to the new facilities, a new photovoltaic (PV) and battery energy storage system is planned for installation on the hillside of the Tish Non Community Center. The PV system is currently slated to connect to the Recreation Center and offset facility's' energy use.

  Understanding the status of the planned projects gives the project consultants the opportunity to provide recommendations early in the process that may offer a better and more effective energy solution.

Appendix A:

Subtask 2.1: Load Profile Assessment – Technical Memo

Recipient Organization:	Bear River Band of the Rohnerville Rancheria
Project Title:	**Bear River Band Energy Options Analysis Project**
Date of Report:	April 30, 2018
Award Number:	DE-IE0000063
Technical Contact:	Edwin Smith, Director of Environmental and Natural Resources 266 Keisner Rd. Loleta, CA 95551 (707) 733-1900 edwinsmith@brb-nsn.gov
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GO Project Monitor:	Tommy Jones (240) 562-1739 Thomas.Jones@ee.doe.gov

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1 Introduction

This technical memo presents the results of the energy analysis work conducted for the *Bear River Band of Rohnerville First Steps* project. The purpose of the energy analysis work is to assess the electric and heating loads for the existing and planned residential and commercial properties in order to develop a future projected load profile for the Rancheria. The load profiles for both the individual properties and for the overall combined projected Rancheria load will be used to identify the demand-side management opportunities that can optimize the Tribes energy use.

The analysis work was divided into the following subtasks with each one representing a section within this report:

- Review past energy assessment work.
- Perform an energy assessment of the existing commercial properties.
- Review the estimated modelled energy use for residential properties.
- Develop estimated load profiles for planned projects.
- Develop a projected combined load profile based on the results from the commercial, residential, and planned facilities analyses.
- Perform an assessment of the heating load for properties with available data.

2 Past Energy Assessments

A review of the 2016 Renewable Energy Sovereignty Master Plan developed by Redwood Energy and Freshwater Environmental Services was done to provide background information on the Rancheria energy assessment work. The first task for Redwood Energy in creating this plan was to determine the current energy use at the Rancheria. They conducted site audits, modeled energy consumption, and analyzed utility bill data for 2013 to 2014. This work was summarized in their *Baseline Energy Audit Report with Recommendations.* The report provided a high-level assessment of the energy use for each service account along with a detailed list of recommended product replacements for upgrading electrical appliances to more efficient models and converting gas-fired appliances (e.g. heaters, gas grills, ovens, etc.) to electrical appliances.

A review of the baseline audit report and associated documentation identified the following key points:

- Energy assessments were performed to determine the electricity and gas consumption for six commercial buildings: Casino, Hotel, Pump & Play, Human Resources & Accounting, Tobacco Traders, and the Gaming Office.
- Energy use was estimated using energy software for the residential homes (Bear River Drive Homes and the Model and Tish Non Village Homes).
- An energy assessment of the Tish Non Community Center was not performed as it was assumed the renewable energy system achieved energy sovereignty for the building.
- The Recreation Center was still under construction at the time of the energy analysis.
- The utility bills used in the analysis were for 2013-2014.

3 Energy Assessment of the Existing Commercial Properties

SERC requested and was given authorization to receive customer electrical energy information from PG&E for 25 residential and commercial accounts, 20 for the Rancheria and 5 for the Casino Resort. The requested information included billing history data and 15-minute interval demand data for the past 3 years. PG&E was able to provide data for the majority of the accounts, but for unknown reasons they were unable to locate interval demand data for the casino, hotel, community center, wastewater treatment plant and two street light accounts.

SERC contacted the Redwood Coast Energy Authority (RCEA) in an effort to gather the missing electrical energy data. RCEA administers Humboldt County's Community Choice Energy program and through their release of customer information authorization process, SERC was able to receive interval data for four of these accounts. The street light accounts were assumed to be relatively minor in comparison to other loads and data was not acquired.

A preliminary screening of the data files was conducted to eliminate residential properties, accounts with little or no energy use or accounts not physically located on the Rancheria. The process resulted in the following 11 commercial accounts to be evaluated in this task:

- Casino
- Hotel
- Pump & Play
- Tish Non Community Center (TNCC)
- Recreation Center
- Waste Water Treatment Plant (WWTP)
- Human Resources & Accounting
- WUSA Water Treatment System
- Billboard
- Tobacco Traders & Coffee Co. (TT&CC)
- Gaming Office

An energy assessment of the interval and billing history data sets for each of the commercial accounts was performed and load profiles for the existing commercial properties were developed. Graphs of the average hourly and peak demand load profile and average monthly energy use are presented in the following pages.

Also included with the graphs are the following results and information:

- average annual energy use
- peak power demand
- billing history data source and date range
- interval data file source and date range
- comments describing load profile characteristics

It should be noted that the data ranges for the utility interval data files vary from account to account. The reasons for this variation include the delivery date for the 3-years of requested data (December 2017), information coming from two different electrical energy providers (PG&E and RCEA), changes with a buildings rate schedule and/or account number (TNCC, WWTP), and a lack of three years of operation (Recreation Center).

3.1 Casino

Average Annual Use: 2,273,402 kWh
Peak Demand: 381 kW
Billing History (PG&E): 01/1/2015 to 10/31/2017
Interval Data (RCEA): 01/2/2015 to 10/16/2017
Comments: The monthly energy use and peak demand power are relatively constant.

Figure 1: Casino – Average and Peak Daily Load Profile (2015 – Sep. 2017)

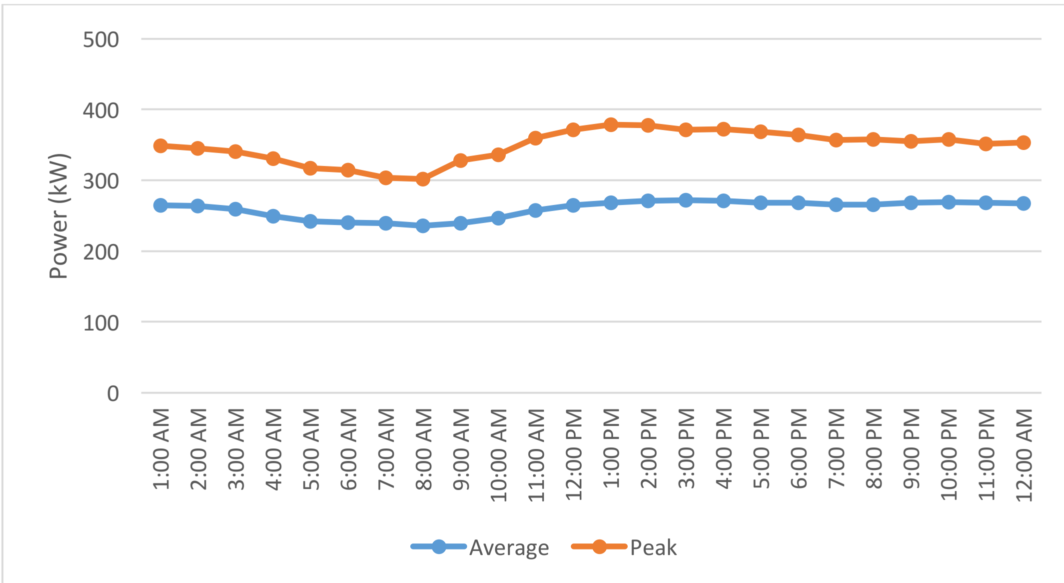
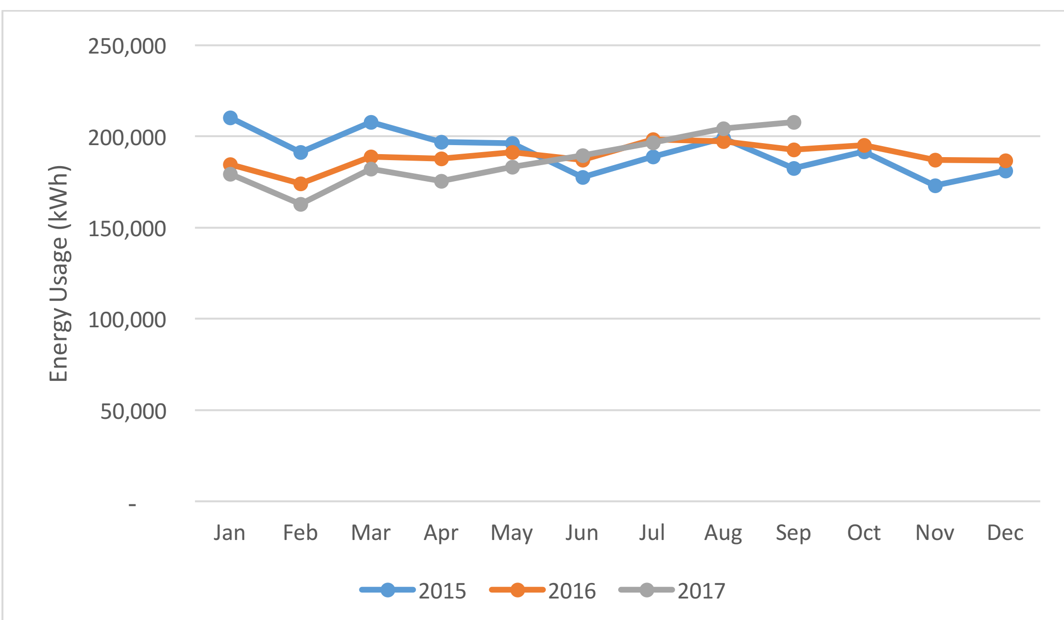


Figure 2: Casino – Monthly Energy Use (2015 – Sep. 2017)



3.2 Hotel

Average Annual Use: 1,044,777 kWh
Peak Demand: 211 kW
Billing History (PG&E): 12/11/2014 to 10/31/2017
Interval Data (RCEA): 01/1/2015 to 10/16/2017
Comments: The monthly energy use and peak demand power are relatively constant.

Figure 3: Hotel – Average and Peak Daily Load Profile (2015 – Sep. 2017)

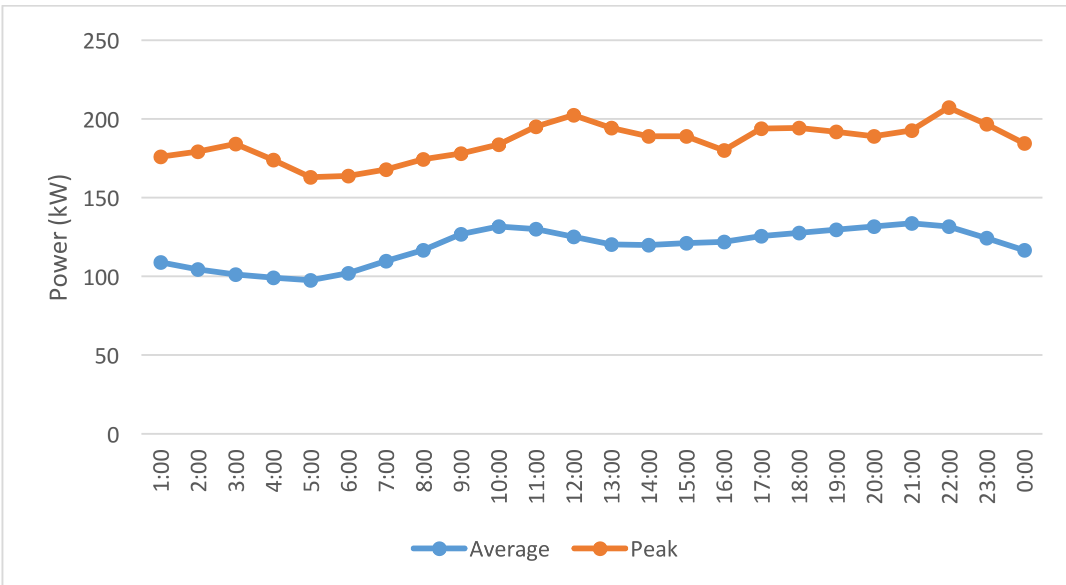
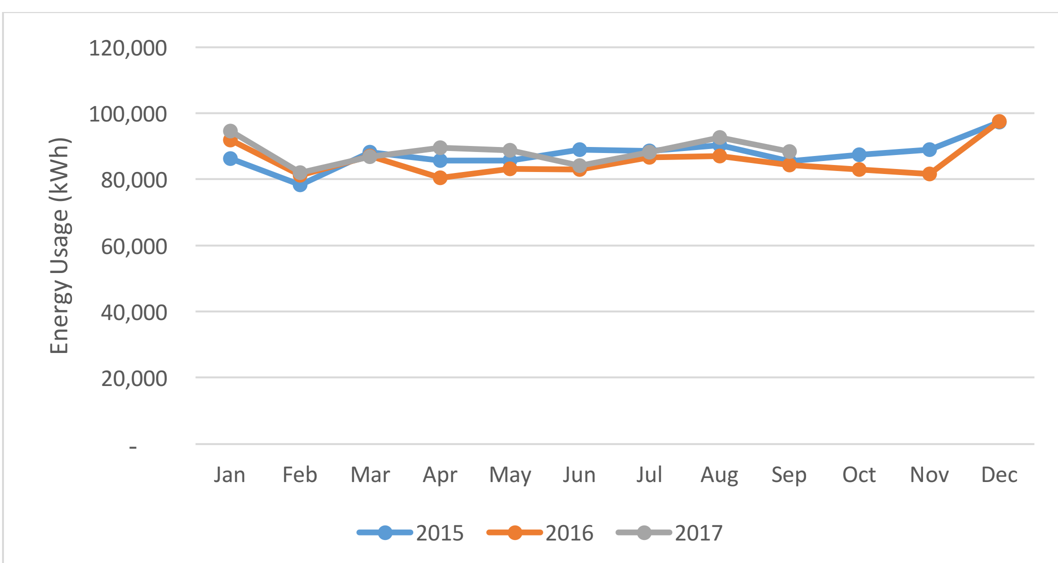


Figure 4: Hotel – Monthly Energy Use (2015 – Sep. 2017)



3.3 Pump and Play

Average Annual Use: 351,650 kWh
Peak Demand: 56 kW
Billing History (PG&E): 12/4/2014 to 11/1/2017
Interval Data (PG&E): 12/6/2014 to 12/5/2017
Comments: The load decreases during daytime hours.

Figure 5: Pump & Play - Average and Peak Daily Load Profile (2015 - Nov. 2017)

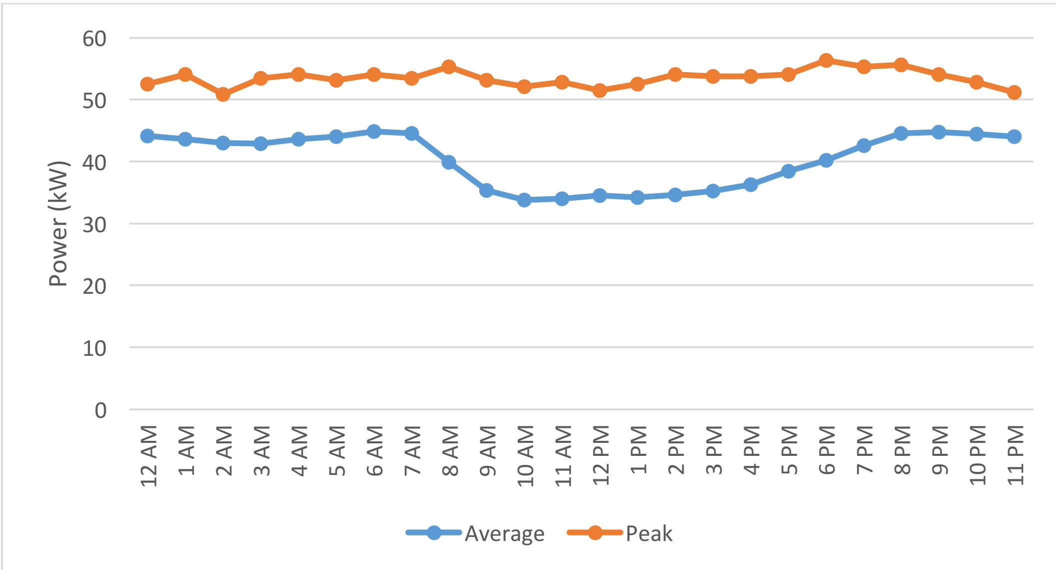
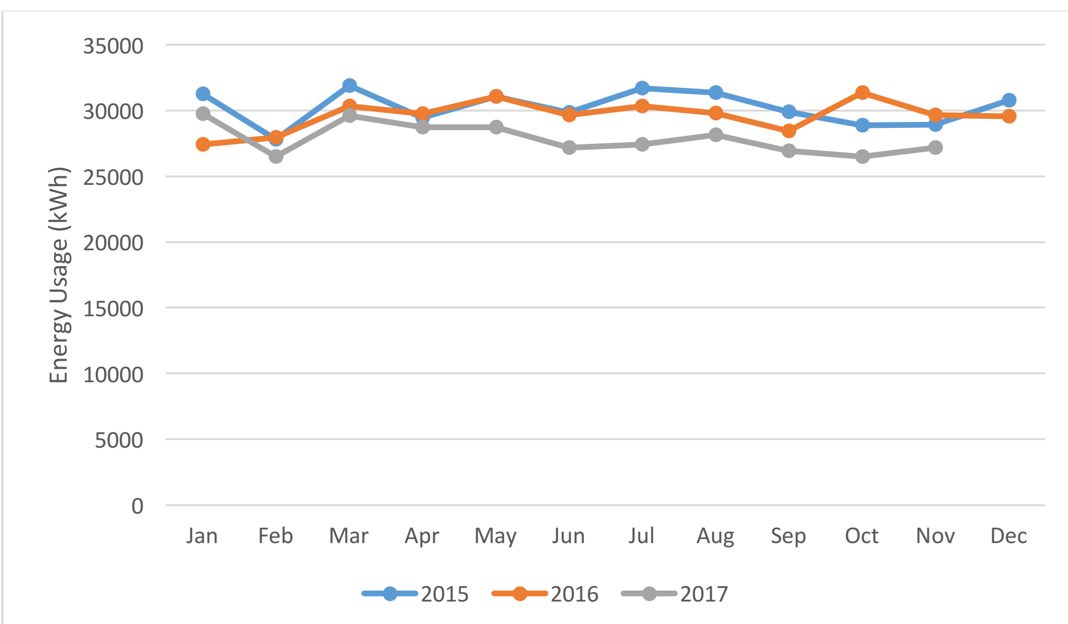


Figure 6: Pump & Play – Monthly Energy Use (2015 - Nov. 2017)



3.4 Tish Non Community Center

Average Annual Use: 272,893 kWh
Peak Demand: 78 kW (abnormal peak in May 2016), normally ~52 kW
Billing History (PG&E): 11/13/2014 to 12/4/2015 (pursuing more current data)
Interval Data (PG&E): 12/5/15 to 10/16/17)
Comments: The TNCC renewable energy resource system (PV, wind and battery system) is connected to the building to reduce the buildings electrical use. The high peaks shown mid-day appear to be from a systems control failure and occurred only for a few days around May 1, 2016. A detailed evaluation of this system and its performance will be presented next quarter in the renewable energy resource assessment technical memo.

Figure 7: Tish-Non Community Center – Average and Peak Daily Load Profile (2016 – Sep. 2017)

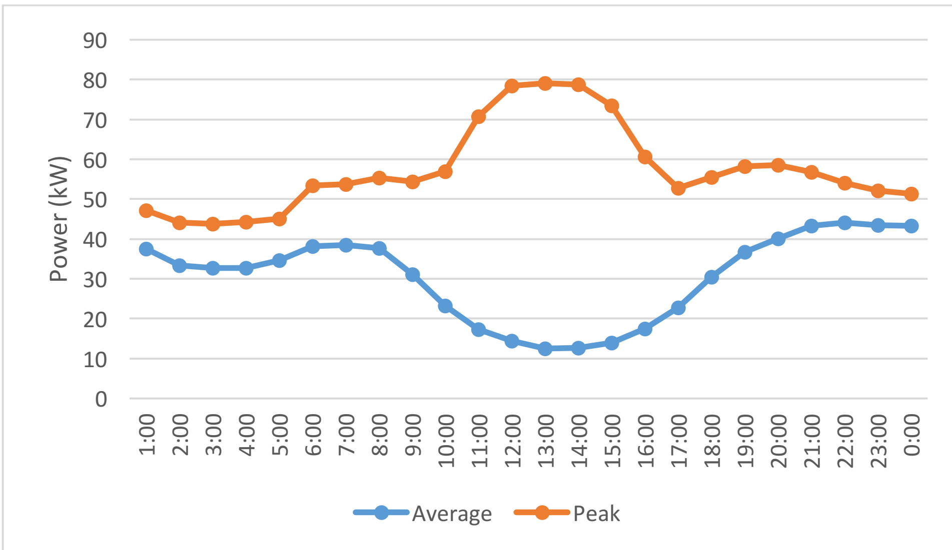
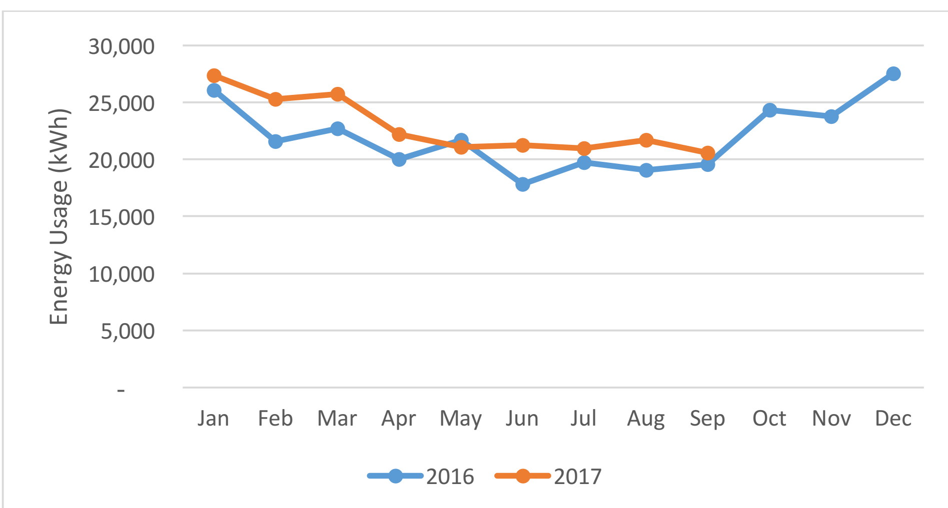


Figure 8: Tish-Non Community Center – Monthly Energy Use (2016 – Sep. 2017)



3.5 Recreation Center

Average Annual Use: 271,765 kWh
Peak Demand: 67 kW
Billing History (PG&E): 11/10/2016 to 11/9/2017
Interval Data (PG&E): 12/1/16 to 12/1/17)
Comments: High peak load relative to energy use throughout entire day.

Figure 9: Recreation Center - Average and Peak Daily Load Profile (Dec. 2016 - Nov. 2017)

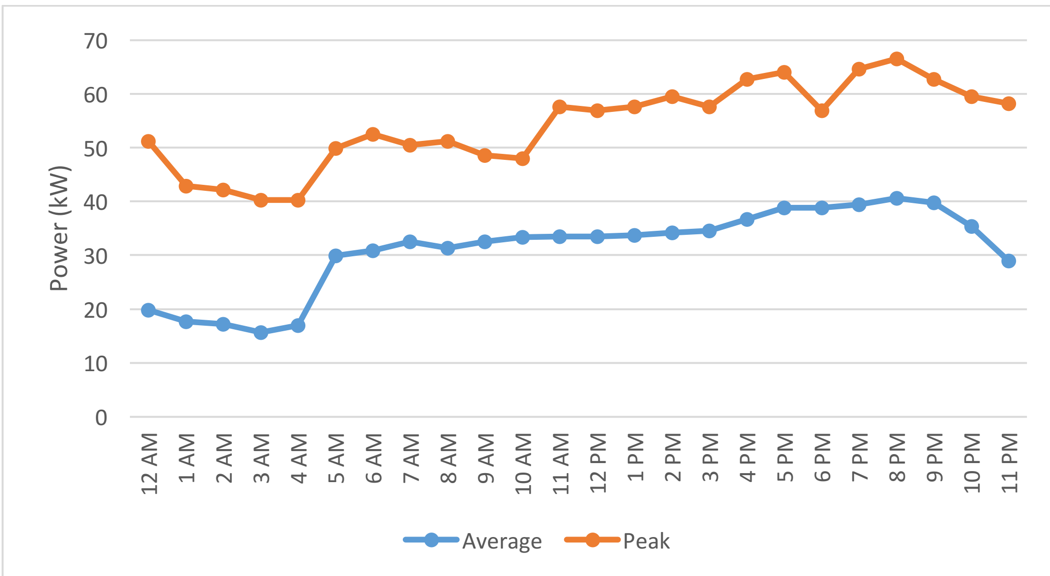
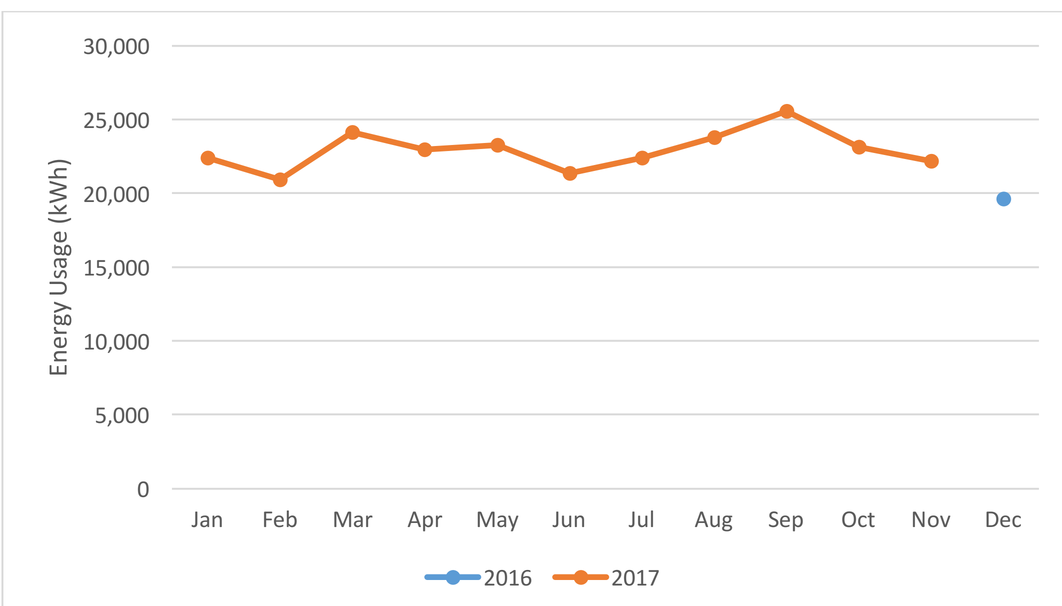


Figure 10: Recreation Center – Monthly Energy Use (Dec. 2016 - Nov. 2017)



3.6 Wastewater Treatment Plant

Average Annual Use: 174,662 kWh
Peak Demand: 48 kW
Billing History (PG&E): 11/9/2016 to 11/9/2017
Interval Data (RCEA): 11/9/16 to 10/16/17
Comments: Cycling equipment pattern, fairly steady consumption year round.

Figure 11: Waste Water Treatment Plant – Average and Peak Daily Load Profile (Nov. 2016 - Oct. 2017)

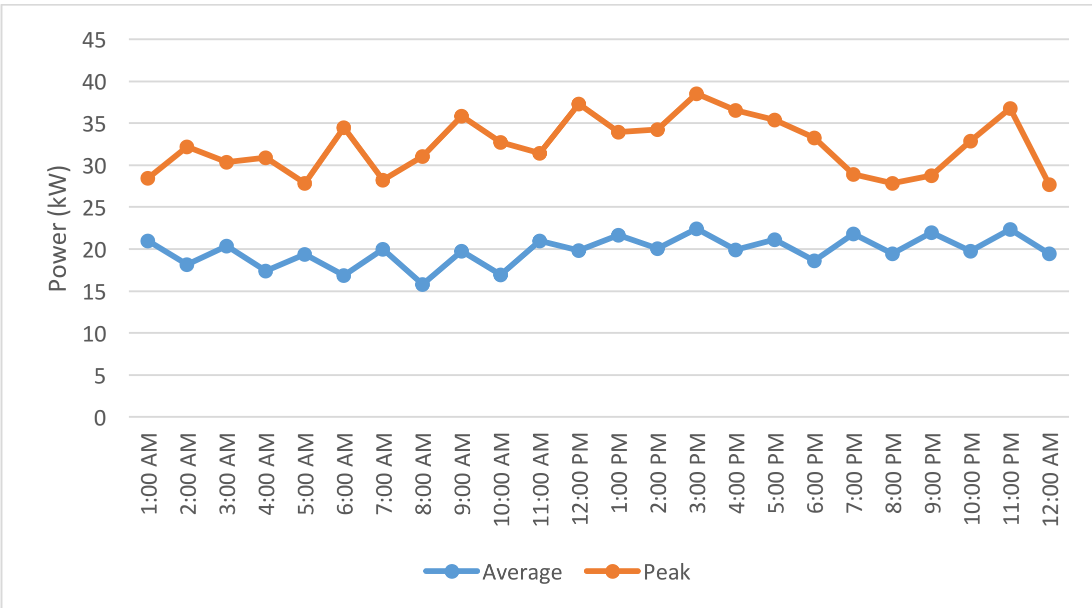
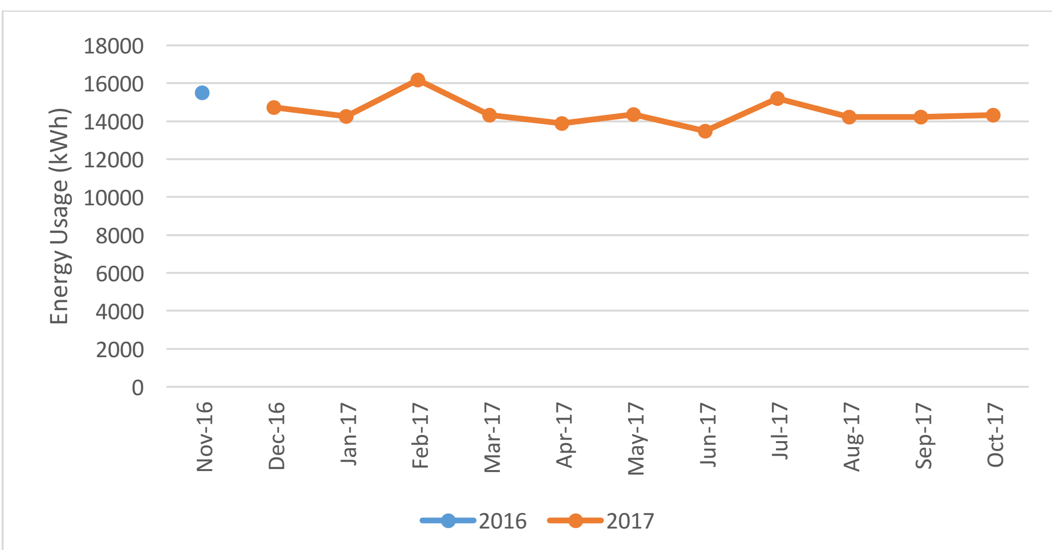


Figure 12: Waste Water Treatment Plant – Monthly Energy Use (Nov. 2016 - Oct. 2017)



3.7 Human Resources & Accounting

Average Annual Use: 76,808 kWh
Peak Demand: 19 kW
Billing History (PG&E): 11/13/2014 to 11/9/2017
Interval Data (PG&E): 12/6/14 to 12/5/17
Comments: Typical office load profile. Less energy use in 2017.

Figure 13: Human Resources & Accounting - Average and Peak Daily Load Profile (Dec. 2014 - Nov. 2017)

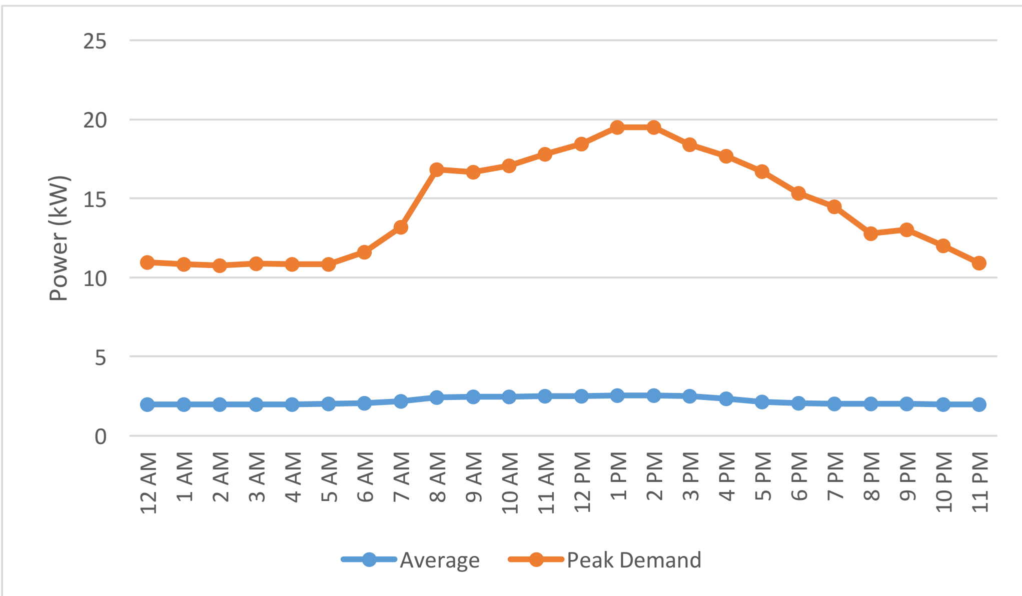
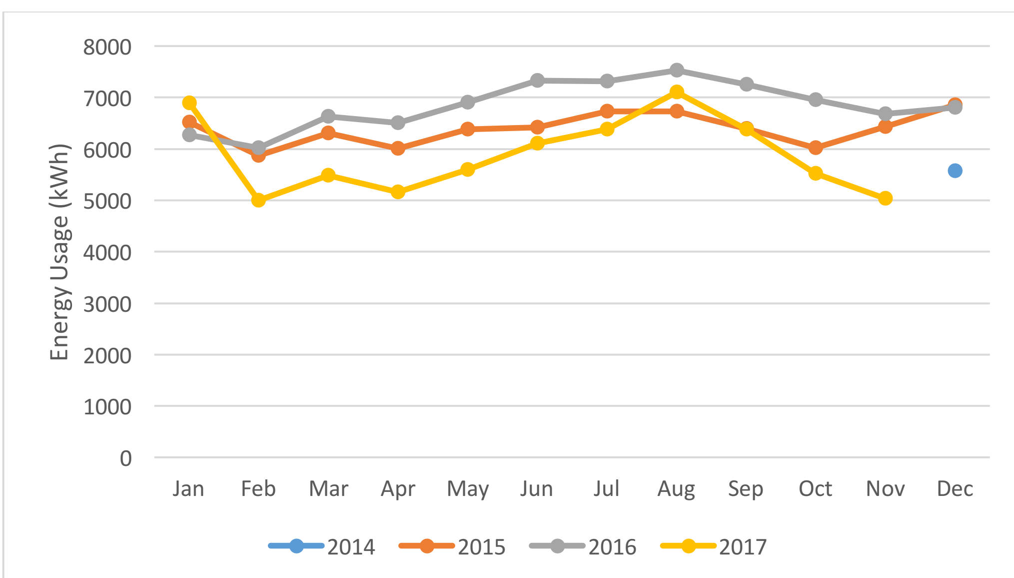


Figure 14: Human Resources & Accounting - Monthly Energy Use (Dec. 2014 - Nov. 2017)



3.8 WUSA – Water Treatment System

Average Annual Use: 69,329 kWh
Peak Demand: 43 kW
Billing History (PG&E): 12/4/2014 to 12/1/2017
Interval Data (PG&E): 12/6/14 to 12/5/17
Comments: Erratic peak loads.

Figure 15: WUSA Singley - Average and Peak Daily Load Profile (Dec. 2014 - Nov. 2017)

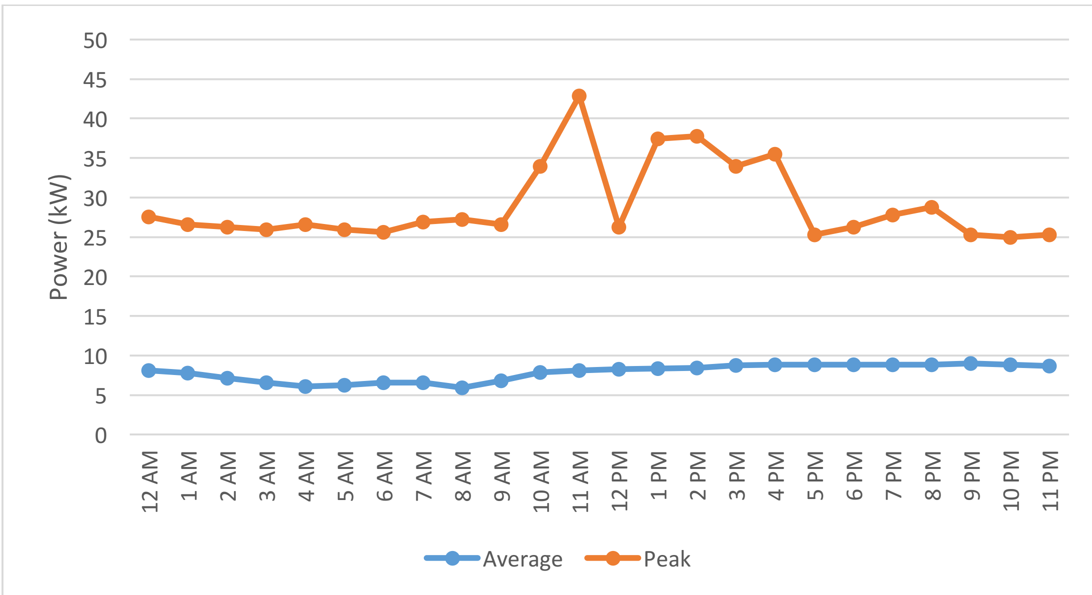
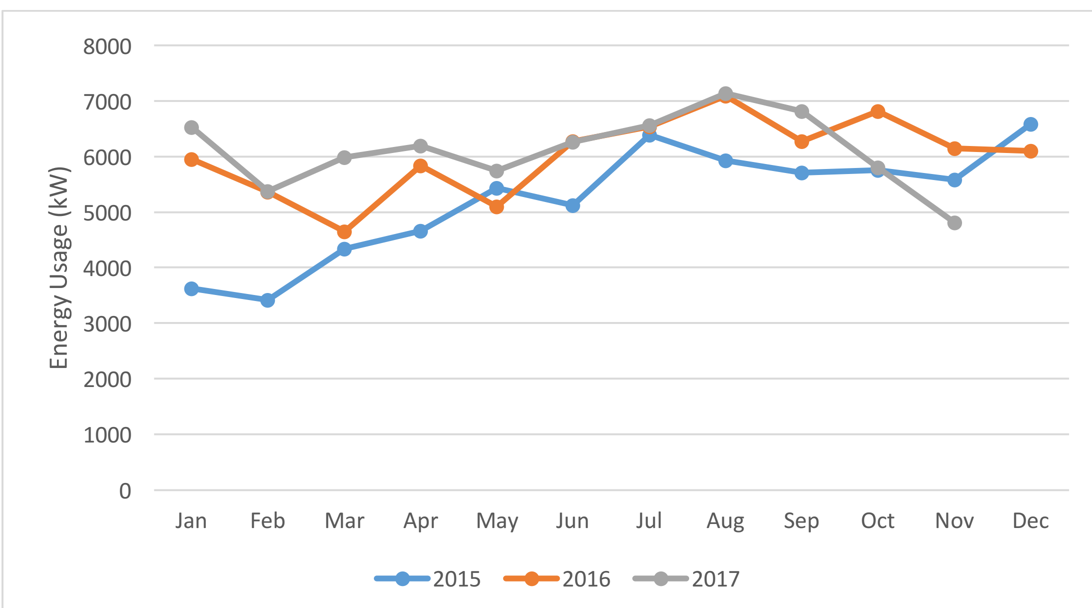


Figure 16: WUSA Singley - Monthly Energy Use (Dec. 2014 - Nov. 2017)



3.9 Billboard

Average Annual Use: 54,407 kWh
Peak Demand: 11 kW
Billing History (PG&E): 12/6/2014 to 12/5/2017
Interval Data (PG&E): 12/6/14 to 12/5/17
Comments: The profile indicates the billboard is operating during daylight and early evening hours and the longer days attributing to the higher use in the summer months.

Figure 17: Billboard - Average and Peak Daily Load Profile (2015 - Nov. 2017)

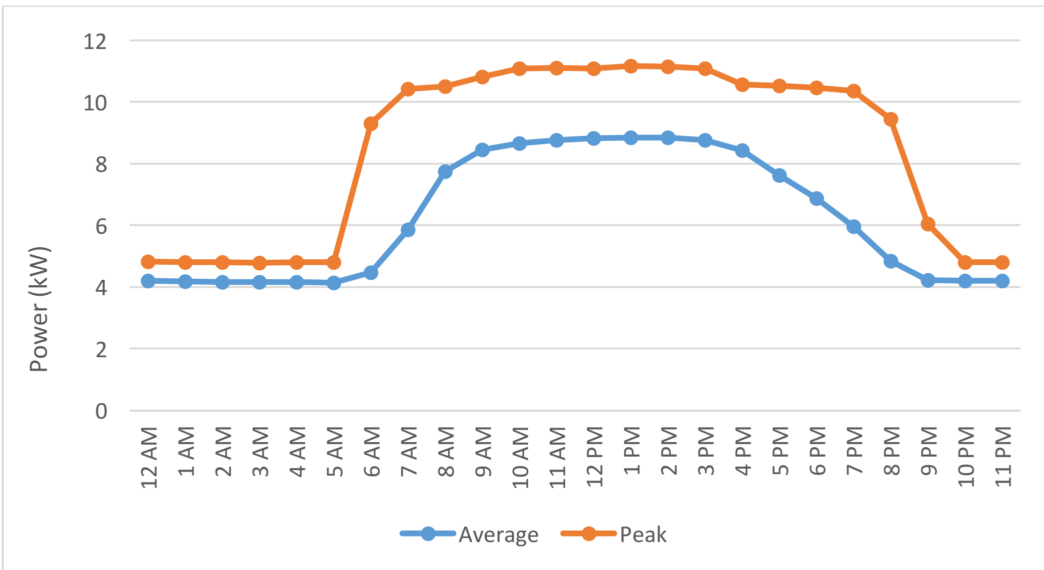
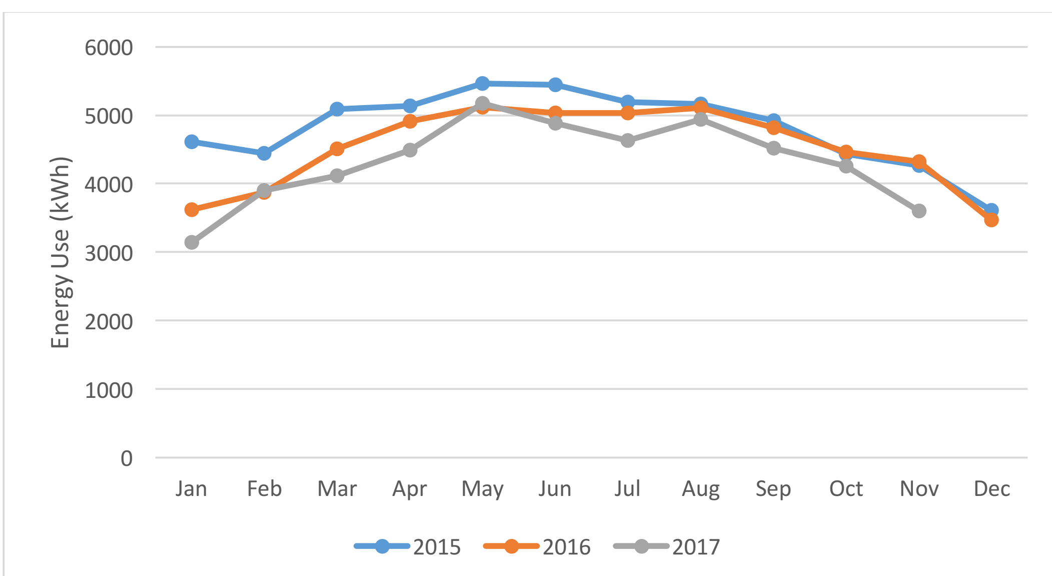


Figure 18: Billboard – Monthly Energy Use (2015 - Nov. 2017)



3.10 Tobacco Traders & Coffee Co.

Average Annual Use: 51,888 kWh
Peak Demand: 13 kW
Billing History (PG&E): 11/14/2014 to 11/9/2017
Interval Data (PG&E): 12/6/14 to 12/5/17
Comments: Early morning peak loads. Less energy use in 2017.

Figure 19: TT & CC - Average and Peak Daily Load Profile (Dec. 2014 - Nov. 2017)

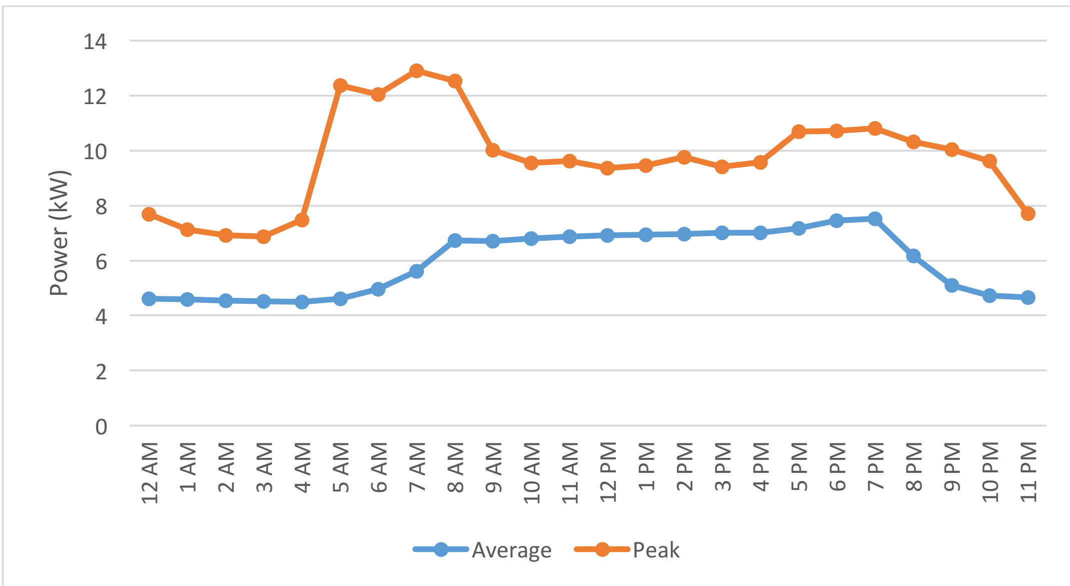
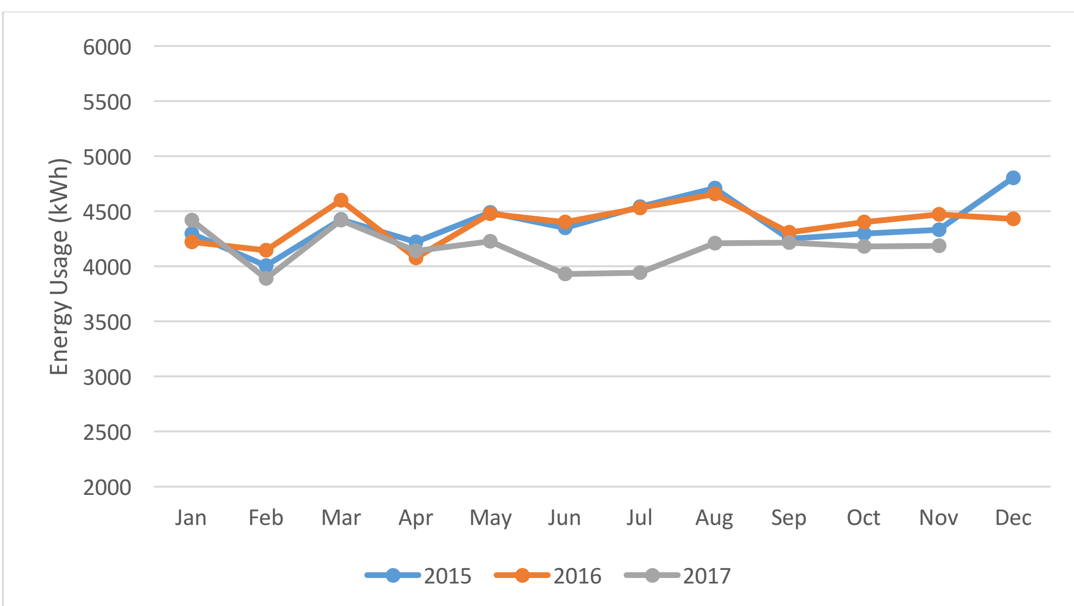


Figure 20: TT & CC – Monthly Energy Use (Dec. 2014 - Nov. 2017)



3.11 Gaming Office

Average Annual Use: 7,548 kWh
Peak Demand: 5 kW
Billing History (PG&E): 12/4/2014 to 11/30/2017
Interval Data (PG&E): 12/6/14 to 12/5/17
Comments: 2017 use higher than previous years.

Figure 21: Gaming Office - Average and Peak Daily Load Profile (2015 - Nov. 2017)

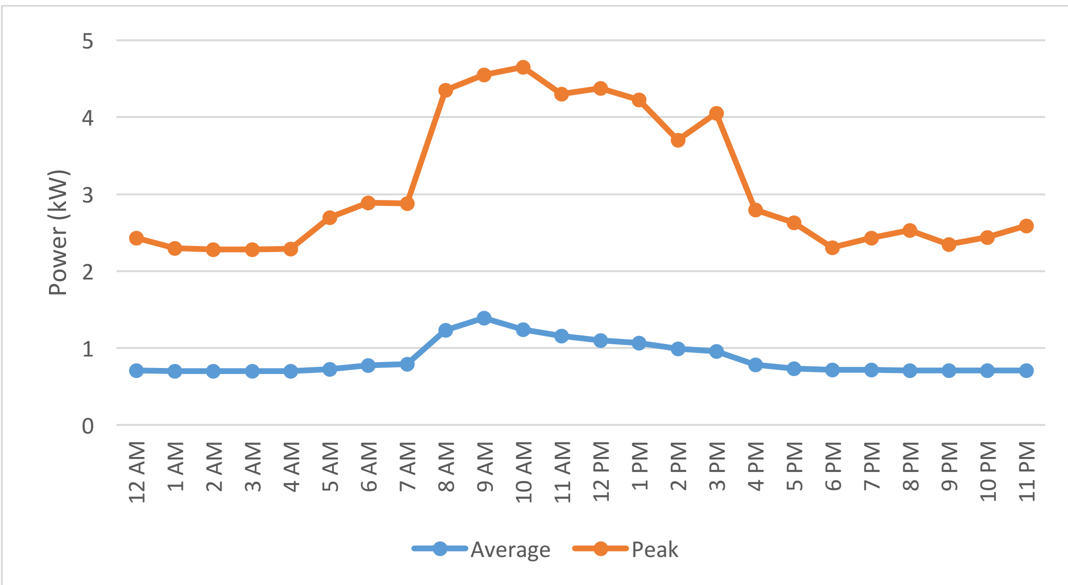
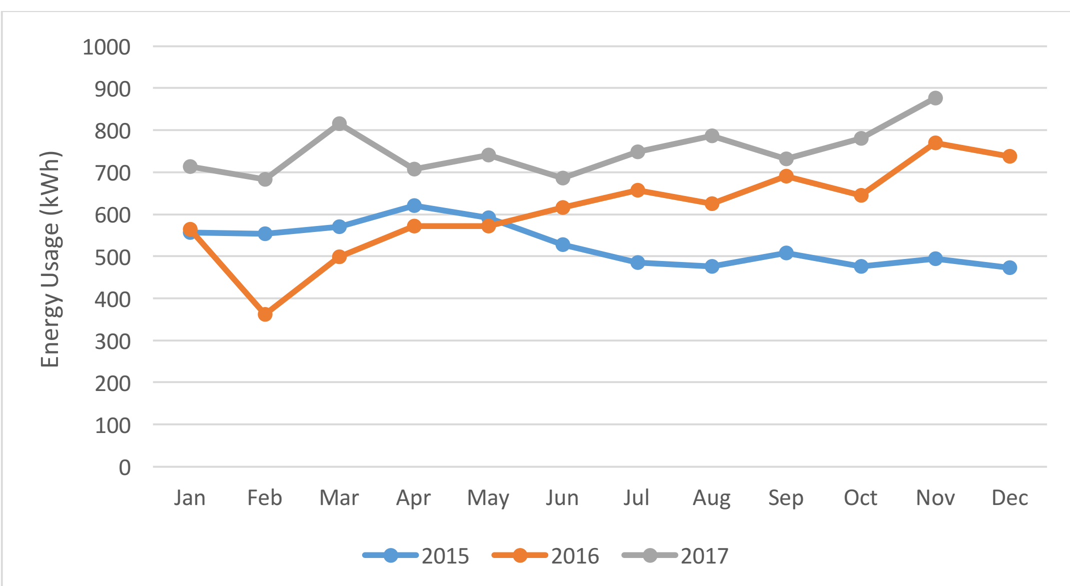


Figure 22: Gaming Office – Monthly Energy Use (2015 - Nov. 2017)



3.12 Energy Assessment Results - Existing Commercial Properties

The billing history and interval data analyses yielded annual energy use for each of the existing commercial properties. For a majority of the accounts, there was data available to calculate the complete annual use for 2015 and 2016. For all accounts, the energy consumption for 2017 was projected using the last 12 months' worth of available data. The results are shown in Table 1 below along with an average annual use. The average energy usage compensates for any yearly variation in building operations and ambient temperature.

The total annual average energy use is 4,649,129 kWh for all commercial facilities. Also shown is the peak demand for each facility during the study period. The total peak demand (906 kW) represents the maximum power delivered to these accounts assuming all facilities were using peak power simultaneously. As shown, the Casino and Hotel together account for the largest portion (71%) of the total energy use and have a combined peak power demand of 592 kW.

Table 1: Energy Use (kWh) and Peak Demand (kW) for Existing Commercial Loads

Facility	*Energy Use 2015*	*Energy Use 2016*	*Energy Use *2017*	*Average Energy Use*	*% of Total*	*Peak Demand*
Casino	2,297,488	2,271,445	2,251,274	2,273,402	48.9%	381
Hotel	1,050,768	1,026,652	1,056,911	1,044,777	22.5%	211
Pump & Play	363,080	355,530	336,339	351,650	7.6%	56
Tish Non Community Center		263,968	281,818	272,893	5.9%	52
Recreation Center			271,765	271,765	5.8%	67
Waste Water Treatment Plant			174,662	174,662	3.8%	48
Human Resources & Accounting	76,701	82,219	71,502	76,808	1.7%	19
WUSA Singley Hill	62,547	72,135	73,305	69,329	1.5%	43
Billboard	57,779	54,298	51,145	54,407	1.2%	11
Tobacco Traders & Coffee Co.	52,736	52,725	50,204	51,888	1.1%	13
Gaming Office	6,332	7,308	9,005	7,548	0.2%	5
			Totals	**4,649,129**	100%	**906**

* the last 12 months of data

4 Estimated Energy Use from Residential Homes

In the Redwood Energy assessment project, the homes were modelled to estimate residential energy use. This modelling work resulted in annual energy consumption estimates for the Bear River Drive homes and the Model A, B, C, D, E homes and the Tish Non Village E, F, homes. These results were presented in their baseline audit report and are reproduced in Table 2 below. Given that these are estimates, subsequent changes in the overall residential energy use due to energy efficiency measures or the addition of new homes are not considered significant enough to reproduce the extensive amount of auditing and modelling work required to generate these estimates. The total combined residential load of 279,298 kWh will be used in this projects energy option planning work.

Table 2: Estimated Energy Use (kWh) for Residential Homes

Facility	*2013-2014*
Bear River Drive Homes (10)	53,284
Model Homes ABCDE and Tish-non Homes EF (41)	226,014
Total	**279,298**

Source: Redwood Energy

5 Estimated Energy Use from Planned Projects

The Tribe is in the process of significantly expanding its infrastructure with six new projects slated for construction in the next two years. The planned projects and their expected completion dates include:

- Recreation Center Phase 3 – Pool (December 2019)
- Bear River Youth Development Center (December 2018)
- Bear River Health and Wellness Center (December 2019)
- Family Entertainment Center (February 2019)
- Two Softball Fields (December 2018)
- Air Conditioning System - Tish Non Community Center (expected June 2018)

SERC has acquired and reviewed available electrical plans and documentation for these new projects and has used this information to estimate anticipated electricity load profiles for each. These estimated profiles are presented in the following sections. Given the limited available information, assumptions including the expected energy use and the operating schedules for the buildings equipment facilities along with the buildings hours of operation were made using a conservative approach. This approach may result in estimated loads higher than actual loads. If needed, a more detailed profile analysis will be conducted for those facilities that could impact the energy option recommendations in future tasks.

The first four facilities listed above use an energy profile estimation method where a Department of Energy (DOE) profile was normalized to the single highest hourly peak load of that profile. Two profiles of representative days per month (288 hour profiles) were then created from the normalized DOE profile: one that uses an average load for each hour of a month, and one that uses a peak load for each hour of a month. Full 8,760 hour profiles were then re-created using these two 288 hour profiles. These were then multiplied by the expected peak load.

5.1 Recreation Center Phase 3 – Pool

Average Annual Use: 546,000 kWh – 573,000 kWh
Peak Demand: 210kW – 213kW

Energy Profile Estimation Method: The anticipated loads were pulled from the electrical one-line and panel schedule shown in 7.2Appendix A. These loads were separated into two main groups which are expected to have different operational profiles:

- Pool equipment, assumed to comprise pumping and filtering loads: representing a total load of 182kVA at 480VAC 3-phase off of new electrical panel R. It is assumed that the full 182kVA pool equipment load will run from midnight to 6 a.m. every day of the year with no seasonal variation.
- Lighting, HVAC, and plug loads: representing a total combined load of 48kVA, comprised of 12.5kVA at 277VAC 3-phase for pool and outdoor lighting off of new electrical panel F, and 35.8kVA at 120/208VAC 1-phase for all other loads off of new electrical panels Q and E. These remaining loads are anticipated to follow an operational profile similar to the "Stand Alone Retail" profile[1] developed by the DOE. Weekend loads were assumed equal to weekday loads.

The assumed operational profile is such that the peak demand of the pool equipment and remaining loads do not occur at the same time. However, the peak demand is still listed as the full pool equipment load plus the highest percentage of the peak load of the remaining loads. This peak load is not shown in the following graphs.

---

[1] An 8,760 hourly load profile for this building type was downloaded from https://openei.org/datasets/files/961/pub/COMMERCIAL_LOAD_DATA_E_PLUS_OUTPUT/USA_OR_Astoria.Rgnl.AP.727910_TMY3/. Profiles for Astoria, OR were used as they are modeled using climate zone 4C (note that Arcata profiles are available, but are modeled using climate zone 4B which is not representative of coastal Humboldt County). For a description of each building type see https://www.energy.gov/eere/buildings/commercial-reference-buildings.

Figure 23: Recreation Center Phase 3 – Estimated Average and Peak Daily Load Profile

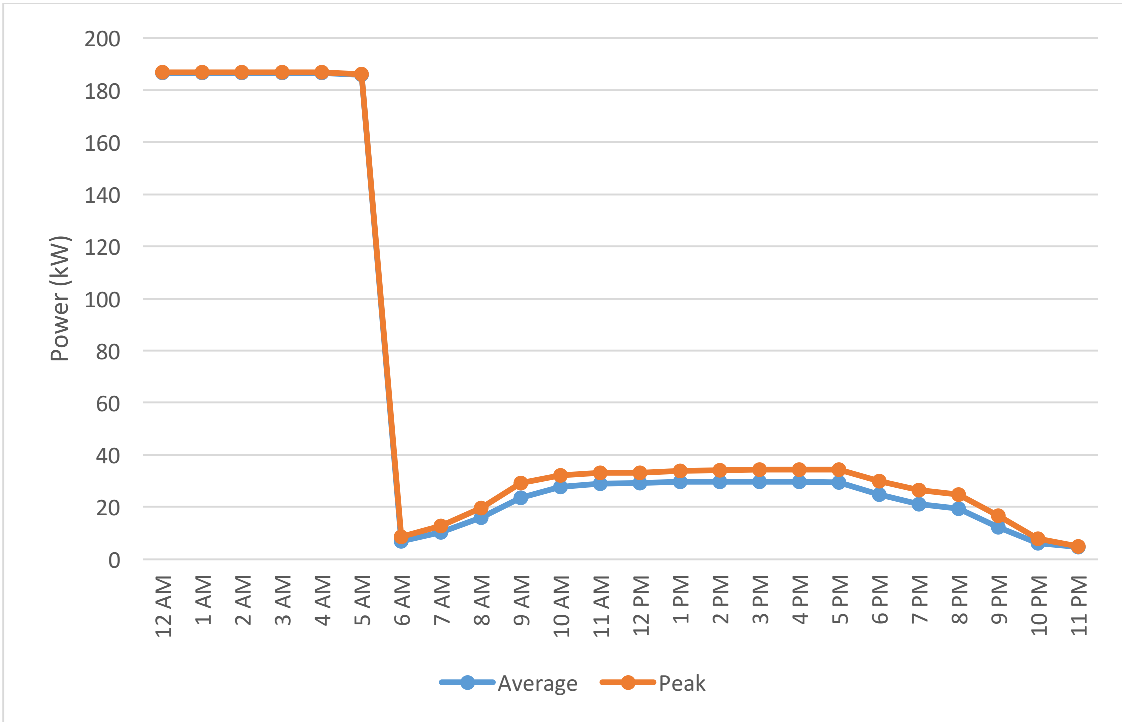
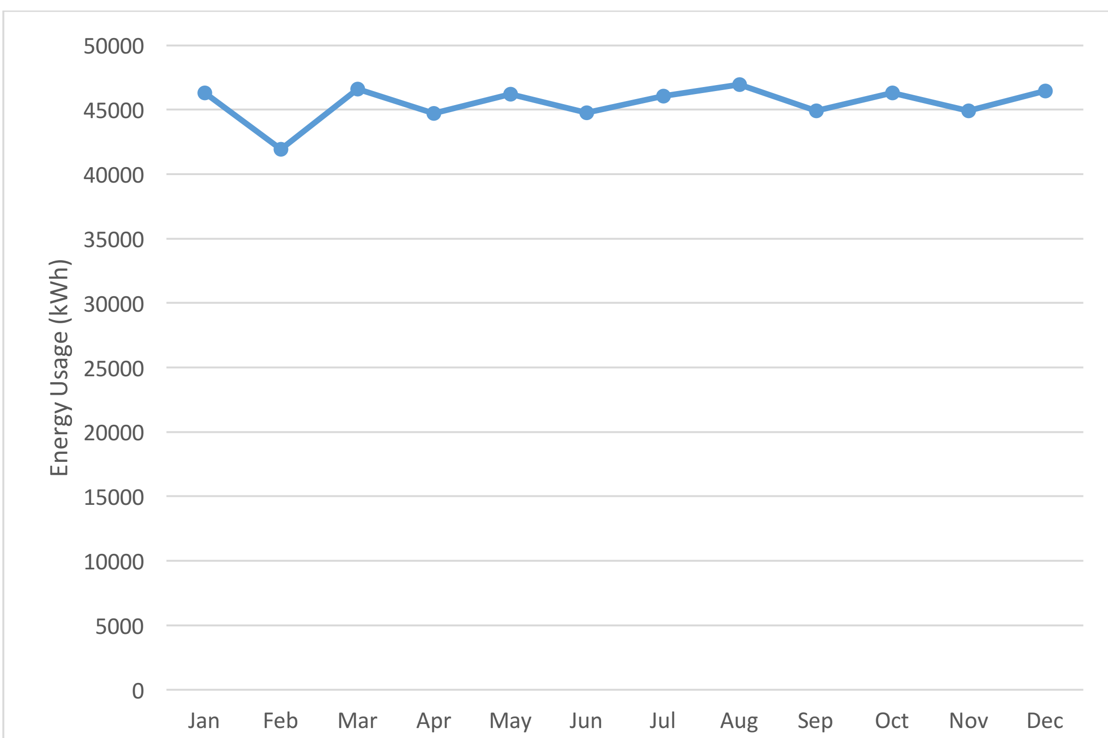


Figure 24: Recreation Center Phase 3 – Estimated Monthly Energy Use



5.2 Bear River Youth Development Center

Average Annual Use: 96,000 kWh – 125,000 kWh
Peak Demand: 20kW – 31kW

Energy Profile Estimation Method: The anticipated loads were estimated based on preliminary design numbers being used for the new Health and Wellness Center obtained directly from the design engineer of that building. This resulted in a total anticipated load of 31kVA at 120/208VAC 3-phase. This was totaled from the following estimates, using an estimated total square footage of 2,600:

- Lighting: 9kVA using 3.5VA per sq. ft.
- Wall Outlets: 3kVA using 1VA per sq. ft.
- HVAC: 9kVA using 1 ton per 350 sq. ft. and 1.2kW per ton
- Additional: 10kVA assuming a fraction of a 50kVA estimate used for the Health and Wellness Center to account for copiers, computers, printers, refrigerator, microwave, etc.

The total 31kVA load is anticipated to follow an operational profile similar to the "Small Office" profile[1] developed by the DOE. Weekend loads were assumed equal to midnight loads (i.e. the Center is assumed closed on the weekend).

Figure 25: Youth Development Center – Estimated Average and Peak Daily Load Profile

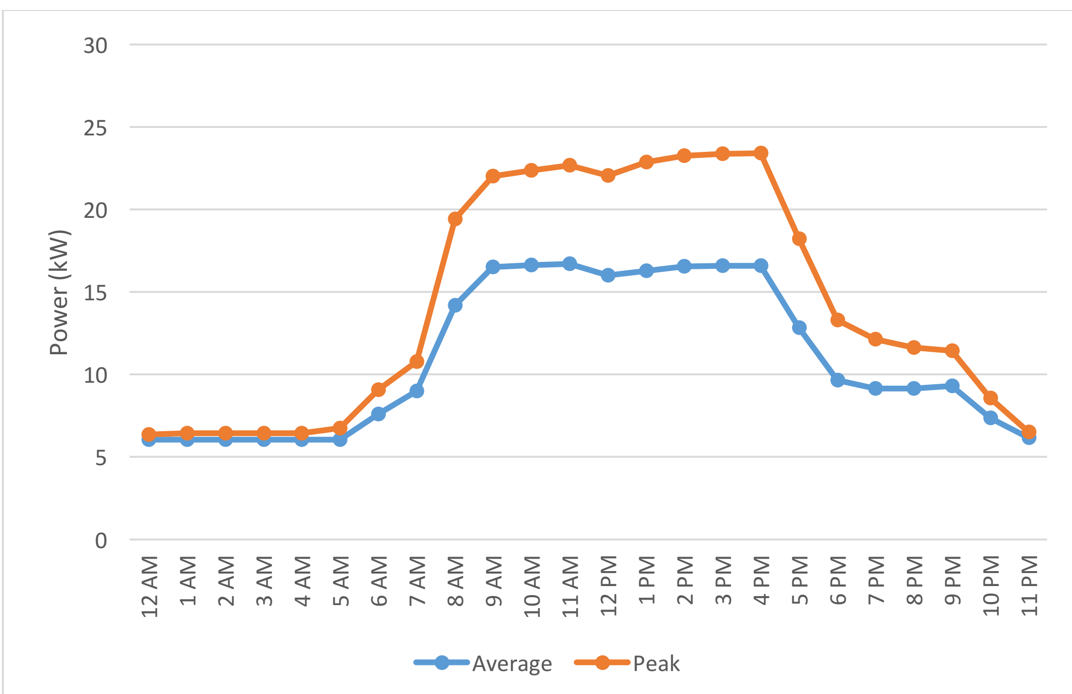
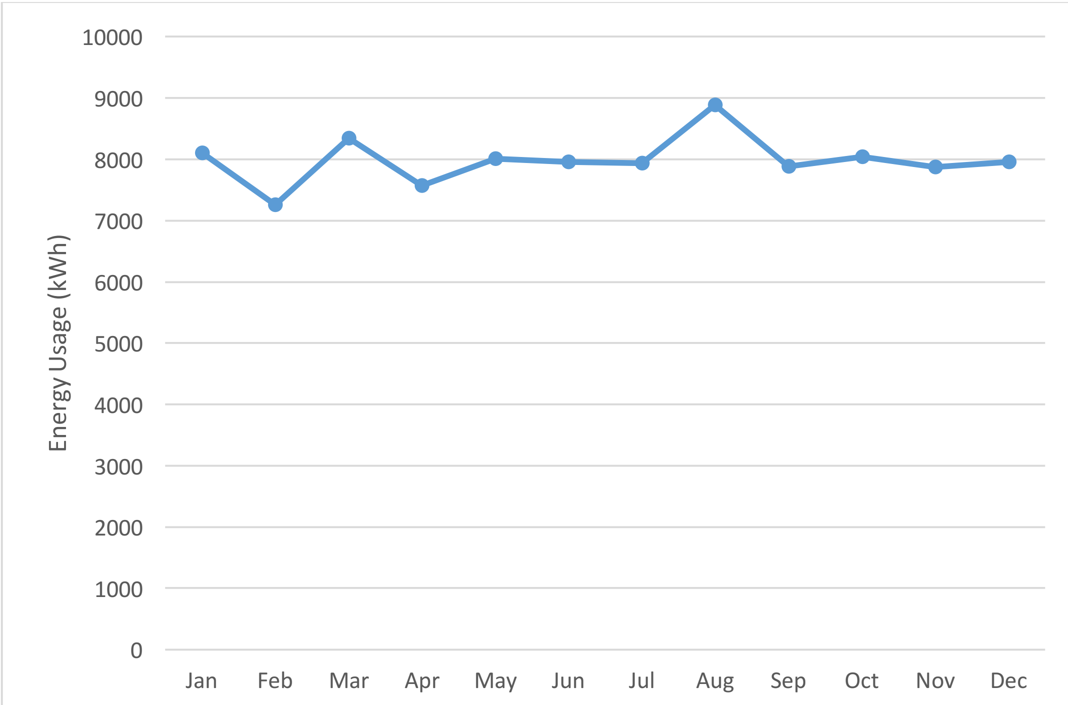


Figure 26: Youth Development Center – Estimated Monthly Energy Use



5.3 Bear River Health and Wellness Center

Average Annual Use: 284,000 kWh – 358,000 kWh
Peak Demand: 66kW – 104kW

Energy Profile Estimation Method: The anticipated loads were estimated based on preliminary design numbers obtained directly from the design engineer. This resulted in a total anticipated load of 104kVA at 120/208VAC 3-phase. This was totaled from the following estimates, using an estimated total square footage of 6,800:

- Lighting: 24kVA using 3.5VA per sq. ft.
- Wall Outlets: 7kVA using 1VA per sq. ft.
- HVAC: 23kVA using 1 ton per 350 sq. ft. and 1.2kW per ton
- Additional: 50kVA estimate to account for medical equipment, copiers, computers, printers, refrigerator, microwave, etc.

The total 104kVA load is anticipated to follow an operational profile similar to the "Small Office" profile[1] developed by the DOE.

Figure 27: Health and Wellness Center – Estimated Average and Peak Daily Load Profile

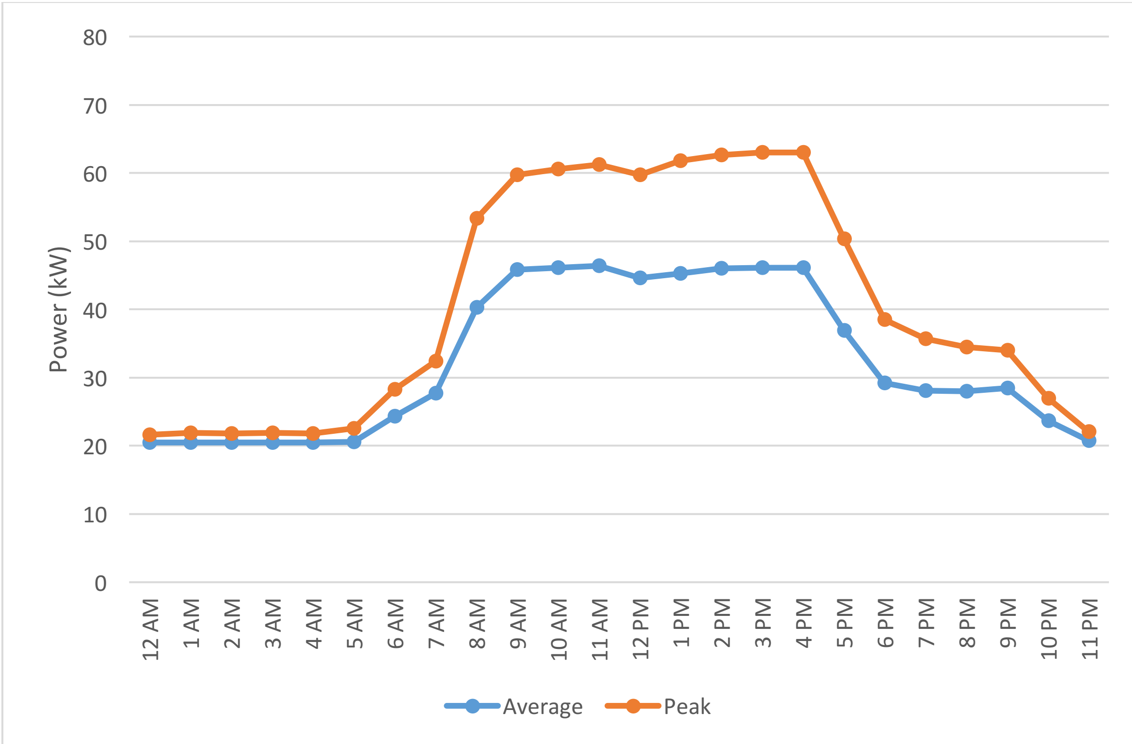
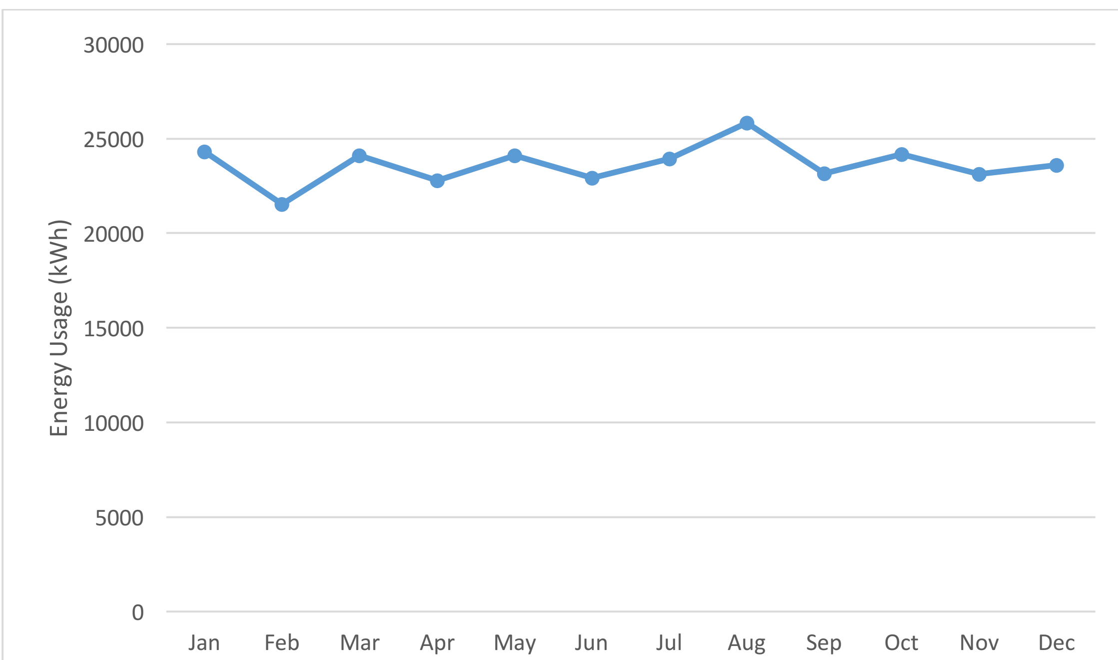


Figure 28: Health and Wellness Center – Estimated Monthly Energy Use



5.4 Family Entertainment Center

Average Annual Use: 1,110,000 kWh – 1,300,000 kWh
Peak Demand: 243kW – 362kW

Energy Profile Estimation Method: The anticipated loads were estimated based on a preliminary electrical one line and associated load calculations obtained from consulting engineering firm. This one line is included in 7.2Appendix A. The load calculations indicate a total anticipated load of 361kVA at 120/208VAC 3-phase. The load is comprised of the following:

- General Equipment: 193.4kVA
- Arcade Equipment: 48kVA
- Kitchen Equipment: 53.3kVA
- Lighting: 34.1kVA
- Receptacles: 24.9kVA
- 25% of largest motor: 7.7kVA

The total 361kVA load is anticipated to follow an operational profile similar to the "Stand Alone Retail" profile[1] developed by the DOE. Weekend loads were assumed equal to weekday loads.

Figure 29: Family Entertainment Center – Estimated Average and Peak Daily Load Profile

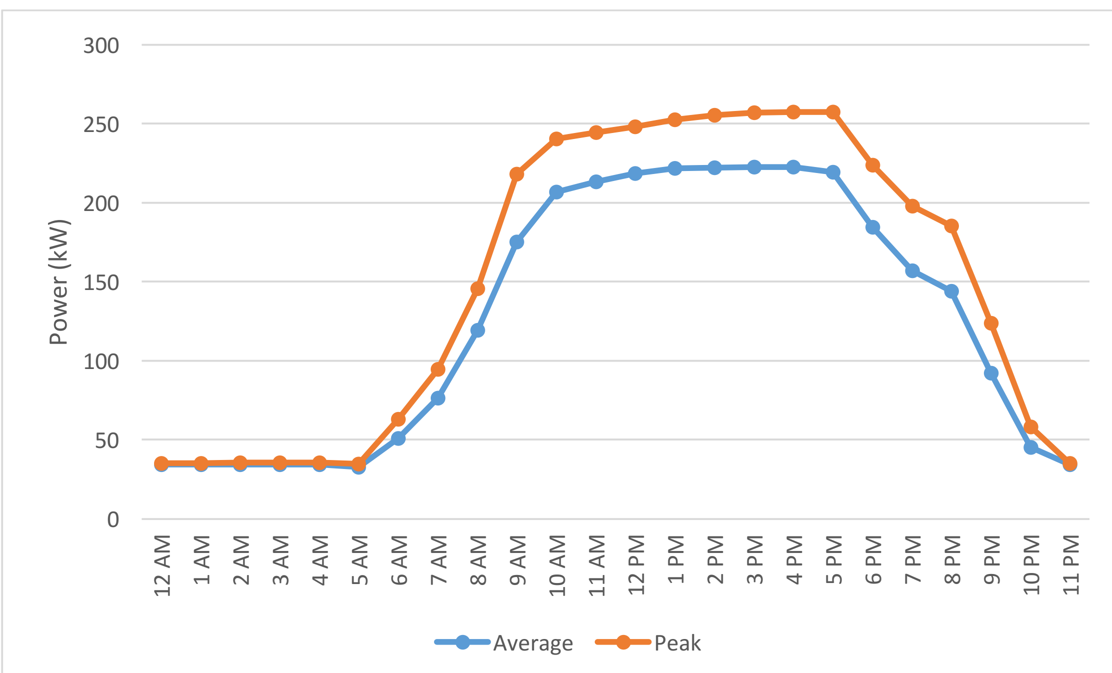
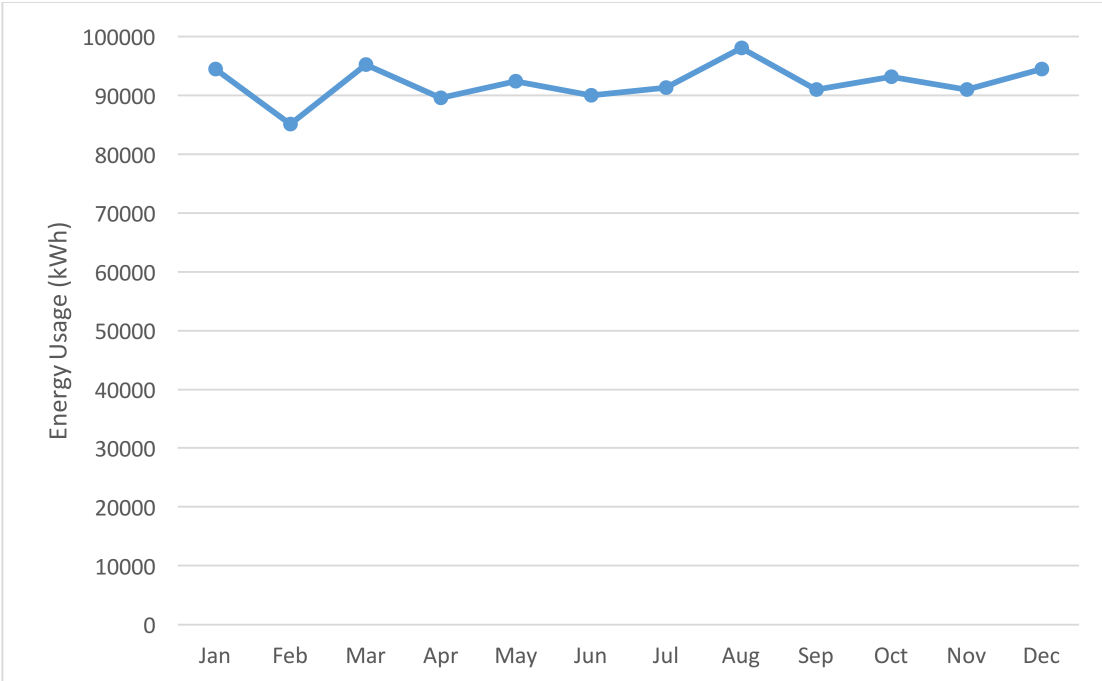


Figure 30: Family Entertainment Center – Estimated Monthly Energy Use



5.5 Softball Fields

Average Annual Use: 38,000 kWh
Peak Demand: 124kW

Energy Profile Estimation Method: The anticipated loads were pulled from the electrical one-line and panel schedule shown in 7.2Appendix A. These loads were separated into two main groups which are expected to have different operational profiles:

- Field lighting: representing a total load of 111kVA at 480VAC 3-phase.
- Concession stand: representing a total load of 18kVA at 208VAC 3-phase.

The softball field is anticipated to only be used during the following times of the year

- May – October
- Wednesday, Friday, Saturday
- 3pm – 10pm

Furthermore, the field lighting load is not turned on until the nearest integer hour before sunset. This means the concession stand load starts earlier in the day than the lighting load. The lighting load is assumed 100% of total load at all times when in use. The concession load is assumed 75% of total load at all times when in use except the opening and closing hours where it is assumed 50% of total load. All loads are assumed zero all other times of the year.

Figure 31: Softball Fields – Estimated Average Daily Load Profile

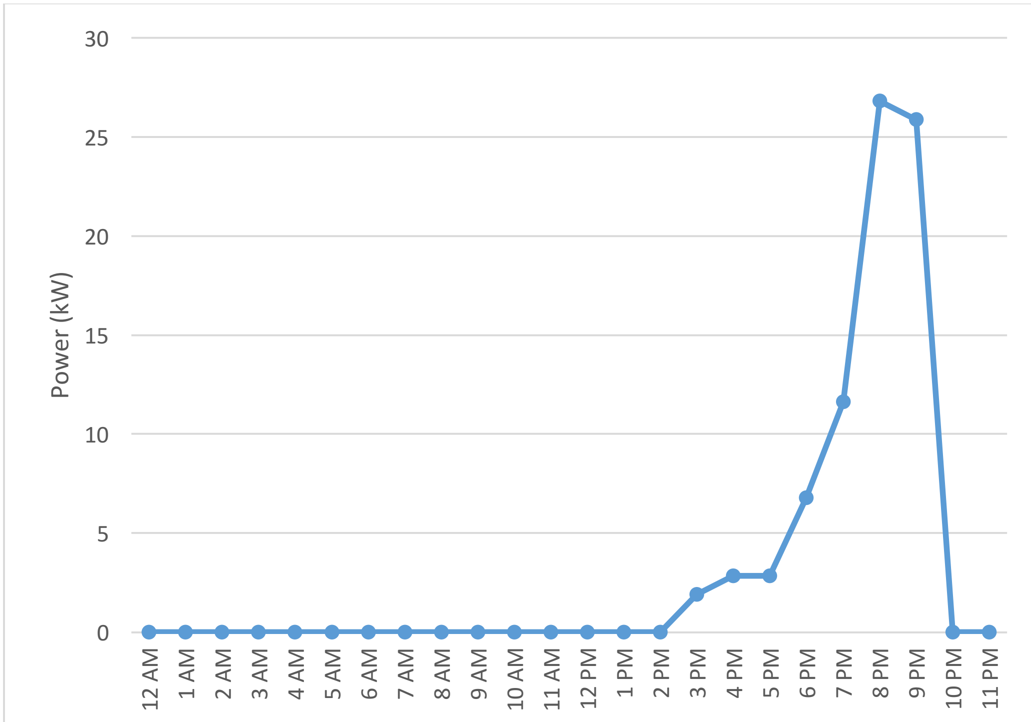
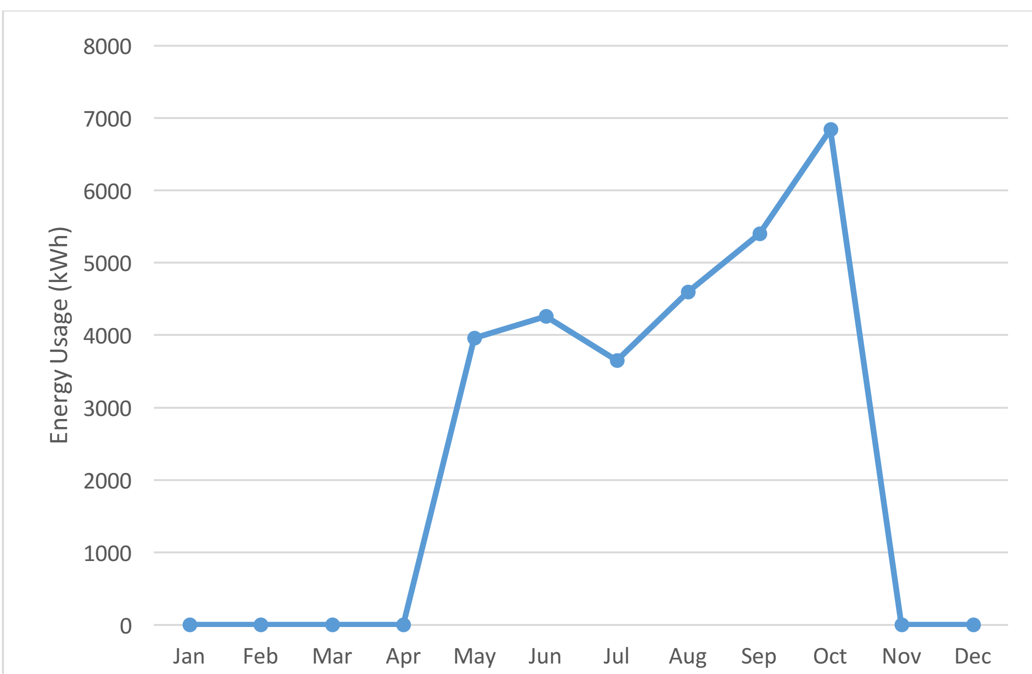


Figure 32: Softball Fields – Estimated Monthly Energy Use



5.6 Air Conditioning System at the Tish Non Community Center

Average Annual Use: 14,000 kWh
Peak Demand: 42kW

Energy Profile Estimation Method: The air conditioning load is estimated based on the consulting design firm's estimate of a total AC system size of 10 units at 3.5 tons each for a total size of 35 tons. Assuming a Seasonal Energy Efficiency Ratio (SEER) of 10, the total electrical power load is assumed to be 42kW.

The operational profile was estimated based on combination of the ambient air temperature and the global direct sunlight measurements from the SoRMS data set in Arcata[2]. The AC units are assumed to not operate unless the ambient air temperature is at or above 18ºC. This value was chosen as it is the temperature used to define a cooling degree day.

In addition to the ambient air temperature criteria, the AC units are assumed to operate only during hours after 12PM, and when the global direct sunlight is estimated to be 50% or greater of the peak value of 928 watts per square meter reported in the SoRMS data[3]. Operation only after 12PM was chosen because the majority of insolation heating load affects the west side of the building where the majority of windows and offices are located. Furthermore, it is assumed that if the AC units do kick on at some point during the day, the AC units are assumed to stop operation if the global direct insolation drops below 40% of the peak value. The AC units are also assumed to not operate if the global direct sunlight is zero, such as on cloudy or foggy days or at night. When operational, the anticipated load is the full 42kW.

Total energy consumption is calculated by assuming that the AC units will operate 40% of any given hour (24 minutes for every operational hour). The AC units are assumed to operate on the weekends as well.

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[2] Data available at http://midcdmz.nrel.gov/hsu/.

[3] The building heating load is primarily driven by direct solar insolation, not outside ambient air temperature. Therefore, an insolation criteria is also imposed on the assumed AC operational profile.

Figure 33: TNCC Air Conditioning System – Estimated Average Daily Load Profile

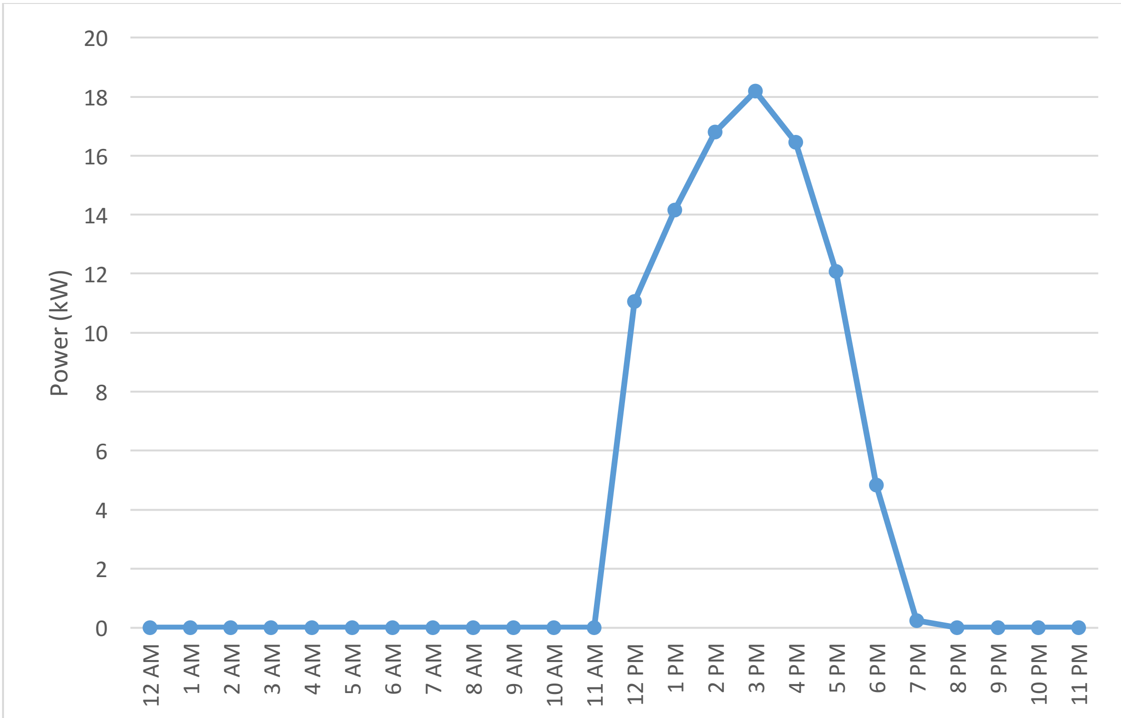
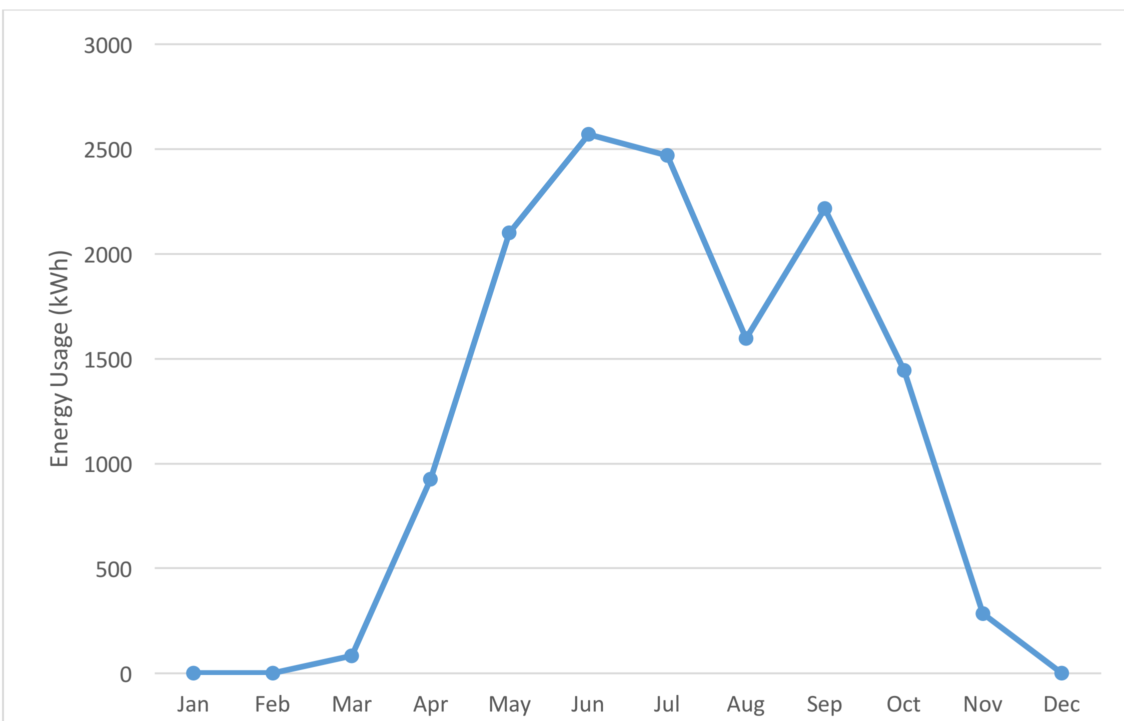


Figure 34: TNCC Air Conditioning System – Estimated Monthly Energy Use



5.7 Summary of Results – Planned Projects

Given that the operating schedules for the major building equipment are unknown, a range of energy usage and peak demand were estimated for most of the buildings with the average for these ranges shown in Table 3 below. The total energy use estimated for the new projects is estimated to be approximately 2,248,000 kWh per year with a total estimated demand of 790 kW.

Table 3: Average Energy Use (kWh) and Average Peak Demand (kW) for Planned Projects

Facility	*Average Energy Use*	*% Total*	*Average Peak*	*% Total*
Family Entertainment Center	1,205,000	54%	302	38%
Recreation Center Phase 3 – Pool	560,000	25%	212	27%
Bear River Health and Wellness Center	321,000	14%	85	11%
Bear River Youth Development Center	110,000	5%	26	3%
Two Softball Fields	38,000	2%	124	16%
Air Conditioning System - TNCC	14,000	1%	42	5%
Totals	**2,248,000**	**100%**	**790**	**100%**

6 Total Projected Load and Recommendations

The projected load for the Rancheria was determined by combining the existing annual energy use for the commercial properties, the modeled energy use for the residential properties, and the estimated energy use from the new planned projects. The energy usage and peak loads for each of these three categories are presented in the table below and result in a projected load of 7,176,427 kWh with a peak demand of 1,728 kW for 2020.

Table 4: Total Projected Annual Energy Use (kWh) and Peak Demand (kW)

Category	*Projected Annual Energy Use - 2020*	*% Total*	*Peak Demand*	*% Total*
Commercial	4,649,129	65%	906	52%
Planned Projects	2,248,000	31%	790	46%
Residential	279,298	4%	32	2%
Total Projected	**7,176,427**	**100%**	**1,728**	**100%**

Operation of the planned projects represents an estimated 45% increase in annual energy use and an 84% increase in total projected peak demand. The total projected load will be used to formulate the various options that will be presented in the energy options implementation plan.

Based on the results, it is recommended that:

- more detailed operational profiles be pursued for those accounts identified in the energy options tasks that may impact future design recommendations (e.g. the Family Entertainment Center, the Recreational Pool, and the Health and Wellness Center),
- energy efficiency measures be employed for the planned projects to minimize energy usage and costs, and
- most importantly, the electrical systems for the new projects be made solar and battery ready to enable easy integration of solar plus energy systems.

7 Heating Load Assessment

In their 2016 energy auditing work, Redwood Energy quantified the gas usage for the existing residential and commercial properties and provided a detailed list of recommended product replacements for converting gas-fired appliances (e.g. heaters, gas grills, ovens, etc.) to electrical appliances. A review of their results was performed and current gas usage results are provided for the large commercial properties where utility data was obtained. Given the past recommendations for home improvements, the residential properties were not re-assessed at this time. Gas consumption for the planned projects was also not evaluated.

7.1 Gas Use by the Large Existing Commercial Properties

Utility billing history data files were obtained and analyzed for the following large commercial properties. The annual and a 3-year average consumption for the facilities are shown in Table 5 resulting in a total average annual usage of 75,753 therms.

Table 5: Gas Usage (Therms) from Large Commercial Facilities

Facility	*2015*	*2016*	**2017*	*Average*	*% Total*
Hotel	40,052	41,057	41,611	40,907	54%
Casino	21,754	27,320	29,591	26,222	35%
Tish Non Community Center	4,755	6,723	7,118	6,199	8%
Recreation Center			2,426	2,426	3%
			Totals	**75,753**	**100%**

7.2 Gas Usage by Residential Homes

In 2016, Redwood Energy conducted an assessment of the gas consumption from the Bear River Drive homes and the Model A, B, C, D, E and the Tish Non Village E, F, homes. These results were presented in from their baseline audit report and are reproduced in Table 6 below.

Table 6: Gas Usage (Therms) for Residential Homes

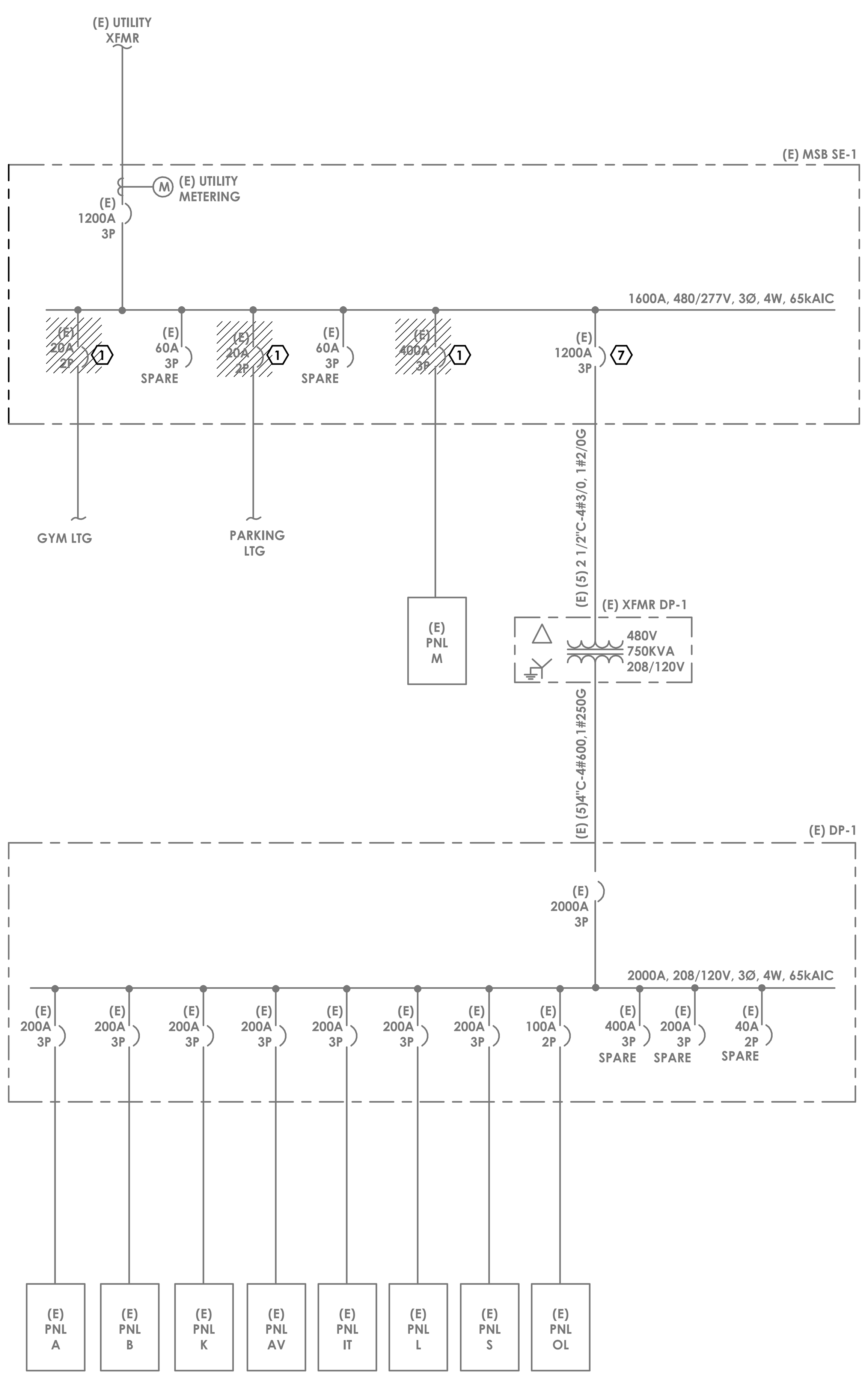
Facility	*Annual (2013-2014)*	% Total
Bear River Drive Homes (10)	5,094	20%
Model Homes ABCDE and Tish-non Homes EF (41)	20,691	80%
Totals	**25,785**	**100%**

Source: Redwood Energy

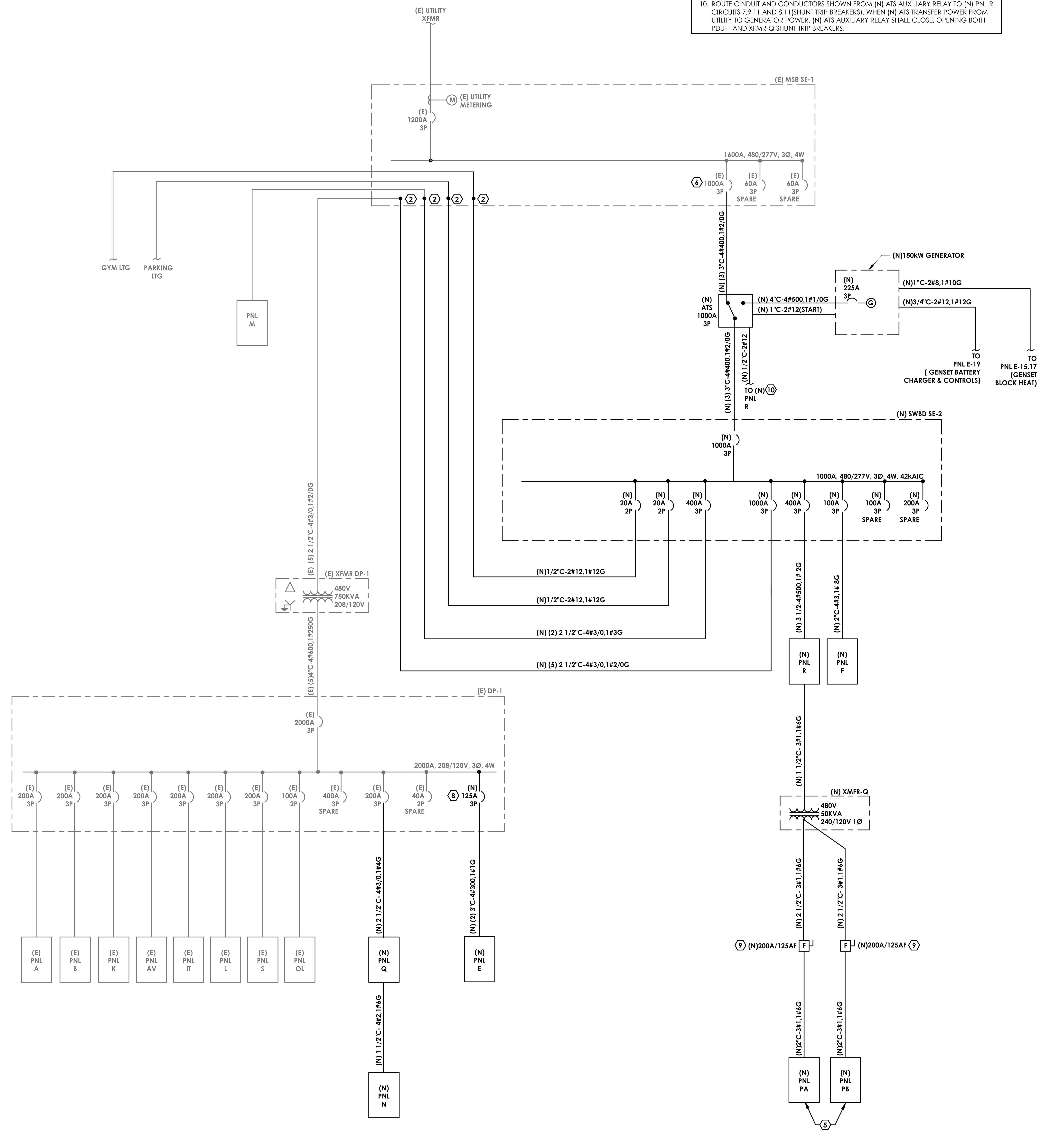
Appendix A Electrical Plans and Information Used for Estimating Loads of New Projects

KEYNOTES

#	NOTE
1.	DISCONNECT AND REMOVE EXISTING BREAKER. EXISTING CONDUCTORS SHALL BE SPLICED. SEE NEW ONE-LINE DIAGRAM, KEYNOTE 2, THIS SHEET.
2.	SPLICE NEW CONDUCTORS TO EXISTING AS SHOWN USING POLARIS IPL SERIES CABLE CONNECTORS (OR EQUAL).
3.	PROVIDE AND INSTALL NEW BREAKER AS SHOWN.
4.	PROVIDE AND INSTALL (N)FUSED DISCONNECTS OR BREAKER ENCLOSURES AS SHOWN. VERIFY FINAL FUSE/BREAKER SIZE AND CONDUIT/CONDUCTOR FEEDERS TO POOL MFR PROVIDED EQUIPMENT.
5.	COORDINATE PROVISION AND INSTALLATION OF POOL EQUIPMENT AND CONTROLS WITH POOL EQUIPMENT PROVIDER/INSTALLER. ELECTRICAL CONTRACTOR SHALL PROVIDE BREAKER SHOWN AND CONDUIT/CONDUCTORS TO (N) PANEL SHOWN.COORDINATE PROVISION AND INSTALLATION OF POOL EQUIPMENT AND CONTROLS WITH POOL EQUIPMENT PROVIDER/INSTALLER. ELECTRICAL CONTRACTOR SHALL PROVIDE BREAKER SHOWN AND CONDUIT/CONDUCTORS TO (N) PANEL SHOWN.
6.	SET EXISTING 1200 A BREAKER TO TRIP AT 1000A.
7.	DISCONNECT EXISTING CONDUCTORS FROM EXISTING BREAKER AS SHOWN. SPLICE TAP AS SHOWN IN THE NEW ONE-LINE DIAGRAM, THIS SHEET. BREAKER SHALL BE REUSED TO FEED THE NEW ATS.
8.	PROVIDE AND INSTALL NEW BREAKER AS SHOWN IN EXISTING SPACE. BREAKER SHALL BE OF SAME TYPE AND RATING AS EXISTING. NOTIFY PROJECT ENGINEER IF THERE IS NO SPACE AVAILABLE.
9.	VERIFY FUSE SIZE WITH POOL EQUIPMENT PROVIDER
10.	ROUTE CINDUIT AND CONDUCTORS SHOWN FROM (N) ATS AUXILIARY RELAY TO (N) PNL R CIRCUITS 7,9,11 AND 8,11(SHUNT TRIP BREAKERS). WHEN (N) ATS TRANSFER POWER FROM UTILITY TO GENERATOR POWER, (N) ATS AUXILIARY RELAY SHALL CLOSE, OPENING BOTH PDU-1 AND XFMR-Q SHUNT TRIP BREAKERS.



DEMO ONE-LINE DIAGRAM 1 E0.4



NEW ONE-LINE DIAGRAM 2 E0.4

REVISIONS

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(707) 444-3440 www.cleekco.com

PACE ENGINEERING REDDING, CALIFORNIA

No. E 017988 ELECTRICAL STATE OF CALIFORNIA

BEAR RIVER RECREATION CENTER ROHNERVILLE RANCHERIA PHASE 3

265 KEISNER ROAD LOLETA, CA 95551

SHEET NAME
ONE-LINE DIAGRAM

SHEET NUMBER
E0.4

DATE: 2/12/18
DRAWN BY: BE/FC
CHECKED BY: TB

BEAR RIVER RECREATION CENTER ROHNERVILLE RANCHERIA 1334.02

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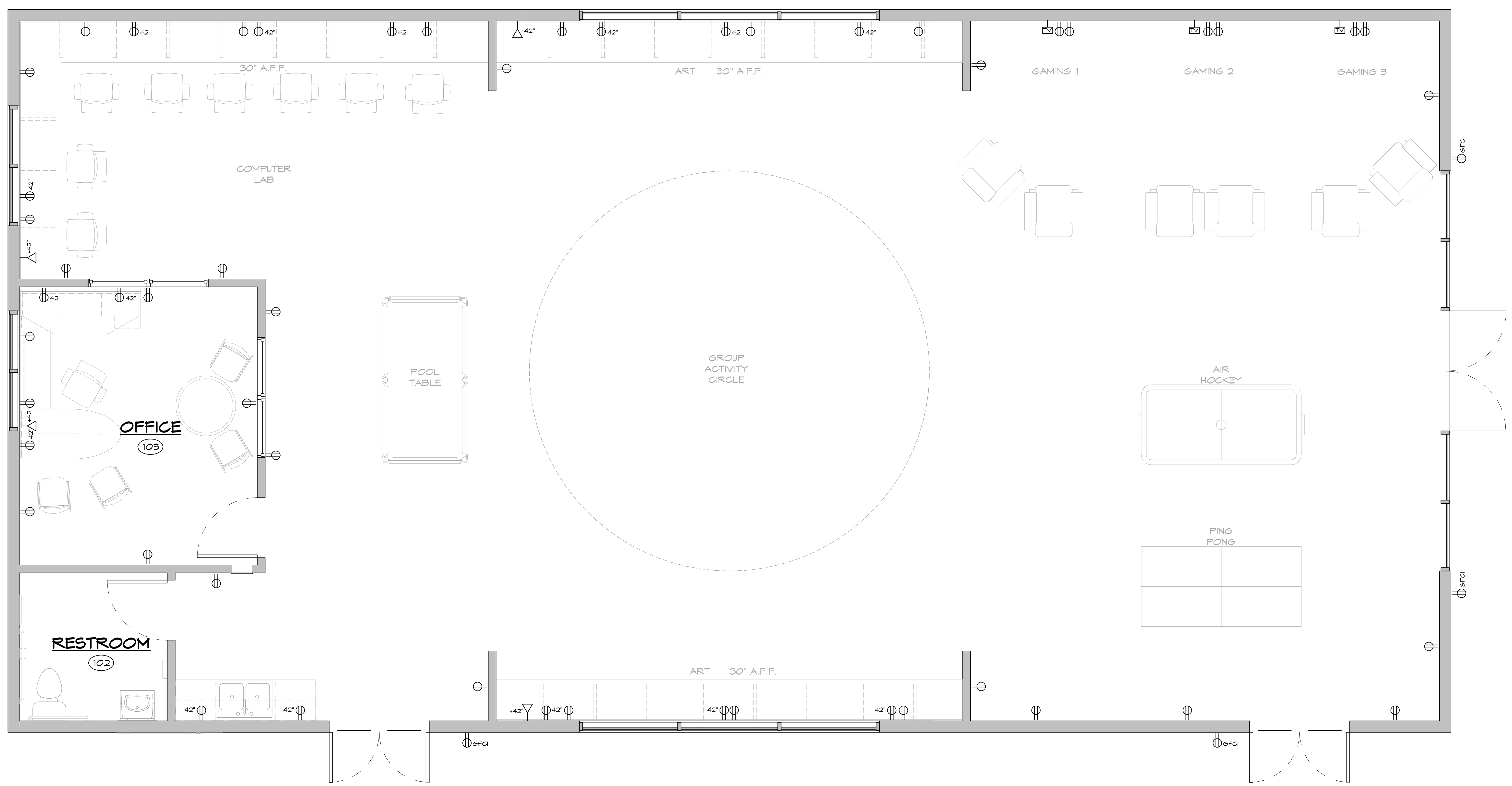
2/12/2018 3:48:14 PM



1 POWER PLAN
1/4" = 1'-0"

PANEL REF.				SUPPLY VOLTAGE			
LOCATION				TERM TYPE			
FED FROM				PHASE & WIRE			
SERVICE				FEEDER CABLES			

CIRCUIT REFERENCE	CIRCUIT DESCRIPTION	BREAKER/ AMP	PHASE	PHASE	BREAKER/ AMP	CIRCUIT DESCRIPTION	CIRCUIT REFERENCE
1							2
3							4
5							6
7							8
9							10
11							12
13							14
15							16
17							18
19							20
21							22
23							24
25							26
27							28
29							30

2 PANEL SCHEDULE
1/4" = 1'-0"

1. BOND ALL METAL GAS AND WATER LINES. CEC 250.104(A), 250.104(B), 250.68(B)
2. NEED PROPER ACCESSIBILITY, WORKING CLEARANCES AROUND ELECTRICAL EQUIPMENT. 30" MIN. OR WIDTH OF EQUIPMENT AND 36" MIN. DEPTH CEC 110.26, 230.70(A)(1), 230.91, 240.24
3. ALL ELECTRICAL WIRING AND EQUIPMENT SUBJECT TO PHYSICAL DAMAGE SHALL BE PROTECTED. CEC 547.5 (E)
4. ALL ELECTRICAL TO BE SECURELY FASTENED AND SUPPORTED BY AN APPROVED MEANS IN ACCORDANCE WITH 2016 CEC.
5. ALL INTERIOR AND EXTERIOR LIGHTS TO BE HIGH EFFICACY
6. ELECTRICAL RECEPTACLE OUTLETS 48" MAX. TO TOP OF BOX AND 15" MINIMUM TO BOTTOM OF BOX ABOVE FINISH FLOOR. 11B-308.2.1

3 ELECTRICAL NOTES
1" = 1'-0"

+42" PHONE
+42" INTERNET
+42" PHONE/INTERNET COMBO
TELEVISION
OUTLET
GFCI GROUND FAULT CIRCUIT INTERRUPTER OUTLET
WP = WEATHER PROOF

4 ELECTRICAL LEGEND
1/4" = 1'-0"

REVISIONS

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APN 309-071-016

SHEET NAME
POWER PLAN

SHEET NUMBER
E-1

DATE: 2/27/2018
DRAWN BY: DCM
CHECKED BY: PA

BEAR RIVER YOUTH DEVELOPMENT CENTER
17073

2/27/2018 10:35:59 AM

Subject: RE: Projects

DJ,

Here are some very preliminary numbers for you to chew on:

Lighting: 6,800 square feet at 3.5 VA/square foot (per CEC 220) is roughly 20,400 VA.

Power/Receptacles: 6,800 square feet at 1.0 VA/square foot (per CEC 220) is roughly 6,800 VA.

HVAC: 1 ton/350 square feet and 1.2kW/1 ton yields roughly 24,000 VA.

Special Loads: Items such as medical equipment, copiers, microwaves, refrigerators, and any other load that need dedicated power. Estimated at 50,000 VA

Total load approximation is 101,200 VA which yields a 400A service at 120/208V, 3-phase, 4-wire.

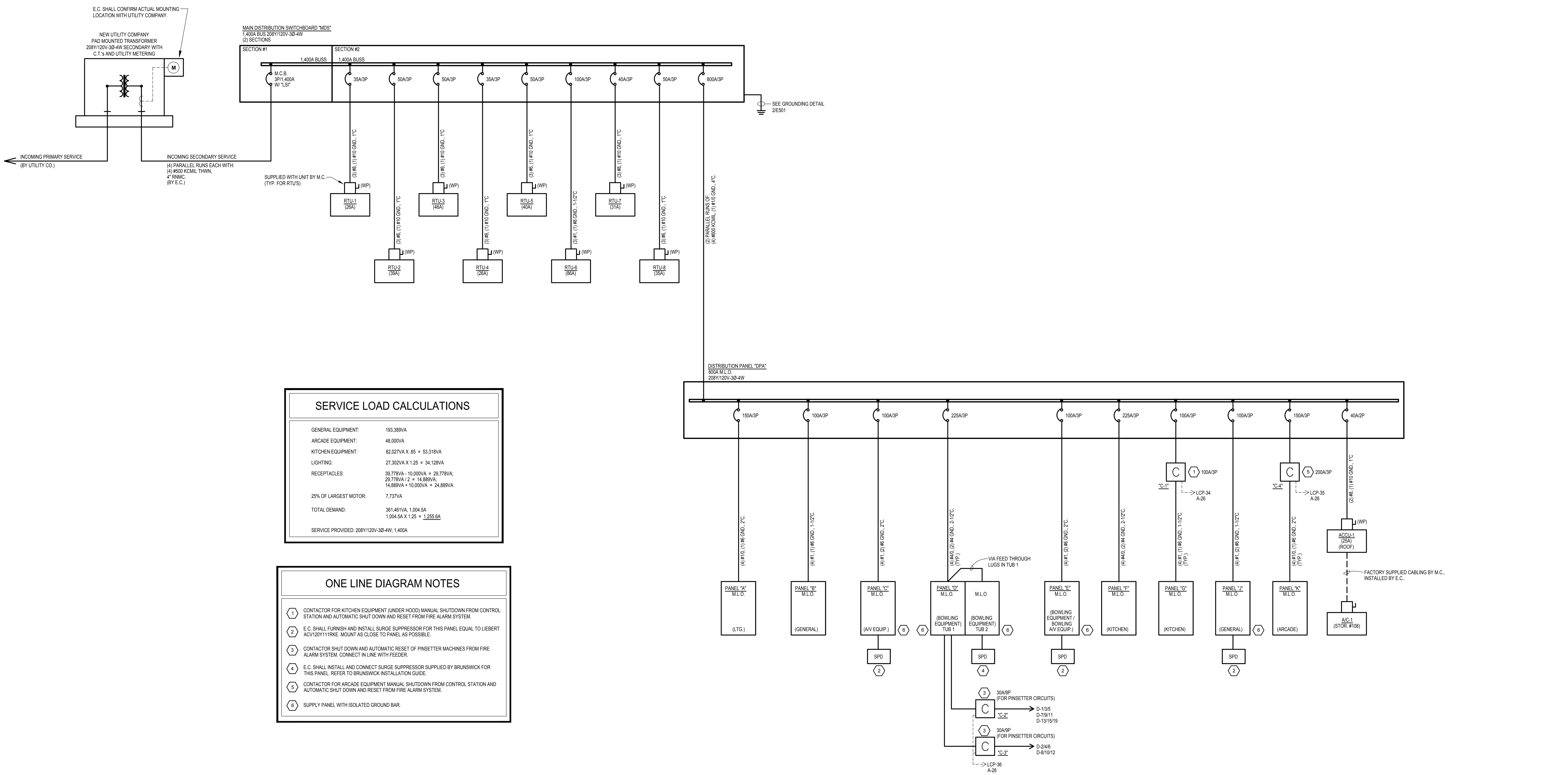
Hope this helps, let me know if anything else is needed at this time.

Thanks!

Tony Bowser, P.E.

PACE Engineering, Inc
1730 South St.
Redding, CA 96001
tbowser@paceengineering.us
Ph: 530-244-0202

Fax: 530-244-1978



SERVICE LOAD CALCULATIONS

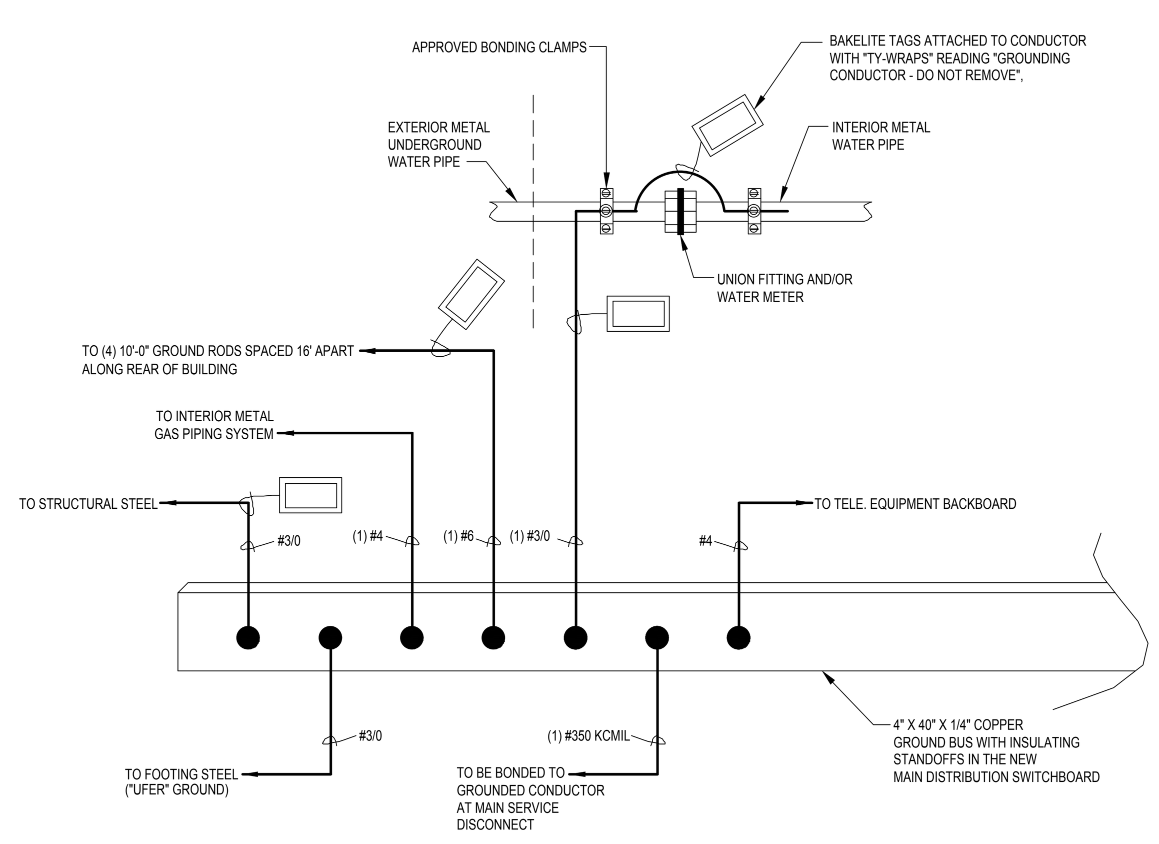
GENERAL EQUIPMENT:	193,389VA
ARCADE EQUIPMENT:	48,000VA
KITCHEN EQUIPMENT:	82,027VA X .65 = 53,318VA
LIGHTING:	27,302VA X 1.25 = 34,128VA
RECEPTACLES:	39,778VA - 10,000VA = 29,778VA; 29,778VA / 2 = 14,889VA; 14,889VA + 10,000VA = 24,889VA
25% OF LARGEST MOTOR:	7,737VA
TOTAL DEMAND:	361,461VA, 1,004.5A 1,004.5A X 1.25 = 1,255.6A

SERVICE PROVIDED: 208Y/120V-3Ø-4W; 1,400A

ONE LINE DIAGRAM NOTES

1. CONTACTOR FOR KITCHEN EQUIPMENT (UNDER HOOD) MANUAL SHUTDOWN FROM CONTROL STATION AND AUTOMATIC SHUT DOWN AND RESET FROM FIRE ALARM SYSTEM.
2. E.C. SHALL FURNISH AND INSTALL SURGE SUPPRESSOR FOR THIS PANEL EQUAL TO LIEBERT ACV120Y111RKE. MOUNT AS CLOSE TO PANEL AS POSSIBLE.
3. CONTACTOR SHUT DOWN AND AUTOMATIC RESET OF PINSETTER MACHINES FROM FIRE ALARM SYSTEM. CONNECT IN LINE WITH FEEDER.
4. E.C. SHALL INSTALL AND CONNECT SURGE SUPPRESSOR SUPPLIED BY BRUNSWICK FOR THIS PANEL. REFER TO BRUNSWICK INSTALLATION GUIDE.
5. CONTACTOR FOR ARCADE EQUIPMENT MANUAL SHUTDOWN FROM CONTROL STATION AND AUTOMATIC SHUT DOWN AND RESET FROM FIRE ALARM SYSTEM.
6. SUPPLY PANEL WITH ISOLATED GROUND BAR.

1 E-501 ELECTRICAL ONE-LINE DIAGRAM
N.T.S.



NOTES:
1. GROUNDING ELECTRODE CONDUCTOR FROM NEUTRAL BONDING POINT TO METAL WATER PIPE SHALL BE CONTINUOUS.

2 E501 GROUNDING DIAGRAM
N.T.S.

MECHANICAL EQUIPMENT CONNECTION SCHEDULE

UNIT	LOAD	LOCATION	VOLTS	FEEDER					CONTROL	STARTER	DISCONNECT	REMARKS
				CKT.	BREAKER	WIRE	GRD.	COND.				
RTU-1	26A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-2	39A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-3	46A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-4	26A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-5	40A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-6	86A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-7	31A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
RTU-8	35A	ROOF	208V/3φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.	M.C.	M.C.	WIRED BY E.C.. DUCT SMOKE DETECTOR WIRED TO BLDG. FIRE ALARM SYSTEM BY E.C..
KMUA-1	1.5HP	ROOF	208V/3φ	F-1/3/5	15A/3P	(3) #12	(1) #12	1"	M.C.	M.C.	E.C.	WIRED BY E.C.. WIRED FOR SHUT-DOWN WITH ACTIVATION ANSUL FIRE SUPPRESSION SYSTEM.
EF-1	1/4HP	ROOF	120V/1φ	DPA-31	20A/1P	(2) #12	(1) #12	1/2"	M.C.	M.C.	M.C.	WIRED BY E.C..
KEF-1	1HP	ROOF	208V/1φ	F-7/9	15A/2P	(2) #12	(1) #12	1"	M.C.	M.C.	E.C.	WIRED BY E.C.. WIRED FOR SHUT-DOWN WITH ACTIVATION ANSUL FIRE SUPPRESSION SYSTEM.
KEF-2	1/8HP	ROOF	120V/1φ	F-11	20A/1P	(2) #12	(1) #12	1"	M.C.	M.C.	E.C.	WIRED BY E.C.. WIRED FOR SHUT-DOWN WITH ACTIVATION ANSUL FIRE SUPPRESSION SYSTEM.
EH-1	15.9A	WATER/FIRE	208V/1φ	DPA-35/37	20A/2P	(2) #12	(1) #12	1/2"	M.C.		M.C.	WIRED BY E.C..
EH-2	15.9A	ELECTRICAL	208V/1φ	DPA-39/41	20A/2P	(2) #12	(1) #12	1/2"	M.C.		M.C.	WIRED BY E.C..
EH-3	15A	VESTIBLE	120V/1φ	DPA-33	20A/1P	(2) #12	(1) #12	1/2"	M.C.		M.C.	WIRED BY E.C..
WH-1	GAS								P.C.			120V GFCI RECEPTACLE FOR POWER VENT.
WH-2	GAS								P.C.			120V GFCI RECEPTACLE FOR POWER VENT.
RCP-1	75W	STOR. #108	120V/1φ	B-3	20A/1P	(2) #12	(1) #12	1/2"	P.C.			WIRED BY E.C.. COORDINATE WITH P.C. FOR TIMER WIRING REQUIREMENTS.
EDWH-1	4.1KW	SERV. AISLE	208V/1φ	E-39/41	30A/2P	(2) #10	(1) #10	3/4"	P.C.		E.C.	WIRED BY E.C..
EWC-1	970W	TOIL. / J.C.	120V/1φ	B-5	20A/1P GFCI	(2) #12	(1) #12	1/2"	P.C.		E.C.	WIRED BY E.C..
ACCU-1 & A/C-1	25A	ROOF	208V/1φ	REFER TO ONE-LINE DIAGRAM & SCHEDULES.					M.C.		M.C.	WIRED BY E.C..

SCHEDULE NOTES:
1. E.C. SHALL FURNISH AND INSTALL BUSSMANN FUSTATS "SSU" WITH THE PROPER SIZED DUAL-ELEMENT FUSETRON TYPE "S" FUSE AS REQUIRED.
2. E.C. SHALL VERIFY FUSE SIZING WITH EQUIPMENT NAMEPLATE RATINGS AND PROVIDE FUSES AS REQUIRED, SEE SPECIFICATIONS.
3. REFER TO APPROVED SHOP DRAWINGS ALL EQUIPMENT ELECTRICAL REQUIREMENTS.
4. COORDINATE ALL CONNECTION REQUIREMENTS TO MECHANICAL / PLUMBING EQUIPMENT WITH EACH APPLICABLE TRADE PRIOR TO ANY ROUGH-IN's.

Thursday, September 14, 2017 at 10:43am E:\4258 EEC Bear River Casino\Electrical\4258 - electrical - schedules - diagrams.dwg User

ARCHITECTS • ENGINEERS
paradigm design
550 3 MILE N.W.
SUITE B
GRAND RAPIDS, MI 49544
PHONE (616) 785 - 5656
WEB ParadigmAE.com

PROJECT

BEAR RIVER FAMILY ENTERTAINMENT CENTER

KEISNER RD
LOLETA, CA 95551

OWNER

BEAR RIVER BAND OF ROHNERVILLE RANCHERIA

226 KEISNER RD
LOLETA, CA 95551

CONSULTANT

RE Rhoades Engineering
Consulting Engineers
Mechanical · Electrical
www.rhoadesengineering.com
4801 Henry St.
Muskegon, MI 49441
T 231-798-4328
F 231-798-2981
1751 Barlow St.
Traverse City, MI 49686
T 231-947-1707
F 231-947-1710
REC #4258

RELEASE DATE

△	DATE	DESCRIPTION
	07-17-17	PHASE 1-SHELL PACKAGE
	07-28-17	PHASE 2-95% COMPLETE CONSTRUCTION PACKAGE
1	09-08-17	ADDENDUM #1

PROJECT

1701004

SHEET

ELECTRICAL
ONE-LINE DIAGRAM

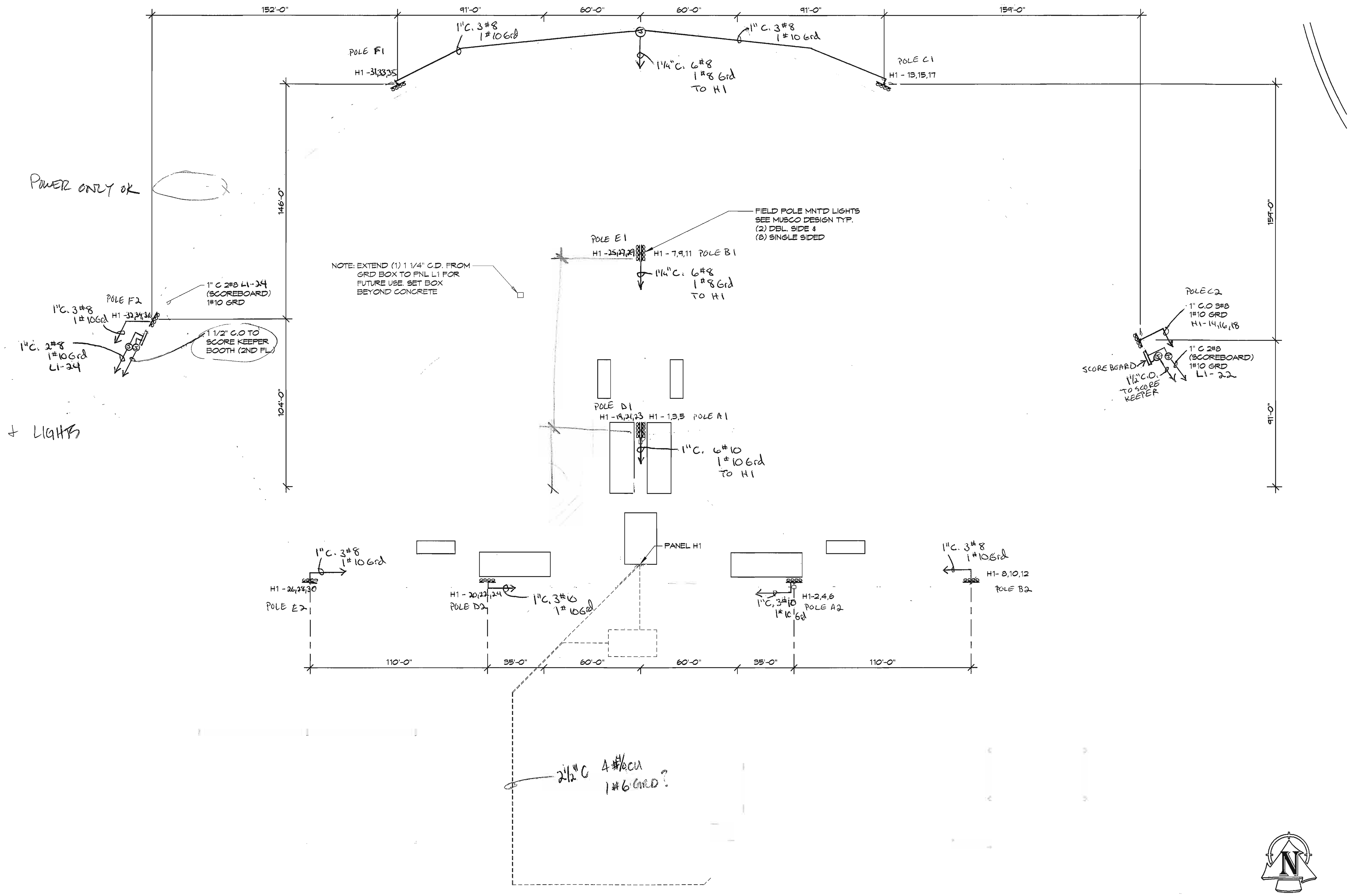
E-501

CHANGES INCLUDE
- ADDED 2ND FIELD W/ LIGHTS + SCORE BOARD.

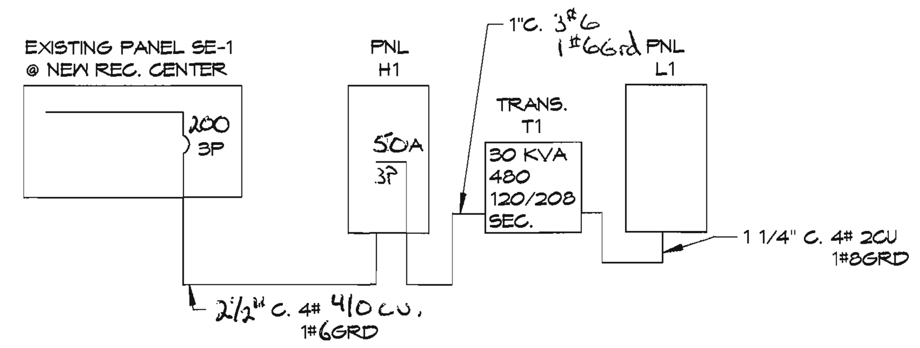
PLEASE VERIFY / CALLOUTS:
- SERVICE SIZE
- CONDUIT SIZES (INCLUDING FEEDER FROM (E) ELEC. ROOM)
- PANEL SCHEDULES
- TRENCH DETAILS

POWER ONLY OK

+ LIGHTS



1 ELECTRICAL SITE PLAN
1" = 40'-0"



4 ONE LINE DIAGRAM
3/8" = 1'-0"

L1-8 DUPLEX OUTLET (L1-8) PRNEL L1 CIRCUIT 8

GFI GROUND FAULT INTERRUPTER DUPLEX OUTLET

SPECIAL OUTLET/ CONNECTION SEE MANUFACTURES REQUIREMENTS

$_{OS}$ WALL MOUNT OCCUPANCY SENSOR WATT STOPPER PW-100

$_{OCI}$ DUAL TECHNOLOGY WALL MOUNT SENSOR WATT STOPPER PW-100

OC CEILING MOUNT DUAL TECHNOLOGY SENSOR WATT STOPPER DT-355

B9 CONCRETE UTILITY BOX

MOTOR/FAN

4' CEILING MOUNT LIGHT
A - FIXTURE TYPE A- SEE SCHEDULE

8' CEILING MOUNT LIGHT
F - FIXTURE TYPE F- SEE SCHEDULE

WALL MOUNT LIGHT- MOUNT 7' ABOVE FINISHED GRADE

EXIT EXIT LIGHT W/ 2 MR16 LAMPS AND 90 MINUTE BATTERY BACKUP

NO LETTERS =EMERGENCY LIGHT W/ 2 MR16 LAMPS + 90 MIN. BATTERY BACKUP

NOTES:

- ALL OUTLETS IN KITCHEN AREA TO BE GROUND FAULT PROTECTED
- EXPOSED WIRING TO BE IN EMT CONDUIT
- INTERIOR CONCEALED WIRING MAY BE ROMEX TYPE NM CABLE
- ALL UNDERGROUND WIRING TO BE IN SCHEDULE 40 PVC CONDUIT
- ALL CONDUIT EXPOSED TO WEATHER TO BE RIGID METAL CONDUIT
- ALL WIRE TO BE COPPER WITH THHN INSULATION
- PROVIDE BLOCKING FOR ALL LIGHTS FIXTURES AND PANELS
- UNDERGROUND CONDUITS TO FIELD LIGHTING TO BE 24" BELOW GRADE
- FOLLOW MANUFACTURES RECOMMENDATIONS FOR CONDUIT AND WIRING REQUIREMENT FOR POWER TO FIELD LIGHTING POLE MOUNTED CONTROL PANE
- PROVIDE POWER TO SCORE BOARD PER MANUFACTURES RECOMMENDATIONS
- PROVIDE 1 1/2" PVC CONDUIT FROM ANNOUNCERS BOOTH TO GROUND BOX AT SCOREBOARD FOR FUTURE USE, INSTALL PULL ROPE

3 ELECTRICAL SYMBOL SCHEDULE
3" = 1'-0"

REVISIONS

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NORTHCOAST LIGHTING & ELECTRIC
1489 HOOVER ST. EUREKA, CA 95501
(707) 269-0724
N L E
LIC# 917736

BEAR RIVER SOFTBALL FIELD
KEISNER RD.
LOLETA, CA
AP# 309-071-16

SHEET NAME
ELECTRICAL SITE PLAN

SHEET NUMBER
E0.1

DATE:	08/10/16
DRAWN BY:	Author
CHECKED BY:	Checker

BEAR RIVER SOFTBALL FIELD
1540.00

8/21/2017 3:57:38 PM

PANEL: H1 480/277 VOLTS 3 PHASE 4 WIRE MAIN: BREAKER
MOUNTING: SIZE: 100 AMP

CKT NO	DESCRIPTION	BRK	LOAD	A	B	C	LOAD	BRK	DESCRIPTION	CKT NO
1	POLE LIGHTS A1	20	6.0	O			6.0	20	POLE LIGHTS A2	2
3	POLE LIGHTS A1		6.0		O		6.0		POLE LIGHTS A2	4
5	POLE LIGHTS A1	3P	6.0			O	6.0	3P	POLE LIGHTS A2	6
7	POLE LIGHTS B1	20	9.6	O			9.6	20	POLE LIGHTS B2	8
9	POLE LIGHTS B1		9.6		O		9.6		POLE LIGHTS B2	10
11	POLE LIGHTS B1	3P	9.6			O	9.6	3P	POLE LIGHTS B2	12
13	POLE LIGHTS C1	20	7.8	O			7.8	20	POLE LIGHTS C2	14
15	POLE LIGHTS C1		7.8		O		7.8		POLE LIGHTS C2	16
17	POLE LIGHTS C1	3P	7.8			O	7.8	3P	POLE LIGHTS C2	18
19	TRANSFORMER T1	40	21.0	O					SPACE	20
21	TRANSFORMER T1		21.0		O				SPACE	22
23	TRANSFORMER T1	3P	21.0			O			SPACE	24

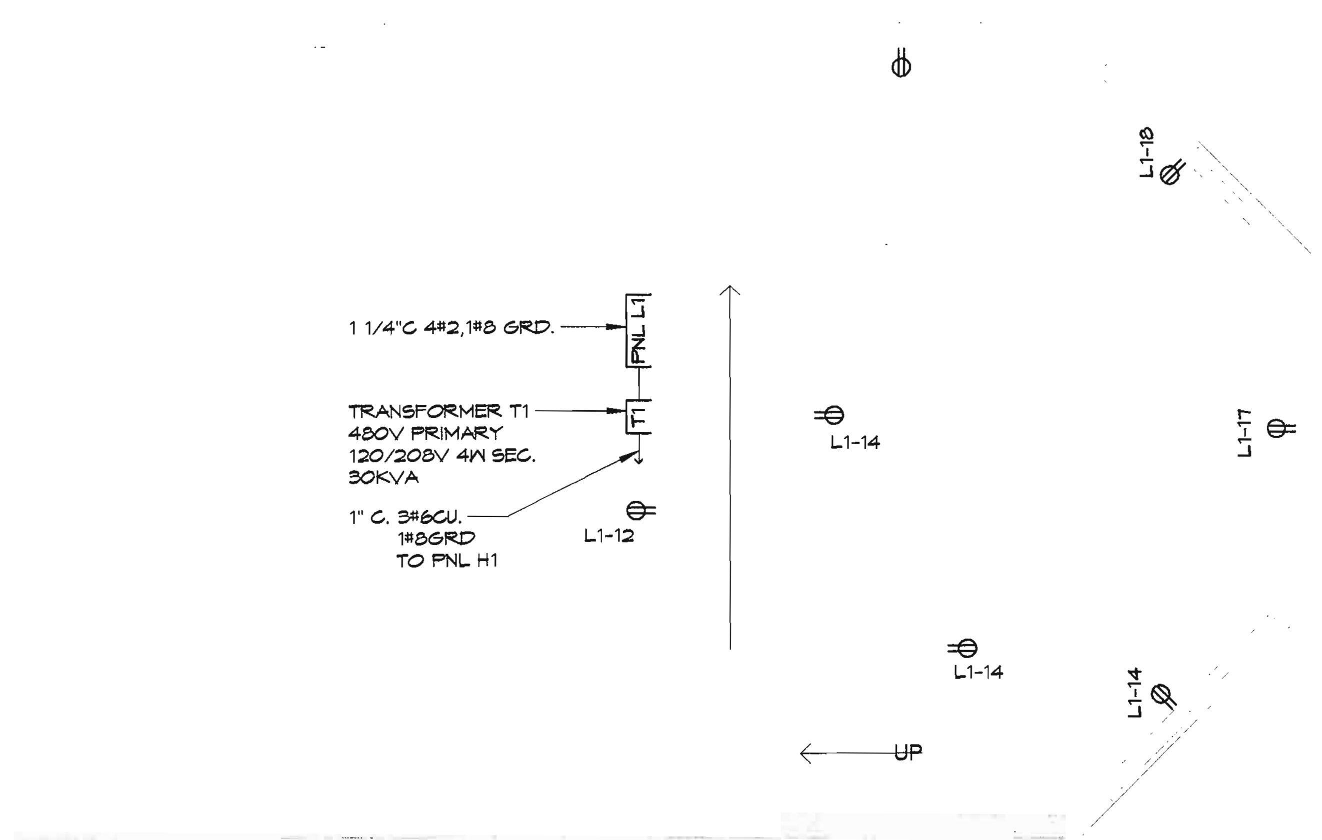
LOAD TOTAL PHASE A = 64.8 AMPS
PHASE B = 64.8 AMPS
PHASE C = 64.8 AMPS

PANEL: L1 120/208 VOLTS 3 PHASE 4 WIRE MAIN: BREAKER
MOUNTING: SURFACE NEMA1 SIZE: 100 AMP

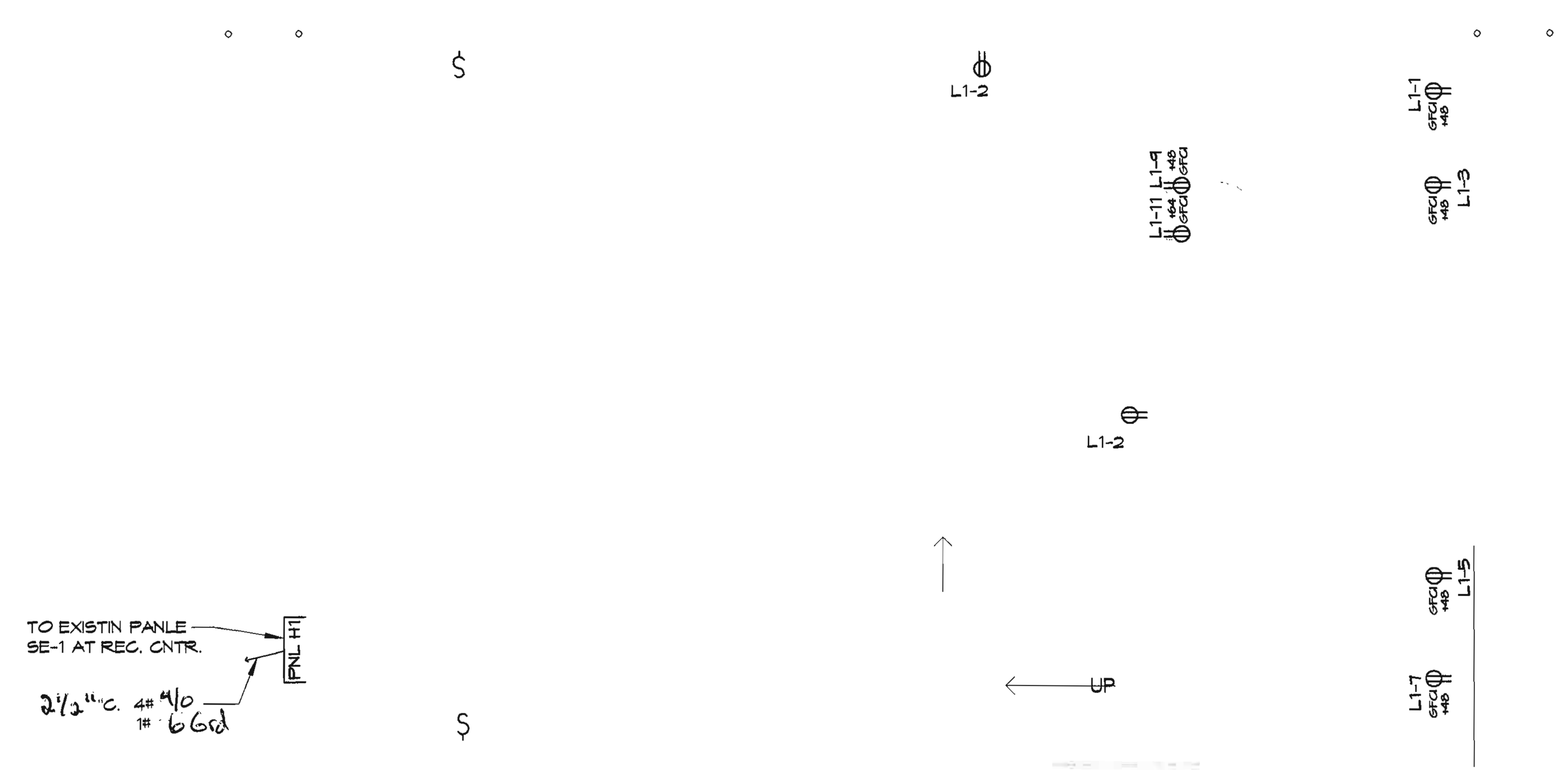
CKT NO	DESCRIPTION	BRK	LOAD	A	B	C	LOAD	BRK	DESCRIPTION	CKT NO
1	REFRIDGERATOR	20	5.0	O			3.0	20	OUTLETS- STORAGE	2
3	OUTLET-HOT DOG WARMER	20	6.7		O		11.7	20	HAND DRYER - WOMENS	4
5	OUTLET- COUNTER	20	1.5			O	11.7	20	HAND DRYER - MENS	6
7	REFRIDGERATOR	20	5.0	O			6.5	20	LIGHTS - MENS, WOMENS, STORAGE, KITCHEN	8
9	OUTLET - COUNTER	20	1.5		O		4.6	20	OUTLETS - 2ND FLOOR STORAGE, STAIRS	10
11	MICROWAVE	20	9.6			O	1.5	20	OUTLETS - 2ND FLOOR STORAGE	12
13	HOOD EXHAUST FAN + LIGHT	20	8.5	O			4.5	20	OUTLETS - BOOT, MECH. CLOSET	14
15	SPARE	20			O			20	SPARE	16
17	OUTLETS BOOTH	20	6.0			O	4.5	20	OUTLETS BOOTH	18
19	SPACE			O			1.5	20	LIGHTS - BUILDING EXTERIOR	20
21	SPACE				O		12.0	20	SCOREBOARD EAST	22
23	SPACE					O	12.0	20	SCOREBOARD WEST	24

LOAD TOTAL PHASE A = 34.0 AMPS
PHASE B = 36.5 AMPS
PHASE C = 46.8 AMPS

3 PANEL SCHEDULE
3/8" = 1'-0"



2 2ND FLOOR POWER PLAN
1/4" = 1'-0"



1 1ST FLOOR POWER PLAN
1/4" = 1'-0"

REVISIONS

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NORTHCOAST LIGHTING & ELECTRIC
1489 HOOVER ST. EUREKA, CA 95501
(707) 269-0724
LIC# 917736

BEAR RIVER SOFTBALL FIELD
KIESNER RD, LOLETA CA
AP# 123-456-78

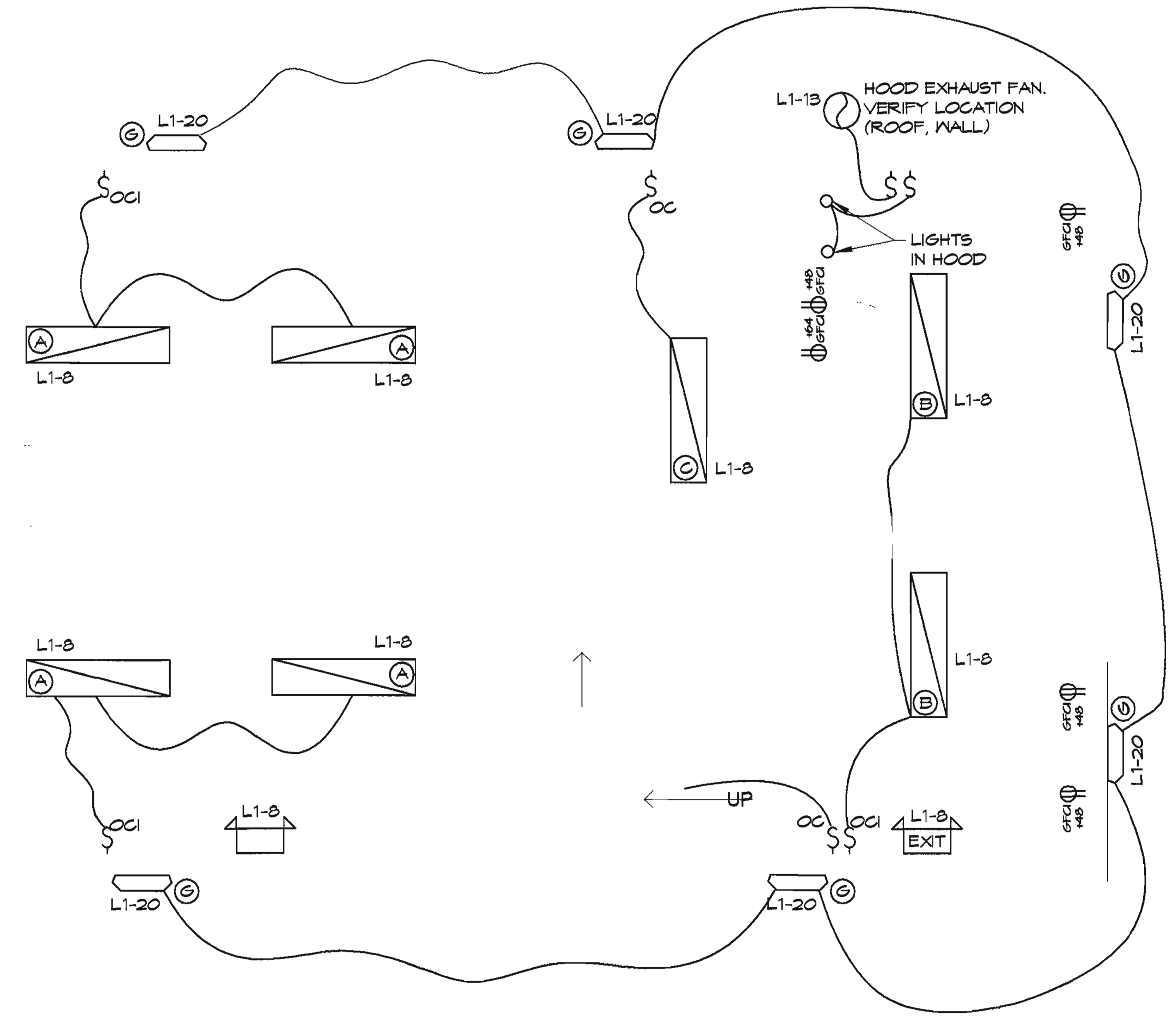
SHEET NAME
SNACK BAR POWER PLAN AND PANEL SCHED.

SHEET NUMBER
E-1

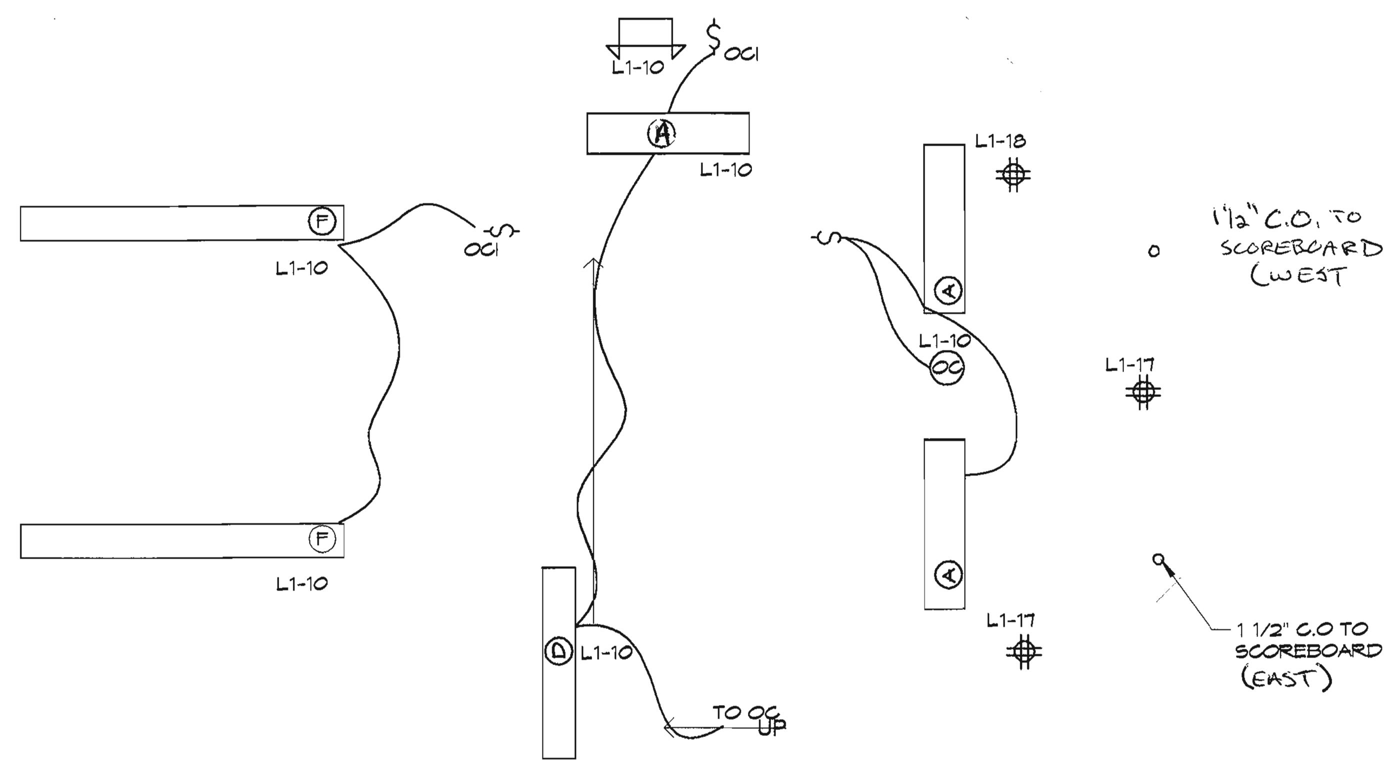
DATE: 8/21/2017
DRAWN BY: DCM
CHECKED BY: DJC

BEAR RIVER SOFTBALL FIELD
1540.00

8/21/2017 3:22:33 PM



1 1ST FLOOR LIGHTING PLAN
1/4" = 1'-0"



2 2ND FLOOR LIGHTING PLAN
1/4" = 1'-0"

3 LIGHTING SCHEDULE
6" = 1'-0"

(A) - DAYBRITE OWN 232W/ 835 LAMPS

(B) - LITHONIA DMS-2-32- mVOLT W/835 LAMPS

(C) - DAYBRITE T232 UNV EB W/CG-4 WIRE GAURD +835 LAMPS

(D) - LITHONIA WC217 mVOLT GEBIOLS W/ 835 LAMPS

(E) - LITHONIA WC232 mVOLT GEBIOLS W/ 835 LAMPS

(F) - DAYBRITE TT232 UNV EB W/(2) CG-4 WIRE GAURD +835 LAMPS

(G) - RAB ENTRA12N LED WALL MOUNT EXTERIOR LIGHT

- LITHONLA EXIT/ EMERGENCY LITH LHQM-S-W-RN w/90 MIN BATTERY BACKUP

MUSCO POLE MOUNTED LIGHTS. SEE MUSCO DESIGN INFORMATION FOR INSTALLATION DETAILS

REVISIONS

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NORTHCOAST LIGHTING & ELECTRIC

N L E

1489 HOOVER ST. EUREKA, CA 95501
(707) 269-0724

LIC# 917736

BEAR RIVER SOFTBALL FIELD

KIESNER RD, LOLETA CA

AP# 123-456-78

SHEET NAME

SNACK BAR LIGHTING PALN W/ SCHED.

SHEET NUMBER

E-2

DATE:	8/21/2017
DRAWN BY:	DCM
CHECKED BY:	DJC

BEAR RIVER SOFTBALL FIELD
1540.00

8/21/2017 3:22:33 PM

PANEL H1 277/480 VOLTS 3 PHASE MAIN BREAKER SIZE 200 AMP

MOUNTING NEMA 3R SURFACE

CIR.	DESCRIPTION	Brk	LOAD	A	B	C	LOAD	Brk	DESCRIPTION	CIR
1	POLE A1 LTG	20	7.4				7.4	20	POLE A2 LTG	2
3	" " "		7.4				7.4		" " "	4
5	" " "	3P	7.4				7.4	3P	" " "	6
7	POLE B1 LTG	20	11.1				11.1	20	POLE B2 LTG	8
9	" " "		14.8				14.8		" " "	10
11	" " "	3P	11.1				11.1	3P	" " "	12
13	POLE C1 LTG	20	11.1				11.1	20	POLE C2 LTG	14
15	" " "		11.1				11.1		" " "	16
17	" " "	3P	7.4				7.4	3P	" " "	18
19	POLE D1 LTG	20	7.4				7.4	20	POLE D2 LTG	20
21	" " "		7.4				7.4		" " "	22
23	" " "	3P	7.4				7.4	3P	" " "	24
25	POLE E1 LTG	20	11.1				11.1	20	POLE E2 LTG	26
27	" " "		14.8				14.8		" " "	28
29	" " "	3P	11.1				11.1	3P	" " "	30
31	POLE F1 LTG	20	11.1				11.1	20	POLE F2 LTG	32
33	" " "		11.1				11.1		" " "	34
35	" " "	3P	7.4				7.4	3P	" " "	36
37	TRANSFORMER T1	50	21.0						SPACE	38
39	" "		21.0						SPACE	40
41	" "	3P	21.0						SPACE	42

TOTAL PHASE A 139.4 AMPS
TOTAL PHASE B 154.2 AMPS
TOTAL PHASE C 124.6 AMPS

Greg Chapman <gsc1@humboldt.edu>

Fwd: New A/C Unit

1 message

Edwin Smith <edwinsmith@brb-nsn.gov> Fri, Apr 6, 2018 at 2:21 PM
To: Gregory S Chapman <gregory.chapman@humboldt.edu>

---------- Forwarded message ---------
From: Matt Bray <mattbray@evansmechanical.com>
Date: Fri, Apr 6, 2018, 2:04 PM
Subject: Re: New A/C Unit
To: Aaron McKinney <aaronmckinney@brb-nsn.gov>
Cc: Edwin Smith <edwinsmith@brb-nsn.gov>, Bill White <ncleinc@yahoo.com>

The refrigeration capacity is 35 tons. There are 10 circuits that are 50 amps and 240 volts each. The minimum circuit ampacity is 35 amps each for a total of 350 amps, but I'm not sure that is an accurate way to determine an expected electrical load. Hopefully Bill can help us with that answer.

On another note, we have all the outdoor units set in place where they are going to be. The connections to the units can all be done as soon as Bill has availability. Thank you.

Sincerely,
Matthew Bray

EVANS MECHANICAL

2930 Broadway St. Ste. A
Eureka, Ca. 95501
www.evansmechanical.com
(707)445-1435

On Fri, Apr 6, 2018 at 1:45 PM, Aaron McKinney <aaronmckinney@brb-nsn.gov> wrote:

> Hello Matt/Bill, would either of you gentlemen be able to answer the following questions relating to the new a/c unit at the Community Center?
>
> 1. Expected electrical load
> 2. Electrical circuit size (voltage and amperage)
> 3. refrigeration capacity (tons)
>
> Thank you for your assistance,
>
> Aaron
> --
> **Aaron Mckinney**
> **Bear River Band of the Rohnerville Rancheria**
> **Procurement Officer**
> **Office 707-733-1900 x238**
> **Fax 707-733-1972**

Appendix B:

Subtask 2.2: Renewable Energy Resource Assessment Technical Memo

Recipient Organization:	Bear River Band of the Rohnerville Rancheria
Project Title:	**Bear River Band Energy Options Analysis Project**
Date of Report:	July 31, 2018
Award Number:	DE-IE0000063
Technical Contact:	Edwin Smith, Director of Environmental and Natural Resources, 266 Keisner Rd. Loleta, CA 95551 (707) 733-1900 edwinsmith@brb-nsn.gov
Business Contact:	same as Technical Contact
Partners:	Humboldt State University Sponsored Programs Foundation and its affiliate, the Schatz Energy Research Center
DOE Project Officer:	Tweedie Doe (240) 562-1617 tweedie.doe@hq.doe.gov
GO Project Monitor:	Tommy Jones (240) 562-1739 Thomas.Jones@ee.doe.gov

---

1 Introduction

This technical memo presents the results of the renewable energy resource assessment work conducted for the *Bear River Band of Rohnerville First Steps* project. The purpose of the resource assessment work is to identify the locations available for on-site renewable energy systems and to estimate the amount of annual energy that could be generated from these new systems.

The assessment work focuses on two on-site renewable energy resources: solar and wind. The following tasks were performed and are presented as sections in this memo:

- Solar Energy
    - overview of the Tish-Non Community Center (TNCC) renewable energy and storage system to evaluate system performance
    - identification of potential solar system locations and quantifying available land
    - sizing of PV systems and estimating on-site solar energy generation using *PV Watts*

- Wind Energy
  - overview of past wind studies
  - identification of potential wind turbine locations
  - estimation of the number of turbines
  - estimation of on-site wind power and energy production

2 Solar Energy

2.1 Overview of TNCC Renewable Energy and Storage System

In 2015, a solar PV and wind energy system was installed at the Tish-Non Community Center. Designed, manufactured, and installed by JLM ENERGY, the system consists of a 100 kW (DC) solar ground mount PV system, 20 small wind turbines (4.8 kW total) and a 30 kW battery energy storage system that is connected to the community centers main service panel. The system was installed to reduce the centers demand charges, provide emergency backup power, and reduce the high electric utility bill.

Based on the specifications sheet for the wind turbines and their relative size compared to the PV system, it is suspected that these devices generate an insignificant amount of energy. Unfortunately, a performance analysis of the wind turbines cannot be accomplished as there was no anemometer installed to measure wind speed as shown in the JLM drawings and the turbines inverters are wired together with the output of the solar arrays and thus were not metered separately.

2.1.1 Location and Layout

The PV array is located on the hillside on the south side of the community center and has an orientation of 160° with the modules tilted at 30°. The modules are arranged in two parallel rows with dimensions of approximately 85 m long and 3.5 m with an inter-row spacing of 6 m. (Google Earth). The area occupied by one row of PV modules and the inter-row spacing results in 800 square meters. Siting 50 kW (half of the solar modules) of rated DC power in this amount of space, results in an installed power density of 250 kw per acre of land or 62 W per square meter.

2.1.2 Annual Energy Production

The JLM-developed, energy management system collects the operational data and provides cloud-based real-time and recent historic performance results that are available for online monitoring by the Tribe. SERC requested and received the entire year of operational data from JML for 2017.

The project team analyzed the data and generated monthly values for the system as shown in Figure 1. The analysis shows that the energy generated from the renewable energy system is approximately 24% of the total building’s annual electrical load.

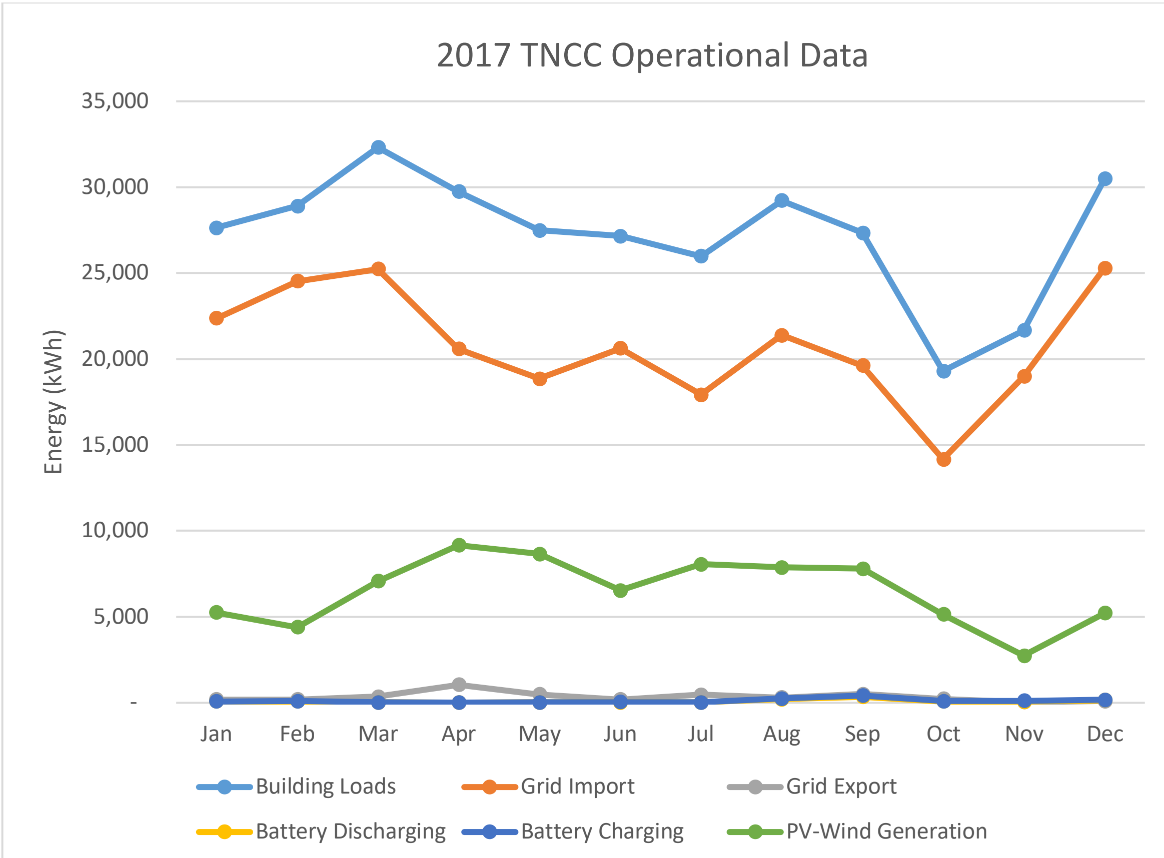

Figure 1: Monthly Energy Values for the TNCC Renewable Energy System

2.2 Potential Solar System Locations

SERC engineers surveyed the Rancheria property using Google Earth in order to identify possible locations for new solar system installations. The site assessment looked at open grass lands, rooftops of existing and planned buildings, and parking lots where future PV canopies could be installed. In the following images, color coded polygons are used to identified the location and the type of system appropriate for the site. The colors correspond to the type of system as follows:

- blue locations for ground-mounted arrays,
- green locations indicate new PV canopies or carports,
- yellow locations for possible roof-mounted systems on the planned facilities, and
- red locations for roof-mounted systems on existing buildings

2.2.1 Potential sites near the Tish-Non Community Center

The site survey identified 7 sites near the TNCC that are suitable for new solar systems are shown in Figure 2 below.

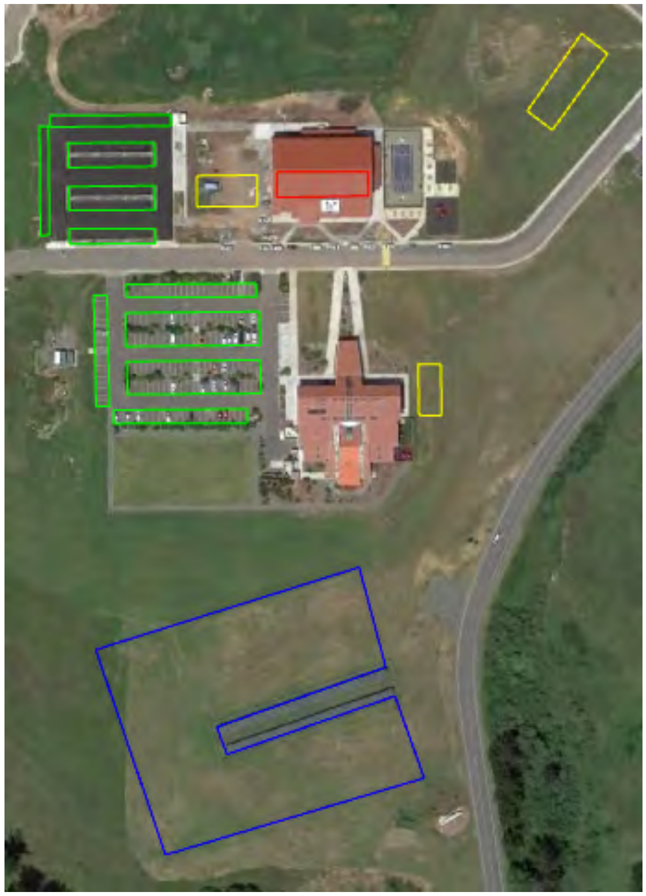

Figure 2: Locations for Potential PV Systems near the Community Center

For each location, SERC engineers utilized the dimension tool in Google Earth to determine the area (in square meters) and the orientation of a potential array. The area, orientation and assumed module tilt for each location are summarized below.

<u>TNCC South Hillside (blue)</u>
The land surrounding the existing TNCC PV solar system is an ideal place for expansion. There are 12,050 m2 of available land for additional solar. The tracking and orientation of a new system would be similar to the existing PV system with an azimuth of 160° and a module tilt of 30°.

<u>TNCC Parking Lot (lower green)</u>
The community center parking lot is great location to install solar carports or canopies. The canopies are divided into two groups based on array orientation. The four east-west (E-W) canopies would have an module orientation of 180° and occupy a combined area of 830 m2. The single north-south (N-S) canopy has a 270° orientation and covers 340 m2. Carports can be designed for module tilts from 0-15°. For this project, we will assume an average tilt design of 7° for all solar canopies.

Recreation Center Parking Lot (upper green)
The Rec Center parking lot can house a similar layout of solar carports. The four E-W canopies cover an area of 1486 m2 and the N-S canopy is 210 m2.

Rec Center Pool, Family Fun Center and Youth Development Center (yellow)
Newly constructed facilities could offer an opportunity to incorporate rooftop solar to offset the building's electrical load. SERC is unaware of any plans the Tribe has to incorporate renewables into these building designs. The Youth Development Center is currently designed with the roof tilted approximately 10° in the east direction. A shading analysis will be needed if this site is pursued as the TNCC may shade the array for certain months of the year.

Recreation Center Roof (red)
The south-facing roof is ideal place for a new PV system. The Tribe, however is concerned that penetrations through the roof could cause water leaks and result in damage to the building and its contents. The roof is constructed of a metal standing seam design and there are commercially available solar array mounting clamps that are made specifically to attach to these types without requiring mounting penetrations. At this time, the Tribe has decided not to pursue this location.

2.2.2 Potential sites near the Casino

An additional four sites were identified on and around the Casino as shown in Figure 3.

Figure 3: Locations for Potential PV Systems near the Casino.

The area, orientation and assumed module tilt for these locations are summarized below.

Pump & Play (green in lower left)
The gas station dispensing canopy is a good location for a PV system. Allowing for border access, the available module area is 240 m2. The orientation of the dispensing structure suggests a solar array orientation of 130° and the module tilt would be similar to that of a solar carport at 7°.

Bear River Drive East Hillside (blue)
A strip of land located at the top of the hill on the east side of the Bear River Drive homes is good location for a new ground-mounted PV solar system. The land is approximately 13 m x 415 meters, capable of houses two rows of solar arrays with an array area of 600 m2. The land has a southeast exposure with an orientation of 130 degrees and a module tilt of 30° will be used to model the potential energy generation.

Casino Parking Lots (upper green)
The parking lots surrounding the casino offer an opportunity to install numerous solar canopies and generate a significant amount on-site power. The canopies have been divided into four groups based on the existing layout and orientation as follows:

- two west lot canopies are long single aisle sections located in front of the casino and have an orientation of 145°
- four angled canopies in the north lot have an orientation of 160°
- eight north lot E-W canopies face straight south (180°) and
- three east lot canopies point toward 115°

Casino Roof Top (red)
The southeast side of the Casino roof offers a good location and orientation for a solar system. The Tribe has communicated that the structural strength of the roof may not be sufficient to handle the weight of a PV system and re-engineering may be needed. The Tribe has elected not to pursue this site.

Table 1 below provides a summary of the sites showing the location, type of system, and the available module area for each site. The estimated array area for the Family Fun Center and the Rec Center Pool Building are unknown as indicated by an asterisk.

Table 1: Location, Type, and Array Area of Potential PV Systems

Site	*Location*	*Type of System*	*Available Area (m2)*
TNCC Hillside	south side	ground-mounted	12050
TNCC Parking Lot	E-W islands	canopy	2800
	N-S islands	canopy	340
Rec Center Parking Lot	E-W islands	canopy	1486
	N-S islands	canopy	210
Pump & Play	dispensing island	canopy	240
Bear River Drive Hillside	top of hillside	ground-mounted	1664
Casino Parking Lot	west lot	canopy	725
	north lot angled	canopy	1549
	north lot	canopy	4978
	east lot	canopy	830
Rec Center	rooftop	roof-mounted	430
Casino	rooftop	roof-mounted	580
Youth Center	rooftop	roof-mounted	175
Family Fun Center	rooftop	roof-mounted	*
Rec Center Pool	rooftop	roof-mounted	*

* construction drawings unavailable

2.3 PV System Sizing and Estimating Potential Energy Production

The size of a PV system is determined by the amount of available space and the type of mounting system used. For ground-mounted systems with multiple rows of arrays, open space is required between rows to prevent inter-row shading. This reduces the , thus reducing the amount of space for occupied by the solar modules. For rooftop solar systems, a buffer is required around the edges of the system to allow for personnel access and to comply with firefighting code requirements. The car canopies are designed for edge to edge panel coverage so there is no reduction in available area.

For sizing the ground-mounted systems, the project team took dimensions of the existing TNCC PV system to determine the amount of land required to accommodate the 100 kW DC system. This approach took into account the inter-row spacing requirements and resulted in a power to land use ratio of approximately 250 kW per acre or 62 W per square meter. This value was used to estimate the size of the TNCC expansion PV system and also the Bear River Drive hillside PV system.

For the rooftop and solar canopy systems, the sizes were estimated using the array area, the typical peak solar irradiance value (1 kW per one square meter of module area) and an assumed panel of 20%.

Using these estimated sizes, the project team used the on-line application known as *PV Watts Calculator* to estimate the potential on-site energy production for the various ground-mounted, rooftop and car canopy locations. Developed by the National Renewable Energy Laboratory (NREL), *PV Watts Calculator* provides monthly and annual electricity generation estimates, monthly and annual average solar radiation, and the monetary value of the electricity produced at commercial facilities. The model can also output estimated hourly energy production that may be used in the energy options phase of the project.

The model requires the only a few basic inputs to provide a good estimate of energy production. These inputs include:

- the sites address or geographic coordinates – this information is used to access the appropriate solar irradiance file from the National Solar Radiation Database (NSRDB)
- the system size (or power rating) in DC (direct current) kilowatts – the model incorporates assumed efficiency losses due to the wiring and the DC to AC inverters to calculate the AC power rating
- tracking and orientation of the solar array – the orientation or azimuth of the array and the module tilt is required to determine the amount of sunlight hitting the panels

The estimated annual energy production (AC output) for each location as outputted by PV Watts is given in

Table 2. The Rec Center and Casino rooftop systems were also analyzed to illustrate the potential electrical generation from these sites if the stated concerns were addressed. The Family Fun Center and the Recreation Center Pool Building also offer a great opportunity to install rooftop solar systems and offset future building loads. With the absence of building design and orientation, these facilities could not be modelled to estimate energy generation.

Table 2: Estimated Annual Energy Production (kWh) for Potential PV Systems

Site	*Location*	*PV Size (kWDC)*	*Orientation (°)*	*Tilt (°)*	*Estimated Annual Energy Production (kWh)*
TNCC Hillside	south side	744	160	30	1,013,564
TNCC Parking Lot	E-W islands	560	180	7	704,915
	N-S islands	68	270	7	80,882
Rec Center Parking Lot	E-W islands	297	180	7	373,857
	N-S islands	42	270	7	49,956
Pump & Play	dispensing canopy	48	130	7	59,037
Bear River Drive	top of hillside	103	130	30	132,058
Casino Parking Lot	west lot	145	130	7	178,340
	north lot angled	310	160	7	388,456
	north lot	996	180	7	1,253,741
	east lot	166	115	7	201,407
Rec Center	rooftop	86	180	20	116,122
Casino	rooftop	116	130	30	148,725
Youth Center	rooftop	175	270	10	41,579
Family Fun Center	rooftop	*	*	*	*
Rec Center Pool	rooftop	*	*	*	*
	Totals	**3,681**			**4,742,638**

The total potential PV system capacity if all sites were developed is 3.681 MW_DC. This would result in an estimated annual energy production of 4,710 MWh. Based on the results from the recent Load Profile Assessment work, this amount of generation could potential offset approximately 62% of the total projected energy use for 2020 (7.176 MWh).

3 Wind Energy

The following sections present methods and results for estimating the potential wind energy resource.

3.1 Past Studies

A number of past wind resource studies and projects have been done. These include:

- NREL Wind Study (2000 – 2001): this study placed an anemometer at 20m and collected 10 minute interval wind speed data over one year.
- Bergey 10kW Turbine Project: a 10kW wind turbine was installed south of the casino in 2009 and was operational through 2016. Power production data was collected.
- TWN Wind Power Inc. (2014): this analysis looked at a locations immediately east and west of the Community Center. It also makes a number of recommendations regarding siting of turbines. It recommends a 50kW turbine at a tower height of 42.7m.
- Humboldt State University (2016): a student engineering project conducted an electricity production and 20 year cost estimate for three different turbine options using both the NREL wind speed data and the Bergey 10kW production data. The study recommends a 100kW turbine at a tower height of 36.6m. It recommends locating the turbines on the west area of the Rancheria near the waste water treatment plant.
- Redwood Energy (2016): a community scale renewable energy analysis was completed. It explores a range of wind development sizes assuming the same 100kW turbine recommended by the HSU study and applies this using the NREL data. The study did not propose a location for the turbines, nor did it analyze constraints on the maximum number of potential turbines.

3.2 Potential Wind Turbine Locations

Shown in Figure 4 is the recommended turbine location area from the HSU study. Because this study was done recently and included feedback from BRB regarding desired locations of wind turbines, additional locations identified in other past studies were not pursued. In addition, other past study areas overlapped with the proposed solar development areas described in the previous section.

The location of the decommissioned Bergey 10kW turbine significantly impacted hotel customers due to noise levels. Therefore this location is not considered as an option even though there is a utility point of connection for this location.

Figure 4: Recommended area for locating wind turbines from the HSU study. Also shown is the location of the Bergey 10kW wind turbine that was decommissioned in 2016.

3.3 Estimating the Potential Number of Turbines

Estimating the potential number of turbines assumes the Northern Power Systems NPS 100C 100kW turbine with a 24m rotor. This is the turbine make and model recommended by the HSU study. The turbines are limited to the HSU study area as shown in Figure 4. The spacing between turbine towers assumes a minimum distance of 3D along a row, and 5D between rows, where "D" is the turbine rotor diameter. [1]

Furthermore, a noise level analysis was done by the HSU study. This study estimated the 60dBAa noise level of the 100kW turbine at a wind speed of 7 m/s occurring a distance of roughly 100ft from the tower. It is assumed that a tower will not be located

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[1] See Gilbert M. Masters. 2004. "Renewable and Efficient Electric Power Systems". John Wiley and Sons, Inc., Hoboken, New Jersey. ISBN 0-471-28060-7.

closer than 100ft to any regularly occupied space such as the waste water treatment plant.

With the above assumptions, it is estimated that a maximum of three turbines could be installed at the Rancheria. This results is shown in Figure 5.

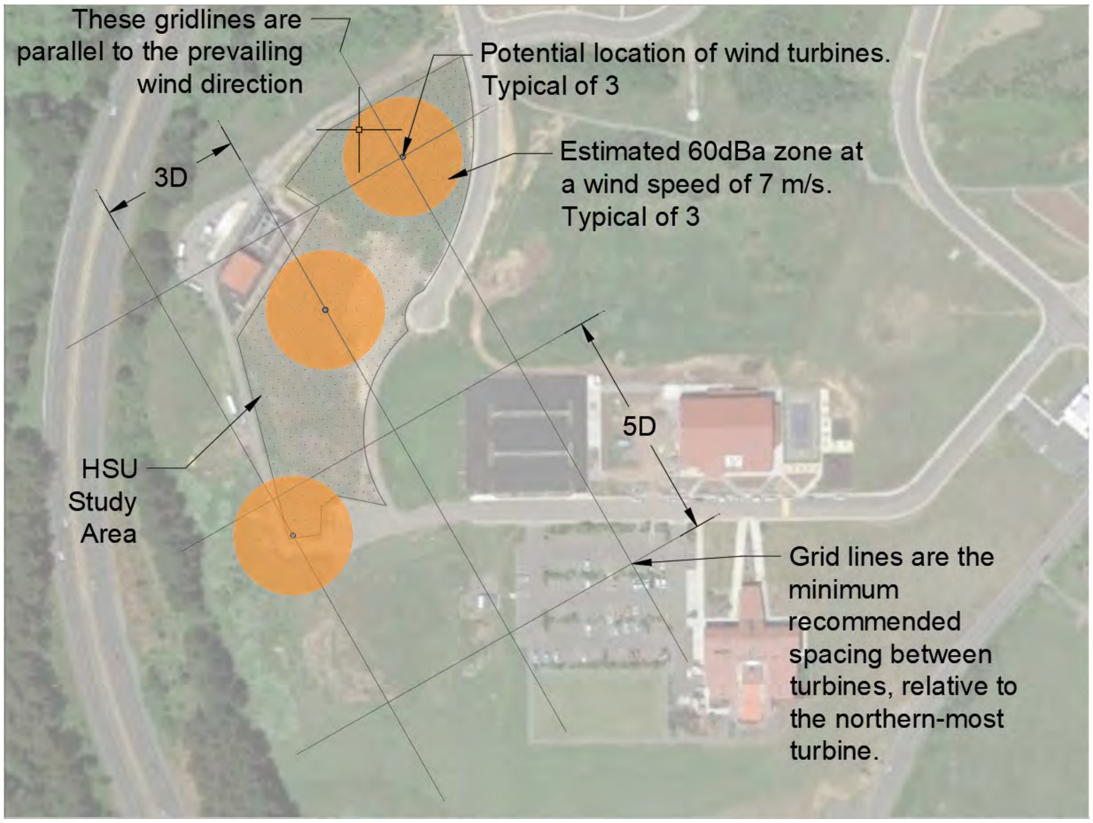

Figure 5: Estimated maximum potential number and location of wind turbines.

3.4 Estimated Power and Energy Production

Historic wind speed data was obtained from two sources:

- Wind speed data was estimated from kWh output data of the Berger 10kW turbine using the published power curve.
- Wind speed data collected by NREL.

The wind speed data was then translated into a daily time series of estimated average instantaneous power output using the power curve for the Northern 100kW turbine. The analysis was done using the R programming language. The scripts developed for this analysis are available upon request.

An efficiency reduction of 90% is assumed for the collective output of all three turbines. This is caused by the reduction in available wind energy due to the proximity of the towers to each other. The efficiency reduction value was derived using an educated guess on where the proposed tower layout lies on the 2x2 tower spacing efficiency curve in Figure 6.28 of Masters, 2004.[1]

The resulting estimated annual energy output for the 3 Northern 100kW turbines placed in the locations shown in Figure 5 is shown in Table 3. The minimum values were calculated as the minimum of the results calculated from the Bergey 10kW turbine and the NREL wind data. Similarly, the average is that of the two sets of results, and the maximum also that of the two sets of results. Also shown is the estimated single highest peak power output for the year.

Table 3: Estimated potential annual energy production and single highest peak output power from three Northern 100kW wind turbines.

Parameter	***Minimum***	***Average***	***Maximum***
Peak Power Output (kW)	128	149	249
Annual Energy Production (MWh)	203	368	533

The time series daily total kWh estimates from the three turbines are shown in Figure 6.

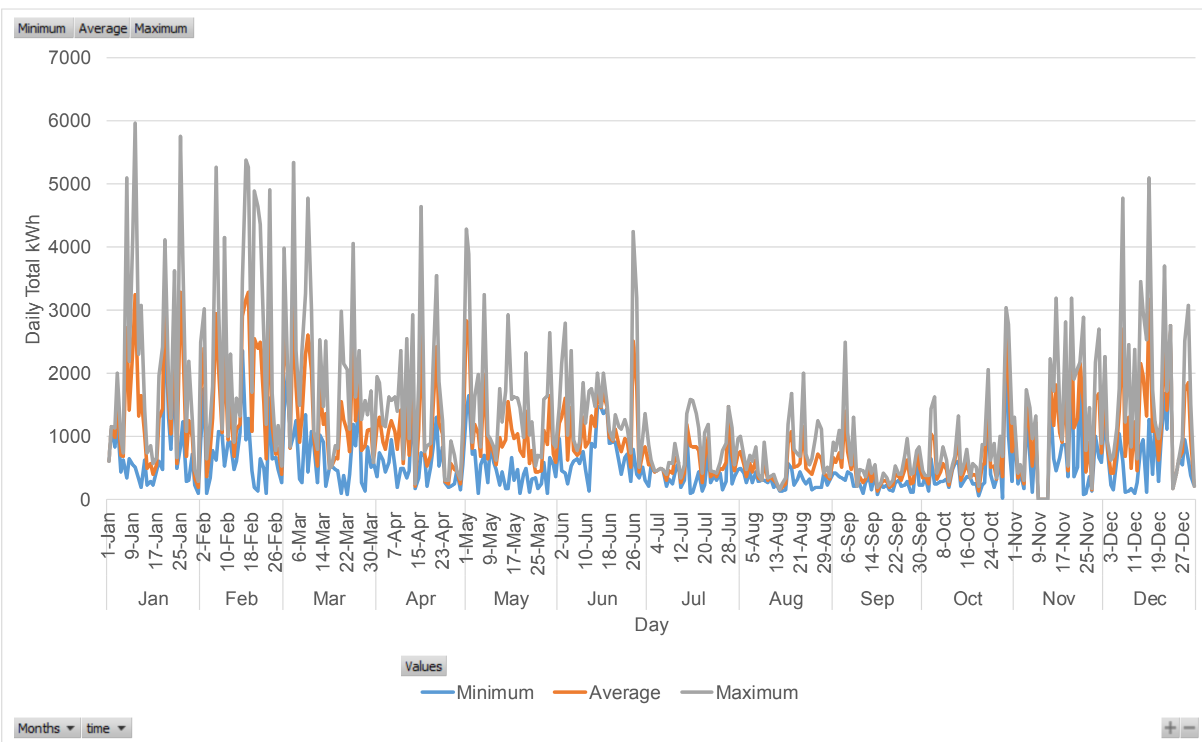

Figure 6: Estimated daily total kWh production for minimum, average, and maximum estimates.

Appendix C:

Subtask 2.3: Demand Side Management Opportunities Assessment Technical Memo

Recipient Organization:	Bear River Band of the Rohnerville Rancheria
Project Title:	**Bear River Band Energy Options Analysis Project**
Date of Report:	October 30, 2018
Award Number:	DE-IE0000063
Technical Contact:	Edwin Smith, Director of Environmental and Natural Resources, 266 Keisner Rd. Loleta, CA 95551 (707) 733-1900 edwinsmith@brb-nsn.gov
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1 Introduction

This technical memo presents the results of the demand side management opportunities assessment work conducted for the *Bear River Band of Rohnerville First Steps* project. The purpose of this task is to review previous work to leverage and identify demand-side management opportunities with a focus on optimizing the load profile of the Bear River Band of Rohnerville Rancheria (BRB) in the context of significant on-site renewable generation.

The following work tasks were performed and are presented in this report:

- Review of the recent energy audit work and associated recommendations
- Identification of specific equipment from the audit report that may provide near-term cost-effective energy savings or fuel-switching opportunities
- High-level energy analysis for possible near-term HVAC retrofits

Energy storage opportunities for the existing and planned facilities will be investigated during the Existing Infrastructure and Renewable Energy Production Readiness

Assessment (Subtask 2.4) and will be incorporated into the Energy Options Implementation Plan (Subtask 2.6) later in this project.

2 Review of Redwood Energy's Audit Report

In 2016 Redwood Energy (RE) and Freshwater Environmental Services created the Renewable Energy Sovereignty Master Plan for the Tribe.

In developing this plan, RE conducted site audits of the existing commercial buildings to identify demand-side opportunities to reduce energy consumption on the Rancheria. In addition to the audit, they modeled energy consumption, and recommended product replacements based on the available high efficiency equipment at that time (2016). This work was presented in their *Baseline Energy Audit Report with Recommended Improvements and Cost Analysis.*

This audit report provided a detailed list of recommended product replacements for upgrading electrical appliances to more efficient models and converting gas-fired appliances (e.g. HVAC units, heaters, gas grills, ovens, etc.) to electrical appliances. Conversion to all electric appliances, known as fuel-switching, is part of BRB's strategic vision to achieve zero net annual utility energy consumption and includes replacing gas burning space and water heaters with heat pumps.

SERC reviewed the report to become familiar with the gas and electrical appliances that exist at each facility and the replacement recommendations to reduce the energy load. Two keys points taken from the reports summary are provided below. Refer to the report for a complete list of recommendations for all audited facilities.

- The Bear River Casino building accounts for approximately 80% of the entire energy consumption at the Rancheria
- The internal Casino slot machines and uninterrupted power supply (UPS) battery back-ups make up approximately 70% of the Casino's energy load

In general, SERC has found that the Redwood Energy site audit was thorough and their general strategy to reduce energy usage by upgrading to more efficient equipment makes sense. SERC did not review the specifications or estimated replacement costs (labor and capital) for the majority of the recommended replacement equipment nor did we conduct any cost analyses to determine whether these investments are financially sound.

Based on the estimated costs in the RE report and the varying age of equipment, implementation of all of the stated recommendations will require a significant financial investment and take a long period of time to complete.

3 Identifying Equipment with Potential Near-term Energy Savings or Fuel-Switching Opportunities

During the review of the RE report, SERC identified two categories from the recommended retrofits that could have an impact on the electrical load in the near term.

The categories include 1) large loads that may have replacement options with significant higher efficiencies and 2) fuel switching opportunities of gas-fired equipment that is near end of life. A brief discussion of each is provided below.

1. Large Loads with More Efficient Replacement Options

   Replacement of old, high energy use equipment provides a good opportunity to reduce the sites electrical energy consumption. The efficiency ratings (e.g. EER, IPLV, and Coefficient of Performance) for these large loads should be reviewed and compared to performance ratings of new replacement options.

   Equipment replacement is most cost-effective at or near its end of life. However, for inefficient high energy-use loads that are currently in operation, a newer, more-efficient model may provide the energy savings needed to make early replacement feasible.

2. Fuel Switching

   Redwood Energy recommended all-electric replacement products for the HVAC systems, hot water heaters and gas-fired kitchen appliances in order to move the Tribe towards their vision of energy self-sufficiency. This wholesale approach would require a substantial investment and there are many factors that should be considered when making these decisions.

   A few of the advantages and disadvantages of fuel switching from natural gas to electricity are listed below:

   - reduces/eliminates natural gas usage and associated greenhouse gas emissions (GHG's) to the environment assuming the replacement electrical energy comes for a renewable or lower carbon generation source
   - keeps energy purchasing under local control by purchasing electricity from the Redwood Coast Energy Authority Community Choice Energy program
   - may allow for self-generation of on-site electrical energy to serve more site loads
   - increases electrical energy consumption which may result in higher energy costs as natural gas is currently relatively cheap compared to electricity
   - requires higher capital costs to purchase all-electric heat pump systems vs conventional central furnaces
   - may not provide the desired performance from kitchen appliances (e.g. electric vs gas-fired grills and ovens)

The Tribe should weigh these factors when deciding whether a specific gas-fired appliance should be replaced with an all-electric model. As with other appliances, fuel switching of gas-fired equipment that is at or near its end of useful life is more cost-effective.

The equipment at the older facilities, specifically the Casino (built in 2004) and the Pump & Play service station should be prioritized. SERC identified a few of RE recommended retrofits that meet the categories above. An energy analysis for replacing this equipment is described in the next section and are examples of how future equipment can be evaluated for replacement.

Given the relative newness of the electrical and gas-fired equipment at the Hotel, Tish-Non Community Center, Recreation Center, and Tobacco Traders, it would be difficult to justify the need for replacement based on an energy savings alone at this time. As these buildings age, the general approach for energy savings and the replacement of equipment with higher efficiencies should be followed.

4 Energy Analysis of Near-term Casino Retrofits

From the audit report, the Casino HVAC systems and uninterruptible power supplies (UPS) for the slot machines stand out as potential energy-saving and fuel-switching opportunities. It is anticipated that any reduction in energy use by implementing these retrofits will have only a small effect on the extremely large electrical load at the Casino and that additional retrofits will be required to provide any significant reduction in the facility's load. Below is a high-level energy analysis to replace three HVAC systems at the Casino. At the time of this memo, SERC did not have enough information available to analyze the slot machine UPSs at the Casino and Pump & Play Station.

The retrofits to be evaluated are the replacement of the existing air-cooled chiller unit with a more efficient all-electric unit and the conversion of two gas-fired furnaces to all-electric heat pumps. The costs shown in the subsequent figures are general results and are not specific to the operating conditions and the actual climate at the Rancheria.

The general approach in the analyses was to estimate the energy savings by determining the applicable efficiency ratings for the existing and replacement systems and then use online energy-savings calculators to calculate the difference in energy consumption for each system. Efficiency values were obtained by referencing the product spec sheets or the HVAC industry performance standards for the year the equipment was manufactured.

4.1 Air-cooled Chiller

One common way to evaluate the performance of a chiller unit is by the integrated part load value (IPLV). Developed by the Air Conditioning, Heating, & Refrigeration Institute (AHRI), this industry standard performance metric is used to compare the characteristics of similar types of chillers at operating conditions other than full load. The IPLV is a weighted average of efficiency at four operating points (25%, 50%, 75% and 100%) for a chiller that follows an averaged load profile.

The cooling load in the Casino is served by a Trane Model CGAM, 30-ton, air-cooled chiller. The product brochure (Appendix A) states that the scroll compressor is 6-8% more efficient than the minimum performance requirements mandated by the Air Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). Increasing the ASHRAE 90.1-2004 minimum IPLV efficiency standard of 10.416 by 6% (given that the system power also includes fans and control power) results in an IPLV for the existing chiller of approximately 11.0.

According to the most recent performance standard (ASHRAE 90.1-2013), the current minimum IPLV efficiency for replacement air-cooled chillers is 15.81 IPLV.

An energy cost savings calculator for air-cooled chillers available from the Office of Energy Efficiency & Renewable Energy (EERE) was used to estimate the reduction in energy consumption by replacing the chiller. The unit was assumed to operate at partial load for 2000 hours per year. Figure 1 shows the annual energy use for the existing and alternative models of chillers with varying performance ratings.

	EXISTING CHILLER	BASE MODEL	FEMP MIN. EFFICIENCY REQUIREMENT	BEST AVAILABLE	YOUR CHOICE
LIFETIME ENERGY COSTS	$53,476	$47,059	$38,222	$29,121	$37,207
ANNUAL ENERGY COSTS	$3,273	$2,880	$2,339	$1,782	$2,277
ANNUAL ENERGY USE (KWH)	65,455	57,600	46,784	35,644	45,541
EFFICIENCY (EER)	11	12.5	15.39	20.2	15.81
LIFETIME ENERGY COST SAVINGS*	$0	$6,417	$15,254	$24,356	$16,270

Figure 1: Estimated Energy Use for Various Air-cooled Chillers

As shown, a replacement chiller with a IPLV of 15.81 results in an annual energy reduction of 19,941 kWh and the selection of the best available chiller (IPLV 20.2) results in an energy savings of 29,811 kWh (65,455 - 35,644 kWh).

Although, the IPLV is a good tool to use for estimating energy savings, it alone should not be used to estimate economic savings. A full system analysis that incorporates the system location and site conditions would provide a more accurate value for the lifetime energy cost savings. This analysis does, however, illustrate that cost savings can be gained from a retrofit.

4.2 Central Roof-top Furnaces

There are two central furnaces that serve the heating and cooling loads of the Casino. Both are AAON, RM Series packaged rooftop units (RTUs) with one having a cooling capacity of 18 tons and the other 25 tons. Fuel-switching these gas-fired RTUs to all-electric heat pumps would result in an increase in electrical consumption, but would eliminate natural gas usage.

The methodology used to analyze the electrical energy and natural gas use for the retrofit is outlined in the following steps:

1. Estimate the annual energy use by the existing RTUs in the cooling mode
2. Estimate the projected annual energy use from a new heat pump in both the cooling and the heating mode
3. Estimate the annual natural gas consumption from the existing RTUs in the heating mode

SERC utilized two energy-savings calculators on the EERE website to perform the energy analysis for converting these RTU's to heat pumps.

Step 1. Estimation of the Annual Energy Use by the Existing RTUs - Cooling Mode

Developed by Pacific Northwest National Laboratory, the Rooftop Unit Comparison Calculator (RTUCC) was used to estimate the energy consumption of the existing (standard) air conditioner systems in the cooling mode.

As shown in Figure 2 and Figure 3, the parameters input summary for the calculator included general information (building type and location), air-conditioner specifications (capacity, schedule and settings) and the EER performance ratings. The default values for the candidate and cost entries were used to allow the calculator to run. The most represented building type was a large hotel and the location of Astoria, Oregon was chosen due to having the correct climate zone as that of the Rancheria's location.

The energy efficiency rating (EER) performance metric is the ratio of net system cooling capacity over the total system input power and is reported in the product spec sheet as 11.7 and 10.4 for the 18 and 25 ton RM Series RTUs, respectively (Appendix B). The total capacity and standard unit EER entries are the most critical inputs to estimate the energy consumption.

The results tables in the RTU figures show the estimated annual energy use for the standard model in the cooling mode is 35,801 kWh for the 18 ton unit and is 54,423 kWh for the 25 ton unit.

Parameter Summary

Feature Name	Candidate	Standard
EER	12	11.7
Unit Cost (k$)	4.5	4
Annual Maintenance Cost ($/year)	0	0
Enable Economizer	on	off
	Applies to Both Units	
Building Type	Hotel-Large	
State, City	OR, ASTORIA	
Schedule	All week, All day	
Setpoint Temperature, Setback	65, 5	
Total Capacity (kBtuh), Oversizing (%)	216, 0	
Electric Utility Rate ($/kWhrs)	0.08	
Equipment Life	15	
Number of Units	1	
Discounted costs, Rate	on, 0.07	

RESULTS

ASTORIA, OR	Candidate	Standard	Savings	
Annual Energy Consumption (kWhrs)	29,135	35,801	6,666	19%
Annual Operating Cost ($)	2,331	2,864	533	19%
15 Year Life Cycle Cost ($)	25,729	30,086	4,357	14%
Annualized Cost ($)	2,825	3,303	478	14%
Net Present Value ($)	4,357			
Payback (yrs)	1.0			
Rate of Return (%)	106.66			
Savings to Investment Ratio (SIR)	9.71			

Figure 2: Parameter Summary and Estimated Annual Energy Use for the 18 ton RTU (cooling mode only)

Parameter Summary

Feature Name	Candidate	Standard
EER	12	10.4
Unit Cost (k$)	4.5	4
Annual Maintenance Cost ($/year)	0	0
Enable Economizer	on	off
	Applies to Both Units	
Building Type	Hotel-Large	
State, City	OR, ASTORIA	
Schedule	All week, All day	
Setpoint Temperature, Setback	65, 5	
Total Capacity (kBtuh), Oversizing (%)	300, 0	
Electric Utility Rate ($/kWhrs)	0.08	
Equipment Life	15	
Number of Units	1	
Discounted costs, Rate	on, 0.07	

RESULTS

ASTORIA, OR	Candidate	Standard	Savings	
Annual Energy Consumption (kWhrs)	40,875	54,423	13,548	25%
Annual Operating Cost ($)	3,270	4,354	1,084	25%
15 Year Life Cycle Cost ($)	34,283	43,654	9,372	21%
Annualized Cost ($)	3,764	4,793	1,029	21%
Net Present Value ($)	9,372			
Payback (yrs)	0.5			
Rate of Return (%)	216.77			
Savings to Investment Ratio (SIR)	19.74			

Figure 3: Parameter Summary and Estimated Annual Energy Use for the 25 ton RTU (cooling mode only)

Step 2. Estimation of the Projected Annual Energy Use by a New Heat Pump - Cooling and Heating Modes

The EERE energy calculator for commercial heat pumps was used to separately estimate the energy savings of each system in the cooling mode and then in the heating mode. The output section for each run give the results for four different heat pumps: user model (your choice), base model, Federal Energy Management Program (FEMP) recommended level, and a best available model. The existing heat pump is not applicable as this is a new installation.

Cooling Mode: For the cooling runs, the system capacity was entered and all other default values, including the EER, were used except that the hours of operation for heating was set to 1 (a zero entry was not allowed as an input), thus forcing the model to quantify energy use for cooling only.

Figure 4 shows the best available 18 ton heat pump operating in the cooling mode has an estimated annual energy use of 30,876 kWh.

INPUT SECTION		
Input the following data (if any parameter is missing, calculator will set to default value).		Defaults
PROJECT TYPE	New Installation	New Installation
CONDENSER TYPE	Air Source	Air Source
EXISTING CAPACITY *	ton	–
EXISTING COOLING EFFICIENCY *	EER	–
EXISTING HEATING EFFICIENCY *	COP	–
EXISTING IPLV EFFICIENCY *	IPLV	–
NEW CAPACITY	18 ton	10 tons
NEW COOLING EFFICIENCY	10.1 EER	10.1 EER
NEW HEATING EFFICIENCY	3.3 COP	3.2 COP
NEW IPLV EFFICIENCY	12.4 IPLV	10.4 IPLV
ENERGY COST	$ 0.06 per kWh	$0.06 per kWh
ANNUAL HOURS OF OPERATION FOR COOLING	1500 hours	1500 hours
ANNUAL HOURS OF OPERATION FOR HEATING	1 hours	1500 hours
QUANTITY OF HEAT PUMPS TO BE PURCHASED	1 unit(s)	1 unit

* Existing values should only be entered when Project Type is a replacement.

Calculate | Reset

OUTPUT SECTION					
PERFORMANCE PER HEAT PUMP	YOUR CHOICE	EXISTING HEAT PUMP	BASE MODEL	FEMP RECOMMENDED LEVEL	BEST AVAILABLE
COOLING EFFICIENCY	10.1 EER		8.5	9.3	10.5
HEATING EFFICIENCY	3.3 COP		2.9	3.1	3.3
IPLV EFFICIENCY	12.4 IPLV		8	9.5	12.4
ANNUAL ENERGY USE	32098 kWh		38139	34859	30876
ANNUAL ENERGY COSTS	$ 1926	$	$ 2288	$ 2092	$ 1853
LIFETIME ENERGY COSTS	$ 20955	$	$ 24893	$ 22761	$ 20161
LIFETIME ENERGY COST SAVINGS	$ 3938	$	$ 0	$ 2132	$ 4732
LIFETIME ENERGY COST SAVINGS FOR 1 HEAT PUMP(S)	$ 3938	$	$ 0	$ 2132	$ 4732

Figure 4: Inputs and Estimated Annual Energy Use for a 18 ton Heat Pump (cooling mode only)

Unfortunately, the calculators capacity is limited to 20 tons and does not allow a direct calculation for the 25 ton RTU. In order to use this calculator to get an approximation of energy use from the 25 ton unit, a comparison analysis between capacity increase and hours or operation was performed. A few test runs indicated that there is a direct correlation between the capacity and hours of operation. For example, a specified percent increase in capacity resulted in the same change in energy use as did the same percentage increase in the hours of operation. This relationship allowed us to input the capacity at 20 tons (a 25% decrease) and use 1,875 hours (a 25% increase) to simulate the 25 ton RTU operating for an assumed 1,500 hours.

Figure 5 shows the best available 25 ton heat pump operating in the cooling mode has an estimated annual energy use of 42,878 kWh.

INPUT SECTION			
Input the following data (if any parameter is missing, calculator will set to default value).			Defaults
PROJECT TYPE	New Installation		New Installation
CONDENSER TYPE	Air Source		Air Source
EXISTING CAPACITY *		ton	–
EXISTING COOLING EFFICIENCY *		EER	–
EXISTING HEATING EFFICIENCY *		COP	–
EXISTING IPLV EFFICIENCY *		IPLV	–
NEW CAPACITY	20	ton	10 tons
NEW COOLING EFFICIENCY	10.1	EER	10.1 EER
NEW HEATING EFFICIENCY	3.2	COP	3.2 COP
NEW IPLV EFFICIENCY	10.4	IPLV	10.4 IPLV
ENERGY COST	$ 0.06	per kWh	$0.06 per kWh
ANNUAL HOURS OF OPERATION FOR COOLING	1875	hours	1500 hours
ANNUAL HOURS OF OPERATION FOR HEATING	1	hours	1500 hours
QUANTITY OF HEAT PUMPS TO BE PURCHASED	1	unit(s)	1 unit

* Existing values should only be entered when Project Type is a replacement.

Calculate | Reset

OUTPUT SECTION					
PERFORMANCE PER HEAT PUMP	YOUR CHOICE	EXISTING HEAT PUMP	BASE MODEL	FEMP RECOMMENDED LEVEL	BEST AVAILABLE
COOLING EFFICIENCY	10.1 EER		8.5	9.3	10.5
HEATING EFFICIENCY	3.2 COP		2.9	3.1	3.3
IPLV EFFICIENCY	10.4 IPLV		8	9.5	12.4
ANNUAL ENERGY USE	44576 kWh		52965	48410	42878
ANNUAL ENERGY COSTS	$ 2675	$	$ 3178	$ 2905	$ 2573
LIFETIME ENERGY COSTS	$ 29104	$	$ 34577	$ 31606	$ 27994
LIFETIME ENERGY COST SAVINGS	$ 5473	$	$ 0	$ 2971	$ 6583
LIFETIME ENERGY COST SAVINGS FOR 1 HEAT PUMP(S)	$ 5473	$	$ 0	$ 2971	$ 6583

Figure 5: Inputs and Estimated Annual Energy Use for a Simulated 25 ton Heat Pump (cooling mode only)

Heating Mode: For the heating runs, the system capacity and annual hours of operation for heating and the coefficient of performance (COP) are the most critical inputs to the calculator. The COP is the ratio between the energy use of the compressor and the amount of useful heat provided by the heat pump.

As shown in Figure 6Figure 6, all of the inputs are set to the default values except that the annual hours of operation for the cooling mode is set to 1 (a zero entry is not allowed as an input), and the hours for heating is set at an assumed 1,500 hours.

The best available 18 ton heat pump operating in the heating mode has an estimated annual energy use of 28,796 kWh.

INPUT SECTION			
Input the following data (if any parameter is missing, calculator will set to default value).			Defaults
PROJECT TYPE	New Installation		New Installation
CONDENSER TYPE	Air Source		Air Source
EXISTING CAPACITY *		ton	–
EXISTING COOLING EFFICIENCY *		EER	–
EXISTING HEATING EFFICIENCY *		COP	–
EXISTING IPLV EFFICIENCY *		IPLV	–
NEW CAPACITY	18	ton	10 tons
NEW COOLING EFFICIENCY	10.1	EER	10.1 EER
NEW HEATING EFFICIENCY	3.2	COP	3.2 COP
NEW IPLV EFFICIENCY	10.4	IPLV	10.4 IPLV
ENERGY COST	$ 0.06	per kWh	$0.06 per kWh
ANNUAL HOURS OF OPERATION FOR COOLING	1	hours	1500 hours
ANNUAL HOURS OF OPERATION FOR HEATING	1500	hours	1500 hours
QUANTITY OF HEAT PUMPS TO BE PURCHASED	1	unit(s)	1 unit

* Existing values should only be entered when Project Type is a replacement.

Calculate Reset

OUTPUT SECTION					
PERFORMANCE PER HEAT PUMP	YOUR CHOICE	EXISTING HEAT PUMP	BASE MODEL	FEMP RECOMMENDED LEVEL	BEST AVAILABLE
COOLING EFFICIENCY	10.1 EER		8.5	9.3	10.5
HEATING EFFICIENCY	3.2 COP		2.9	3.1	3.3
IPLV EFFICIENCY	10.4 IPLV		8	9.5	12.4
ANNUAL ENERGY USE	29696 kWh		32770	30655	28796
ANNUAL ENERGY COSTS	$ 1782	$	$ 1966	$ 1839	$ 1728
LIFETIME ENERGY COSTS	$ 19388	$	$ 21390	$ 20008	$ 18801
LIFETIME ENERGY COST SAVINGS	$ 2002	$	$ 0	$ 1382	$ 2589
LIFETIME ENERGY COST SAVINGS FOR 1 HEAT PUMP(S)	$ 2002	$	$ 0	$ 1382	$ 2589

Figure 6: Inputs and Estimated Annual Energy Use for a 18 ton Heat Pump (heating mode only)

Similar to the cooling mode analysis, the heating mode analysis of the 25 ton unit required the capacity be set to 20 tons and the heating hours set to 1,875, thus simulating a 25 ton heat pump operating for an assumed 1,500 hours annually in the heating mode.

Figure 7 shows the best available 25 ton unit heat pump has an estimated annual energy use of 39,989 kWh.

INPUT SECTION			
Input the following data (if any parameter is missing, calculator will set to default value).			Defaults
PROJECT TYPE	New Installation		New Installation
CONDENSER TYPE	Air Source		Air Source
EXISTING CAPACITY *		ton	–
EXISTING COOLING EFFICIENCY *		EER	–
EXISTING HEATING EFFICIENCY *		COP	–
EXISTING IPLV EFFICIENCY *		IPLV	–
NEW CAPACITY	20	ton	10 tons
NEW COOLING EFFICIENCY	10.1	EER	10.1 EER
NEW HEATING EFFICIENCY	3.2	COP	3.2 COP
NEW IPLV EFFICIENCY	10.4	IPLV	10.4 IPLV
ENERGY COST	$ 0.06	per kWh	$0.06 per kWh
ANNUAL HOURS OF OPERATION FOR COOLING	1	hours	1500 hours
ANNUAL HOURS OF OPERATION FOR HEATING	1875	hours	1500 hours
QUANTITY OF HEAT PUMPS TO BE PURCHASED	1	unit(s)	1 unit

* Existing values should only be entered when Project Type is a replacement.

Calculate Reset

OUTPUT SECTION					
PERFORMANCE PER HEAT PUMP	YOUR CHOICE	EXISTING HEAT PUMP	BASE MODEL	FEMP RECOMMENDED LEVEL	BEST AVAILABLE
COOLING EFFICIENCY	10.1 EER		8.5	9.3	10.5
HEATING EFFICIENCY	3.2 COP		2.9	3.1	3.3
IPLV EFFICIENCY	10.4 IPLV		8	9.5	12.4
ANNUAL ENERGY USE	41239 kWh		45507	42570	39989
ANNUAL ENERGY COSTS	$ 2474	$	$ 2730	$ 2554	$ 2399
LIFETIME ENERGY COSTS	$ 26917	$	$ 29702	$ 27788	$ 26101
LIFETIME ENERGY COST SAVINGS	$ 2785	$	$ 0	$ 1914	$ 3601
LIFETIME ENERGY COST SAVINGS FOR 1 HEAT PUMP(S)	$ 2785	$	$ 0	$ 1914	$ 3601

Figure 7: Inputs and Estimated Annual Energy Use for a Simulated 25 ton Heat Pump (heating mode only)

Step 3. Estimation of the Annual Natural Gas Consumptions by the Existing RTUs

The natural gas consumption rates for the two existing RM Series RTUs were approximated by performing a linear interpolation of the technical data table in the product specifications sheet. At full capacity, the gas input rate is 408 MBh (4.08 therms per hour) for the 18 ton unit and 462 MBh (4.62 therms per hour) for the 25 ton unit.

Using the minimum thermal efficiency of 80% for warm air furnaces as cited in ASHRAE 90.1-2004 and assuming 1,500 hours of heating operation per year, the current annual gas consumption is estimated at 7,650 (18 ton) and 8,663 (25 ton) therms. This results in a total gas consumption savings from fuel-switching the central furnaces to heat pumps of approximately 16,313 therms per year.

5 Energy Analysis Results for HVAC Retrofits

The energy-savings calculator outputs from the chiller and RTU replacement analyses is summarized in Table 1. The table presents the estimated annual energy use for the existing equipment and for the best (most efficient) replacement products available on the market. Also shown are the change in energy use and the percent change of the Casino load. Negative values represent an energy savings or decrease in load.

Replacing the 30 ton chiller would reduce the annual energy use by approximately 29,811 kWh. However, fuel switching the RTUs to new all-electric heat pumps would increase the usage an additional 23,871 kWh per year for the 18 ton unit and 28,444 kWh for the 25 ton unit. If all three retrofits were implemented, the total annual energy use would increase by 22,504 kWh.

The average annual load at the Casino over the past three years is 2,269,589 kWh. The percent change in load decreases by approximately 2% for the cooling mode and increases by 3% in the heating mode, resulting in an overall increase in the Casino load of 1%.

Table 1: HVAC Retrofits Electrical Energy Summary

HVAC Unit	Mode of Operation	Existing Annual Energy Use (kWh)	Replacement Annual Energy Use (kWh)	Change in Annual Energy Use (kWh)	Change in Casino Load (%)
30 ton Chiller	Air-cooled	65455	35644	**-29811**	**-1.31**
18 ton RTU	cooling mode	35801	30876	-4925	-0.22
	heating mode		28796	28796	1.27
			Subtotal	**23871**	**1.05**
25 ton RTU	cooling mode	54423	42878	-11545	-0.51
	heating mode		39989	39989	1.76
			Subtotal	**28444**	**1.25**
			TOTAL	**22504**	**0.99**

Although the electrical energy use at the Casino would increase by 1%, the retrofits would reduce the consumption of natural gas at the Casino by 16,313 therms (Table 2) Eliminating this amount of natural gas would prevent 86.5 metric tons of greenhouse gas emissions from entering the environment.

Table 2: HVAC Retrofits Natural Gas Consumption Summary

HVAC Unit	Mode of Operation	Existing Annual Gas Consumption (therms)	Replacement Annual Gas Consumption (kWh)	Change in Annual Gas Use (kWh)
18 ton RTU	heating mode	7650	0	-7650
25 ton RTU	heating mode	8663	0	-8663
			TOTAL	**-16313**

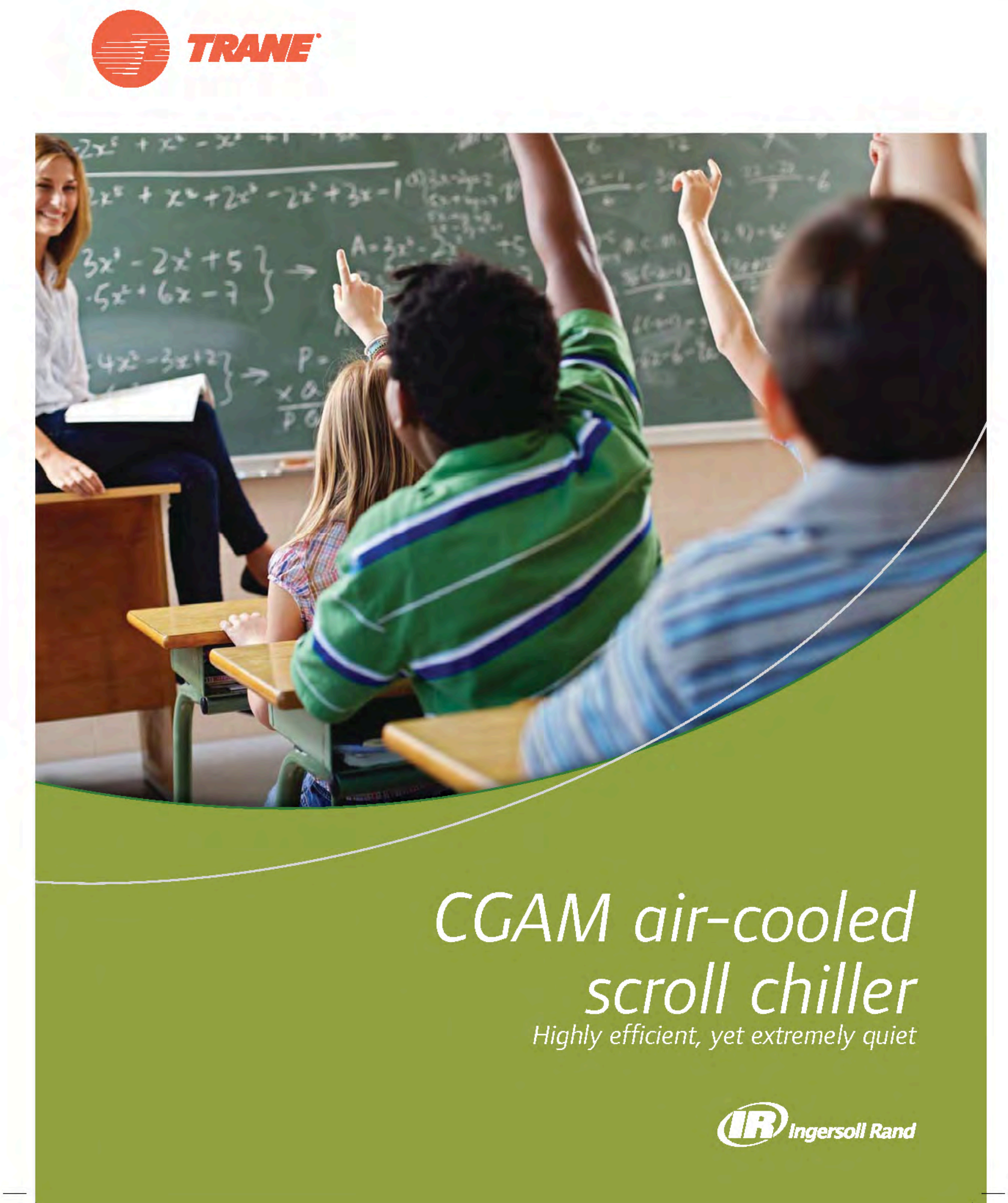
6 Conclusion

SERC looked at those retrofit recommendations from the RE report, and focused on replacement and fuel switching options for existing HVAC units on the Casino. Analysis was limited to these recommendations because

- The Casino both represents the largest energy load and the oldest commercial infrastructure
- The retrofit recommendations for the HVAC units represented the largest potential change to the load profile for the Casino
- Fuel switching gas kitchen appliances was not considered a reasonable or desirable option
- Information on potential replacement options for the Casino UPS units was not obtained as of the completion of this report. However, since UPS units are regulated under the gaming commission they cannot be removed or significantly altered in any way. It is expected that efficiency gains from newer technology will only result in a reduction of a few percent.

The goal of this exercise was to determine if significant changes to the load profiles developed in the Task 2.1 Technical Memo would be needed to account for demand-side retrofits. The results show that changes to the load profile from major retrofit options would be within the error of the Task 2.1 load profiles. Future implementation of energy options developed under this project can reasonably use the Task 2.1 load profiles without modification for early design development.

Appendix A Trane 30-ton Air-Cooled Chiller Unit



Balancing energy efficiency and quiet operation

Energy efficiency, sound, reliability, controls and service are all vitally important to the effective operation of a building. Trane engineers know how important all these factors are to you—so we designed them all into our new 20-130 ton model CGAM chiller. Using the best elements of each design we created an extremely quiet and highly efficient chiller.

High efficiency and quiet operation

Most air-cooled chillers require you to choose between a highly-efficient unit or a low-noise unit. A quieter fan often produces less air flow, reducing efficiency. With the Trane CGAM chiller, we have designed these two very important benefits into one chiller.

Our design team compiled the best approaches from around the globe to optimize the CGAM chiller so that it meets global green initiatives and ASHRAE energy efficiency standards.

The Trane CGAM chiller is one of the most efficient air-cooled chillers, even among screw compressor equipment. Low sound levels are standard, with a 5–8db reduction compared to previous Trane air-cooled chiller models. And, with factory-installed attenuation, Trane further reduces sound levels—up to an additional 3db.

Reliability you can count on

Energy efficiency and quiet operation are increasingly critical. As a result, we perform extensive testing on the compressors and units, confirming their robust design and durability while ensuring our high standards for reliability.

Our testing includes:

- Extreme testing includes cold ambient starts, hot water starts and high ambient operation
- Compressor accelerated life cycle testing, including high pressure ratio, high load test, flooded starts/stops, start/stop testing and phase reversal

On-site test facility ensures reliability and performance verification

- Performance modeling and verification, both during design and for the life of the chiller
- FEA analysis confirms the unit structure can withstand shipping, rigging and operational activity
- Electrical testing with destructive testing for short circuit withstand rating

To minimize leaks, Trane improved the coil structure stability by strengthening the coil frame and changing the construction method. Now we use a single copper tube for two passes through the coil to reduce braze joints on one side of the coil, eliminating up to 60 joints. Furthermore, the new construction method ensures all coils are square, so the coil components are better aligned.

Factory installed reliability

We offer several factory-installed features that further reduce energy consumption, add redundancy for mission-critical operations and reduce jobsite installation time — when every day counts.

A factory-installed pump package, designed specifically for this unit, comes pre-wired and factory-tested. The dual pump setup provides built-in redundancy and the standard inverter delivers added pump energy savings.

With the factory-installed buffer tank, you can install the chiller in applications with less than a three minute water loop and still reliably maintain precise temperature control.

The flow switch and water strainer are also factory installed as standard, reducing jobsite installation requirements and ensuring reliable operation.

Trane reduces energy costs by incorporating an ice storage system design that uses ice made at night, when energy demand and cost are lowest, to cool the building during the day.

Low life cycle costs

Trane engineers, using some of the best analytic approaches and tools in the industry, can find ways to reduce your energy usage by optimizing energy efficiency and performance at every point within your system. We design systems tailored for your specific application. For example, using partial heat recovery, the heat rejected from the condenser while cooling the building can be redirected through a factory-installed heat exchanger on the chiller to provide heat for VAV reheat coils. This provides more efficient dehumidification in commercial buildings, or for pre-heating laundry or pool water in lodging applications.

Another energy saving strategy is making ice wherever energy costs are less expensive, and then using it for cooling during the day. Ice storage can be used in many applications including: K-12 schools, government jobs and industrial processes.

Air-cooled scroll chiller
Model CGAM (20-130 Ton)

Appendix B AAON RM Series Central Furnaces

AAON®

The Name To Remember.

RM·RN SERIES

PACKAGED ROOFTOP UNITS

RM 2 to 30 Tons

RN 26 to 70 Tons

Vertical Discharge Condensers

Horizontal Airflow Curb Available on All Models Including Air Handlers

High Performance Composite Panel Construction – RN Models

The AAON® RM/RN Series continues the industry leading performance in packaged rooftop equipment. All units are available with backward-inclined plenum fans for energy efficient delivery of airflow and stable static pressure.

For installation flexibility RM/RN units are available in four cabinet sizes from 2 to 70 tons cooling capacity and mount to three common curb sizes.

The 2-15 ton units share a curb, the 16-30 ton share a curb, and the RN 26-70 ton have a common curb. These curb commonalities provide ease of installation and a variety of configurations.

RM SERIES

AAON®

VERTICAL DISCHARGE | **2 to 30 Tons**

Accessible, Dependable and Expandable

Exclusive AAON® slide out blower assembly provides easy access and service loop.

The AAON® manufactured gas heat exchanger tubes have an exclusive patented "dimple" to assure maximum heat transfer.

Optional AAONAIRE® energy recovery wheel enhances IAQ and reduces power consumption.

Standard Features

- Compressors, controls and heating components are located in a single isolated compartment
- Scroll compressors are installed on a sheet metal deck and rubber isolation mounted for quiet efficient operation
- Thermostatic expansion valves on DX coils
- Manual reset high pressure cutoff
- Automatic reset low pressure cutoff
- Roof sloped and cross-broken for proper drainage
- Bottom access return and supply air
- Single point power connection
- Double wall access doors with stainless hinges
- Slide out blower assembly for easy service
- Notched blower drive belts
- Direct drive condenser fans
- G90 galvanized cabinet construction
- Gray polyurethane paint passes 2000 hour salt spray test
- Run test report, wiring diagram, installation manual and startup form located in control access compartment

Optional Features

- Economizer – full modulating or 3-position outside air
- Power Exhaust – with or without AAONAIRE® energy recovery wheel
- Gas Heat Exchanger – Stainless Steel
- Blower Motors – oversized and/or high efficiency
- Blower Fan – VFD volume control
- Air Filter – multiple options and monitoring devices
- GFI convenience outlet
- Smoke Detectors or Firestats – return and/or supply air
- Humidity Control:
  - Hot Gas Reheat
  - Modulating Hot Gas Reheat
  - Return Air Bypass
  - Hot Gas Bypass
- Compressor isolation valves
- Phase and brown-out protection
- Disconnect switch
- Burglar bars in return and/or supply air
- All double wall construction
- Drain Pan – Stainless Steel
- Horizontal supply and return air curb
- Unit available with R-410A refrigerant

Technical Data

Unit Size	Model	Nominal Capacity in Tons	EER Rating	Gas MBh Input	Electric kW	RM Series Dimensions in Inches: Length (HW*)	Width	Height
A	02	2.3	12.8	3 sizes to 180	Up to 40	78.0 (118.0)	75.0	35.4
	03	3.0	12.8					
	04	4.2	11.4					
	05	5.1	11.8					
	06	6.7	10.4					
	07	7.9	10.3					
B	08	8.4	11.2	3 sizes to 390	Up to 60	78.0 (118.0)	87.0	43.4
	10	10.5	11.0					
	13	13.2	10.8					
	15	14.4	10.6					
C	16	15.4	12.2	3 sizes to 480	Up to 100	105.8 (154.1)	98.9	59.5
	18	17.8	11.7					
	20	19.8	11.5					
	25	24.9	10.4					
	30	26.0	9.5					

NOTE: 2 to 5 ton models are SEER rated.

* Length with AAONAIRE® energy recovery wheel.

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RN SERIES

VERTICAL DISCHARGE | 26 to 70 Tons

Accessible, Dependable and Expandable

Standard Features

- All cabinet walls, roof and floor shall be a high performance composite panel constructed with G90 galvanized steel on both sides and a closed cell polyurethane foam interior core providing a rigid, impact resistant surface. All panels have a thermal break with no metal contact from inside to outside.
  - the walls and roof of the conditioned air compartments shall be 2 inches thick with a minimum R value of 12.5. The roof of the conditioned air compartments shall be sloped at a minimum of 1/4 inch per foot
  - the floor of the conditioned air and control compartments shall be 1 inch thick with a minimum R value of 6.25
- Access doors with stainless hinges and zinc cast lockable handles
- Drain pan – Stainless Steel
- Compressors and unit controls contained within single isolated compartment
- Scroll compressors installed on sheet metal deck with rubber isolation mounts for quiet efficient operation
- Direct drive blower plenum fan(s)
- Blower motor(s) installed on rubber isolation mounts for quiet efficient operation
- Direct drive condenser fan(s)
- Bottom access return and supply air
- Roof sloped for proper drainage
- Single point power connection
- Thermostatic expansion valves on DX coils
- Manual reset high pressure cutoff
- Automatic reset low pressure cutoff
- Run test report, wiring diagram, installation manual and startup form in control access compartment
- Gray polyurethane paint coating which passes 2000 hour salt spray test

Optional Features

- Power return with axial fan and economizer
- Power exhaust with axial fan and economizer
- Power exhaust with plenum fan, economizer and AAONAIRE® energy recovery wheel
- Economizer and empty heat wheel section
- Power exhaust with plenum fan, economizer and empty heat wheel section
- Gas heat exchanger - Stainless Steel
- Blower motors may be oversized and/or high efficiency
- Direct drive blower fan control with VFD or AAON® banded wheel
- Air filters with multiple options, efficiencies and monitoring devices
- GFI convenience outlet
- Smoke detectors or firestats in return and/or supply air
- Humidity Control:
  - Hot Gas Reheat
  - Modulating Hot Gas Reheat
  - Return Air Bypass
  - Hot Gas Bypass
- Compressor isolation valves
- Phase and brown-out protection
- Disconnect switch
- Burglar bars in return and/or supply air
- Horizontal supply and return air curb
- Interior metal panels are available as stainless steel
- Unit available with R-410A refrigerant

Cutaway of panel wall showing thermal break and foam core.

Horizontal Airflow Curb Available on All Models

Technical Data

Unit Size	Model	Nominal Capacity in Tons	EER Rating	Gas MBh Input	Electric kW	RN Series Dimensions in Inches: Length (HW*)	Width	Height
D	26	26 to 70	12.0	2 sizes to 780	4 to 240	155.0 (203.5)	101.8	96.6
	31		11.7					
	40		10.5					
	50		10.8					
	60		10.1					
	70		9.4					

* Length with AAONAIRE® energy recovery wheel.

RM·RN

VERTICAL DISCHARGE | 800 to 28,000 Nominal CFM

Packaged Rooftop Air Handlers

RM 2-30 Ton

Standard Features

2 to 30 ton air handlers share the same cabinet platform and features as the RM product line.

Optional Features

- Economizer for full modulating or 3-position outside air
- Power exhaust with forward curve fan
- Power exhaust with forward curve fan and economizer
- Power exhaust with AAONAIRE® energy recovery and plenum fan
- Humidity Control:
  - Hot Gas Reheat
  - Modulating Hot Gas Reheat
  - Return Air Bypass
  - Hot Gas Bypass
- Blower motors may be oversized and/or high efficiency
- Blower fan with VFD volume control
- Air filters with multiple options and/or monitoring devices
- Smoke detectors or firestats in return and/or supply air
- Phase and brown-out protection
- Disconnect switch
- Burglar bars in return and/or supply air
- All double wall construction
- Drain Pan – Stainless Steel
- Horizontal supply and return air curb
- Unit available with R-410A refrigerant

RN 26-70 Ton

Standard Features

26 to 70 ton air handlers share the same cabinet platform and features as the RN product line.

Optional Features

- Economizer for full modulating or 3-position outside air
- Economizer, empty heat wheel section
- Economizer, empty heat wheel section, plenum fan power exhaust
- Economizer, axial fan power exhaust
- Economizer, axial fan power return
- Economizer, AAONAIRE® energy recovery, plenum fan power exhaust
- Humidity Control:
  - Hot Gas Reheat
  - Modulating Hot Gas Reheat
  - Return Air Bypass
  - Hot Gas Bypass
- Blower motors may be oversized and/or high efficiency
- Blower Fan with VFD volume control
- Air filters with multiple options and/or monitoring devices
- Smoke detectors or firestats in return and/or supply air
- Phase and brown-out protection
- Disconnect switch
- Burglar bars in return and/or supply air
- Drain pan – Stainless Steel
- Horizontal supply and return air curb
- Interior metal panels are available as stainless steel
- Unit available with R-410A refrigerant

Horizontal Airflow Curb Available on All Models

Technical Data

Unit Size	Model	Nominal CFM	Dimensions in Inches: Length (HW*)	Width	Height
A	02	800	78.0 (118.0)	56.5	35.4
	03	1,200			
	04	1,600			
	05	2,000			
	06	2,400			
	07	2,800			
B	08	3,200	78.0 (118.0)	60.3	43.4
	10	4,000			
	13	5,200			
	15	6,000			
C	16	6,400	99.3 (148.3)	62.5	55.0
	18	7,200			
	20	8,000			
	25	10,000			
	30	12,000			
D	26	10,400	155.0 (203.5)	101.8	66.1
	31	12,400			
	40	16,400			
	50	20,000			
	60	24,000			
	70	28,000			

* Length with AAONAIRE® energy recovery wheel.

The Name To Remember.

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Tulsa, OK 74107
918-583-2266
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Rev. 2 03/06 • R 42960

Appendix D:

Subtask 2.4: Existing Infrastructure and Renewable Energy Production Assessment Technical Memo

Recipient Organization:	Bear River Band of the Rohnerville Rancheria
Project Title:	**Bear River Band Energy Options Analysis Project**
Date of Report:	January 25, 2019
Award Number:	DE-IE0000063
Technical Contact:	Edwin Smith, Director of Environmental and Natural Resources, 266 Keisner Rd. Loleta, CA 95551 (707) 733-1900 edwinsmith@brb-nsn.gov
Business Contact:	same as Technical Contact
Partners:	Humboldt State University Sponsored Programs Foundation and its affiliate, the Schatz Energy Research Center
DOE Project Officer:	Tweedie Doe (240) 562-1617 tweedie.doe@hq.doe.gov
GO Project Monitor:	Tommy Jones (240) 562-1739 Thomas.Jones@ee.doe.gov

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1 Introduction

This technical memo presents the results of the infrastructure and renewable energy production assessment work conducted for the *Bear River Band of Rohnerville First Steps* project. The purpose of the assessment work is to determine the readiness for integrating renewable energy systems into the existing and planned electrical infrastructure.

Expanding on the previous load profile and energy resource work, the following infrastructure assessment subtasks were performed and their outcomes presented:

- Request and review utility and site electrical infrastructure documentation
- Review the potential renewable energy systems presented in Task 2.2
- Identify options for the electrical point of interconnection (POI) for each RE system based on the size of the energy system and the electrical infrastructure
- Obtain feedback from the Strategic Vision Advisory Committee
- Summarize the readiness for integrating renewable energy systems

2 Utility and Site Electrical Infrastructure Documentation

SERC requested electrical system documentation for the Rohnerville Rancheria and Casino Resort in the form of utility record drawings, building electrical drawings, planned facility plan sets, back-up generator specifications, and electrical drawings for the new electric vehicle charging station.

The Tribe provided the following information for the Rancheria:

- a high-level utility civil record drawing
- the Tish-Non Community Center (TNCC) PV system plan set, and
- design notes and preliminary drawings for the planned facilities

The information was used to conduct a high-level assessment of the infrastructure. However, additional information (utility transformer specifications, building main switchgear specifications, and site loads) is needed to verify that the proposed POI options are viable.

The information obtained to date for the Casino Resort included diesel generator specification sheets for the Casino and the Pump & Play gas station. Additional information is required to evaluate the existing infrastructure and determine the possible points for connecting the renewable energy systems to the grid or a buildings electrical system.

3 Review of Potential Renewable Energy (RE) Systems

An overview of the photovoltaic (PV) and wind energy systems previously presented in Task 2.2 report is given below.

3.1 PV Systems

There are seven sites on the Rancheria (Figure 1) and four sites at the Casino Resort (Figure 2) that may be suitable locations for new solar PV systems. The colors in figures correspond to the type of system:

- blue locations for ground-mounted arrays,
- green locations indicate new PV canopies or carports,
- yellow locations for possible roof-mounted systems on the planned facilities, and
- red locations for roof-mounted systems on existing buildings.

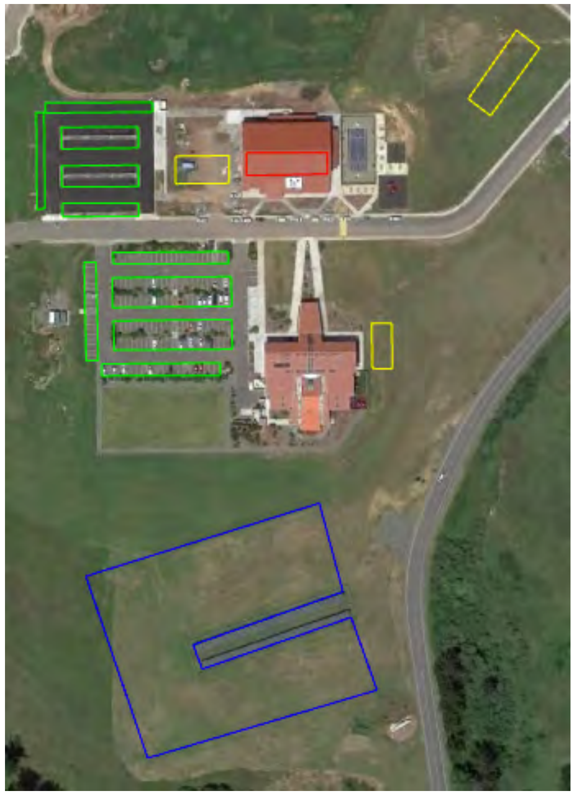

Figure 1: Locations for Potential PV Systems on the Rancheria

Figure 2: Locations for Potential PV Systems at the Casino Resort.

Due to insufficient electrical and/or building information, the roof-mounted systems for the planned facilities (yellow) have not been evaluated for infrastructure readiness.

Table 1 and Table 2 lists the PV system location, maximum size, and estimated annual energy production for the Rancheria and Casino Resorts. The system sizes represent the maximum that can be installed given the sites footprint. Also shown are the maximum PV power and annual energy production if all systems were installed.

For the parking lot sites, the areas were divided up based on the orientation of the parking spaces (solar carports). The TNCC and the Rec Center lots have two PV systems each and the larger casino parking lot has four separate PV systems.

The sizes of the PV systems were determined by the amount of available space and the type of mounting system used. Using these estimated sizes, the project team used the on-line application known as *PV Watts Calculator* to estimate the potential on-site energy production for the various ground-mounted, rooftop and car canopy locations. Further details on the sizing and energy production estimations can be found in the Task 2.2 report.

Table 1: PV Size and Estimated Annual Energy Production (kWh) for Potential Rancheria PV Systems

Site	*Location*	*PV Size (kWDC)*	*Estimated Annual Energy Production (kWh)*
TNCC Hillside	south side	744	1,013,564
TNCC Parking Lot	E-W islands	560	704,915
	N-S islands	68	80,882
Rec Center Parking Lot	E-W islands	297	373,857
	N-S islands	42	49,956
Rec Center	rooftop	86	116,122
	Totals (maximum)	**1,798**	**2,339,296**

Table 2: PV Size and Estimated Annual Energy Production (kWh) for Potential Casino Resort PV Systems

Site	*Location*	*PV Size (kWDC)*	*Estimated Annual Energy Production (kWh)*
Pump & Play	dispensing island	48	59,037
Bear River Drive Hillside	top of hillside	103	132,058
Casino Parking Lot	west lot	145	178,340
	north lot angled	310	388,456
	north lot	996	1,253,741
	east lot	166	201,407
Casino	rooftop	116	148,725
	Totals (maximum)	**1,767**	**2,213,038**

3.2 Wind Energy System

In the renewable energy resource assessment, three potential locations for wind turbines near the waste water treatment plant (top left corner) were identified (Figure 3).

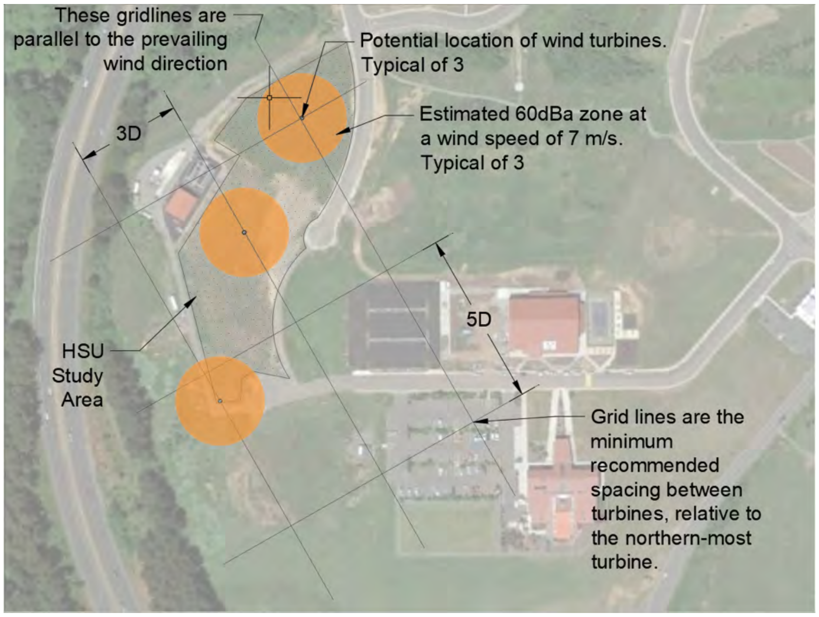

Figure 3: Location of potential wind turbines.

The annual energy production for 3 Northern100kW turbines is shown in **Error! Reference source not found.**. Details on how the energy production was calculated can be found in the Task 2.3 report.

Table 3: Estimated potential annual energy production and single highest peak output power from three Northern 100kW wind turbines.

Parameter	***Minimum***	***Average***	***Maximum***
Peak Power Output (kW)	128	149	249
Annual Energy Production (MWh)	203	368	533

4 Electrical Point of Interconnection (POI) Options

The available electrical infrastructure documentation was referenced to identify the possible electrical points of interconnections (POI) for the PV and wind energy systems. The size of the RE system and the specifications and available capacity of the nearby switchgear are analyzed to determine if the RE system can tie into the existing electrical infrastructure. If the RE system size exceeds the existing infrastructure capacity, a new utility generating account is proposed. The limitations and requirements for establishing a new generating account will be investigated in upcoming project tasks.

For each site, the option to install a battery energy storage system (BESS) and the need for possible upgrades to equipment within the existing infrastructure are evaluated.

4.1 Tish-Non Community Center

There are two photovoltaic systems that could be installed at the Community Center: a ground-mounted PV system on the south hillside and a solar carport system in the parking lot.

If the entire areas identified in Figures 1 and 2 are utilized, the hillside and the parking lot could accommodate a 744-kWDC system and a 628-kWDC system, respectively. Either system would be six to seven times larger than the existing TNCC renewable energy system (rated at 100 kWDC) and would generate a significant amount of energy for the Rancheria.

According to the single-line diagram of the existing renewable energy system, the PV AC disconnect is rated for 600A (450A fused) and connects to the centers main service panel (MSP). The MSP has a rating of only 1000A, which may be just enough capacity for another 100-kW system to be added to the buildings electrical system. A more detailed analysis that included the site loads is required to determine the actual available capacity of the existing switchboards.

Given the large size of both PV systems, and the limited available capacity of the existing electrical system, the recommended option for the TNCC is:

> Option 1: Set up a new generating account and connect the PV system(s) to the subgrade electrical distribution line on Keisner Road. The new service would include a new transformer and service meter and panel, and the energy generated would offset energy use at not only the community center, but other Rancheria accounts via a net energy aggregate metering plan offered by the local utility.

4.2 Recreation Center

There are two proposed solar PV locations: in the parking lot and on the roof. One other possibility could be the new rooftop for the proposed pool. However, insufficient information is available at this time to evaluate this option.

A solar carport system sized up to 339 kWDC could fit within the parking lot, and could generate over 400,000 kWh of renewable energy per year (Table 1). A rooftop system could be approximately 86 kWDC and generate around 100,000 kWh per year.

The Tribe is concerned that penetrations through the roof could cause water leaks and result in damage to the existing building. The roof is constructed of a metal standing seam design and there are commercially available solar array mounting clamps that are made specifically for this type of roof without requiring mounting penetrations. It is recommended that the Tribe consider a roof-mounted PV system.

Plans are currently underway to expand the Recreation Center and construct an adjacent building to house a new swimming pool. This expansion provides not only a good opportunity to incorporate a renewable energy system that could offset existing and future energy loads, but also the opportunity to consider a BESS that could mitigate the anticipated increase in peak demand from the operation of new pool equipment, thus providing additional cost savings.

According to the one-line diagram in the Phase 3 design plan set, the existing electrical system will be modified to power the new building and pool equipment. The existing main switchboard (MSB SE-1) will be reconfigured to include one main 1000A circuit and two spare circuits. The 1000A main circuit will supply a new distribution switchboard (SWBD SE-2) that will power the existing loads and the new building. A 50-kW generator and automatic transfer switch will be installed between to the two switchboards to provide back-up power during grid outages (Figure 4).

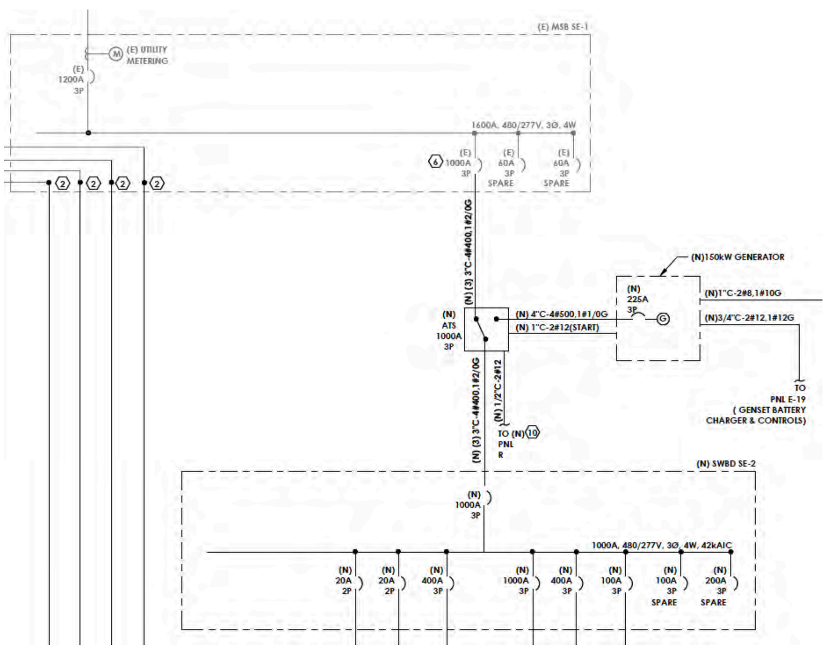

Figure 4: Screenshot of Rec Center One Line Diagram (Phase 3)

Options for connecting the PV system and/or battery energy storage system to the building are:

<u>Option 1</u>: MSB SE-1 is a 1600A, 480V, 3-phase switchboard that includes the 1000A circuit and two spares. The spare circuits currently show 60A breakers that could accommodate up to a 49-kW PV system each, for a total of 98 kW. However, given the 1600 rating and the 1000A new circuit, SE-1 may actually have 600A of available capacity. Upsizing the breakers to 600A total could allow up to a 492-kW PV system to be connected to the switchboard, large enough to accommodate both PV systems and a 150-kW battery energy storage system.

Option 2: The new SWBD SE-2 has a spare 100A circuit and a spare 200A circuit. The combined capacity of these breakers could allow for a combined PV and BESS capacity up to 246 kW.

A detailed analysis of SE-1 and SE-2 that includes the site loads would be required to determine the actual available capacity of these switchboards. The carport PV system can then be sized to match this available capacity. Sizing a BESS would then follow.

4.3 Pump & Play

A 48-kWDC PV system on the dispenser island canopy matches well with the gas station's peak demand (56 kW) as identified in the load profile assessment work. Although there are no building electrical infrastructure drawings to reference, a photo of the station's back-up diesel generator nameplate shows that the diesel generator is rated for 125 kW. This indicates there may be a POI in the existing electrical system. Further investigation is needed to determine. Equipment upgrades may be required if the existing infrastructure does not offer an appropriate point of connection.

4.4 Bear River Drive East Hillside

A 100 kW PV system can fit in the available land on the east hillside of Bear River Drive. No documentation is available to identify a point of connection; however, there may be the possibility to connect the system to the previously-installed wind turbine service account. Additional information is needed to determine this.

4.5 Casino Parking Lots

The parking lots surrounding the casino offer an opportunity to install numerous solar canopies with the potential to install up to 1.6 MW of PV power. This would generate a significant amount of on-site power that could offset almost the entire energy use by the Casino. The following options for electrical interconnection are possible depending on the amount of PV installed, the available capacity and limitations of the Casino's electrical system, and the desire to include a BESS to reduce peak demand:

Option 1: Establish a new generating account with the utility to offset energy use from the Casino and possibly other Casino Resorts accounts (peak demand charges will not be reduced).

Option 2: Determine the existing available electrical capacity and maximize the size of the PV and battery system. The point of connection is behind the meter and the generated RE will offset the facility's energy use and reduce the peak demand. Electrical equipment upgrades to the existing infrastructure may be needed to handle a large amount of renewable energy.

Option 3: If a significant amount of PV is installed that might exceed existing available capacity, and equipment upgrades are not possible or not cost-effective, then a hybrid of both Options 1 and 2 could be implemented.

4.6 Wind Energy System

There is no building information available for the wastewater treatment plant to assess the readiness for integrating a wind system into the existing and/or proposed infrastructure. Setting up a new generating account may be the best option for this system.

5 Strategic Advisory Committee Feedback

As of the writing of this memo a Strategic Advisory Committee has not been created. Therefore, the assessments and recommendations provided in this report have not yet been reviewed by a committee consisting of key representatives associated with the Tribe. The Tribe should consider establishing a Strategic Advisory Committee to ensure stakeholder input and guidance for the remaining project activities.

6 Infrastructure Readiness Summary

The point of interconnection (POI) options for each of the renewable energy systems is summarized below. Additional infrastructure documentation along with a site visit will be required to further evaluate the options presented or identify more appropriate locations for integrating the renewable energy systems.

Tish-Non Community Center - the most appropriate POI for the hillside PV and/or solar carport system(s) is at the utility distribution line on Keisner Road. A new generating account with the utility should be established.

Recreation Center - the two possible POI's for a rooftop and/or solar carport PV system(s) along with a possible battery energy storage system are:

- The spare breakers on the main switchboard (MSB SE-1). If upsized to 600A total, the circuits could handle up to 492 kW of renewable energy.
- The spare breakers on the new switchboard (SWBD SE-2). The circuits could handle up to 246 kW of renewable energy.

Pump & Play - the most likely POI for the dispensing canopy PV system is at the station's main service panel. Further investigation is needed to determine whether panel upgrades are required.

Bear River Drive - the exact POI for a ground-mounted PV system is unknown. One possibility may be to connect the system to the previously-installed wind turbine electrical service panel. Further research is required.

Casino - the most appropriate location for connecting the solar carport PV and possible battery energy storage system will depend on the amount of PV installed, the available capacity, limitations of the Casino’s electrical system, and the desire to include a BESS to reduce peak demand. The three POI options are:

- connect to the utility distribution line and establish a new generating account.
- connect to the Casino’s electrical infrastructure. Equipment upgrades may be needed to handle a large amount of renewable energy.
- connect to both locations if installed PV capacity exceeds the Casino’s available capacity and Casino equipment upgrades are not possible or not cost-effective.

Wind Energy System

Setting up a new generating account may be the best option for this system.

Appendix E

Energy Options Implementation Plan

Bear River Energy Options Analysis Project

Prepared for: Bear River Band of Rohnerville Rancheria

Prepared by: Schatz Energy Research Center

EERE Award Number:
DE-IE0000063

Sponsoring Program Office:
U.S. Department of Energy
Office of Indian Energy Policy and Programs
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Grant Recipient:
Bear River Band of Rohnerville Rancheria
Edwin Smith, past Director of Environmental and Natural Resources

Project Title:
Bear River Band Energy Options Analysis Project

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Project Overview

This Bear River Band of Rohnerville Rancheria (BRB) Energy Options Analysis provides a detailed assessment of energy solutions and a comprehensive implementation plan for moving toward development of energy sufficiency in alignment with the BRB's strategic vision of "zero net annual utility energy consumption." The objective of this effort is a comprehensive analysis resulting in a thorough understanding of BRB's energy resources and loads, including current and projected future energy consumption. This analysis encompasses "demand-side" options that reduce energy consumption, and local commercially viable and renewable "supply-side" options. The identified opportunities were reviewed by a tribal advisory committee to ensure options are in alignment with the BRB's strategic vision of energy self-sufficiency for the tribal community.

Background

The Bear River Tribe was originally established in 1910 as a home for homeless, landless Native American Indians. In 1958 Rohnerville Rancheria was one of 34 California tribes that was terminated by an act of congress known as the Rancheria Act. In December of 1983, the Bear River Band of Rohnerville Rancheria, along with sixteen (16) other California Tribes, regained their federal recognition status by a class action lawsuit known as the Tillie-Hardwick case. The United States granted Federal recognition to the Tribe as a result of the lawsuit, but it did not provide the Tribe with compensation for the land, resources, rights and heritage/culture that was taken from them. Tribal Chairpersons lobbied Congress to get funds set-aside for three years for the Tribe.

In 2009, the Tribe's Environmental and Natural Resources department implemented a Wind Turbine pilot project to test the feasibility of the wind power around the Tribe's core Reservation lands. This led to the installation of a 10kW wind turbine that has since been successfully operated and maintained by the Tribe's Environmental and Natural Resources department. The wind project was further studied by the Tribe in partnership with Humboldt State University (HSU) who conducted a technical and economic feasibility analysis for the development of wind energy resources on the Rancheria. In 2014, the Tribe contracted with TWN Wind Power to assess wind resources feasibility to achieve the community's goals of self-sufficiency and sustainability. TWN examined how small-scale distributed wind energy generation projects would benefit the Tribal community and provided an assessment of the average annual wind speeds on the Reservation and advised on which areas to consider for future distributed wind energy projects.

In 2014, the Tribe developed an Energy Development Plan facilitated and documented for the Department of Energy (DOE), Office of Indian Energy (IE) through Sandia National Laboratories by Indigenous Collaboration. That Plan contains the Bear River Tribes Energy vision. The Bear River Tribe's subsequent vision and mission are as follows:

> *"The vision of the Bear River Band of Rohnerville Rancheria is shaping a secure healthy future by responsibly exercising sovereignty, investing in our people, refining and evolving as a tribal organization, preserving and revitalizing our culture while serving the best interests of all people."*

“The mission of Bear River Band of Rohnerville Rancheria is to promote balance between quality of life, self-sufficiency, sustainability and cultural awareness for Bear River.”

In 2015, the Tribe contracted with JLM Energy to install 400 solar panels and 20 small wind turbines. This project offsets energy usage of the Tish Non Community Center. The max output of the solar panels is 100kw per day and the max output for the wind turbines is 35kw per day. In 2016, Tribal Council hired Redwood Energy to develop a Renewable Energy Sovereignty Master Plan for the Tribe. This Plan included a detailed energy audit, and an initial general high-level energy assessment which this analysis leverages and builds upon.

Project Approach

In alignment with BRB’s Energy Development Strategic Plan, the project team conducted the following steps:

- Expanded on past energy assessments by developing current and future load profiles (demand and energy) of residential and commercial properties.
- Leveraged and expanded on recently identified demand-side reduction strategies by identifying additional behind-the-meter demand-side management opportunities.
- Leveraged past renewable energy resource assessments using currently available data as well as available reputable resource assessment tools.
- Assisted with the development of a tribal advisory committee that identified demand-side optimization options and supply-side renewable energy production options that are in alignment with the BRB’s strategic vision.
- Assessed the status of existing infrastructure on both sides of the utility meter regarding readiness for future renewable energy production development.

Energy Options Analysis Overview

In the previous energy plan prepared in 2016, Redwood Energy and Freshwater Environmental Services Renewable developed the *Community-Scale Renewable Energy and Energy Storage Analysis Plan.* This plan was a high-level analysis that investigated multiple scenarios using a variety of renewable energy technologies including solar, wind, biomass, and battery energy storage to estimate the size and costs for installing a community-scale microgrid that would meet the high-energy demand at the Rancheria.

The master plan did not address the complexities of implementing a community-scale microgrid. The financial investment required for the acquisition of utility-owned electrical infrastructure, the implementation of sophisticated energy management control systems throughout the Rancheria, the staffing of highly-skilled personnel for on-going operations and maintenance, and the large financial investment required to own and operate such a system are not to be underestimated. The sheer magnitude of this type of project can inhibit progress.

Given the complexity and cost to implement a community-scale microgrid project, the design team for this analysis took a step back in the planning process and focused on energy systems that can be implemented in the near term. The approach taken was to design and propose renewable energy systems based on reliable and proven technologies that will:

- generate clean, renewable energy to reduce utility energy imports
- provide energy savings over the life the project and reduce the greenhouse gas (GHG) emissions
- serve as the core energy generators if a community scale or multiple-facility microgrid is implemented

A total of eight preliminary renewable energy systems were identified. This energy plan presents the engineering design work starting with the design review process of the preliminary energy systems through the performance and cost analyses of the selected energy options. These results are presented in the following sections of this report:

1. Preliminary Energy Systems
   Key tribal members and the newly-formed Strategic Vision Advisory Committee participated in the development of the renewable energy systems by providing valuable feedback during the design review process. These design comments along with concerns expressed regarding aesthetics were used to modify the preliminary system designs.
2. Energy Options

   In the final design review step, the project team and members of the BRB’s Department of Environmental and Natural Resources screened the modified preliminary systems and selected the top three energy options. The performance and costs for each option were estimated and the summary results are presented.
3. Net Energy Metering Program

   This section provides general information on the net energy metering program offered by PG&E and looks at the parcel map of the Rancheria to verify eligibility for aggregated loads.
4. Conclusion and Recommendations

   In the final section, the performance and costs for implementing the energy options are summarized and actionable recommendations are made for the Tribe to pursue future development, such as a feasibility study of the preferred options.

Preliminary Energy Systems

The project team and the director of the BRB's Department of Environmental and Natural Resources identified available locations for renewable energy systems throughout the Rancheria. Preliminary system designs and energy output estimates were developed. The result was eight preliminary renewable energy system designs, all of which are photovoltaic (PV) systems. The locations for these systems are shown below:

1	Tish Non Community Center hillside	5	Pump & Play gas station
2	Tish Non Community Center parking lot	6	Bear River Drive hillside
3	Recreation Center parking lot	7	Casino
4	Recreation Center	8	Casino parking lot

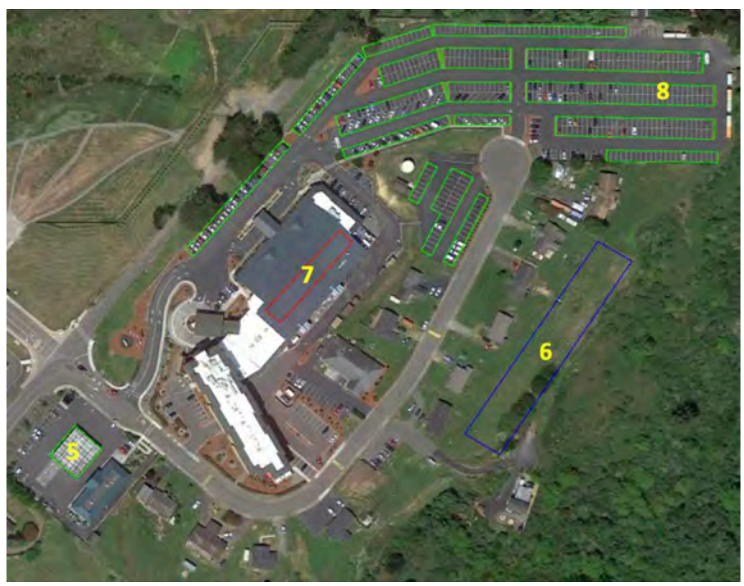

Figure 1: Preliminary PV System Locations.

A wind energy system design was pursued but was not presented as an energy option. The lack of measured wind resource data at the identified site (near the waste water treatment facility), the uncertainty of the noise level profile from the wind turbines and its impact on the rest of the Rancheria, and the amount of land required for this type of power generation are some of the reasons for not recommending this type of system. A biomass energy option was also not investigated or proposed as an energy option. The complexity of implementing and operating such a system or group of systems (e.g. gasifiers) is not well-suited for the Tribe. The lack of appropriate or available land, and the need to create a new division of skilled operations and maintenance staff experienced in biomass operations would require a significant amount of effort, all making biomass an undesirable option.

Design Review

The BRB's participation into the development of the renewable energy systems was through key tribal members of the Environmental and Natural Resources Department and Facilities Management and from the newly-formed Strategic Vision Advisory Committee. Two design review meetings were held with the tribal members and/or the advisory committee to solicit feedback on the system location, design, and to identify any potential issues with the system. Tribal members provided comments on each system and indicated whether the project team should move forward and evaluate the system as a potential energy option. They also provided information regarding projects currently under development. Design review comments from these meetings can be found in the appendices.

Modified Preliminary Systems

The preliminary systems were revised based on the input from the design review team with particular attention paid to aesthetics. The final preliminary designs are presented in the following sections.

Tish Non Community Center Hillside PV System

The initial design for the Tish Non Community Center (TNCC) southern hillside was a 744-kWDC ground-mounted PV system. The size was based on the utilization of a majority of the hillside area with the potential to generate over seven times the energy of the existing TNCC 100-kWDC renewable energy system.

Strategic Vision Advisory Committee members expressed concern over how expansion of the hillside PV array would negatively affect aesthetics and block the view to the south. The committee suggested taking this into account for the height of the array and/or moving the expansion further downslope.

In addition to feedback on the design, the committee also notified the design team that a services agreement contract was signed with a third party to install a new 200-kWDC PV system on the TNCC hillside adjacent to the existing solar system. The new system will include a 30-kW battery system and will connect to the Recreation Centers electrical system.

The final preliminary design is shown in Figure 2. The footprints for the existing TNCC renewable energy system and the planned TNCC-Recreation Center NEM 200-kWDC photovoltaic system (green box) are shown in Figure 2.The remaining available space for development is represented by the blue and black boxes.

Figure 2: PV Systems on the TNCC Hillside.

Both of the remaining available areas are the same size as the planned system and each one can accommodate a 200-kWDC system. Area A is located downslope of the existing array, and would have the same layout as the planned system. It would consist of three parallel rows of panels with the same azimuth, tilt and inter-row spacing as the other systems. An installation in Area B would maximize the potential energy production from the hillside given the aesthetic limitations and would be in line with the other 8 rows of arrays (three for the planned system, two in the existing system, and three for the System A).

The electrical point of connection alternatives for the for the hillside PV systems are the Waste Water Treatment Plant or to the utility grid on Keisner Road.

Tish Non Community Center Solar Carport PV System

The initial design for the TNCC parking lot was a 628-kWDC carport PV system. The size was based on the utilization of the entire lot and had the potential to generate over six times the energy of the existing TNCC renewable energy system.

The Advisory Committee’s concerns with the original solar carport design included parking, maneuverability of delivery trucks, and aesthetics. Another consideration identified by the design team is the vegetation in and around the parking lot. The trees and shrubs could cause installation problems and shading issues in the future. Removal of trees is not desired.

The modified system design at the TNCC is a solar carport renewable energy system comprising of five canopies for a combined system size of 325 kWDC.

Figure 3 shows the final preliminary design. Blue areas recommended for development and red areas are not recommended. The truck maneuverability concern is addressed by narrowing the width of the proposed carports at the end of each island, and the potential shading and aesthetics issues are addressed by removing the carports on the north side of the trees to allow the majority of the vegetation to remain.

Figure 3: Carport in the TNCC Parking Lot.

Even with these mitigation actions, some trees exist in the pop-out islands on the south side of the main islands that may need to be relocated. This balanced approach of keeping some of the vegetation on the islands will soften the look of the metal canopy structures.

The electrical point of connection alternatives for the parking lot carports are the same as for the Hillside PV system; at the Waste Water Treatment Plant or to the utility grid on Keisner Road.

Recreation Center Solar Carport PV System

The initial design for the parking lot was a 339-kWDC carport PV system and included a battery energy storage system (BESS) option to mitigate the anticipated increase in peak demand from the operation of new pool equipment.

There were no concerns expressed by the committee with the carport design, however, the planned TNCC Hillside PV system and the hold status of the Phase 3 Pool Installation project have both impacted the Recreation Centers carport PV energy option.

The proposed carport energy option at the Recreation Center is comprised of multiple solar canopies for a combined system size of 325 kWDC (Figure 4).

Figure 4: Recreation Center Carport and Rooftop PV System

A shading issue was identified from trees on the southern edge of the parking lot. This prompted the relocation of the southern array to the handicap parking area on the west side of the lot, causing a slight decrease in the proposed system size.

The center two rows will impact the vegetation in the islands and may also require the trees at the island ends to be removed or pruned as necessary to prevent shading of the solar array. A shading analysis should be done during the design phase to assess the impacts associated with the system installation and operation. There are also two light poles in the center islands that would need to be modified or relocated.

The uncertainty of the Phase 3 project makes it difficult to know if the Rec Center's upgraded electrical system is a viable option for the point of interconnection for the carport PV system. The other electrical point of connection alternatives are also the Waste Water Treatment Plant, the new Family Fun Center or the utility grid on Keisner Road.

Recreation Center Rooftop PV System

The preliminary system design for the Recreation Center was a rooftop-mounted, PV system rated for 86 kWDC.

Initially, the committee expressed a concern with mounting a PV rack to the Recreation Center's roof and the potential for leaks. After discussing the availability of mounting systems designed for standing seam roofs, similar to that of the Center, that do not require any roof penetrations, the committee agreed pursue this energy option.

The modified system design is the same as the preliminary system design, a rooftop-mounted, PV system rated for 86 kWDC (red box in Figure 4). The point of interconnection for this system is in the existing or newly-installed electrical panel at the Recreation Center. Additional design work is required to determine if this system can be installed in conjunction with the planned 200-kWDC PV system that will also connect to the Center's electrical switchgear.

Pump & Play Dispensing Canopy PV System

The preliminary design for the gas station was a 48-kWDC PV system installed on top of the dispensing canopy.

The committee provided positive feedback for this system and the modified system design is the same as the preliminary system design, a canopy-mounted, PV system rated for 48 kWDC (Figure 5).

Figure 5: Pump & Play PV System

A backup diesel generator rated for 125 kW is currently connected to the station's main service panel. The electrical point of interconnection will be behind the meter at this electrical panel. A new service account would be a net energy metering plan (NEM2) where the energy generated would offset energy use at the gas station.

Bear River Drive East Hillside PV System

The preliminary design for the Bear River Drive hillside was a 100-kWDC ground-mounted PV system. The committee stated that the residents objected to installing a renewable energy system at this location and that the land was currently being used as a leach field. No further study was pursued for this location.

Casino Solar Carport PV System with a Battery Energy Storage System

The preliminary design for the Casino was the installation of multiple solar carports in the parking lot surrounding the Casino. A full build out of the PV system would result in a total system size of up to 1,617 kWDC, large enough to generate enough on-site energy to offset almost the entire energy consumed at the Casino. A battery energy storage system (BESS) was also included to lower the peak load and reduce demand charges.

The Tribe supported this option, but wanted to ensure there were no conflicts with the recreation vehicle site plans at this location. The Director of Environmental and Natural Resources suggested that the north and east carports be removed from the design due to recreational vehicle and semi-truck parking. The modified system design for the Casino parking lot is a solar carport renewable energy system comprising of multiple canopies for a combined system size up to 1,100 kWDC.

Figure 6 shows the solar carport layout with the north and east carports removed.

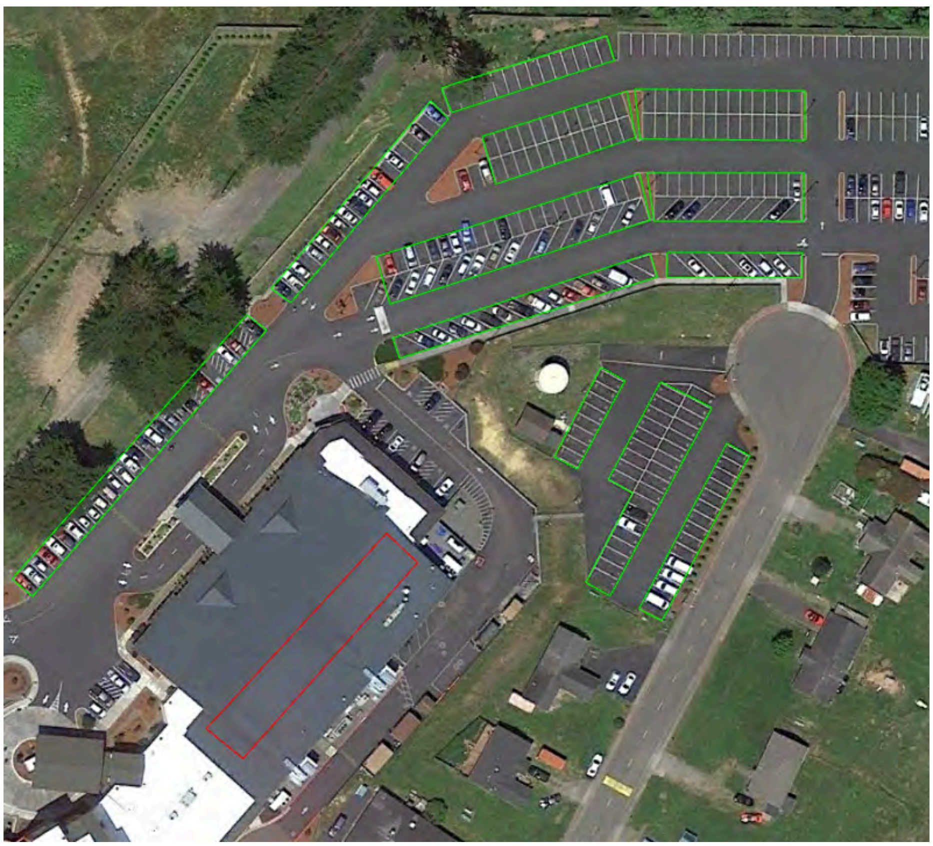

Figure 6: Preliminary Carport Locations in the Casino Parking Lot

Casino Rooftop PV System Option

The roof of the Casino is an ideal location for a PV system. The orientation aligns with good solar insolation and the location addresses aesthetic concerns in that the system would only be visible to a limited number of residences and not be visible to the public. This system, however, was not recommended as there was concern with the structural integrity of the casino roof.

Energy Options

In the final design review meeting, the project team and key tribal members from the Department of Environmental and Natural Resources screened the modified preliminary systems and identified the top prospective energy options. The team evaluated each of the modified systems based on size, location, aesthetics, type of utility service arrangement, likelihood of implementation, and the ability to move towards the Tribes goals for zero net annual utility energy consumption.

The top three energy options are:

Energy Option 1 - TNCC Hillside PV System -a 400-kWDC ground-mounted system connected to the utility grid that would offset energy use at the Wastewater Treatment Plant and Family Fun Center.

Energy Option 2 - Pump & Play Microgrid - a 48-kWDC PV with a battery energy storage system connected behind the meter that is capable of islanding and supplying facility loads during grid outages.

Energy Option 3 -Casino PV and Carport Systems - a large generation system that includes a combination of a rooftop PV system and multiple solar carports that is connected to the casino or utility grid to offset the substantial amount of energy use at the Casino.

The three options include a large grid-tied aggregated PV system at the TNCC, a building level microgrid at the gas station, and a group of PV and carport systems at the Casino. The prospective energy options would operate under net metering agreements described in the previous section, offsetting the retail cost of a customer's energy use.

The TNCC hillside PV system was selected over the TNCC solar carport system due to ease of installation, anticipated lower costs, and for aesthetic purposes. Energy options at the Recreation Center were not pursued given the uncertainty with the pool expansion project and the installation of the planned PV-battery system for the Recreation Center. The casino rooftop PV system was included in the third energy option. A structural review of the casino building is recommended to ensure the building can support the additional weight of the PV array.

System Performance and Cost Analysis

The performance and costs were analyzed for each renewable energy system. System performance was estimated using the System Advisor Model (SAM). Developed by the National Renewable Energy Laboratory (NREL), SAM provides an estimate of the annual energy generation based on PV array size, orientation, tilt, and regional weather data.

The cost analysis provides the following for each system:

- an estimate of installed cost based on an assumed cost of $3/W of installed DC capacity for the ground-mounted and roof-mounted systems, and $3.75/W for the solar carports,
- an estimate of first year savings,

- the Net Present Value for the system assuming 100% grant funding, and
- the Net Present Value of the system if 50% was from grant- funding and the remaining 50% through a load (50/50).

First year energy savings were calculated by coupling energy generation estimates from SAM with PG&E time of use tariffs for each facility served in the net metering account. The resulting net present value (NPV) results include installation costs, operation and maintenance (O&M) costs, and profit from energy savings to calculate the total value of a proposed energy option. All costs shown in this analysis are in current year dollars (2020). The parameters used in the NPV calculations are a 1% net energy escalation rate, a 2% real discount rate and a 10-year loan term with an annual interest rate of 3% and a monthly interest rate of 0.25%. Also incorporated in the system cost calculations is an operations and maintenance cost estimated at $15/kW of capacity per year. This estimate was based on NREL's 2019 technology baseline for similarly sized grid-connected solar systems[1].

Energy Option 1 - TNCC Hillside Photovoltaic System

This energy option is highly recommended as it would generate a significant amount of renewable energy, moving the tribal community closer to their strategic vision of energy self-sufficiency.

The 400-kWDC PV system would be ground-mounted on the south hillside and would connect to the utility distribution line via a new service meter and transformer, as required by the utility company. The system would be designated a renewable energy generator (customer-generator) as part of a new net energy metering aggregated (NEM2A) service account that would serve two aggregate loads, the Wastewater Treatment Plant and the Family Fun Center.

If additional generation capacity were to be added, such as the Planned Recreation PV system, the Recreation Center could be added as a third aggregate load and the generation system would offset electrical loads at all three facilities. Inclusion of the planned system would simplify and reduce the installation costs and ongoing management of both projects.

As shown in Figure 7, the energy system is sited adjacent to the existing TNCC PV system and the planned Recreation Center PV system. Generated power would connect to the utility grid at one of the three points of interconnection (POI).

[1] NREL (National Renewable Energy Laboratory). 2019. *2019 Annual Technology Baseline*. Golden, CO: National Renewable Energy Laboratory. https://atb.nrel.gov/electricity/2019.

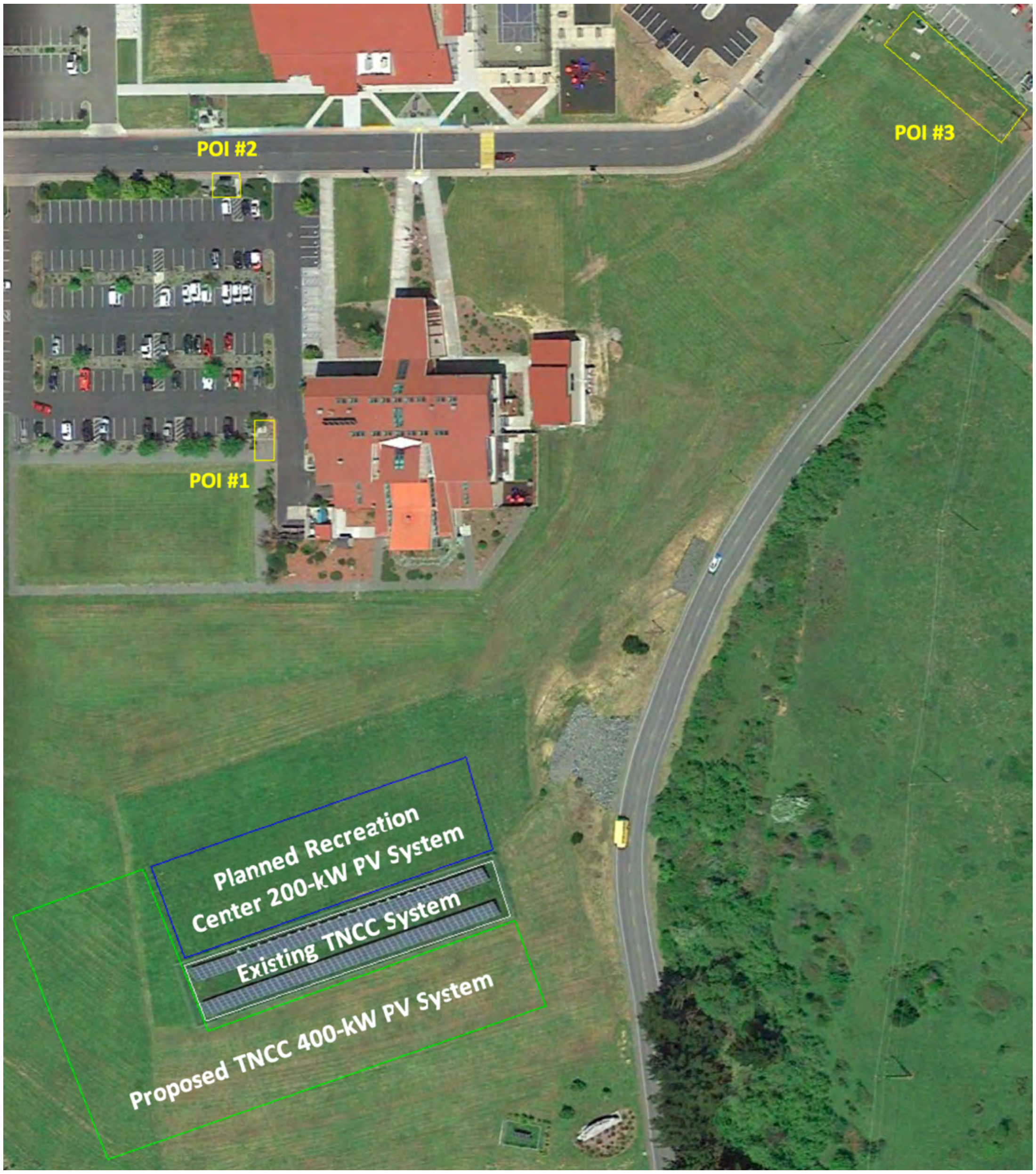

Figure 7: Energy Option 1 - TNCC Hillside PV System

The estimated installed cost for the 400-kW system is $1,200,000 and model simulations show the PV array would produce approximately 560,000 kWh per year. Assuming retail energy savings are based on an aggregation between the Family Entertainment Center (FEC) on the A10SX tariff, and the Wastewater Treatment Plant on the E19SV tariff, this amount of renewable energy production equates to a first-year energy cost savings of approximately $63,000.

The energy generated from this system will cover 100% of the annual combined loads for the Wastewater Treatment Plant and the Family Fun Center (500,457 kWh/year). The estimated generation is approximately 10% greater than the annual combined loads, indicating the PV system size is slightly larger than what is required to offset loads at these two facilities. The WWTP load is based on multiple years of data, however, the FEC was just recently opened and the average annual energy use is not well defined. Follow up analysis is recommended to ensure the generation and aggregate loads match on an annual basis. If follow up analysis still indicates that generation is greater than the combined load, then another eligible facility could be added as an aggregated load and the excess generation could offset use for that facility.

If the project were 100% grant-funded project, the NPV would be $1,250,000 and it would have a positive cash flow through its lifetime. For a 50/50 funding scenario, the project would have an NPV of $630,000 with negative cash flows for the first 10 years, and positive cash flows for the following 15 years.

The electrical points of interconnection (POI) options will need to be evaluated in the feasibility stage to determine the most appropriate point of connection. The future implications of selecting the POI should be considered in the study. POI #3 may be the best location if a future microgrid were to be installed. It is located near the point where utility power enters the Rancheria and has available open space for installing electrical switchgear and a large battery energy storage system. The following provide a summary of the POI options.

Connect to the TNCC building transformer (POI #1)

Located at the southeast end of the TNCC parking lot, the building transformer is the closest possible point of interconnection. The transformer electrical specifications (e.g. ampacity) and physical features will determine if PV array power can be connected to the line side of the transformer. If so, a new step-up transformer will be required in order to boost PV system voltage up to grid voltage. The new transformer and customer service meter could be located adjacent to the existing utility transformer.

Connect to the Keisner Road utility junction box (POI #2)

The second POI option is at the utility junction box (J-5531) just north of the TNCC parking lot. A screenshot from the BRB's utility plan[2] (Figure 8) show the junction box (JB) and pullbox (PB) for the underground distribution line along Keisner Road. A new transformer will be required and can be sited in the vicinity of the junction box or adjacent to the TNCC transformer discussed above. Further investigation is required to determine if there are available spare conduits between the TNCC transformer and the junction box. If spares are not available, trenching through or around the TNCC parking lot will be required.

[2] Bear River Band Utilities 6588 CIV RECORD UTILITY PLAN, LACO Associates, 2012

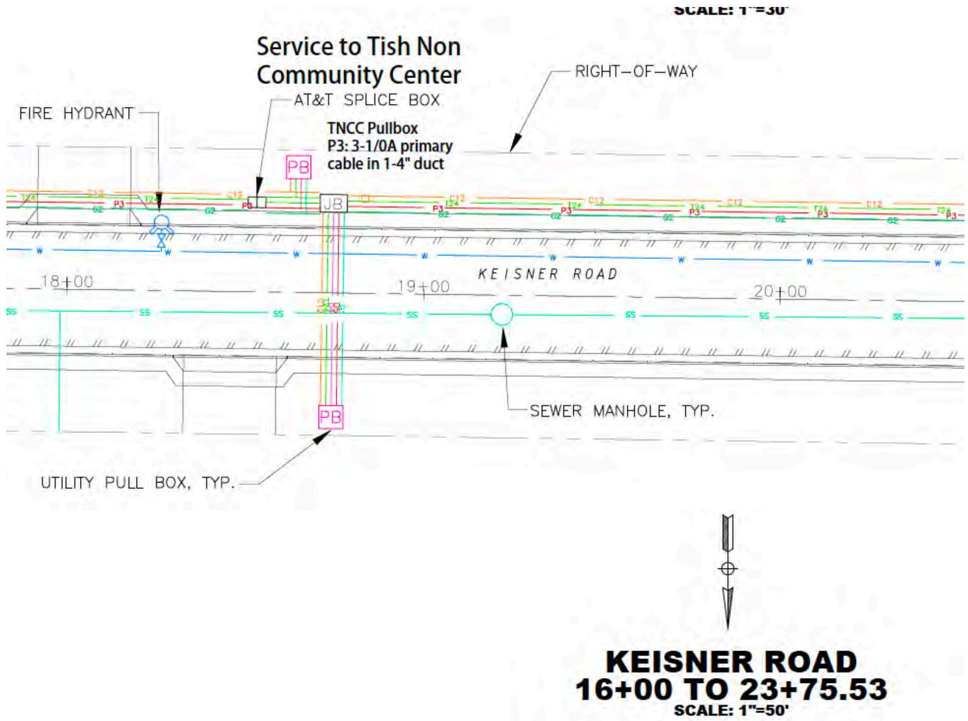

Figure 8: POI #2 for TNCC PV System - Section of the Rancheria's Utility Plan

Connect to switchgear or the distribution line near the Tobacco Traders (POI #3)

The third option for interconnection is on the south side of the Bear River Tobacco Traders parking lot. Investigation during the feasibility study is required to identify the existing electrical switchgear and determine if a suitable point of connection already exists. If not, a service drop from the road distribution line to a new utility transformer would be required. Trenching to this location may be less expensive than through the TNCC parking lot pavement. This location may be the best suitable location for potential future microgrid equipment.

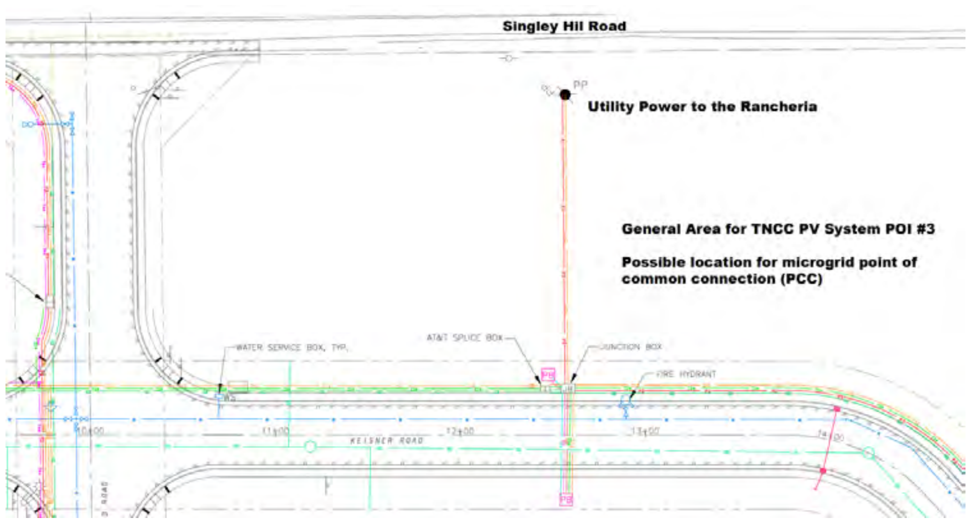

Figure 9: POI #3 for TNCC PV System - section of the Rancheria's Utility Plan

Energy Option 2 - Pump & Play Microgrid

The Pump & Play gas station and convenience store offers an opportunity to install a microgrid facility that can help provide back-up power and additional resilience to a critical facility while also serving to lower facility energy costs and reduce the facility's carbon footprint. Gas station convenience stores have been shown to serve as critical facilities during times of widespread power outage. They provide fuel and other critical resources, such as ice, refrigeration for cold food and beverages, and cooking appliances to serve hot food and beverages. These basic services can be a critical lifeline, especially for emergency first responders and other disaster relief personnel during a widespread disaster.

A 48-kWDC canopy-mounted, NEM PV system is proposed for the gas station. This array is expected to produce approximately 59,000 kWh per year and meet about 17% of the annual electricity consumption for the facility. Assuming retail energy savings based on the E19SV tariff, this equates to a first-year cost savings of approximately $11,000.

If this PV system were 100% grant-funded project, the NPV would be $115,000, with a positive cash flow through the lifetime of the project. For a 50/50 funding scenario, the PV system would have an NPV of $40,000 with negative cash flows for the first 10 years, and positive cash flows for the following 15 years.

The gas station currently has a 125-kW diesel generator that provides backup power in the event of a grid outage. Additional, clean backup power can be provided by adding battery energy storage and suitable electrical protection and controls along with this solar PV system, thereby creating a facility-scale microgrid.

The U.S. Department of Energy defines a microgrid as "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode."[3] In order to provide back-up power and resilience during large scale outages the distributed energy resources, in this case the solar PV and battery storage, are design to form the islanded microgrid and provide on-going, quality electric power. The duration of the power supply depends on the size and state of charge of the battery, the electrical demand, and the electrical output from the solar PV array.

The required sizing of the battery storage for the Pump & Play microgrid was assessed by examining the seasonal electric load for the facility along with the expected seasonal solar electricity output from the solar PV system. It was assumed that the historical electrical load would remain unchanged. The electrical load for the store is rather flat over all hours of the day and all seasons of the year. The assumed peak power draw for this exercise was assumed to be 56 kW, with a daily electrical load of 960 kWh (an average power demand of 40 kW). Based on our System Advisor Model analysis, the

[3]https://www.energy.gov/sites/prod/files/2016/06/f32/The%20US%20Department%20of%20Energy%27s%20Microgrid%20Initiative.pdf

solar PV array output was assumed to be 250 kWh/day on an average summer day and 60 kWh/day on an average winter day.

Table 1 shows the expected run times on solar PV and battery during summer and winter for different battery sizes. A modular battery energy storage size of 170 kWh was used for this analysis. That corresponds to the smallest battery size available from Tesla for their PowerPack 2 series battery storage systems. Batteries of similar size from other manufacturers could be substituted as well. It can be seen that a single PowerPack 2 module will provide at least about 4 hours of runtime at any time of day or year (during the daytime this runtime would be slightly extended). For comparison, four PowerPack 2 modules would provide about one day of runtime in the summer, and five PowerPack 2 modules would be needed for one day of runtime in the winter. It should also be noted that the PowerPack 2 comes with a power capacity of 110 kW. This is approximately twice the peak electrical load at the Pump and Play, and this meets the general best practice of sizing the inverter power capacity to be at least 2-3 times greater than the facility peak load.

Table 1: Pump & Play Microgrid Run Times for Various Battery Capacities

Runtime (hours)	*Battery Capacity (kWh)*	*# PowerPack 2 modules*
4	170	1
9	340	2
13	510	3
23 (summer)	680	4
24 (winter)	850	5

If during a disaster there was a decision made to shed non-critical electrical loads, for example shutting down gaming machines, the facility run-times on battery and PV power would be extended. In contrast, if during a disaster scenario electrical loads were increased, for example due to increased services being provided like greater production of ice, then run times would decrease. In addition, it is possible that additional PV generation could be added to the convenience store southeast facing roof and/or to the field to the southeast of the store. Additional PV generation capacity would also extend back-up power run times.

Figure 10 shows a possible site layout for the microgrid. The 48 kW PV array is located on the fueling island canopy. A concrete pad would need to be installed to support the battery energy storage and associated electrical switchgear needed for the installation. The approximate size of the concrete pad needed to support the 850-kWh battery system shown in the table above is estimated to be 250 square feet. The 170-kWh battery system would require approximately half that size concrete pad.

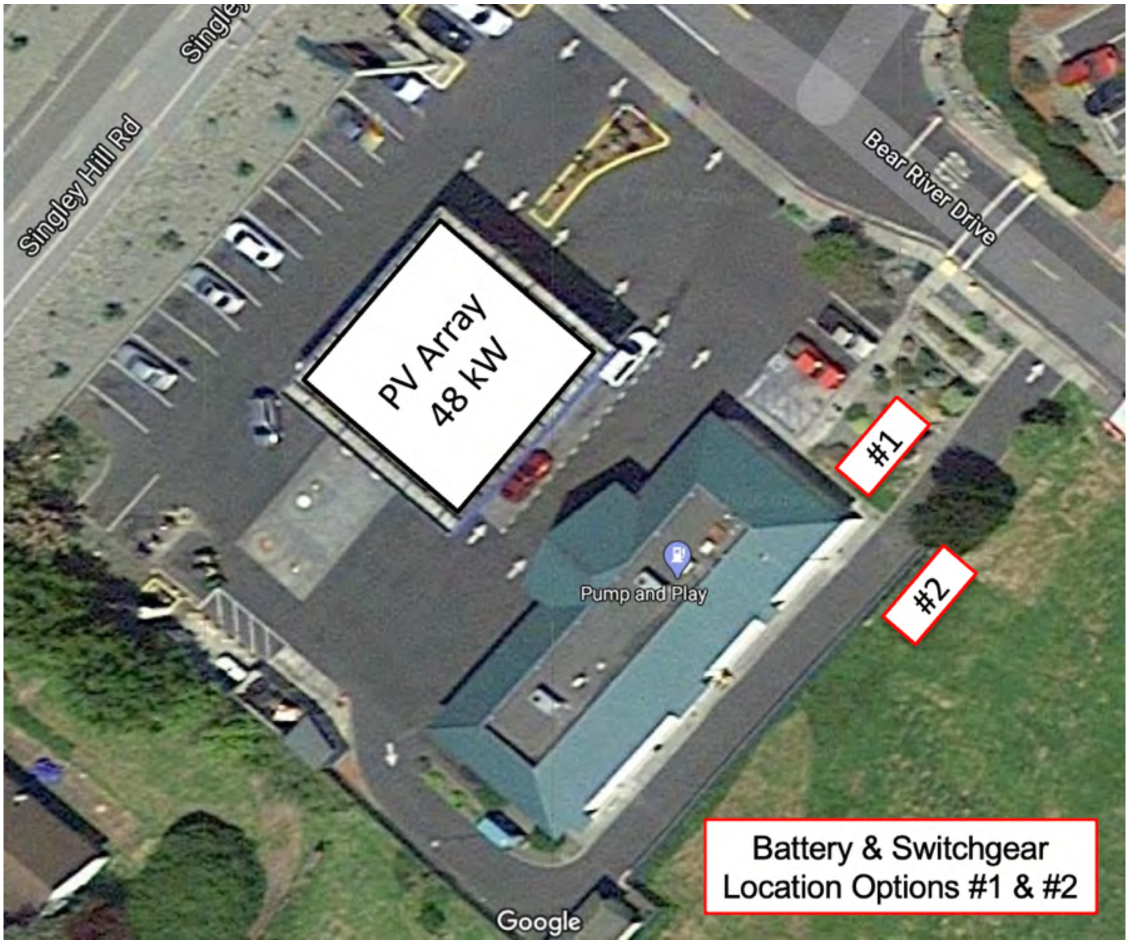

Figure 10: Energy Option 2 -Pump & Play Microgrid

Figure 11 provides a simplified electrical single line diagram for the proposed microgrid. The key components include: solar PV array, battery energy storage system, microgrid controller, and SCADA[4] controlled circuit breakers.

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4 SCADA stands for Supervisory control and data acquisition. SCADA systems allow for automated control of electrical and mechanical systems.

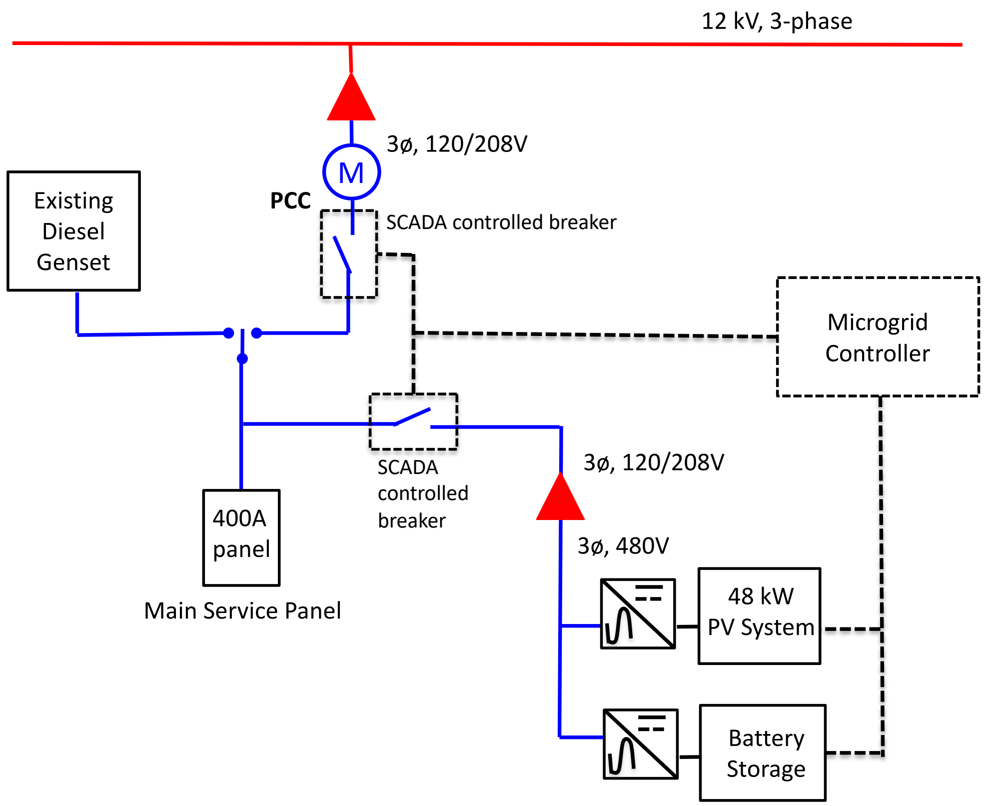

Figure 11: Pump & Play Single Line Diagram

The estimated costs to implement a microgrid at the gas station is between $485k and $810k, depending on the number of battery modules installed (Table 2). These costs are in addition to the design/build cost of the PV system. Beyond resiliency, the microgrid offers the ability for energy arbitrage, in that energy generated during the day can be stored in the battery system and then discharged later in the evening when grid prices are higher, thereby providing a revenue stream. The savings that energy arbitrage offers depends on many factors including time-of-use rates, battery capacity, and the amount of energy available. Quantifying the potential savings for microgrid operation would require further analysis.

Table 2: Cost Estimate for Microgrid Equipment and Work Tasks

Categories	*4 Hours of Runtime 170 kWh*	*1 Day of Runtime 850 kWh*
Li-ion Battery Energy Storage System	$100,000	$380,000
Microgrid Controller	$80,000	$80,000
PG&E Interconnection	$60,000	$60,000
Balance of System	$65,000	$80,000
Engineering, Construction, Project Management, Commissioning	$140,000	$160,000
Site Work	$40,000	$50,000
Estimated Total	**$485,000**	**$810,000**

Energy Option 3: Casino PV and Carport System

This project would involve the installation of approximately 1 MW of PV capacity from multiple renewable energy systems located on and around the Bear River Casino. The casino uses an average of 2,273,400 kWh of energy per year, accounting for approximately 49% of all the energy consumption on the Rancheria. This energy option would generate a significant amount of renewable energy to meet part of this high-energy demand.

The renewable energy systems include a 125-kW rooftop PV system on the casino and four solar carport systems of various PV sizes located in the surrounding parking lots (Figure 12).

Given the high costs for these systems, the project could be implemented in a phased approach as funding becomes available. In the first phase, the service account would be established with the utility and the initial energy systems would be installed and connected to the selection point of interconnection with the electrical system designed for future capacity and connectivity. As future funding was obtained, additional systems could then be added to the further offset the casino demand.

Figure 12: Energy Option 3 - Casino PV and Carport Systems

There are two different general points of interconnection for these systems; to the casino's electrical system or to the utility grid. The amount of PV capacity installed, the available capacity and limitations of the casino's electrical system, and the existing utility infrastructure that can offer a POI will need to be examined in further detail through the feasibility study.

If the existing casino switchgear can (or can be upgraded to) accommodate the power generation from the new systems, a behind the meter NEM2 service arrangement could be established and the point of interconnection would be in the vicinity of POI #1 in Figure 12. If this is not feasible or too costly, an aggregate NEM2A service arrangement would need to be established and the systems could connect to the grid. The grid-tied connections could possibly be to existing utility infrastructure located on the Rancheria near POI #1 or to the distribution line along Singley Hill Road (POI #2).

The estimated cost to install 1 MW of solar PV systems is $3,000,000 and if fully grant funded, the project would have an NPV of approximately $2,500,000. For a 50/50 funded project, the NPV would be approximately $973,000, with negative cash flows for the first 10 years, and positive cash flows for the following 15 years.

The performance summary and cost analysis results for the individual solar systems are present below in Table 3 and Table 4 below.

Table 3: Casino Rooftop and Solar Carport Performance Summary

System	*PV Size (kWDC)*	*Annual Energy Production (kWh)*	*Annual Energy Use at Casino (kWh)*	*% of Load Met*	*25 Year GHG Emission Reductions (MT CO2e)*
Rooftop PV	125	175,389	2,273,402	8%	83
Solar Carport West - 100kW	100	118,957	2,273,402	5%	57
Solar Carport North Angled - 300kW	300	388,751	2,273,402	17%	185
Solar Carport North - 225kW	225	291,256	2,273,402	13%	138
Solar Carport East - 150kW	150	185,743	2,273,402	8%	88

Table 4: Casino Rooftop and Solar Carport Cost Analysis Results

System	PV Size (kWDC)	Installed Cost ($)	Annual Energy Savings (year1)	100% Grant Funded NPV	50% Grant 50% Loan NPV
Rooftop PV	125	$375,000	$17,508	$345,822	$150,665
Solar Carport West - 100kW	100	$375,000	$11,886	$238,596	$43,439
Solar Carport North Angled - 300kW	300	$1,125,000	$39,118	$785,308	$199,836
Solar Carport North - 225kW	225	$843,750	$58,983	$518,598	$79,495
Solar Carport East - 150kW	150	$562,500	$18,596	$372,606	$79,871

Energy Option Performance and Cost Summary

The performance summary and cost analysis results for the prospective energy options are shown in Table 5 and Table 6 below.

Table 5: Energy Options Performance Summary

#	Option	PV Size (kWDC)	Annual Energy Production (kWh)	Annual Energy Use (kWh) and Facility Served	% of Load Met	25 Year GHG Emission Reductions (MT CO2e)
1	TNCC PV System	400	562,973	168,000 WWTP 332,000 FEC	100%	267
2	Pump & Play Microgrid	48	59,039	351,650	17%	28
3	Casino PV Systems	900	1,160,096	2,273,402	51%	551
	All Energy Options	1348	1,782,108	4,981,586	36%	847

The facilities served include the Wastewater Treatment Plant and Family Entertainment Center for option 1, the gas station for option 2, and the Casino for option 3. The total annual energy use value for the All Energy Options line is the current annual energy consumption from the all commercial facilities[5].

The total greenhouse gas (GHG) emission reductions for the life of the systems (25 years) is estimated at 847 metric tons of carbon dioxide equivalent (MT CO_2e) [6]. The Tribe currently purchases electricity

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5 This value is the total annual average energy use for all commercial facilities of 4,649,129 kWh based on the data from 2015-2017 as reported in the Load Profile Assessment task plus the recent estimated energy use of 332,457 kWh per year at the Family Entertainment Center.

6 These data were calculated using greenhouse gas emissions factors provided by Redwood Coast Energy Authority that have not yet been verified by an authorized third party. They are based on RCEA's 2018 power portfolio and exclude biogenic emissions associated with the biomass power in the portfolio, which is consistent with reporting protocols used by the California Air Resources Board and the Intergovernmental Panel on Climate Change.

through the Redwood Coast Energy Authority (RCEA) Community Choice Energy program. REpower is the standard electricity service level offered by RCEA and is provided at a lower cost and has a higher mix of renewables than PG&E.

Table 6: Energy Options Cost Analysis Results

#	Option	PV Size (kWDC)	Installed Cost ($)	Annual Energy Savings (year1)	100% Grant Funded NPV	50% Grant 50% Loan NPV
1	TNCC PV System	400	$1,200,000	$63,242	$1,257,979	$633,477
2	Pump & Play Microgrid	48	$144,000	$5,920	$115,493	$40,553
3	Casino PV Systems	900	$3,281,250	$146,091	$2,260,930	$553,306
	All Energy Options	1348	$4,625,250	$215,253	$3,634,402	$1,227,336

Key Results

- At a total installed cost of $4.6M, the implementation of the three energy options would offset 36% of the annual energy use for all commercial facilities on the Rancheria. This amount of self-generation results in a first-year savings of $215k and would have a NPV between $1.2M and $3.6M, depending on the source of project funding.
- The TNCC Hillside energy option can provide 100% of the annual energy use at the Wastewater Treatment Plant and the Family Entertainment Center. For an installed cost of $1.2M, the system will have a first-year savings of $63k.
- With an installed cost of $144k, the photovoltaic system in the Pump & Play Microgrid can offset 17% of the gas station demand, providing a modest savings relative to the other energy options. The additional cost required to implement a microgrid at this facility is estimated between $485k and $810k, depending on the desired system runtime (Table 2). The added savings for microgrid operation (i.e. energy arbitrage) is not known without conducting detailed energy model simulations. The value of providing additional backup power and resiliency from this renewable system versus the existing diesel generator should be determined by the Tribe.
- Full implementation of the Casino energy option will offset 51% of the load at the Casino. Installation of all PV and solar carport systems will cost $3.3M and result in a first-year savings of $146k.
- The Net Present Value for the TNCC energy option is much higher than that of the Casino option. The main reason for this difference is the lower assumed installation cost of $3/W for the TNCC ground-mounted system versus the estimated higher installed cost of $3.75 per watt for the solar carports.

Net Energy Metering Program

This section provides general information on the net energy metering program offered by PG&E and looks at the parcel map of the Rancheria to verify eligibility for aggregated loads.

The renewable energy systems will connect either directly to a buildings electrical system or to the utility grid via a new electrical service. To be eligible for net metering, the energy systems must be sized no larger than to offset the annual consumption for the facilities they serve. The project team evaluated utility meter data and calculated the average annual energy use for all commercial facilities to ensure the proposed PV systems were properly sized. If the facility load changes or if additional facilities are to be added to the aggregated system, the generation - load balance calculations should be revisited.

The NEM program is governed by Rule 21 as stipulated by the California Public Utilities Commission. This tariff describes the requirements for interconnection, operating and metering of generation facilities connected to the distribution grid. A net energy metering schedule is applicable to customers who take service on an applicable time of use (TOU) rate schedule[7]. The energy option will follow a NEM2 schedule when the generating system is connected behind the meter at a specified facility or will follow the NEM2A schedule when connected to the grid via a new service account.

Net energy metering (NEM) allows customers who generate their own energy ("customer-generators") to serve their energy needs directly onsite and to receive a financial credit on their electric bills for any surplus energy fed back to their utility[8]." The TNCC PV system is a NEM account. Customers can submit a NEM Interconnection Pre-Application

Net Energy Metering Aggregation (NEM2A) allows a single customer with multiple meters on the same property, or on adjacent or contiguous properties, to use renewable generation (e.g. solar panels) to serve the aggregated load behind all eligible meters and receive the benefits of Net Energy Metering (NEM2). Criteria for NEM2A includes:

- There is no maximum generator size; however, the system must be sized to the customer's recent annual load.
- Accounts have to be located on the same property as the renewable generator or on properties adjacent or contiguous to it.
- All of the properties have to be solely owned, leased or rented by the same customer of record who is listed on the PG&E bill.
- Additional NEMA information can be found on PG&E's website at : https://www.pge.com/en_US/for-our-business-partners/interconnection-renewables/net-energy-metering/nem-aggregation.page?ctx=large-business

7 PG&E Electric NEM2 Schedule

8 Source: https://www.cpuc.ca.gov/General.aspx?id=3800

The same customer of record must be listed for each PG&E account. To determine what facilities are eligible to serve as an aggregated load, the parcel map of the Rancheria Figure 13 was downloaded from the Humboldt County Web GIS website (http://webgis.co.humboldt.ca.us/HCEGIS2.0/).

As shown on the map, the Tish Non Community Center is at the center of Parcel 309-071-016. This large, triangular area is bounded by the easement along Hwy 101 on the west, Singley Road on the east, and an east-west boundary north of the Waste Water Treatment Plant and softball fields. This means that a large PV system installed within this parcel can serve as the generation account and the energy generated from it could offset energy use from eligible facilities within or adjacent to this parcel as long as the customer on the accounts are the same. Facilities under a NEM metering schedule, such as the TNCC PV-battery system or the planned PV-battery for the Recreation Center, are not eligible aggregated loads for a NEM2A arrangement.

Figure 13: Parcel Map for the Bear River Rancheria

Conclusion and Recommendations

The Bear River Band Energy Options Implementation Plan presents the energy design work from the design review stage of the preliminary energy systems through the performance and cost analyses of the selected energy options.

Key tribal members and the newly-formed Strategic Vision Advisory Committee participated in the development of the renewable energy systems by providing valuable feedback during the design review process. These comments, along with additional input, were used to modify the designs in preparation for final screening. In the final design review step, the project team and members of the Department of Environmental and Natural Resources screened the modified preliminary systems and selected the top three energy options. These projects were selected based on a set of criteria that included the system size, type of system, likelihood of implementation, and the projects' ability to move the Tribe closer to its goal of zero net annual utility energy consumption.

The prospective energy options would operate under net metering agreements described in the previous section, offsetting the retail cost of energy use. This approach likely provides the greatest economic benefit. A summary of the top energy options are provided below.

Option 1 - TNCC Hillside Photovoltaic System

This project is a 400-kWDC PV system operating under a net energy metering aggregated account. The generated energy would offset 100% of the demand at the Wastewater Treatment Plant and Family Fun Center, providing significant cost savings throughout the life of the project.

Option 2 - Pump & Play Microgrid

This microgrid project includes a 48-kWDC photovoltaic system that can offset 17% of the gas station demand providing modest cost savings. With the addition of a battery energy storage system and microgrid controller, the system would provide additional backup power and resiliency for critical services provided at the gas station.

Option 3: Casino PV and Carport System

This project would involve the installation of up to 900 kW of PV capacity from multiple photovoltaic energy systems. If fully implemented, the system could offset 56% of the energy use at the Casino, providing significant cost savings over the life of the project.

At a total installed cost of $4.6M, the implementation of these three energy options would offset 36% of the annual energy use from all commercial facilities on the Rancheria. This amount of self-generation results in an annual net revenue stream with a first-year savings of $215k. The combined NPV for all options is between $1.2M and $3.6M, depending on whether 50% or 100% of the projects' costs are covered by grant funding, respectively.

The energy options can provide substantial energy cost savings and move the Tribe closer to their vision of zero net annual utility energy consumption. The energy options also lay the foundation for a future community-scale or multiple-facility microgrid. Given the location for the electric points of interconnection for the two large PV systems, it would be possible to install a microgrid on either or both sides of Singley Hill Road. The TNCC PV system could be the core renewable energy generator for a west-side microgrid, and the Casino PV system could serve an east-side microgrid. However, even though these systems offer a possibility for expansion, the criticality of the facilities served and the cost and complexity associated with installing and operating a microgrid should be carefully considered.

Recommendations

The following recommendations are provided to assist the Tribe to move the implementation plan forward into a feasibility analysis stage and beyond.

1. Consider expanding the size of Energy Option1 - TNCC Hillside Photovoltaic System by including the photovoltaic system planned for the Recreation Center and making the Recreation Center another aggregate load in the NEM2A aggregate system.
2. Pursue funding. A list of potential grant funding opportunities can be found in Appendix B. If only partial funding is available, reduce the project scope and move forward with implementation in a phased approach.
3. Submit a NEM interconnection pre-application report request to PG&E to obtain information on the available capacity of the distribution line for the points of interconnections identified for each energy option.
4. Conduct a detailed feasibility study for the three energy options. The study should estimate annual energy production based on the final PV system size to ensure production does not exceed aggregate annual loads. It should also estimate cost savings and system costs based on the results of the PG&E pre-application report for the identified point of interconnection.
5. Start the interconnection process with PG&E by submitting an interconnection request. The engineering review part of the process will identify any utility system upgrades required and cost responsibilities.

Note that if a phased approach is taken for the aggregate TNCC Hillside PV System and/or Casino PV and Solar Carport System, the electrical infrastructure (i.e. conductors, utility transformer, etc.) should be sized for the full build-out capacity of the energy option.

A phased approach at the Pump & Play location would initially involve the installation of the photovoltaic system. If upgrades to the main electrical panel are required, it is recommended to design and size the new panel to accommodate a possible future microgrid. If the conversion to renewable energy resiliency is deemed valuable, seek additional funding and install the battery energy storage system, microgrid controller, and the necessary switchgear to implement a building microgrid.

Additional Energy Planning and Efficiency Recommendations

These additional recommendations are to assist the Tribe in reaching their energy goals.

- Verify the performance of the TNCC PV-battery system to ensure the system is operating properly, specifically the battery energy storage system. Estimate the cost savings and effectiveness of the battery system in reducing peak demand charges.
- Pursue energy efficiency opportunities for existing Tribal facilities utilizing existing energy efficiency programs and services offered by PG&E and the Redwood Coast Energy Authority. Refer to the Demand Side Management Opportunities Technical Memo for details on identified opportunities.
- Continue to involve the Strategic Vision Advisory Committee, Tribal leadership and the Tribal community throughout the energy system implementation process.
- Consider designing future buildings that can accommodate rooftop solar both electrically and physically.

Appendix A: Strategic Vision Advisory Committee - Meeting Notes

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Appendix B: Grant Funding Opportunities

Organization	Opportunity	Funding Information / Eligible Costs	Amount	Match Requirements
DOE Office of Indian Energy	Energy Infrastructure Deployment on Tribal Lands	Projects which funding can be used for include, installation of energy generating systems and/or energy efficiency measures for Tribal Buildings, deployment of community-scale energy generating systems and energy storage on Tribal Lands, installation of energy systems for autonomous operation (independent of the traditional centralized electric power grid) to power a single or multiple essential tribal facilities during emergency situations or for tribal community resilience, and deployment of energy infrastructure and integrated energy systems to electrify Tribal Buildings.	\$50,000-\$2,000,000	Minimum 50% for the total allowable costs of the project.
USDA	RUS High Energy Cost	The grant funds may be used to acquire, construct, or improve energy generation, transmission, or distribution facilities serving communities where the average annual residential expenditure for home energy exceeds 275% of the national average. Eligible projects also include on-grid and off-grid renewable energy projects and the implementation of energy efficiency and energy conservation projects for eligible communities. Projects cannot be for the primary benefit of a single household or business. Grant funds may not be used for the preparation of the grant application, operating costs, or for the purchase of any equipment, structures, or real estate not directly associated with the provision of community energy services.	\$100,000-\$3,000,000	None, but match funds do increase the likelihood of being funded.

Organization	Opportunity	Funding Information / Eligible Costs	Amount	Match Requirements
USDA	Rural Energy for America Program Energy Audit and Renewable Energy Development Assistance Grants	Provides grants for energy audits and renewable energy development assistance to rural small businesses. Tribal governments are eligible. Funds can be used for salaries related directly to the project, travel expenses, office supplies, administrative expenses and project related equipment operating expenses.	Max $100,000	None
U.S. Department of Commerce	Economic Development Assistance Program	EDA provides strategic investments on a competitive merit basis to support economic development, foster job creation, and attract private investment in economically distressed areas of the United States. EDA funds will support construction, non-construction, technical assistance, and revolving loan fund projects. Grants and cooperative agreements made under these programs are designed to leverage existing regional assets and support the implementation of economic development strategies that advance new ideas and creative approaches to advance economic prosperity in distressed communities.	$100,000-$3,000,000	Dependent on regional financial metrics compared to the national average. Between 50-80 percent.
U.S. Department of the Interior Bureau of Indian Affairs	Energy and Mineral Development Program (EMDP)	The goal of the EMDP is to assist tribes by helping to expand tribal knowledge of energy and mineral resources on their lands and to bring tribal energy and mineral projects to the point where the economic benefits can be realized from the targeted resource in an economically efficient and environmentally sound manner. Projects may include performing initial resource exploration, defining potential targets for development, performing market analysis to establish production/demand for a given commodity, perform economic evaluation and analysis of the resources.	Typical award sizes up to ~$100,000	None

Organization	Opportunity	Funding Information / Eligible Costs	Amount	Match Requirements
U.S. Department of the Interior Bureau of Indian Affairs	Tribal Energy Development Capacity (TEDC)	The goal is to develop the Tribal management capacity, and technical capacity to develop or enhance their business and regulatory environment needed to maximize the economic impact of energy resource development. The energy project(s) for which the applicant seeks to build tribal energy development capacity can be, existing or planned, tribally owned or privately owned. Projects may include utility feasibility studies, establishing tribal business charters under federal, state, or tribal law with a focus on energy resource development, adopting a secured transactions code.	No min/max requirements on projects.	None
Federal Emergency Management Agency (FEMA)	Pre-Disaster Mitigation Grant	This program is designed to assist state, tribal, territorial and local governments in reducing overall risk to the population and structures from future hazard events, while also reducing the reliance on federal funding from future disasters. The projects that can be funded under this program are fairly broad, and should be screened against the full solicitation. This funding source would be suitable for funding microgrid projects that provide resilience in times of disaster and natural hazards.	$10,000,000 max	Between 10%-25% total project costs
California Energy Commission (CEC)	Electric Program Investment Charge (EPIC)	Meant to support investment in clean energy technologies that provide benefits to the electricity ratepayers in PG&E, SDG&E, and SCE utility territories. Funds must be used for on-grid projects in PG&E territory. Projects need to have a research component and funds typically cannot be used for routine energy projects that are already proven to be technologically feasible and cost-effective, such as rooftop solar projects. The research component of these projects can introduce a fair amount of risk.	Minimum and maximum award amounts will be specific to various EPIC solicitations.	0%-20% requirement.

Organization	Opportunity	Funding Information / Eligible Costs	Amount	Match Requirements
State of California	Tribal Nation Grant Fund	The stated funding priorities for the Tribal Nation Grant Fund are “facilitating tribal self-governance and improving the quality of life of tribal people throughout the state, prioritizing projects and programs that promote effective self-governance, self-determined communities, and economic development.”	$400,000 (in 2019)	None
Wells Fargo/Grid Alternatives	Tribal Solar Accelerator Fund (TSAF)	Aims to catalyze the growth of solar energy and expand solar job opportunities in tribal communities across the United States. For awarded tribes, TSAF provides technical assistance on solar project development and renewable energy strategy, installation of solar PV systems, workforce development, and community outreach.	$250,000 max	None