Water System Energy Audit

Final Report
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City and Borough of Juneau
Water System

Prepared for:

City and Borough of Juneau

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Abbreviations

AEL&P	Alaska Electric Light & Power Co.	LCB	Last Chance Basin
BB	Bonnie Brae	LL	Lena Loop
BTUH	BTU per hour	LLC	Life Cycle Cost
CBJ	City and Borough of Juneau	MS	Mountain Side
CH	Crow Hill	NEMA	National Electrical Manufacturers Assoc
CP	Cedar Park	PRV	Pressure reducing valve
HP	Horsepower	SC	Salmon Creek
GPM	Gallons per minute	SCADA	Supervisory Control & Data Acquisition
kW	Kilowatt	VFD	Variable frequency drive
kWh	Kilowatt-hour		

Section 1

Executive Summary

This report presents the findings of an energy audit of the City and Borough Of Juneau's Water System. The purpose of the energy audit is to identify energy conservation opportunities (ECOs) that, if implemented, will provide a life cycle savings.

The findings were gathered from on-site observations, review of construction documents, and interviews with water utility operations and maintenance personnel.

The energy audit was performed by Jim Rehfeldt, P.E. of Alaska Energy Engineering LLC with technical engineering assistance by Jim Dorn, P.E. of Carson Dorn, Inc.

SYSTEM DESCRIPTION

The CBJ water system has two water sources. The Last Chance Basin Well Field consists of five wells, linked to an on-site chlorination system, which supply the community-wide low elevation distribution system and a high elevation distribution system. The Salmon Creek Pump Station treats water from the Salmon Creek Reservoir surface water source and pumps it to the Salmon Creek chlorination tank which is connected to the community-wide low elevation system.

There are three steel tank water storage reservoirs connected to the low elevation system that provide water storage—Lemon Creek Reservoir, East Valley Reservoir, and Auke Bay Reservoir.

There are three steel tank water storage reservoirs and pump stations that boost system pressure to serve upland or distant areas. The Crow Hill Pump Station and Reservoir supplies upland areas in Douglas. Cedar Park Pump Station and West Juneau Reservoir supply upland areas in West Juneau. Lena Loop Pump Station and Reservoir supply the upland areas of Lena Loop and the end of the distribution system "out the road".

Three pump stations supply upland areas, but do not include reservoir storage. The Mountain Side Pump Station supplies the upland areas of Mountain Side Estates. The Bonnie Brae Pump Station supplies upland areas in Bonnie Brae Subdivision, and the Lee Street Pump Station supplies upland areas on Lee Street.

An energy audit of the following sites was performed:

- Last Chance Basin Well Field
- Salmon Creek Pump Station
- Crow Hill Pump Station
- Cedar Park Pump Station
- Bonnie Brae Pump Station
- Mountain Side Pump Station
- Lena Loop Pump Station

Water Production

The Last Chance Basin Well Field and Salmon Creek Water Source produced 1,500M gallons of water in 2008. The facilities are all-electric and consumed 2,500 MWh of electricity in 2008 at a cost of $206,000.

ENERGY CONSERVATION OPPORTUNITIES

The energy audit revealed that all of the sites have energy conservation opportunities. The energy performance of each ECO is evaluated based on the operating parameters of the water system and facilities. The economic viability of each ECO is evaluated by a life cycle cost analysis.

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs at each site are listed from highest to lowest priority.

Last Chance Basin Well Field

- LCB-1: Optimize Mill Tunnel Flow to the Low Elevation System
- LCB-2: Set and Monitor Consistent Heating Setpoints
- LCB-3: Repair Exterior Lighting Photocells
- LCB-4: Adjust Cooling Setpoints
- LCB-5: Adjust Cooling and Emergency Generator Makeup Air Louvers
- LCB-6: Weather-strip Exterior Doors

Salmon Creek Pump Station

- SC-1: Turn Off Freezer
- SC-2: Set and Monitor Consistent Heating Setpoints
- SC-3: Repair Exterior Lighting Photocells
- SC-4: Weather-strip Exterior Doors
- SC-5: Replace Heating Thermostat

Crow Hill Pump Station

- CH-1: Change the Electric Rate
- CH-2: Set and Monitor Consistent Heating Setpoints
- CH-3: Weather-strip Exterior Doors

Cedar Park Pump Station

- CP-1: Set and Monitor Consistent Heating Setpoints
- CP-2: Weather-strip Exterior Doors

Bonnie Brae Pump Station

- BB-1: Set and Monitor Consistent Heating Setpoints

Mountain Side Pump Station

- MS-1: Change the Electric Rate
- MS-2: Set and Monitor Consistent Heating Setpoints
- MS-3: Weather-strip Exterior Doors

Lena Loop Pump Station

- LL-1: Set and Monitor Consistent Heating Setpoints
- LL-2: Weather-strip Exterior Doors

Recommended Energy Conservation Opportunities

The following tables list the recommended ECOs and the construction, maintenance, and energy costs over a 25-year period. The ECOs for each site are listed from highest to lowest priority. Table 1-1 provides a prioritized listing of all the ECOs. Table 1-2 provides a listing of each recommended ECO by facility.

Table 1-1: Life Cycle Cost Analysis Summary (Priority Ranking)

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC [1]
High Priority				
CP-3: Replace Oversize Heater	$500	$0	($17,400)	($16,900)
LL-3: Restore Variable Speed Pumping	$200	$0	($4,700)	($4,500)
LCB-7: Install VFD on Well 2 Pump	$17,000	$2,000	($387,000)	($368,000)
CH-5: Replace Oversize Heaters	$1,100	$0	($14,900)	($13,800)
LL-4: Replace Oversize Heaters	$1,600	$0	($21,000)	($19,400)
LCB-8: Install VFD/ Replace Motor Well 3 Pump	$7,000	$2,000	($91,000)	($82,000)
LCB-9: Install VFD on Well 1 Pump	$10,000	$2,000	($106,000)	($94,000)
LCB-10: Replace Treatment Building HW Heater	$700	$0	($6,700)	($6,000)
CH-6: Seal Louvers During Winter Months	$100	$0	($800)	($700)
LCB-11: Replace Oversize Heaters	$3,700	$0	($20,900)	($17,200)
MS-4: Replace Oversize Heaters	$1,100	$0	($5,600)	($4,500)
CP-4: Change Lighting Control	$200	$0	($1,000)	($800)
SC-6: Seal Louvers During Winter Months	$1,200	$0	($5,700)	($4,500)
SC-7: Replace Soda Ash Motor	$600	$0	($1,900)	($1,300)
CP-5: Seal Cooling Louvers During Winter Months	$100	$0	($300)	($200)
High Priority Total	$45,100	$6,000	($684,900)	($633,800)
Low Priority				
LCB-12: Install VFD/Replace Motor Well 4 Pump	$17,000	$2,000	($52,000)	($33,000)
SC-8: Replace Older Transformers	$15,700	$0	($42,600)	($26,900)
LCB-13: Install VFD/Replace Motor Well 5 Pump	$17,000	$2,000	($45,000)	($26,000)
LCB-15: Seal Louvers During Winter Months	$600	$0	($1,200)	($600)
MS-5: Seal Cooling Louvers During Winter Months	$200	$0	($400)	($200)
CP-6: Install VFDs and Replace Motors on Pumps	$31,000	$2,300	($47,000)	($13,700)
CH-7: Install VFDs and Replace Motors on Pumps	$33,400	$2,300	($49,300)	($13,600)
LCB-14: Replace Older Transformers	$16,500	$0	($22,200)	($5,700)
BB-3: Replace Older Transformer	$5,800	$0	($7,300)	($1,500)
LL-5: Seal Cooling Louvers During Winter Months	$100	$0	($100)	$0
Medium Priority Total	$137,300	$8,600	($267,100)	($121,200)
Totals	**$182,400**	**$14,600**	**($952,000)**	**($755,000)**

Note: Negative numbers, in parenthesis, represent savings.
LCB = Last Chance Basin; SC=Salmon Creek; CH=Crow Hill; CP=Cedar Park; BB=Bonnie Brae; MS=Mountain Side; LL=Lena Loop

Table 1-2: Life Cycle Cost Analysis Summary (by Facility)

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC [1]
Last Chance Basin Well Field				
High Priority				
LCB-7: Install VFD on Well 2 Pump	$17,000	$2,000	($387,000)	($368,000)
LCB-8: Install VFD/Replace Motor on Well 3	$7,000	$2,000	($91,000)	($82,000)
LCB-9: Install VFD on Well 1 Pump	$10,000	$2,000	($106,000)	($94,000)
LCB-10: Replace Treatment Bldg. HW Heater	$700	$0	($6,700)	($6,000)
LCB-11: Replace Heating Units	$3,700	$0	($20,900)	($17,000)
Medium Priority				
LCB-12: Install VFD/Replace Motor on Well 4	$17,000	$2,000	($52,000)	($33,000)
LCB-13: Install VFD/Replace Motor on Well 5	$17,000	$2,000	($45,000)	($26,000)
LCB-14: Replace Transformers	$16,500	$0	($22,200)	($5,000)
LCB-15: Seal Cooling Louvers during Winter	$600	$0	($1,200)	($600)
Last Chance Basin Well Field Totals	$89,500	$10,000	($732,000)	($632,500)
Salmon Creek Pump Station				
High Priority				
SC-6: Seal Cooling/Gen. Louvers during Winter	$1,200	$0	($5,700)	($4,500)
SC-7: Replace Soda Ash Motor	$600	$0	($1,900)	($1,300)
Medium Priority				
SC-8: Replace Older Transformers	$15,700	$0	($42,600)	($26,900)
Salmon Creek Totals	$17,500	$0	($50,200)	($32,700)
Crow Hill Pump Station				
High Priority				
CH-4: Replace Heating Unit	$1,100	$0	($14,900)	($13,800)
CH-5: Seal Cooling Louvers during Winter	$100	$0	($800)	($700)
Medium Priority				
CH-6: Install VFD and Replace Motor	$33,400	$2,300	($49,300)	($13,600)
Crow Hill Pump Station Totals	$34,600	$2,300	($65,000)	($28,100)
Cedar Park Pump Station				
High Priority				
CP-3: Replace Electric Heater	$500	$0	($17,400)	($16,900)
CP-4: Control Light Fixture	$200	$0	($1,000)	($800)
CP-5: Install VFD and Replace Motor	$31,000	$2,300	($47,000)	($13,700)
Medium Priority				
CP-6: Seal Cooling Louvers during Winter	$100	$0	($300)	($200)
Cedar Park Pump Station Totals	$31,800	$2,300	($65,700)	($31,600)
Bonnie Brae Pump Station				
Medium Priority				
BB-3: Replace Older Transformer	$5,800	$0	($7,300)	($1,500)
Mountain Side Pump Station				
High Priority				
MS-4: Replace Oversized Heaters	$1,100	$0	($5,600)	($4,500)
Medium Priority				
MS-5: Seal Cooling Louver during Winter	$200	$0	($400)	($200)
Mountain Side Pump Station Totals	$1,300	$0	($6,000)	($4,700)
Lena Loop Pump Station				
High Priority				
LL-3: Restore Variable Speed Pumping Operation	$0	$0	($4,800)	($4,800)
LL-4: Replace Oversized Heaters	$1,600	$0	($21,000)	($19,400)
Medium Priority				
LL-5: Seal Cooling Louver during Winter	$100	$0	($130)	($30)
Lena Loop Pump Station Totals	$1,700	$0	($25,900)	($24,200)
Totals	**$182,400**	**$14,600**	**($952,000)**	**($755,000)**

Note: Negative numbers, in parenthesis, represent savings.

Energy Savings

Table 1-3 shows the current energy costs and projected ECO energy savings at each site.

Table 1-3: Energy Savings Summary

	Energy Cost 2008	Projected ECO Savings	%
Last Chance Basin Well Field	$113,000	$40,000	36%
Salmon Creek Pump Station (CBJ cost) [1]	$15,000	$2,700	18%
Crow Hill Pump Station	$16,000	$3,500	22%
Cedar Park Pump Station	$12,000	$3,500	29%
Mountain Side Pump Station	$5,000	$320	6%
Lena Loop Pump Station	$4,000	$1,400	35%
Bonnie Brae Pump Station	$2,000	$400	20%
Vaults, Reservoirs, Other Pump Stations	$42,000	-	-
Totals	$209,000	$52,000	25%

1. At the Salmon Creek Pump Station, AEL&P pays for up to 3,214.2 kWh per day of pumping energy. The CBJ pays for additional pumping energy and all other loads.

FACILITY GUIDELINES

Many of the sites have the same or similar ECOs. This indicates that there is a need to establish guidelines that optimize the facility and operational energy consumption. The following guidelines were developed based on the findings of the energy audit. The guidelines should be incorporated into new and renovated facilities. Given the long service life of the existing facilities, they should also be applied when possible as part of ongoing facility maintenance.

Building Envelope

The water system facilities are electrically heated. None of the existing buildings is optimally insulated for the current cost of heat.

The optimal insulation level depends upon the type of construction and the cost of heat, which varies at each facility. While an envelope optimization analysis is beyond the scope of this energy audit, the following insulation levels, based on indoor temperature of 55°F, are likely to be optimal for most facilities. In general, an overall heating load of 10 BTUH per sqft is achievable and optimal.

- Walls: R-25 to R-34 (depends upon wall construction)
- Roof: R-45 to R-60 (depends upon roof construction)
- Perimeter Footing: R-15
- Floor slab-on-grade: R-10
- Doors: Insulated metal doors and frames, with thermal break and weather-stripping

Electric Heating

The water system facilities are heated with electric heating units. Most heaters are permanently installed units, but there are some portable heaters plugged into outlets. Controls include wall thermostats, integral thermostats supplied with the heater, and no control (always on).

The electric heaters are oversized in most of the buildings. While an oversized heater will supply the same amount of heat as a properly sized heater, it will incur higher demand changes. For example, a heater that is 2 kW oversized, will incur added unnecessary demand charges of $235 annually when compared to a properly sized heater that supplies the same amount of heat.

Integral thermostats provide poor control because they are influenced by the output of the heater, which causes them to turn off before the room has come up to temperature.

The following guidelines are recommended for heating the buildings and the numerous water system vaults:

- Establish a reasonable indoor temperature. A setpoint of 55°F is likely to provide freeze protection and humidity control.
- Properly size the heaters for the heating load.
- Install permanent heaters and control them from wall thermostats with temperature setpoints. Attached a nameplate to each thermostat with the setpoint.
- For facilities with heating loads of 3 kW or higher, reduce demand charges by installing two or more heaters with a maximum size of 3 kW. Provide each heater with a separate thermostat and stagger the thermostat setpoints with a minimum 3°F differential so the heating demand can vary with the heating load.

Cooling Systems

There are several cooling schemes installed in the facilities. A recommended scheme is:

- Install a cabinet exhaust fan (interior insulation) sized for 6 air changes per hour.
- The exhaust fan should be connected to an automatic exhaust damper and exhaust louver. Insulate the discharge duct and louver with 2” duct insulation. Install an insulated 12x12 access door for the automatic damper.
- Install a makeup air louver with automatic damper. Connect a 36” length of insulated ductwork to within 12” of the floor. Locate the outlet to provide good cross-flow to the exhaust fan. Insulate all with 2” duct insulation.
- The makeup and exhaust ductwork is recommended to provide a thermal break between the louver and the inside.
- Control the fan and dampers from a wall thermostats set at 75°F.

Lighting

At most of the facilities, the lighting is operated a minimal number of hours each year. Inexpensive fluorescent T-8 lighting is optimal.

Exterior lighting is operated 50% of the year. Energy efficient metal halide lighting is recommended with integral photocells. Photocell control should be fine-tuned so the lighting is off during daylight hours.

Transformers

Most of the buildings are supplied with 480V power. The benefit of a 480V service, when compared to 208V/120V service, is that smaller conductors are required and motors are slightly more efficient at higher voltages. The downside is the investment in a step-down transformer that is downstream of the utility meter. The losses of the step-down transformer are paid by the owner.

Most transformer losses are converted to heat. The heat gain to the building can be beneficial during the heating season, but is inefficient when it is not needed. There are two methods for reducing the transformer losses. First, the transformer should be right-sized. Losses are typically a percentage of the transformer capacity, so a smaller transformer costs less and has smaller losses. Second, highly energy efficient transformers should be used.

Recommendations for transformers are:

- Determine if the motor loads and motor efficiencies warrant a 480V service and the losses associated with a step-down transformer.
- Right-size the transformer by establishing reasonable estimates of loads.
- Use energy efficient transformers. Transformers that are 15 kVA and larger should meet the energy efficiency requirements of NEMA Standard TP 1-2001. Smaller transformers do not have standards for energy efficiency.
- Locate the transformer near the floor where the heat output will create convective currents, spreading the heat though the facility.

Operational Guidelines

The following guidelines were developed based on energy conservation opportunities in the existing facilities and operations. The guidelines are recommended to improve the energy performance of the water system.

Pumps

Pumps consume the majority of the energy consumed by the water system. The pumps should be right-sized and selected for optimal efficiency. Variable speed pumping allows pumps to operate for longer periods at lower flow rates, which reduces energy consumption and demand charges. Variable speed pumping also negates the need for PRVs which essentially dissipate pump energy. The many energy and operational benefits of variable speed pumping should be implemented where appropriate.

Motors

Many of the motors in the water system are less efficient than modern motors. Replacing the motors with NEMA Premium® efficient motors will reduce energy consumption and demand charges.

The energy cost of operating a motor usually exceeds the purchase price. Whether an investment in an energy efficient motor should be made depends upon the cost of the motor, cost of electricity, and the number of operating hours each year. There is no guideline that is applicable to all of these variables. NEMA Premium® motors may not be available in the required frames.

Table 1-4 provides the full load efficiencies of "standard" and NEMA Premium® motors.

Table 1-4: Motor Full Load Efficiency

Horsepower	"Standard"	NEMA Premium®
1	76.7 to 82.5	85.5
1.5	79.1 to 84.0	86.5
2	80.8 to 84.0	86.5
3	81.4 to 87.5	89.5
5	83.3 to 87.5	89.5
7.5	85.5 to 89.5	91.7
10	85.7 to 89.5	91.7
15	86.6 to 91.0	92.4
20	88.5 to 91.0	93.0
25	89.3 to 92.4	93.6
30	89.6 to 92.4	93.6
40	90.2 to 93.0	94.1
50	91.3 to 93.0	94.5
60	91.8 to 93.6	95.0
75	91.7 to 94.1	95.4
100	92.3 to 94.5	95.4

Demand Control

AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand. As a rule of thumb, each kW of peak load adds $10 in demand charges to the monthly electric bill. For example, at Cedar Park Pump Station, one pump fills the reservoir each night. If the second pump also operated simultaneously for over 15 minutes, it will add 44 kW x $10 = $440 in demand charges to that month's bill.

Demand charges are applicable to the following facilities:

- Last Chance Basin
- Crow Hill Pump Station
- Cedar Park Pump Station
- Mountain Side Pump Station
- Lena Loop Pump Station

The following strategies are recommended to minimize demand:

- Implement the above facility and operational guidelines at each facility.
- Use variable speed pumping and establish control sequences that operate pumps for longer periods at lower flow rates.
- At facilities with redundant pumps, limit simultaneous operation of pumps to emergencies and testing. Perform back-to-back tests within one billing cycle so the added demand charges are applied to a single month's bill.
- Use NEMA Premium® energy efficient motors where operating hours warrant the investment.
- Right-size equipment such as pumps, transformers, and electric heaters.

SUMMARY

The water system facilities are in good condition and appear to be well maintained. However, there is financial incentive to invest in energy efficiency at each water system facility and obtain a 25% reduction in energy costs. The water system facilities are very similar, which provides an incentive to establish and implement consistent guidelines for facility construction and operation.

The author would like to express appreciation to the CBJ Water Department operation and maintenance personnel who provided assistance during this project. Their knowledge of the water systems and interest in energy efficiency was invaluable.

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Section 2
Introduction

This report presents the findings of an energy audit of the City and Borough of Juneau's Water System. The purpose of the energy audit is to identify energy conservation opportunities (ECOs) that will provide a life cycle savings.

The following facilities were audited:

- Last Chance Basin Well Field
- Salmon Creek Pump Station
- Crow Hill Pump Station
- Cedar Park Pump Station
- Bonnie Brae Pump Station
- Mountain Side Pump Station
- Lena Loop Pump Station

The findings were gathered from on-site observations, review of documentation, and interviews with water utility operations and maintenance personnel.

The energy audit was performed by Jim Rehfeldt, P.E. of Alaska Energy Engineering LLC with technical assistance by Jim Dorn, P.E. of Carson Dorn, Inc.

BACKGROUND

System Description

The CBJ water system has two water sources: Last Chance Basin Well Field and Salmon Creek. The distribution system consists of a community-wide low elevation system and several high elevation systems scattered throughout the area.

Last Chance Basin Well Field

The Last Chance Basin Well Field consists of five wells supplying the community-wide low elevation distribution system and a high elevation distribution system.

The low elevation water supply flows from the well field through an on-site chlorine treatment system and through the Jualpa Tunnel (former mine tunnel), which provides chlorine contact time, and into the distribution system.

The high elevation system supplies the upland area surrounding downtown Juneau. Water flows from the well field through a second on-site chlorine treatment system and into the Mill Tunnel (former mine tunnel), which provides storage for both the high and low elevation systems, and into the high elevation distribution system.

Salmon Creek Water Source

Salmon Creek consists of a surface water source that is connected to the community-wide low elevation system. Water from Salmon Creek flows through an Alaska Electric Light & Power Company hydroelectric facility and is pumped from the tailrace through an on-site chlorination system and into the Salmon Creek Reservoir which provides chlorine contact time. The water flows from the reservoir through a soda ash treatment system and into the community-wide low elevation distribution system. AEL&P pays some of the pumping costs as part of an agreement with the CBJ.

Low Elevation System Reservoirs

There are three reservoirs connected to the low elevation system that provide water storage—Lemon Creek Reservoir, East Valley Reservoir, and Auke Bay Reservoir.

High Elevation System Pump Stations and Reservoirs

There are three steel tank water storage reservoirs and pump stations that boost system pressures to serve upland or distant areas. The Crow Hill Pump Station and Reservoir supplies upland areas in Douglas. Cedar Park Pump Station and West Juneau Reservoir supply upland areas in West Juneau. Lena Loop Pump Station and Reservoir supply the upland areas of Lena Loop and the end of the distribution system "out the road".

Three pump stations supply upland areas, but do not include reservoir storage. The Mountain Side Pump Station supplies the upland areas of Mountain Side Estates. The Bonnie Brae Pump Station supplies upland areas in Bonnie Brae Subdivision, and the Lee Street Pump Station supplies upland areas on Lee Street.

Water Production

The Last Chance Basin Well Field and Salmon Creek Water Source produced 1,500 million gallons of water in 2008. The flow from each source was:

- Last Chance Basin Well Field: 1,100M gallons
- Salmon Creek Pump Station: 400M gallons

The amount of water pumped by the major high elevation pump stations in 2008 was:

- Crow Hill Pump Station: 31M gallons
- Cedar Park Pump Station: 20M gallons
- Lena Loop Pump Station: 12M gallons
- Mountain Side Pump Station: 7M gallons
- Bonnie Brae Pump Station: 4M gallons

Energy Use per Facility

Table 2-1 provides a breakdown of the water system energy use.

Table 2-1: Annual Energy Use and Cost Summary

Facility	Usage kWh	Demand kW	Cost $	Cost ¢/kWh	Cost ¢/kgal
Last Chance Basin Well Field	1,280,000	223	$113,000	8.1	10
Salmon Creek Pump Station (Total) [1]	556,000	280	$70,000	12.1	18
Salmon Creek Pump Station (CBJ) [1]	136,000	-	$15,000	10.2	4
Crow Hill Pump Station	149,000	48	$16,000	11.0	52
Cedar Park Pump Station	52,000	57	$12,000	16.6	60
Mountain Side Pump Station	46,000	10	$5,000	10.6	71
Lena Loop Pump Station	34,000	15	$4,000	12.1	33
Bonnie Brae Pump Station	16,000	-	$2,000	11.5	50
Vaults, Reservoirs, Pump Stations	323,000	-	$42,000	13.0	-
Water System Totals [2]	2,500,000	-	$264,000	10.4	
CBJ Totals [3]	2,080,000	-	$209,000	9.9	

1. At the Salmon Creek Pump Station, AEL&P pays for up to 3,214.2 kWh per day of pumping energy. The CBJ pays for additional pumping energy and all other loads.
2. Includes AEL&P pumping costs at Salmon Creek Pump Station.
3. Excludes AEL&P pumping costs at Salmon Creek Pump Station.

Analysis

One column in the above table lists the effective energy cost per kWh (¢/kWh), which is the sum of the energy and demand charges per kWh. A site with a significantly higher effective cost has disproportionately higher demand charges. There should be opportunities at these facilities to reduce demand and lower the energy bill.

- Cedar Park Pump Station: Has the highest effective electricity cost because the large pumps operate only a few hours each day.
- Lena Loop Pump Station: Has high effective energy costs due to oversized electric heaters that create high demand changes year-round.
- Crow Hill Pump Station: Has relatively high effective electricity cost because the high horsepower pumps operate a few hours each day. In addition, the pump station powers electric heaters in PRV vaults, which also contribute to the total demand.
- Vaults, Reservoirs, and Small Pump Stations: These facilities consume 13% of the energy, but provide no pumping. It is likely that electric heating is the main load that offers energy saving opportunities. The high effective cost (¢/kWh) is likely because monthly service charges at each facility make up a significant portion of the bill.

The energy cost per kgal indicates the amount of energy required to pump the water. As expected, the high elevation pump stations have higher energy costs per gallon due to the pressure requirements of lifting water to the high elevation pressure.

- The larger the pumping head, the higher the energy cost per gallon. When comparing Cedar Park and Crow Hill, the primary difference is that Cedar Park has the larger pressure gain.
- Mountain View Pump Station: Has the highest cost per kgal because the pumps operate continuously, even when flows are minimal. This added cost is not significant enough to warrant investment in a reservoir.
- Lena Loop Pump Station: Has a relatively low cost per kgal because the pumping head is smaller.
- Last Chance Basin produces water for less cost per gallon than Salmon Creek. This is due to the higher elevation of the well field, which is slightly offset by pumping to the high elevation system. Since AEL&P pays some of the pumping costs at Salmon Creek, it produces water at less cost to the CBJ than Last Chance Basin.

METHODOLOGY

Energy Conservation Opportunities (ECOs)

Energy conservation opportunities were identified by evaluating the energy systems and the operating parameters of the water system. The process for identifying the ECOs acknowledges the limitations of modifying existing buildings and systems, most of which were constructed when energy costs were much lower. The ECOs represent practical measures to improve the energy efficiency of the system.

Life Cycle Cost Analysis

The ECOs are evaluated using life cycle cost analysis to determine if an energy efficiency investment will provide a savings over a 25-year life. The analysis incorporates construction, replacement, maintenance and repair, and energy costs to determine the total cost over the life of the ECO. Future maintenance and energy cash flows are discounted to present worth using escalation factors for general inflation, energy inflation, and the value of money. The methodology is based on the National Institute of Standards and Technology (NIST) Handbook 135 – Life Cycle Cost Analysis.

Life cycle cost analysis is preferred to simple payback for facilities that have long—often perpetual—service lives. Simple payback, which compares construction cost and present energy cost, is reasonable for short time periods of 2-4 years, but yields below optimal results over longer periods because it does not properly account for the time value of money or the effect inflation has on operating budgets. Accounting for energy inflation and the cost of money properly values the true cost of facility ownership and seeks to minimize the total cost over its life.

Appendix C contains the life cycle cost calculations of each ECO.

Construction Costs

The cost estimates are derived based on a preliminary understanding of the scope of each ECO as gathered during the walk-through audit. The construction costs assume in-house labor at $60 for work typically performed by maintenance staff and contract labor for larger projects and electrical work. The estimates assume some efficiency gain by being incorporated into larger, energy efficiency or other construction projects. This will spread mobilization costs over a number of ECOs and minimize costs.

When ECOs are taken for implementation, the cost estimate should be revisited once the scope and preferred method of performing the work has been determined. It is possible some ECOs will not provide a life cycle savings once the scope is finalized.

Maintenance Costs

Maintenance costs are based on in-house labor using historical maintenance efforts and industry standards. Maintenance costs are determined for the 25-year life of each ECO and represent realistic levels of effort to maintain the relative systems.

Energy Analysis

The energy performance of each ECO is evaluated using operating parameters of the water system and facilities. Appendix B contains the energy analysis calculations.

Prioritization

A prioritized ranking of the ECOs was calculated for each building using the following formula:

Prioritization Factor = Life Cycle Savings / Capital Costs

This factor puts weight on the capital cost of an ECO, which is aligned with budgeting realities that allow early implementation of low cost improvements while higher cost ECOs must wait for funding and implementation.

The ECOs are grouped into the following prioritized categories:

- Behavioral or Operational: ECOs that need minimal capital investment but require operational or behavioral changes. A life cycle cost analysis is not performed of these ECOs because the energy savings is difficult to quantify and a life cycle savings is certain.
- High Priority: ECOs that require a small capital investment and offer a life cycle savings.
- Medium Priority: ECOs that require a significant capital investment to provide a life cycle savings. Some offer a substantial life cycle savings but require planning and investment to implement. Many medium priority ECOs return a high life cycle savings and offer substantial incentive to increase investment in building energy efficiency.
- Low Priority: ECOs that will save energy but do not provide a life cycle savings.

Economic Factors

Economic factors are significant to the findings and should undergo careful scrutiny.

- Nominal Interest Rate: This is the nominal rate of return on an investment without regard to inflation. The analysis uses a rate of 5.0% which is the current cost of bonds for CBJ capital improvement projects.
- Inflation Rate: This is the average inflationary change in prices over time. The analysis uses an inflation rate of 3.0% which is the consumer price index average of the past 25-years.
- Real Discount Rate: This is the actual rate of return when the inflation rate is considered. The analysis uses a real discount rate of 1.9% which is a calculated value derived from the nominal interest rate and the inflation rate.
- Economic Period: This is the period of time in which costs are considered. The analysis is based on a 25-year economic period with construction beginning in 2009.

Electricity

The water facilities are all–electric facilities. The electric rates applied to each site are determined by Alaska Electric Light & Power Company (AEL&P) based on the provisions of their tariff. The section for each site discusses the applicable electric rate.

AEL&P is a privately owned utility regulated by the Regulatory Commission of Alaska. Power generation facilities utilized by AEL&P include both hydroelectric and diesel plants. Currently, the hydroelectric plants generate most of the electricity and the diesel plants provide backup.

Over recent history, electricity inflation has been less than 1% per year, which has lagged general inflation. This trend has been discontinued in recent years as fuel oil price increases led to more electric heating loads. The winter of 2007/2008 is the first extended period where AEL&P had to supplement with diesel generation. This caused a temporary Power Cost Adjustment of 1.2¢ per kWh.

In the fall of 2009, the new Lake Dorothy Hydroelectric Facility will begin producing power. The power from Lake Dorothy will be more expensive than power from the existing hydroelectric facilities. It is assumed that the community will consume most of the Lake Dorothy Phase 1 power in the near future and that the blended generation cost will raise electric rates 1.5¢ per kWh. The life cycle cost analysis includes a 1.5¢/kWh increase in electric costs.

Even with Lake Dorothy, electric heating loads are likely to continue to place demands on the hydroelectric generation facilities. A recent CBJ energy balance report indicates that Juneau's heating energy—which is currently met with fuel oil—is 175% higher than non-heating electrical energy. This is a large potential load that could convert to electricity if high fuel oil inflation occurs again. In essence, Juneau's future electricity prices are tied to fuel oil inflation. The life cycle cost analysis uses an electric inflation of 2.5%, which is higher than the historic average to account for future electric heating price pressures.

Table 2-2: Summary of Economic and Energy Factors

Factor	Rate or Cost	Factor	Rate or Cost
Nominal Discount Rate	5.0%	Electricity	Current rates + 1.5¢/kWh
General Inflation Rate	3.0%	Electricity Inflation	2.5%
Real Discount Rate	1.9%		

Section 3

Last Chance Basin Well Field

INTRODUCTION

The Last Chance Basin Well Field consists of five wells, each with a well pump located in a separate building. The wells pump ground water into a high elevation distribution system and a low elevation distribution system. The water is chlorinated prior to flowing to the distribution systems.

A single electrical service supplies energy to the well field for pumping loads, heating, and lighting. The electric service feeds a main distribution panel in the Treatment Building which distributes power to the five well buildings and the Treatment Building.

Energy Data

Electricity is billed under AEL&P's Rate 34, Large Government, which charges for both electrical consumption (kWh) and peak electric demand (kW). Electrical consumption is the amount of energy consumed and electric demand is the rate of consumption. AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand.

Table 3-1: AEL&P Large Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh	4.93¢	4.62¢
Demand Charge per kW	$11.53	$7.35
Service Charge per month	$99.24	$99.24

1. Currently, a Power Cost Adjustment of 1.2¢ per kWh is added to pay for diesel supplementation due to low hydroelectric water levels. That charge will end in a few months.

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- From 2006 to 2008, energy consumption averaged 1,282,000 kWh per year
- Energy usage varies monthly due to normal changes in water production that occur with system demand and staging of the LCB and Salmon Creek water sources.
- Energy usage is highest in the summer due to increased water demand from cruise ships and summer tourism.
- Energy usage is increasing annually even as water production has dropped. This is because well production has been decreasing, so additional wells are being staged on earlier to protect the pumps from cavitating. A well reconditioning project is currently in progress to improve well production.

Electrical Demand

- From 2005 to 2008, monthly demand has been very consistent at an average of 223 kW.

Costs

- During 2007-2008, annual energy costs averaged $113,000 per year.
- The monthly electric bill has the following breakdown.
  1. Energy consumption (kWh) = 74%
  2. Electrical demand (kW) = 25%
  3. Customer charges = 1%
- The effective cost (sum of energy and demand charges) is 8.1¢ per kWh.
- The well field has an annual load factor 67%, which is the ratio of the average load to the peak load. This high load factor indicates cost efficient operations where pumps operate for long periods and are not cycled for short durations. The primary benefit of a high load factor is proportionally lower demand charges which result in a lower effective cost per kWh.

BUILDINGS

There are five ground water wells in the Last Chance Basin Well Field that supply water. Each has a well pump located in separate buildings. A Treatment Building contains the electric service, an emergency generator, and treatment systems for the low pressure system.

Building Envelopes

Description

Table 3-2: Building Envelope

Room	Description (inside to outside)	R-value	Remarks
Wells 1 and 2			
Walls	Laminate panel; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping
Well 3: Original Building			
Walls	No drawing record		
Roof	No drawing record		
Floor slab	No drawing record		
Perimeter	No drawing record		
Doors	Insulated metal door and frame	R-2	No thermal break Poor weather-stripping

Table 3-2: Building Envelope (continued)

Room	Description (inside to outside)	R-value	Remarks
Well 3 Addition			
Walls	Laminate panel; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-2	No thermal break Poor weather-stripping
Wells 4 and 5			
Walls	Gypsum board; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gypsum board; 3" rigid; roof joists; plywood; metal	R-18	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-4	Frame w/o thermal break
Treatment Building			
Walls	Gypsum board; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gypsum board; attic rafters, R-30 batt insulation	R-32	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-2	No thermal break Poor weather-stripping

Analysis

The buildings all have similar insulation levels despite being upgraded at different times. This suggests that insulation levels have not been optimized as electricity costs have increased.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wallboard typically more than offsets the life cycle energy savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

Door weather-stripping can be installed or upgraded to seal the opening, minimizing infiltration. There is no economical way to replace doors and frames with thermally broken units.

Heating Systems

Description

The buildings are heated by electric heating units. At Wells 1, 2, 4, and 5, a wall thermostat controls the heaters. At Well 3, a thermostat integral with the heater controls the heater. The thermostat setpoints varied from 65°F to 78°F.

Analysis

Reducing the heating setpoint to 55°F will save energy while maintaining sufficient warmth to prevent freezing and control humidity.

The electric heaters are oversized in most of the buildings.

Table 3-3: Heating Units

Well	Capacity, kW	Heat Loss, kW	Oversized, kW
Well 1	5	3	2
Well 2	5	3	2
Well 3 [1]	12	9	3
Well 4	5	3	2
Well 5	5	3	2
Treatment Building	7	7	-

1. The heat loss at Well 3 is estimated due to lack of documentation on building construction.

Cooling Systems

Description

Each building has a natural cooling system. At Wells 1, 2, 4, and 5, the system consists of an operable louver(s) and an exhaust fan. At Well 3, the system consists of an exhaust fan that draws in cooling air through leakage paths in the building envelope. A wall thermostat opens the louvers (where applicable) and operates the fan when the temperature exceeds the setpoint.

Analysis

The outside air louvers are not insulated or thermally broken, which allows heat a direct conductive path to the outside. A few of the louvers do not seal tightly, which allows infiltration heat loss.

The Well 3 cooling system draws cooling air into cracks in the building envelope. This is not desirable as it also draws moisture into the envelope. An outside air louver should be installed if the cooling system operates regularly.

In a few buildings, the cooling setpoint was set too close to the heating setpoint. If the heater overshoots the setpoint, more likely if the heater is oversized, the cooling system could operate, sending the heat outdoors. It is recommended that the cooling setpoints be set at 75°F or higher and the heating setpoints be set at 55°F.

Domestic Hot Water Heating

Description

Hot water heaters produce warm water for generating hypochlorite solution. At Well 3, a 1.5 kW instantaneous electric hot water heater is installed. At the Treatment Building, a 30 gallon electric water heater with a 4.5 kW heating element is installed.

Analysis

The 1.5 kW instantaneous hot water heater at Well 3 incurs lower demand charges than the 4.5 kW electric hot water heater at the Treatment Building. Both facilities produce equal size batches of hypochlorite and each heater is capable of producing enough hot water. Installing an instantaneous hot water heater at the Treatment Building will reduce demand charges.

Lighting

Description

Table 3-4: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Well 1				
Interior	4 / Surface	2 / T8	Switch	-
Exterior	1 / Surface	1 / MH	Photocell	On during daylight
Well 2				
Interior	4 / Surface	2 / T8	Switch	-
Exterior	1 / Surface	1 / MH	Photocell	On during daylight
Well 3				
Interior	7 / Surface	2 / T8	Switch	-
Exterior	2 / Surface	1 / MH	Photocell	On during daylight
Well 4				
Interior	2 / Surface	2 / T12	Switch	Inefficient
Exterior	1 / Surface	1 / MH	Photocell	-
Well 5				
Interior	2 / Surface	2 / T12	Switch	Inefficient
Exterior	1 / Surface	1 / MH	Photocell	-
Treatment Building				
Interior	19 / Surface	2 / T12	Switch	Inefficient
Exterior	3 / Surface	1 / MH	Photocell	-

Analysis

The interior T12 lighting has a much lower efficacy than the T8 lighting. However, the lighting is used only a few hours each year and there is no economic incentive to upgrade the lighting.

Several exterior lights were on during daytime due to failure of the photocells.

Transformers

Description

Each building is supplied with 480V power for the pumps. A transformer is installed to step down the 480V building power to obtain 208V/120V power.

Table 3-5: Transformers

Pump Station	Size	Remarks
Well 1	10 kVA	No replacement
Well 2	10 kVA	No replacement
Well 3	30 kVA	Less efficient
Well 4	7.5 kVA	No replacement
Well 5	7.5 kVA	No replacement
Treatment Building	45 kVA	Less efficient

Analysis

Transformers 15 kVA or larger can be upgraded to meet the energy efficiency requirements of NEMA Standard TP 1-2001.

PROCESS

The Last Chance Basin Well Field supplies a high elevation distribution system and a low elevation distribution system. The high elevation system serves the upland area surrounding downtown Juneau. The low elevation system supplies the city-wide distribution system. The following table shows the capacity of the each well pump and the system it supplies.

Table 3-6: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Low Elevation System			
Well 1	800	115	40
Well 2 [1]	1,300	235	100
Well 4	1,950	66	50
Well 5	1,600	92	50
High Elevation System			
Well 3 (primary)	1,150	200	100
Well 2 [1]	1,300	235	100

1. Well 2 typically supplies the low elevation system, but has sufficient pump capacity to supply the high elevation system when needed.

Low Elevation System

Description

Wells 1, 2, 4, and 5 supply water to the low elevation system. Each pump has a downstream pressure reducing valve that reduces the pump outlet pressure. Typical pressure drops across each pressure reducing valve are 17 psig, 83 psig, 8 psig, and 17 psig at wells 1, 2, 4, and 5, respectively.

The water from the wells flows past the Treatment Building, where it is injected with chlorine, and continues through the Jualpa Tunnel, which provides chlorine contact time prior to entering the distribution system. The high elevation of the LCB wells would over-pressurize the low elevation system, so pressure reducing valves at Cope Park and 8th Street lower to distribution pressure.

The SCADA system sequences the low elevation pumps to meet system water demand. Operators manually set the pump flow rates and operating sequence regularly as well conditions change.

Analysis

The PRVs, which serve necessary functions of maintaining constant distribution pressure, essentially dissipate pumping energy. The amount of lost energy can be reduced by optimally sizing the pumps so there is minimal excess head at the pump discharge. Unfortunately, properly sized pumps require sufficient head to overcome well draw-down, screen accumulation, and piping pressure drop at maximum flow, so some pressure drop is necessary. An energy efficient solution is to use variable frequency drives (VFDs) to control the speed of each pump to match the system pressure and flow requirements. This will reduce both pumping energy and demand charges.

Pump 2 is sized to supply either the high or low elevation systems. When supplying the low elevation system, the pump has excess head which results in an 83 psig pressure drop across the discharge PRV. This energy penalty is substantial, and warrants using Well 2 to supply the low elevation systems only when necessary. If the pump is controlled by a VFD, the energy penalty will be substantially reduced.

High Elevation System

Description

Well 3 (primary) and Well 2 (standby) supply water to the high elevation system. Each pump has a PRV that reduces the pump outlet pressure as needed to limit well production. Typical pressure drops across each flow control valve are 6 psig and 21 psig at pumps 3, and 2, respectively.

The water is treated at Well 3, where it is injected with chlorine and pumped up into the Mill Tunnel, which provides storage for the high elevation system and fire water storage for downtown Juneau. The elevation of the Mill Tunnel is high enough to over-pressurize the high elevation system. To prevent this from occurring, there is a PRV at 8th Street that reduces to distribution pressure. Since the high elevation system supplies the Mill Tunnel on the same end as the outlet to the high elevation system (using the same pipe), chlorine levels in the Mill Tunnel are maintained by flowing water out the other end of the tunnel into the low elevation system through a PRV, where the pressure is significantly reduced to the low elevation distribution pressure.

The SCADA system operates the high elevation pumps in a Well 3 lead / Well 2 standby configuration to maintain the water elevation in the Mill Tunnel.

Analysis

The PRV between the high elevation and low elevation system has a large pressure drop of 87 psig. This dissipation of pumping energy, while necessary to maintain water quality in the Mill Tunnel, should be optimized so flow to the low elevation system is limited to the minimum necessary to maintain water quality.

Strategies to reduce pumping energy and demand costs by properly sizing pumps and using VFDs, as discussed for the low elevation system, are also applicable to the high pressure system.

Motors

Description

Table 3-7: Motors

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Well 1	40	94.5%	94.1%	Efficient motor
Well 2	100	95.4%	95.4%	Efficient motor
Well 3	100	93.0%	95.4%	Less efficient
Well 4	50	90.2%	94.5%	Less efficient
Well 5	50	90.2%	94.5%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are operated a significant number of hours each year. Replacing the Pump 3, 4, and 5 motors with NEMA Premium® efficient motors will reduce energy consumption.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Last Chance Basin-1: Optimize Mill Tunnel Flow to the Low Elevation System

Purpose: Considerable pumping energy is dissipated through the Franklin Street PRV when the Mill Tunnel supplies the low elevation system. This energy loss can be minimized by optimizing the flow rate needed to maintain Mill Tunnel chlorine levels.

Scope: Monitor Mill Tunnel chlorine levels and reduce the flow from the Mill Tunnel to the low elevation system to the minimum required to maintain water quality in the tunnel.

Recommendation: This ECO is recommended without additional analysis.

Last Chance Basin-2: *Set and Monitor Heating Setpoints*

Purpose: The heating setpoints exceed the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Replace integral thermostats with wall thermostats. Reset all heating thermostats at 55°F. This ECO is applicable to all heating thermostats.

Recommendation: This ECO is recommended without additional analysis. All heating units should be controlled from a separate wall thermostat with a setpoint of 55°F. Building maintenance funds will be used for this work.

Last Chance Basin-3: *Repair Exterior Lighting Photocells*

Purpose: Several exterior light fixtures remain on during daylight hours. Adjusting or replacing the internal photocell on each fixture so the light turns off during daytime will save lighting energy.

Scope: Adjust or replace faulty exterior lighting photocells so the lamps are off during the day. This ECO is applicable to all buildings.

Recommendation: This ECO is recommended without additional analysis.

Last Chance Basin-4: *Adjust Cooling Setpoints*

Purpose: The cooling setpoints should be at least 20°F higher than the heating setpoint to prevent unintentional operation of the cooling system.

Scope: Adjust the cooling system setpoint to 75°F or higher so the cooling system does not turn on inadvertently. This ECO is applicable to Wells 1, 2, 4, and 5.

Recommendation: This ECO is recommended without additional analysis.

Last Chance Basin-5: *Adjust Cooling and Emergency Generator Makeup Air Louvers*

Purpose: Several louvers do not seal tightly, which allows cool, humid air to infiltrate into the building. Adjusting the louvers so they seal tight will minimize infiltration and save heating energy.

Scope: Adjust the cooling louvers so they seal tightly when closed. This ECO is applicable to all buildings except Well 3.

Recommendation: This ECO is recommended without additional analysis.

Last Chance Basin-6: *Weather-strip Exterior Doors*

Purpose: The weather-stripping on many of the doors is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping. This ECO is applicable to nearly all LCB doors.

Recommendation: This ECO is recommended without additional analysis. Building maintenance funds will be used for this work.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Last Chance Basin-7: *Install VFD on Well 2 Pump*

Purpose: The Well 2 pump is a constant speed pump that is sized to deliver water to either the high elevation or low elevation systems. When the well is supplying the low elevation system—most of the time—the system must drop a considerable amount of pressure through PRVs to deliver water at the distribution pressure. Installing a variable speed drive to align the pump operation with the water delivery requirements will minimize the pumping energy lost to pressure reduction.

Scope: Install a VFD to control the Well 2 pump.

Analysis: Well 2 supplied 251M gallons of water in 2008. The pump operated 3,900 hours at an average output of 482 gpm. This output is below the rated pump capacity of 1,300 gpm so considerable energy was lost to the PRVs.

The analysis assumed an average Well 2 output of 800 gpm with a discharge pressure of 2 psig. Variable speed operation will provide an annual energy savings of 277,000 kWh and 348 kW of demand and an annual cost savings of $20,900.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD on Well 2 Pump	$17,000	$2,000	($387,000)	($368,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-8: *Install VFD and Replace Motor on Well 3 Pump*

Purpose: The Well 3 pump is a constant speed pump that drops pressure through PRVs to deliver water at the distribution pressure. Installing a variable speed drive to align the pump operation with the water delivery requirements will minimize the pumping energy lost to pressure reduction. The motor is less efficient than NEMA Premium® standards.

Scope: Install a VFD and NEMA Premium® motor.

Analysis: Well 3 supplied 251M gallons of water in 2008. The pump operated 3,900 hours at an average output of 1,070 gpm.

The analysis assumed the pump will operate for longer periods at 800 gpm, which will reduce friction losses in piping and electrical demands. Variable speed operation with a more efficient motor will provide an annual savings of 37,000 kWh and 264 kW of demand and an annual cost savings of $4,900.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD/Replace Motor on Well 3 Pump	$7,000	$2,000	($91,000)	($82,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-9: *Install a VFD on Well 1 Pump*

Purpose: The Well 1 pump is a constant speed pump that drops pressure through a PRV to deliver water at the distribution pressure. Installing a variable speed drive to align the pump operation with the water delivery requirements will minimize the pumping energy lost to pressure reduction.

Scope: Install a VFD to control Well 1 pump.

Analysis: Well 1 supplied 144M gallons of water in 2008. The pump operated 4,500 hours at an average output of 530 gpm. This output is below the rated pump capacity of 800 gpm, which indicates that a considerable amount of energy was lost to the PRVs.

The analysis assumed an average output of 650 gpm with a discharge pressure of 2 psig. Variable speed operation will provide an annual savings of 67,000 kWh and 156 kW of demand and an annual cost savings of $5,700.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD on Well 1 Pump	$10,000	$2,000	($106,000)	($94,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-10: *Replace Treatment Building Hot Water Heater*

Purpose: The Treatment Building has an electric hot water heater with integral 4.5 kW heating elements. Replacing the heater with a 1.5 kW instantaneous heater, like the one installed at Well 3, will reduce standby losses and demand charges.

Scope: Replace the Treatment Building hot water heater with a 1.5 kW instantaneous hot water heater.

Analysis: The instantaneous hot water heater will reduce annual demand by 36 kW and heat loss by 147 kWh, and provide an annual cost savings of $400.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Treatment Building HW Heater	$700	$0	($6,700)	($6,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-11: Replace Oversize Heaters

Purpose: Most of the electric heating units are oversized, creating higher demand charges while delivering the same amount of heat as a properly sized heater. The demand charges will be reduced if properly sized heaters are installed.

Scope: Replace oversized heating units in each building with properly sized heaters.

- Well 1: Replace a 5 kW heater with a 3 kW heater.
- Well 2: Replace a 5 kW heater with a 3 kW heater.
- Well 3: Replace a 7.5 kW heater with a 3 kW heater. Install a second 3 kW heater with separate thermostat. Stage the thermostat setpoints at 58°F and 53°F.
- Well 4: Replace a 5 kW heater with a 3 kW heater.
- Well 5: Replace a 5 kW heater with a 3 kW heater.

Analysis: The properly sized heaters will reduce annual demand by 115 kW and provide an annual cost savings of $1,100.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Oversize Heaters	$3,700	$0	($20,900)	($17,200)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. The ECOs are listed from highest to lowest priority.

Last Chance Basin-12: Install VFD and Replace Motor on Well 4 Pump

Purpose: The Well 4 pump is a constant speed pump that drops pressure through PRVs to deliver water at the distribution pressure. Installing a variable speed drive to align the pump operation with the water delivery requirements will minimize the pumping energy lost to pressure reduction. The motor is less efficient than NEMA Premium® standards.

Scope: Install a VFD and NEMA Premium® motor.

Analysis: Well 4 supplied 243M gallons of water in 2008. The pump operated 7,200 hours at an average output of 560 gpm. This output is below the rated pump capacity of 1,950 gpm, which indicates that a considerable amount of energy was lost to the PRVs.

The analysis assumed an average output of 1,000 gpm with a discharge pressure of 2 psig. Variable speed operation will provide an annual savings of 43,000 kWh and 12 kW of demand and an annual cost savings of $2,800.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD/Replace Motor on Well 3 Pump	$17,000	$2,000	($52,000)	($33,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-13: Install VFD and Replace Motor on Well 5 Pump

Purpose: The Well 5 pump is a constant speed pump that drops pressure through PRVs to deliver water at the distribution pressure. Installing a variable speed drive to align the pump operation with the water delivery requirements will minimize the pumping energy lost to pressure reduction. The motor is less efficient than NEMA Premium® standards.

Scope: Install a VFD and NEMA Premium® motor.

Analysis: Well 5 supplied 148M gallons of water in 2008. The pump operated 6,000 hours at an average output of 413 gpm. This output is below the rated pump capacity of 1,600 gpm, which indicates that a considerable amount of energy was lost to the PRVs.

The analysis assumed an average output of 900 gpm with a discharge pressure of 2 psig. Variable speed operation will provide an annual savings of 37,000 kWh and 12 kW of demand and an annual cost savings of $2,400.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD/Replace Motor on Well 5 Pump	$17,000	$2,000	($45,000)	($26,000)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-14: Replace Older Transformers

Purpose: The transformers within the buildings have lower efficiencies than modern, energy efficient transformers. Replacing the transformers will save electricity.

Scope: Replace older dry-type transformers with energy efficient models.

- Well 3: Replace a 30 kVA transformer.
- Treatment Building: Replace a 45 kVA transformer.

Analysis: This ECO will reduce annual transformer losses by 15,600 kWh and 21 kW in demand, and provide an annual cost savings of $1,200.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Older Transformers	$16,500	$0	($22,200)	($5,700)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Last Chance Basin-15: Seal Cooling Louvers During Winter Months

Purpose: The cooling louvers are metal and provide a direct conductive path for heat to flow to the outdoors. The louver seals are poor, which allows infiltration. Installing removable, insulated panels during the winter months when cooling is not needed will reduce heating costs.

Scope: Install removable, insulated panels in the louver openings at wells 1, 2, 4, and 5.

Analysis: Insulating the louvers will save 1,049 kWh per year, reduce infiltration, and an annual cost savings of $100.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Insulate Louvers	$600	$0	($1,200)	($600)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Section 4

Salmon Creek Pump Station

INTRODUCTION

The Salmon Creek Pump Station has two buildings, the Point of Entry (POE) Building and the Treatment Building. The POE Building contains an emergency generator, soda ash mixing equipment, the POE vault, and a tool room. The Treatment Building consists of a pump room, control room, hypochlorite solution room, and treatment room with a lab.

The water from the Salmon Creek Dam flows into a wet well located under the Pump Station. The water is drawn out of the wet well by the pumps, it is treated with chlorine and transferred to the Salmon Creek Reservoir.

Energy Data

CBJ / AEL&P Agreement

The CBJ and AEL&P have an agreement to share the water from the Salmon Creek Dam to accommodate their electric power and water requirements. The essence of the agreement is that AEL&P has a right to generate power from all water stored behind the Salmon Creek Dam, but must pump 4.64 ft^3/sec (2,322 gpm) up to the Salmon Creek Reservoir. If the CBJ requires additional water, it must pay to pump the water from the tailrace. A summary of the 1984 agreement is as follows:

- AEL&P repaired the Salmon Creek Conduit from the Upper Powerhouse near the dam to the Lower Powerhouse adjacent to the Salmon Creek Pump Station. CBJ contributed $900,000 toward the repair.
- CBJ has a water right of 4.64 ft^3/sec (2,322 gpm) of pressurized water from the conduit delivered to the Salmon Creek Reservoir.
- At their option, AEL&P can pass the CBJ water right of 4.64 ft^3/sec (2,322 gpm) through the Salmon Creek Powerhouse and pay to pump the water from the powerhouse tailrace to the Salmon Creek Reservoir.
- The CBJ has a right to additional water from the powerhouse tailrace, but must pay the pumping costs.
- The agreement will expire in 2014.

The agreement does not provide information on the water rights of the parties or why the CBJ right to water from the pressurized conduit from Salmon Creek Reservoir was set at 2,322 gpm. The CBJ would have a substantial incentive to maximize water production from Salmon Creek if it had a larger right to pressurized water from the conduit.

CBJ Electric Bills

There are four electric meters on the building. One measures total consumption and the other three measure usage by each of the three pumps. AEL&P pays the first 3,124.2 kWh of pumping energy and the CBJ pays for additional pumping energy and all other usage (heat, treatment, lights, etc.).

AEL&P was not able to provide a basis for the 3,142.2 kWh credit amount. A calculation based on the installed pumps and motors (2,322 gpm @ 270' of head; η_p = 83%; η_m = 95%) determined that AEL&P should pay for 3598.5 kWh per day.

The CBJ portion of the electric use is billed under AEL&P's Rate 31, Small Government which charges for electrical consumption (kWh). There are no demand charges, even though the usage justifies the facility being on a demand rate. This is likely because the agreement does not provide a mechanism for assigning demand charges to either party.

Table 4-1: AEL&P Small Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh [2]	9.33¢	7.42¢
Service Charge per month	$18.80	$18.80

1. Currently, a Power Cost Adjustment of 1.2¢ per kWh is added to pay for diesel supplementation due to low hydroelectric water levels. That charge will end in a few months.

Electric Usage

Four years of electrical billing data was obtained from Alaska Electric Light & Power Company. The data and usage graphs are provided in Appendix A. On the average, AEL&P has paid for 73% of the energy consumed.

Total Energy Consumption

- From 2005 to 2008, consumption averaged 556,000 kWh per year.
- Energy use varies widely from month to month with no discernable pattern.
- Consumption varies from year to year as water production changes with system demand and turbidity levels.
- Consumption is highest in the beginning of the year, drops off during summer when Salmon Creek is often to turbid to be used as a water source, and is moderate during the fall and winter.

Total Electrical Demand

- From 2005 to 2008, demand has averaged 280 kW per month.
- Electric demand fluctuates widely from month to month, with up to three pumps operating simultaneously. The effective cost is 12.8¢/kWh which is much higher than Last Change Basin's cost of 8.6¢/kWh. The reason LCB has a lower effective cost is that usage and demand is more consistent from month to month.

CBJ Energy Usage and Costs

- From 2005 to 2008, consumption averaged 136,000 kWh per year.
- During 2007-2008, annual energy costs averaged $14,500 per year.
- The CBJ pays an effective cost of 10.2¢ per kWh.

BUILDINGS

The Salmon Creek Pump Station has two buildings, the Point of Entry (POE) Building and the Treatment Building.

Building Envelopes

Description

Table 4-2: Building Envelopes

Room	Description (inside to outside)	R-value	Remarks
Point of Entry Building			
Walls	Laminate panel; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping
Treatment Building			
Walls	Laminate panel; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping

Analysis

The buildings have similar insulation levels and are electrically heated at a current cost of 10.2¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board typically more than offsets the life cycle energy savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

Door weather-stripping can be installed or upgraded to seal the opening, minimizing infiltration. There is no economical way to replace doors and frames with thermally broken units.

Heating Systems

Description

The buildings are heated by electric heating units located in each room. All of the heaters are controlled by wall thermostats. The thermostat setpoints varied from 65°F to 75°F.

Analysis

Reducing the temperature to 55°F will save energy while insuring freeze protection and humidity control.

The thermostat in the POE tool room does not have temperature gradations that allow for accurately setting the temperature. Installing a temperature gage will provide operators a visual indication of room temperature.

The electric heaters are oversized. However, since there are no demand charges on the electric service, this oversizing does not result in unnecessary demand charges.

Ventilation Systems

Description

POE Building: The Soda Ash Room in the POE Building has a natural cooling system that consists of a louver. The louver does not close to reduce infiltration. The Generator Room in the POE Building has louvers for generator discharge and combustion air.

Treatment Building: The Pump Room in the Treatment Building has a ventilating unit that supplies outside air. It has a cooling coil that uses potable water to cool the air. The unit operates when the temperature exceeds the setpoint of 80°F. It rarely operates.

Analysis

The louvers are not insulated or thermally broken, which allows heat a direct conductive path to the outside. The cooling louvers should be sealed and insulated during winter months to minimize heat loss. The generator louvers should be permanently sealed and insulated until such time as the generator is returned to service.

Domestic Hot Water Heating

Description

POE Building: Two 50 gallon electric hot water heaters provide hot water for mixing soda ash.

Treatment Building: A 30 gallon electric water heater provides hot water for mixing hypochlorite solution. An instantaneous hot water heat supplies hot water to the lab.

Lighting

Description

Table 4-3: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
POE Building				
Interior	11 / Surface	2 / T12	Switch	-
Exterior	2 / Surface	1 / MH	Photocell	-
Treatment Building				
Interior	19/ Surface	2 / T12	Switch	-
Exterior	2 / Surface	1 / MH	Photocell	On during daylight

Analysis

The interior T12 lighting has a much lower efficacy than T8 lighting. However, the lighting is used a few hours each year and there is no economic incentive to upgrade the lighting.

The photocells are out of adjustment on one of exterior fixtures.

Transformers

Description

Each building is supplied with 480V power. A transformer is installed to step down the 480V building power to obtain 208V/120V power.

Table 4-4: Transformers

Pump Station	Size	Remarks
POE Building	24 kVA	Less efficient
Treatment Building	75 kVA	Less efficient

Analysis

The transformers are less efficient that current models.

Appliances

Description

The Treatment Building lab has a refrigerator and a freezer.

Analysis

The freezer is used to store ice but the ice is never used.

PROCESS

Description

The Salmon Creek Pump Station transfers water to the Salmon Creek Reservoir, which supplies the low elevation distribution system. There are three pumps that draw water from the wet well fed by AEL&P's Lower Powerhouse tailrace.

Table 4-5: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Pump 1	2,100	270	200
Pump 2	2,100	270	200
Pump 3	2,100	270	200

Sodium hypochlorite solution is produced on-site by dissolving salt in softened water, which results in a concentrated brine solution. The solution is electrolyzed and forms a sodium hypochlorite solution in water.

Soda ash is injected into the water to reduce its aggressiveness.

The water from the pumps is injected with chlorine and pumped to the Salmon Creek Reservoir which provides chlorine contact time. The water flows from the reservoir and is injected with soda ash prior to entering the low elevation system. The reservoir elevation over-pressurizes the low elevation system, so pressure reducing valves in the POE Building reduce to distribution pressure.

The SCADA system provides lead/lag/standby sequencing of the pumps to maintain the level in the reservoir. The SCADA maintains the flow from the reservoir to the distribution system at a manually set rate.

Analysis

Since the agreement with AEL&P essentially pays for the operation of the lead pump, there is no incentive to convert it to variable speed. However, if a substantial number lag pump operating hours occurs, there is incentive to convert one pump to variable speed so it can operate at slower flow rates for longer periods, saving energy.

Current operations are not taking full advantage of the 3,142 kWh per day that AEL&P must pay. If the Salmon Creek source is available 10 months of the year, this comes to 943,000 kWh per year. The pumps currently use 420,000 kWh per year, or approximately 45% of the "free" energy.

Motors

Description

Table 4-6: Motors

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	200	93.6%	96.2%	Less efficient
Pump 2	200	93.6%	96.2%	Less efficient
Pump 3	200	95.0%	96.2%	Less efficient
Soda Ash Pump	1	75.5%	85.5%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

Since AEL&P pays for the majority of the pumping, there is little incentive to upgrade the pump motors.

Upgrading the motor on the soda ash injection pump, which operates a significant number of hours, will reduce energy costs.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Salmon Creek-1: Turn Off Freezer

Purpose: The freezer in the Treatment Building lab stores ice that has no purpose. Turning off the freezer will save energy.

Scope: Turn off the freezer in the Treatment Building lab.

Recommendation: This ECO is recommended without additional analysis.

Salmon Creek-2: Set and Monitor Heating Setpoints

Purpose: The heating setpoints exceed the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset all heating thermostats at 55°F. This ECO is applicable to all heating thermostats.

Recommendation: This ECO is recommended without additional analysis. All heating units should be controlled from a separate wall thermostat with a setpoint of 55°F.

Salmon Creek-3: *Adjust Exterior Lighting Photocells*

Purpose: Several exterior light fixtures remain on during daylight hours. Adjusting or replacing the internal photocell on each fixture so the light turns off during daytime will save lighting energy.

Scope: Adjust or replace faulty exterior lighting photocells so the lamps are off during the day. This ECO is applicable to all buildings.

Recommendation: This ECO is recommended without additional analysis.

Salmon Creek-4: *Weather-strip Exterior Doors*

Purpose: The weather-stripping on many of the doors is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping. This ECO is applicable to nearly all doors.

Recommendation: This ECO is recommended without additional analysis.

Salmon Creek-5: *Replace Heating Thermostat*

Purpose: The heating units are most efficiently controlled from wall thermostats with temperature setpoint markings.

Scope: Replace thermostats where applicable so all heating units are controlled from wall mounted thermostats with temperature setpoints. This ECO is applicable to the POE Tool Room.

Analysis: This ECO is recommended without additional analysis.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Salmon Creek-6: *Seal Cooling and Emergency Generator Louvers*

Purpose: The louvers offer a direct conductive path for heat to flow to the outdoors. Sealing the louver with insulated panels will reduce heating costs. The insulated panel on the cooling louver should be removable so the louver can function during warmer weather.

Scope: Install insulated panels in the louver openings. This is applicable to the POE Building.

Analysis: Sealing the louvers will save 2,600 kWh in heating energy annually and provide an annual cost savings of $300.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Insulate Louvers	$1,200	$0	($5,700)	($4,500)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Salmon Creek-7: *Replace Soda Ash Motor*

Purpose: Motor efficiencies have improved in recent years due to national standards such as NEMA Premium® MG-1. Replacing less efficient motors with NEMA Premium® motors will reduce energy costs.

Scope: Replace inefficient motors with NEMA Premium® MG-1compliant efficient motors. This ECO is applicable to the soda ash motor. There is no incentive to upgrade the pump motors because AEL&P pays the majority of the pumping costs.

Analysis: Replacing the soda ash motor will reduce energy consumption by 846 kWh for an annual savings of $100.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Soda Ash Motor	$600	$0	($1,900)	($1,300)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

Salmon Creek-8: *Replace Older Transformers*

Purpose: The transformers within the buildings have lower efficiencies than modern, energy efficient transformers. Replacing the transformers will save electricity.

Scope: Replace older dry-type transformers with newer energy efficient models.

- POE Building: Replace a 24 kVA transformer.
- Pump Station: Replace a 75 kVA transformer.

Analysis: This ECO will reduce annual transformer losses by 19,400 kWh and 2 kW in demand and provide an annual cost savings of $2,300.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Older Transformers	$15,700	$0	($42,600)	($26,900)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Low Priority Energy Conservation Opportunities

Low priority energy conservation opportunities do not offer a life cycle energy savings and are not recommended.

Salmon Creek-9: *Maximize AEL&P Paid Pumping*

Purpose: The CBJ is utilizing only 45% of the pumping energy that AEL&P is obligated to pay under their agreement (assuming the Salmon Creek source is available for 10 months of the year). Increasing water production from Salmon Creek will save energy costs.

Scope: Maximize the AEL&P benefit by operating the pumps for 24 pump-hours each day.

Analysis: Maximizing the AEL&P paid pumping will use an additional 523,000 kWh. This will displace production at Last Chance Basin with an annual cost savings of $33,000 and a life cycle energy savings of $153,000 until the agreement expires in 2014.

This ECO is not achievable due to systemic limitations on how much water can be supplied by Salmon Creek. An analysis to determine if Salmon Creek production can be increased is beyond the scope of this energy audit. However, there is financial incentive to evaluate if changes in the distribution system can be made to increase Salmon Creek production.

Recommendation: This ECO is not recommended because it is not feasible to increase Salmon Creek production. It is recommended that an evaluation be performed to determine if changes in the distribution system can be made to increase Salmon Creek production.

Section 5

Crow Hill Pump Station

INTRODUCTION

The Crow Hill Pump Station consists of two pumps that supply water from the low elevation distribution system to the Crow Hill Reservoir, which supplies the high elevation areas in Douglas.

Energy Data

The Pump Station is billed for electricity under AEL&P's Rate 91, Off-Peak Service which has two different rate structures. During peak hours of 6:00 am to 10:00 pm, both electrical consumption (kWh) and peak electric demand (kW) are billed. During off-peak hours of 10:00 pm to 6:00 am, only electrical consumption (kWh) is charged. Electrical consumption is the amount of energy consumed and electric demand is the rate of consumption. AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand. Table 5-1 lists the current electric charges:

Table 5-1: AEL&P Off Peak Service Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Service Charge per month	$26.12	$26.12
Off-Peak (10:00 pm to 6:00 am)		
Energy Charge per kWh	6.14¢	6.14¢
On-Peak (6:00 am to 10:00 pm)		
Energy Charge per kWh	4.93¢	4.62¢
Demand Charge per kW	$11.53	$7.35

1. Currently, a Power Cost Adjustment of 1.2¢ per kWh is added to pay for diesel supplementation due to low hydroelectric water levels. That charge will end in a few months.

The Off-peak Rate has higher energy costs, which are typically more than offset by the lack of demand charges. Thus, the off-peak rate can offer savings if most of the load is shifted to off-peak hours. Unfortunately, the pumps are being operated during on-peak hours causing the station to incur the same demand charges as the firm power rate. In addition, several vaults and the Crow Hill reservoir are also powered from the Pump Station. Heaters at these sites also increase the on-peak energy and demand charges. AEL&P billing records show an average of 5,000 kWh on-peak and 9,000 kWh off-peak.

When loads are operated during peak hours, regular demand charges are assessed, negating the primary benefit of the off-peak rate. This is causing the Off-peak Rate to cost more than the regular rate. The energy costs for the pump station under the different rates are:

- All Loads Shifted to Off-peak Rate: $10,300
- Regular Rates: $14,900
- Current Operating Strategy (On-peak and Off-peak Loads): $15,700 per year

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- From 2005 to 2008, consumption averaged 148,500 kWh per year.
- Consumption has decreased from 2005 to 2208, which indicates that less water is being pumped.
- Energy consumption is highest in the winter due to water use for freeze protection.

Electrical Demand

- From 2005 to 2008, demand averaged 48 kW per month.
- The demand was very inconsistent. This is likely due to irregularities in pump testing and the electric heating loads of the vaults and reservoir.

Costs

- During 2007-2008, annual energy costs averaged $15,700 per year.
- The monthly electric bill has the following breakdown.

  1. Energy consumption (kWh) = 55%
  2. Electrical demand (kW) = 37%
  3. Customer charges = 8%

- Electricity has an effective cost (sum of energy and demand charges) of 11.0¢ per kWh.
- The pump station has an annual load factor 34%. This is the ratio of the average load (kW) to the peak load (kW). This is a low load factor that indicates the pumps are not operated many hours, but they have a high load when they are operated. A low load factor causes demand charges to make up a disproportionately high portion of the electric bill.

BUILDING

Envelope

Description

Table 5-2: Building Envelope

Component	Description (inside to outside)	R-value	Remarks
Walls	Gyp. Bd; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	Low R-value
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping

Analysis

Insulation levels are not optimal for electric heating at a current cost of 11.0¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board typically more than offsets the life cycle energy savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

Door weather-stripping can be installed or upgraded to seal the opening, minimizing infiltration. There is no economical way to replace doors and frames with thermally broken units.

Heating System

Description

The building is heated by two 5 kW electric heating units controlled by a wall thermostat set at 80°F.

Analysis

The thermostat setpoint was extremely high. Reducing the temperature to 55°F will save energy while maintaining a warm enough temperature to keep the humidity low.

The electric heaters are oversized.

Table 5-3: Heating Units

Building	Capacity, kW	Heat Loss, kW	Oversized, kW
Crow Hill PS	10	4	6

Cooling System

Description

The building has a natural cooling system consisting of a cabinet exhaust fan and a makeup air louver with automatic damper. The same thermostat that controls the heaters operates the exhaust fan and opens the damper when the temperature exceeds the setpoint.

Analysis

The relief air louver is not insulated or thermally broken, which allows heat a direct conductive path to the outside.

Lighting

Description

Table 5-4: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Interior	9 / Surface	2 / T12	Switch	Inefficient
Exterior	2 / Surface	1 / MH	Photocell	-

Analysis

The interior T12 lighting has a much lower efficacy than T8 lighting. However, the lighting is used only a few hours each year and there is no economic incentive to upgrade the lighting.

Transformer

Description

The building is supplied with 480V power for the pumps. A 7.5 kVA transformer is installed to step down the 480V building power to obtain 208V/120V power.

PROCESS

Description

The Crow Hill Pump Station supplies the Crow Hill Reservoir and the high elevation distribution system in Douglas. There are two pumps, operated in a lead/standby configuration.

Table 5-5: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Pump 1	400	375	60
Pump 2	400	375	60

Each pump has a downstream pressure reducing valve that reduces the pump outlet pressure to system pressure. Typical pressure drop across each flow control valve is 15 psig.

The SCADA system sequences the pumps to fill the reservoir each night. This operating sequence was set up to take advantage of AEL&P's off-peak rate.

Analysis

The reason for using PRVs to limit the pump output is not apparent. The valves essentially dissipate pumping energy that could be utilized to increase flow rate and fill the reservoir quicker.

If the PRVs are used to limit flow, the amount of lost energy can be reduced by optimally sizing the pumps so there is minimal excess head at the pump discharge. Another solution is to use variable frequency drives (VFDs) to control the speed of each pump to match the system pressure and flow requirements. This will allow the pumps to fill the reservoir over a longer period, reducing both pumping energy and demand charges.

Motors

Description

Table 5-6: Motor Table

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	60	91.0%	95.0%	Less efficient
Pump 2	60	91.0%	95.0%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are not as efficient as current standards. Replacing the motors with NEMA Premium® efficient motors will reduce energy consumption and demand charges.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Crow Hill-1: *Change the Electric Rate*

Purpose: The Pump Station is on the Off-peak Rate but is not taking full advantage of the rate because there are significant on-peak loads and the pumps are tested on-peak. Both increase demand charges.

Scope: Change the electric rate to normal firm power.

Analysis: Electrical costs for the off-peak rate are $15,800 and per year. If the pump station was on normal firm rates, the costs would be $14,900 per year. Putting the pump station on normal firm power rates will save $900 per year.

Recommendation: Change the electric billing rate from off-peak to the normal firm power rate (Schedule 34 – Large Government).

Crow Hill-2: *Set and Monitor Heating Setpoints*

Purpose: The heating setpoint exceeds the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset the heating thermostat to 55°F.

Recommendation: This ECO is recommended without additional analysis.

Crow Hill-3: *Weather-strip Exterior Doors*

Purpose: The weather-stripping on the door is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping.

Recommendation: This ECO is recommended without additional analysis.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Crow Hill-4: *Replace Oversize Heaters*

Purpose: The electric heater is oversized, creating higher demand charges while delivering the same amount of heat as a properly sized heater. Demand charges will be reduced if properly sized heating units are installed.

Demand charges can be further reduced by installing two heaters, each sized for 50% of the heating load. The heaters will have separate thermostats so only one heater comes on most of the year.

Scope: Replace the oversized heating unit with two 50% heaters, each controlled from a separate thermostat. Set the heater setpoints at 58°F and 52°F to reduce demand charges during warmer months.

Analysis: Replacing the heating units will reduce annual demand by 82 kW and annual costs by $800.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Oversized Heating Unit	$1,100	$0	($14,900)	($13,800)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Crow Hill-5: *Seal Cooling Louvers During Winter Months*

Purpose: The cooling louver provides a direct conductive path for heat to flow to the outdoors. Installing removable, insulated panels during the winter months when cooling is not needed will reduce heating costs.

Scope: Install removable, insulated panels in the louver openings.

Analysis: Insulating the louvers will reduce annual heating energy by 647 kWh and annual energy costs by $40.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Seal Cooling Louvers During Winter Months	$100	$0	($800)	($700)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

The ECOs in this group are listed from highest to lowest priority.

Crow Hill-6: *Install VFDs and Replace Motors on Pumps*

Purpose: The pump motors are less efficient than NEMA Premium motors. The pumps operate at constant speed with a PRV on the pump discharge to supply water at the distribution pressure. Variable speed pumping will eliminate the loss of pump energy through the PRV and allow for longer reservoir fill times, decreasing piping friction and demand charges.

Scope: Upgrade the pump motors to NEMA Premium and install a VFD on each pump to allow variable speed operation.

Analysis: The pumps are operating at 400 gpm to fill the reservoir. A VFD will allow slower reservoir filling, which will reduce pipe friction and demand charges. The analysis is based on filling the reservoir at 200 gpm. The VFD and efficient motors will reduce annual energy use by 8,610 kWh, demand by 216 kW, and costs by $2,700.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD and Replace Motors on Pumps	$33,400	$2,300	($49,300)	($13,600)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Low Priority Energy Conservation Opportunities

Low priority energy conservation opportunities do not offer a life cycle energy savings and are not recommended.

Crow Hill-7: *Replace Pump Motors*

Purpose: Motor efficiencies have improved in recent years due to standards such as NEMA Premium MG-1. Replacing less efficient motors with NEMA Premium motor will reduce energy and demand costs.

Scope: Replace the pump motors with energy efficient motors.

Recommendation: This ECO is not recommended. ECO Crow Hill – 5 is recommended in its place.

Section 6

Cedar Park Pump Station

INTRODUCTION

The Cedar Park Pump Station consists of two pumps that supply water from the low elevation distribution system to the West Juneau Reservoir and the high elevation system in West Juneau.

Energy Data

Electricity is billed under AEL&P's Rate 34, Large Government, which charges for both electrical consumption (kWh) and peak electric demand (kW). Electrical consumption is the amount of energy consumed and electric demand is the rate of consumption. AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand.

Table 6-1: AEL&P Large Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh	4.93¢	4.62¢
Demand Charge per kW	$11.53	$7.35
Service Charge per month	$99.24	$99.24

1. Currently, a Power Cost Adjustment of 1.2¢ per kWh is added to pay for diesel supplementation due to low hydroelectric water levels. That charge will end in a few months.

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- From 2005 to 2007, consumption averaged 57,400 kWh per year.
- Consumption increased in 2008 to 74,000 kWh because a new area was added to the high elevation system.
- Usage is highest in the winter due to water use for freeze protection.

Electrical Demand

- From 2005 to 2008, demand has averaged 57 kW per month.
- The demand is very consistent.
- The monthly demand is 10 kW above the demand created by the pumps and other loads within the building. The site investigation failed to turn up the source of this load.

Costs

- During 2007-2008, annual energy costs averaged $11,600 per year.
- The monthly electric bill has the following breakdown.
  1. Energy consumption (kWh) = 36%
  2. Electrical demand (kW) = 54%
  3. Customer charges = 10%
- Electricity has an effective cost (sum of energy and demand charges) of 16.6¢ per kWh.
- The pump station has an annual load factor 15%. This is the ratio of the average load (kW) to the peak load (kW). This is a low load factor that indicates the pumps are not operated many hours, but they have a high load when they are operated.
- A low load factor causes demand charges to make up a disproportionately high portion of the electric bill.

BUILDING

Envelope

Description

Table 6-2: Building Envelope

Component	Description (inside to outside)	R-value	Remarks
Aboveground wall	Gyp. Bd; 2" rigid; 8" concrete	R-10	Low R-value
Belowground wall	Gyp. Bd; 2" rigid; 8" concrete	R-10	Low R-value
Roof	Gyp. bd.; 2" rigid; 8" concrete	R-10	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping

Analysis

Insulation levels are not optimal for electric heating at the current cost of 16.6¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board typically more than offsets the life cycle energy savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

Door weather-stripping can be installed or upgraded to seal the opening, minimizing infiltration. There is no economical way to replace doors and frames with thermally broken units.

Heating System

Description

The building is heated by a 10 kW electric heating unit controlled by a wall thermostat set at 65°F.

Analysis

The thermostat setpoint is high. Reducing the temperature to 55°F will save energy while maintaining a warm enough temperature to keep the humidity low.

The electric heater is oversized.

Table 6-3: Heating Units

Building	Capacity, kW	Heat Loss, kW	Oversized, kW
Cedar Park PS	10	2	8

Cooling System

Description

The building has a natural cooling system consisting of an operable damper. A wall thermostat opens the damper when the temperature exceeds the setpoint.

Analysis

A single louver offers minimal cooling effect. If cooling is needed, a second louver that allows bottom to top cross flow is recommended.

The relief air louver is not insulated or thermally broken, which allows heat a direct conductive path to the outside.

Lighting

Description

Table 6-4: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Interior	3 / Surface	2 / T12	Switch	Inefficient
Interior	1 / Surface	2 / T12	On 24/7	Inefficient
Exterior	2 / Surface	1 / MH	Photocell	-

Analysis

The interior T12 lighting has a much lower efficacy than T8 lighting. However, most of the fixtures are only used a few hours each year and there is no economic incentive to upgrade the lighting. For no apparent reason, one fixture remains on continuously.

Transformer

Description

The building is supplied with 480V power for the pumps. A 10 kVA transformer is installed to step down the 480V building power to obtain 208V/120V power.

PROCESS

Description

The Cedar Park Pump Station supplies the West Juneau Reservoir and a high elevation distribution system in Douglas. There are two pumps, operated in a lead/standby configuration.

Table 6-5: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Pump 1	275	420	50
Pump 1	275	420	50

Each pump has a downstream PRV that reduces the pump outlet pressure to maintain the rated flow. Typical pressure drops across each flow control valve are 15 psig.

The SCADA system sequences the pumps in a lead/standby configuration to fill the reservoir each night.

Analysis

The reason for using PRVs to limit the pump output is not apparent. The valves essentially dissipate pumping energy that could be utilized to increase flow rate and fill the reservoir quicker.

If it is necessary to limit the flow rate, the amount of lost energy can be reduced by optimally sizing the pumps so there is minimal excess head at the pump discharge. Another solution is to use variable frequency drives (VFDs) to control the speed of each pump to match the system pressure and flow requirements. This will allow the pumps to fill the reservoir over a longer period, reducing both pumping energy and demand charges.

Motors

Description

Table 6-6: Motors

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	50	89.5%	94.5%	Less efficient
Pump 2	50	89.5%	94.5%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are not as efficient as current standards. Replacing the motors with NEMA Premium® efficient motors will reduce energy consumption and demand charges.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Cedar Park-1: Set and Monitor Heating Setpoints

Purpose: The heating setpoint exceeds the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset the heating thermostat to 55°F.

Recommendation: This ECO is recommended without additional analysis.

Cedar Park-2: Weather-strip Exterior Doors

Purpose: The weather-stripping on the door is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping.

Recommendation: This ECO is recommended without additional analysis.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Cedar Park-3: Replace Oversize Heaters

Purpose: The electric heating unit is oversized, creating higher demand charges while delivering the same amount of heat as a properly sized heater. The demand charges will be lower if a properly sized heater is installed.

Scope: Replace a 10 kW heater with a 2 kW heater.

Analysis: Replacing the heater will reduce annual demand charges by 96 kW and costs by $900.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Oversize Heaters	$500	$0	($17,400)	($16,900)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Cedar Park-4: Change Lighting Control

Purpose: One light fixture is on continuously for no apparent reason. Putting the fixture on the circuit controlled by the wall switch will save energy.

Scope: Place a light fixture on the circuit controlled by the wall switch.

Analysis: Turning off the fixture will reduce annual energy use by 828 kWh and cost by $50.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Control Light Fixture	$200	$0	($1,000)	($800)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Cedar Park-5: Seal Cooling Louver During Winter Months

Purpose: The cooling louver provides a direct conductive path for heat to flow to the outdoors. Installing removable, insulated panels during the winter months when cooling is not needed will reduce heating costs.

Scope: Install removable, insulated panels in the louver openings.

Analysis: Insulating the louver will reduce annual energy use by 216 kWh and cost by $15.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Insulate Louvers	$100	$0	($300)	($200)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

The ECOs in this group are listed from highest to lowest priority.

Cedar Park-6: Install VFD and Replace Motors on Pumps

Purpose: The pumps are constant speed pumps with less efficient motors that drop pressure through a PRV to deliver water at the distribution pressure. Replacing the motors and installing VFDs to convert to variable flow will reduce pumping energy and demand costs.

Scope: Replace the motors with NEMA Premium motors, install a VFD for each pump, and convert to variable speed pumping.

Analysis: The pumps are operating at 275 gpm to fill the reservoir. A VFD will allow slower reservoir filling, which will reduce pipe friction and demand charges. The analysis is based on filling the reservoir at 150 gpm. The VFD and efficient motors will reduce annual energy use by 6,700 kWh, demand by 216 kW, and cost by $2,500.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Install VFD/Replace Motor on Pumps	$31,000	$2,300	($47,000)	($13,700)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Low Priority Energy Conservation Opportunities

Low priority energy conservation opportunities do not offer a life cycle energy savings and are not recommended.

Cedar Park-7: Replace Pump Motors

Purpose: Motor efficiencies have improved in recent years due to standards such as NEMA Premium MG-1. Replacing less efficient motors with NEMA Premium motor will reduce energy and demand costs.

Scope: Replace the pump motors with energy efficient motors.

Recommendation: This ECO is not recommended. ECO Cedar Park – 4 is recommended in its place.

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Section 7

Bonnie Brae Pump Station

INTRODUCTION

The Bonnie Brae Pump Station consists of two pumps that supply water from the low elevation distribution system to the higher elevation system in Bonnie Brae Subdivision.

Energy Data

The Pump Station is billed for electricity under AEL&P's Rate 31, Small Government which charges for electrical consumption (kWh). Table 7-1 lists the current electric charges:

Table 7-1: AEL&P Small Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh	9.33¢	7.42¢
Service Charge per month	$18.80	$18.80

1. Currently, a Power Cost Adjustment of 1.2¢ per kWh is added to pay for diesel supplementation due to low hydroelectric water levels. That charge will end in a few months.

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- From 2005 to 2007, consumption averaged 14,600 kWh per year.
- Consumption was lower in 2005 but has been consistent from 2006 to 2008.
- Usage is highest in the winter due to water use for freeze protection.

Costs

- During 2007-2008, annual energy costs averaged $1,800 per year.
- Electricity has an effective cost of 11.5¢ per kWh.

BUILDING

Envelope

Description

Table 7-2: Building Envelope

Component	Description (inside to outside)	R-value	Remarks
Wall	Gyp. Bd; 3/12" batt, wood cladding	R-14	Low R-value
Roof	Gyp. bd.; 7-1/2" batt, ¾" plywood roof	R-22	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping

Analysis

Insulation levels are not optimal for electric heating at the current cost of 11.5¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board is prohibitive to obtaining a life cycle savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

There is no economical way to replace doors and frames with thermally broken units. Door weather-stripping should be installed or upgraded to seal the opening, minimizing infiltration.

Heating System

Description

The building is heated by a 6 kW electric heating unit controlled by an integral thermostat set at 62°F.

Analysis

The thermostat setpoint is high. Reducing the temperature to 55°F will save energy while maintaining a warm enough temperature to keep the humidity low.

Integral thermostats offer poor control of the heater because they do not have temperature graduations and are influenced by the heat output of the heater. Wall thermostats are recommended.

The electric heater is oversized. It is not creating excessive demand charges because the Pump Station is not on the demand rate.

Lighting

Description

Table 7-3: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Interior	4 / Surface	1 / 60W incandescent	Switch	Inefficient
Exterior	1 / Surface	1 / 60W incandescent	Photocell	Inefficient

Analysis

The interior incandescent lighting has a much lower efficacy than fluorescent T8 lighting. However, most of the fixtures are only used a few hours each year and there is no economic incentive to upgrade the lighting.

Transformer

Description

The building is supplied with 480V power for the pumps. A 15 kVA transformer is installed to step down the 480V building power to obtain 208V/120V power.

Analysis

The transformer is less efficient than current models.

PROCESS

Description

The Bonnie Brae Pump Station supplies the higher elevation areas of Bonnie Brae. There is no data available on the pumps and their capacity. System pressure is maintained by two hydro pneumatic tanks located within the Pump Station. Local controls sequence the pumps in a lead/lag configuration to maintain system pressure.

Analysis

The pumps typically operate for only 2 to 5 minutes each cycle. Since the station is not on the demand rate, this low load factor does not create excessive demand charges.

Motors

Description

Table 7-4: Motors

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	5	84.0%	89.5%	Less efficient
Pump 2	5	84.0%	89.5%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are not as efficient as current standards. Replacing the motors with NEMA Premium® efficient motors will reduce energy consumption and demand charges.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Bonnie Brae-1: Set and Monitor Heating Setpoints

Purpose: The heating setpoint exceeds the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset the heating thermostat to 55°F.

Recommendation: This ECO is recommended without additional analysis.

Bonnie Brae-2: Weather-strip Exterior Doors

Purpose: The weather-stripping on the door is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping.

Recommendation: This ECO is recommended without additional analysis.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

The ECOs in this group are listed from highest to lowest priority.

Bonnie Brae-3: Replace Older Transformer

Purpose: The transformer has a lower efficiency than modern, energy efficient transformers. Replacing the transformer will save electricity.

Scope: Replace older dry-type transformer with a newer energy efficient model.

Analysis: Replacing the transformer will reduce annual energy consumption by 3,900 kWh and cost by $400.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace 15 kW Transformer	$5,800	$0	($7,300)	($1,500)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Low Priority Energy Conservation Opportunities

Low priority energy conservation opportunities do not offer a life cycle energy savings and are not recommended.

Bonnie Brae-4: Replace Pump Motors

Purpose: Motor efficiencies have improved in recent years due to standards such as NEMA Premium MG-1. Replacing less efficient motors with NEMA Premium motor will reduce energy and demand costs.

Scope: Replace the pump motors with energy efficient motors.

Analysis: Replacing the moots will reduce annual energy use by 286 kWh and cost by $40. This is not sufficient savings to offset the cost of replacement.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Upgrade Pump Motors	$1,600	$0	($500)	$1,100

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is not recommended.

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Section 8

Mountain Side Pump Station

INTRODUCTION

The Mountain Side Pump Station consists of two pumps that supply water from the low elevation distribution system to the high elevation areas of Mountain Side Estates.

Energy Data

The Pump Station is billed for electricity under AEL&P's Rate 34, Large Government which charges for both electrical consumption (kWh) and peak electric demand (kW). Electrical consumption is the amount of energy consumed and electric demand is the rate of consumption. AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand. Table 8-1 lists the current electric charges:

Table 8-1: AEL&P Large Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh	4.93¢	4.62¢
Demand Charge per kW	$11.53	$7.35
Service Charge per month	$99.24	$99.24

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- From 2006 to 2008, consumption averaged 46,400 kWh per year.
- Consumption was consistent during this period.
- Usage is slightly higher in the winter due to water use for freeze protection.

Electrical Demand

- From 2005 to 2008, demand has averaged 10 kW per month.
- The demand is mostly consistent. There are a few months each year where it spikes, due to simultaneous operation of two or three pumps. This likely occurs during flushing of the water mains.

Costs

- During 2007-2008, annual energy costs averaged $5,200 per year.
- The monthly electric bill has the following breakdown.
  1. Energy consumption (kWh) = 57%
  2. Electrical demand (kW) = 20%
  3. Customer charges = 23%
- Electricity has an effective cost (sum of energy and demand charges) of 10.6¢ per kWh.
- The pump station has an annual load factor of 62%. This is the ratio of the average load (kW) to the peak load (kW). This is a high load factor that indicates the pumps are operating for long periods.
- This service could be changed to AEL&P Rate 31, Small Commercial with demand charges. This will reduce the effective cost to 9.0 ¢/kWh, saving $800 per year.

BUILDING

Envelope

Description

Table 8-2: Building Envelope

Component	Description (inside to outside)	R-value	Remarks
Walls	Gyp. Bd; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 3-1/2" rigid; 2x12 joists; plywood; metal	R-21	
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	Low R-value
Door	Insulated metal door and frame	R-2	No thermal break No weather-stripping

Analysis

Insulation levels are not optimal for electric heating at the current cost of 10.6¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board is prohibitive to obtaining a life cycle savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

There is no economical way to replace doors and frames with thermally broken units. Door weather-stripping should be installed or upgraded to seal the opening, minimizing infiltration.

Heating Systems

Description

The building is heated by two 3 kW electric heating units controlled by a wall thermostat set at 60°F.

Analysis

The thermostat setpoint is high. Reducing the temperature to 55°F will save energy while maintaining a warm enough temperature to keep the humidity low.

The electric heaters are oversized.

Table 8-3: Heating Units

Building	Capacity, kW	Heat Loss, kW	Oversized, kW
Mountain Side PS	6	4	2

Cooling Systems

Description

The building has a natural cooling system consisting of a cabinet exhaust fan and a makeup air louver with automatic damper. A wall thermostat operates the exhaust fan and opens the makeup damper when the temperature exceeds the setpoint.

Analysis

The relief air louver is not insulated or thermally broken, which allows heat a direct conductive path to the outside.

Lighting

Description

Table 8-4: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Interior	5 / Surface	2 / T8	Switch	-
Exterior	2 / Surface	1 / MH	Photocell	-

Transformer

Description

The building is supplied with 480V power for the pumps. A 15 kVA transformer is installed to step down the 480V building power to obtain 208V/120V power.

Analysis

The transformer is less efficient than current models.

PROCESS

Description

The Mountain Side Pump Station supplies the high elevation distribution system in Mountain Side Estates. There are three pumps, operated in a lead/lag/standby configuration.

Table 8-5: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Pump 1	200	125	10
Pump 2	200	125	10
Pump 3	200	125	10

System pressure and flow is maintained by continuous pump operation. Pumps 1 and 2 are variable speed pumps controlled by VFDs. Pump 3 is a constant speed pump.

The SCADA system operates the pumps in a lead/lag/standby configuration to maintain distribution pressure. Pumps 1 and 2 alternate lead/lag positions, with their speed controlled to maintain pressure. Pump 3 is always the standby pump and operates only during fire flows.

Analysis

Distribution flow rates are often less than the minimum capacity of the pumps, especially during nighttime. The VFDs turn down to minimum speed during these periods.

Motors

Description

Table 8-6: Motor Table

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	10	85.7%	91.7%	Less efficient
Pump 2	10	85.7%	91.7%	Less efficient
Pump 3	10	85.7%	91.7%	Less efficient

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are not as efficient as current standards. Replacing the motors with NEMA Premium® efficient motors will reduce energy consumption and demand charges.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Mountain Side-1: *Change the Electric Rate*

Purpose: The pump station is currently on the Large Government Rate (Rate 34). It is eligible to be on Small Government Rate 31, which would result in a lower cost per kWh.

Scope: Change the electric service to AEL&P Rate 31, Small Government.

Analysis: Changing the electric rate will reduce annual costs by $800.

Recommendation: This ECO is recommended.

Mountain Side-2: *Set and Monitor Heating Setpoints*

Purpose: The heating setpoint exceeds the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset the heating thermostat to 55°F.

Recommendation: This ECO is recommended without additional analysis.

Mountain Side-3: *Weather-strip Exterior Doors*

Purpose: The weather-stripping on the door is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping.

Recommendation: This ECO is recommended without additional analysis.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Mountain Side-4: *Replace Oversized Heaters*

Purpose: The electric heating units are oversized, creating higher demand charges while delivering the same amount of heat as a properly sized heater. Reduce demand charges by replacing the oversized heaters with two properly sized heaters, each with separate thermostat.

Scope: Replace the oversized heating unit with a 2 kW heater. Install a second 2 kW heater with separate thermostat. Set the heater setpoints at 58°F and 52°F to reduce demand charges during warmer months.

Analysis: Replacing the heaters will reduce annual energy demand by 34 kW and cost by $300.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Oversized Heaters	$1,100	$0	($5,600)	($4,500)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

The ECOs in this group are listed from highest to lowest priority.

Mountain Side-5: *Seal Cooling Louvers During Winter Months*

Purpose: The cooling louver provides a direct conductive path for heat to flow to the outdoors. Installing removable, insulated panels during the winter months when cooling is not needed will reduce heating costs.

Scope: Install removable, insulated panels in the louver openings.

Analysis: Insulating the louvers will reduce annual energy use by 359 kWh and cost by $20.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Seal Cooling Louver During Winter Months	$200	$0	($400)	($200)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Low Priority Energy Conservation Opportunities

Low priority energy conservation opportunities do not offer a life cycle energy savings and are not recommended.

Mountain Side-6: Replace Older Transformer

Purpose: The transformer has a lower efficiency than modern, energy efficient transformers. Replacing the transformers will save electricity.

Scope: Replace a less efficient 15 kW transformer.

Analysis: Replacing the transformer will reduce annual energy use by 3,900 kWh, demand by 5.4 kW, and cost by $300. The energy cost savings is insufficient to offset the cost of replacement.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Transformer	$5,800	$0	($5,600)	$200

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is not recommended.

Mountain Side-7: Replace Pump Motors

Purpose: Motor efficiencies have improved in recent years due to standards such as NEMA Premium MG-1. Replacing less efficient motors with NEMA Premium motor will reduce energy and demand costs.

Scope: Replace the pump motors with energy efficient motors.

Analysis: Replacing the pump motors will reduce annual energy use by 376 kWh and cost by $24. The energy cost savings is insufficient to offset the cost of replacement.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Pump Motors	$2,300	$0	($500)	$1,800

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is not recommended.

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Section 9

Lena Loop Pump Station

INTRODUCTION

The Lena Loop Pump Station consists of two pumps that supply water to the Lena Loop Reservoir which distributes water to areas at the end of the distribution system.

Energy Data

The Pump Station is billed for electricity under AEL&P's Rate 31, Small Government which charges for both electrical consumption (kWh) and peak electric demand (kW). Electrical consumption is the amount of energy consumed and electric demand is the rate of consumption. AEL&P determines the electric demand by averaging demand over a continuously sliding fifteen-minute window. The highest fifteen-minute average during the billing period determines the peak demand. The following table lists the current electric charges:

Table 9-1: AEL&P Small Government Rate

Charge [1]	On-peak (Nov-May)	Off-peak (June-Oct)
Energy Charge per kWh	5.36¢	4.75¢
Demand Charge per kW	$10.27	$6.87
Service Charge per month	$27.16	$27.16

Four years of electrical energy usage data was obtained from AEL&P. The data and usage graphs are provided in Appendix A

Energy consumption

- Consumption was 34,400 kWh in 2008.
- Consumption has decreased significantly the past two years. There is no explanation for the drop.
- Usage is highest in the winter due to water use for freeze protection.

Electrical Demand

- From 2005 to 2008, demand has averaged 15 kW per month.
- The demand is very inconsistent. This is due to operation of the two electric heaters, which have a combined load that is greater than the lead pump.

Costs

- During 2007-2008, annual energy costs averaged $4,300 per year.
- The monthly electric bill has the following breakdown:
  1. Energy consumption (kWh) = 53%
  2. Electrical demand (kW) = 39%
  3. Customer charges = 8%
- Electricity has an effective cost (sum of energy and demand charges) of 12.1¢ per kWh.
- The pump station has an annual load factor 37%. This is the ratio of the average load (kW) to the peak load (kW). This is a low load factor that indicates the pumps are not operated many hours, but they have a high load when they are operated. A low load factor causes demand charges to make up a disproportionately high portion of the electric bill.

BUILDING

Envelope

Description

Table 9-2: Building Envelope

Component	Description (inside to outside)	R-value	Remarks
Walls	Gyp. Bd; 1-1/2" rigid; 8" CMU	R-7	Low R-value
Roof	Gyp. bd.; 12 batt in attic	R-30	Low R-value
Floor slab	Concrete slab-on-grade	R-2	No insulation
Perimeter	Concrete footing; 2" rigid, inside face	R-10	Low R-value
Door	Insulated metal door and frame	R-2	No frame thermal break No weather-stripping

Analysis

Insulation levels are not optimal for electric heating at the current cost of 12.1¢ per kWh.

The walls and roofs are under insulated. Insulation can be added but the cost of removing items from the surfaces, adding insulation, and installing wall board is prohibitive to obtaining a life cycle savings.

The floor slabs are under insulated. However, there is no economical way to add insulation to the floor slabs.

There is no economical way to replace doors and frames with thermally broken units. Door weather-stripping should be installed or upgraded to seal the opening, minimizing infiltration.

Heating Systems

Description

The building is heated by two 7.5 kW electric heating units with integral thermostats set at 70°F.

Analysis

The thermostat setpoint is extremely high. Reducing the temperature to 55°F will save energy while maintaining a warm enough temperature to keep the humidity low.

The electric heaters are oversized.

Table 9-3: Heating Units

Building	Capacity, kW	Heat Loss, kW	Oversized, kW
Lena Loop PS	15	7	8

Cooling Systems

Description

The building has a natural cooling system consisting of an exhaust fan that discharges through an exhaust louver and automatic damper. There is no makeup air louver. A wall thermostat, set at 80°F, operates the fan and opens the damper.

Analysis

The relief air louver is not insulated or thermally broken, which allows heat a direct conductive path to the outside. The automatic damper hangs open. The lack of a makeup air louver causes the fan to draw humid makeup air through cracks in the envelope.

Lighting

Description

Table 9-4: Lighting Fixtures and Lamps

Room	Fixture No. / Type	Lamp No. / Type	Control	Remarks
Interior	12 / Surface	2 / T8	Switch	-
Exterior	2 / Surface	1 / MH	Photocell	-

Transformer

Description

The building is supplied with 480V power for the pumps. A 30 kVA transformer is installed to step down the 480V building power to obtain 208V/120V power.

Analysis

The transformer meets the energy efficiency requirements of NEMA Standard TP 1-2001.

PROCESS

Description

The Lena Loop Pump Station supplies the Lena Loop Reservoir, which serves areas at the end of the distribution system. There are two pumps operate in a lead/standby configuration.

Table 9-5: Pumps

Pump	Flow, GPM	Head, ft	Motor HP
Pump 1	250	68	10
Pump 2	250	68	10

The pumps are variable speed with VFD controllers. The SCADA system sequences the pumps in a lead/lag configuration to maintain the reservoir elevation. Speed controls have been disabled.

Analysis

The system is not making optimal use of the VFDs to fill the reservoir slowly, saving energy and demand charges.

Motors

Description

Table 9-6: Motor Table

Service	Horsepower	Efficiency	New Efficiency [1]	Remarks
Pump 1	10	91.7%	91.7%	Efficient motor
Pump 2	10	91.7%	91.7%	Efficient motor

1. New motor efficiency is based on NEMA Premium® MG-1 efficiency motors.

Analysis

The pump motors are energy efficient.

ENERGY CONSERVATION OPPORTUNITIES

Behavioral or Operational Energy Conservation Opportunities

Top priority should be given to the following behavioral or operational ECOs that require minimal investment and offer immediate savings. The ECOs in this group are listed from highest to lowest priority.

Lena Loop-1: *Set and Monitor Heating Setpoints*

Purpose: The heating setpoint exceeds the temperature needed for freeze protection and humidity control. Establishing a consistent setpoint of 55°F will save energy and provide operating personnel a consistent standard to follow.

Scope: Reset the heating thermostat to 55°F.

Recommendation: This ECO is recommended without additional analysis.

Lena Loop-2: *Weather-strip Exterior Doors*

Purpose: The weather-stripping on the door is poor or does not exist. Adding weather-stripping will reduce heat loss and minimize infiltration of damp air into the building.

Scope: Replace or add door weather-stripping.

Recommendation: This ECO is recommended without additional analysis.

High Priority Energy Conservation Opportunities

High priority energy conservation opportunities provide a high life cycle savings for the relative investment. The ECOs in this group are listed from highest to lowest priority.

Lena Loop-3: *Restore Variable Speed Pumping*

Purpose: The pumps have VFD controllers but the speed controls have been disabled. Variable speed pumping will minimize the pumping energy lost to pipe friction, decrease demand charges, and improve the load factor, effectively decreasing the cost of power per kWh.

Scope: Restore variable speed operation of the pumps.

Analysis: The pumps are operating at an average of 172 gpm to fill the reservoir. VFD pump control will allow slower reservoir filling, which will reduce pipe friction and demand charges. The analysis is based on filling the reservoir at 86 gpm. Variable speed operation will reduce annual energy use by 702 kWh, demand by 24 kW, and energy cost by $258.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Restore Variable Speed Pumping	$0	$0	($4,700)	($4,700)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Lena Loop-4: *Replace Oversize Heaters*

Purpose: The electric heating units are oversized, creating higher demand charges while delivering the same amount of heat as a properly sized heater. Reduce demand charges by replacing the oversized heaters with two properly sized heaters, each with separate thermostat.

Scope: Replace the two oversized heating units with two 2 kW heater. Install a third 3 kW heater with separate thermostat. Set the two 2 kW heater setpoints at 58°F and 55°F and set the 3 kW heater setpoint at 52°F to reduce demand charges during warmer months.

Analysis: Replacing the heaters will reduce annual demand charges by 128 kW and energy cost by $1,250.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Replace Oversize Heaters	$1,600	$0	($21,000)	($19,400)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Medium Priority Energy Conservation Opportunities

Medium priority energy conservation opportunities provide life cycle energy savings that exceed the investment cost required to implement the change. These ECOs have a lower priority because the cost of implementation is high or the savings is minimal.

The ECOs in this group are listed from highest to lowest priority.

Lena Loop-5: *Seal Cooling Louvers During Winter Months*

Purpose: The cooling louver provides a direct conductive path for heat to flow to the outdoors. Installing removable, insulated panels during the winter months when cooling is not needed will reduce heating costs.

Scope: Install removable, insulated panels in the louver openings.

Analysis: Insulating the louvers will reduce annual energy use by 108 kW and energy costs by $30.

Energy Conservation Opportunity	Construction	Maintenance	Energy	Total LCC
Seal Cooling Louver During Winter Months	$100	$0	($100)	($0)

Note: Negative numbers, in parenthesis, represent savings.

Recommendation: This ECO is recommended.

Appendix A

Energy Use Data

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Electric Use Data

March 9, 2009

Last Chance Basin Well Field

ELECTRIC RATE

AEL&P Electric Rate 34	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0493	0.0462
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	99.24	99.24
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Jan	67,000	191	89,040	219	106,240	241	122,680	229
Feb	74,480	208	111,640	225	128,800	234	107,160	213
Mar	66,040	208	115,320	225	136,280	243	107,920	222
Apr	71,000	166	93,000	232	95,960	243	102,040	208
May	75,040	246	77,080	212	118,400	228	112,760	225
Jun	95,320	220	94,320	236	119,080	238	136,880	226
Jul	74,720	226	105,640	235	97,840	234	119,320	223
Aug	85,800	230	109,440	227	129,960	233	118,240	224
Sep	79,480	239	90,080	239	116,200	229	94,240	218
Oct	104,440	235	109,160	242	95,400	223	82,200	215
Nov	93,200	209	112,120	209	94,200	197	81,520	193
Dec	99,760	221	115,360	218	107,480	214	92,200	212
Total	986,280		1,222,200		1,345,840		1,277,160	
Average	82,190	217	101,850	227	112,153	230	106,430	217
Load Factor	52.0%		61.6%		66.9%		67.1%	

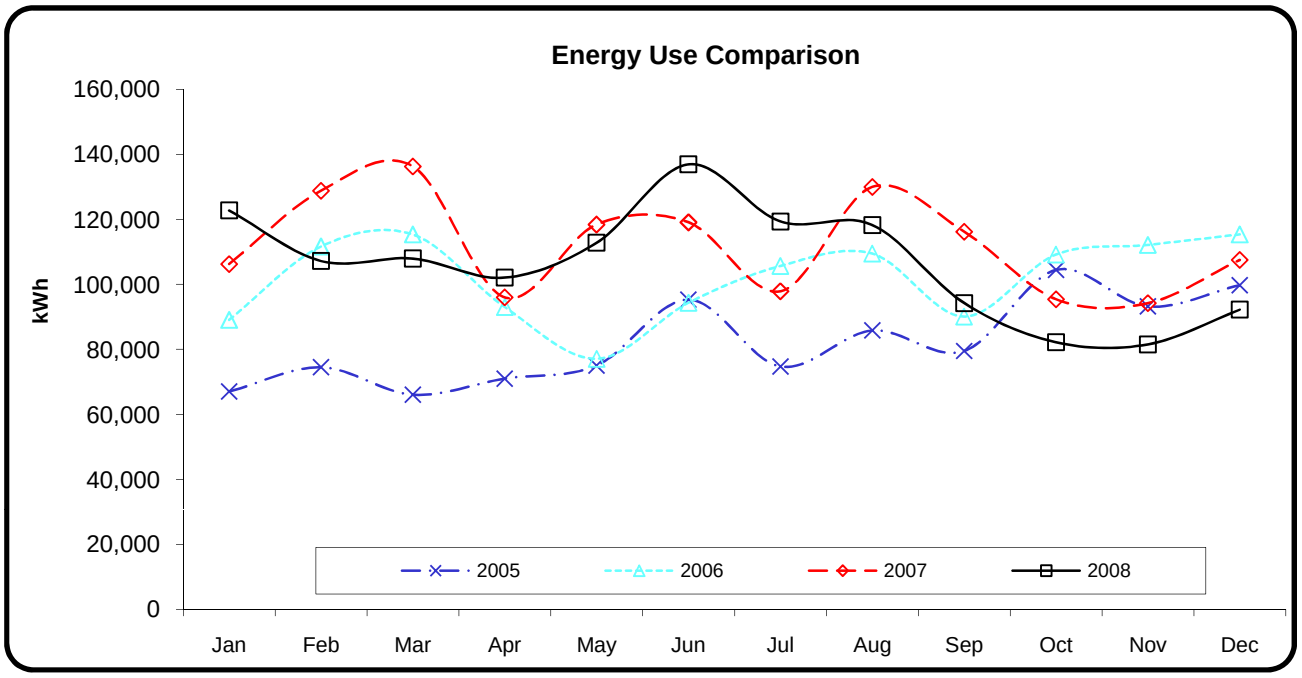
ELECTRIC BILLING DETAILS

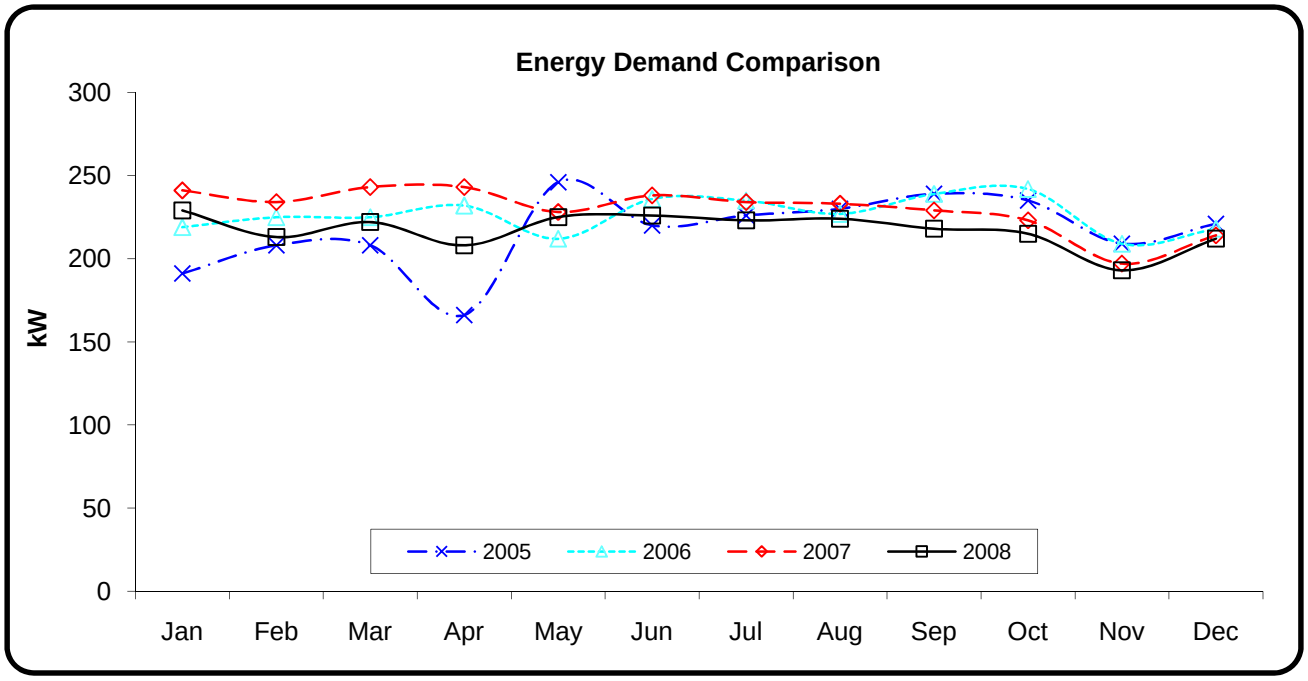
Electrical costs are based on the current electric rates.

Month	2007				2008				
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	% Change
Jan	6,555	2,779	99	9,433	7,569	2,640	99	10,309	9.3%
Feb	7,947	2,698	99	10,744	6,612	2,456	99	9,167	-14.7%
Mar	8,408	2,802	99	11,309	6,659	2,560	99	9,317	-17.6%
Apr	5,921	2,802	99	8,822	6,296	2,398	99	8,793	-0.3%
May	7,305	2,629	99	10,033	6,957	2,594	99	9,651	-3.8%
Jun	6,978	1,749	99	8,827	8,021	1,661	99	9,781	10.8%
Jul	5,733	1,720	99	7,552	6,992	1,639	99	8,730	15.6%
Aug	7,616	1,713	99	9,427	6,929	1,646	99	8,674	-8.0%
Sep	6,809	1,683	99	8,592	5,522	1,602	99	7,224	-15.9%
Oct	5,590	1,639	99	7,329	4,817	1,580	99	6,496	-11.4%
Nov	5,812	2,271	99	8,183	5,030	2,225	99	7,354	-10.1%
Dec	6,631	2,467	99	9,198	5,689	2,444	99	8,232	-10.5%
Total	$ 81,306	$ 26,952	$ 1,191	$ 109,449	$ 77,092	$ 25,447	$ 1,191	$ 103,730	-5.2%
Average	$ 6,775	$ 2,246	$ 99	$ 9,121	$ 6,424	$ 2,121	$ 99	$ 8,644	-5.2%
Cost ($/kWh)				0.0813				0.0812	-0.1%

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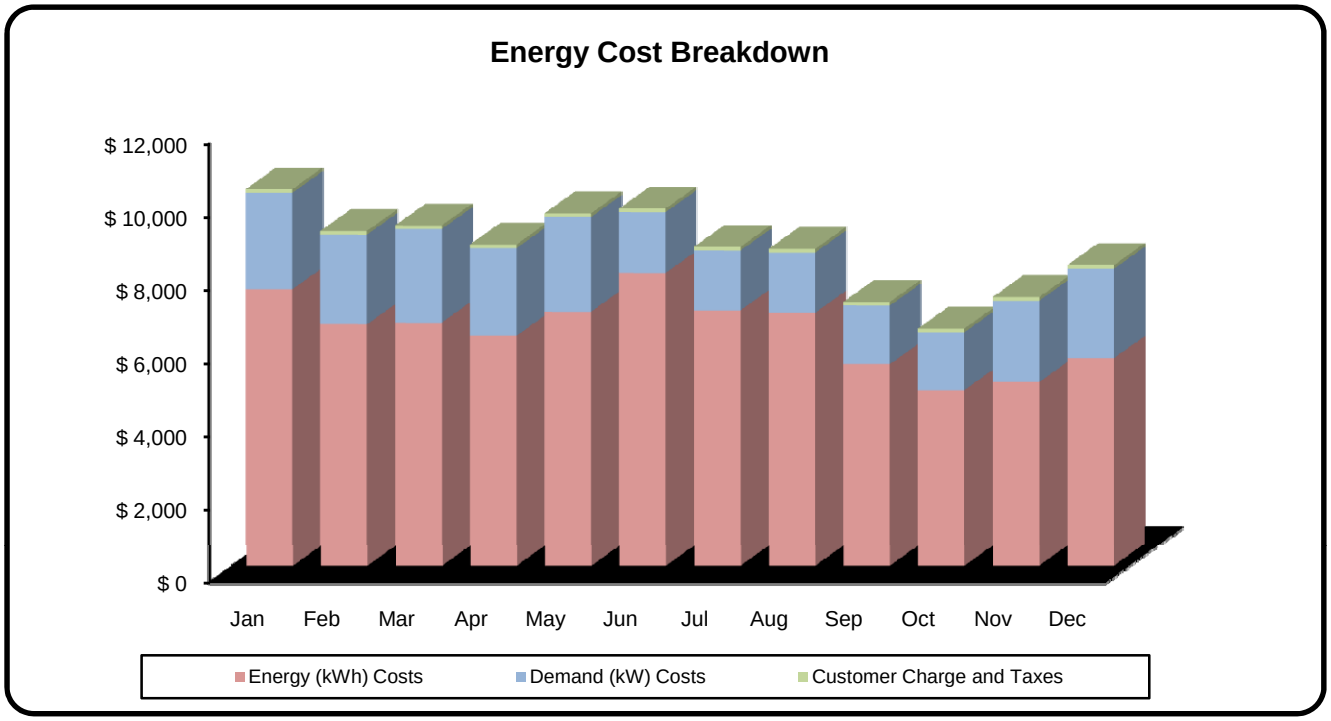
Last Chance Basin Well Field

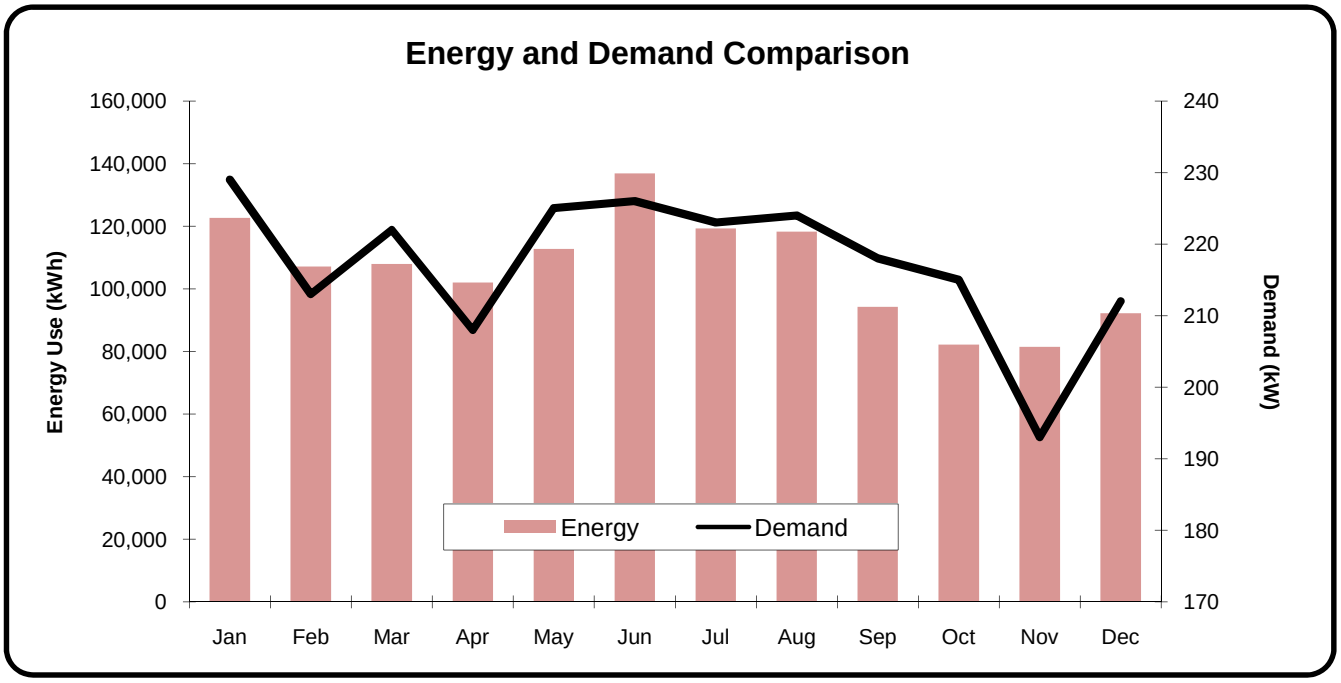




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Last Chance Basin Well Field





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Electric Use Data

March 10, 2009

Salmon Creek Pump Station

ELECTRIC RATE

AEL&P Electric Rate 34	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0493	0.0462
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	99.24	99.24
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Jan	0		10,720	30	67,520	331	36,480	323
Feb	80,960	200	13,280	32	18,400	189	60,960	466
Mar	77,600	192	14,240	304	25,280	331	69,760	194
Apr	71,520	187	70,080	317	69,760	325	56,480	186
May	70,720	307	57,120	314	56,800	454	28,800	314
Jun	63,680	317	51,840	325	55,200	320	3,360	22
Jul	69,280	298	67,200	318	79,200	443	2,080	8
Aug	58,400	301	64,800	315	37,120	443	49,440	312
Sep	67,680	314	68,160	310	61,600	437	73,760	171
Oct	6,240	173	15,840	293	44,640	440	54,400	171
Nov	21,440	310	8,160	29	46,720	269	37,120	304
Dec	40,960	299	56,480	454	34,560	451	30,080	318
Total	628,480		497,920		596,800		502,720	
Average	52,373	263	41,493	253	49,733	369	41,893	232
Load Factor	27.2%		22.4%		18.4%		24.7%	

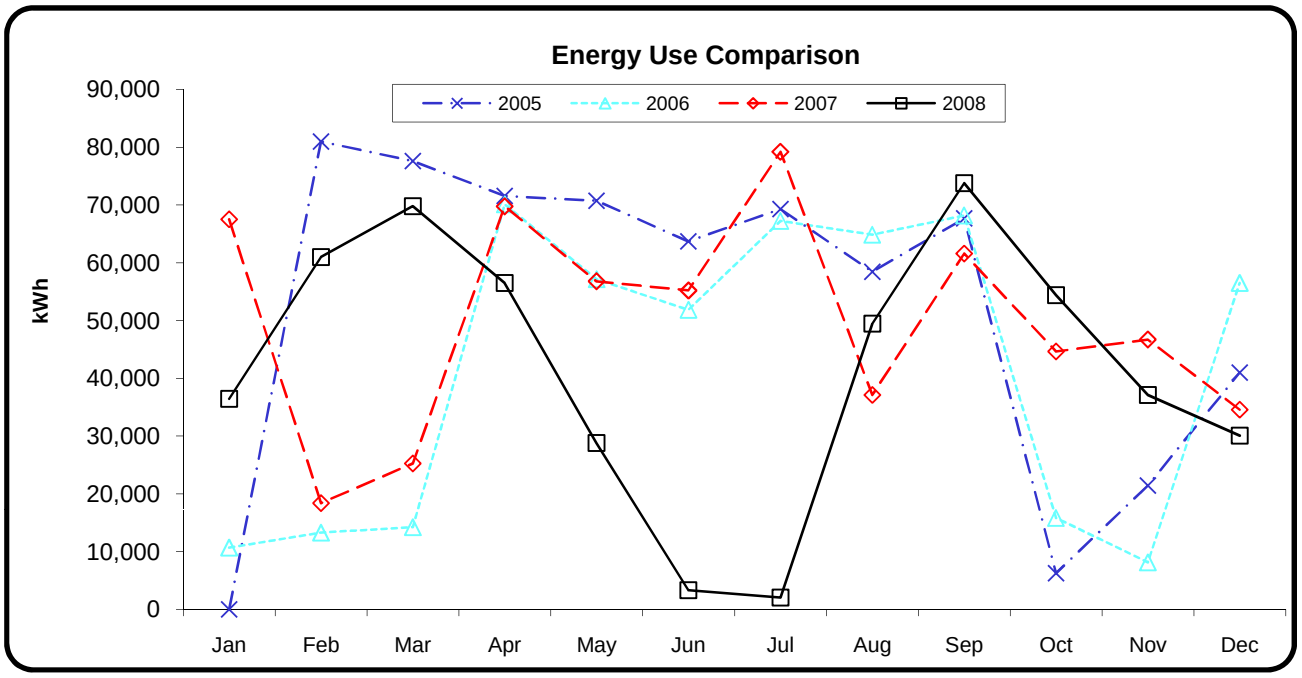
ELECTRIC BILLING DETAILS

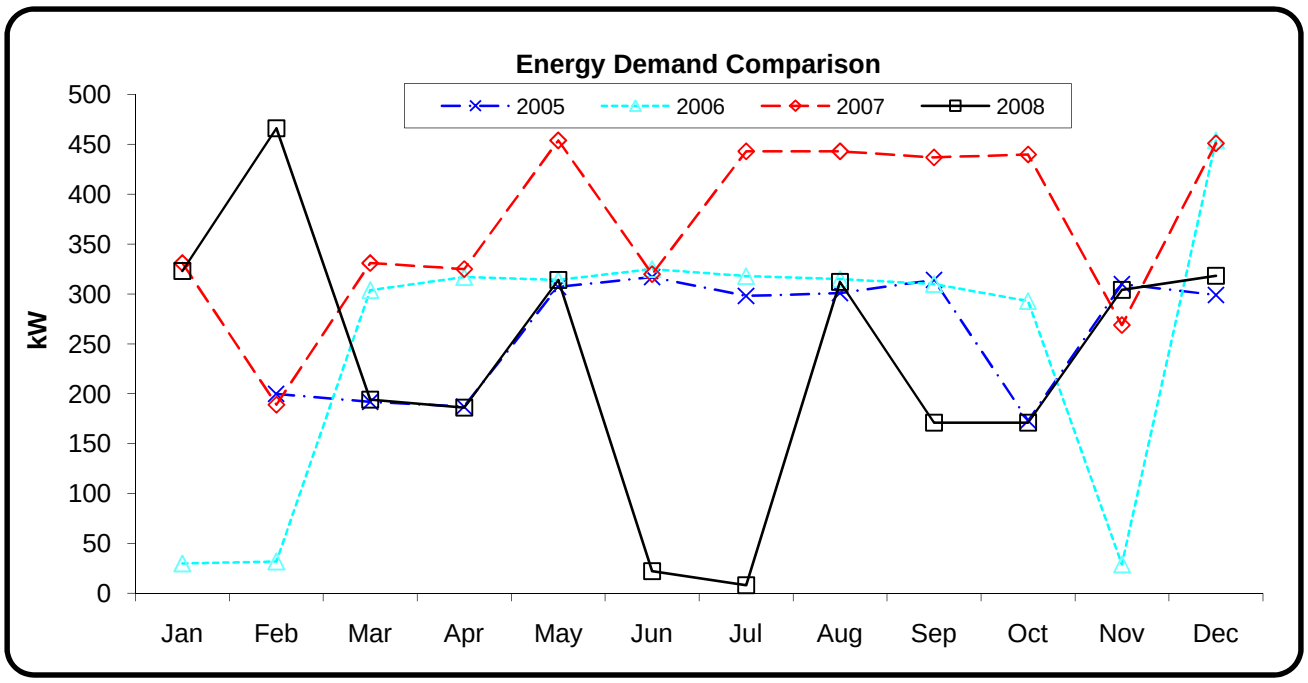
Electrical costs are based on the current electric rates.

Month	2007				2008				
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	% Change
Jan	4,166	3,816	99	8,082	2,251	3,724	99	6,074	-24.8%
Feb	1,135	2,179	99	3,414	3,761	5,373	99	9,233	170.5%
Mar	1,560	3,816	99	5,475	4,304	2,237	99	6,640	21.3%
Apr	4,304	3,747	99	8,151	3,485	2,145	99	5,729	-29.7%
May	3,505	5,235	99	8,838	1,777	3,620	99	5,497	-37.8%
Jun	3,235	2,352	99	5,686	197	162	99	458	-91.9%
Jul	4,641	3,256	99	7,996	122	59	99	280	-96.5%
Aug	2,175	3,256	99	5,530	2,897	2,293	99	5,290	-4.4%
Sep	3,610	3,212	99	6,921	4,322	1,257	99	5,678	-18.0%
Oct	2,616	3,234	99	5,949	3,188	1,257	99	4,544	-23.6%
Nov	2,883	3,102	99	6,083	2,290	3,505	99	5,895	-3.1%
Dec	2,132	5,200	99	7,432	1,856	3,667	99	5,622	-24.4%
Total	$ 35,961	$ 42,406	$ 1,191	$ 79,557	$ 30,450	$ 29,298	$ 1,191	$ 60,939	-23.4%
Average	$ 2,997	$ 3,534	$ 99	$ 6,630	$ 2,537	$ 2,442	$ 99	$ 5,078	-23.4%
Cost ($/kWh)				0.1333				0.1212	-9.1%

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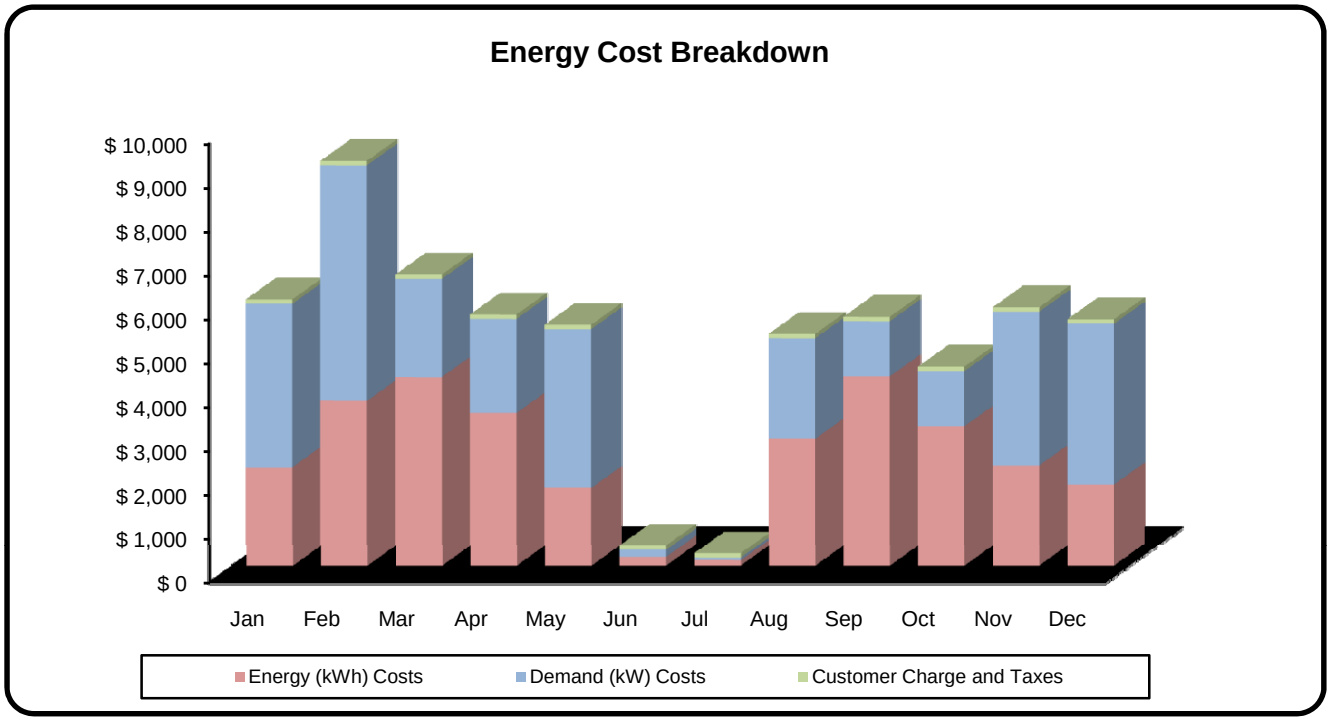
Salmon Creek Pump Station

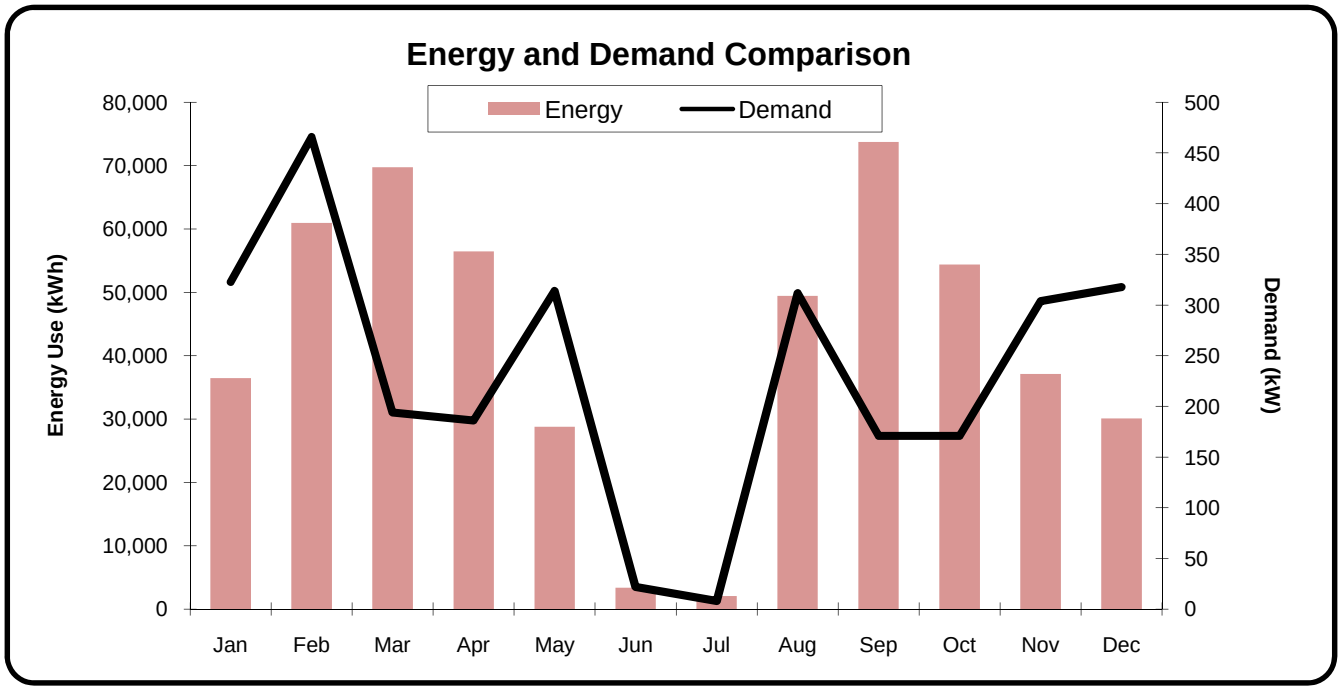




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Salmon Creek Pump Station





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Electric Use Data

March 9, 2009

Salmon Creek Pump Station - CBJ Account

ELECTRIC RATE

AEL&P Electric Rate 20	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0933	0.0742
Customer Charge ($ / mo)	18.80	18.80
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION

Month	2005 kWh	2006 kWh	2007 kWh	2008 kWh
Jan	0	10,720	18,160	16,320
Feb	19,880	13,280	13,920	20,480
Mar	19,120	11,520	13,160	19,880
Apr	16,040	16,720	17,440	16,720
May	14,400	14,000	14,600	10,920
Jun	8,520	11,600	11,800	3,360
Jul	8,000	10,360	11,040	2,080
Aug	7,560	8,800	7,520	6,200
Sep	8,760	7,640	5,880	8,800
Oct	4,240	4,760	8,560	8,160
Nov	7,840	8,160	12,600	10,600
Dec	13,040	17,240	13,160	12,160
Total	127,400	134,800	147,840	135,680
Average	10,617	11,233	12,320	11,307

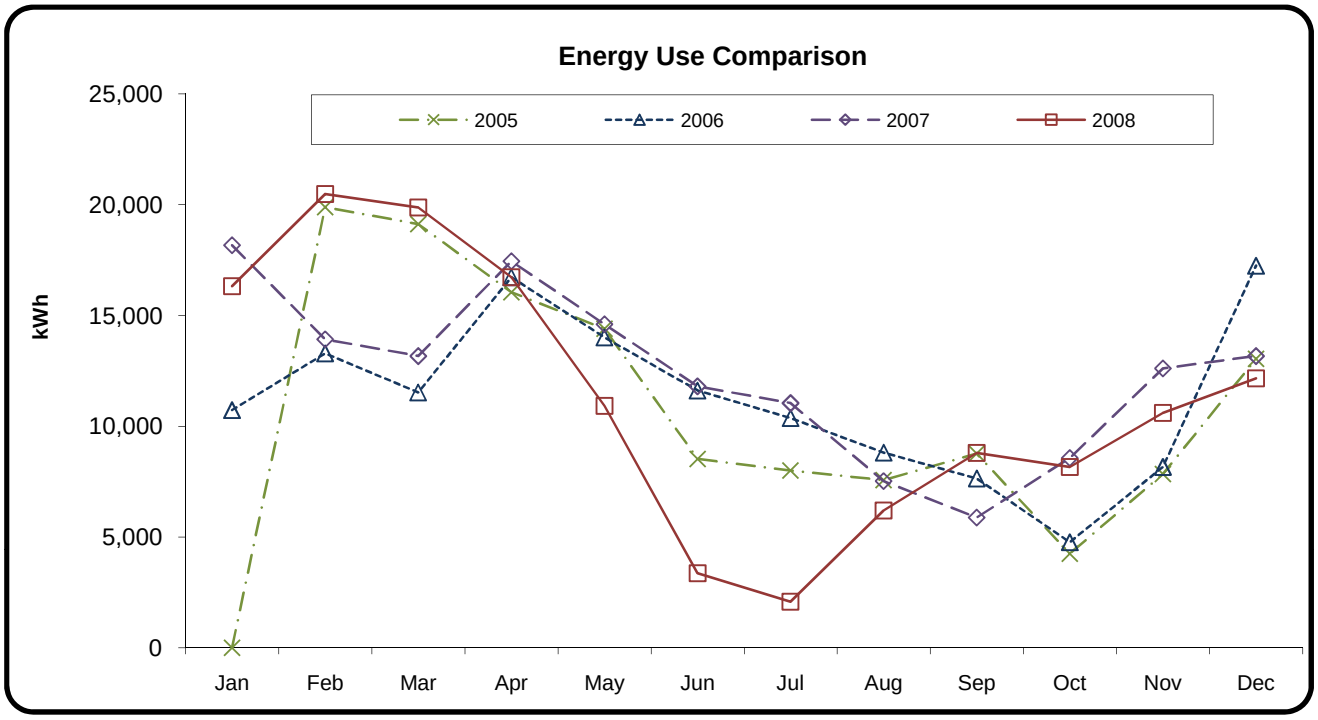
ELECTRIC BILLING DETAILS

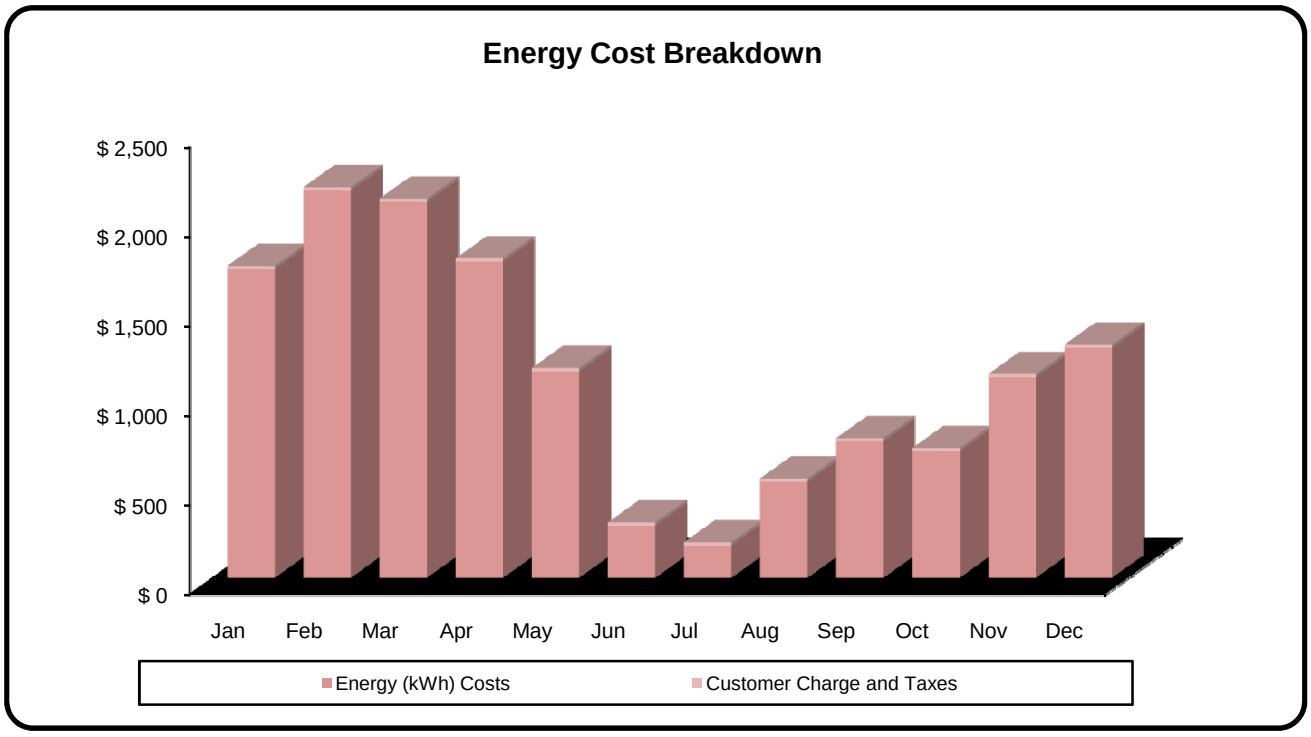
Electrical costs are based on the current electric rates.

	2007			2008			
Month	Energy	Cust & Tax	Total	Energy	Cust & Tax	Total	% Change
Jan	1,919	19	1,938	1,725	19	1,744	-10.0%
Feb	1,471	19	1,490	2,165	19	2,184	46.5%
Mar	1,391	19	1,410	2,101	19	2,120	50.4%
Apr	1,843	19	1,862	1,767	19	1,786	-4.1%
May	1,543	19	1,562	1,154	19	1,173	-24.9%
Jun	1,022	19	1,041	291	19	310	-70.2%
Jul	956	19	975	180	19	199	-79.6%
Aug	651	19	670	537	19	556	-17.1%
Sep	509	19	528	762	19	781	47.9%
Oct	741	19	760	707	19	725	-4.6%
Nov	1,332	19	1,351	1,120	19	1,139	-15.7%
Dec	1,391	19	1,410	1,285	19	1,304	-7.5%
Total	$ 14,771	$ 226	$ 14,996	$ 13,795	$ 226	$ 14,021	-6.5%
Average	$ 1,231	$ 19	$ 1,250	$ 1,150	$ 19	$ 1,168	-6.5%
Cost ($/kWh)			$0.1014			$0.1033	1.9%

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Salmon Creek Pump Station - CBJ Account





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Electric Use Data

March 10, 2009

Crow Hill Pump Station

ELECTRIC RATE

AEL&P Electric Rate 91	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0614	0.0614
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	26.12	26.12
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Jan	16,960	70	15,360	64	14,120	61	13,280	66
Feb	14,440	63	14,400	45	15,040	63	15,760	40
Mar	14,000	65	14,840	14	14,840	65	12,840	59
Apr	14,680	70	13,360	69	12,640	60	11,960	56
May	12,000	62	11,600	62	12,080	58	9,560	23
Jun	11,680	61	10,240	55	11,360	57	9,280	25
Jul	12,080	60	10,560	57	10,520	43	8,600	21
Aug	10,640	6	9,840	10	9,960	43	8,920	56
Sep	10,880	58	11,600	34	10,320	24	7,880	58
Oct	12,480	52	11,680	12	10,520	42	9,240	44
Nov	12,600	59	14,960	66	12,120	59	13,680	64
Dec	13,880	13	15,320	13	14,640	59	14,800	34
Total	156,320		153,760		148,160		135,800	
Average	13,027	53	12,813	42	12,347	53	11,317	46
Load Factor	33.5%		42.0%		32.0%		34.1%	

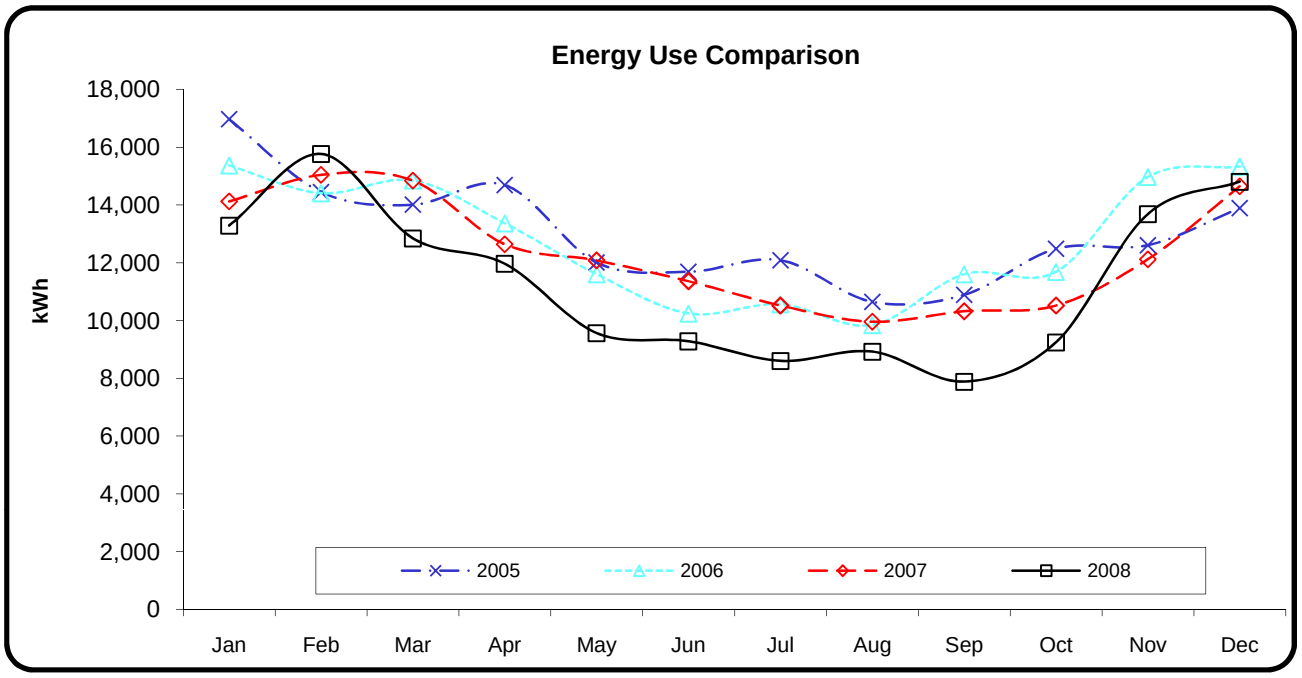
ELECTRIC BILLING DETAILS

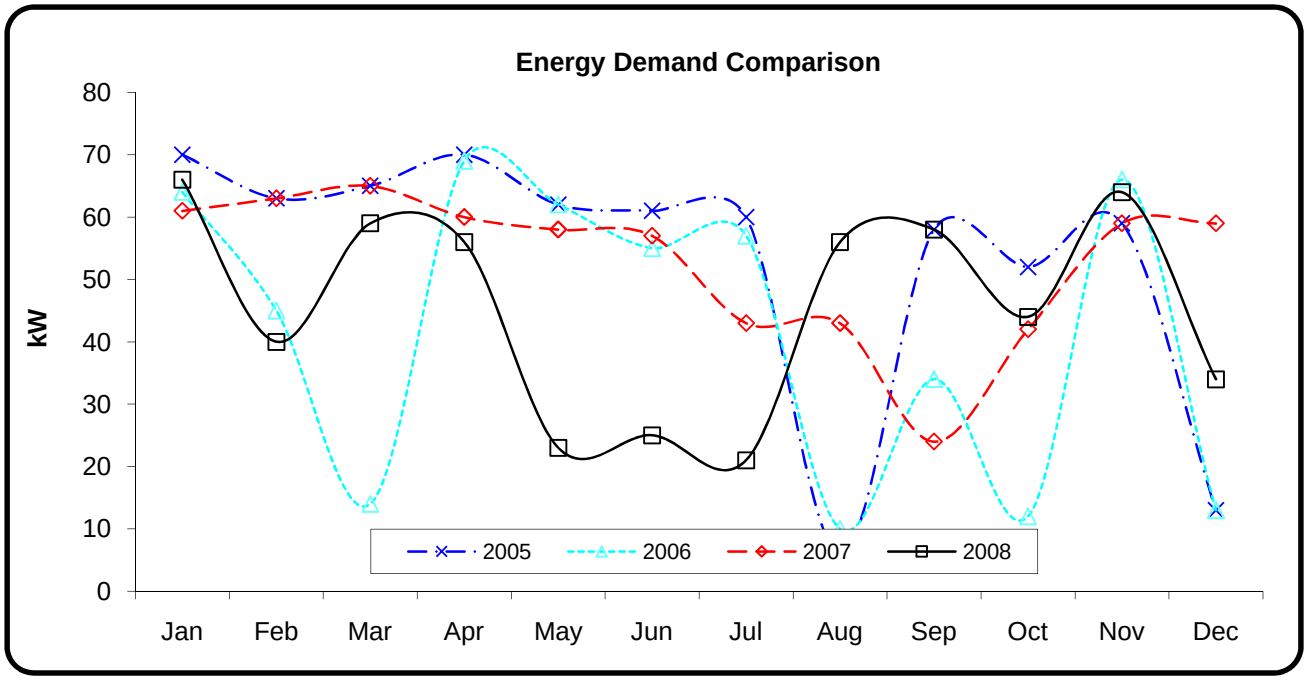
Electrical costs are based on the current electric rates.

Month	2007				2008				
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	% Change
Jan	1,042	703	26	1,771	980	761	26	1,767	-0.2%
Feb	1,110	726	26	1,862	1,163	461	26	1,650	-11.4%
Mar	1,095	749	26	1,871	948	680	26	1,654	-11.6%
Apr	933	692	26	1,651	883	646	26	1,554	-5.8%
May	891	669	26	1,586	706	265	26	997	-37.2%
Jun	838	419	26	1,283	685	184	26	895	-30.3%
Jul	776	316	26	1,119	635	154	26	815	-27.1%
Aug	735	316	26	1,077	658	412	26	1,096	1.7%
Sep	762	176	26	964	582	426	26	1,034	7.2%
Oct	776	309	26	1,111	682	323	26	1,031	-7.2%
Nov	894	680	26	1,601	1,010	738	26	1,774	10.8%
Dec	1,080	680	26	1,787	1,092	392	26	1,510	-15.5%
Total	$ 10,934	$ 6,436	$ 313	$ 17,684	$ 10,022	$ 5,443	$ 313	$ 15,778	-10.8%
Average	$ 911	$ 536	$ 26	$ 1,474	$ 835	$ 454	$ 26	$ 1,315	-10.8%
Cost ($/kWh)				0.1194	64%	34%	2%	0.1162	-2.7%

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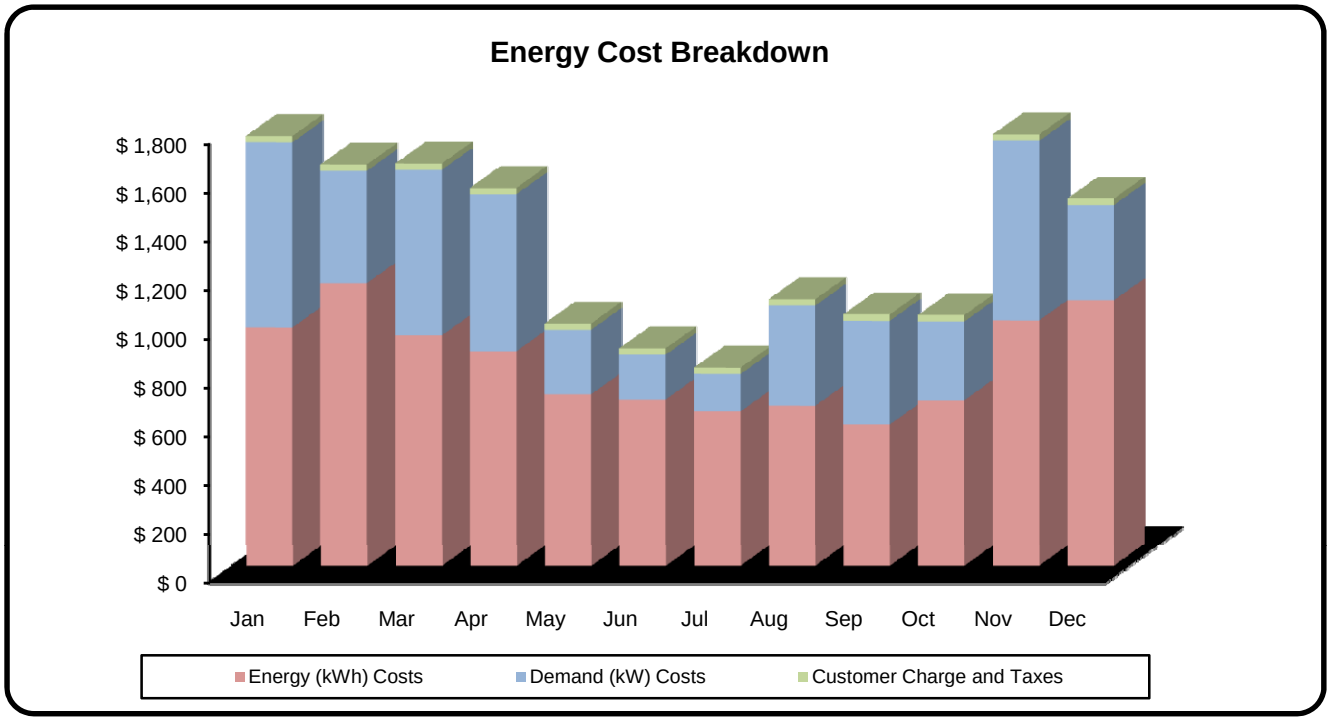
Crow Hill Pump Station

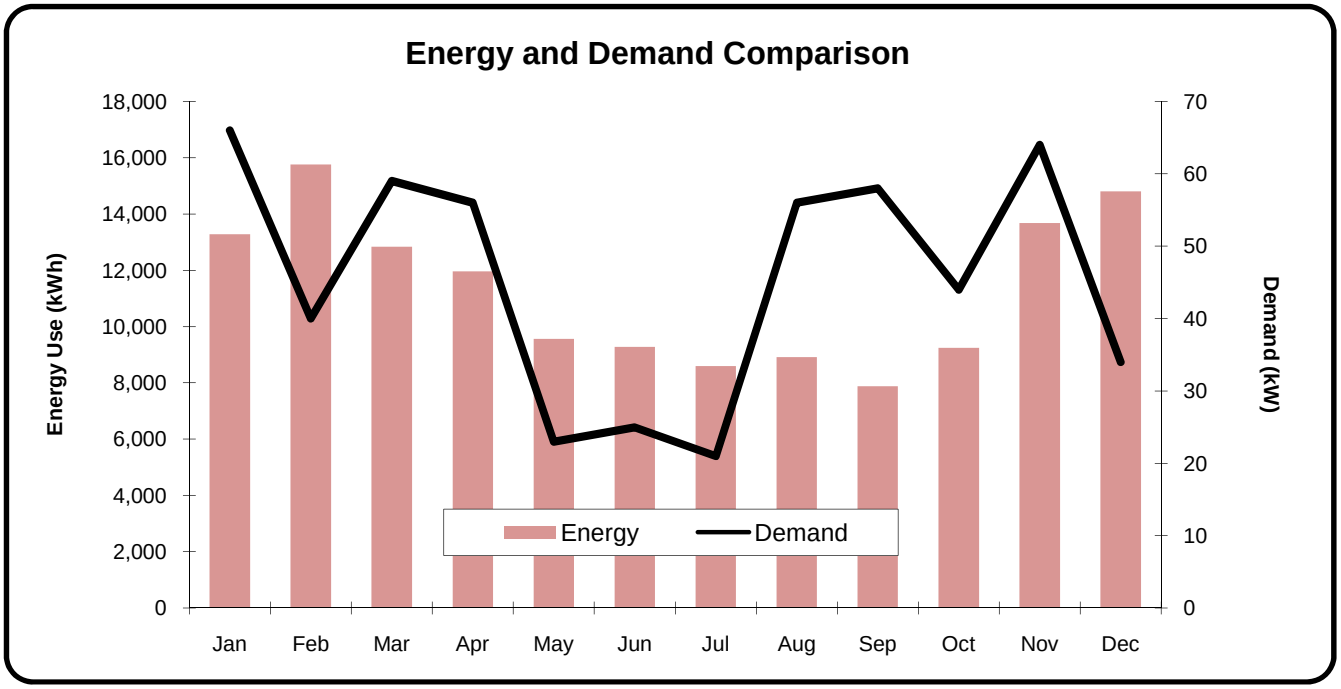




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Crow Hill Pump Station





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Electric Use Data

March 9, 2009

Crow Hill Pump Station

ELECTRIC RATE

AEL&P Electric Rate 34	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0493	0.0462
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	99.24	99.24
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008	
	kWh	kW	kWh	kW	kWh	kW	kWh	kW
Jan	16,960	70	15,360	64	14,120	61	13,280	66
Feb	14,440	63	14,400	45	15,040	63	15,760	40
Mar	14,000	65	14,840	14	14,840	65	12,840	59
Apr	14,680	70	13,360	69	12,640	60	11,960	56
May	12,000	62	11,600	62	12,080	58	9,560	23
Jun	11,680	61	10,240	55	11,360	57	9,280	25
Jul	12,080	60	10,560	57	10,520	43	8,600	21
Aug	10,640	6	9,840	10	9,960	43	8,920	56
Sep	10,880	58	11,600	34	10,320	24	7,880	58
Oct	12,480	52	11,680	12	10,520	42	9,240	44
Nov	12,600	59	14,960	66	12,120	59	13,680	64
Dec	13,880	13	15,320	13	14,640	59	14,800	34
Total	156,320		153,760		148,160		135,800	
Average	13,027	53	12,813	42	12,347	53	11,317	46
Load Factor	33.5%		42.0%		32.0%		34.1%	

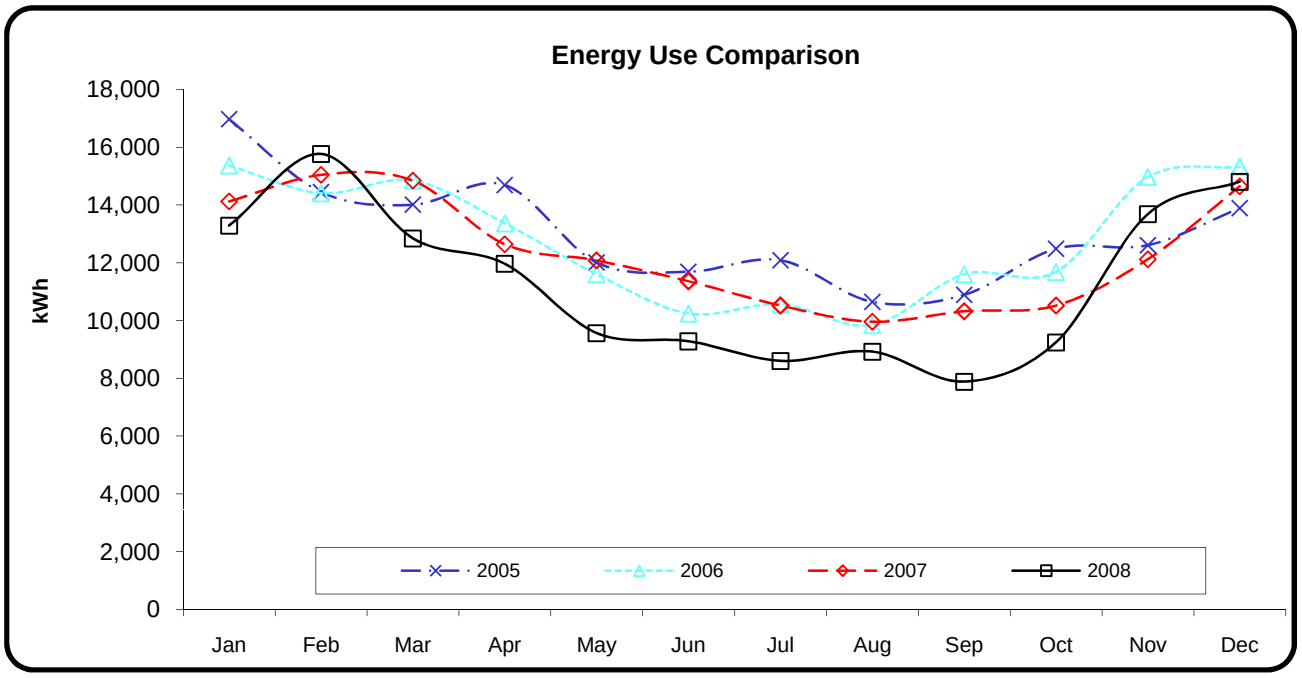
ELECTRIC BILLING DETAILS

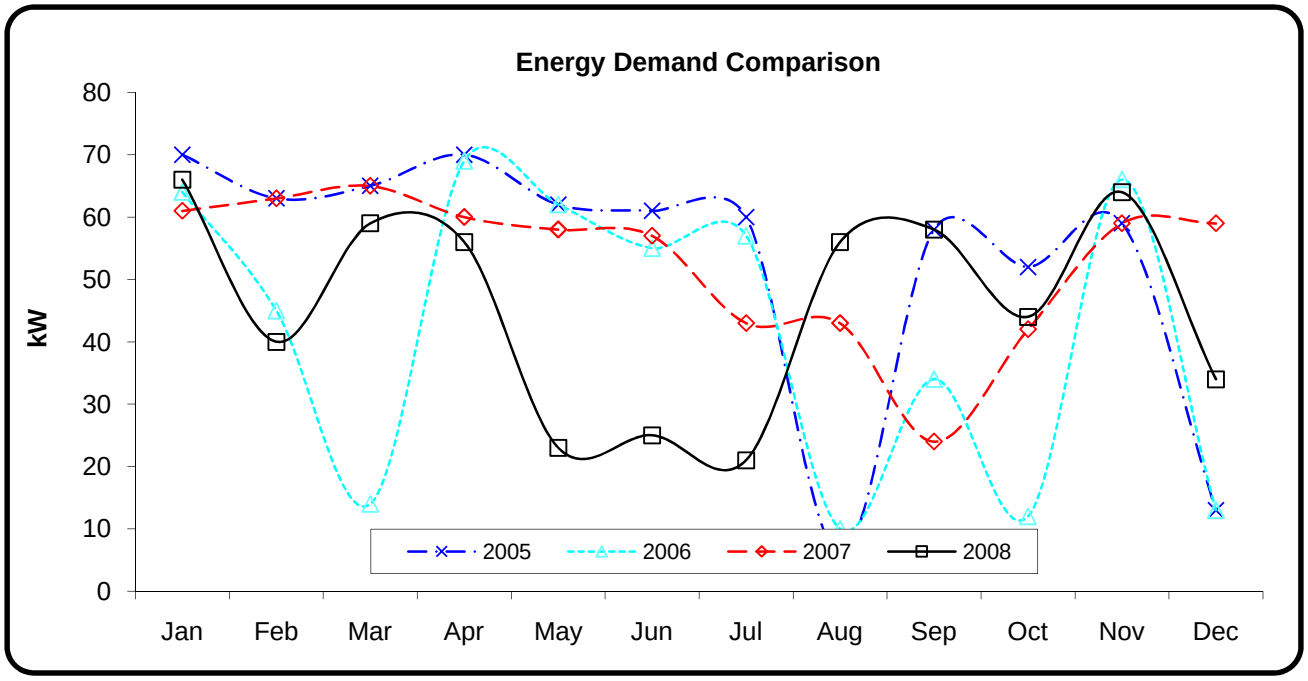
Electrical costs are based on the current electric rates.

Month	2007				2008				
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	% Change
Jan	871	703	99	1,674	819	761	99	1,680	0.3%
Feb	928	726	99	1,754	972	461	99	1,533	-12.6%
Mar	916	749	99	1,764	792	680	99	1,572	-10.9%
Apr	780	692	99	1,571	738	646	99	1,483	-5.6%
May	745	669	99	1,513	590	265	99	954	-36.9%
Jun	666	419	99	1,184	544	184	99	827	-30.2%
Jul	616	316	99	1,032	504	154	99	758	-26.6%
Aug	584	316	99	999	523	412	99	1,034	3.5%
Sep	605	176	99	880	462	426	99	987	12.1%
Oct	616	309	99	1,024	541	323	99	964	-5.9%
Nov	748	680	99	1,527	844	738	99	1,681	10.1%
Dec	903	680	99	1,683	913	392	99	1,404	-16.5%
Total	$ 8,978	$ 6,436	$ 1,191	$ 16,605	$ 8,243	$ 5,443	$ 1,191	$ 14,876	-10.4%
Average	$ 748	$ 536	$ 99	$ 1,384	$ 687	$ 454	$ 99	$ 1,240	-10.4%
Cost ($/kWh)				0.1121				0.1095	-2.3%

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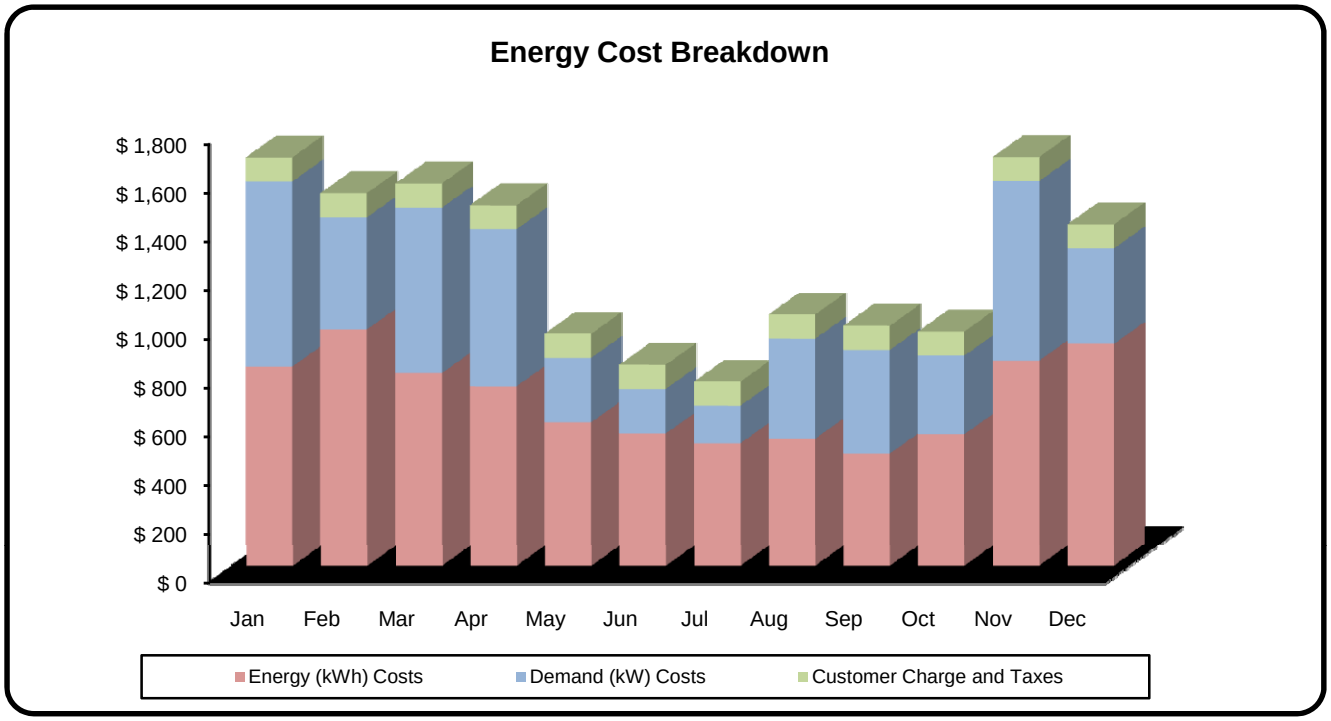
Crow Hill Pump Station

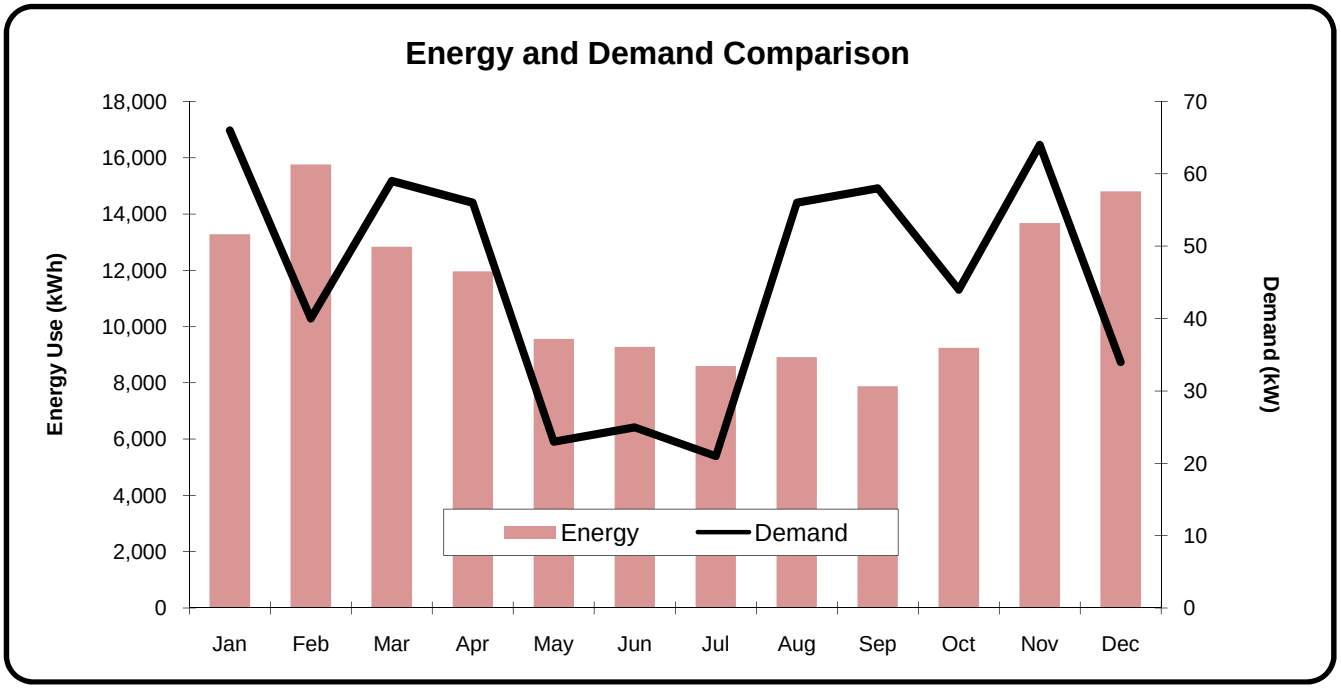




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Crow Hill Pump Station





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Electric Use Data

March 9, 2009

Cedar Park Pump Station

ELECTRIC RATE

AEL&P Electric Rate 34	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0493	0.0462
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	99.24	99.24
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008		Average
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	
Jan	5,320	59	4,988	58	4,321	57	6,519	59	21,148
Feb	4,774	59	5,107	59	5,620	57	8,340	58	23,841
Mar	4,259	59	5,768	59	5,044	59	6,564	59	21,635
Apr	4,559	59	4,566	59	4,447	58	6,277	59	19,849
May	3,602	59	4,258	59	3,993	57	5,669	58	17,522
Jun	3,499	50	4,848	58	4,021	57	5,315	49	17,683
Jul	3,731	50	3,783	55	3,687	53	5,347	50	16,548
Aug	3,515	50	3,508	59	3,838	57	5,672	50	16,533
Sep	3,600	50	3,788	58	3,569	52	5,142	57	16,099
Oct	3,745	58	3,624	58	3,633	57	5,517	58	16,519
Nov	4,536	59	4,864	58	3,717	49	6,611	57	19,728
Dec	4,959	58	4,896	59	5,469	59	7,011	57	22,335
Total	50,099		53,998		51,359		73,984		57,360
Average	4,175	56	4,500	58	4,280	56	6,165	56	4,780
Load Factor	10.2%		10.6%		10.5%		15.1%		57

ELECTRIC BILLING DETAILS

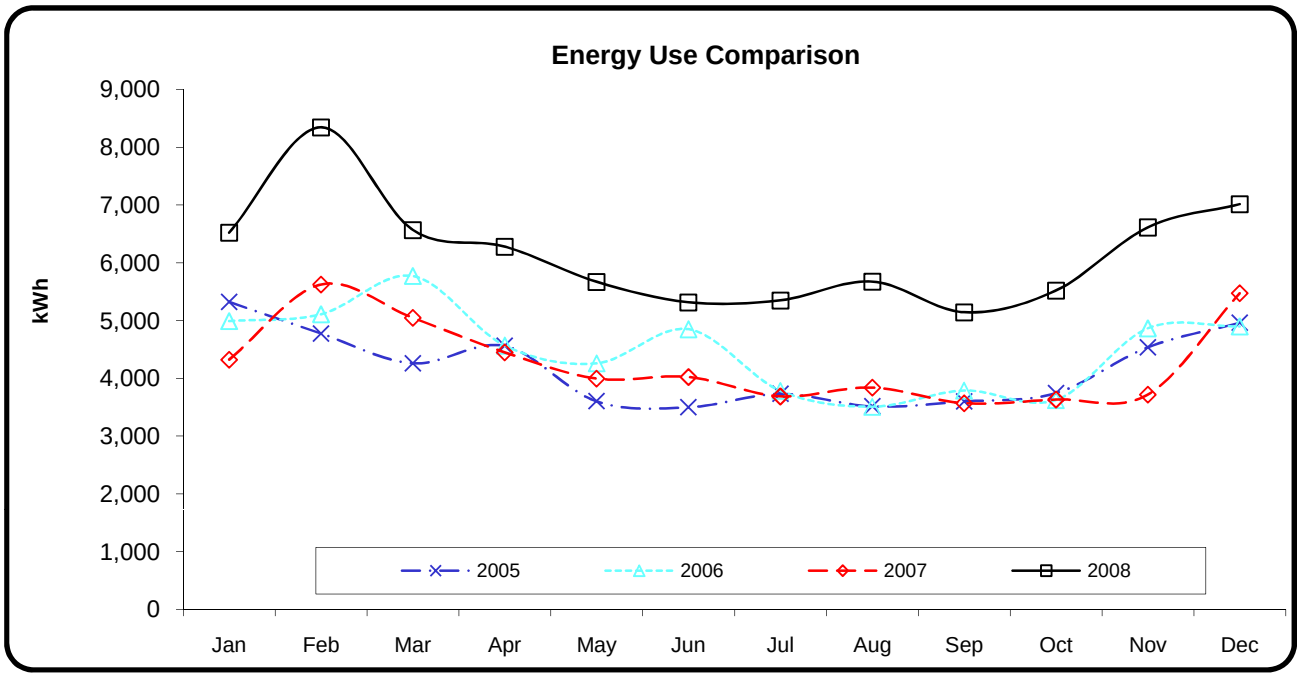
Electrical costs are based on the current electric rates.

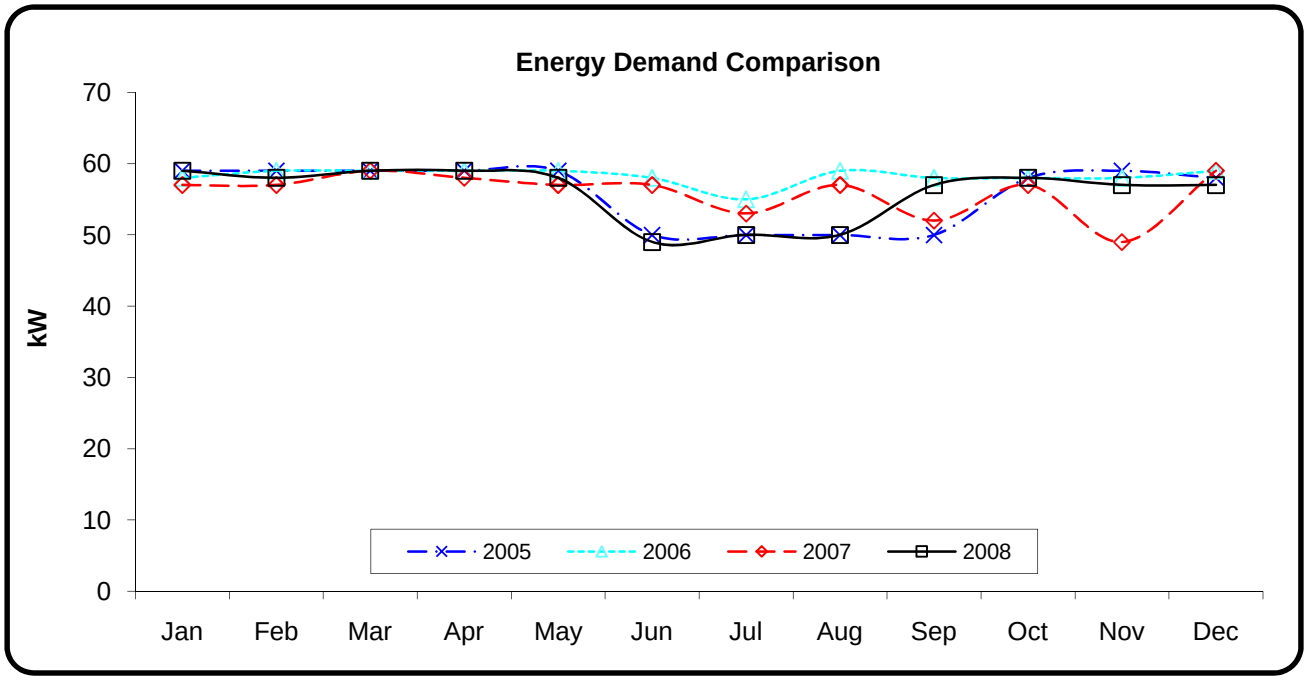
Month	2007				2008				% Change
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	
Jan	267	657	99	1,023	402	680	99	1,182	15.5%
Feb	347	657	99	1,103	515	669	99	1,283	16.3%
Mar	311	680	99	1,091	405	680	99	1,185	8.6%
Apr	274	669	99	1,042	387	680	99	1,167	11.9%
May	246	657	99	1,003	350	669	99	1,118	11.5%
Jun	236	419	99	754	311	360	99	771	2.3%
Jul	216	390	99	705	313	368	99	780	10.7%
Aug	225	419	99	743	332	368	99	799	7.5%
Sep	209	382	99	691	301	419	99	820	18.7%
Oct	213	419	99	731	323	426	99	849	16.1%
Nov	229	565	99	894	408	657	99	1,164	30.3%
Dec	337	680	99	1,117	433	657	99	1,189	6.5%
Total	$ 3,111	$ 6,594	$ 1,191	$ 10,896	$ 4,481	$ 6,633	$ 1,191	$ 12,305	12.9%
Average	$ 259	$ 550	$ 99	$ 908	$ 373	$ 553	$ 99	$ 1,025	12.9%
Cost ($/kWh)				0.2122	36%	54%	10%	0.1663	-21.6%

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Yearly Comparison
March 9, 2009

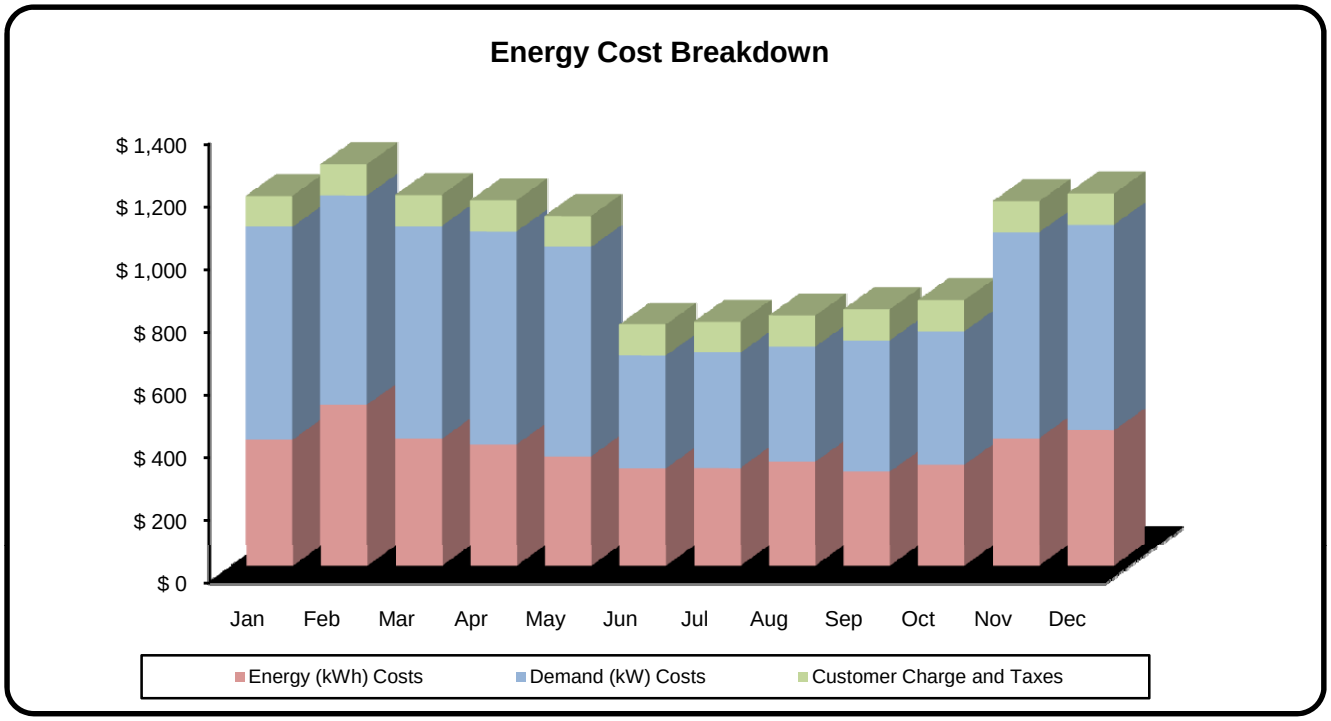
Cedar Park Pump Station

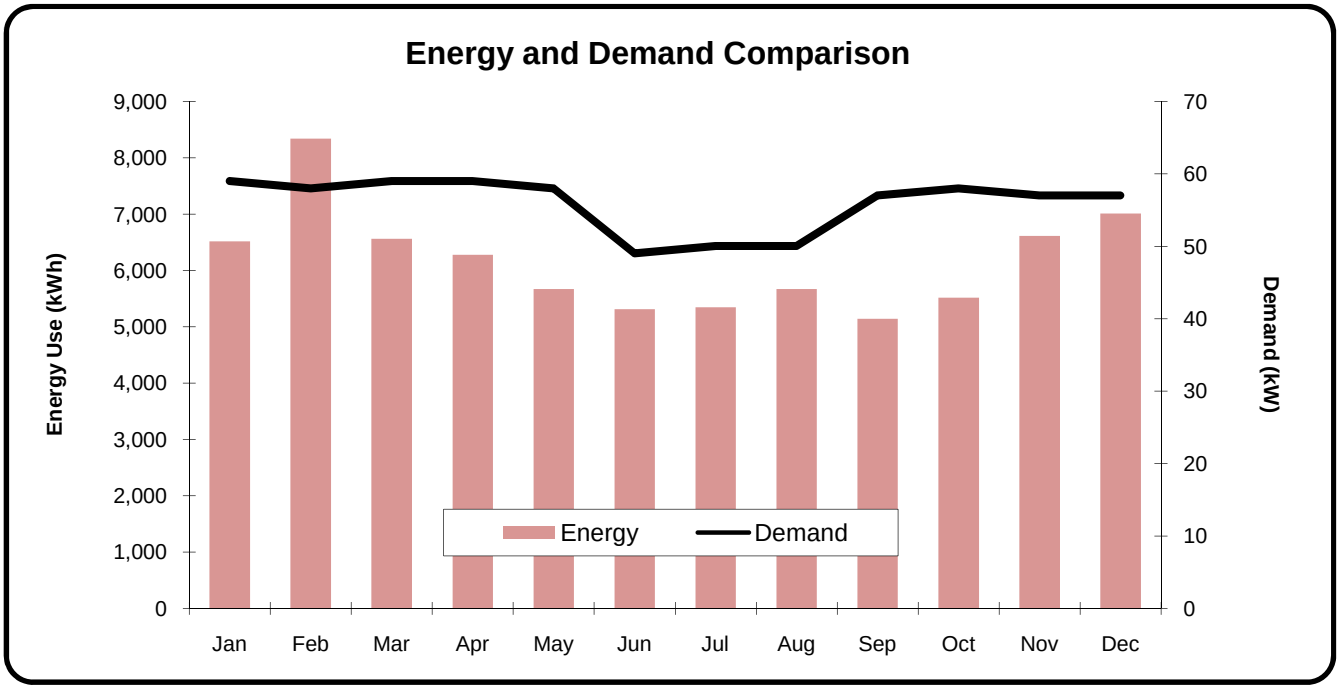




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Cedar Park Pump Station





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Electric Use Data

March 9, 2009

Bonnie Brae Pump Station

ELECTRIC RATE

AEL&P Electric Rate 20	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0933	0.0742
Customer Charge ($ / mo)	18.80	18.80
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION

Month	2005 kWh	2006 kWh	2007 kWh	2008 kWh
Jan	1,411	1,926	1,997	1,613
Feb	1,360	1,763	1,754	1,537
Mar	1,220	1,925	1,735	1,863
Apr	1,029	1,493	1,619	1,121
May	857	1,333	1,110	1,028
Jun	666	727	878	939
Jul	628	540	887	824
Aug	798	682	714	757
Sep	664	579	786	996
Oct	868	1,125	1,088	1,132
Nov	1,143	1,537	1,268	1,343
Dec	1,682	1,505	1,633	2,183
Total	12,326	15,135	15,469	15,336
Average	1,027	1,261	1,289	1,278

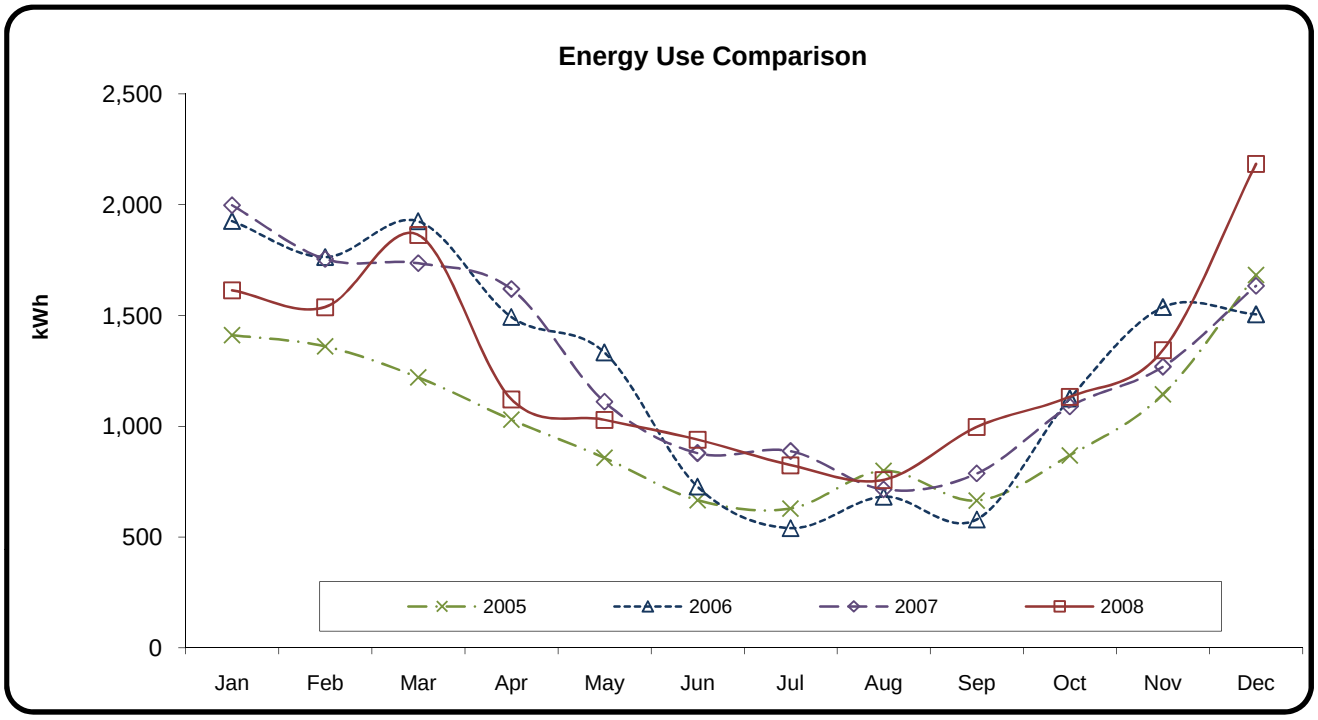
ELECTRIC BILLING DETAILS

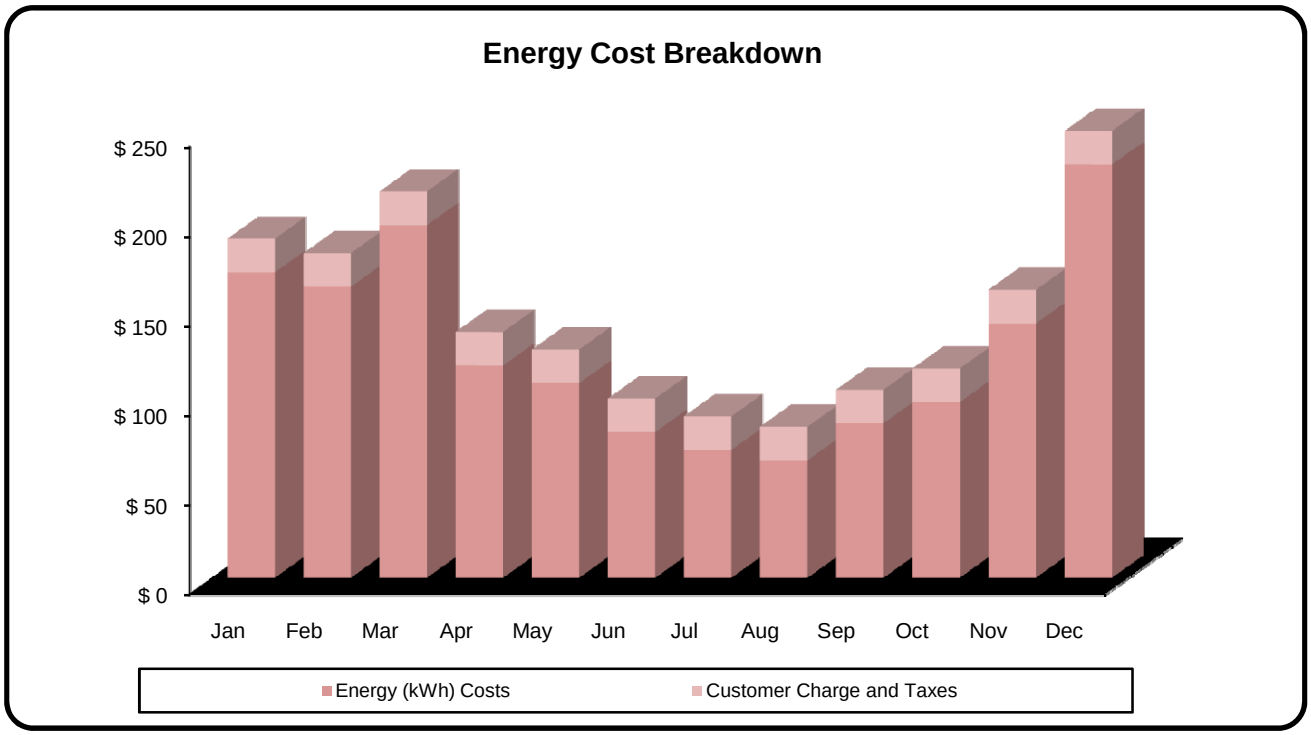
Electrical costs are based on the current electric rates.

	2007			2008			
Month	Energy	Cust & Tax	Total	Energy	Cust & Tax	Total	% Change
Jan	211	19	230	170	19	189	-17.7%
Feb	185	19	204	162	19	181	-11.2%
Mar	183	19	202	197	19	216	6.7%
Apr	171	19	190	118	19	137	-27.7%
May	117	19	136	109	19	127	-6.4%
Jun	76	19	95	81	19	100	5.6%
Jul	77	19	96	71	19	90	-5.7%
Aug	62	19	81	66	19	84	4.6%
Sep	68	19	87	86	19	105	20.9%
Oct	94	19	113	98	19	117	3.4%
Nov	134	19	153	142	19	161	5.2%
Dec	173	19	191	231	19	250	30.4%
Total	$ 1,552	$ 226	$ 1,778	$ 1,532	$ 226	$ 1,758	-1.1%
Average	$ 129	$ 19	$ 148	$ 128	$ 19	$ 146	-1.1%
Cost ($/kWh)			0.114908238			0.114620701	-0.3%

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Bonnie Brae Pump Station





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Electric Use Data

March 9, 2009

Mountain Side Pump Station

ELECTRIC RATE

AEL&P Electric Rate 34	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0493	0.0462
Demand ($ / kW)	11.53	7.35
Customer Charge ($ / mo)	99.24	99.24
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008		Average
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	
Jan	4,240	11	4,418	9	4,271	8	4,676	9	17,605
Feb	4,344	9	4,022	9	4,154	9	4,624	9	17,144
Mar	3,862	9	3,963	9	4,181	12	4,305	10	16,311
Apr	3,784	9	3,921	9	3,909	8	4,361	9	15,975
May	3,394	9	3,621	8	3,888	9	4,005	9	14,908
Jun	3,963	21	3,092	8	3,498	28	3,793	7	14,346
Jul	3,546	8	3,112	9	3,539	6	4,119	9	14,316
Aug	3,801	6	3,213	5	3,627	6	3,637	8	14,278
Sep	3,559	6	3,240	6	3,442	10	3,723	10	13,964
Oct	3,781	6	3,213	24	3,707	12	3,831	12	14,532
Nov	3,924	9	3,858	14	3,832	9	3,949	8	15,563
Dec	4,172	9	4,098	8	4,295	9	4,266	9	16,831
Total	46,370		43,771		46,343		49,289		46,443
Average	3,864	9	3,648	10	3,862	11	4,107	9	3,870
Load Factor	56.7%		50.8%		50.4%		61.9%		10

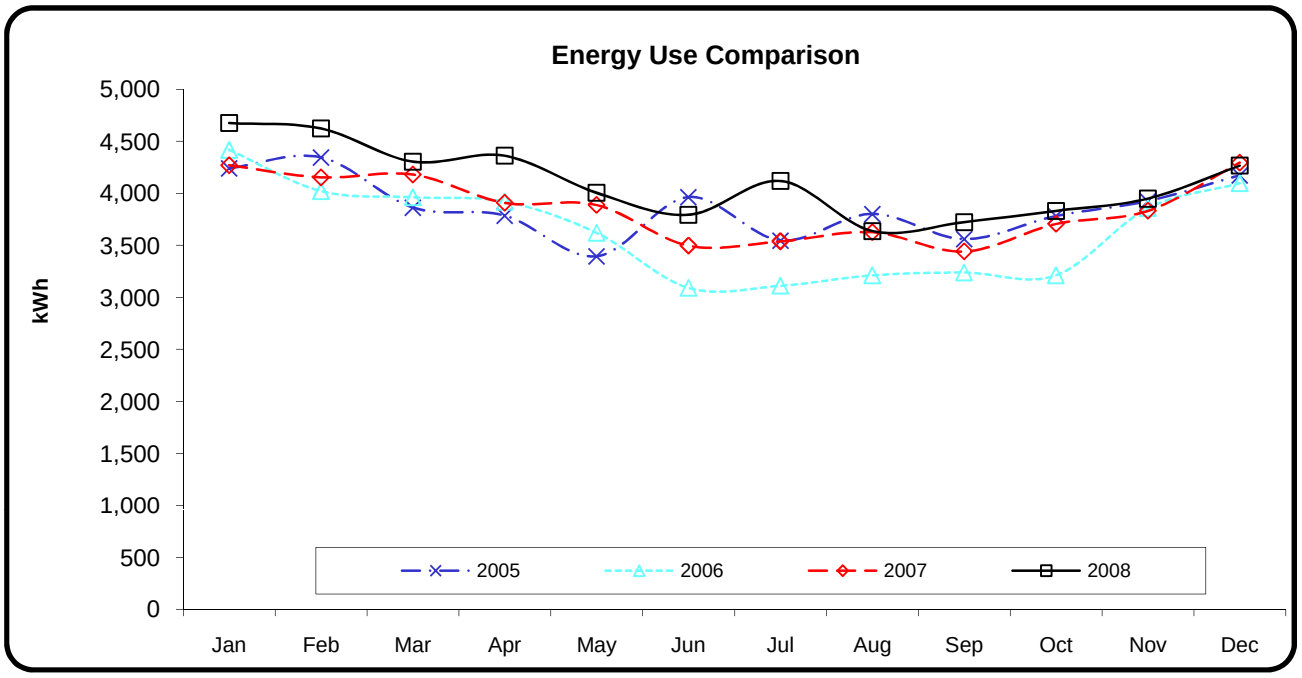
ELECTRIC BILLING DETAILS

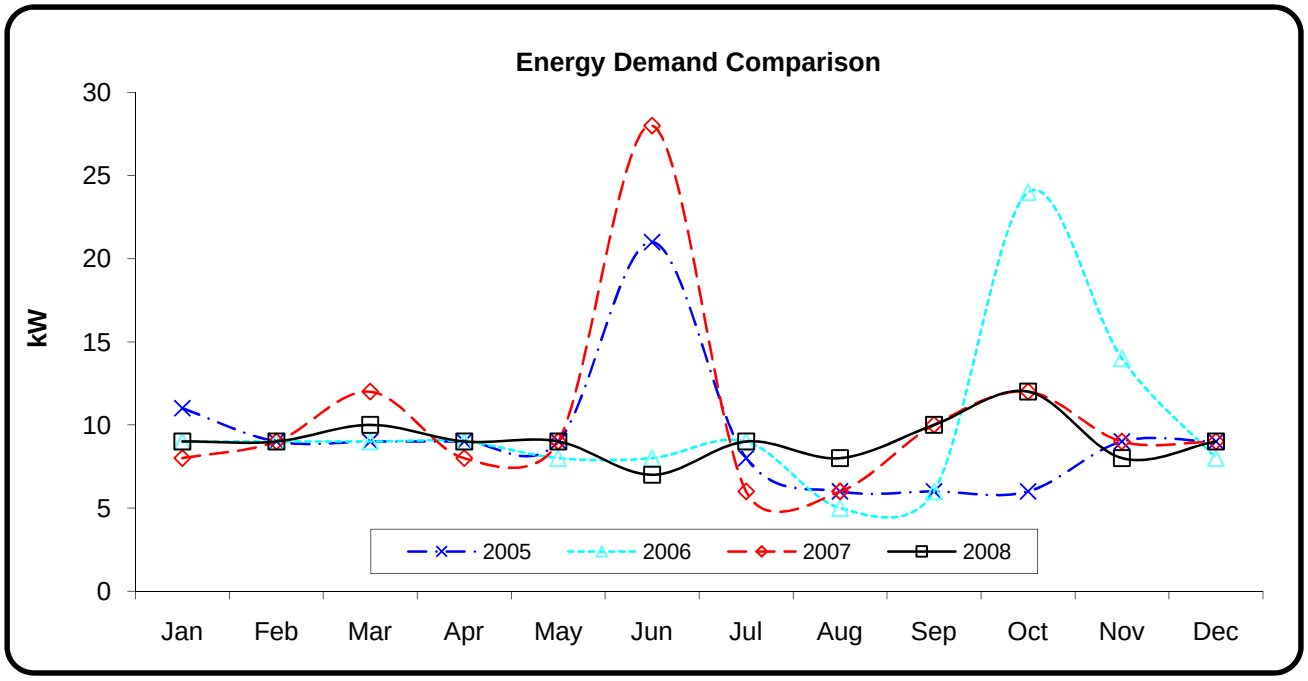
Electrical costs are based on the current electric rates.

Month	2007				2008				% Change
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	
Jan	264	92	99	455	289	104	99	492	8.0%
Feb	256	104	99	459	285	104	99	488	6.3%
Mar	258	138	99	496	266	115	99	480	-3.1%
Apr	241	92	99	433	269	104	99	472	9.1%
May	240	104	99	443	247	104	99	450	1.6%
Jun	205	206	99	510	222	51	99	373	-26.9%
Jul	207	44	99	351	241	66	99	407	16.0%
Aug	213	44	99	356	213	59	99	371	4.3%
Sep	202	74	99	374	218	74	99	391	4.4%
Oct	217	88	99	405	224	88	99	412	1.8%
Nov	236	104	99	439	244	92	99	435	-1.0%
Dec	265	104	99	468	263	104	99	466	-0.4%
Total	$ 2,804	$ 1,194	$ 1,191	$ 5,189	$ 2,982	$ 1,064	$ 1,191	$ 5,237	0.9%
Average	$ 234	$ 99	$ 99	$ 432	$ 248	$ 89	$ 99	$ 436	0.9%
Cost ($/kWh)				0.1120	57%	20%	23%	0.1063	-5.1%

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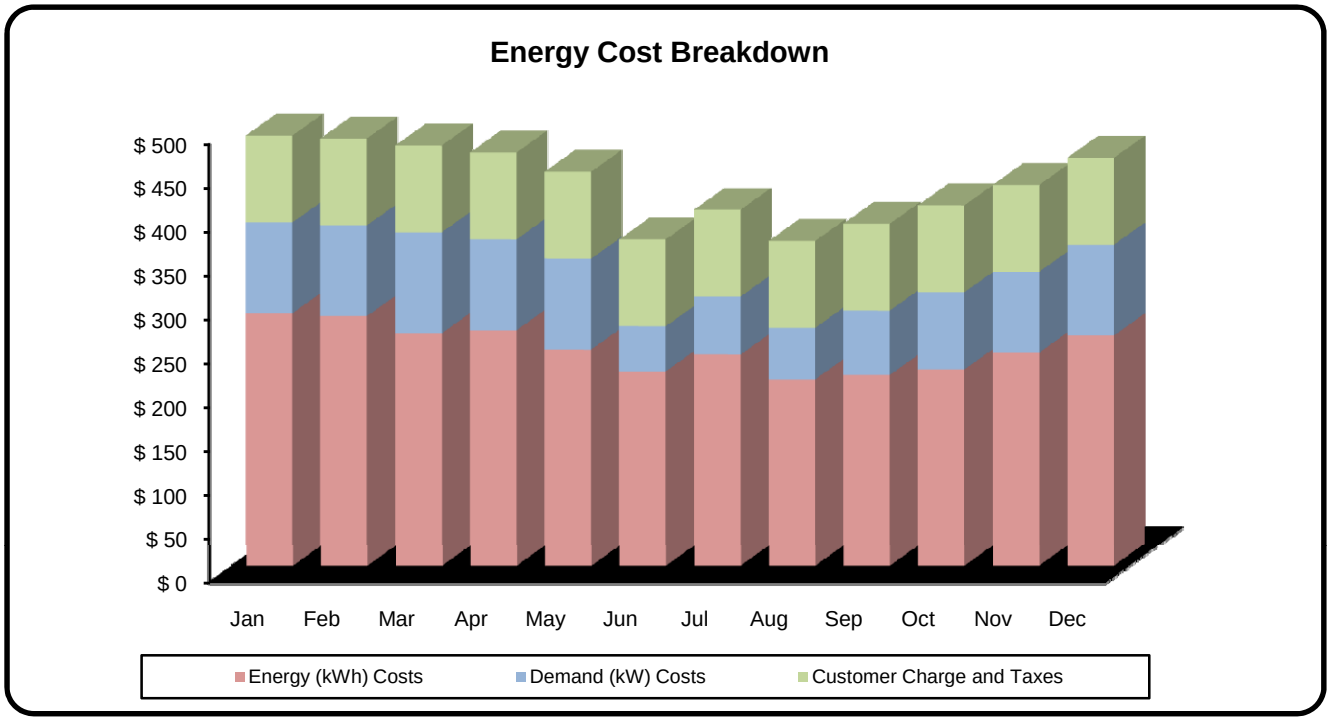
Mountain Side Pump Station

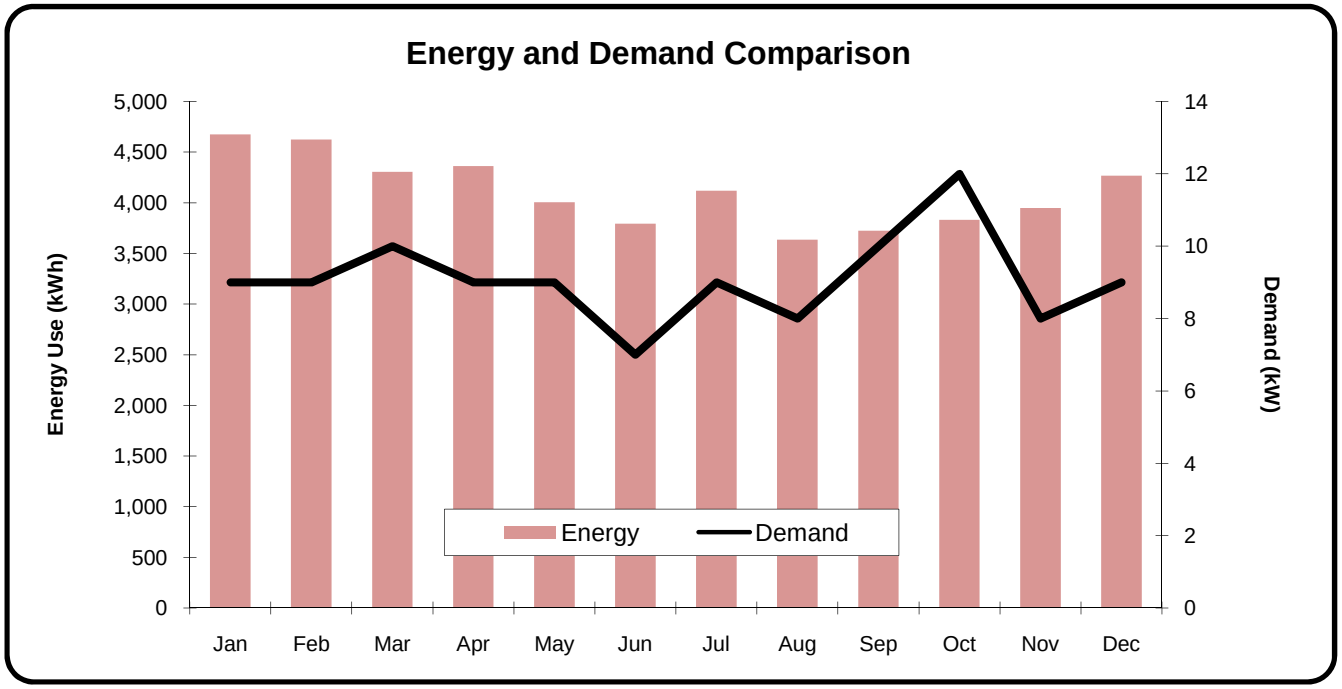




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Mountain Side Pump Station





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Electric Use Data

March 9, 2009

Lena Loop Pump Station

ELECTRIC RATE

AEL&P Electric Rate 31	On-Peak Nov-May	Off-peak Jun-Oct
Electricity ($ / kWh)	0.0536	0.0475
Demand ($ / kW)	10.27	6.87
Customer Charge ($ / mo)	27.16	27.16
Power Cost Adjustment ($ / kWh)	0.012037	0.012037
Regulatory Cost Charge ($ / kWh)	0.000362	0.000362
Sales Tax (%)	0.0%	0.0%

ELECTRICAL CONSUMPTION AND DEMAND

Month	2005		2006		2007		2008		Average
	kWh	kW	kWh	kW	kWh	kW	kWh	kW	
Jan	4,920	14	5,400	19	4,720	18	3,400	17	18,440
Feb	5,120	20	6,240	14	5,040	18	3,760	22	20,160
Mar	5,520	13	5,760	22	5,040	18	3,440	18	19,760
Apr	4,640	15	5,560	21	5,000	18	3,080	12	18,280
May	4,200	14	4,560	12	4,480	17	2,320	11	15,560
Jun	4,280	10	4,520	10	2,280	11	1,720	8	12,800
Jul	3,120	7	3,840	11	2,080	14	1,960	15	11,000
Aug	3,480	15	3,520	17	2,080	11	1,760	14	10,840
Sep	3,440	15	3,520	15	1,880	10	1,760	6	10,600
Oct	3,160	11	3,560	16	2,160	16	2,800	15	11,680
Nov	3,600	14	4,680	18	2,520	11	4,320	19	15,120
Dec	5,760	18	5,040	18	2,960	17	4,080	19	17,840
Total	51,240		56,200		40,240		34,400		45,520
Average	4,270	14	4,683	16	3,353	15	2,867	15	3,793
Load Factor	42.3%		39.9%		30.8%		26.8%		15

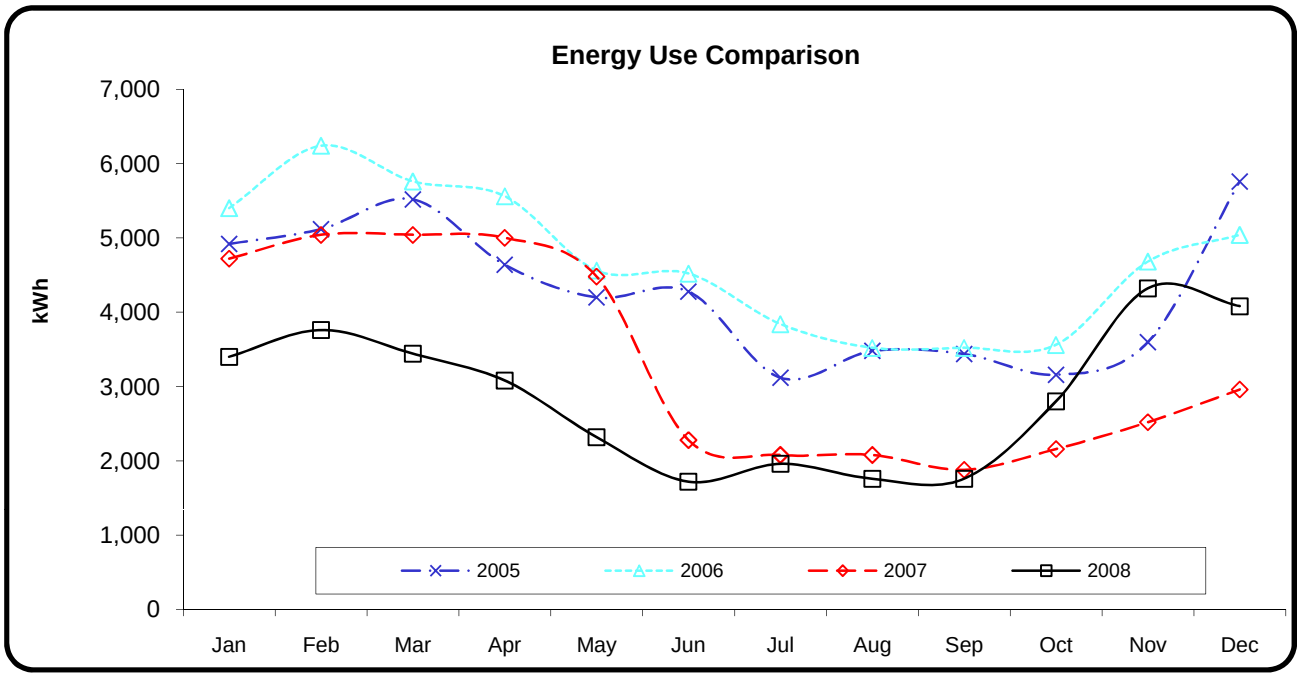
ELECTRIC BILLING DETAILS

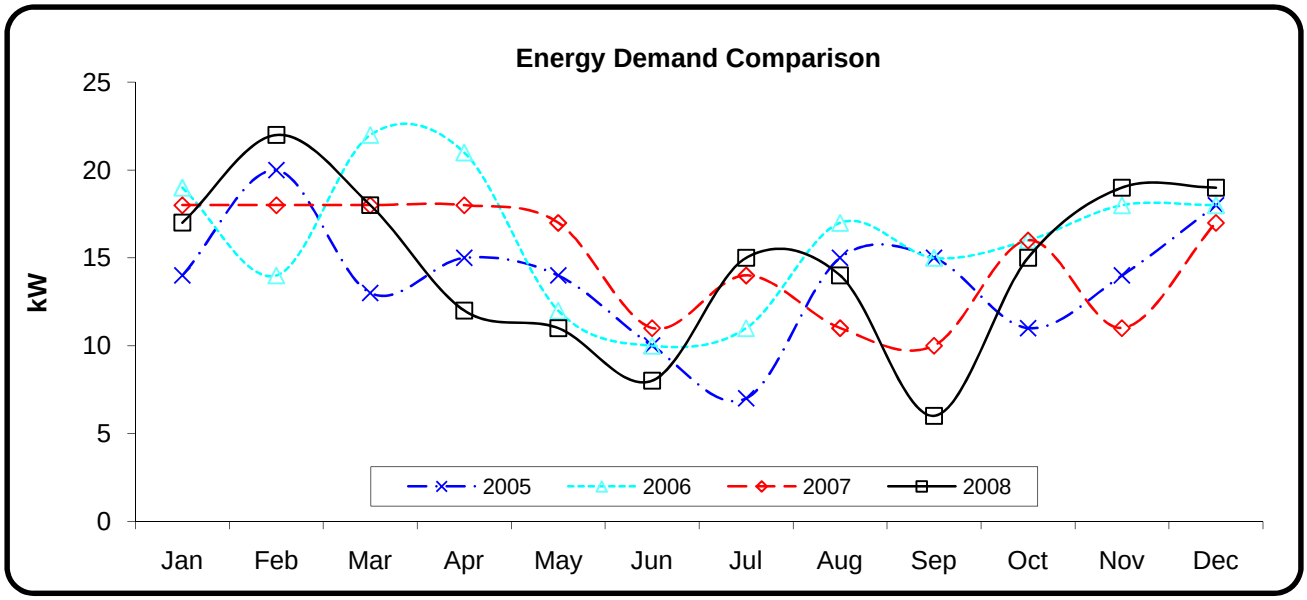
Electrical costs are based on the current electric rates.

Month	2007				2008				% Change
	Energy	Demand	Cust & Tax	Total	Energy	Demand	Cust & Tax	Total	
Jan	312	185	27	524	224	175	27	426	-18.6%
Feb	333	185	27	545	248	226	27	501	-8.0%
Mar	333	185	27	545	227	185	27	439	-19.4%
Apr	330	185	27	542	203	123	27	354	-34.7%
May	296	175	27	497	153	113	27	293	-41.0%
Jun	137	76	27	239	103	55	27	185	-22.6%
Jul	125	96	27	248	117	103	27	248	-0.1%
Aug	125	76	27	227	105	96	27	229	0.6%
Sep	113	69	27	208	105	41	27	174	-16.6%
Oct	129	110	27	266	168	103	27	298	11.8%
Nov	166	113	27	306	285	195	27	507	65.6%
Dec	195	175	27	397	269	195	27	492	23.8%
Total	$ 2,592	$ 1,628	$ 326	$ 4,545	$ 2,209	$ 1,610	$ 326	$ 4,146	-8.8%
Average	$ 216	$ 136	$ 27	$ 379	$ 184	$ 134	$ 27	$ 345	-8.8%
Cost ($/kWh)				0.1130	53%	39%	8%	0.1205	6.7%

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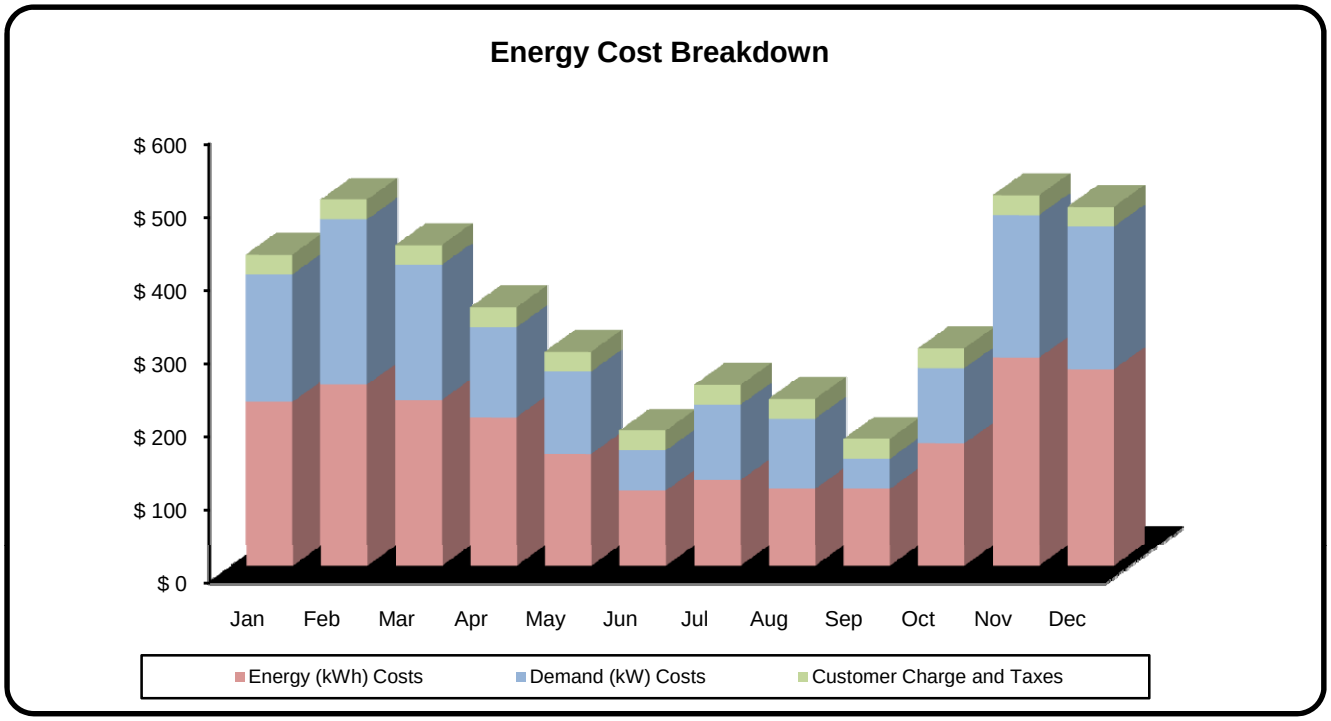
Lena Loop Pump Station

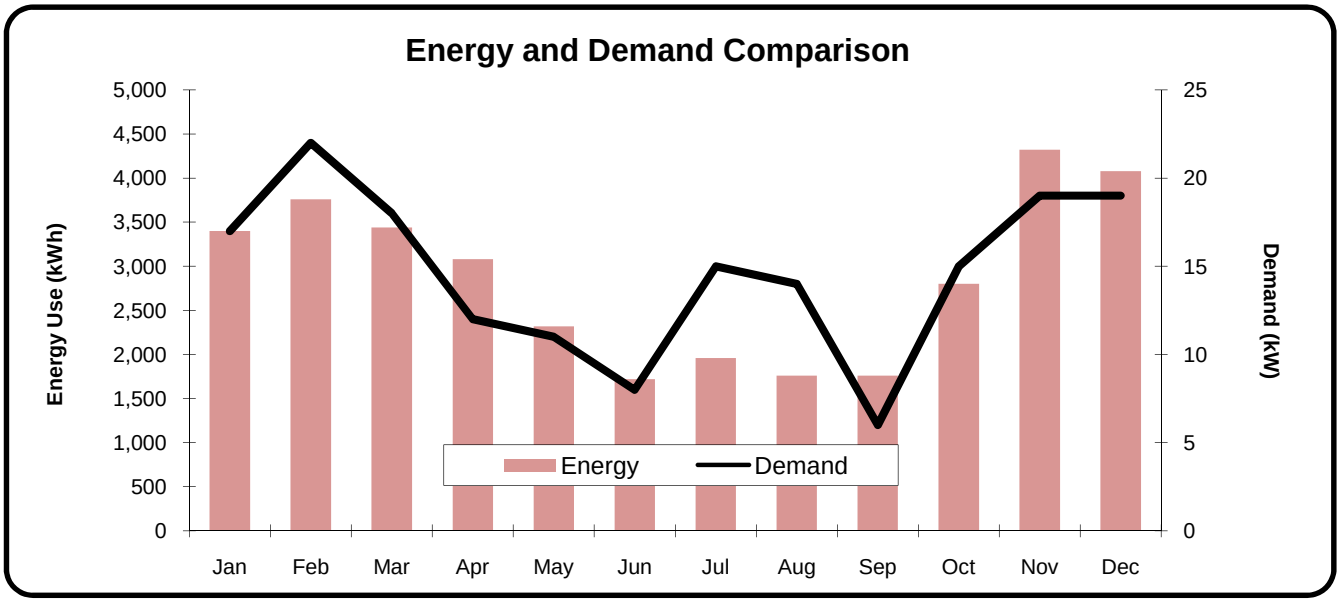




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Lena Loop Pump Station





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Appendix B

Calculations

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Energy Analysis
May 7, 2009

CBJ Water System Energy Audit

Last Chance Basin Well Field

LAST CHANCE BASIN

Heating Load Calculations

Wells 1 and 2

	R-value	Area	ΔT	kW
Wall	7.0	720	59	1.7
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	21.0	275	59	0.2
Floor	7.0	275	18	0.2
	F-value	ln ft	ΔT	
Perimeter	0.4	72	59	0.5
Totals				2.9
			BTUH/sqft	36
			Installed Capacity, kW	5.0
			Oversizing, kW	2.1

Wells 4 and 5

	R-value	Area	ΔT	kW
Wall	7.0	520	59	1.2
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	18.0	160	59	0.2
Floor	7.0	160	18	0.1
	F-value	ln ft	ΔT	
Perimeter	0.4	52	59	0.4
Totals				2.1
			BTUH/sqft	44
			Installed Capacity, kW	5.0
			Oversizing, kW	2.9

Well 3

No Data: Assume	
Area, sqft	575
BTUH/sqft	50
Heating Load, kW	8.4
Installed Capacity, kW	12.0
Oversizing, kW	3.6

Treatment Building

	R-value	Area	ΔT	kW
Wall	7.0	1,824	59	4.2
Window	2.0	0	59	0.0
Door	2.0	126	59	1.1
Roof	32.0	1,188	59	0.6
Floor	7.0	1,188	18	0.9
	F-value	ln ft	ΔT	
Perimeter	0.4	152	59	1.1
Totals				7.9
			BTUH/sqft	23
			Installed Capacity, kW	8.0
			Oversizing, kW	0.1

Low Elevation Flow Rates

Well	kGal/yr	hours	Ave GPM
Well 1	144,329	4,538	530
Well 2	241,560	8,360	482
Well 4	243,030	7,236	560
Well 5	147,577	5,960	413
	776,496	8,760	1,477

Well Flow Rates

Well	kGal/yr	hours	gpm	Ave GPM
Well 3	251,042	3,899	1,073	478

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CBJ Water System Energy Audit

Last Chance Basin Well Field

Low Elevation System: FCV and PRV Losses

	GPM	Head.ft	ηp	ηm	HP	kW	Hours	$/kWh	$/kW	Annual $
Well 1 FCV	530	39	80.1%	94.5%	7	5	4,538	$0.06	$9.79	$2,021
Well 2 FCV (LE)	482	192	82.7%	94.5%	30	22	8,360	$0.06	$9.79	$13,805
Well 4 FCV	560	18	82.2%	90.2%	4	3	7,236	$0.06	$9.79	$1,452
Well 5 FCV	413	39	78.4%	90.2%	6	4	5,960	$0.06	$9.79	$2,054
							26,094			$19,332
PRV's	1,477	69	81.1%	92.3%	35	26	8,760	$0.06	$10.00	$16,636
Total										$35,968

High Elevation System

	GPM	Head.ft	ηp	ηm	HP	kW	Hours	$/kWh	$/kW	Annual $
Pump 3 FCV	1,073	14	78.0%	93.0%	5	4	3,899	$0.06	$10.00	$1,368
8th St PRV	228	69	78.0%	93.0%	5	4	8,760	$0.06	$10.00	$2,647
S. Franklin PRV	250	199	78.0%	93.0%	17	13	8,760	$0.06	$10.00	$8,335
										$12,351

Mill Tunnel Change Rate

Cap, Mgals	GPM	Change/wk
3.2	250	0.8

Well 1 VFD

Pump	GPM	Head.ft	ηp	ηm	HP	kW	Hours	kgals	MWh
No VFD	530	150	75.0%	94.5%	28	21	4,538	144,308	96
With VFD	650	45	75.0%	94.5%	10	8	3,700	144,308	29
Savings						13			67

Well 2 VFD

Pump	GPM	Head.ft	ηp	ηm	HP	kW	Hours	kgals	MWh
No VFD	482	305	75.0%	95.4%	52	39	8,360	241,771	324
With VFD	800	45	75.0%	95.4%	13	9	5,037	241,771	47
Savings						29			277

Well 3 VFD and Motor

Pump	GPM	Head.ft	ηp	ηm	HP	kW	Hours	kgals	MWh
No VFD	1,073	209	78.0%	91.0%	80	59	3,899	251,018	232
With VFD	800	183	78.0%	95.0%	50	37	5,230	251,018	195
Savings						22			37

Well 4 VFD and Motor

Pump	GPM	Head.ft	ηp	ηm	HP	kW	Hours	kgals	MWh
No VFD	560	84	81.0%	90.2%	16	12	7,236	243,130	88
With VFD	1,000	45	81.0%	94.5%	15	11	4,052	243,130	45
Savings						1			43

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CBJ Water System Energy Audit

Last Chance Basin Well Field

Well 5 VFD and Motor

Pump	GPM	Head.ft	ηp	ηm	HP	kW	Hours	kgals	MWh
No VFD	413	100	81.0%	90.2%	14	11	5,960	147,689	64
With VFD	900	45	81.0%	94.5%	13	10	2,735	147,689	27
Savings						1			37

Properly Sized Heaters

Well	Exist kW	New kW	Months	Savings kW
1	5	3	12	24
2	5	3	12	24
3	7.5	3	12	54
	0	3	9	-27
	0	2	4	-8
4	5	3	12	24
5	5	3	12	24
				115

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	14.6	14	409	1,049

Replace Well 3 Hot Water Heater

Well	Exist kW	New kW	Months	Savings kW	Losses
3	4.5	1.5	12	36	

T,room	T,tank	Gallons	Area, cuft	Rtank	Loss, kBTU	Loss, KWH
55	120	30	14	16	503	147

Replace Transformers

	KW	ηold	ηnew	KW	kWh
Replace transformer	30	95.0%	97.5%	0.75	6,570
Replace transformer	45	95.4%	97.7%	1.04	9,067

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CBJ Water System Energy Audit

Salmon Creek Pump Station

Heating Load Calculations

Point of Entry Building

	R-value	Area	ΔT	kW
Wall	7.0	1,120	59	2.4
Window	2.0	0	59	0.0
Door	2.0	147	59	1.3
Roof	40.0	640	59	0.3
Floor	7.0	640	18	0.5
	F-value	ln ft	ΔT	
Perimeter	0.4	112	59	0.8
Totals				5.2
			BTUH/sqft	28
			Installed Capacity, kW	23.0
			Oversizing, kW	17.8

Treatment Building

	R-value	Area	ΔT	kW
Wall	7.0	1,120	59	2.5
Window	2.0	0	59	0.0
Door	2.0	105	59	0.9
Roof	18.0	640	59	0.6
Floor	7.0	640	18	0.5
	F-value	ln ft	ΔT	
Perimeter	0.4	112	59	0.8
Totals				5.3
			BTUH/sqft	28
			Installed Capacity, kW	28.0
			Oversizing, kW	22.7

Wells 1 and 2

	R-value	Area	ΔT	kW
Wall	7.0	720	59	1.7
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	21.0	275	59	0.2
Floor	7.0	275	18	0.2
	F-value	ln ft	ΔT	
Perimeter	0.4	72	59	0.5
Totals				2.9

Replace Transformers

	KW	ηold	ηnew	KW	kWh
Replace transformer	24	94.0%	97%	0.72	6,307
	75	96.0%	98.0%	1.50	13,140
				2.2	19,447

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	36.0	14	1,008	2,587

AEL&P Pumping

	GPM	Head.ft	ηp	ηm	HP	kW	Hours	KWH
Maximum	2,322	275	83%	95%	205	153	7,320	1,117,859
Actual 2008	2,100	275	83%	95%	185	138	2,062	284,788
					20	15	28%	833,071

Replace Less Efficient Motors

Motor	HP	ηold	ηnew	Hours	ΔKW	ΔKWH
Soda Ash	1	75.5%	85.5%	7,320	0.1	846

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CBJ Water System Energy Audit

Crow Hill Pump Station

Two Properly Sized Electric Heaters

	R-value	Area	ΔT	kW
Wall	7.0	840	59	2.0
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	40.0	392	59	0.2
Floor	7.0	392	18	0.3
	F-value	ln ft	ΔT	
Perimeter	0.4	84	59	0.6
Totals				3.3
			BTUH/sqft	29

	kW	Months	Demand, kW
Exist	10	12	120
Heater 1	2	12	24
Heater 2	2	7	14
Savings			82

Installed Capacity, kW	10.0
Oversizing, kW	6.7

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	9.0	14	252	647

Upgrade Motors and Convert to Variable Speed Pumping

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	400	325	45	69.0%	91.0%	60	44	1,496	66,494
New	200	325	11	69.0%	95.0%	26	19	2,992	57,885
							25		8,610

Assume 18 kW savings

Upgrade Motors

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	400	325	45	69.0%	91.0%	60	44	1,496	66,494
New	400	325	45	69.0%	95.0%	57	43	1,496	63,695
							2		2,800

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CBJ Water System Energy Audit

Cedar Park Pump Station

Properly Sized Electric Heater

	R-value	Area	ΔT	kW
Above wall	10.0	200	59	0.3
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Below wall	10.0	580	20	0.3
Roof	10.0	380	59	0.7
Floor	7.0	380	15	0.2
Totals				1.7
			BTUH/sqft	16

Installed Capacity, kW	10.0
Oversizing, kW	8.3

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	3.0	14	84	216

Control Light Fixture

Watts	Hours saved	kWH
96	8,604	826

Upgrade Motors and Convert to Variable Speed Pumping

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	275	356	52	67.0%	91.0%	47	35	1,496	51,915
New	150	356	15	67.0%	95.0%	22	16	2,743	45,219
							18		6,696

Upgrade Motors

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	275	356	52	67.0%	91.0%	47	35	1,496	51,915
New	275	356	52	67.0%	95.0%	45	33	1,496	49,729
							1		2,186

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CBJ Water System Energy Audit

Bonnie Brae Pump Station

Properly Sized Electric Heater

	R-value	Area	ΔT	kW
Wall	7.0	352	59	0.8
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	40.0	120	59	0.1
Floor	7.0	120	18	0.1
	F-value	ln ft	ΔT	
Perimeter	0.4	44	59	0.3
Totals				1.5
			BTUH/sqft	42
			Installed Capacity, kW	6.0
			Oversizing, kW	4.5

Replace Transformer

KW	ηold	ηnew	KW	kWh
15	94.0%	97%	0.45	3,942

Upgrade Motors

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	125	60	12	65.0%	84.0%	4.2	3.1	1,496	4,650
New	125	60	12	65.0%	89.5%	3.9	2.9	1,496	4,364
							0		286

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CBJ Water System Energy Audit

Mountain Side Pump Station

Replace Oversize Heaters

	R-value	Area	ΔT	kW
Wall	7.0	816	59	2.0
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	21.0	220	59	0.2
Floor	2.0	220	18	0.6
	F-value	ln ft	ΔT	
Perimeter	0.4	68	59	0.5
Totals				3.4
			BTUH/sqft	53

Installed Capacity, kW		6.0
Oversizing, kW		2.6

	kW	Months	Demand, kW
Exist	6	12	72
Heater 1	2	12	24
Heater 2	2	7	14
Savings			34

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	5.0	14	140	359

Replace Transformer

KW	ηold	ηnew	KW	kWh
15	94.0%	97%	0.45	3,942

Upgrade Motors

Average Water Demand

gpy	hrs	gpm
7,336,000	8,760	14.0

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	14	105	12	55.0%	85.7%	0.9	0.7	8,760	5,741
New	14	105	12	55.0%	91.7%	0.8	0.6	8,760	5,365
							0.0		376

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CBJ Water System Energy Audit

Lena Loop Pump Station

Properly Sized Heating Units

	R-value	Area	ΔT	kW
Wall	7.0	1,120	59	2.7
Window	2.0	0	59	0.0
Door	2.0	21	59	0.2
Roof	30.0	775	59	0.4
Floor	2.0	775	18	2.0
	F-value	ln ft	ΔT	
Perimeter	0.4	112	59	0.8
Totals				6.2
			BTUH/sqft	27

	kW	Months	Demand, kW
Exist	15	12	180
Heater 1	2	12	24
Heater 2	2	8	16
Heater 3	3	4	12
Savings			128

Installed Capacity, kW	15.0
Oversizing, kW	8.8

Insulate Louvers

	R-value	Area	dT	BTUH	kWh
Decreased heat loss	0.5	1.5	14	42	108

Convert to Variable Speed Pumping

Existing Water Demand

gpy	hrs	gpm
23,699,000	2,303	171.5

	GPM	Static, ft	Friction, ft	ηp	ηm	HP	kW	Hours	kWH
Existing	172	58	7	58.0%	91.7%	5	4	2,303	9,129
New	86	58	2	58.0%	91.7%	2	2	4,606	8,427
							2		702

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Appendix C

Life Cycle Cost Analysis

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Life Cycle Cost Analysis

August 17, 2009

Last Chance Basin Well Field

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

LCB-7: Install VFD on Well 2 Pump	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	1	ea	$16,700.00	$17,000
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,000
Energy Costs					
Electric Energy	1 - 25	-277,000	kWh	$0.063	($324,000)
Electric Demand	1 - 25	-348	kW	$9.79	($63,000)
Net Present Worth					**($368,000)**

LCB-8: Install VFD and Replace Motor on Well 3 Pump	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	1	ea	$16,700.00	$0
Replace motor	0	1	ea	$6,900.00	$7,000
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,000
Energy Costs					
Electric Energy	1 - 25	-37,000	kWh	$0.063	($43,000)
Electric Demand	1 - 25	-264	kW	$9.79	($48,000)
Net Present Worth					**($82,000)**

LCB-9: Install VFD on Well 1 Pump	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	1	ea	$10,200.00	$10,000
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,000
Energy Costs					
Electric Energy	1 - 25	-67,000	kWh	$0.063	($78,000)
Electric Demand	1 - 25	-156	kW	$9.79	($28,000)
Net Present Worth					**($94,000)**

LCB-10: Replace Treatment Building HW Heater	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace hot water heater	0	1	ea	$700	$700
Energy Costs					
Electric Energy	1 - 25	-147	kWh	$0.063	($170)
Electric Demand	1 - 25	-36	kW	$9.79	($6,540)
Net Present Worth					**($6,010)**

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Last Chance Basin Well Field

LCB-11: Replace Oversize Heaters	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Well 1: Replace 5 kW heater with 3 kW heater	0	1	ea	$500.00	$500
Well 2: Replace 5 kW heater with 3 kW heater	0	1	ea	$500.00	$500
Well 3: Replace 7.5 kW heater with 3 kW heater	0	1	ea	$500.00	$500
Well 3: Install 3 kW heater, power, and wall thermostat	0	1	ea	$610.00	$610
Well 3: Install 2 kW heater, power, and wall thermostat	0	1	ea	$590.00	$590
Well 4: Replace 5 kW heater with 3 kW heater	0	1	ea	$500.00	$500
Well 5: Replace 5 kW heater with 3 kW heater	0	1	ea	$500.00	$500
Energy Costs					
Electric Demand	1 - 25	-115	kW	$9.79	($20,890)
Net Present Worth					**($17,190)**

LCB-12: Install VFD and Replace Motor on Well 4 Pump	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	1	ea	$11,600.00	$12,000
Replace motor	0	1	ea	$4,680.00	$5,000
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,000
Energy Costs					
Electric Energy	1 - 25	-43,000	kWh	$0.063	($50,000)
Electric Demand	1 - 25	-12	kW	$9.79	($2,000)
Net Present Worth					**($33,000)**

LCB-13: Install VFD and Replace Motor on Well 5 Pump	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	1	ea	$11,600.00	$12,000
Replace motor	0	1	ea	$4,680.00	$5,000
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,000
Energy Costs					
Electric Energy	1 - 25	-37,000	kWh	$0.063	($43,000)
Electric Demand	1 - 25	-12	kW	$9.79	($2,000)
Net Present Worth					**($26,000)**

LCB-14: Replace Older Transformers	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 30 kW transformer	0	1	ea	$7,500	$7,500
Replace 45 kW transformer	0	1	ea	$9,000	$9,000
Energy Costs					
Electric Energy	1 - 25	-15,635	kWh	$0.063	($18,300)
Electric Demand	1 - 25	-21.5	kW	$9.79	($3,900)
Net Present Worth					**($5,700)**

LCB-15: Seal Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panel	0	8	ea	$80.00	$600
Energy Costs					
Electric Energy	1 - 25	-1,049	kWh	$0.063	($1,200)
Net Present Worth					**($600)**

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Salmon Creek Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

SC-6: Seal Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panels	0	3	ea	$400.00	$1,200
Energy Costs					
Electric Energy	1 - 25	-2,587	kWh	$0.118	($5,700)
Net Present Worth					**($4,500)**

SC-7: Replace Soda Ash Motor	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 1 HP motor	0	1	ea	$640	$600
Energy Costs					
Electric Energy	1 - 25	-846	kWh	$0.118	($1,900)
Electric Demand	1 - 25	0	kW	$9.79	$0
Net Present Worth					**($1,300)**

SC-8: Replace Older Transformers	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 24 kVA transformer	0	1	ea	$6,700	$6,700
Replace 45 KVA transformer	0	1	ea	$9,000	$9,000
Energy Costs					
Electric Energy	1 - 25	-19,447	kWh	$0.118	($42,600)
Net Present Worth					**($26,900)**

SC-9: Maximize AEL&P Pumping Energy	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
	0				$0
Energy Costs					
Electric Energy	1 - 5	-523,000	kWh	$0.063	($153,000)
Electric Demand	1 - 5	0	kW	$9.79	$0
Net Present Worth					**($153,000)**

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Crow Hill Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

CH-5: Replace Oversize Heaters	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 10 kW heater with 2 kW heater	0	1	ea	$480.00	$500
Install 2 kW heater, power, and wall thermostat	0	1	ea	$590.00	$600
Energy Costs					
Electric Demand	1 - 25	-82	kW	$9.79	($14,900)
Net Present Worth					**($13,800)**

CH-6: Seal Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panel	0	1	ea	$100.00	$100
Energy Costs					
Electric Energy	1 - 25	-647	kWh	$0.063	($760)
Net Present Worth					**($660)**

CH-7: Install VFDs and Replace Motors on Pumps	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	120	HP	$200	$24,000
Replace 60 HP motor	0	2	ea	$4,700	$9,400
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,314
Energy Costs					
Electric Energy	1 - 25	-8,610	kWh	$0.063	($10,066)
Electric Demand	1 - 25	-216	kW	$9.79	($39,242)
Net Present Worth					**($13,594)**

CH-8: Replace Pump Motors	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 60 HP motor	0	2	ea	$4,700	$9,400
Energy Costs					
Electric Energy	1 - 25	-2,800	kWh	$0.063	($3,300)
Electric Demand	1 - 25	-24	kW	$9.79	($4,400)
Net Present Worth					**$1,700**

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Cedar Park Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

CP-3: Replace Oversize Heater	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 10 kW heater with 2 kW heater	0	1	ea	$480.00	$500
Energy Costs					
Electric Demand	1 - 25	-96	kW	$9.79	($17,400)
Net Present Worth					**($16,900)**

CP-4: Change Lighting Control	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Connect fixture to the light switch	0	1	ea	$175.00	$200
Energy Costs					
Electric Energy	1 - 25	-826	kWh	$0.063	($1,000)
Net Present Worth					**($800)**

CP-5: Seal Cooling Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panel	0	1	ea	$100.00	$100
Energy Costs					
Electric Energy	1 - 25	-216	kWh	$0.063	($300)
Net Present Worth					**($200)**

CP-6: Install VFDs and Replace Motors on Pumps	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
VFD + integration	0	2	ea	$11,600	$23,200
Replace 50 HP motor	0	2	ea	$3,900	$7,800
Annual Costs					
VFD maintenance	1 - 25	2	hr	$60.00	$2,300
Energy Costs					
Electric Energy	1 - 25	-6,696	kWh	$0.063	($7,800)
Electric Demand	1 - 25	-216	kW	$9.79	($39,200)
Net Present Worth					**($13,700)**

CP-7: Replace Pump Motors	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 50 HP motor	0	2	ea	$3,900	$7,800
Energy Costs					
Electric Energy	1 - 25	-2,186	kWh	$0.063	($2,600)
Electric Demand	1 - 25	-12	kW	$9.79	($2,200)
Net Present Worth					**$3,000**

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Bonnie Brae Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

BB-3: Replace Older Transformer	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace transformer	0	1	ea	$4,400	$5,800
Energy Costs					
Electric Energy	1 - 25	-3,942	kWh	$0.100	($7,320)
Net Present Worth					**($1,520)**

Upgrade Pump Motors	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 5 HP motor	0	2	ea	$820	$1,640
Energy Costs					
Electric Energy	1 - 25	-286	kWh	$0.100	($531)
Net Present Worth					**$1,109**

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Mountain Side Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

MS-4: Replace Oversize Heaters	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 6 kW heater with 2 kW heater	0	1	ea	$480.00	$480
Install 2 kW heater, power, and wall thermostat	0	1	ea	$590.00	$590
Energy Costs					
Electric Demand	1 - 25	-34	kW	$8.85	($5,580)
Net Present Worth					**($4,510)**

MS-5: Seal Cooling Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panel	0	1	ea	$150.00	$150
Energy Costs					
Electric Energy	1 - 25	-359	kWh	$0.065	($430)
Net Present Worth					**($280)**

MS-6: Replace Older Transformer	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace transformer	0	1	ea	$5,800	$5,800
Energy Costs					
Electric Energy	1 - 25	-3,942	kWh	$0.065	($4,750)
Electric Demand	1 - 25	-5.4	kW	$8.85	($890)
Net Present Worth					**$160**

MS-7: Replace Pump Motors	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 10 HP motor	0	2	ea	$1,150	$2,300
Energy Costs					
Electric Energy	1 - 25	-376	kWh	$0.065	($454)
Electric Demand	1 - 25	0	kW	$8.85	$0
Net Present Worth					**$1,846**

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Lena Loop Pump Station

Basis

25	Study Period (years)	3.0%	General Inflation
5.00%	Nominal Discount Rate	6.0%	Fuel Inflation
1.94%	Real Discount Rate	2.5%	Electricity Inflation

LL-3: Restore Variable Speed Pumping	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
	0	1	ea	$200	$200
Energy Costs					
Electric Energy	1 - 25	-702	kWh	$0.065	($800)
Electric Demand	1 - 25	-24	kW	$8.85	($3,900)
Net Present Worth					**($4,500)**

LL-4: Replace Oversize Heaters	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Replace 7.5 kW heater with 2 kW heater	0	2	ea	$480.00	$1,000
Install 3 kW heater, power, and wall thermostat	0	1	ea	$610.00	$600
Energy Costs					
Electric Demand	1 - 25	-128	kW	$8.85	($21,000)
Net Present Worth					**($19,400)**

LL-5: Seal Cooling Louvers During Winter Months	Year	Qty	Unit	Base Cost	Year 0 Cost
Construction Costs					
Install insulated panel	0	1	ea	$100.00	$100
Energy Costs					
Electric Energy	1 - 25	-108	kWh	$0.065	($130)
Net Present Worth					**($30)**