



A Bureau Veritas Group Company

LEVEL II ENERGY AUDIT

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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Sacramento, California 95824

DLR GROUP

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EMG PROJECT #:

136988.19R000-075.268

DATE OF REPORT:

October 28, 2019

ONSITE DATE:

October 3, 2019

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

JOHN STILL ELEMENTARY (WEST CAMPUS)

2200 John Still Drive
Sacramento, California 95832



engineering | environmental | capital planning | project management

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Certification

EMG has completed an Energy Audit of John Still Elementary (West Campus) located at 2200 John Still Drive in Sacramento, California. EMG visited the site on October 3, 2019.

The assessment was performed at the Client's request using methods and procedures consistent with ASHRAE Level II Energy Audit and using methods and procedures as outlined in EMG's Proposal.

This report has been prepared for and is exclusively for the use and benefit of the Client identified on the cover page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and EMG.

This report, or any of the information contained therein, is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of EMG. Any reuse or distribution without such consent shall be at the client's or recipient's sole risk, without liability to EMG.

Estimated installation costs are based on EMG's experience on similar projects and industry standard cost estimating tools including *RS Means and Whitestone Cost Lab*. In developing the installed costs, EMG also considered the area correction factors for labor rates for Sacramento, California. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

EMG certifies that EMG has no undisclosed interest in the subject property and that EMG's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Kaustubh Anil Chabukswar at 800.733.0660, ext. 7512.

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1. Executive Summary

The purpose of this Energy Audit is to provide Sacramento City Unified School District and John Still Elementary (West Campus) with a baseline of energy usage and the relative energy efficiency of the facility and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal & Utility grants towards energy conservation, support performance contracting, justify a municipal bond funded improvement program, or as a basis for replacement of equipment or systems.

Bldg #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	Administration Building	Building	5800	30-50
2	Building C	Building	6900	40-60
3	Building D	Building	7400	40-60
4	Building E	Building	7400	40-60
5	Building F	Building	7400	40-60
6	Building K	Building	5900	30-50
7	Library	Building	5300	30-50
8	MPR	Building	8500	50-60
9	Restrooms Building	Modular	700	5-10

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

1.1. Energy Conservation Measures

EMG has identified three Energy Conservation Measures (ECMs) for this property. The savings for each measure is calculated using standard engineering methods followed in the industry, and detailed calculations for ECM are provided in Appendix for reference. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, EMG has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings.

Summary of Financial Information for Recommended Non-Renewable Energy Conservation Measures

ITEM	ESTIMATE
Net Initial ECM Investment (<i>Current Dollars Only</i>)	\$ 100,247 (<i>In Current Dollars</i>)
Estimated Annual Cost Savings (<i>Current Dollars Only</i>)	\$12,486 (<i>In Current Dollars</i>)
ECM Effective Payback	8.03 years
Estimated Annual Energy Savings	14.44%

ITEM	ESTIMATE
Estimated Annual Energy Utility Cost Savings (<i>Excluding Water</i>)	14.79%
Estimated Annual Water Cost Saving	0.41%

Solar Photovoltaic (PV) Screening for JOHN STILL ELEMENTARY (WEST CAMPUS)

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	410	
Estimated KW Rating	129	KW
Potential Annual kWh Produced	198,707	kWh
% of Current Electricity Uses	50.2%	
FINANCIAL SUMMARY		
Investment Cost	\$ 451,500	
Estimated Energy Cost Savings	\$31,793	
Payback without Incentives	14.2	Years
Incentive Payback but without SRECs	8.6	Years
Payback with All Incentives	8.6	Years

Key Metrics to Benchmark the Subject Property's Energy Usage Profile

- **Building Site Energy Use Intensity** - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- **Building Source Energy Use Intensity** – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- **Building Cost Intensity** - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- **Greenhouse Gas Emissions** - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO₂). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

SITE ENERGY USE INTENSITY (EUI)	RATING
Current Site Energy Use Intensity (EUI)	28 kBtu/ft ²
Post ECM Site Energy Use Intensity (EUI)	24 kBtu/ft ²
SOURCE ENERGY USE INTENSITY (EUI)	RATING
Current Source Energy Use Intensity (EUI)	85 kBtu/ft ²
Post ECM Source Energy Use Intensity (EUI)	72 kBtu/ft ²
BUILDING COST INTENSITY (BCI)	RATING
Current Building Cost Intensity	\$1.17/ft ²
Post ECM Building Cost Intensity	\$1.00/ft ²

Summary of the Greenhouse Gas Reductions from Recommended Non-Renewable Energy Conservation Measures

The following table provides a summary of the projected Greenhouse Gas Emissions reductions as a result of the recommended Energy Conservation Measures:

GREENHOUSE GAS EMISSIONS REDUCTION	
Estimated Annual Thermal Energy Reduction	220 MMbtu
Total CO ₂ Emissions Reduced	20.37 MtCO ₂ /Yr
Total Cars Off the Road (Equivalent)*	4
Total Acres of Pine Trees Planted (Equivalent)*	5

**Equivalent reductions per DOE emissions calculation algorithms*

Zero Net Energy Analysis for Renewable and Non-Renewable Recommended Measures

ZERO NET ENERGY ANALYSIS	
Building Annual Net Energy Consumption	1,520,822 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	219,637 kBtu
Total Annual Energy Savings from Renewable Energy Measures	677,988 kBtu
Total Annual Energy Savings	897,625 kBtu
Net Energy Consumption from Grid Post Implementation	623,197 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	59%

Energy Conservation Measures Screening:

EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

$$\text{Simple Payback} = \frac{\text{Initial Cost}}{\text{Annual Savings}}$$

2. Savings-to-Investment Ratio (SIR) – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value over the estimated useful life (EUL) of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy efficiency recommendations should be based on a calculated SIR, with larger SIRs receiving a higher priority. A project is typically only recommended if SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

$$\text{SIR} = \frac{\text{Present Value (Annual Savings, } i\%, \text{ EUL)}}{\text{Initial Cost}}$$

List of Recommended Energy Conservation Measures For John Still Elementary (West Campus)

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		\$	Therms	kWh	kgal	\$	\$	\$	Years		\$	Years
Capital Cost Recommendations												
1	Install Low Flow Faucet Aerators	\$1,142	0	2,465	17	\$488	\$0	\$488	2.34	3.65	\$3,024	10.00
	Location: Throughout Buildings											
2	Upgrade Building Lighting to LED and Install Automatic Lighting Controls	\$61,267	0	51,438	0	\$8,093	\$3,160	\$11,253	5.44	2.19	\$73,067	15.00
	Location: Building Interior And Exterior											
3	Re-Commission The Building & Its Control Systems	\$24,762	198	11,805	0	\$2,133	\$0	\$2,133	11.61	1.03	\$698	15.00
	Location: Throughout											
Total For Capital Cost		\$87,171	198	65,708	17	\$10,714	\$3,160	\$13,874	6.28			
	<i>Interactive Savings Discount @ 10%</i>		-20	-6,571	-2	-\$1,071	-\$316	-\$1,387				
	<i>Total Contingency Expenses @ 15%</i>	\$13,076										
Total for Improvements		\$100,247	179	59,137	15	\$9,643	\$2,844	\$12,486	8.03			



In addition to the above measures, EMG has identified the following measure(s) but has not recommended as they fail to meet the above-mentioned financial criteria of SIR>1.0. Thus, EMG has classified the measure(s) as recommended for consideration.

List of Recommended For Consideration Energy Conservation Measures For John Still Elementary (West Campus)												
ECM #	Description of ECM	Initial Investment	Annual Energy Savings		Annual Water Savings	Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			\$	Natural Gas								
1	Replace Existing Air Conditioners with Energy Star Air Conditioners	\$107,893	0	32,857	0	\$5,170	\$258	\$5,428	19.88	0.60	-\$43,093	15.00
	Location: Throughout											
2	Install Low Flow Tankless Restroom Fixtures	\$52,377	0	0	262	\$1,550	\$0	\$1,550	33.78	0.35	-\$33,868	15.00
	Location: Throughout Building											
3	Replace Existing Water Heater With New Energy Efficient Units	\$18,532	88	1,052	0	\$288	\$0	\$288	64.32	0.21	-\$14,569	18.00
	Location: Throughout Buildings											
Total for Improvements		\$178,802	88	33,909	262	\$7,008	\$258	\$7,267	24.61			

2. Introduction

The purpose of this Energy Audit is to provide John Still Elementary (West Campus) and Sacramento City Unified School District with a baseline of energy usage, the relative energy efficiency of the facility, and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal and Utility grants towards energy conservation, as well as support performance contracting, justify a municipal bond-funded improvement program, or as a basis for replacement of equipment or systems.

The energy audit consisted of an onsite visual assessment to determine current conditions, itemize the energy consuming equipment (i.e. Boilers, Make-Up Air Units, DWH equipment); review lighting systems both exterior and interior; and review efficiency of all such equipment. The study also included interviews and consultation with operational and maintenance personnel. The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

ENERGY AND WATER USING EQUIPMENT

- EMG has surveyed the common areas, office areas, rooms, maintenance facilities and mechanical rooms to document utility-related equipment, including heating systems, cooling systems, air handling systems and lighting systems.

BUILDING ENVELOPE

- EMG has reviewed the characteristics and conditions of the building envelope, checking insulation values and conditions. This review also includes an inspection of the condition of walls, windows, doors, roof areas, insulation and special use areas

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

- Based on the information gathered during the on-site assessment, the utility rates, as well as recent consumption data and engineering analysis, EMG has identified opportunities to save energy and provide probable construction costs, projected energy/utility savings and provide a simple payback analysis.

ANALYSIS OF ENERGY CONSUMPTION

- Based on the information gathered during the on-site assessment, EMG has conducted an analysis of the energy usage of all equipment, and identified which equipment is using the most energy and what equipment upgrades may be necessary. As a result, equipment upgrades, or replacements are identified that may provide a reasonable return on the investment and improve maintenance reliability.

ENERGY AUDIT PROCESS

- Interviewing staff and review plans and past upgrades
- Performing an energy audit for each use type
- Performing a preliminary evaluation of the utility system
- Analyzing findings, utilizing ECM cost-benefit worksheets
- Making preliminary recommendations for system energy improvements and measures
- Estimating initial cost and changes in operating and maintenance costs based on implementation of energy efficiency measures
- Ranking recommended cost measures, based on the criticality of the project and the largest payback

REPORTING

The EMG Energy Audit Report includes:

- A comprehensive study identifying all applicable Energy Conservation Measures (ECMs) and priorities, based on initial cost and payback
- A narrative discussion of building systems/components considered and a discussion of energy improvement options;
- A summary of ECMs including initial costs and simple paybacks, based on current utility rates and expected annual savings.

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	35
Operational Weeks / Year	36
Estimated Facility Occupancy	410
% of Male Occupants	205

POINT OF CONTACT	
Point of Contact Name	Maggie Navarro
Point of Contact Title	Maintenance Supervisor
Point of Contact – Contact Number	-

3.2. Building Heating, Ventilating and Air-Conditioning (HVAC)

Description:

Heating and cooling are mainly provided by rooftop packaged units. There are also split system with furnaces throughout the buildings.

The Mechanical Equipment Schedule in Appendix contains a summary of the HVAC Equipment at the property.

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Rooftop Packaged Units
Secondary Heating System	Forced Air Furnace Ductless Split Systems
Hydronic Distribution System	Not Applicable
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Packaged Units
Secondary Cooling System	Split Systems, Ductless Split System
Hydronic Distribution System	Not Applicable
Cooling Mode Set-point	73 °F
Cooling Mode- Set-back Temperature	93 °F

AIR DISTRIBUTION SYSTEM	
Building Ventilation	Rooftop Exhaust Fans
On-Demand Ventilation System in Use?	No
Energy Recovery Wheel / Enthalpy Wheel Exhaust Fans	No

DOMESTIC HOT WATER SYSTEM	
Primary Domestic Water Fuel	Natural Gas and Electricity

3.3. Lighting

Description:

The lighting in the school building primarily consists of T8 linear fluorescent lamp fixtures in classrooms and hallways. The fixtures were observed to be operating on bi-level mode in the classrooms. The exterior lights were primarily High Intensity Discharge (HID) fixtures.

The detailed lighting schedule and the proposed LED alternative is provided in Appendix.

4. Utility Analysis

Establishing the energy baseline begins with an analysis of the utility cost and consumption of the building. Utilizing the historical energy data and local weather information, we evaluate the existing utility consumption and assign it to the various end-uses throughout the buildings. The Historical Data Analysis breaks down utilities by consumption, cost and annual profile.

This data is analyzed, using standard engineering assumptions and practices. The analysis serves the following functions:

- Allows our engineers to benchmark the energy and water consumption of the facilities against consumption of efficient buildings of similar construction, use and occupancy.
- Generates the historical and current unit costs for energy and water
- Provides an indication of how well changes in energy consumption correlate to changes in weather.
- Reveals potential opportunities for energy consumption and/or cost reduction. For example, the analysis may indicate that there is excessive, simultaneous heating and cooling, which may mean that there is an opportunity to improve the control of the heating and cooling systems.

By performing this analysis and leveraging our experience, our engineers prioritize buildings and pinpoint systems for additional investigation during the site visit, thereby maximizing the benefit of their time spent on-site and minimizing time and effort by the customer's personnel.

Based upon the utility information provided about the Sacramento City Unified School District, the following energy rates are utilized in determining existing and proposed energy costs.

Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
\$0.16 /kWh	\$1.39 /therm	\$ 5.92 /kGal

The data analyzed provides the following information: 1) breakdown of utilities by consumption, 2) cost and annual profile, 3) baseline consumption in terms of energy/utility at the facility, 4) the Energy Use Index, or Btu/sq ft, and cost/sq ft. For multiple water meters, the utility data is combined to illustrate annual consumption for each utility type.

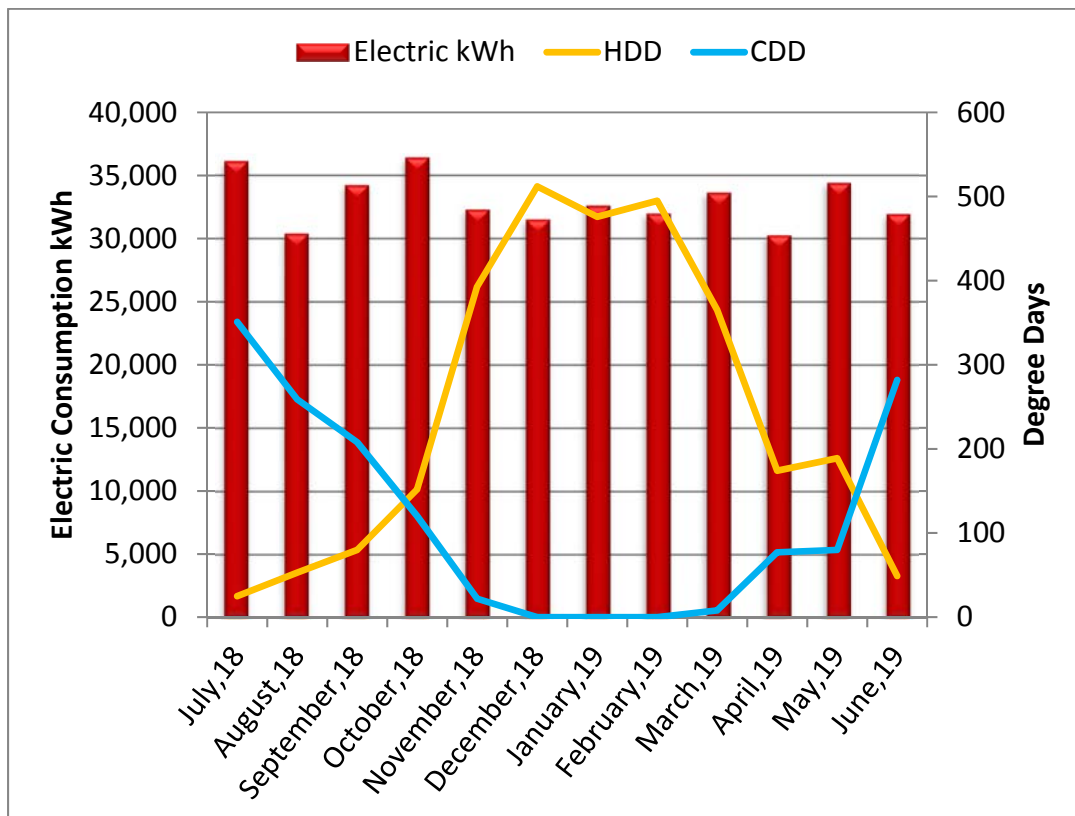
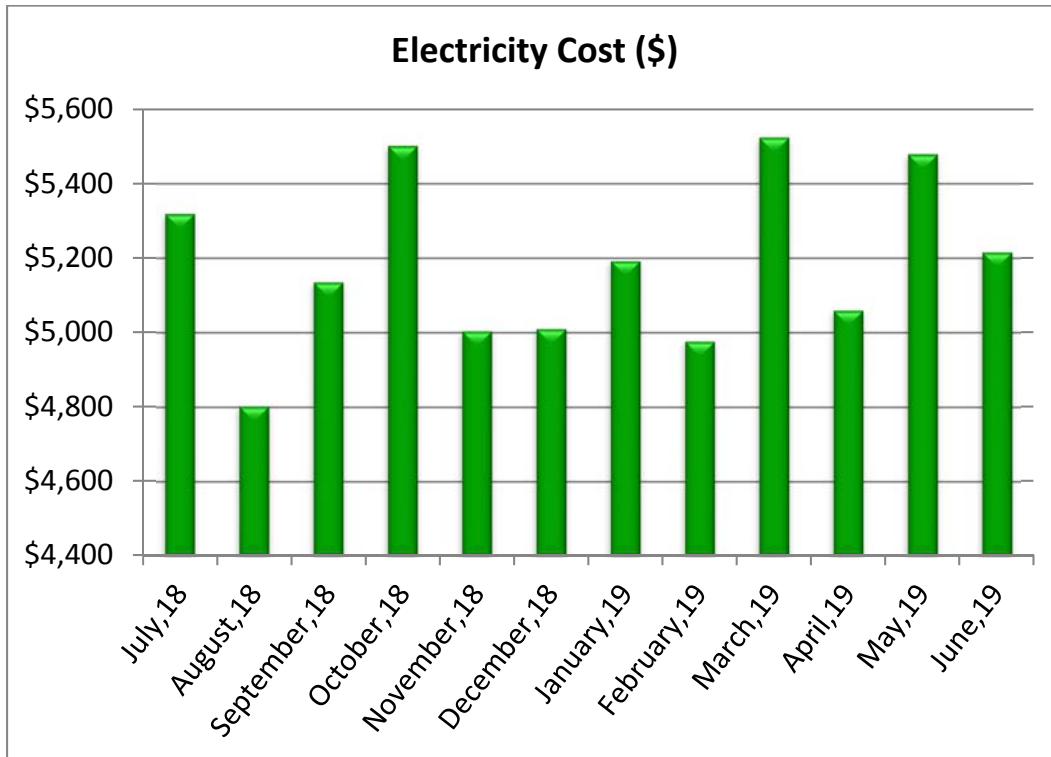
4.1. Electricity

SMUD satisfies the electricity requirements for the facility. The primary end uses for electric utility comprises of lighting, cooling, water heaters, office/school equipment, and appliances in the break room.

The table below provides the electric use for the period of twelve continuous months.

Electric Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KWH)	UNIT COST/KWH	TOTAL COST
July,18	36,098	\$0.15	\$5,319
August,18	30,371	\$0.16	\$4,804
September,18	34,199	\$0.15	\$5,136
October,18	36,393	\$0.15	\$5,501
November,18	32,274	\$0.16	\$5,005
December,18	31,482	\$0.16	\$5,011
January,19	32,576	\$0.16	\$5,193
February,19	31,959	\$0.16	\$4,978
March,19	33,608	\$0.16	\$5,523
April,19	30,233	\$0.17	\$5,060
May,19	34,380	\$0.16	\$5,478
June,19	31,920	\$0.16	\$5,216
Total/average	395,493	\$0.16	\$62,225



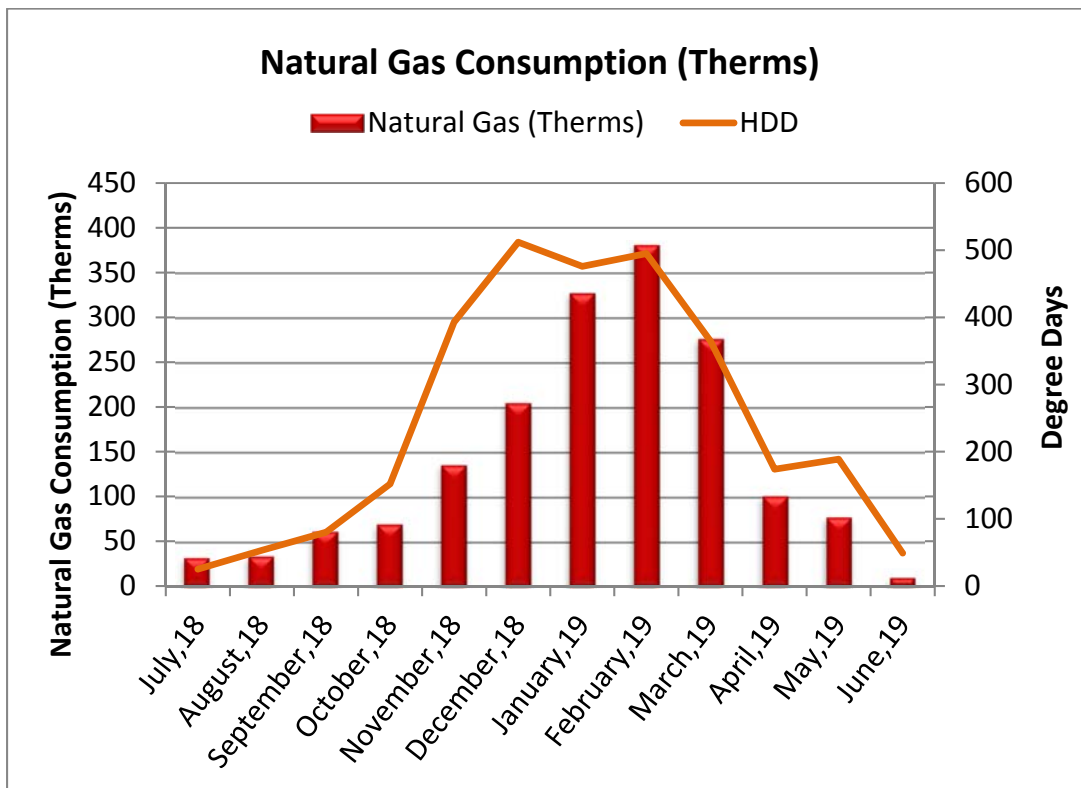
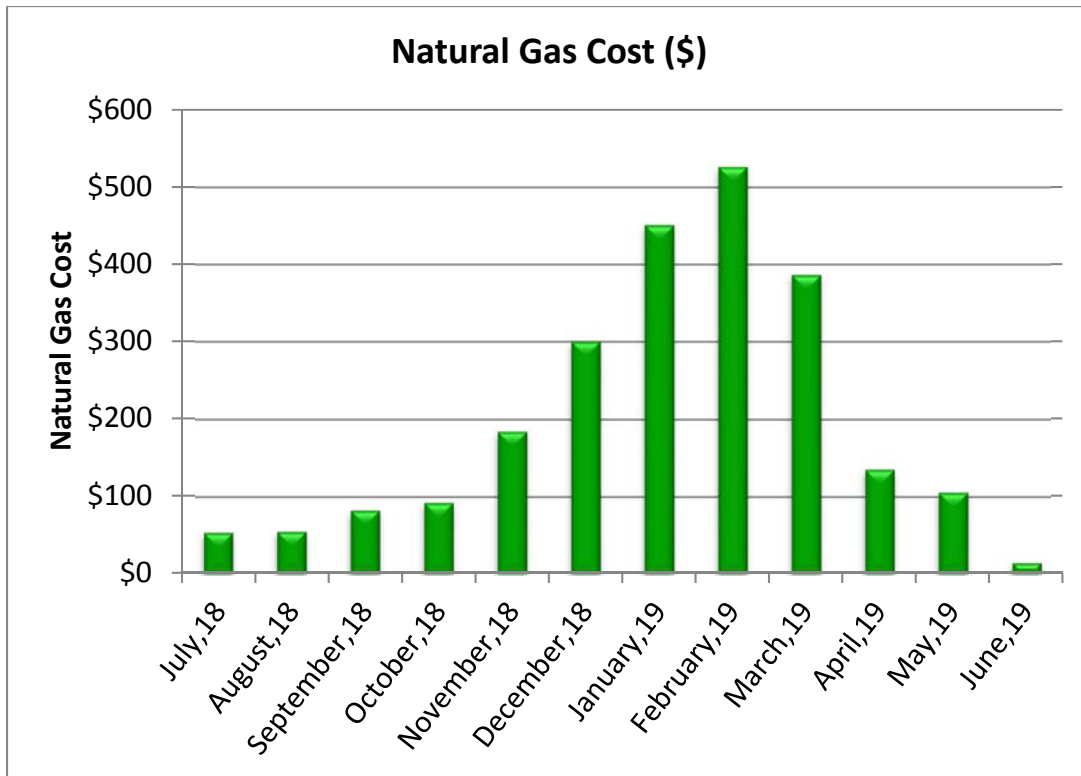
4.2. Natural Gas

PGE satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

The analysis of the 12 months of consumption is provided below.

Natural Gas Consumption and Cost Data

BILLING MONTH	CONSUMPTION (THERMS)	UNIT COST/THERM	TOTAL COST
July, 18	32	\$1.65	\$53
August, 18	34	\$1.59	\$54
September, 18	62	\$1.32	\$81
October, 18	70	\$1.31	\$91
November, 18	136	\$1.35	\$184
December, 18	205	\$1.46	\$300
January, 19	328	\$1.38	\$451
February, 19	381	\$1.38	\$526
March, 19	277	\$1.39	\$386
April, 19	101	\$1.33	\$134
May, 19	78	\$1.35	\$105
June, 19	10	\$1.37	\$14
Total/average	1,714	\$1.39	\$2,378

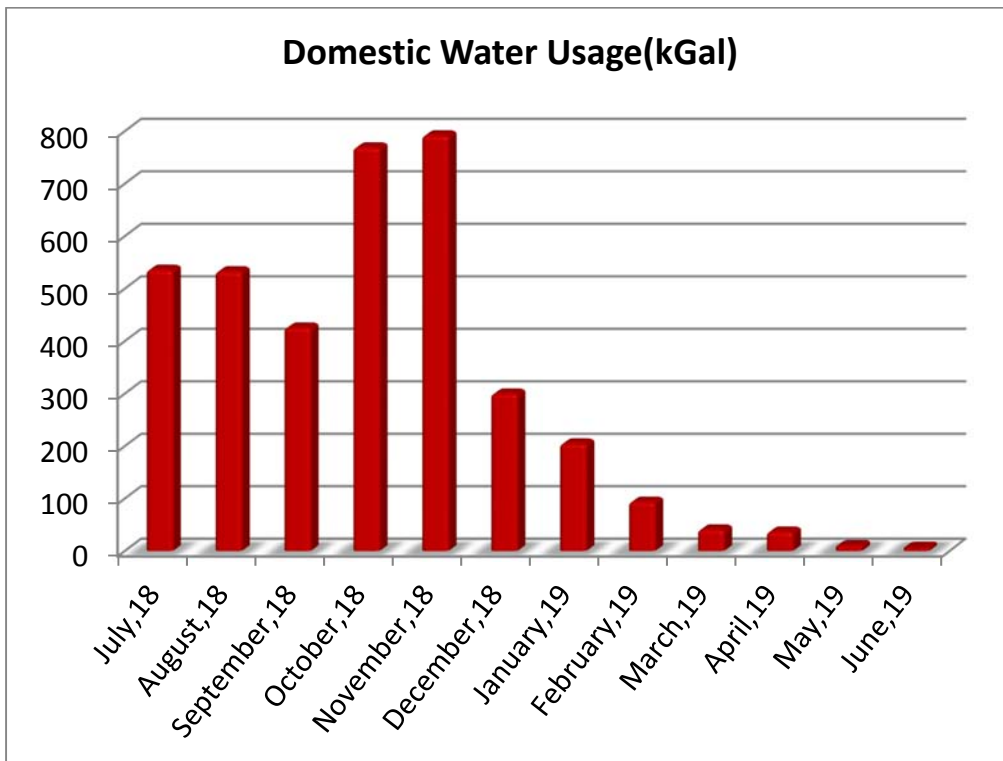
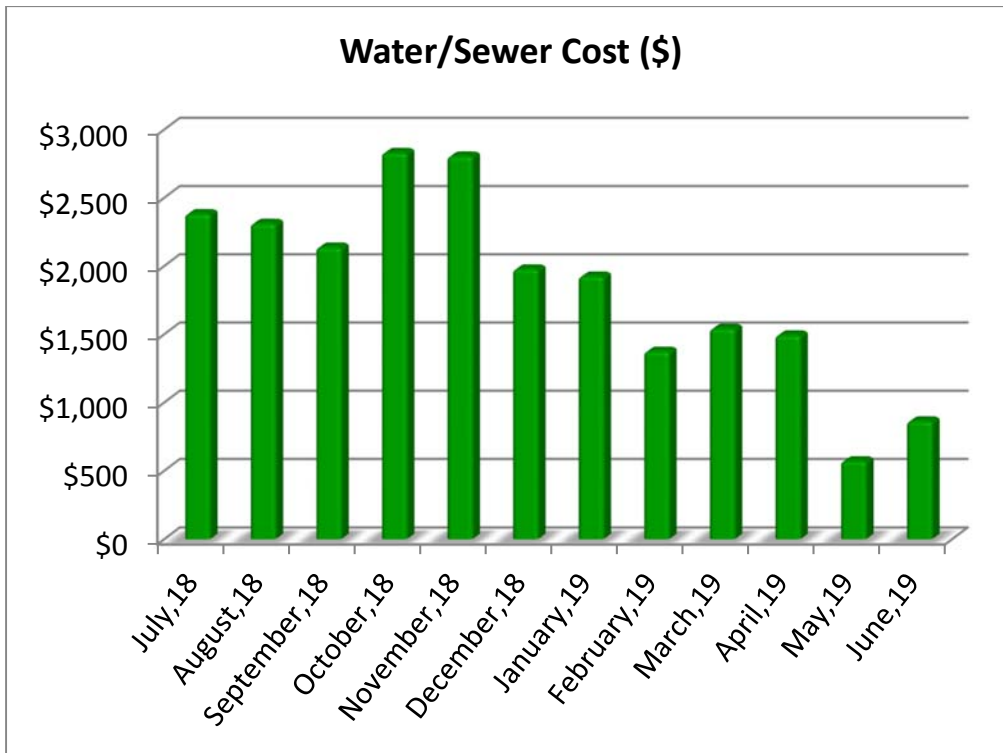


4.3. Water and Sewer

The City of Sacramento satisfies the water requirements for the facility. The primary end use of water is the plumbing fixtures such as staff showers, water closets, and lavatories. The table below provides the twelve continuous months' worth of consumption and cost for water in kGal for the facility.

Water and Sewer Consumption and Cost Data

BILLING MONTH	CONSUMPTION (KGAL)	UNIT COST/KGAL	TOTAL COST
July,18	537	\$4.44	\$2,386
August,18	534	\$4.34	\$2,315
September,18	427	\$5.01	\$2,141
October,18	770	\$3.68	\$2,834
November,18	793	\$3.54	\$2,808
December,18	301	\$6.58	\$1,981
January,19	206	\$9.36	\$1,928
February,19	95	\$14.51	\$1,378
March,19	42	\$36.79	\$1,545
April,19	38	\$39.39	\$1,497
May,19	11	\$52.27	\$575
June,19	7	\$123.86	\$867
Total/average	3,761	\$5.92	\$22,255



5. Renewable Energy Discussions

5.1. Rooftop Solar Photovoltaic Feasibility

Solar Energy Feasibility

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current electricity via the photovoltaic effect. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can plug into the existing infrastructure to power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current. Solar arrays are typically measured by the peak electrical power they produce, in watts, kilowatts, or even megawatts.

When determining if a site is suitable for a solar application, two basic considerations must be evaluated:

- At minimum, the sun should shine upon the solar collectors from 9 AM to 3 PM. If less, the application may still be worthwhile, but the benefit will be less.
- The array should face south and be free of any shading from buildings, trees, rooftop equipment, etc. If the array is not facing directly south, there will be a penalty in transfer efficiency, reducing the overall efficiency of the system.

SOLAR PV QUESTIONNAIRE	RESPONSE
Does the property have a south, east, or west facing roof or available land of more than 250 square feet per required Solar Array Panel?	Yes
Is the area free from any shading such as trees, buildings, equipment etc throughout the whole day?	Yes
Can the panels be mounted at an incline of roughly 25-45 degrees? (equal to latitude of property)	Yes
Is the property in an area with acceptable average monthly sunlight levels?	Yes
Has the roofing been replaced within the past 3-5 years?	No
Is the roof structure sufficient to hold solar panels?	Additional Study Required
Is the property located in a state eligible for net metering?	Yes

A solar feasibility analysis of the site has resulted in the building containing more than sufficient amount of roof area for solar electricity generation. The analysis through the use of National Renewable Energy Laboratory’s solar photovoltaic software assisted in calculating the potential electricity generated from the allocated land and roof area set for solar photovoltaic installment. The allocated roof area was through looking at the roof and surrounding areas at a bird’s eye view. Also detailed in the report are incentives and rebates that can potentially bring down the installation cost of the ECMs and result in a higher return on investment and quicker payback period.

The approach taken in the solar photovoltaic (PV) roof analysis begins with surveying the roof and determine areas on the roof where solar PV panels can potentially be installed.

- 1) Conducting a preliminary sizing of solar PV panels on the roofs and on the ground and its potential electricity production for its first year of installment using the National Renewable Energy Laboratory (NREL) PV WATTS Version 2 Software.
- 2) Calculate energy and cost savings for the site as a sole proprietor of the system capable of collecting state, local, and federal tax credits and incentives and interconnecting and selling the renewable energy electrical production to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS		
Estimated Number of Panels	410	
Estimated KW Rating	129	KW
Potential Annual kWh Produced	198,707	kWh
% of Current Electricity Uses	50.2%	
FINANCIAL SUMMARY		
Investment Cost	\$ 451,500	
Estimated Energy Cost Savings	\$31,793	
Payback without Incentives	14.2	Years
Incentive Payback but without SRECs	8.6	Years
Payback with All Incentives	8.6	Years

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current. Modules of cells are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can connect to existing AC infrastructure to power lights, motors, and other loads.

Cost of production has fallen years with increasing demand and through production and technological advances. The cost dropped from \$8–10/watt in 1996 to \$4–7/watt in 2006. The market is diversifying with new types of panels suited to unique installation methods including stick on sheets and PV spray coating. The solar PV cost used in the analysis was set at \$7.0/Watt which includes design, construction, administration, and installation and maintenance cost throughout the life of the solar panels.

One breakthrough for PV is “Net Metering”. When more PV electric power is generated than is consumed on site, the electric service meter reverses to “sell” the excess power directly back onto the power grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

A kilowatt-hour costing \$0.15 might be valued at \$0.30 when produced by PV and sent to the grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

The low payback period is highly dependent on the marketing potential of selling Solar Renewable Certificates to electricity generated providers who are under state regulations to contain a certain percentage of their electricity generation derived from renewable energy such as wind and solar.

Solar facilities are encouraged to sell their SRECs on the market (either spot market or through long-term contracts). Utilities may use SRECs for compliance under the state RPS for the year in which they are generated. Utilities may purchase up to 10% more SRECs than they require for compliance and “bank” those surplus SRECs for compliance during the following two years. Any SRECs pricing can range from \$300 - \$450/MWh and can be sold across state borders to other utility providers looking to purchase SRECs. EMG has selected to use the market value of \$300/MWh minus 5% administrative fee in the analysis.

A number of states and corresponding electrical utility supplier are required under regulation to have a certain percentage of its electricity be produced by solar energy. To offset that they allow other utility companies to buy Renewable Energy Credits (REC) credit off their customers and facilities that produce their own solar energy. Typically the national market, the utility market is \$400 per MWh to Utility Suppliers for not meeting this standard percentage so these REC credits are sold for \$350 per MWh. (1 REC credit = 1 MWh).

State charges these utility companies to meet their state compliance of 0.2% of the entire electricity consumption from solar energy by 2022 (from.005% in 2008 aggregated up to 0.2% by 2022). The REC credits correspond to these percentages as they aggregate each year.



6. Operations and Maintenance Plan

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

Building Envelope

- ✓ Ensure that the building envelope has proper caulking and weather stripping.
- ✓ Patch holes in the building envelope with foam insulation and fire rated caulk around combustion vents
- ✓ Inspect building vents semiannually for bird infestation
- ✓ Inspect windows monthly for damaged panes and failed thermal seals
- ✓ Repair and adjust automatic door closing mechanisms as needed.

Heating and Cooling

- ✗ Pilots lights on furnaces and boilers be turned off in summer
- ✗ All preventive maintenance should be performed on all furnaces and boilers, which would include cleaning of burners and heat exchanger tubes.
- ✗ Ensure that the combustion vents exhaust outside the conditioned space and the vent dampers are functional
- ✗ Ensure that the control valves are functioning properly before start of every season
- ✗ Ensure steam traps are functional before start of each heating season
- ✗ Ensure use of chemical treatment for boiler make up water
- ✗ Ensure boiler outside temperature re-set is set to 55F
- ✗ Ensure use of chemical treatment for Colling tower water to prevent corrosion
- ✗ Ensure the duct work in unconditioned space is un-compromised and well insulated
- ✓ Duct cleaning is recommended every 10 years. This should include sealing of ducts using products similar to 'aero-seal'
- ✗ Ensure use of economizer mode is functional and used
- ✗ Ensure that the outside air dampers actuators are operating correctly
- ✗ Ensure air coils in the AHU and FCA's are pressure washed annually
- ✓ Return vents should remain un-obstructed and be located centrally
- ✓ Temperature settings reduced in unoccupied areas and set points seasonally adjusted.
- ✓ Evaporator coils and condenser coils should be regularly cleaned to improve heat transfer
- ✓ Refrigerant pipes should be insulated with a minimum of ¾" thick Elastomeric Rubber Pipe Insulation
- ✓ Ensure refrigerant pressure is maintained in the condensers
- ✓ Change air filters on return vents seasonally. Use only filters with 'Minimum Efficiency Rating Value'(MERV) of 8

Central Domestic Hot Water Heater

- ✓ Never place gas fired water heaters adjacent to return vents so as to prevent flame roll outs
- ✓ Ensure the circulation system is on timer to reduce the losses through re-circulation
- ✓ Ensure all hot water pipes are insulated with fiberglass insulation at all times
- ✓ Replacement water heater should have Energy Factor (EF)>0.9
- ✓ Tank-type water heaters flushed monthly

**Lighting
Improvements**

- ✓ Utilize bi-level lighting controls in stairwells and hallways.
- ✓ Use LED replacement lamps
- ✓ Clean lighting fixture reflective surfaces and translucent covers.
- ✓ Ensure that timers and/or photocells are operating correctly on exterior lighting
- ✓ Use occupancy sensors for offices and other rooms with infrequent occupancy

Existing Equipment and Replacements

- ✓ Ensure that refrigerator and freezer doors close and seal correctly
- ✓ Ensure kitchen and bathroom exhaust outside the building and the internal damper operates properly
- ✓ Ensure that bathroom vents exhaust out
- ✓ Office/ computer equipment either in the “sleep” or “off” mode when not used

7. Appendices

APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: Lighting System Schedule

APPENDIX D: ECM Checklist

APPENDIX E: ECM Calculations

APPENDIX F: Solar PV

APPENDIX A: Glossary of Terms

Glossary of Terms and Acronyms

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period – The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

SIR - The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy-efficiency recommendations be based on a calculated SIR, with larger SIRs receiving a higher priority. A project typically is recommended only if the SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

Life Cycle Cost - The sum of the present values of (a) Investment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs; (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO₂). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX B: Mechanical Equipment Inventory

Mechanical Inventory							
System	Make	Model	Serial Number	Input Capacity	Location	Location-Floor	Quantity
Water Heater	A. O. Smith	Inaccessible	Inaccessible	20 GAL	John Still Elementary (West Campus) / Administration Building	Custodian closet	1
Water Heater	A. O. Smith	DSE 20	SJ06113848	20 GAL	John Still Elementary (West Campus) / Building D	Custodian closet	1
Water Heater	A. O. Smith	DSE 20	SJ06113844	20 GAL	John Still Elementary (West Campus) / Building E	Custodian closet	1
Water Heater	A. O. Smith	DSE 20	122129-F08	20 GAL	John Still Elementary (West Campus) / Building F	Custodian closet	1
Water Heater	A. O. Smith	DSE 20	SJ06113847	20 GAL	John Still Elementary (West Campus) / Building K	Custodian closet	1
Water Heater	A. O. Smith	DSE 30	SJ06113782	30 GAL	John Still Elementary (West Campus) / Library	Custodian closet	1
Water Heater	A. O. Smith	BTN120108	G06M000117	120 GAL	John Still Elementary (West Campus) / MPR	Custodian closet	1
Domestic Booster Pump Station	JDL System	JDL2E-180-75-ST	27A1644	5 HP	John Still Elementary (West Campus) / Site	Site	1
Domestic Booster Pump Station	No tag/plate found	No tag/plate found	No tag/plate found	5 HP	John Still Elementary (West Campus) / Site	Site	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275X242FN	5 TON	John Still Elementary (West Campus) / Building C	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275YA22FU	5 TON	John Still Elementary (West Campus) / Building C	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M.W.	5 TON	John Still Elementary (West Campus) / Building C	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M262611JP2FO	5 TON	John Still Elementary (West Campus) / Building C	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275X2M2F+	5 TON	John Still Elementary (West Campus) / Building C	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	E7Q2111021RE2FR	5 TON	John Still Elementary (West Campus) / Building D	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	E7Q2111021M27FF	5 TON	John Still Elementary (West Campus) / Building D	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275X802FP	5 TON	John Still Elementary (West Campus) / Building D	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	E7Q211323N5A2F5	5 TON	John Still Elementary (West Campus) / Building D	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275XXP2FW	5 TON	John Still Elementary (West Campus) / Building D	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275YAW2FH	5 TON	John Still Elementary (West Campus) / Building E	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275X2B2FU	5 TON	John Still Elementary (West Campus) / Building E	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275U12F5	5 TON	John Still Elementary (West Campus) / Building E	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26295WGA2F1	5 TON	John Still Elementary (West Campus) / Building E	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26295U612FN	5 TON	John Still Elementary (West Campus) / Building E	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M280518C72F5	5 TON	John Still Elementary (West Campus) / Building F	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M2802271E2F+	5 TON	John Still Elementary (West Campus) / Building F	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M281455652FL	5 TON	John Still Elementary (West Campus) / Building F	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M280227322FV	5 TON	John Still Elementary (West Campus) / Building F	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M280228CF2FB	5 TON	John Still Elementary (West Campus) / Building F	Building exterior	1
Ductless Split System	Carrier	38BNC018301	1307001174	1.5 TON	John Still Elementary (West Campus) / Building K	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	54M26275X1J2F.	5 TON	John Still Elementary (West Campus) / Building K	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	No tag/plate found	5 TON	John Still Elementary (West Campus) / Building K	Building exterior	1
Condensing Unit	American Standard Inc.	4A6C3060A4000BB	No tag/plate found	5 TON	John Still Elementary (West Campus) / Building K	Building exterior	1
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	500 CFM	John Still Elementary (West Campus) / Library	Roof	2
Exhaust Fan	No tag/plate found	No tag/plate found	No tag/plate found	1200 CFM	John Still Elementary (West Campus) / MPR	Roof	2
Exhaust Fan	Inaccessible	Inaccessible	Inaccessible	500 CFM	John Still Elementary (West Campus) / Restrooms Building	Roof	2
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053KB1V	20 kW	John Still Elementary (West Campus) / Building C	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	630576F1V	20 kW	John Still Elementary (West Campus) / Building C	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	6305J91V	20 kW	John Still Elementary (West Campus) / Building C	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053K81V	20 kW	John Still Elementary (West Campus) / Building C	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	630388M2V	20 kW	John Still Elementary (West Campus) / Building C	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	6305NRM1V	20 kW	John Still Elementary (West Campus) / Building D	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053KC1V	20 kW	John Still Elementary (West Campus) / Building D	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053J71V	20 kW	John Still Elementary (West Campus) / Building D	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	630335SK2V	20 kW	John Still Elementary (West Campus) / Building D	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053K11V	20 kW	John Still Elementary (West Campus) / Building D	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	630355B2V	20 kW	John Still Elementary (West Campus) / Building E	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	630411B2V	20 kW	John Still Elementary (West Campus) / Building E	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63035R42V	20 kW	John Still Elementary (West Campus) / Building E	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053J51V	20 kW	John Still Elementary (West Campus) / Building E	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053K11V	20 kW	John Still Elementary (West Campus) / Building E	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	90810ME2V	20 kW	John Still Elementary (West Campus) / Building F	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	80912EE2V	20 kW	John Still Elementary (West Campus) / Building F	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	80912EH2V	20 kW	John Still Elementary (West Campus) / Building F	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	80910MD2V	20 kW	John Still Elementary (West Campus) / Building F	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	90812BC2V	20 kW	John Still Elementary (West Campus) / Building F	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63053KE1V	20 kW	John Still Elementary (West Campus) / Building K	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	63004MF2V	20 kW	John Still Elementary (West Campus) / Building K	Above ceiling	1
Furnace	American Standard Inc.	ZTEC3F60A1000AA	Inaccessible	20 kW	John Still Elementary (West Campus) / Building K	Above ceiling	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	6 TON	John Still Elementary (West Campus) / Administration Building	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	6 TON	John Still Elementary (West Campus) / Administration Building	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	4 TON	John Still Elementary (West Campus) / Administration Building	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	5 TON	John Still Elementary (West Campus) / Library	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	8 TON	John Still Elementary (West Campus) / Library	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	6 TON	John Still Elementary (West Campus) / MPR	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	2 TON	John Still Elementary (West Campus) / MPR	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	13 TON	John Still Elementary (West Campus) / MPR	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	3 TON	John Still Elementary (West Campus) / MPR	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	6 TON	John Still Elementary (West Campus) / MPR	Roof	1
Packaged Unit (RTU)	AAON, Inc.	No tag/plate found	No tag/plate found	13 TON	John Still Elementary (West Campus) / MPR	Roof	1
Air Curtain	Berner International	KUR-034	illegible	1000 CFM	John Still Elementary (West Campus) / MPR	Kitchen	1

APPENDIX C: Lighting System Schedule



Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	LUX	Control Quantity	Existing Control	Lamp Details				Fixture Details				Existing Consumption	
									Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	C-Building	Interior	1	CLASSROOM	C02	350	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	140	1x4 Indirect Troffer	20	0	9	2,160	9,677
2	D-Building	Interior	1	CLASSROOM	D05	350	20	Light Switch	Linear Fluorescent	T8	4' 32W T8	140	1x4 Indirect Troffer	20	0	9	2,160	9,677
3	D-Building	Interior	1	STORAGE	D-Storage	200	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	684	175
4	D-Building	Interior	1	JANITORIAL	D-Custodian	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44
5	D-Building	Interior	1	RESTROOM	D-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	9	2,160	691
6	D-Building	Interior	1	RESTROOM	D-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
7	E-Building	Interior	1	CLASSROOM	E04	350	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	140	1x4 Indirect Troffer	20	0	9	2,160	9,677
8	F-Building	Interior		CLASSROOM	F04	350	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	140	1x4 Indirect Troffer	20	0	9	2,160	9,677
9	F-Building	Interior	1	JANITORIAL	F-Janitor	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	684	44
10	F-Building	Interior		RESTROOM	F-Girls	300		Timer	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	1	9	2,160	691
11	F-Building	Interior		RESTROOM	F-Girls	300		Timer	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
12	F-Building	Interior	1	RESTROOM	F-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	9	2,160	691
13	F-Building	Interior	1	RESTROOM	F-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
14	F-Building	Interior	1	STORAGE	F-Storage	200	0	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	9	684	175
15	D-Building	Interior	1	RESTROOM	D-Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	9	2,160	691
16	D-Building	Interior	1	RESTROOM	D-Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
17	E-Building	Interior	1	RESTROOM	E-Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	9	2,160	691
18	E-Building	Interior	1	RESTROOM	E-Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
19	E-Building	Interior		RESTROOM	E-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	9	2,160	691
20	E-Building	Interior		RESTROOM	E-Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	9	2,160	415
21	E-Building	Interior		STORAGE	E-Storage	-	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	9	684	88
22	E-Building	Interior	1	JANITORIAL	E-Custodian	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	684	44
23	E-Building	Interior	1	RESTROOM	E-Staff #1	200	1	Timer	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	2,160	138
24	E-Building	Interior	1	RESTROOM	E-Staff #2	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	2,160	138
25	Library	Interior	1	LIBRARY	Library	325	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	1x4 Indirect Troffer	2	0	20	2,160	1,244
26	Library	Interior	1	LIBRARY	Library	325	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	1x4 Indirect Troffer	2	1	20	2,160	415
27	Library	Interior	1	LIBRARY	Library	325	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Prism Troffer	12	0	8	2,160	2,488
28	Library	Interior	1	CLASSROOM	Media	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	9	1,260	484
29	Library	Interior	1	CLASSROOM	Handicap #1	325	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	9	1,260	484
30	Library	Interior	1	CLASSROOM	Handicap #2	325	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	1x4 Indirect Troffer	4	0	10	1,260	968
31	Library	Interior	1	RESTROOM	Restroom	200	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	9	2,160	276
32	Library	Interior	1	CLASSROOM	Office	325	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	9	2,160	829
33	K-Building	Interior	1	JANITORIAL	K-Janitor	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44
34	K-Building	Interior	1	JANITORIAL	N/A	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	684	88
35	K-Building	Interior	1	CLASSROOM	KO1	325	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	8	1,260	484
36	K-Building	Interior	1	CLASSROOM	KO1	325	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	36	1x4 Indirect Troffer	6	0	10	1,260	1,452
37	K-Building	Interior	1	CLASSROOM	KO2	325	4	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	2x4 Prism Troffer	8	0	8	1,260	968
38	K-Building	Interior	1	CLASSROOM	KO2	325	4	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	42	1x4 Indirect Troffer	6	0	10	1,260	1,693
39	K-Building	Interior	1	RESTROOM	N/A	325	36	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	8	2,160	829
40	Administration	Interior	1	OPEN OFFICE	Main Office	325	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	1x4 Indirect Troffer	2	0	11	2,160	1,244
41	Administration	Interior	1	OPEN OFFICE	Main Office	325	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	14	1x4 Indirect Troffer	2	0	11	2,160	968
42	Administration	Interior	1	OPEN OFFICE	Main Office	325	3	Light Switch	CFL	CFL - 4 Pin	CFL7	46	Recessed Can-hor8"	23	0	8	2,160	696
43	Administration	Interior	1	OPEN OFFICE	Main Office	325	3	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,160	415
44	Administration	Interior	1	OFFICE	Parent Center	325	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,160	415
45	Administration	Interior	1	RESTROOM	Accessible All Gender	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	2,160	276
46	Administration	Interior		RESTROOM	Conference B	275	2	Wall-Mounted Sensor	Linear Fluorescent	T8 U	U 31W T8	16	2x2 Prism Troffer	8	0	8	2,160	1,071
47	Administration	Interior	1	RESTROOM	Staff Lounge	275	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8 U	U 31W T8	20	2x2 Prism Troffer	10	0	8	2,160	1,339
48	Administration	Interior	1	OFFICE	Staff Workroom	275	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	18	2x4 Prism Troffer	6	0	8	2,160	1,244
49	Administration	Interior	1	RESTROOM	Staff Men	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	2,160	138
50	Administration	Interior	1	RESTROOM	Staff Women	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	2,160	138
51	Administration	Interior	1	OFFICE	Nurse	275	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	8	2,160	829
52	Administration	Interior	1	RESTROOM	N/A	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	2,160	138
53	Administration	Interior	1	JANITORIAL	Custodian	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44
54	Administration	Interior	1	OFFICE	Mr. Brown	325	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	15	2x4 Prism Troffer	5	0	8	2,160	1,037
55	Administration	Interior	1	OFFICE	Princial	325	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	2,160	415
56	Restroom Building	Interior	1	RESTROOM	Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	1	0	8	2,160	276
57	Restroom Building	Interior	1	RESTROOM	Boys	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	1	0	8	2,160	553
58	Restroom Building	Interior	1	RESTROOM	Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	1	0	8	2,160	276
59	Restroom Building	Interior	1	RESTROOM	Girls	300	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	1	0	8	2,160	553

60	Multi-Purpose	Interior	1	STORAGE	Storage #1	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	684	88										
61	Multi-Purpose	Interior	1	AUDITORIUM	Stage	275	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	22	2x4 Prism Troffer	11	0	10	720	507										
62	Multi-Purpose	Interior	1	AUDITORIUM	Stage	275	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	9	720	92										
63	Multi-Purpose	Interior	1	STORAGE	Storage #2	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44										
64	Multi-Purpose	Interior	1	RESTROOM	Boys	325	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	2	0	10	2,160	829										
65	Multi-Purpose	Interior	1	RESTROOM	Girls	325	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	1x4 Prism Troffer	1	0	10	2,160	415										
66	Multi-Purpose	Interior	1	RESTROOM	Girls	325	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	10	1x4 Prism Troffer	1	0	10	2,160	691										
67	Multi-Purpose	Interior	1	AUDITORIUM	Multi-Purpose	225	4	Light Switch	CFL	CFL - 4 Pin	CFL7	38	Recessed Can-hor8"	19	0	10	2,160	575										
68	Multi-Purpose	Interior	1	AUDITORIUM	Multi-Purpose	225	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	66	1x4 Prism Troffer	3	0	18	2,160	4,562										
69	Multi-Purpose	Interior	1	OFFICE	gie Navarro, Plant Mar	275	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	10	2,160	415										
70	Multi-Purpose	Interior	1	KITCHEN	Kitchen	-	0	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	2x4 Prism Troffer	10	0	9	1,800	1,152										
71	Multi-Purpose	Interior	1	STORAGE	Storage #3	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	684	88										
72	Multi-Purpose	Interior	1	JANITORIAL	Custodian	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44										
73	Multi-Purpose	Interior	1	JANITORIAL	Changing	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	8	684	44										
74	Multi-Purpose	Interior	1	RESTROOM	Restroom	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	2,160	138										
75	Multi-Purpose	Interior	1	STORAGE	Storage #4	275	0	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	9	684	175										
76	Multi-Purpose	Interior	1	STORAGE	Storage #5	275	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	684	44										
77	Multi-Purpose	Interior	1	MECHANICAL	N/A	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	1,512	97										
78	Multi-Purpose	Exterior	1	MECHANICAL	Storage	200	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	1,512	97										
79	Multi-Purpose	Exterior	1	AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	7	Wallpack-Vertical	7	0	10	2,160	1,058										
80	Administration	Exterior	1	AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	14	Wallpack-Vertical	14	0	9	2,160	2,117										
81	K-Building	Exterior	1	AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	10	Wallpack-Vertical	10	0	9	2,160	1,512										
82	Library	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	9	Wallpack-Vertical	9	0	10	2,160	1,361										
83	E-Building	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	9	Wallpack-Vertical	9	0	9	2,160	1,361										
84	C-Building	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	9	Wallpack-Vertical	9	0	9	2,160	1,361										
85	D-Building	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	9	Wallpack-Vertical	9	0	9	2,160	1,361										
86	F-Building	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	9	Wallpack-Vertical	9	0	9	2,160	1,361										
87	Restroom Building	Exterior		AUDITORIUM	Building Exterior	-	1	Photosensor	HID	MH	MH70	2	Wallpack-Vertical	2	0	9	2,160	302										
88	Administration	Exterior		AUDITORIUM	Site Lighting	-	1	Photosensor	HID	HPS	HPS200	14	Shoebox Dual Head	7	0	20	2,160	6,048										
89	Administration	Exterior		AUDITORIUM	Site Lighting	-	1	Photosensor	HID	HPS	HPS200	16	Shoebox	16	0	20	2,160	6,912										
Totals																					1,477		417				157,788	105,849



Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Existing Control	Control Quantity	Fixture Details					Existing Consumption			Proposed - Post Retrofit						
								Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
1	C-Building	Interior	1	CLASSROOM	C02	Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	20	140	9	2,160	9,677	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	5,141	4,536
2	D-Building	Interior	1	CLASSROOM	D05	Light Switch	20	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	20	140	9	2,160	9,677	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	5,141	4,536
3	D-Building	Interior	1	STORAGE	D-Storage	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	684	175	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	93	82
4	D-Building	Interior	1	JANITORIAL	D-Custodian	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
5	D-Building	Interior	1	RESTROOM	D-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
6	D-Building	Interior	1	RESTROOM	D-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
7	E-Building	Interior	1	CLASSROOM	E04	Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	20	140	9	2,160	9,677	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	5,141	4,536
8	F-Building	Interior	1	CLASSROOM	F04	Light Switch	5	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	20	140	9	2,160	9,677	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	5,141	4,536
9	F-Building	Interior	1	JANITORIAL	F-Janitor	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
10	F-Building	Interior	1	RESTROOM	F-Girls	Timer	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
11	F-Building	Interior	1	RESTROOM	F-Girls	Timer	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
12	F-Building	Interior	1	RESTROOM	F-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
13	F-Building	Interior	1	RESTROOM	F-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
14	F-Building	Interior	1	STORAGE	F-Storage	Wall-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	9	684	175	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	684	93	82
15	D-Building	Interior	1	RESTROOM	D-Girls	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
16	D-Building	Interior	1	RESTROOM	D-Girls	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
17	E-Building	Interior	1	RESTROOM	E-Girls	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
18	E-Building	Interior	1	RESTROOM	E-Girls	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
19	E-Building	Interior	1	RESTROOM	E-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	10	9	2,160	691	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	367	324
20	E-Building	Interior	1	RESTROOM	E-Boys	Ceiling-Mounted Sensor	0	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	6	9	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
21	E-Building	Interior	1	STORAGE	E-Storage	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	9	684	88	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	47	41
22	E-Building	Interior	1	JANITORIAL	E-Custodian	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
23	E-Building	Interior	1	RESTROOM	E-Staff #1	Timer	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
24	E-Building	Interior	1	RESTROOM	E-Staff #2	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
25	Library	Interior	1	LIBRARY	Library	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	2	18	20	2,160	1,244	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	661	583
26	Library	Interior	1	LIBRARY	Library	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	2	6	20	2,160	415	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
27	Library	Interior	1	LIBRARY	Library	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	12	36	8	2,160	2,488	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	1,322	1,166
28	Library	Interior	1	CLASSROOM	Media	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	9	1,260	484	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	257	227
29	Library	Interior	1	CLASSROOM	Handicap #1	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	9	1,260	484	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	257	227
30	Library	Interior	1	CLASSROOM	Handicap #2	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	4	24	10	1,260	968	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	514	454
31	Library	Interior	1	RESTROOM	Restroom	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	9	2,160	276	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	147	130
32	Library	Interior	1	CLASSROOM	Office	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	9	2,160	829	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	441	389
33	K-Building	Interior	1	JANITORIAL	K-Janitor	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
34	K-Building	Interior	1	JANITORIAL	N/A	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	684	88	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	47	41
35	K-Building	Interior	1	CLASSROOM	KO1	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	8	1,260	484	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	257	227
36	K-Building	Interior	1	CLASSROOM	K01	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	6	36	10	1,260	1,452	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	771	680
37	K-Building	Interior	1	CLASSROOM	K02	Ceiling-Mounted Sensor	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	24	8	1,260	968	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	514	454
38	K-Building	Interior	1	CLASSROOM	K02	Ceiling-Mounted Sensor	4	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	6	42	10	1,260	1,693	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,260	900	794
39	K-Building	Interior	1	RESTROOM	N/A	Wall-Mounted Sensor	36	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	6	12	8	2,160	829	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	441	389
40	Administration	Interior	1	OPEN OFFICE	Main Office	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	2	18	11	2,160	1,244	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	661	583
41	Administration	Interior	1	OPEN OFFICE	Main Office	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 1x4 Indirect Troffer	2	14	11	2,160	968	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	514	454
42	Administration	Interior	1	OPEN OFFICE	Main Office	Light Switch	3	CFL	CFL - 4 Pin	CFL7; Recessed Can-hor8"	23	46	8	2,160	696	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
43	Administration	Interior	1	OPEN OFFICE	Main Office	Wall-Mounted Sensor	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	8	2,160	415	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	2,160	220	194
44	Administration	Interior	1	OFFICE	Parent Center	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	8	2,160	415	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	220	194
45	Administration	Interior	1	RESTROOM	Accessible All Gender	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	2,160	276	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	147	130
46	Administration	Interior	1	RESTROOM	Conference B	Wall-Mounted Sensor	2	Linear Fluorescent	T8 U	U 31W T8; 2x2 Prism Troffer	8	16	8	2,160	1,071	ECM	RB - Replace Bulb	Retain Existing Controls	U 16W LED T8	2,160	553	518
47	Administration	Interior	1	RESTROOM	Staff Lounge	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8 U	U 31W T8; 2x2 Prism Troffer	10	20	8	2,160	1,339	ECM	RB - Replace Bulb	Retain Existing Controls	U 16W LED T8	2,160	691	648
48	Administration	Interior	1	OFFICE	Staff Workroom	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	6	18	8	2,160	1,244	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	661	583
49	Administration	Interior	1	RESTROOM	Staff Men	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
50	Administration	Interior	1	RESTROOM	Staff Women	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
51	Administration	Interior	1	OFFICE	Nurse	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	8	2,160	829	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	441	389
52	Administration	Interior	1	RESTROOM	N/A	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	2,160	138	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	2,160	73	65
53	Administration	Interior	1	JANITORIAL	Custodian	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	8	684	44	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	684	23	21
54	Administration	Interior	1	OFFICE	Mr. Brown	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	5	15	8	2,								

APPENDIX D: ECM Checklist

NA	In Place	Evaluate	ECM Description
✓			Add Reflective Coating To Exterior Windows
	✓		Replace External Windows
	✓		Upgrade Insulation
✓			Control External Air Leakage In Commercial Buildings
✓			Install Reflective Insulation Between Radiators And External Wall
✓			Replace Existing Motors With High Efficiency Motors
✓			Install On-Demand Ventilation on Air Handlers
✓			Reduce HVAC Hours of Operation
✓			Install Variable Frequency Drives (VFD)
✓			Install Outside Air Temperature Reset Controls For Hot Water Boilers
✓			Install Chilled Water Reset Control
✓			Install Timers On Exhaust Fans
✓			Install Energy Savers on Vending, Snack Machines
	✓		Install Building Energy Management System and Replace Terminal Units
		✓	Re-Commission The Building & Its Control Systems
✓			Replace Inefficient Heating Plant
✓			Replace Inefficient Cooling Plant
		✓	Replace Existing Air Conditioners with Energy Star Air Conditioners
	✓		Replace Unit Electric Heaters with Natural Gas Fired Unit Heaters
✓			Convert From Gas Pilot to Electronic Ignition for Boilers
	✓		Insulate Hot Water Pipes
	✓		Insulate Refrigerant Lines
✓			Insulate Hot Surfaces And Tanks
✓			Insulate Air Ducts
✓			Replace Defective Steam Traps
✓			Upgrade Electric Heating System To Heat Pumps
	✓		Replace Inefficient Furnace System
	✓		Replace Rooftop Package Unit
✓			Install Energy Recovery Wheel on Air Handling Unit
		✓	Replace Existing Water Heater With New Energy Efficient Units
		✓	Replace Incandescent/Halogen Lamps With Energy Efficient Lamps
		✓	Upgrade Inefficient Linear Fluorescent Lamps And Fixtures
	✓		Upgrade EXIT SIGNS With LED EXIT Signs
	✓		Bilevel and Tandem Linear Fluorescent Lighting ECM
		✓	Replace High Intensity Discharge (HID) Lamps With Energy Efficient Lamps
✓			Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s)
✓			Replace Existing Freezers With High Efficiency Freezers
✓			Install Low Flow Shower Heads
		✓	Install Low Flow Faucet Aerators
✓			Install Low Flow Restroom Flush Tank Toilets
		✓	Install Low Flow Tankless Restroom Fixtures

APPENDIX E: ECM Calculations

<i>UIC</i>	Re-Commission The Building & Its Control Systems	
EAC10	Location: Throughout	
Enter the Total Area of The Facility	55,300	SqFt
Select the Type of Heating Fuel:	Natural Gas	(Select)
Estimated Annual Heating Fuel Consumption:	1,323	Therms
Is the Property Cooled?	Yes	(Select)
Estimated Annual Electrical Energy Consumed For Cooling:	78,700	kWh
Estimated Energy Savings From Re-Commissioning on Building Systems:	15%	(Select)
Estimated Heating Energy Saving Post Re-Commissioning:	198	Therms
Estimated Cooling Energy Saving Post Re-Commissioning:	11,805	kWh
Average Heating Fuel Rate Paid By The Property:	\$1.39	\$/Therm
Average Electrical Rate Paid By The Property:	\$0.16	\$/kWh
Annual Energy Cost Savings:	\$2,133	\$
Estimated Cost For Re-Commissioning The Facility: <i>(LBNL 2009 Report on Building Commissioning)</i>	\$24,762	\$
Simple Payback Period:	11.61	Yrs
<i>Type of Recommendation</i>	Capital Cost ECM Recommendation	

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ECM DESCRIPTION

The goal of commissioning of a facility is to ensure that the equipments in the facility are performing as per the desired standards or as per design standards. The role of commissioning in existing buildings is to identify the almost inevitable "drift" from where things should be and puts the things back on track. Based on the LBNL 2009 Report on Building Commissioning the average re-commissioning of existing buildings yielded atleast 16% of energy savings across the facility. This average has been developed based on over 643 buildings that were commissioned across United States in different climatic zones.

Thus EMG strongly recommends re-commissioning of all existing buildings in order to ensure that all the sensors, equipments and control systems are working as per the design conditions.

SUMMARY:

Initial Investment:	\$24,762	Simple Payback:	11.61	Years
Energy Cost Savings:	\$2,133			

UIC		Install Low Flow Faucet Aerators	
EAP2-b	Location: Throughout Buildings		
Property Type:	<input type="text" value="Commercial"/>	Estimated No. of Operational Weeks	<input type="text" value="36"/>
		Number of Occupied Days/Week (Max 7)	<input type="text" value="5"/>
KITCHEN FAUCETS		BATHROOM FAUCETS	
Number of Occupants Affected By Retrofit	<input type="text" value="410"/>	Number of Occupants Affected by Retrofit	<input type="text" value="410"/>
Do You Want To Replace Kitchen Faucets Aerators	<input type="text" value="Yes"/> (Select)	Do You Want To Replace Bathroom Faucets Aerators	<input type="text" value="Yes"/> (Select)
Total Number of Faucet Aerators To Be Replaced	<input type="text" value="35"/>	Total Number of Faucet Aerators To Be Replaced	<input type="text" value="40"/>
Total Number of Faucets To Be Replaced:	<input type="text" value="0"/>	Total Number of Faucets To Be Replaced:	<input type="text" value="0"/>
GPM of Existing Faucet Aerators	<input type="text" value="2.2"/> GPM	GPM of Existing Faucet Aerators	<input type="text" value="2.2"/> GPM
GPM of Proposed Faucet Aerator	<input type="text" value="1.5"/> GPM	GPM of Proposed Faucet Aerator	<input type="text" value="0.5"/> GPM
Estimated Number of Uses Per Day	<input type="text" value="1"/>	Estimated Number of Uses Per Day	<input type="text" value="1"/>
Annual Water Savings From Installing Low Flow Aerators:		<input type="text" value="17.00"/> kGal	
WATER & ENERGY SAVING CALCULATION		COST SAVING CALCULATION	
Select Type of Water Heater Fuel:	<input type="text" value="Electric"/> (Select)	Property Location in United States	<input type="text" value="North Central Localities"/>
Energy Factor of Domestic Hot Water Heater:	<input type="text" value="0.86"/> EF	Heating Fuel Tariff	<input type="text" value="\$0.16"/> \$/kWh
Hot Water Discharge Temperature at Faucet	<input type="text" value="110.00"/> °F	Water Tariff (\$/1000 Gal)	<input type="text" value="\$5.92"/> \$/kGal
Equivalent Heating Fuel Savings: <small>Savings Discounted by 15% to Account For Cold Water Use</small>	<input type="text" value="2,465"/> kWh	Annual Cost Savings In Form of Water	<input type="text" value="\$101"/> \$
Annual Water Savings	<input type="text" value="17.00"/> kGal	Annual Energy Savings From Water Heater	<input type="text" value="\$388"/> \$
COST BENEFIT ANALYSIS			
Estimated Total Annual Cost Savings	<input type="text" value="\$488"/> \$\$	Estimated Total Installation Cost	<input type="text" value="\$1,142"/> \$\$
Simple Payback Period	<input type="text" value="2.34"/> Years	Type of Recommendation	<input type="text" value="Capital Cost ECM Recommendation"/>

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ECM EXPLANATION:

By reducing the flow of water coming from the restroom faucets, aerators can generate energy savings at low cost and with easy installation. The savings generated would be in the form of reduced water and sewer costs and at the same time aerators would save energy by reducing the demand for hot water. The average faucet has a flow rate of about 2 to 4 GPM. Adding a screw-in faucet aerator reduces the flow to 0.5 to 1.5 GPM in the bathroom and 2.2 GPM in the kitchen. In addition to saving energy and water, the "foamier" water that comes from faucet aerators wets objects better than water from a faucet with no aerator, which tends to bounce off the object rather than thoroughly wetting it.

EMG recommends replacing the proposed faucet aerators with new low flow aerators as mentioned above. The proposed ECM shall also result in an annual energy saving in form of reduction in water heating bills.

Summary:

Initial Investment: \$1,142 Estimated Annual Cost Savings: \$488 Simple Payback Period (Yrs): 2.34

UIC	Install Low Flow Tankless Restroom Fixtures	
EAP4	Location: Throughout Building	
ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES		
Number of Males	205	
Number of Females	205	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	36	
Number of Urinals To Be Retrofitted	16	
Number of Water Closets To Be Retrofitted	51	
No. of Water Closets With Separate Flush Tank <i>(Typical Residential Type)</i>	0	
Estimated Restroom Usage/Individual/Day <i>Default is 4 Uses/Day For Residential/Office</i>	4	(Select)
Urinal Water Savings		
Do you Want To Make Any Changes To The Urinals?	Yes	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve**	0.125	GPF
<small>**1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals</small>		
Estimated Annual Water Savings From Urinal	103.32	kGal
Water Closet Water Savings		
Tankless Water Closets		
Do The Water Closet Need To Be Retrofitted?	(Select)	Yes
Existing Gallons Per Flush Ratings For Water Closet Flushes	1.60	GPF
Are The Existing Water Closet Being Replaced? <i>(If No, Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)</i>	(Select)	No
No. of Tankless Water Closets	51	
GPF of Proposed Dual Flush- Water Closet Valve*	Solid Waste (20%) 1.60 Liquid Waste (80%) 0.48	GPF
<small>*Federal Law Requires All Flushes Not To Exceed 1.6 GPF</small>		
Estimated Annual Water Savings From Male Users	26.45	kGal
Estimated Annual Water Savings From Female Users	132.25	kGal
Total Water Savings From Water Closets	158.70	kGal
Water & Cost Saving Calculations		
Water Savings Calculation		
Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	158.70	kGal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	103.32	kGal
Total Annual Water Savings in kGal	262.02	kGal
Cost Savings Calculations		
Enter Water Tariff Rate (\$/1000Gal)	\$5.92	\$\$
Estimated Cost Savings From Water	\$1,550	\$\$
Estimated Cost of Retrofit		
Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture <i>(Includes Labor)</i>	\$20,806	\$\$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves (\$80 Per Unit) <i>(Includes Labor)</i>	\$31,571	\$\$
<small>(Up For Liquid Waste And Down For Solid Waste)</small>		
Estimated Total Cost For Retrofit	\$52,377	\$\$
Simple Pay Back Period	33.78	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

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ECM EXPLANATION:

The highest water utilization at any home/office occurs in the restrooms. It is estimated that on an average a normal human being uses the restroom at least four times a day. Keeping with the global water conservation objectives, federal law prohibits use of any new water closet flushes over 1.6 GPF. At the same time the '1992 EpACT' mandates all new Urinals to have a maximum 1.0 GPF flush valves on urinals.

EMG recommends replacing all urinals above 1.0 GPF with a new 0.5 GPF or lesser urinals. At the same time EMG also recommends replacing all the water closets having a GPF rating of 1.6 and over with low flow water closet fixtures equipped with dual flush valves.

In case the property doesn't wish to replace the entire water closet fixtures, EMG recommends retrofitting all the tankless water closet flush fixtures with new dual flush fixtures that would result in a 30% water savings per flush for liquid wastes, while retaining the same flush rate for solid wastes.

SUMMARY:

Initial Investment: \$52,377 Simple Payback Period: 33.78 Yrs
Annual Cost Savings: \$1,550

UIC	Replace Existing Water Heater With New Energy Efficient Units				
EAD3	Location: Throughout Buildings				
Step 1	Existing Water Heater Details	Building D,K,F,E	Library	MPR	Specify Location Here
	Number of Water Heaters Being Replaced:	5	1	1	
	Select Existing Hot Water Heater Fuel	Electric	Electric	Natural Gas	Electric
	Insert Energy Factor of Existing Water Heater	0.86 EF	0.86 EF	0.60 EF	
	Input Existing Water Heater Input Rating	3.00 kW	6.00 kW	120.00 kBtus	
	Select One Method For Calculation	Annual Heating Hours	Annual Heating Hours	Annual Heating Hours	Annual DWH Load
	Insert Average Annual Hours of Operation	500 hrs	600 hrs	200 hrs	
	Annual Water Heater Energy Consumption/Heater	1,500 kWh	3,600 kWh	240 Therms	#DIV/0! hrs
	Total Estimated Annual Energy Consumption For all Heaters	7,500 kWh	3,600 kWh	240 Therms	0 kWh
	Total Estimated Annual Operating Energy Costs For all Heaters	\$1,180 \$	\$566 \$	\$333 \$	\$0 \$
Step 2	Proposed New Water Heater				
	Proposed Hot Water Heater Fuel	Electric	Electric	Natural Gas	Natural Gas
	Capacity of the Proposed New Water Heater	20-Gal,2.5-kW	20-Gal,2.5-kW	100-Gal,150-kBtu	
	Energy Factor of Proposed Water Heater	0.95 EF	0.95 EF	0.95 EF	0.00 EF
	Proposed Water Heater Input Rating	2.50 kW	2.50 kW	150.00 kBtu/h	0.00 kBtu/h
	Annual kBtu/h Consumption For All The Proposed Water Heaters	23,166 kBtu/h	11,120 kBtu/h	15,158 kBtu/h	#DIV/0! kBtu/h
	Estimated Annual Water Heater Fuel Consumption (All Heaters)	6,789 kWh	3,259 kWh	152 Therms	0 Therms
	Estimated Total Annual Energy Costs	\$1,068 \$	\$513 \$	\$210 \$	\$0 \$
Step 3	Energy & Cost Saving Calculation				
	Estimated Cost of New Water Heater/Unit	\$776 \$	\$776 \$	\$7,760 \$	\$0 \$
	Total Estimated Installation Cost	\$5,791 \$	\$1,158 \$	\$11,582 \$	\$0 \$
	Total Estimated Annual Cost Savings	\$112 \$	\$54 \$	\$123 \$	\$0 \$
	Total Annual Cost Savings:	\$288	Total Initial Investment::	\$18,532	
	Simple Pay Back Period	64.32			
	Type of Recommendation	Capital Cost ECM Recommendation			

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ECM SUMMARY:

Electric resistance is the most expensive method for heating domestic hot water. A natural gas or propane fired water system provide more units of heat with direct burning of fuel while high wattage draw is required for electric water heaters to create resistance heat. This electric usage can be seen with the increase power demand for the site and the additional kWh consumption. The installation process of the gas/propane fired water heater requires additional measures with tying a gas line or fuel tank to the system along with installing an exhaust gas vent. This process is not a costly retrofit if a current gas line or tank is at the site. The hot water exhaust duct can be tied to the existing gas fired furnaces or boilers for an easy retrofit.

SUMMARY:

Initial Investment: \$5,791 Simple Payback: 64.32 yrs
 Annual Cost Savings: \$112

UIC		Replace Existing Air Conditioners with Energy Star Air Conditioners			
EAH3	Location: Throughout				
					Electric Rate: <input type="text" value="\$0.16"/> \$/kWh
	<i>Throughout</i>	<i>Specify Type</i>	<i>Specify Type</i>	<i>Specify Type</i>	
Number of Existing Air Conditioners	<input type="text" value="23"/> Qty	<input type="text" value=""/> Qty	<input type="text" value="0"/> Qty	<input type="text" value=""/> Qty	
Insert Cooling Capacity of Existing Air-Conditioner	<input type="text" value="60,000"/> Btuh	<input type="text" value=""/> Btuh	<input type="text" value=""/> Btuh	<input type="text" value=""/> Btuh	
Please Input The Existing EER of The Air-Conditioner:	<input type="text" value="9.00"/> EER	<input type="text" value=""/> EER	<input type="text" value=""/> EER	<input type="text" value=""/> EER	
Estimated Annual Operating Hours:	<input type="text" value="500"/> Hrs	<input type="text" value=""/> Hrs	<input type="text" value=""/> Hrs	<input type="text" value=""/> Hrs	
Select Proposed Air Conditioner Type:	<input type="text" value="Split System-60000"/>	<input type="text" value="-"/>	<input type="text" value="-"/>	<input type="text" value="-"/>	
Estimated New Annual Operating Hours:	<input type="text" value="500"/> Hrs	<input type="text" value=""/> Hrs	<input type="text" value=""/> Hrs	<input type="text" value=""/> Hrs	
Please Input The Btu/Hr of The New Air-Conditioner:	<input type="text" value="60,000"/> Btuh	<input type="text" value="-"/> Btuh	<input type="text" value="-"/> Btuh	<input type="text" value="-"/> Btuh	
EER of Proposed Air-Conditioning System:	<input type="text" value="15.75"/> EER	<input type="text" value="-"/> EER	<input type="text" value="-"/> EER	<input type="text" value="-"/> EER	
Total Energy Consumption For Existing Air conditioner:	<input type="text" value="76,667"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	
Total Energy Consumption For Proposed Air conditioner:	<input type="text" value="43,810"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	
Annual kWh savings for all Air conditioner:	<input type="text" value="32,857"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	<input type="text" value="0"/> kWh	
Estimated Annual Energy Cost Savings:	<input type="text" value="\$5,170"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	
Estimated Annual O&M Savings:	<input type="text" value="\$258"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	
Total Annual Cost Savings:	<input type="text" value="\$5,428"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	
Estimated Installed Cost For All Air conditioner:	<input type="text" value="\$107,893"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	<input type="text" value="\$0"/>	
Total Initial Investment:	<input type="text" value="\$107,893"/>	Total Annual Electric Savings:	<input type="text" value="32,857"/> kWh		
Total Annual Cost Savings:	<input type="text" value="\$5,428"/>	Simple Payback:	<input type="text" value="19.88"/> Yrs		
Type of Recommendation	<input type="text" value="Capital Cost ECM Recommendation"/>				

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ECM DESCRIPTION:
 Advances in compressor and condenser technology have allowed for the development of more efficient air conditioning systems. As a result cooling can be provided at the same rate, with a lower energy input. Energy efficiency ratio (EER) is the ratio of cooling output to power input. Seasonal energy efficiency ratio (SEER) is an adjusted figure based on the length of the cooling season. A higher EER or SEER indicates a more efficient unit which can provide the same cooling capacity while consuming less energy. The minimum standard for air conditioner performance in most areas is currently 13 SEER as EMG recommends replacing all the identified air conditioners with the new proposed high efficiency air conditioners as mentioned above.

Summary:
 Initial Investment: \$107,893 Simple Payback: 19.88 Yrs
 Energy Cost Savings: \$5,428

UIC	Upgrade Building Lighting to LED and Install Automatic Lighting Controls
EAL10	Location: Building Interior and Exterior

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	375	1,393	51,438	\$8,230.12	\$3,159.74

Existing Technology	Sub-Technology	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
CFL	CFL - 2 Pin	0	0	0	0	\$0	\$0
CFL	CFL - 4 Pin	0	0	0	0	\$0	\$0
CFL	CFL - Screw-in	0	0	0	0	\$0	\$0
Circiline	T9	0	0	0	0	\$0	\$0
Incan/H/MR	H	0	0	0	0	\$0	\$0
Incan/H/MR	Incan	0	0	0	0	\$0	\$0
Incan/H/MR	MR	0	0	0	0	\$0	\$0
HID	HPS	2	23	23	8,424	\$1,348	\$557
HID	MH	9	78	78	5,560	\$890	\$1,447
HID	MV	0	0	0	0	\$0	\$0
HID	QL	0	0	0	0	\$0	\$0
Linear Fluorescent	T8	74	256	256	36,288	\$5,806	\$1,112
Linear Fluorescent	T12	0	0	0	0	\$0	\$0
Linear Fluorescent	T8 U	2	18	18	1,166	\$187	\$45
Linear Fluorescent	T12 U	0	0	0	0	\$0	\$0
Linear Fluorescent	T5	0	0	0	0	\$0	\$0
Linear Fluorescent	T6	0	0	0	0	\$0	\$0
Linear Fluorescent	T10	0	0	0	0	\$0	\$0

Proposed Controls	No. of Controls	Location	No. of Controls
Photo Sensor	0	Ceiling Mounted	4
Wall Mounted	51		

Initial Investment		Equipment Rentals	
Material Cost	\$26,927.98	Scissor Lift 26' - Interior Spaces	\$370.00
Labor Cost	\$33,969.40	Bucket Truck - Exterior Spaces	\$0.00
Local Electric Rate:	\$0.16 \$/kWh	Estimated Annual Energy Savings:	51,438
Hourly Labor Rate For Electrician:	\$82.45	Estimated Annual Energy Cost Savings:	\$8,230
Budgeted Initial Investment:	\$61,267	Estimated Annual O&M Cost Savings:	\$3,160
Estimated Return on Investment:	5.38 Years	Estimated Annual Cost Savings:	\$11,390

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APPENDIX F: Solar PV

UIC	Install Fixed Tilt Solar Photovoltaic System
EAR-2	Details:

Select State: **Northern California** Electric Rate: **\$0.16** \$/KWH Annual Electric Consumption: **395,493** KWH

Roof No.	Description	Number of Roofs	DC System Size Per Roof	PV System Sizing For All Roofs	Estimated Number of 315 Watt PV Panels:	Total Estimated Annual Electricity Generated/ Roof	Total Estimated Electricity Generated (All Roofs)	Total Cost Savings	Installation Cost: (\$3.5/Watt)	Simple Pay Back Period without Incentives	One Time Potential Utility or State Incentives	One Time Potential Federal Incentives	Annual Potential Incentives and Rebates		Simple Pay Back Period with All Incentives
			kW	kW		kWh	kWh			Yrs		Dept. of Treasury Renewable Grant (30%)	Federal REPI Incentive	Solar Renewable Certificates (SRECS)- (~\$0/MWH)	Years
1	Building 1	1	44.00	44	140	67,776	67,776	\$10,844	\$154,000	14.2	\$0	30%	\$0.02	\$0	8.6
2	Building 2	1	16	16	51	24,800	24,800	\$3,968	\$56,350	14.2	\$0	\$16,905	\$546	\$0	8.6
3	Building 3	1	8	8	27	12,939	12,939	\$2,070	\$29,400	14.2	\$0	\$8,820	\$285	\$0	8.6
4	Building 4	1	11	11	35	17,098	17,098	\$2,736	\$38,850	14.2	\$0	\$11,655	\$376	\$0	8.6
5	Building 5	1	17	17	55	26,494	26,494	\$4,239	\$60,200	14.2	\$0	\$18,060	\$583	\$0	8.6
6	Building 6	1	19	19	59	28,497	28,497	\$4,560	\$64,750	14.2	\$0	\$19,425	\$627	\$0	8.6
7	Building 7	1	14	14	43	21,103	21,103	\$3,376	\$47,950	14.2	\$0	\$14,385	\$464	\$0	8.6
		7		129	410	198,707.0	198,707	\$31,793	\$451,500	14.20	\$0	\$135,450	\$4,372	\$0	8.57

Solar Rooftop Photovoltaic Analysis	
Total Number of Roofs	7
Estimated Number of Panels	410
Estimated KW Rating	129 KW
Potential Annual KWh Produced	198,707 KWh
% of Current Electricity Load	50.2%

Financial Analysis	
Investment Cost	\$451,500
Estimated Energy Cost Savings	\$31,793
Potential Rebates	\$135,450
Potential Annual Incentives	\$4,372
Payback without Incentives	14.2 years
Incentive Payback but without SRECS	8.6 years
Payback with All Incentives	8.6 years

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