



LEVEL II ENERGY AUDIT

SACRAMENTO CITY UNIFIED SCHOOL DISTRICT

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Sacramento, California 95824

DLR GROUP

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ZERO NET ENERGY ASHRAE LEVEL II AUDIT

AMERICAN LEGION

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Sacramento, California 95817

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EMG PROJECT #:

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September 26-27, 2019



engineering | environmental | capital planning | project management

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Certification

EMG has completed an Energy Audit of American Legion located at 3801 Broadway in Sacramento, California. EMG visited the site on September 26-27, 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 CostLab*. 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 and 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 American Legion 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 and 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.

Building #	Structures Assessed	Building Type	EMG Calculated Area (SF)	Estimated Occupancy
1	Buildings 00A and 00E: 1977	Office and Classroom	25,246	156
2	Building 00B: 1977	Classroom	5,101	32
3	Building 00C: 1977	Classroom	3,562	22
4	Building 00D: 1977	Classroom	2,937	18
5	Portable Building P01: 2004	Classroom	2880	18
6	Portable Building P02: 2004	Restroom	480	3
7	Portable Building P03: 2000	Classroom	960	6
8	Gymnasium: 2019	Gymnasium	7900	49

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 Five 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>)	\$ 73,845 (<i>In Current Dollars</i>)
Estimated Annual Cost Savings (<i>Current Dollars Only</i>)	\$11,181 (<i>In Current Dollars</i>)
ECM Effective Payback	6.6 years
Estimated Annual Energy Savings	13.77%
Estimated Annual Energy Utility Cost Savings (<i>Excluding Water</i>)	9.20%
Estimated Annual Water Cost Saving	3.37%

Solar Photovoltaic (PV) Screening for PROP N

Solar Rooftop Photovoltaic Analysis		
Estimated Number of Panels	235	
Estimated KW Rating	74	KW
Potential Annual kWh Produced	114,980	kWh
% of Current Electricity Uses	17.6%	
Financial Summary		
Investment Cost	\$259,000	
Estimated Energy Cost Savings	\$16,097	
Payback without Incentives	16.1	Years
Incentive Payback but without SRECs	9.7	Years
Payback with All Incentives	9.7	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)	51 kBtu/ft ²
Post ECM Site Energy Use Intensity (EUI)	44 kBtu/ft ²
Source Energy Use Intensity (EUI)	Rating
Current Source Energy Use Intensity (EUI)	157 kBtu/ft ²
Post ECM Source Energy Use Intensity (EUI)	143 kBtu/ft ²
Building Cost Intensity (BCI)	Rating
Current Building Cost Intensity	\$1.98/ft ²
Post ECM Building Cost Intensity	\$1.80/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	342 MMbtu
Total CO ₂ Emissions Reduced	24.59 MtCO ₂ /Yr
Total Cars Off the Road (Equivalent)*	5
Total Acres of Pine Trees Planted (Equivalent)*	6

**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	2,484,417 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	431,593 kBtu
Total Annual Energy Savings from Renewable Energy Measures	392,312 kBtu
Net Energy Consumption from Grid Post Implementation	1,660,512 kBtu
% Energy Reduction (Renewable + Non- Renewable)	33%

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 American Legion												
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 Timers On Exhaust Fans	\$3,539	1,405	11,617	0	\$3,618	\$0	\$3,618	0.98	12.20	\$39,653	15.00
	Location:Throuhgout											
2	Install Low Flow Faucet Aerators	\$1,691	741	0	77	\$1,658	\$0	\$1,658	1.02	8.37	\$12,454	10.00
	Location: Throuhgout											
3	Upgrade Building Lighting to LED and Install Automatic Lighting Controls	\$58,983	0	36,911	0	\$5,286	\$1,860	\$7,147	8.25	1.45	\$26,332	15.00
	Location: Building Interior And Exterior											
Total For Capital Cost		\$64,213	2,145	48,529	77	\$10,563	\$1,860	\$12,423	5.17			
	Interactive Savings Discount @ 10%		-215	-4,853	-8	-\$1,056	-\$186	-\$1,242				
	Total Contingency Expenses @ 15%	\$9,632										
Total for Improvements		\$73,845	1,931	43,676	69	\$9,506	\$1,674	\$11,181	6.60			

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 American Legion												
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	Electricity	kgal	\$	\$	\$	Years		\$	Years
1	Install Low Flow Tankless Restroom Fixtures	\$33,734	0	0	256	\$2,101	\$0	\$2,101	16.06	0.74	-\$8,652	15.00
	Location: Throuhgout											
2	Replace Existing Water Heater With New Energy Efficient Units	\$5,880	0	1,904	0	\$273	\$0	\$273	21.57	0.64	-\$2,130	18.00
	Location:Throuhgout											
Total for Improvements		\$39,614	0	1,904	256	\$2,374	\$0	\$2,374	16.69			

2. Introduction

The purpose of this Energy Audit is to provide American Legion 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	40
Operational Weeks / Year	38
Estimated Facility Occupancy	304
% of Male Occupants	50%

Point of Contact	
Point of Contact Name	Evony Cole
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	916-395-5000

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

Description:

Heating is provided by Forced Air Furnace and Rooftop Packaged Units; Cooling is provided primarily by Split Systems and secondary by Rooftop Packaged Units.

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

Building Central Heating System	
Primary Heating System	Forced Air Furnace
Secondary Heating System	NA
Hydronic Distribution System	NA
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

Building Cooling System	
Primary Cooling System	Split Systems
Secondary Cooling System	Package Units
Hydronic Distribution System	NA

Building Cooling System	
Cooling Mode Set-point	68 °F
Cooling Mode- Set-back Temperature	93 °F

Air Distribution System	
Building Ventilation	Roof Top 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	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 Linear Fluorescent (T-8) and High Intensity Discharge (HID) fixtures.

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

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
\$0.14 /kWh	\$1.39 /therm	\$ 8.20 /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.

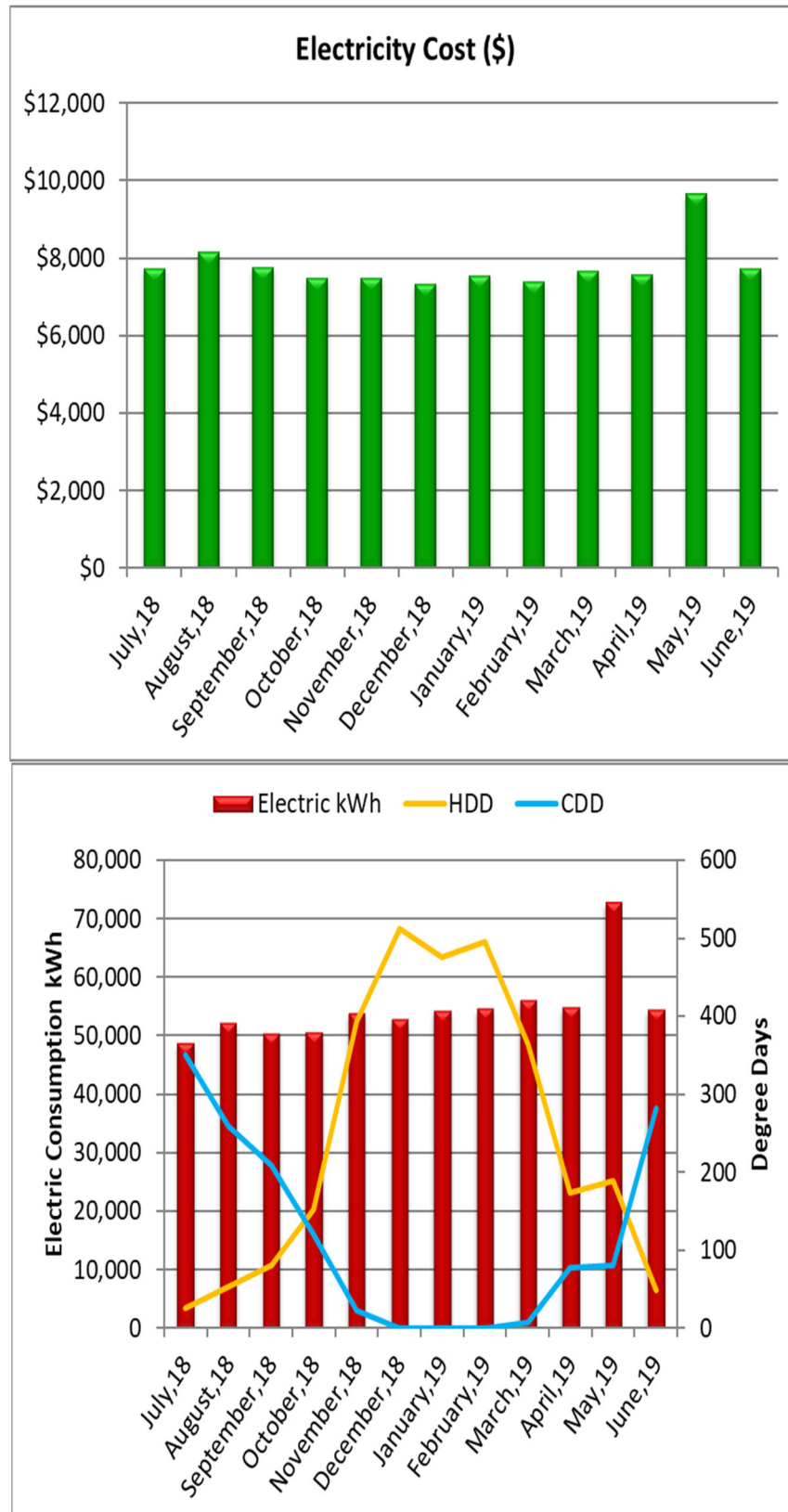
4.1. Electricity

PGE satisfies the electricity requirements for the facility. The primary end uses for electric utility comprises of lighting, cooling, 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	48,640	\$0.16	\$7,743
August,18	52,063	\$0.16	\$8,185
September,18	50,398	\$0.15	\$7,777
October,18	50,478	\$0.15	\$7,484
November,18	53,685	\$0.14	\$7,484
December,18	52,670	\$0.14	\$7,342
January,19	54,208	\$0.14	\$7,563
February,19	54,580	\$0.14	\$7,408
March,19	55,997	\$0.14	\$7,692
April,19	54,674	\$0.14	\$7,600
May,19	72,640	\$0.13	\$9,683
June,19	54,316	\$0.14	\$7,751
Total/average	654,349	\$0.14	\$93,712



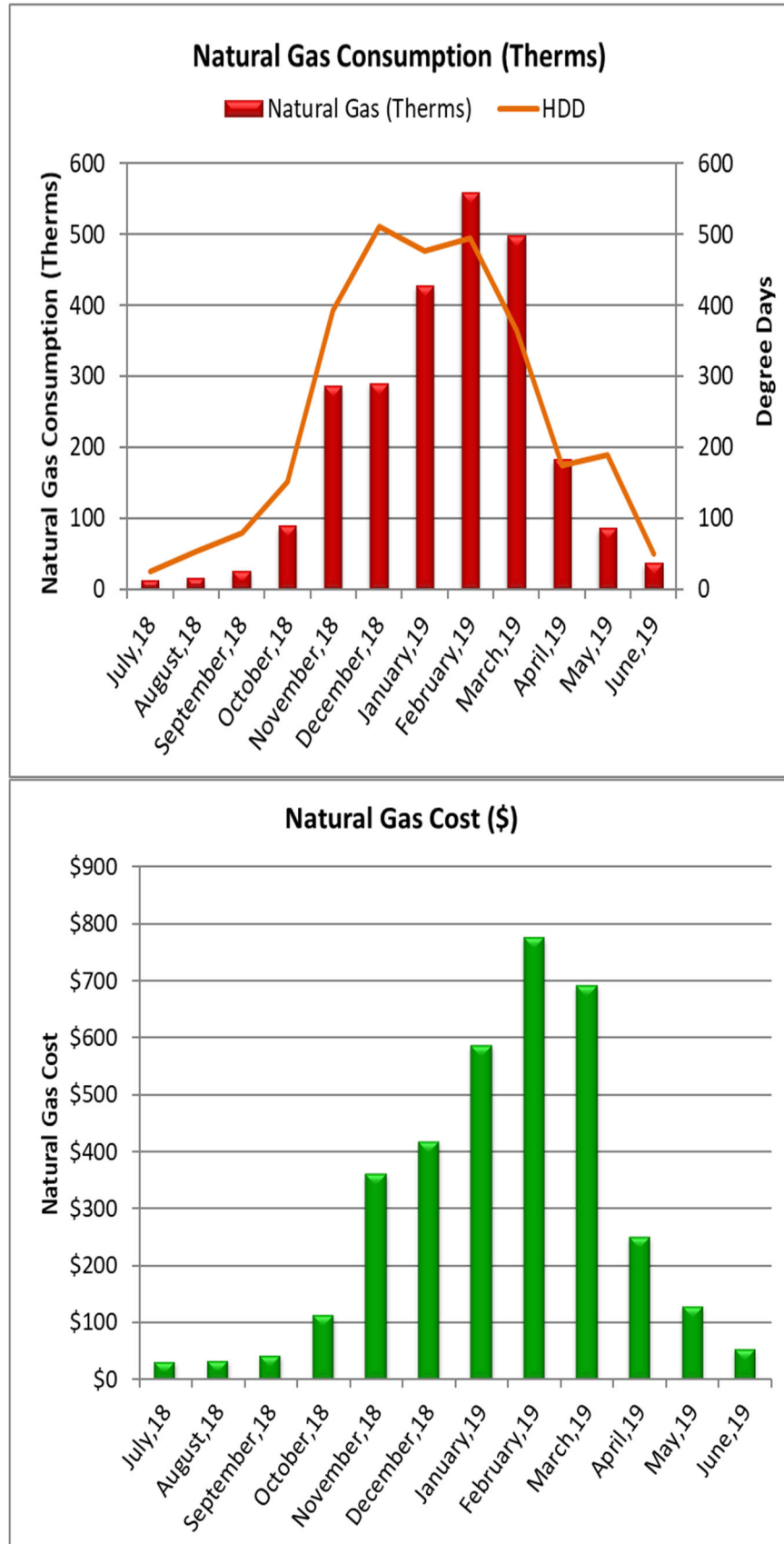
4.2. Natural Gas

Spurr Gas 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	13	\$2.38	\$32
August, 18	16	\$2.17	\$35
September, 18	26	\$1.67	\$44
October, 18	90	\$1.27	\$114
November, 18	287	\$1.27	\$363
December, 18	290	\$1.44	\$419
January, 19	428	\$1.37	\$588
February, 19	560	\$1.39	\$777
March, 19	499	\$1.39	\$693
April, 19	184	\$1.37	\$252
May, 19	87	\$1.49	\$130
June, 19	37	\$1.48	\$55
Total/average	2,518	\$1.39	\$3,503

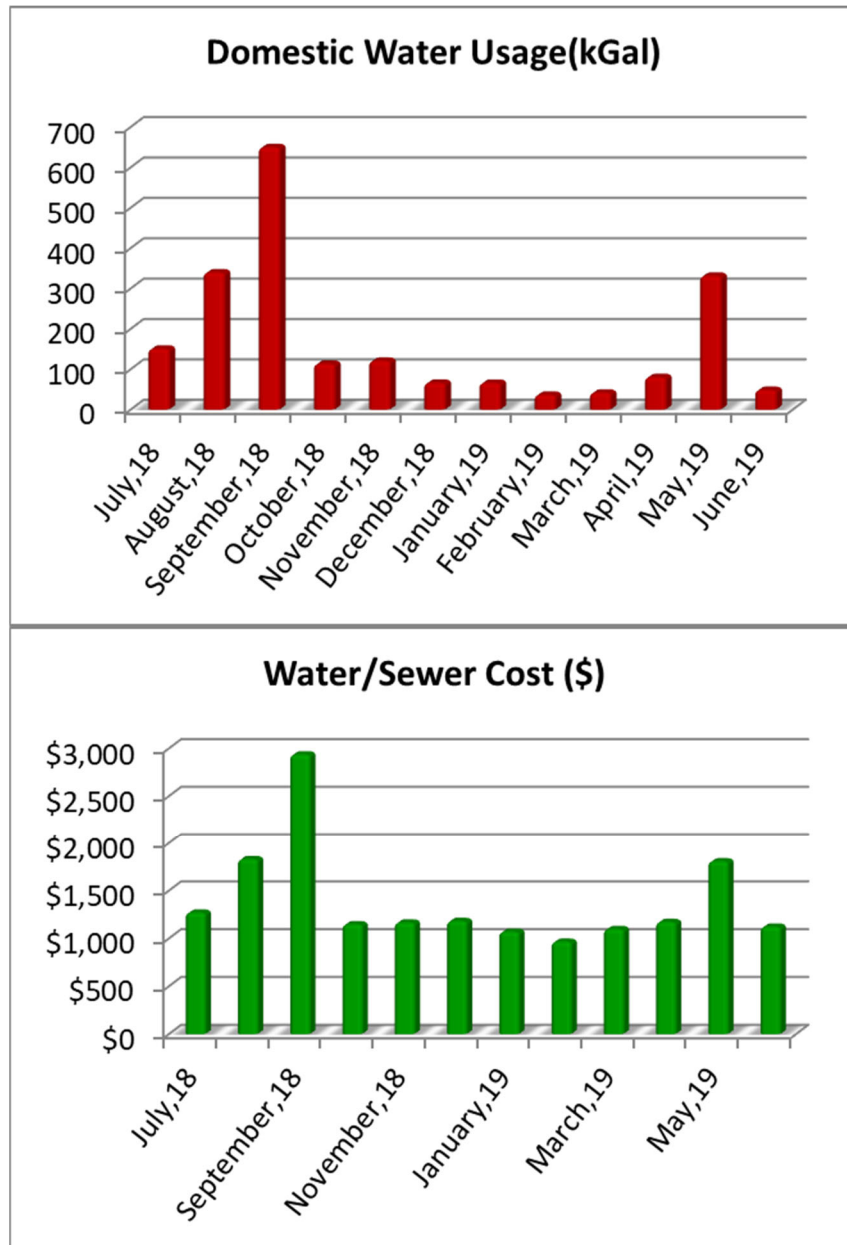


4.3. Water and Sewer

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	151	\$8.43	\$1,272
August, 18	340	\$5.39	\$1,831
September, 18	650	\$4.52	\$2,938
October, 18	113	\$10.13	\$1,149
November, 18	121	\$9.65	\$1,167
December, 18	66	\$17.84	\$1,183
January, 19	66	\$16.18	\$1,070
February, 19	37	\$26.27	\$966
March, 19	42	\$26.21	\$1,099
April, 19	81	\$14.56	\$1,173
May, 19	332	\$5.45	\$1,808
June, 19	49	\$23.05	\$1,124
Total/average	2,047	\$8.20	\$16,779



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 needed
Is the property located in a state eligible for net metering?	Yes

A solar feasibility analysis of the American Legion 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		KW kWh
Estimated Number of Panels	235	
Estimated KW Rating	74	
Potential Annual kWh Produced	114,980	
% of Current Electricity Uses	17.6%	
Financial Summary		Years
Investment Cost	\$259,00	
Estimated Energy Cost Savings	\$16,097	
Payback without Incentives	16.1	
Incentive Payback but without SRECs	9.7	
Payback with All Incentives	9.7	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

D10 CONVEYING											
Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode Qty
1	1446227	D1011	Elevator	1500 - 2500 LB	American Legion / 00A/00E Main Building	MR01, elevator room	No tag/plate found	No tag/plate found	10184		00263443
2	1446156	D1011	Elevator Controls	1 CAR	American Legion / 00A/00E Main Building	MR01, elevator room	Motion Control Engineering Inc.	HMC-1000-PHC	3213052	2006	00263444
3	1446264	D1013	Wheelchair Lift		American Legion / 00B Auditorium	Stage	Garaventa	GENESIS OPEL	27355	2004	00263406
D20 PLUMBING											
Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode Qty
1	1443065	D2021	Backflow Preventer	.75 INCH	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	Wilkins Zurn	975XL	899127		00256615
2	1446100	D2021	Backflow Preventer	3 INCH	American Legion / Site	Site	Febco	LF860	A1907111203	2018	00263439
3	1446233	D2021	Backflow Preventer	4 INCH	American Legion / Site	Site	Kennedy	Inaccessible	Inaccessible	2015	00263438
4	1446157	D2023	Domestic Circulation/Booster Pump	5 HP	American Legion / Site	Site	Goulds Water Technology	3656	J1812191	2018	00263440
5	1443052	D2023	Water Heater	120 GAL	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	State Industries, Inc.	PCE12020RTA	0920M001142	2010	00263446
6	1446085	D2023	Water Heater	3.8 GPM	American Legion / Gymnasium	Laundry	Rheem	RTGH-95DVLN-2	W181939580	2019	00256865
7	1446067	D2023	Water Heater	3.8 GPM	American Legion / Gymnasium	Laundry	Rheem	RTGH-95DVLN-2	W181939581	2019	00256864
8	1446204	D2023	Water Heater	No tag/plate found	American Legion / 00D Carpentry	M007	No tag/plate found	No tag/plate found	No tag/plate found		
9	1446065	D2023	Water Heater	50 GAL	American Legion / 00B Auditorium	M001, hot water heater closet	A. O. Smith	DSE50	SM041019023	2004	00256896
10	1446118	D2023	Water Heater	6 GAL	American Legion / P02 Restrooms	ZC01	American Water Heater Co.	E61-6U-015SV	0800101	2004	00263432
11	1446094	D2091	Air Compressor	10 HP	American Legion / 00D Carpentry	M007	Ingersoll Rand	No tag/plate found	No tag/plate found		00263434
12	1443045	D2091	Air Compressor	3 HP	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	Champion	No tag/plate found	No tag/plate found		00256616
13	1443094	D2091	Compressed Air Dryer	100 CFM	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	Van Air Systems	RAD-10 115-1-60X	98VIA-VE566-05A	1998	00263447
D30 HVAC											
Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode Qty
1	1443037	D3032	Condensing Unit/Heat Pump [CU-1.1]	5 TON	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	TSA060S4N45Y	5818K09309	2019	00256577
2	1443115	D3032	Condensing Unit/Heat Pump [CU-1.2]	5 TON	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	TSA060S4N45Y	5818K09314	2019	00256578
3	1443031	D3032	Condensing Unit/Heat Pump [CU-1.3]	4 TON	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	TSA048S4N44Y	5818K02974	2019	00256588
4	1443056	D3032	Condensing Unit/Heat Pump [CU-1.4]	4 TON	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	TSA048S4N44Y	5818K02965	2019	00256576
5	1446209	D3032	Condensing Unit/Heat Pump [CU-1E]	3.5 TON	American Legion / 00B Auditorium	Roof	Carrier	No tag/plate found	No tag/plate found	2004	00263407
6	1443110	D3032	Condensing Unit/Heat Pump [CU-2.1]	5 TON	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	TSA060S4N45Y	5818K09311	2019	00256602
7	1443111	D3032	Condensing Unit/Heat Pump [CU-2.3]	5 TON	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	TSA060S4N45Y	5818K09307	2019	00256603
8	1443059	D3032	Condensing Unit/Heat Pump [CU-2.4]	5 TON	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	TSA060S4N45Y	5818K09301	2019	00256601
9	1443103	D3032	Condensing Unit/Heat Pump [CU-2.5]	4 TON	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	TSA048S4N44Y	5818K02982	2019	00256604
10	1443100	D3032	Condensing Unit/Heat Pump [CU-2.6]	5 TON	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	TSA060S4N45Y	5818K09304	2019	00256600
11	1443063	D3032	Condensing Unit/Heat Pump [CU-3.1]	5 TON	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	TSA060S4N45Y	5818K09283	2019	00256594
12	1443082	D3032	Condensing Unit/Heat Pump [CU-3.3]	5 TON	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	TSA060S4N45Y	5818K09308	2019	00256595
13	1443090	D3032	Condensing Unit/Heat Pump [CU-3.4]	5 TON	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	TSA060S4N45Y	5818K09310	2019	00256585
14	1443068	D3032	Condensing Unit/Heat Pump [CU-3.5]	4 TON	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	TSA048S4N44Y	5818K02972	2019	00256596
15	1443044	D3032	Condensing Unit/Heat Pump [CU-3.6]	5 TON	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	TSA060S4N45Y	5818K09306	2019	00256584
16	1443043	D3032	Condensing Unit/Heat Pump [CU-4.1]	3 TON	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	TSA036S4N44Y	5818B13804	2019	00256597
17	1443040	D3032	Condensing Unit/Heat Pump [CU-4.2]	5 TON	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	TSA060S4N45Y	5818K09298	2019	00256598
18	1443035	D3032	Condensing Unit/Heat Pump [CU-4.3]	5 TON	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	TSA060S4N45Y	5818K09295	2019	00256593
19	1443080	D3032	Condensing Unit/Heat Pump [CU-4.4]	4 TON	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	TSA048S4N44Y	5818K02973	2019	00256599
20	1446106	D3032	Condensing Unit/Heat Pump	20 TON	American Legion / 00B Auditorium	Site	Trane	RAUCC20ECR0300D0G0000	C98K00543	1998	00263410
21	1446199	D3032	Condensing Unit/Heat Pump	5 TON	American Legion / 00C V Wing	Roof	Carrier	38BRC060---321	4097E00443	1997	00263401
22	1446178	D3032	Ductless Split System [SCU-1]	1 TON	American Legion / Gymnasium	Roof	Johnson Controls	DHX12CSB21S	DOG1801023	2019	00256874
23	1446216	D3039	Ceiling Fan		American Legion / Gymnasium	Gymnasium				2019	2
24	1446222	D3041	Air Handler (AHU)	9100 CFM	American Legion / 00B Auditorium	Attic	Airdyne	UAH 100	1194	1994	00263405
25	1446196	D3041	Fan Coil Unit [Heat M94]	3.5 TON	American Legion / 00B Auditorium	Attic	Carrier	FC4CNF042	3504A70301	2004	00263441
26	1446068	D3042	Exhaust Fan [KEF-1]	1001 - 2000 CFM	American Legion / Gymnasium	Roof	Greenheck	CUE-180-VG-20-G	15685942	2019	00256868
27	1446221	D3042	Exhaust Fan [KEF-2]	1001 - 2000 CFM	American Legion / Gymnasium	Roof	Greenheck	CUE-180-VG-20-G	15685940	2019	00256867
28	1446135	D3042	Exhaust Fan [KEF-3]	1001 - 2000 CFM	American Legion / Gymnasium	Roof	Greenheck	CUE-141HP-VG-5-X	15685943	2019	00256869
29	1446077	D3042	Exhaust Fan	501 - 1000 CFM	American Legion / 00C V Wing	Roof	Greenheck	GB-071-4X-QD-R2	05F15435	2005	00263403
30	1446153	D3042	Exhaust Fan	501 - 1000 CFM	American Legion / 00C V Wing	Roof	JennAir	201 AR	No tag/plate found		00263402
31	1446129	D3042	Exhaust Fan	501 - 1000 CFM	American Legion / 00C V Wing	Roof	Greenheck	GB-071-4X-QD-R2	05F15436	2005	00263404
32	1443033	D3042	Exhaust Fan	CFM	American Legion / 00A/00E Main Building	MZ-4, Roof	Greenheck	GB-141-3X-QD	05G24410	2005	00256592
33	1443049	D3042	Exhaust Fan	CFM	American Legion / 00A/00E Main Building	MZ-1, Roof	Greenheck	GB-091-4X-QD-R2	05E23302	2005	00256587
34	1443107	D3042	Exhaust Fan [REF-1]	CFM	American Legion / 00A/00E Main Building	MZ-1, Roof	Greenheck	SQB 12 4	465000		00256519
35	1446205	D3042	Exhaust Fan [REF-1]	1001 - 2000 CFM	American Legion / Gymnasium	Roof	Greenheck	CUE-141-VG-5-X	15685944	2019	00256870
36	1446112	D3051	Air Conditioner	2 TON	American Legion / 00C V Wing	C009	Mars	RAD-283M	1306721116410130088	2013	00256861
37	1443077	D3051	Furnace [AHU-1]	88 MBH	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	EL296UH090XV60C-1	5919C09462	2019	00256618

38	1443102	D3051	Furnace [AHU-1]	88 MBH	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	EL296UH090XV60C-1	5919B10389	2019	00256579
39	1443079	D3051	Furnace [AHU-1]	88 MBH	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	EL296UH090XV60C-1	1719A13158	2019	00256522
40	1443083	D3051	Furnace [AHU-1]	88 MBH	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	EL296UH090XV60C-1	1719A13176	2019	00256589
41	1443041	D3051	Furnace [AHU-2]	88 MBH	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	EL296UH090XV60C-1	5918D06630	2019	00256517
42	1443113	D3051	Furnace [AHU-2]	88 MBH	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	EL296UH090XV60C-1	5919B24780	2019	00256620
43	1443098	D3051	Furnace [AHU-3]	88 MBH	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	EL296UH090XV60C-1	1719A34779	2019	00256590
44	1443039	D3051	Furnace [AHU-3]	88 MBH	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	EL296UH090XV60C-1	5918D12012	2019	00256523
45	1443050	D3051	Furnace [AHU-3]	88 MBH	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	EL296UH090XV60C-1	5919B15322	2019	00256617
46	1443061	D3051	Furnace [AHU-3]	88 MBH	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	EL296UH090XV60C-1	5919B10393	2019	00256581
47	1443075	D3051	Furnace [AHU-4]	88 MBH	American Legion / 00A/00E Main Building	MZ-4, Roof	Lennox	EL296UH090XV60C-1	5919B10398	2019	00256619
48	1443072	D3051	Furnace [AHU-4]	88 MBH	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	EL296UH090XV60C-1	1719A34789	2019	00256583
49	1443029	D3051	Furnace [AHU-4]	88 MBH	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	EL296UH090XV60C-1	5918D12018	2019	00256524
50	1443101	D3051	Furnace [AHU-4]	88 MBH	American Legion / 00A/00E Main Building	MZ-1, Roof	Lennox	EL296UH090XV60C-1	5918D12017	2019	00256516
51	1443070	D3051	Furnace [AHU-5]	88 MBH	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	EL296UH090XV60C-1	5919B15332	2019	00256580
52	1443054	D3051	Furnace [AHU-5]	88 MBH	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	EL296UH090XV60C-1	5918D06633	2019	00256521
53	1443084	D3051	Furnace [AHU-6]	88 MBH	American Legion / 00A/00E Main Building	MZ-3, Roof	Lennox	EL296UH090XV60C-1	1719A43687	2019	00256582
54	1443071	D3051	Furnace [AHU-6]	88 MBH	American Legion / 00A/00E Main Building	MZ-2, Roof	Lennox	EL296UH090XV60C-1	5918D12014	2019	00256520
55	1446267	D3051	Furnace	132 MBH	American Legion / 00C V Wing	M007, closet	Carrier	58PAV135-16120	1897A05095	1997	00256613
56	1446263	D3051	Furnace	150 MBH	American Legion / 00C V Wing	M010, closet	Rheem	3201 150	49 NO PAN		00256862
57	1446228	D3051	Unit Heater	Inaccessible	American Legion / 00D Carpentry	Throughout building	Reznor	Inaccessible	Inaccessible		Inaccessible2
58	1446110	D3052	Heat Pump	3.5 TON	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Bard	WH431-A05GP4XXX	176D041908298-02	2004	00263413
59	1446154	D3052	Heat Pump	3.5 TON	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Bard	WH431-A05GP4XXX	176M041968196-02	2004	00263414
60	1446167	D3052	Heat Pump	3.5 TON	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Bard	WH431-A05GP4XXX	176M041968195-02	2004	00263412
61	1446117	D3052	Heat Pump	4.5 TON	American Legion / P03 HS	Building exterior	Crispaire	AVP60HPA10NB-1000	AL34855	2000	00263415
62	1446126	D3052	Packaged Unit (RTU) [AC-1]	25 TON	American Legion / Gymnasium	Roof	Johnson Controls	J25ZJN30P2C1BCA3C1	N1C9737770	2019	00256875
63	1446082	D3052	Packaged Unit (RTU) [AC-2]	4 TON	American Legion / Gymnasium	Roof	Johnson Controls	JA4ZJN06B2A1GCA3A2	N1C9737831	2019	00256871
64	1446269	D3052	Packaged Unit (RTU) [MAU-1]	17.5 TON	American Legion / Gymnasium	Roof	York	JROA210C2A2B	181104701001	2019	00256873
65	1446248	D3052	Packaged Unit (RTU)	10 TON	American Legion / 00D Carpentry	Site	Lennox	LGH120H4MM3Y	5617E10880	2017	00263435

D40 FIRE PROTECTION

Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode	Qty
1	1446055	D4011	Backflow Preventer	6 INCH	American Legion / Site	Site	Kennedy	KS-FW	1967820619	2019	00263442	
2	1456404	D4031	Fire Extinguisher		American Legion / 00B Auditorium	Throughout building						2
3	1443032	D4031	Fire Extinguisher		American Legion / 00A/00E Main Building	Throughout building						23
4	1456853	D4031	Fire Extinguisher		American Legion / P01 Classrooms P1, P2, P3	Throughout building						3
5	1446107	D4031	Fire Extinguisher		American Legion / Gymnasium	Throughout building				2019		5
6	1446102	D4031	Fire Extinguisher		American Legion / 00D Carpentry	Throughout building						
7	1446087	D4031	Fire Extinguisher		American Legion / 00C V Wing	Throughout building						4
8	1457232	D4031	Fire Extinguisher		American Legion / P03 HS	Throughout building						

D50 ELECTRICAL

Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode	Qty
1	1446211	D5012	Building/Main Switchboard	1200 AMP	American Legion / 00B Auditorium	Site	General Electric	No tag/plate found	181-34425	1977	00263411	
2	1443051	D5012	Building/Main Switchboard	2000 AMP	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	Sylvania	762350	95551-1	1977	00263430	
3	1446083	D5012	Building/Main Switchboard	800 AMP	American Legion / 00D Carpentry	Site	GE	No tag/plate found	Illegible		00263436	
4	1446218	D5012	Main Distribution Panel [Distribution Panel BLDG C]	350 AMP	American Legion / 00C V Wing	Site	Safety Switchboard Co.	Illegible	Illegible	1977	00263437	
5	1446214	D5012	Main Distribution Panel	200 AMP	American Legion / P03 HS	Building exterior	Cutler-Hammer	No tag/plate found	No tag/plate found	2000	00263431	
6	1446190	D5012	Main Distribution Panel [Panel G]	600 AMP	American Legion / Gymnasium	Storage	Eaton	No tag/plate found	SSR0953562-001	2019	00256866	
7	1443089	D5012	Main Distribution Panel [PANEL M]	400 AMP	American Legion / 00A/00E Main Building	M118, Electrical Panel Room	Sylvania	BM-55261	R0-95551	1977	00256614	
8	1446273	D5012	Main Distribution Panel [Portable Panel 1]	125 AMP	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Square D	No tag/plate found	No tag/plate found	2004	00256891	
9	1446115	D5012	Main Distribution Panel [Portable Panel 2]	125 AMP	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Square D	No tag/plate found	No tag/plate found	2004	00256892	
10	1446095	D5012	Main Distribution Panel [Portable Panel 3]	125 AMP	American Legion / P01 Classrooms P1, P2, P3	Building exterior	Square D	No tag/plate found	No tag/plate found	2004	00256893	
11	1446119	D5012	Main Distribution Panel [Portable Panel 4]	125 AMP	American Legion / P02 Restrooms	Building exterior	Square D	No tag/plate found	No tag/plate found	2004	00263433	
12	1456791	D5022	Light Fixture		American Legion / Gymnasium	Building exterior				2019		9
13	1456399	D5022	Light Fixture	100 WATT	American Legion / 00B Auditorium	Building exterior						3
14	1456633	D5022	Light Fixture	100 WATT	American Legion / 00D Carpentry	Building exterior						3
15	1446093	D5022	Light Fixture	100 WATT	American Legion / P02 Restrooms	Building Exterior				2004		2
16	1446212	D5022	Light Fixture	100 WATT	American Legion / 00A/00E Main Building	Building exterior						4
17	1446173	D5022	Light Fixture	100 WATT	American Legion / P01 Classrooms P1, P2, P3	Building Exterior				2004		3
18	1456435	D5022	Light Fixture	100 WATT	American Legion / 00C V Wing	Building exterior						
19	1457267	D5022	Light Fixture	100 WATT	American Legion / P03 HS	Building exterior						2
20	1443058	D5037	Fire Alarm Control Panel		American Legion / 00A/00E Main Building	S122, Manager	Fire-Lite Alarms, Inc.	MS-9600	No tag/plate found	2003	00263448	
21	1446243	D5092	Emergency/Exit Combo LED		American Legion / 00B Auditorium	Throughout building						4
22	1446091	D5092	Emergency/Exit Combo LED		American Legion / P03 HS	Throughout building						2

23	1443091	D5092	Exit Sign Light Fixture		American Legion / 00A/00E Main Building	Throughout building						10
24	1446191	D5092	Exit Sign Light Fixture		American Legion / 00C V Wing	Throughout building						3
25	1446060	D5092	Exit Sign Light Fixture		American Legion / Gymnasium	Throughout building				2019		4

E10 EQUIPMENT

Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode	Qty
1	1443074	E1027	Dust Collection System [SEC-1]		American Legion / 00A/00E Main Building	M104, utility closet	Air Sentry INC	Air Sentry	No tag/plate found		00256606	
2	1446224	E1093	Commercial 10 LF	10 LF	American Legion / Gymnasium	Culinary classroom	CaptiveAire Systems	4824 ND-2	3125479	2019	00256608	
3	1446271	E1093	Commercial 10 LF	10 LF	American Legion / Gymnasium	Culinary classroom	CaptiveAire Systems	4824 ND-2	3125479	2019	00263450	
4	1446210	E1093	Commercial 4 LF	4 LF	American Legion / Gymnasium	Culinary classroom	CaptiveAire Systems	5424 VHB	3125479	2019	00263457	
5	1446137	E1093	Commercial Convection Oven, Double		American Legion / Gymnasium	Culinary classroom	Imperial	Inaccessible	Inaccessible	2019	00263456	
6	1446130	E1093	Commercial Convection Oven, Single		American Legion / 00B Auditorium	Kitchen	Moffat	Turbofan 32	No tag/plate found		00256900	
7	1446169	E1093	Commercial Convection Oven, Single		American Legion / 00B Auditorium	Kitchen	Moffat	Turbofan 32	No tag/plate found		00256899	
8	1446071	E1093	Commercial Dairy Cooler/Wells		American Legion / 00B Auditorium	Kitchen	Beverage-Air Corporation	SM58N-W	10407136		00256902	
9	1446150	E1093	Commercial Dairy Cooler/Wells		American Legion / 00B Auditorium	Cafeteria	Beverage-Air Corporation	SM58N	No tag/plate found		00256904	
10	1446133	E1093	Commercial Dishwasher	No tag/plate found	American Legion / Gymnasium	Culinary classroom	Hobart	Advansys	Inaccessible	2019	00263455	
11	1446236	E1093	Commercial Food Warmer		American Legion / 00B Auditorium	Kitchen	Metro	TC90	TC90 02237	2002	00256901	
12	1446187	E1093	Commercial Food Warmer		American Legion / 00B Auditorium	Kitchen	Cres Cor	Inaccessible	Inaccessible		00256903	
13	1446202	E1093	Commercial Food Warmer		American Legion / Gymnasium	Culinary classroom	Doyon	Inaccessible	Inaccessible	2019	00263458	
14	1446141	E1093	Commercial Freezer, 2-Door Reach-In		American Legion / 00B Auditorium	Kitchen	True Manufacturing Co	T-49F	3955013		00256897	
15	1446274	E1093	Commercial Freezer, 3-Door Reach-In		American Legion / Gymnasium	Laundry	True Manufacturing Co	TS-72F-HC	9705344	2019	00256863	
16	1446159	E1093	Commercial Griddle		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00263451	
17	1446121	E1093	Commercial Griddle		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00263453	
18	1446152	E1093	Commercial Griddle		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00256610	
19	1446230	E1093	Commercial Griddle		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00256612	
20	1446246	E1093	Commercial Icemaker, Freestanding		American Legion / Gymnasium	Culinary classroom	Hoshizaki	Inaccessible	Inaccessible	2019	00263459	
21	1446234	E1093	Commercial Range/Oven, 4-Burner		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00263452	
22	1446144	E1093	Commercial Range/Oven, 4-Burner		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00256611	
23	1446182	E1093	Commercial Range/Oven, 4-Burner		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00256609	
24	1446111	E1093	Commercial Range/Oven, 4-Burner		American Legion / Gymnasium	Culinary classroom	Vulcan	No tag/plate found	No tag/plate found	2019	00263454	
25	1446109	E1093	Commercial Refrigerator, 2-Door Reach-In		American Legion / 00B Auditorium	Kitchen	True Manufacturing Co	T-49	3953648		00256898	
26	1446064	E1093	Commercial Refrigerator, 2-Door Reach-In		American Legion / Gymnasium	Culinary classroom	True Manufacturing Co	TS-49-HC	9619547	2019	00263460	
27	1446232	E1093	Commercial Refrigerator, 2-Door Reach-In		American Legion / Gymnasium	Culinary classroom	True Manufacturing Co	TS-49-HC	9619544	2019	00263449	
28	1446171	E1093	Commercial Refrigerator, 2-Door Reach-In		American Legion / 00B Auditorium	Cafeteria	True Manufacturing Co	TS-49	6758727		00256905	
29	1446061	E1093	Commercial Refrigerator, 2-Door Reach-In		American Legion / 00B Auditorium	Cafeteria	True Manufacturing Co	TS-49	7493541		00256872	
30	1446059	E1093	Commercial Walk-In Freezer		American Legion / 00B Auditorium	Kitchen	Duracold	F1	59251	2005	00256894	
31	1446149	E1093	Commercial Walk-In Refrigerator		American Legion / 00B Auditorium	Kitchen	Duracold	F1	59251	2005	00256895	
32	1446143	E1093	Commercial Walk-In Refrigerator/Freezer, Condenser		American Legion / 00B Auditorium	Roof	No tag/plate found	No tag/plate found	No tag/plate found	2005	00263408	
33	1446074	E1093	Commercial Walk-In Refrigerator/Freezer, Condenser		American Legion / 00B Auditorium	Roof	No tag/plate found	No tag/plate found	No tag/plate found	2005	00263409	
34	1446098	E1094	Residential Clothes Dryer		American Legion / Gymnasium	Laundry	LG	DLEX3700W	906KWWZ6N481	2019		
35	1446062	E1094	Residential Clothes Washer		American Legion / Gymnasium	Laundry	LG	Inaccessible	Inaccessible	2019		
36	1446089	E1099	Bleacher	1 - 15 TIER	American Legion / Gymnasium	Gymnasium				2019		75

G40 OTHER

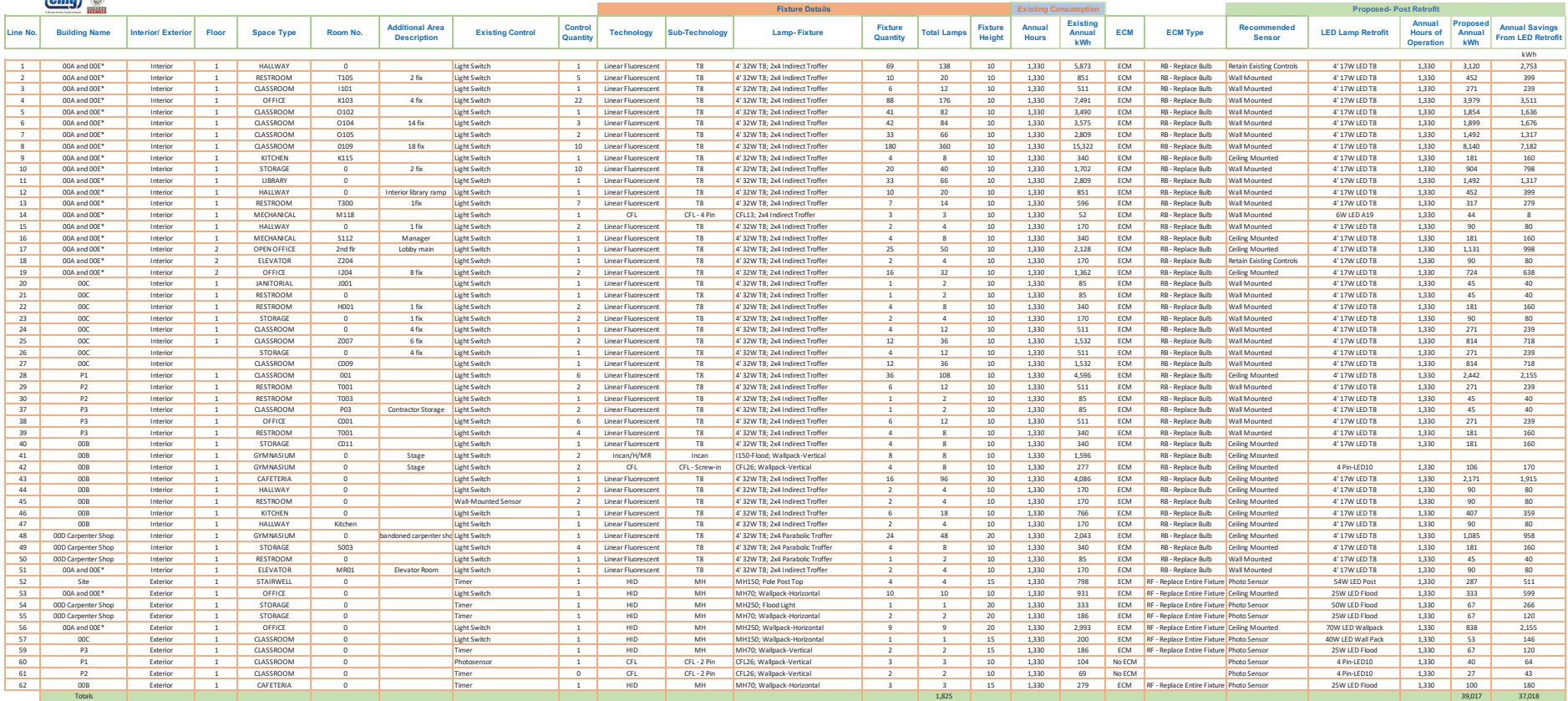
Index	ID	UFCode	Component	Capacity	Building	Location Detail	Manufacturer	Model	Serial	Dataplate Yr	Barcode	Qty
1	1443055	G4021	Site Pole Light	105 - 200 WATT	American Legion / Site	Site						4
2	1446166	G4021	Site Pole Light	105 - 200 WATT	American Legion / Site	Site				2019		5

APPENDIX C:

Lighting System Schedule



										Lamp Details				Fixture Details				Existing Consumption		
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Additional Area Description	LUX	Control Quantit y	Existing Control	Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh	
1	00A and 00E*	Interior	1	HALLWAY	0		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	138	2x4 Indirect Troffer	69	0	10	1,330	5,873	
2	00A and 00E*	Interior	1	RESTROOM	T105	2 fix	-	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	2x4 Indirect Troffer	10	0	10	1,330	851	
3	00A and 00E*	Interior	1	CLASSROOM	I101		330	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Indirect Troffer	6	0	10	1,330	511
4	00A and 00E*	Interior	1	OFFICE	K103	4 fix	-	22	Light Switch	Linear Fluorescent	T8	4' 32W T8	176	2x4 Indirect Troffer	88	0	10	1,330	7,491	
5	00A and 00E*	Interior	1	CLASSROOM	O102		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	82	2x4 Indirect Troffer	41	0	10	1,330	3,490	
6	00A and 00E*	Interior	1	CLASSROOM	O104	14 fix	-	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	84	2x4 Indirect Troffer	42	0	10	1,330	3,575	
7	00A and 00E*	Interior	1	CLASSROOM	O105		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	66	2x4 Indirect Troffer	33	0	10	1,330	2,809	
8	00A and 00E*	Interior	1	CLASSROOM	O109	18 fix	-	10	Light Switch	Linear Fluorescent	T8	4' 32W T8	360	2x4 Indirect Troffer	180	0	10	1,330	15,322	
9	00A and 00E*	Interior	1	KITCHEN	K115		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	10	1,330	340	
10	00A and 00E*	Interior	1	STORAGE	0	2 fix	-	10	Light Switch	Linear Fluorescent	T8	4' 32W T8	40	2x4 Indirect Troffer	20	0	10	1,330	1,702	
11	00A and 00E*	Interior	1	LIBRARY	0		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	66	2x4 Indirect Troffer	33	0	10	1,330	2,809	
12	00A and 00E*	Interior	1	HALLWAY	0	Interior library ran	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	20	2x4 Indirect Troffer	10	0	10	1,330	851	
13	00A and 00E*	Interior	1	RESTROOM	T300	1fix	-	7	Light Switch	Linear Fluorescent	T8	4' 32W T8	14	2x4 Indirect Troffer	7	0	10	1,330	596	
14	00A and 00E*	Interior	1	MECHANICAL	M118		-	1	Light Switch	CFL	CFL - 4 Pin	CFL13	3	2x4 Indirect Troffer	3	0	10	1,330	52	
15	00A and 00E*	Interior	1	HALLWAY	0	1 fix	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
16	00A and 00E*	Interior	1	MECHANICAL	S112	Manager	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	10	1,330	340	
17	00A and 00E*	Interior	2	OPEN OFFICE	2nd flr	Lobby main	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	50	2x4 Indirect Troffer	25	0	10	1,330	2,128	
18	00A and 00E*	Interior	2	ELEVATOR	Z204		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
19	00A and 00E*	Interior	2	OFFICE	I204	8 fix	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	32	2x4 Indirect Troffer	16	0	10	1,330	1,362	
20	00C	Interior	1	JANITORIAL	J001		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Indirect Troffer	1	0	10	1,330	85	
21	00C	Interior	1	RESTROOM	0		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Indirect Troffer	1	0	10	1,330	85	
22	00C	Interior	1	RESTROOM	H001	1 fix	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	10	1,330	340	
23	00C	Interior	1	STORAGE	0	1 fix	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
24	00C	Interior	1	CLASSROOM	0	4 fix	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Indirect Troffer	4	0	10	1,330	511	
25	00C	Interior	1	CLASSROOM	Z007	6 fix	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Indirect Troffer	12	0	10	1,330	1,532	
26	00C	Interior		STORAGE	0	4 fix	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Indirect Troffer	4	0	10	1,330	511	
27	00C	Interior		CLASSROOM	C009		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	2x4 Indirect Troffer	12	0	10	1,330	1,532	
28	P1	Interior	1	CLASSROOM	001		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	108	2x4 Indirect Troffer	36	0	10	1,330	4,596	
29	P2	Interior	1	RESTROOM	T001		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Indirect Troffer	6	0	10	1,330	511	
30	P2	Interior	1	RESTROOM	T003		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Indirect Troffer	1	0	10	1,330	85	
31	Gym	Interior	1	CLASSROOM	0		-	2	Light Switch	LED	-	-	24	2x4 Indirect Troffer	12	0	10	1,330	-	
32	Gym	Interior		KITCHEN	0	Culinary classroom	-	2	Light Switch	LED	-	-	22	2x4 Indirect Troffer	11	0	10	1,330	-	
33	Gym	Interior	1	STORAGE	0		750	4	Light Switch	LED	-	-	12	2x4 Indirect Troffer	6	0	10	1,330	-	
34	Gym	Interior	1	OFFICE	0		-	2	Light Switch	LED	-	-	4	2x4 Indirect Troffer	2	0	10	1,330	-	
35	Gym	Interior	1	GYMNASIUM	0	Gym	-	2	Ceiling-Mounted Sensor	LED	-	-	40	Highbay	10	0	30	1,330	-	
36	Gym	Interior	1	RESTROOM	0		-	4	Light Switch	LED	-	-	12	2x4 Indirect Troffer	6	0	10	1,330	-	
37	P3	Interior	1	CLASSROOM	P03	Contractor Storage	-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Indirect Troffer	1	0	10	1,330	85	
38	P3	Interior	1	OFFICE	C001		-	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	2x4 Indirect Troffer	6	0	10	1,330	511	
39	P3	Interior	1	RESTROOM	T001		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	10	1,330	340	
40	00B	Interior	1	STORAGE	C011		350	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Indirect Troffer	4	0	10	1,330	340
41	00B	Interior	1	GYMNASIUM	0	Stage	-	2	Light Switch	Incand/H/MR	Incand	1150-Flood	8	Wallpack-Vertical	8	0	10	1,330	1,596	
42	00B	Interior	1	GYMNASIUM	0	Stage	-	2	Light Switch	CFL	CFL - Screw-in	CFL26	8	Wallpack-Vertical	4	0	10	1,330	277	
43	00B	Interior	1	CAFETERIA	0		350	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	96	2x4 Indirect Troffer	16	0	30	1,330	4,086	
44	00B	Interior	1	HALLWAY	0		-	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
45	00B	Interior	1	RESTROOM	0		-	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
46	00B	Interior	1	KITCHEN	0		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	18	2x4 Indirect Troffer	6	0	10	1,330	766	
47	00B	Interior	1	HALLWAY	Kitchen		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
48	00D Carpenter Shop	Interior	1	GYMNASIUM	0	Adjoined carpenter	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	48	2x4 Parabolic Troffer	24	0	20	1,330	2,043	
49	00D Carpenter Shop	Interior	1	STORAGE	S003		-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Parabolic Troffer	4	0	10	1,330	340	
50	00D Carpenter Shop	Interior	1	RESTROOM	0		-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Parabolic Troffer	1	0	10	1,330	85	
51	00A and 00E*	Interior	1	ELEVATOR	MR01	Elevator Room	-	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	2x4 Indirect Troffer	2	0	10	1,330	170	
52	Site	Exterior	1	STAIRWELL	0		-	1	Timer	HID	MH	MH150	4	Pole Post Top	4	0	15	1,330	798	
53	00A and 00E*	Exterior	1	OFFICE	0		-	1	Light Switch	HID	MH	MH70	10	Wallpack-Horizontal	10	0	10	1,330	931	
54	00D Carpenter Shop	Exterior	1	STORAGE	0		-	1	Timer	HID	MH	MH250	1	Flood Light	1	0	20	1,330	333	
55	00D Carpenter Shop	Exterior	1	STORAGE	0		-	1	Timer	HID	MH	MH70	2	Wallpack-Horizontal	2	0	20	1,330	186	
56	00A and 00E*	Exterior	1	OFFICE	0		-	1	Light Switch	HID	MH	MH250	9	Wallpack-Horizontal	9	0	20	1,330	2,993	
57	00C	Exterior	1	CLASSROOM	0		-	1	Light Switch	HID	MH	MH150	1	Wallpack-Horizontal	1	0	15	1,330	200	
58	Gym	Exterior	1	GYMNASIUM	0	Exterior led	-	1	Light Switch	LED	-	-	9	Wallpack-Vertical	9	0	10	1,330	-	
59	P3	Exterior	1	CLASSROOM	0		-	1	Timer	HID	MH	MH70	2	Wallpack-Vertical	2	0	15	1,330	186	
60	P1	Exterior	1	CLASSROOM	0		-	1	Photosensor	CFL	CFL - 2 Pin	CFL26	3	Wallpack-Vertical	3	0	10	1,330	104	
61	P2	Exterior	1	CLASSROOM	0		-	0	Timer	CFL	CFL - 2 Pin	CFL26	2	Wallpack-Vertical	2	1	10	1,330	69	
62	00B	Exterior	1	CAFETERIA	0		-	1	Timer	HID	MH	MH70	3	Wallpack-Horizontal	3	0	15	1,330	279	
63	Site	Exterior	1	STAIRWELL	0		-	1	Timer	LED	-	-	10	Pole Post Top	5	0	30	1,330	-	
Totals													1,825		862			83,790	77,631	



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

UIC	Install Timers On Exhaust Fans			
EAC7A	Location:Throuhgout			
Type of Exhaust Fan: Rooftop Exhaust Fans				
EXISTING CONDITION				
No. of Timers to Be Installed:	10	Qty	HP of Individual Fan Motor:	0.17 HP
No. of Exhaust Fans:	10		Total kW:	1.27 kW
Existing Daily Hours of Operation/Exhaust Fan:	15.00	Hrs/Day	Annual kWh For All Fans:	6,943 kWh
PROPOSED CONDITION				
New Daily Hours With Timers/Exhaust Fan:	0.94	Hrs/Day	New Annual kWh For All Fans:	434 kWh
Type of Heating Fuel:	Natural Gas		Is The Property Cooled?	Yes
Only For Apt. Bathroom Exhaust Fans			Only For Roof Top Exhaust Fans- Commerical Spaces	
CFM for Individual Bathroom Exhaust Fans (For bathrooms<100Sqft)	90	CFM	No. of Water Closets In Building	32
Total Exhaust CFM From All Fans	900	CFM	No. of Urinals In Building	5
Annual Heating Energy Savings	0	kbtu	Total CFM for All Restroom Exhaust	1,850 CFM
Annual Cooling Energy Savings	0	kbtu	Annual Heating Energy Savings	112,379 kbtu
			Annual Cooling Energy Savings	56,189 kbtu
Energy & Cost Savings				
Estimated Annual Heating Plant Efficiency	80.00	%	Estimated Annual Cooling Plant Efficiency	11.00 EER
Annual Heating Energy Savings	1,405	Therms	Annual Cooling Energy Savings	5,108 kWh
Annual Electric Fan Motor Savings	6,509	kWh		
COST ANALYSIS				
Electric Rate:	\$0.14	\$/kWh	Total Annual Electric Savings	11,617 kWh
Material Cost For Timers:	\$1,693	\$	Total Annual Non Electric Savings	1,405 Therms
Total Cost for Installing Timers	\$3,539	\$	Annual Cost savings:	\$3,618 \$
Simple Payback:	0.98	Yrs		
Type of Recommendation	Capital Cost ECM Recommendation			

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ECM DESCRIPTION:

Exhaust fans are generally used in areas with high concentrations of pollutants generated from occupants' activities. These exhaust requirements are rarely continuous, and the fans should operate only as needed. Continuous operations of bathroom exhaust fans results in exhausting conditioned air out. This causes low pressures in the conditioned space, which is filled up by infiltrated air from unconditioned spaces. Air infiltration leads to increase loads on heating and cooling system increasing the energy consumed to condition the space. In addition to this the fan motor is also consumes energy to operate, though insignificant as compared to the HVAC losses.

In case of the residential properties with individual exhaust fans in the bathrooms, EMG recommends installing timer switches on each bathroom fan to control the fan operations. Bathroom fans are essential to exhaust out the excess humidity and odor control. The timer switch will limit the operation time to 20 mins.

In case of central exhaust systems that have roof top or side wall mounted exhaust fans, EMG recommends a single electronic timer control to restrict the exhaust fan operations to typical building occupancy hours +/- 2 hrs. A single electronic timer would be able to control all the exhaust fans.

Summary:

Initial Investment: \$1,693
Energy Cost Savings: \$3,618

Simple Payback: 0.98 Years

UIC	Install Low Flow Faucet Aerators			
EAP2-b	Location: Throughout			
Property Type:		Commercial	Estimated No. of Operational Weeks	
			35	
			Number of Occupied Days/Week (Max 7)	
			5	
KITCHEN FAUCETS		BATHROOM FAUCETS		
Number of Occupants Affected By Retrofit		304	Number of Occupants Affected by Retrofit	
			304	
Do You Want To Replace Kitchen Faucets Aerators		Yes (Select)	Do You Want To Replace Bathroom Faucets Aerators	
			Yes (Select)	
Total Number of Faucet Aerators To Be Replaced		32	Total Number of Faucet Aerators To Be Replaced	
			79	
Total Number of Faucets To Be Replaced:		0	Total Number of Faucets To Be Replaced:	
			0	
GPM of Existing Faucet Aerators		2.2 GPM	GPM of Existing Faucet Aerators	
			2.2 GPM	
GPM of Proposed Faucet Aerator		1 GPM	GPM of Proposed Faucet Aerator	
			0.5 GPM	
Estimated Number of Uses Per Day		4	Estimated Number of Uses Per Day	
			6	
Annual Water Savings From Installing Low Flow Aerators:		76.61 kGal		
WATER & ENERGY SAVING CALCULATION		COST SAVING CALCULATION		
Select Type of Water Heater Fuel:		Natural Gas (Select)	Property Location in United States	
			North Central Localities	
Energy Factor of Domestic Hot Water Heater:		0.44 EF	Heating Fuel Tariff	
			\$1.39 \$/Therm	
Hot Water Discharge Temperature at Faucet		110.00 °F	Water Tariff (\$/1000 Gal)	
			\$8.20 \$/kGal	
Equivalent Heating Fuel Savings:		741 Therms	Annual Cost Savings In Form of Water	
<i>Savings Discounted by 15% to Account For Cold Water Use</i>			\$628 \$	
Annual Water Savings		76.61 kGal	Annual Energy Savings From Water Heater	
			\$1,030 \$	
COST BENEFIT ANALYSIS				
Estimated Total Annual Cost Savings		\$1,658 \$\$	Estimated Total Installation Cost	
			\$1,691 \$\$	
Simple Payback Period		1.02 Years	Type of Recommendation	
			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: \$1,691 Estimated Annual Cost Savings: \$1,658 Simple Payback Period (Yrs): 1.02

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	788	1,679	36,911	\$5,167.61	\$1,860.31

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	1	3	3	8	\$1	\$9
CFL	CFL - Screw-in	1	4	4	170	\$24	\$60
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	0	0	0	0	\$0	\$0
HID	MH	8	32	32	4,095	\$573	\$503
HID	MV	0	0	0	0	\$0	\$0
HID	QL	0	0	0	0	\$0	\$0
Linear Fluorescent	T8	42	749	749	32,638	\$4,569	\$1,288
Linear Fluorescent	T12	0	0	0	0	\$0	\$0
Linear Fluorescent	T8 U	0	0	0	0	\$0	\$0
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		No. of Controls
Photo Sensor	6	Ceiling Mounted	28
Wall Mounted	94		

Initial Investment		Equipment Rentals	
Material Cost	\$21,102.61	Scissor Lift 26' - Interior Spaces	\$445.00
Labor Cost	\$35,485.45	Bucket Truck - Exterior Spaces	\$1,950.00
Local Electric Rate:	\$0.14 /kWh	Estimated Annual Energy Savings:	36,911
Hourly Labor Rate For Electrician:	\$82.45	Estimated Annual Energy Cost Savings:	\$5,168
Budgeted Initial Investment:	\$58,983	Estimated Annual O&M Cost Savings:	\$1,860
Estimated Return on Investment: (Including O&M Savings)	8.39 Years	Estimated Annual Cost Savings:	\$7,028

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UIC	Install Low Flow Tankless Restroom Fixtures	
EAP4	Location: Thruhgout	
ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES		
Number of Males	152	
Number of Females	152	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	38	
Number of Urinals To Be Retrofitted	5	
Number of Water Closets To Be Retrofitted	29	
No. of Water Closets With Separate Flush Tank <i>(Typical Residential Type)</i>		
Estimated Restroom Usage/Individual/Day <i>Default is 4 Uses/Day For Residential/Office</i>	5	(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	101.08	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?	(Select) Yes	
<small>(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)</small>		
No. of Tankless Water Closets	29	
GPF of Proposed Dual Flush- Water Closet Valve*	1.60	GPF
<small>*Federal Law Requires All Flushes Not To Exceed 1.6 GPF</small>		
	Solid Waste (20%)	0.48
	Liquid Waste (80%)	GPF
Estimated Annual Water Savings From Male Users	25.88	kGal
Estimated Annual Water Savings From Female Users	129.38	kGal
Total Water Savings From Water Closets	155.26	kGal
Water & Cost Saving Calculations		
Water Savings Calculation		
Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	155.26	kGal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	101.08	kGal
Total Annual Water Savings in kGal	256.34	kGal
Cost Savings Calculations		
Enter Water Tariff Rate (\$/1000Gal)	\$8.20	\$\$
Estimated Cost Savings From Water	\$2,101	\$\$
Estimated Cost of Retrofit		
Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture <i>(Includes Labor)</i>	\$6,502	\$\$
Cost For Replacing Existing Water Closet With A New Water Closet And- Dual Flush Valves <i>(Up For Liquid Waste And Down For Solid Waste)</i>	\$27,232	\$\$
Estimated Total Cost For Retrofit	\$33,734	\$\$
Simple Pay Back Period	16.06	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:	\$33,734	Simple Payback Period:	16.06 Yrs
Annual Cost Savings:	\$2,101		

UIC	Replace Existing Water Heater With New Energy Efficient Units			
EAD3	Location:Throuhgout			
Step 1	Existing Water Heater Details	<i>M118, Electrical Panel Room</i>	<i>00B Auditorium</i>	
	Number of Water Heaters Being Replaced:	1	1	
	Select Existing Hot Water Heater Fuel	Electric	Electric	Natural Gas
	Insert Energy Factor of Existing Water Heater	0.44 EF	0.44 EF	
	Input Existing Water Heater Input Rating	4.50 kW	1.50 kW	
	Select One Method For Calculation	Annual Heating Hours	Annual Heating Hours	Annual DWH Load
	Insert Average Annual Hours of Operation	613 hrs	613 hrs	
	Annual Water Heater Energy Consumption/Heater	2,759 kWh	920 kWh	
	Total Estimated Annual Energy Consumption For all Heaters	2,759 kWh	920 kWh	
	Total Estimated Annual Operating Energy Costs For all Heaters	\$395 \$	\$132 \$	
Step 2	Proposed New Water Heater			
	Proposed Hot Water Heater Fuel	Electric	Electric	Natural Gas
	Capacity of the Proposed New Water Heater	120-Gal,6-kW	50-Gal,4.5-kW	
	Energy Factor of Proposed Water Heater	0.90 EF	0.95 EF	
	Proposed Water Heater Input Rating	6.00 kW	4.50 kW	
	Annual kBtuh Consumption For All The Proposed Water Heaters	4,601 kBtuh	1,453 kBtuh	
	Estimated Annual Water Heater Fuel Consumption (All Heaters)	1,349 kWh	426 kWh	
	Estimated Total Annual Energy Costs	\$193 \$	\$61 \$	
Step 3	Energy & Cost Saving Calculation			
	Estimated Cost of New Water Heater/Unit	\$2,593 \$	\$1,347 \$	\$0 \$
	Total Estimated Installation Cost	\$3,870 \$	\$2,010 \$	\$0 \$
	Total Estimated Annual Cost Savings	\$202 \$	\$71 \$	\$0 \$
	Total Annual Cost Savings:	\$273	Total Initial Investment::	\$5,880
	Simple Pay Back Period	21.57		
	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: \$3,870 Simple Payback: 21.57 yrs
 Annual Cost Savings: \$202

APPENDIX F:

Solar PV

UIC		Install Fixed Tilt Solar Photovoltaic System													
EAR-2		Details:													
Select State:		Northern California		Electric Rate:		\$0.14		\$/KWh		Annual Electric Consumption:		654,349		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
												30%	\$0.02	\$0	
1	Building 1	1	13.00	13	41	20,199	20,199	\$2,828	\$45,500	16.1	\$0	\$13,650	\$444	\$0	9.7
2	Building 2	1	11	11	35	17,247	17,247	\$2,415	\$38,850	16.1	\$0	\$11,655	\$379	\$0	9.7
3	Building 3	1	16	16	52	25,482	25,482	\$3,567	\$57,400	16.1	\$0	\$17,220	\$561	\$0	9.7
4	Building 4	1	20	20	62	30,454	30,454	\$4,264	\$68,600	16.1	\$0	\$20,580	\$670	\$0	9.7
5	Building 5	1	14	14	44	21,598	21,598	\$3,024	\$48,650	16.1	\$0	\$14,595	\$475	\$0	9.7
6				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0	
7				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0	
8				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0	
9				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0	
10				0	0		0	\$0	\$0		\$0	\$0	\$0	\$0	
		5		74	235	114,980.0	114,980	\$16,097	\$259,000	16.09	\$0	\$77,700	\$2,530	\$0	9.69

Solar Rooftop Photovoltaic Analysis	
Total Number of Roofs	5
Estimated Number of Panels	235
Estimated KW Rating	74
Potential Annual KWh Produced	114,980
% of Current Electricity Load	17.6%

KW
KWh

Financial Analysis	
Investment Cost	\$259,000
Estimated Energy Cost Savings	\$16,097
Potential Rebates	\$77,700
Potential Annual Incentives	\$2,530
Payback without Incentives	16.1
Incentive Payback but without SRECS	9.7
Payback with All Incentives	9.7

years
years
years

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